

#### **Detailed Specifications for Civil work:**

##### **M-1 Water:**

- 1.2** Water shall not be salty or brackish and shall be clean, reasonably clear and free objectionable quantities of silt and traces of oil and injurious alkalis, salts, organic matter and other deleterious material which will either weaken the mortar or concrete or cause efflorescence or attack the steel in R.C.C Container for transport, storage and handling of water shall be clean. Water shall conform to the standards specified in I.S.456-1978.
- 1.3** 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 I.S.269-1976. 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.
- 1.4** 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 concrete during curing or those which produce objectionable stains or other unsightly deposits on concrete or mortar surfaces.
- 1.5** Hard and bitter water shall not be used for curing.
- 1.6** Portable water will be generally found suitable for curing mortar or concrete.

##### **M-2. Lime:**

- 2.1.** Lime shall be hydraulic lime as per I.S. 712-1973. Necessary test shall be carried out as per I.S. 6932 (Parts I to X), 1973.
- 2.2.** The following field 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 while colour indicates quick lime, and solid lumps are the unburnt lime stone.
  - (2)** Acid tests for determining the carbonate content in lime, Excessive amount of impurities and rough determination of class of lime.
- 2.3.** Storage shall comply with I.S. 712-1973. 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 I.S. 1624-1974 to show the acceptability of materials.

##### **M-3. Cement :**

- 3.1** Cement shall be ordinary Portland slag cement as per I.S. 269-1976 or Portland slag cement as per I.S. 455-1976.

**M-4. White Cement :**

**4.1** The white cement shall conform to I.S. 80412-E 1978.

**M-5. Coloured Cement:**

**5.1** Coloured cement shall be with white or gray Portland cement as specified in the item of the work.

**5.2** The pigments used for coloured cement shall be of approved quality and shall not exceed 10% of cement used in the Mix. The mixture of pigment shall be properly grounded to have a uniform colour and shade. The pigments shall have such properties to provide for durability under exposure to sunlight and weather.

**5.3** The pigment shall have the property such that it is neither by the cement nor detrimental to it.

**M-6. Sand:**

**6.1.** Sand shall be natural sand, clean, well graded, hard strong durable and gritty particle free from injurious amounts of dust clay, kankar nodules, soft or flaky particles shale, alkali, salts organic matter, loam, mica or another deleterious substance and shall be got approved from the Engineer-in-charge. The sand shall not contain more than 8 percent of silt as determined by field test. If necessary the sand shall be washed to make it clean.

**6.2.** Coarse Sand : The fineness modulus of coarse sand shall not be less than 2.5 and shall not exceed 3.0.  
The sieve analysis of coarse shall be as under:

I.S.Sieve	Percentage by weight	I.S.Sieve	Percentage by weight
Designation	Passing Sieve	Designation	Passing Sieve
4.75 mm.	100	600 Micron	30-100
2.36 mm.	90 to 100	300 Micron	5-70
1.18 mm.	70-100	150 Micron	0-50

**6.3 Fine Sand:**The fineness modulus shall not exceed 1.0. The sieve analysis of fine sand shall be as under:

I.S.Sieve	Percentage by weight	I.S.Sieve	Percentage by weight
Designation	Passing Sieve	Designation	Passing Sieve
4.75 mm.	100	600 Micron	40-85
2.36 mm.	100	300 Micron	5-50
1.18 mm.	70-100	150 Micron	0-10

**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 field test is given as 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. The clean water shall be added upto 150 mm. mark. The mixture shall be stiffed vigorously and the content 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 lowering the silt 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 stone and be hard strong, dense, durable, clean, of proper gradation and free from skin or coating likely to prevent 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 I.S. 383-1970. 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:**

I.S.Sieve	Percentage by weight	I.S.Sieve	Percentage by weight
Designation	through Sieve	Designation	through Sieve
12.50 mm.	100%	4.75 mm.	0-20%
10.00 mm.	85-100%	2.36 mm.	0-25%

- 8.3. The crushing strength of grit will be such as to allow the concrete in which it is used to be built up to the specified strength of concrete.
- 8.4. The necessary tests for grit shall be carried out as per the requirements of I.S. 2386 (Parts I to VII) 1963, 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 sintered 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 free from clay, dirt ash or other deleterious matter.
- 9.3 **The average grading for cinder aggregates shall be as mentioned below :**

**9.4**

I.S.Sieve Designation	Percentage passing	I.S.Sieve Designation	Percentage passing
20 mm.	100	4.75 mm.	70

10 mm.	86	2.36 mm.	52
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**M-10. Lime Mortar :**

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

**Sand:** 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 the item. The slaked lime and sand be measured by volume.

**10.3. Preparation of Mortar :**

**10.3.1.** Lime mortar shall be prepared by wet process as per I.S. 1625-1971. 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 the 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 is 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 specification M -1. Cement : Cement shall conform to specification M- 3.

**Sand:** Sand shall conform to M-6

**11.2** Preparation of Mix :11.2.1 Cement and shall be mixed to specified proportion, sand being measured by measuring boxes. The proportion of cement will be by volume on the basis of 50 kg / Bag of cement being equal to 0.0342 Cu.m. The mortar may be hand mixed or machine mixed as directed.

**11.3** Preparation of mortar : 11.3.1 In hand mixed mortar cement and sand in the specified proportions shall be thoroughly mixed dry on a clean impervious platform by turning over at least 3 times or more till a homogenous mixture of uniform colour is obtained., Mixing platform shall be so arranged that no extraneous material shall get mixed with mortar or mortar 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.

**11.3.1** 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 machine crushed stone of black trap or equivalent and be hard, strong m dense, durable clean and free from skin and coating likely to prevent proper adhesion for mortar.
- 12.2** The aggregate shall generally be cubical in shape. Unless special stones of particular quarries are mentioned aggregates shall be machine crushed from the best black trap or equivalent 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 than the cover, Whichever is smaller.

**TABLE**

<b>I.S.sieve</b>	<b>percentage passing for single sized aggregates of nominal size</b>			<b>I.S.Sieve Designation sized</b>	<b>Percentage passing for single aggregates of Nominal size</b>		
80 mm.	--	--	--	12.5 mm.	--	--	--
63 mm.	100	--	--	10 mm.	0.5	0.02	0.30
40 mm.	85-100	100	--	4.75 mm	--	0.5	0.5
20 mm.	0-20	85-100	100 mm.	2.35	--	--	--
15 mm.	--	--	85-100				

**NOTE:** This percentage may be carried some what by Engineer-in-charge when considered necessary for obtaining better density 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 test indicated in I.S. 383-1970 and I.S. 456-1978 shall have to be carried out to ensure the acceptability. The aggregates 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.

**M-13. Black Trap or Equivalent Hard Stone Coarse :**

- 13.1** Aggregate For Design Mix Concrete : Coarse aggregate shall be of machine crushed stone of black trap or equivalent hard stone and be 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 quarries are mentioned, aggregates shall be machine crushed from the best, black trap or equivalent hard stones as approved. Aggregate shall have no deleterious reaction with cement.
- 13.3** The necessary tests indicated in I.S. 383-1970 and I.S. 456-1978 shall have to be carried out to ensure the acceptability of the material.
- 13.4** If aggregate is covered with dust it shall be washed with water to make it clean.

**M-14. Brick Bats Aggregate :**

**14.1** Brick bat aggregate shall be broken from well burnt or slightly over burnt and dies brick. It shall be homogeneous in texture roughly cubical shape, clean and free from dirt of any other foreign material. The brick bats shall be of 40 mm. to 50 mm. size unless otherwise specified in the item. The unburnt or over burnt brick bats shall not be allowed.

**14.2** The brick bats shall be measured by volume by suitable boxes or as directed.

**M-15 Bricks :**

**15.1** The bricks shall be hand or machine moulded and made from suitable soils and kiln-burnt. They shall be free from crack and nodules of free lime. They shall have smooth rectangular faces with sharp corners and shall be of uniform colour. The bricks shall be moulded with a frog of 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 600 mm.

**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 as under :  $(9" \times 4\frac{3}{8}" \times 2\frac{3}{4}')$  225 x 110 x 75 mm.

**15.4** Only bricks of one standard size shall be used on one work. The following tolerances shall be permitted in the conventional size adopted in a particular work.

Length : 1.8 (3.0 mm.) Width :  $1\frac{1}{6}"$  (1.51 mm.) Height :  $1\frac{1}{6}"$  1.50 mm.)

**15.5** The crushing strength of the bricks shall not be less than 35 Kg./Sq.Cm. The average water absorption shall not be more than 20 percent by weight. Necessary tests for crushing strength and water absorption etc. shall be carried out as per I.S. .3493 (Part-I to IV) 1976.

**M-16 Stone :**

**16.1** The stone shall be of the specified variety such as Granite/Trap Stone. Quartzite 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 I.S. 1134-1974. The minimum crushing strength of the stone shall be 200 kg./Sq. Cm. 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 compacted in texture, sound, durable and free from soft patches. It shall have a minimum crushing strength of 100 K.G/S.q. Cm. 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 types of stone in which white clay occur, should not be used.
- 17.4** special corner stones shall be provided where so directed.

**M-18. Mild Steel Bars :**

- 18.1** Mild steel bars reinforcement for R.C.C work shall conform to I.S. 432(Part-II) 1966 and shall be tested quality. It shall also comply with relevant part of I.S. 456-1978.
- 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 100 mm. length and weight payable worked out at the rate specified below :
- |                         |                        |
|-------------------------|------------------------|
| 1. 6mm. x 0.22 Kg./Rmt  | 8.20mm.2.47 Kg./Rmt    |
| 2. 8mm. x 0.39 Kg./Rmt. | 9. 22mm.2.98 Kg./Rmt   |
| 3. 10mm x 0.62 Kg./Rmt  | 10. 25mm. 3.85 Kg./Rmt |
| 4. 12mm x 0.89 Kg./Rmt  | 11. 28mm. 4.83 Kg./Rmt |
| 5. 14mm x 1.21 Kg./Rmt  | 12. 32mm. 6.31 Kg./Rmt |
| 6. 16mm x 1.58 Kg./Rmt  | 13. 36mm.7.99 Kg./Rmt  |
| 7. 18mm x 3.00 Kg./Rmt  | 14. 40mm 9.86 Kg./Rmt. |

**M-19. High yield Strength Steel Deformed Bars :**

- 19.1** High yield strength steel deformed bars are either cold twisted or hot rolled, shall conform to I.S. 1739-1966 and I.S.1139-1966 respectively.
- 19.2** Other provision and requirements shall conform to specification NO. M-18 for Mild steel bars.

**M-20. High Tensile Steel Wire:**

- 20.1** The high tensile wires for the use in prestressed concrete work shall conform to I.S. 2090-1962.
- 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 I.S. 1785-1962. Testing shall be done as per I.S. 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 times the diameter of wire itself so that wire springs back straight back straight on being uncoiled.

**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 I.S. 280-197.

**21.2.** The use of black wire be permitted for binding reinforcement bars. It shall be free from rust, Oil paint, grease, looser mile 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 I.S. 226-1965. The steel shall be free from the defects mentioned in I.S. 226-1975 and shall have a smooth finish. The material shall have a smooth finish. The material shall be free from loose mile scale, rust pits or other defects affecting the strength and durability. Rivet bars shall conform to I.S. 1148-1973.

**22.2.** When the steel is supplied by the Contractor test certificates of the manufactures shall be obtained according to I.S. 226-1975 and other relevant Indian Standards.

**M-23. Galvanised Iron Sheets :**

**23.1** The galvanised iron sheets shall be plain or corrugated sheets of specified in item. The G.I. sheets shall conform it I.S. 217-1977. 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 as directed as per site condition.

**23.2** The length and width of G.I. sheet shall be as directed as per site condition.

**M-23 (A) G.I Valleys gutter ridges :**

**23.A.1.** The G.I.ridges 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 shape without damage to the sheets in process of bending.

**23.A.2.** Valleys gutters and flashings shall also be 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 shall conform to I.S. 459-1970.

**24.2. Ridges & Hips :**

**24.2.1** Ridges and hips shall be same thickness at that of A.C.sheets. The types of ridges suitable for the type of sheets and locations.

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

**M-25. Manglore Pattern Roof Tiles :**



- 1.1** The mangalore pattern tiles shall conform to I.S. 654-1972 for Class AA or Class "A" type as specified in 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 :**

- 26.1.** The shuttering shall be either of wide planking of 30 mm. minimum thickness with or without steel lining roof steel plates stiffened by steel angles. The shuttering shall be supported on battens and beams and props of vertical ballies properly cross braced together so as to make the centering rigid. In places of bulky props, brick pillar of adequate section built in mud mortar may be used.
- 26.2.** 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 of 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.
- 26.3.** 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.
- 26.4.** The props shall consist of bullies having 100 mm. minimum diameter measured at mid length and 80 mm, at thin end and shall be placed as per design requirement. These shall rest squarely on wooden sole plates 40 mm. thick and minimum bearing area of 0.10 sq. m. laid on sufficiently hard base.
- 26.5.** Double wedges shall further be provided between the sole plate and the wooden props so as to facilitate tightening and easing of shuttering without jerking the concrete.
- 26.6.** 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 planed 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.
- 26.7.** As far as practicable, clamps shall be used to hold the forms together and use of nails and spikes avoided.
- 26.8.** The surface of timber shuttering that would come in contact with concrete shall be well wetted and coated with soap solutions before the concreting is done. Alternatively coat of raw linseed oil or oil of approved manufacturer may be applied in place of soap solution. In case of steel shuttering either soap solution or raw linseed oil shall be applied after thoroughly cleaning the surface. Under no circumstances black or burnt oil shall be permitted.
- 26.9.** The shuttering for beams and slabs shall have camber of 4 mm. per meter (1 to 250) or as directed by the Engineer-in-charge so as to offset the subsequent

deflection. For cantilevers, The camber at free end shall be 1/50 of the projected length or as directed by the Engineer-in-charge.

**M-27. Expansion joints-Premouldedfilter :**

**27.1** The item provides for expansion joints in R.C.C frame structures for internal joints, as well as exposed joints, with the use of premoulded bituminous joint filler.

**27.2** Premoulded bituminous joint filler, i.e. performed strip of expansion joint filler shall not get deformed or broken by twisting, bending or other handling 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 otherwise specified.

**27.4** Premoulded bituminous joint filler shall conform to I.S. 1838-1961.

**M-28 Expansion joints-Copper strips & hold fasts :**

**28.1** The item provide for expansion joints in R.C.C frame structure for internal joints as well as for exposed joints with the use of necessary copper strip and hold fasts.

**28.2** Copper sheet shall be of 1.25 mm. thick and of 1.25 mm. width when the 'U' shape in middle. Copper strips shall have hold fast of 3 mm. diameter copper rod fixed to the plate soldered on 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 the concrete work shall be 25 mm. Depth of 'U' to be provide in the expansion joint, in the copper plate shall be of 25 mm.

**M-29. Teak wood :**

**29.1** The teak wood shall be of good quality as required for the item to be executed. When the kind of wood is not specifically mentioned, good Indian teak wood as approved shall be used.

**29.2** Teak wood shall generally be free from large, loose, dead or cluster knots, flaws, shakes, 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 rot, decay, harmful fungi and other defects of harmful nature which will affect the strength durability of its usefulness for the purpose for which it is required. The colour shall be uniform as far as possible. Any effort 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 scantlings, planks etc. shall be sawn in straight lines and planes in the direction of grains and of uniform thickness.

**29.4** The tolerances in the dimensions shall be allowed at the rate of 1.5 m.m. per face to be planed.

**29.5 First class teak wood : 29.5.1.** First class teak wood shall have no individual hard and sound knots, more than 6 sq. cm. size and the aggregate area of such knots shall not be more than 1% of area of 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 Sq. cms. in size and aggregate area of such knots shall not-exceed 2% of the area of piece.

**M-29. (A) Non-teak wood :**

The non teak-wood shall be chemically treated, seasoned as per IS Specifications and 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 approval.

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 shutters after proper seasoning and chemical treatment.

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 fibers as far as possible. It shall be free from decay, rot, decay harmful fungi and other defects of nature which 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 scantlings planks etc. shall be sawn in straight lines and planes in the direction of grain and uniform thickness.

The department will use the Agency to produce certificate from forest Department in event of Disputes and the decision of the Department shall be final and binding to the contractor.

The tolerance in the dimension shall be allowed as 1.5 mm. per face to be planed.

**M-30. Wooden flush door shutters (solid core) :**

**30.1** The solid core type flush door shutters shall be decorative or non-decorative 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 I.S. 2202- (Part-I) 1980. 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 I.S. 303-1275.

**30.2** 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 hopping rebating opening of glazing, Venetian etc. shall be provided if specified in the drawing.

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

**30.4** The shutters shall be tested for

**(1) End immersion test :** The test shall be carried out as per I.S. 2202 (part-I) 1980. There shall be no delamination at the end of the test.

- (2) **Knife test :** The face panel when tested in accordance with I.S. 1659-1979 shall pass the test.
- (3) **Glue adhesion Test :** The flush door shall be tested for glue adhesive test in accordance with I.S. 2202 (Part-I) 1980. 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 and 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, knots holes and other permissible wood defects shall not be considered in assessing the sample.
- 30.5** 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.
- 30.6** The thick 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. Aluminum doors, Windows, Ventilators.**
- 31.1** Aluminum alloy used in the manufacture of extruded window sections shall conform to I.S. designation HEA-WP of I.S. :733-1975 and also to I.S. Designation WVG-WP of I.S. 1285-1975. The Section shall be as specified in the drawing and design. The fabrication shall be done as directed.
- 31.2** The hinges shall be cast or extruded aluminum hinges of same type as in windows but of large size.
- 31.3** The hinges shall normal be of 50 mm. projecting type. Non-projecting type of hinges may also be used if directed. The handles of door shall be of specified in the drawing and design. The fabrication shall be done as directed.
- M-32. Rolling Shutters :**
- 32.1** The rolling shutter shall conform to I.S. 6248-1979. Rolling shutters shall be supplied of specified type with accessories. The size of the rolling shutters shall be 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 mm., width not less than 1.25 mm. thick and 80 mm. wide for shutters 3.5 mm in width and above unless otherwise specified.
- 32.2** Guide channels shall be of mild steel deep channel section and of rolled pressed or built up (fabricated) jointures construction. The thickness of sheet used shall not be less than 3.15 mm.
- 32.3** Hood covers shall be made of M.S. Sheets not less that 0.92 mm. thickness For shutters having width 3.5 Meter and above the thickness of M.S. 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 position. The spring pipe shaft etc. shall be supported on strong M.S. or malleable C.I. brackets. The brackets shall be fixed on or under the lintel as specified with raw plugs and screws bolts etc.

- 32.5** The rolling shutters shall be of self rolling type up to 8 Sq.m. clear area without ball bearing and p to 12 Sq.m. clear area with ball bearing. If the rolling shutters are larger, 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. Either steel pulleys or ball bearing 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. M.S., channels of heavy sections unless otherwise shown on drawings. The distance center to center of pickets shall be 12 cms. with an opening of 10 Cms.
  - (b) Pivoted M.S. 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 manufactures from cold drawn steel wire "as drawn" or galvanised steel conforming to I.S. 226-1975 with longitudinal and transverse wire securw4ely connected at every intersection by a process of electrical resistance welding and conforming to I.S. 4948-1974. It shall be fabricated and finished in workmanlike manner and shall be free from injurious defects and shall be rust proof. The type of mesh shall be oblong or square as directed. The mesh sizes and size 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 size 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 Expanded metal steel sheet shall conform to I.S. 412-1975, Except that blank sheets need not be with guaranteed mechanical properties. The size of the diamond mesh of expended metal and dimensions of strands (width and thickness) shall be as specified. The tolerance in nominal weight of expended metal sheets shall be of + 10 percent.
- 35.2.** Expanded metal in panels shall be in one whole piece panel each as far as stock size permit. The expanded metal sheets shall be coated with suitable protective coating to prevent corrosion.

**M-36. Mild Steel Wire (Wire ) :**

**36.1** Mild steel wire may be galvanised, as indicated All finished steel wire shall be well cleanly drawn to the dimensions and size of wire as specified in item. The wire shall be sound, free from splits, surface flaws, rough jagged and imperfect edges and other harmful surface defects and shall conform to I.S. 280-1978.

**M-37. Plywood :**

**37.1** The plywood for general purpose shall conform I.S. 303-1975. 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 right angle to the grain in the adjacent layer.

**37.2** The Chief advantages of plywood over a signal board of the same thickness is the more uniform strength of the plywood, along the length and width of the plywood and grater resistance to cracking and splitting with change in moisture content.

**37.3** Usually synthetic resins are used for gluing, pherolic resins are usually cured in a hot press which compresses and simultaneously heats the plies between hot plates which maintain a temperature of 90 degrees C. to 140 degrees C. and a pressure of 11 to 14 kg/sq.cm. on the wood. The time of heating may be anything from 2 to 69 minutes depending upon thickness.

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

**37.5** According to I.S. 303-1975 the plywood for general purpose shall be of three grades **BWR**, **WWR** and **CWR**, depending upon the adhesives used for bonding and 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 a moisture content not less than 8 percent and not more than 16 percent.

**37.6** Thickness of plywood Boards :

**TABLE**

Boar d	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.

**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 king of glass to be used shall be mentioned in the item or specification or in the special provisions or as shown in detailed

drawings. Thickness of glass panes shall be uniform. The specifications or 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/Sq.m. for panes upto 600 mm x 600 mm.

**38.2.2** For panes larger than 600 mm. x 600 mm. and upto 800 m. x 800 mm. the glass weighing not less than 8.75 Kg/Sq.m. shall be used. For bigger panes upto 900 mm. x 900 mm. glass weighing not less than 11.25 Kg/Sq.m. 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 I.S. : 1761-1960. Sheet glass of the specified colours shall be used, if so shown on detailed drawings or so specified. For important buildings and for panes with any dimension 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 the thickness mentioned in the item or as shown in the detailed drawing or as specified. In absence of any specified thickness and type of glass shall be as per details on drawings or as specified or as directed.

**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, figured, ribbed or fluted or frosted glass as may be specified 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 may be used. Thickness of glass shall not be less than 6 mm. Wired glass shall be of type and thickness as specified.

**M-39. Acrylic Sheets :**

**39.1.** Acrylic sheet be of thickness as specified in the item and of an specified shape and size as the case may be. Panels may be 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. 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 available in complete range of standard transparent, translucent and opaque colours. Sheets shall 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 boards used for face panels shall be of best quality free from any defects. The particle boards shall be made with phenolmaldehyde adhesive. The particle boards shall conform to I.S. 3087-1965. "Specification for wood particle board for general purpose". The size and the thickness shall be as indicated.

**M-41. Expanded polystyrene of framed stopper slabs :**

**41.1** The expanded polystyrene ceiling boards and tiles shall be approved make and shall be of size, thickness, finish and colour as indicated. It shall be of high density and suitable for use as insulating material. The insulating material shall be like slab of Thermocol etc.

**M-42. Resin bonded fiber glass :**

**42.1** The resin bonded fiber glass tiles, or rolls shall be of approved make and shall be of sizes, thickness and finish as indicated.

**42.2.** For test of Minerrak wool thermal insulation Blanket I.S. : 3144?1965 shall be followed.

**42.3.** Insulation wool blanket shall be with following coverings on one or both sides as indicated.

(1) Bituminisedhessain Kraft paper for keeping out dust.

(2) Hessian cloth or Kraft paper for keeping out dust.

(3) G.I. wire netting, suitable for surface 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 specifications.

**43.1.2** They shall be of iron, bras, aluminum, chromium plated iron chromium plated brass, copper oxidised iron, copper oxidised brass or anodized aluminum as specified.

**43.1.3** The fixtures shall be heavy, Medium or light type. The fixtures and fastenings shall be smooth finished and shall be such as will ensure ease of operation.

**43.1.4** The samples of fixtures and fastenings shall be got approved as regards quality and shape before providing them in position.

**43.1.5** Brass and anodised aluminum 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 n opposite directions.

**43.3. Butt hinges :**

**43.3.1.** Railway standard heavy type butt hinges shall be used when so specified.

**43.3.2.** The strap hinges shall be manufactured from M. S. Sheet.



- 43.4 Siding door bold (Aldrops):** 43 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 as shall be used and shall be got approved.
- 43.6 Door Latch:**43.7.1The size of door latch shall be taken as the length of latch.
- 43.7 Bathroom Latch :**43.5.1 Bathroom latch shall be similar to tower bolt.
- 43.8 Handle :** 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 size of the handle.
- 43.9 Door Stopper:** 43.9.1 door stoppers shall be either floor door stopper type or door catch type floor stopper shall be of overall size as specified as shall have rubber cushion.
- 43.10 Door Catch :**43.10.1 Door catch shall be fixed as height of about 900 mm from the floor level so 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 fixate. The catch shall be fixed 20 mimesed the face of the door for easy operation of catch.
- 43.11 Wooden Door stop with highs :**
- 43.11.1** wooden door stop of size 100mm X 60 mm X 40 mm shall be fixed on the door frame with a high of 75 mm size at high of 900 mm from the floor level the wooden door stop shall be provided with 3 coats of approve oil paint.
- 43.12 Case meant window fastener :**Casement window fastener for single leaf window shutter shall be left or right handled 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 directed as directed. 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 form minimum 3 mm thick plate and projected pivot shall not be less than 12 mm length and shall be firmly riveted to the base plate in case of brass pivot.

#### **M-44. Paints :**

##### **44.1 (A) Oil Paints :**

- 44.1.1.** 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 or specific shade or tint is not available, white ready mixed paint with approved stainer will be allowed. In such a case, the contractor shall ensure that the shade of the paint so allowed shall be uniform.
- 44.1.2.** All the paints shall meet 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 curing, livering, 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.

**44.1.3.** Ready mixed paint shall be used exactly as received from the manufactures and generally according to their instructions and without any admixtures whatsoever.

**44.2. (B) Enamel Paints :**

**44.2.1.** The enamel paint shall satisfy in general requirements as mentioned in specification of oil paints. Enamel paint shall conform to I.S. 2933-1975.

**M-45 French polish :**

**45.1.** The french polish of requirement and shape shall be prepared with the below mentioned ingredients and other necessary materials:

(I) Denatured sprit of approved quality (ii) Chandras (iii) Shellac (iv) Pigment.

**45.2.** The French polish so prepared shall conform to I.S. : 348-1968.

**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 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 machine crushed. They shall be free from foreign matter, dust etc. Except as above, the chips shall conform to I.S. : 2114-1962.

**M-47. Flooring Tiles :**

**47.1. (A) Plain Cement tiles :**

**47.1.1.** The plain cement tiles shall be general purpose type. These are the tiles in the manufacturer of which no pigments are used Cement used in the manufacturer of tiles shall be as per Indian Standards.

**47.1.2.** The tiles shall be manufactured from a mixture of cement and natural aggregates by pressure process. During manufacture, the tiles shall be subjected to a pressure of not less than 140 Kg/Sq. Cm. The proportion of cement to aggregate in the backing of the tiles shall be not less than 1:3 by weight. The wearing face through the tiles are of plain cement, shall be provided with stone chips of 1 to 2 mm. Size. The proportions of cement to the marble chips 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 wearing layer shall be uniform through out its face and thickness. On removal from mould, the tiles shall be kept in moist conditions continuously at least for seven days and subsequently, if necessary, for such long period as would ensure their conformity to requirements of I.S. : 1237-1980 regarding strength resistance to wear and water absorption.

**47.1.3.** The wearing face of the tiles shall be plain, free from projections, depressions and cracks and shall be reasonably parallel to the back face of the tile. All angles shall be right and all edges shall be sharp and true.

**47.1.4.** The size of tiles shall generally be square shape 24.85 Cm. x 24.85 Cm. or 25 Cm. x 25 Cm. The thickness of tiles shall be 20 mm.

**47.1.5.** Tolerance of length and breadth shall be plus or minus one millimeter, Tolerance or thickness shall be plus 5 mm.

**47.1.6.** The tiles shall satisfy the tests as regards transverse strength, resistance to wear and water absorption as per I.S.:1237-1980.

**47.2. (B) Plain Coloured Tiles :**

**47.2.1.** These tiles shall have the same specification as per plain cement tiles as per (A) above except that they shall have a plain wearing surface where in pigments are used. They shall conform to I.S. 1237-1980.

**47.2.2.** The pigment used for colouring cement shall not exceed 10 percent 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.

**47.2.3.** The colour of the tiles shall be specified in the item or as directed.

**47.3. (C) Marble mosaic tiles :**

**47.3.1.** These tiles have the same specifications as per plain cement tiles except the requirements as stated below:

**47.3.2.** The marble mosaic tiles shall conform to I.S. 1237-1980. The wearing face of the tiles shall be mechanical ground and filled. The wearing face of tiles shall be free from projections, depressions and cracks and shall be reasonably parallel to the back face of the tiles. All angles shall be right angles and all edges shall be sharp and true.

**47.3.3.** Chips used in the tiles be from smallest up to 20 mm. size. The minimum thickness of wearing layer of tiles shall of 6 mm. For pattern of chips to be used 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.

**47.3.4.** Any particular samples, If found suitable shall be approved by the Engineer-in-charge, or he may ask for a few more samples to be prepared indicating roughly the particular sized chips to be more or less in the samples presented. The samples 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 backing layer and wearing surface, materials, ingredients, colour shade, chips, distribution etc. required.

**47.3.5.** The tiles shall be prepared from cement conforming to Indian Standards or coloured Portland cement generally depending upon the colour of tiles to be used or as directed.

**47.4. (D) Chequered Tiles:**

**47.4.1.** Chequered tiles shall be plain cement tiles or marble mosaic tiles. The former shall have the same specification as per (A) above and the latter as per marble mosaic tiles as per (C) except as mentioned below :

**47.4.2.** 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.

**47.4.3.** The grooves in the chequers shall be uniform and straight. The depth of the grooves shall not be less than 3 mm. The chequered 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.

**47.4.4.** Tiles shall conform to relevant I.S. 1237-1980.

**47.5 (E) Chequered Tiles for Stair cases :**

**47.5.1.** The requirements of these tiles shall be the same as chequered as per (D) above except in following respects;

- (1)** The length of a tile including nose shall be 330 mm.
- (2)** The minimum thickness shall be 28 mm.
- (3)** The nosing shall have also the same wearing layer as 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 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 green. Brown colour stones shall not be allowed for use. They shall be without any soft veins, cracks or flows.

**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 minus 30 mm. on account 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 stones shall be truly chiselled and table rubbed with coarse sand before paving. All angles and edges of the stone 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 Stones**

**49.1.** Polished kotah stone shall have same specifications as per rough kotah stone except as mentioned below:

**49.2.** The stones shall have machine polished smooth surface. When brought on site, the stones shall be single polished or double polished depending upon its use. The stones for paving shall generally be single polished. The stones to be used for dado, skirting, platforms, sink, veneering, sills, steps, etc. Where machine polishing after the stones are fixed in situ is not possible, shall be double polished.

**M-50. Dholpur Stone Slab :**

**50.1.** Dholpur stone slab shall be of best quality as approved by the Engineer-in-charge. The stone slab shall be even, sound and durable, regular in shape and of uniform colour.

**50.2.** The size of the stone shall be specified in the item or detailed drawings 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 plus or minus 2 mm. The provisions in respect of polishing as for polished Kotah stone shall apply to polished Dholpur stone also. All angles and edges of the face of the stone slab shall be fine chiseled or polished as specified in the item of work and all the four edges shall be machine cut. All angle and edges of the stone slab shall be true and plane.

**50.3.** The sample of stone shall be got approved from the Engineer-in-charge for shade and tint for a particular work. It shall be ensured that stones to be used in a particular work shall not differ much in shade or tint from the approved sample.

**M-51. Marble Slab:**

**51.1.** Marble slab shall be white or of other colour and of best quality as approved by the Engineer-in-charge

**51.2.** Slabs shall be hard, uniform and homogeneous in texture. They shall have even crystalline grain and free from defects and cracks. The surface shall be machine polished to an even and perfectly plane surface and edges machine cut true and square. The rear face shall be rough 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 450mm x 450mm. and preferable 300 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 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 I.S. 1130-1969.

**M-52 Granite Stone Slab :**

**52.1** Granite shall be of approved colour and quality. The stone shall be hard, even, sound 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 items.

**52.3** All exposed face shall be double polished to tender truly smooth and the 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 P.V.C. Flooring :**

**53.1** P.V.C sheets for P.V.C. floor covering shall be homogenous flexible type, conforming to I.S. 3452-1966. The P.V.C covering shall neither develop any toxic effect while put to use nor shall give off any disagreeable odor.

**53.2** Thickness of flexible type covering tiles shall be as specified in the description of the item.

**53.3** The flexible type shall be backed with Hussein or other woven fabric. The following tolerances shall be applicable on the nominal dimension of the sheet rolls or tiles :

(a) Thickness + 0.15 mm

(b) Length or Width :

1. 300 mm. square tiles + 0.20 mm.    39.00 mm. square tiles    +0.30 mm.
2. 600 mm. square tiles + 0.40 mm.    4 Sheets ad rolls    +0.10 percent

**53.4 Adhesive :**

**53.4.1** The adhesive for PVC flooring shall be of the type and make recommended by the manufacturers of PVC sheets/tiles.

**M-54. Facing tiles :**

**54.1.** The facing tiles (burnt clay facing bricks) shall be free from cracks, flaws and nodules of free lime. They shall be thoroughly burnt and shall have plane rectangular faces with parallel sides and sharp straight right edged 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 I.S. 2691-1972.

**54.2.** The standard size of facing brick tiles shall be 19 x 9 x 4 cms. The facing brick tiles shall be provided with frog which shall conform to I.S. 1077-1976.

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

**Size Tolerance for**

	<b>1<sup>st</sup> class Brick</b>	<b>2<sup>nd</sup> class Brick</b>
19 cm.	+ 6 mm.	+ 10 mm.
9 cm.	+ 3 mm.	+ 7 mm.
4 cm.	+1.5 mm	+ 3 mm.

**54.4** The tolerance for distortion or war page 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 cms. Max. 2.5 mm.

-do- above 19 cm. Max 3.0 mm.

**54.5** The average compressive strength obtained as sample of five tiles when tested in accordance with the procedure laid as per I.S. 1077-1976 shall be not less than 175 Kg./Sq. Cm. The average compressive strength of any individual bricks shall be not less than 160 Kg/Sq.Cm.

**54.6** The average water absorption for five bricks tiles shall not exceed 12 percent of average weight of brick before testing.

The absorption for each individual bricks shall not exceed 25 percent.

**54.7** The brick tiles when tested in accordance with I.S. 1077-1976, 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 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 plus or minus 1.5 mm. The thickness of tile shall be 6 mm. Except as above the tiles shall conform to I.S. 777-1970.

**M-56. Galvanised iron pipes and fittings :** **56.1.** Galvanised iron pipe shall be of the medium type and of required diameter and shall comply with I.S. 1239-1979. The specified diameter of the pipes shall refer to the inside diameter of the bore, Clamps, screw and all galvanised iron fittings shall be of the standard 'R' or equivalent make.

**M-57. Bib cock and stop cock :**

**57.1** A bib cock is a draw off tap with a horizontal inlet and free outlet. A stop cock is a valve with a suitable means of connection for insertion in a pipe line for controlling or stopping the flow.

**57.2** They shall be of screw down type and of brass chromium plated and of diameter as specified in the description of the item. They shall conform to I.S. 781-1977 and they shall be of best Indian make. They shall be polished bright.

**57.3** The minimum finished weight of bib cock and stop cock shall be as given below :

Diameter	Bib cock	Stop cock	Diameter	Bibcock	Stop cock
8 mm.	0.25 Kg.	0.25 Kg.	15 mm.	0.40 Kg.	0.40 Kg.
10 mm.	0.30 Kg.	0.35 Kg.	20 mm.	0.75 Kg.	0.75 Kg.

**M-58. Gun metal wheel valve :**

**58.1.** The gun metal wheel valve be of approved quality. These shall be gun metal fitted with wheel and shall be of gate valve opening full way and of the size as specified. These shall conform to I.S. 778-1971.

**M-59. White glazed porcelain wash basin :**

**59.1.** Wash basin shall be of white porcelain first quality best Indian make and it shall conform to I.S. 2556 (Part-IV) 1972 and I.S. 771-1979.

The size of the wash basin shall be as specified in the item, Wash basin shall be of one piece construction with continued over-flow arrangements. All internal angles shall be designed so as to facilitate cleaning. Wash basin shall have single tap hole or two holes as specified. Each basin shall have a circular waste hole which is either rebated or beveled internally with 65 mm. diameter at top and 10 mm. depth to suit the waste fitting. The necessary stud slot to receive the bracket on the under side of the basin shall be provided. Basin shall have an internal soap holder recess which shall fully drain into the bowl.

**59.2.** White glazed pedestal of the quality and colour as that of the basin shall be provided where specified in the item. It shall be completely recessed at the back for reception of supply and wash pipe. It shall be capable of supporting the basin rigidly and adequately and shall be so designed as to make the height from floor to top of basin 750mm. to 800 mm. as directed.

**M-60. European type water closet/with low level flushing :**

**60.1.** The European type water closet shall be white glazed porcelain first quality and shall be of wash down type conforming to I.S. 2556-1973 and I.S. 771-1979.

**60.2.** 'S' trap shall be provided as required with water seal not less than 50 mm. The solid plastic seat and cover shall be of the best Indian make conforming to I.S. 2548-1980. They shall be made of moulded syntactic materials which shall be tough and hard with high resistance to solvents and shall be free from blisters and other surface defects and shall have chromium plated brass hinges and rubber buffer of suitable size.

**M-61. Orissa type water closet :**

**61.1.** The specification of Orissa type white glazed water closet of first quality shall conform to I.S. 2556 (Part-III) 1981 and relevant specification of Indian type water closet except that pan will be with the integral squatting pan of size 580 mm x 440 mm. with raised footrest.

**M-62. Indian type water closet :**

**62.1.** The Indian type white glazed water closet of first quality shall be of size as specified in the item and conforming to I.S. 771-1979 and I.S. 2556 (Part-II) 1981. Each pan shall have integral flushing ring of suitable type with adequate number of holes as required to have satisfactory flushing. It shall also have inlet at back or front connecting flush pipe as directed. The inside of the bottom of the pan shall have sufficient slope from the front towards the outlet and surface shall be uniform and smooth.

Pan shall be provided with 100 mm. diameter 'P' or 'S' trap with approximately 50 mm. water seal and 50 mm. diameter vent horn.

**M-62. (A) Foot Rests :**

**62-A-1** A pair of white glazed earthen ware rectangular foot rests of minimum size 250 mm. x 130 mm 20 mm. shall be provided with water closet.

**M-63. Glazed Earthen Ware Sink :**



**63.1.** The glazed earthen-ware sink shall be specified size colour and quality. The sink shall conform to I.S. 771 Part-II-1979 waste coupling of standard pattern with brass chain and rubber plug shall be provided with sink.

**63.2.** The pipes shall conform to I.S. 1239-Part-I 1973 and I.S. 404-1962 for steel and lead pipes respectively 32 mm. brass waste coupling of standard pattern with brass chain and rubber plug shall be provided with sink.

**M-64. Glazed earthen ware Lipped type flat back urinal/corner type urinal :**

**64.1** The lipped type urinal shall be flat back or corner type as specified in the item and shall conform to I.S. 771-1979. It shall be of best Indian make and size as specified and approved by the Engineer-in-charge. The flat back or corner type urinal must be 1<sup>st</sup> quality free from any defects, cracks, etc.

**M-65. Low level enamel flushing tank :**

**65.1.** The low level flushing tank shall be of 15 liters capacity. It shall conform to I.S. 774-1971. The flushing vaster shall be of best quality and free from any defects. The flushing tank shall have outlet 32 mm. diameter The outlet shall be connected with W.C. Pan by lean pipe or P.V.C. pipe as specified. The flushing tank shall be provided with inlet and outlet for fixing G.I. inlet pipes and overflow pipes. The flushing castern shall be provided with chromium plated handle for flushing. The flushing tank shall be provided with brackets of cast iron so that it can be fixed on wall at specified height. The brackets shall Conform to I.S. 775-1970.

**M-66. Cast iron flushing cistern :**

**66.1.** The cast iron flushing cistern shall be of 15 liters capacity. It shall conform to I.S. 774-1971. The flushing cistern shall be of best quality free from any defects. The flushing cistern shall have outlet of 32 mm. diameter. The outlets shall be connected to lead pipe of 32 mm. diameter. The lead pipe shall conform to I.S. 404 (Part-I) 1962. For fixing G.I. inlet pipes and overflow pipe 20 mm. diameter. inlet and outlet shall be provided. The flushing cistern shall be provided with galvanised iron chain and pull of sufficient length and shall be got approved from the Engineer-in-charge. The cast iron flushing cistern shall be painted with one coat of anticorrosive paint and two coats of paints. The flushing cistern shall be fixed on two C.I. brackets. The C.I. brackets shall conform to I.S. 775-1970.

**M-67. Flush cock :**

**67.1.** Half turn flash cock (Heavy Weight) shall be of gun metal chromium plated of diameter as specified in the description of the item. The flush cock shall conform to relevant Indian Standard.

**M-68. Cast iron pipes and fittings :**

**68.1.** All soil waster, vent and antisiphonage pipes and fittings shall conform to I.S. 1729-1964. The pipe shall have spigot and socket ends with head on spigot end. The pipes and fittings shall be true to shape, smooth, cylindrical, their inner and outlet surfaces being as nearly as practicable concentric. They shall be sound and nicely cast and shall be free from cracks, laps, pinholes or other imperfection and shall be neatly dressed and carefully fettled.

- 68.2.** The end of pipes and fittings shall be of reasonable square to their axis.
- 68.3.** The sand cast iron pipes shall be of the diameter as specified in the description and shall be in lengths of 1.5 M, 1.8 M. and 2 M. including socket ends of the pipe unless shorter lengths are either specified or required at junctions etc. The pipes and fittings shall be supplied without ears unless specified or directed otherwise.

**68.4. Tolerances.**

- 68.4.1.** The Standard weights and thickness of pipes shall be as shown in the following table : A tolerance up to minus 10 percent may however be against these standard weights.

Sr. no.	Nominal	Thickness	Overall Weight of pipe excluding ears
			1.5 m. long    1.8m. long    2.m. long
1.	75 mm.	50 mm.	12.83 Kg.    16.52 Kg.    18.37 Kg.
2.	100 mm.	5.0 mm.	18.14 Kg.    21.67 Kg.    24.15 Kg.

- 68.4.2.** A tolerance upto minus 15 percent in thickness and 20 mm. in length will be allowed. For fittings tolerance in lengths shall be plus 15 mm. and minus 10 mm.

- 68.4.3.** The thickness of fittings and their socket and spigot dimensions shall conform to the thickness and dimensions specified for the corresponding sizes of straight pipes. The tolerances in weights and thickness shall be the same as for straight pipes.

**M-69. NahniTrap :**

- 69.1.** Nahni trap shall be of cast iron and shall be sound and free from porosity or other defects which affect serviceability The thickness of the base metal shall not be less than 6.5 mm. The surface shall be smooth and free from craze, ships and other flaws or any other kind of defects which affect serviceability. The size of nahni trap shall be as specified and shall be of self cleaning design.
- 69.2.** The Nahni trap shall be of quality approved by the Engineer-in-charge and shall generally conform to the relevant Indian Standards.
- 69.3.** The Nahni trap provided shall be with deep seal, minimum 50 mm, except at places where trap with deep seal can not be accommodated. The cover shall be cast iron. Performed cover shall be provided on the trap of appropriate size.

**M-70. Gully Trap :**

- 70.1** Gully Trap shall conform to I.S. 651-1980. It shall be sound, free defects such as fire cracks. The glaze of the traps shall be free from crazing. They shall give a sharp clear note when struck with light hammer. There shall be no broken blisters.
- 70.2** The size of the gully trap shall be as specified in the item.
- 70.3** Each gully trap shall have one C.I. gratings of square size corresponding to the dimensions of inlet of gully trap, It will also have a water tight. C.I. cover with frame inside dimensions 300 mm. x 300 mm., the cover with frame inside dimension, 300 mm. 300 mm., the cover weighing not less than 4:53 Kg. and the

frame not less than 2.72 Kg. The grating cover and frame shall be of sound and good casting and shall have truly square machined seating faces.

**M-71. Glaze Stone Ware Pipe And Fitting :**

**71.1.** The pipes and fittings shall be of best quality as approved by the Engineer-in-charge. The pipe shall be of best quality manufactured from stone-ware of fire clay, salt glazed thoroughly burnt through the whole thickness, of a close even texture, shall be smooth and perfectly glazed. The pipe shall be capable to withstand pressure of 1.5 mm. lead without showing sign of leakage. The thickness of the wall shall not be less than 1/12<sup>th</sup> of the internal dia. The depth of socket shall not be less than 38 mm. The socket shall be sufficiently large to allow a joint of 1 mm. around the pipe.

**71.2.** The pipes shall generally conform to relevant I.S. 651-1980.

**M-72. Wall Peg Rail :**

**72.1.** The aluminum wall peg rail shall have three aluminum pegs of approved quality and size. It shall be fixed on teakwood plant of size 450 mm. x 75 mm. x 20 mm. The teakwood shall be french polished or oil painted as specified.

**M-73. G.I. Water Spot :**

**73.1.** The G.I. pipes of 40 mm. dia shall be of medium quality and specials shall be of 'R' brand or equivalent brand of best approved quality.

**73.2.** The pipe shall have length as required for the thickness of wall in which it is fixed. and at the outside end tee and bend cut at half the length shall be provided and at other end coupling shall be provided to have better fixing. The water spout shall be provided as per detailed drawings or as directed.

**M-74. Asbestos Cement Pipe (A.C. Pipe):**

**74.1.** The asbestos cement pipe of diameter as specified in the description of the item shall conform to I.S. 1626-1980. Specials like bends, shoes cowl, etc. shall conform to relevant Indian Standards. The interior of pipe shall have a smooth finish, regular surface and regular, internal diameter. The tolerance in all dimensions shall be as per I.S. 1626-Part-I 1980.

**M-75. Crydon Ball valve :**

**75.1.** Ball valve of screwed type including polyethylene float and necessary lever etc. shall be of the size as mentioned in the description of item and shall conform to I.S. 1703-1977.

**M-76. Bitumen Felt For Water Proofing And Damp Proofing :**

**76.1** Bitumen felt shall be on the fiber bases and shall be type 2, self finished grade-2 and shall conform to I.S. 1322-1970.

**M-77 Selected Earth :**

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

**77.2.** 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 suitable 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 stacking of material shall be done as directed by the Engineer-in-charge in such a way as not to interfere with any constructional activities and in proper stacks.

- 77.3.** 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 the requirements of selected earth mentioned above :

**M-78. Barbed Wire :**

- 78.1.** The barbed wire shall be of galvanised steel and it shall generally conform to I.S. 278-1978. The barbed wire shall be of type-I whose nominal diameter for line wire shall be 2.5 mm. and point wire 2.24 mm. The nominal distance between two bars shall be 75 mm. Unless otherwise specified in the item. The barbed wire shall be formed by twisting together two line wires, One containing the barbs. The size of the line and point wires and barb spacings shall be as specified above. The permissible deviation from the nominal diameter of the line wire and point wire shall not exceed  $\pm 0.08$  mm.
- 78.2.** The barbs shall carry four points 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 angles to each other. The barbs shall have a length of not less than 13 mm. and not more than 13 mm. and not more than 18 MM. The points shall be sharp and cut at an angle not greater than 35 degree of the axis of the wire forming the barbs.
- 78.3.** The line and point wire shall be circular section free from scale and other defects and shall be uniformly galvanized. The line wire shall be in continuous length and shall not contain any weld other than those in the rod before it is drawn. The distance between two successive splices shall not be less than 15 meters.
- 78.4.** The lengths per 100 Kg. of barbed wire I.S. type I shall be as under  
Nominal 1000 meter Minimum 834 Meter Maximum 1066 Meter.

## **Technical Specifications**

### **Item:-**

**Box cutting the road surface to proper slope and camber for making a base for road work including removing the excavated stuff and depositing on the road side slope as directed upto 500 Mt.lead. Etc. complete.**

The sub grade/sub-base/ base to receive the water bound macadam course shall be prepared to the specified grade and camber and made of dust and other extraneous materials. Any nets or soft places shall be corrected in on approved manner and rolled until firm. Cutting shall be paid on cross section area as established by the longitudinal level and cross sections for this purpose. The work shall be started after the initial longitudinal section of the ground and cross sections are taken and recorded. The final surface shall confirm to proper profile, camber and super-elevation etc. as directed by the Engineer. The earthwork shall be paid on sectional measurements, cross sectional etc taken. No allowance or payments shall be made for materials excavated prior to the taking of levels by the Engineer.

The rate is inclusive of cutting in all soil and Murrum including removal of all shrubs, jungle cutting, cutting stuff in slopes, side drain bank etc complete. This item also includes the clearing the sides and demarking the line as per requirement and cutting out the. existing trees on the road side, no extra payment will be paid for at the time of preparing final bill, the road formation in embankment and cutting shall have be perfect condition true to grade, camber and side slope duly dressed and damages due to rain cuts etc., during entire working period shall have to be done by the contractor. The work taken in length shall be completed in all respects viz. width, grades, camber, side drains, side slopes etc. and measurements for incomplete work shall not be taken otherwise.

### **1.0 Mode of Measurement & Payment:**

1.1. The unit rate box cutting shall include the cost of all materials, tools and plant required for excavation in all type of soils in grade and camber, line and levels and finishing as per direction of the Engineer-in-charge, excavation and all other incidental expenses for producing item of box cutting of specified breadth and depth and grade to complete the item or its components as shown on the drawings and according to these specifications.

1.2. The box cutting shall be measured for its cross sectional area and computing volumes of earth work in cubic metres by the method of average end areas

1.3. The payment will be made on Cubic Metre basis of the finished work.

**Item:-**

**Filling in foundation and plinth with murrum or selected soil in layers of 20cm. thickness including watering, ramming and consolidating etc. complete.**

**1.0. Materials**

1.1. Murrum shall be clean, of good binding quality and of approved quality obtained from approved pots/quarries of disintegrated rocks which contain silicons material and natural mixture of clay of calcarious origin. The size of murrum shall not be more than 20 mm.

**2.0. Workmanship**

2.1. The relevant specifications of item No. 4.12 shall be followed except that the murrum or selected soil shall be filled in foundations and plinth in 20 cms. layer including consolidating, ramming, watering, dressing etc. complete.

**3.0. Mode of measurements & payment**

3.1. The relevant specifications of item No. 4.12 shall be followed.

3.2. The rate includes cost of collecting and caning murrum/ or selected earth of approved quality with all lead and labour required for filling in trenches and plinth.

3.3. Rate shall be for a unit of one cubic meter.

**Item:-**

**Construction of Grannular sub base 150m (Grade -I ) by providing coarse garded material using M/C. metal in uniform layer with motor grader on prepared surface mixing by mix in place method with vibratory roller to achive the desired complete as per close 401.**

**401. GRANULAR SUB-BASE**

**401.1. Scope** This work shall consist of laying and compacting well-graded material on prepared sub grade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

**401.2. Materials**

**401.2.1.** The material to be used for the work shall be natural sand Murrum, gravel, crushed stone, or combination thereof depending upon the grading required. Materials like crushed slag crushed concrete, brick metal and kankar may be allowed only with the specific approval of the Engineer. The material shall be free from organic or other deleterious constituents and conform to one of the three grading given in Table. While the grading in Table 400-1 are in respect of close-graded granular sub-base materials, one each for maximum particle size of 75 mm, 53 mm and 26.5 mm, the corresponding grading for the corresponded materials for each of the three maximum particle sizes are Oven at Table 400-2. The grading to be adopted for a project shall be as specified in the Contract.

**401.2.2. Physical requirements:** The material shall have a 10 per cwt fines value of 50 KN or more (for sample in soaked condition) when tested in compliance with BS: 812 (Part I 11). The water absorption value of the coarse aggregate shall be determined as per IS: 2386 (Part 3); if this value is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS: 3, 83 FBR Grading II and III materials, the CBR shall be determined at the density and moisture content likely to be developed in equilibrium conditions which shall be taken as being the density relating to a uniform air voids content of 5 per cent.

<b>TABLE 400-1 GRADING FOR CLOSE-GRADED GRANULAR SUB-BASE</b>	
<b>IS Sieve Designation</b>	<b>Per cent by weight passing the IS sieve</b>
75.0 mm	-
53.0 mm	-
26.5 mm	-
9.50 mm	1
4.75 mm	0
2.36 mm	0
0.425 mm	6
0.075 mm	5
<b>CBR Value (Minimum)</b>	<b>2</b>

**Note:** The material passing 425 micron (0.425 mm) sieve for all this grading when tested according to IS: 2720 (Part 5) shall have liquid limit and plasticity index not more than 25 and 6 per cent respectively.

**401.3. Strength of sub-base:** It shall be ensured prior to actual execution that the material to be used in the sub-base satisfies the requirements of CBR and other physical requirements when compacted and finished. When directed by the Engineer, this shall be verified by performing CBR tests in the laboratory as required on - specimens remolded at field dry density and moisture content and any other tests for the quality" of materials, as may be necessary.

#### **401.4. Construction Operations**

**401.4.1. Preparation of sub grade :** Immediately prior to the laying of sub-base, the sub grade already finished to Clause 301 or 305 as applicable shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water if necessary and rolled with two passes of 80 -100 KN smooth wheeled roller.

**401.4.2. Spreading and compacting:** The sub-base material of grading specified in the Contract shall be spread on the prepared sub grade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation or other means as approved by the Engineer. When the sub-base material consists of combination of materials mentioned in Clause 401.2.1, mixing shall be done mechanically by the mixing-place method.

Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small-sized jobs. The equipment used for mix-in-place construction shall be a rotator or similar approved equipment capable of mixing the material to the desired degree, if so desired by the engineer; trial runs with the equipment shall be carried out to establish its suitability for the work.

Moisture content of the loose material shall be checked in accordance with IS: 2720 (Part 2) and suitably adjusted by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from 1 per cent above to 2 per cent below the optimum moisture content corresponding to IS: 2720 (Part 8). While adding water, due allowance shall be made for evaporation losses. After water has been added the material shall be processed by mechanical or other approved means like disc harrows, rotators until the layer is uniformly wet.

Immediately thereafter, rolling shall start. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 KN weight may be used. For a compacted single layer up to 225 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 KN static weight with plain drum or pad foot drum or heavy pneumatic tyred roller of minimum 200 to 300 KN weight having a minimum tyre pressure of 0.7 MN/m<sup>2</sup> or equivalent capacity roller capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional cross fall and super-elevation and shall commence at 6 the edges and progress towards the centre for portions having cross fall on both sides.

Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling, the grade and cross fall (camber) shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material, the speed of the roller shall not exceed 5 km per hour. Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry density for the material determined as per IS: 2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

#### **401.5. Surface Finish and Quality Control of Work**

The surface finish of construction shall conform to the requirements of Clause 902. Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

**401.6. Arrangements for Traffic:** During the period of construction, arrangement of traffic shall be maintained in accordance with Clause 112.

**401.7. Measurements for Payment:** Granular sub-base shall be measured as finished work in position in cubic metres. The quantity of materials to be consumed at loose



volume of 1.32 Cmt. for a compacted thickness of 1.00 Cmt. of G.S.B. and the materials to be brought on site should be cross checked by Engineer-in-charge by measuring the volume of trucks / tippers or of equivalent vehicles carrying materials at site and if the measurement is checked on tonne basis, then the volume & weight should be converted accordingly & the materials brought on site should be of loose volume of 1.32 Cmt. / Cmt. of compacted thickness as required. The expenses for cross checking on weight measurement converting in to volumetric system should be borne by contractor & if the payment is not made by the contractor, then the same amount should be recovered from the bill of contractors. The above checking should be on test check basis & if required, the contractor is bound to cross check all the quantity of materials to Department as per the instructions of Engineer-in-charge. The protection of edges of granular sub-base extended over the full formation as shown in the drawing shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

**401.8. Rate:**

The Contract unit rate for granular sub-base shall be payment in full for carrying out the required operations including full compensation for

- (i) Making arrangements for traffic to Clause 112 except for initial treatment to verges, shoulders and construction of diversions.
- (ii) Furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lifts.
- (iii) All labour, tools, equipment and incidentals to complete the work to the Specifications. (iv) Carrying out the work in pan widths of road where directed
- (v) Carrying out the required tests for quality control.

**Item:-**

**Providing and laying compacted W.B.M 150 mm thick of machin crushed B.T . Metal of size of size 45 mm to 63mm with using 20 % stone screenings (Grit ) and stone dust as filler including spreading , watering and consolidation by vibratory roller etc. complete.**

**404. Scope of Work :-**

**404.1.1.** This work shall consist of clean, crushed aggregates mechanically interlocked by rolling and bonding together with screening binding material where necessary and water laid on a properly prepared sub-grade / sub-base / base or existing pavement, as the case may be and finished in accordance with the requirements of these Specifications and in close conformity with the lines, grades, cross-sections and thickness as per approved plans or as directed by the Engineer.

**404.1.2.** It is, however, not desirable to lay water bound macadam on an existing thin black topped surface without providing adequate drainage facility for water that would get accumulated , at the interface of existing Bitumenous surface and water bound macadam.

**404.2. Materials**

**404.2.1. Coarse aggregates:** Coarse aggregates shall be either crushed or broken stone, crushed slag, over burnt (Jhama) brick aggregates or any other naturally occurring aggregates such as kankar and laterite of suitable quality. Materials other than crushed or broken stone and crushed slag shall be used in sub-base courses only. If crushed gravel/ shingle is used, not less than 90 per cent by weight of the gravel/ shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table 400-6. The type and size range of the aggregate shall be specified in the Contract or shall be as specified by the Engineer. If the water absorption value of the coarse aggregate is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per I.S.: 2386 (Part 5).

**404.2.2. Crushed or broken stone:** The crushed or broken stone shall be hard, durable and free from excess flat, elongated, soft and disintegrated particles, dirt and other deleterious material.

**TABLE 400-6. PHYSICAL REQUIREMENTS OF COARSE AGGREGATES FOR WATER BOUND MACADAM FOR SUB-BASE/BASE COURSES**

Test		Test Method	Requirements
1.	Los Angeles Abrasion value or Aggregate Impact Value	IS : 2386 (Part - 4)  IS : 2386 (Part - 4) or IS :	40 per cent (Max)  30 per cent (Max)
2.	Combined Flakiness and Elongation Indices (Total) ***	IS : 2386 (Part - I)	30 per cent (Max)

Aggregate may satisfy requirements of either of the two tests.

Aggregates like brick metal, kankar, laterite etc. which get softened in presence of water shall be tested for Impact value under wet conditions in accordance with IS: 5640.

The requirement of flakiness index and elongation index shall be enforced only in the case of crushed broken stone and crushed slag.

**404.2.3. Crushed slag:** Crushed slag shall be made from air-cooled blast furnace slag. It shall be of angular shape, reasonably uniform in quality and density and generally free from thin, elongated and soft pieces, dirt or other deleterious materials. The weight of crushed slag shall not be less than 11.2 kN per M<sup>3</sup> and the percentage of glossy material shall not be more than 20. It should also comply with the following requirements:

- (i) Chemical stability : To comply with requirements of appendix of BS : 1047
- (ii) Sulphur content : Maximum 2 per cent
- (iii) Water absorption : Maximum 10 per cent

**404.2.4. Over burnt (Jhama) brick aggregates:** Jhama brick aggregates shall be made from over burnt bricks or brick bats and be free from dust and other objectionable and deleterious materials.

**404.2.5. Grading requirement of coarse aggregates:** The coarse aggregates shall conform to one of the Gradings given in Table 400-7 as specified, provided; however, the use of Grading No.1 shall be restricted to sub-base courses only.

**TABLE 400-7. GRADING REQUIREMENTS OF COARSE AGGREGATES**

Grading No.	Size Range	IS Sieve Designation		Per cent by weight passing
1.	90 mm to 45 mm	125	mm	100
		90	mm	90 – 100
		63	mm	25 – 60
		45	mm	0 – 15
		22.4	mm	0 – 5
2.	63 mm to 45 mm	90	mm	100
		63	mm	90 – 100
		53	mm	25 – 75
		45	mm	0 – 15
		22.4	mm	0 – 5
3.	53 mm to 22.4 mm	63	mm	100
		53	mm	95 – 100
		45	mm	65 – 90
		22.4	mm	0 – 10

Note: The compacted thickness for a layer with Grading I shall be 100 mm while for layer with other

Gradings i.e. 2 & 3, it shall be 75 mm.

**404.2.6. Screenings:** Screenings to fill voids in the coarse aggregate shall generally consist of the same material as the coarse aggregate. However, where permitted, predominantly non-plastic material such as moorurn or gravel (other than rounded river borne material) may be used for this purpose provided liquid limit and plasticity index of such material are below 20 and 6 respectively and fraction passing 75 micron sieve does not exceed 10 per cent.

Screenings shall conform to the grading set forth in Table 400-8. The consolidated details of quantity of screenings required for various grades of stone aggregates are given in Table 400-9. The table also gives the quantities of materials (loose) required for 10 m<sup>2</sup> for sub-base/base compacted thickness of 100/75 mm.

The use of screenings shall be omitted in the case of soft aggregates such as brick metal, kankar, laterites, etc. as they are likely to get crushed to a certain extent under rollers.

**TABLE 400-8. GRADING FOR SCREENINGS**

<b>Grading Classification</b>	<b>Size of Screenings</b>	<b>IS Sieve Designation</b>		<b>Per cent by weight passing the IS Sieve</b>
A	13.2 mm	13.2	mm	100
		11.2	mm	95 – 100
		5.6	mm	15 – 35
		180	micron	0 – 10
B	11.2 mm	11.2	mm	100
		5.6	mm	90 – 100
		180	micron	15 - 35

**TABLE 400-9.**  
**APPROXIMATE QUANTITIES OF COARSE AGGREGATES AND SCREENINGS REQUIRED FOR**  
**100/75 MM COMPACTED THICKNESS OF WATER BOUND MACADAM (WBM) SUB-**  
**BASE/BASE COURSE FOR 10M<sup>2</sup> AREA**

Classification	Size Range	Compacted thickness	Loose Qty.	Screening			
				Stone Screening		Crushable Type such as Moorum or	
				Grading Classification & size	For WBM Sub-base / base	Grading Classification & Size	Loose Qty.
Grading 1	90 mm to 45 mm	100 mm	1.21 to 1.43 m <sup>3</sup>	Type A 13.2 mm	0.27 to 0.30 m <sup>3</sup>	Not uniform	0.30 to 0.32 m <sup>3</sup>
Grading 2	63 mm to 45 mm	75 mm	0.91 to 1.07 m <sup>3</sup>	Type A 13.2 mm	0.12 to 0.15 m <sup>3</sup>	Not uniform	0.22 to 0.24 m <sup>3</sup>
Grading 2	63 mm to 45 mm	75 mm	0.91 to 1.07 m <sup>3</sup>	Type B 11.2 mm	0.20 to 0.22 m <sup>3</sup>	Not uniform	0.22 to 0.24 m <sup>3</sup>
Grading 3	53 mm to 22.4 mm	75 mm	0.91 to 1.07 m <sup>3</sup>	Type B 11.2 mm	0.18 to 0.21 m <sup>3</sup>	Not uniform	0.22 to 0.24 m <sup>3</sup>

**404.2.7. Binding material:** Binding material to be used for water bound macadam as a filler material meant for preventing ravelling, shall comprise of a suitable material approved by the Engineer having a Plasticity Index(PI) value or less than 6 as determined in accordance with IS: 2720 (Part-5).

The quantity of binding material where it is to be used will depend on the type of screenings. Generally, the quantity required for 75 mm compacted thickness of water bound macadam will be 0.06-0.09 m<sup>3</sup>/10m<sup>2</sup> and 0.08-0.10m<sup>3</sup>/10m<sup>2</sup> for 100 mm compacted thickness.

The above mentioned quantities should be taken as a guide only, for estimation of quantities for construction etc.

Application of binding materials may not be necessary when the screenings used are of crushable type such as moorum or gravel.

### **404.3. Construction Operations**

**404.3.1. Preparation of base:** The surface of the sub-grade/ sub-base/base to receive the water bound macadam course shall be prepared to the specified lines and cross fall (camber) and made free of dust and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm surface is obtained if necessary by sprinkling water. Any sub-base/base/surface irregularities, where predominant, shall be made good by providing appropriate type of profile corrective course (levelling course) to Clause 501 of these Specifications.

As far as possible, laying water bound macadam course over an existing thick Bitumenous layer may be avoided since it will cause problems of internal drainage of the pavement at the interface of two courses. It is -desirable to completely pick out the existing thin Bitumenous wearing course where water bound macadam is proposed to be laid over it. However, where the intensity of rain is low and the interface drainage facility is efficient, water bound macadam can be laid over the existing thin Bitumenous surface by cutting 50 mm x 50 mm furrows at an angle of 45 degrees to the centre line of the, pavement at one metre intervals in the existing road. The directions and depth of furrows shall be such that they provide adequate bondage and also serve to drain water to the existing granular base course beneath the existing thin Bitumenous surface.

**404.3.1 Inverted choke:** If water bound macadam is to be laid directly over the sub-grade, without any other intervening pavement course, a 25 mm course of screenings (Grading B) or coarse sand shall be spread on the prepared sub-grade before application of the aggregates is taken up. In case of a fine sand or silty or clayey sub-grade, it is advisable to lay 100 mm insulating layer of screening or coarse sand on top of fine grained soil, the gradation of which will depend upon whether it is intended to act as a drainage layer as well. As a preferred alternative to inverted choke, appropriate Geosynthetics performing functions of separation and drainage may be used over the prepared sub-grade as directed by the Engineer. Section 700 shall be applicable for use of Geosynthetics.

**404.3.3. Spreading coarse aggregates:** The coarse aggregates shall be spread uniformly and evenly upon the prepared sub-grade/sub-base / base to proper profile by using templates placed across the road about 6 m apart, in such quantities that the thickness of each compacted layer is not more than 100 mm for Grading 1 and 75 mm for Grading 2 and 3, as specified in Clause 404.2.5. Wherever possible, approved mechanical devices such as aggregate spreader shall be used to spread the aggregates uniformly so as to minimise the need for manual rectification afterwards. Aggregates placed at locations which are inaccessible to the spreading equipment, may be spread in one or more layers by any approved means so as to achieve the specified results.

The spreading shall be done from stockpiles along the side of the roadway or directly from vehicles. No segregation of large or fine aggregates shall be allowed and the coarse aggregate as spread shall be of uniform gradation with no pockets of fine material.

The surface of the aggregates spread shall be carefully checked with templates and all

high or low spots remedied by removing or adding aggregates as may be required. The surface shall be checked frequently with a straight edge while spreading and rolling so as to ensure a finished surface as per approved drawings.

The coarse aggregates shall not normally be spread more than 3 days in advance of the subsequent construction operations.

**404.3.4. Rolling:** Immediately following the spreading of the coarse aggregate, rolling shall be started with three wheeled power rollers of 80 to 100 kN capacity or tandem or vibratory rollers of 80 to 100 kN static weight. The type of roller to be used shall be approved by the Engineer based on trial run.

Except on super elevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inward parallel to the centre line of the road, in successive passes uniformly lapping preceding tracks by at least one half width.

Rolling shall be discontinued when the aggregates are partially compacted with sufficient void space in them to permit application of screenings. However, where screenings are not to be applied, as in the case of crushed aggregates like brick metal, laterite and kankar, compaction shall be continued until the aggregates are thoroughly keyed. During rolling, slight sprinkling of water may be done, if necessary. Rolling shall not be done when the sub-grade is soft or yielding or when it causes a wave-like motion in the sub-grade or sub-base course.

The rolled surface shall be checked transversely and longitudinally, with templates and any irregularities corrected by loosening the surface, adding or removing necessary amount of aggregates and re-rolling until the entire surface conforms to desired cross fall (camber) and grade. In no case shall the use of screenings be permitted to make up depressions.

Material which gets crushed excessively during compaction or becomes segregated shall be removed and replaced with suitable aggregates.

It shall be ensured that shoulders are built up simultaneously along with water bound macadam courses as per Clause 407.4.1.

**404.3.5. Application of screenings:** After the coarse aggregate has been rolled to Clause 404.3.4, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregate. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motions of hand shovels or by mechanical spreaders, or directly from tipper with suitable grit spreading arrangement. Tipper operating for spreading the screenings shall be so driven as not to disturb the coarse aggregate.

The screenings shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms, hand brooms or both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until

no more screenings can be forced into the voids of the coarse aggregate. The spreading, rolling, and brooming of screenings shall be carried out in only such lengths of the road which could be completed within one day's operation.

**404.3.6. Sprinkling of water and grouting:** After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and to distribute them evenly. The sprinkling, sweeping and rolling operation shall be continued, with additional screenings applied as necessary until the coarse aggregate has been thoroughly keyed, well-bonded and firmly set in its full depth and a grout has been formed of screenings. Care shall be taken to see that the base or sub-grade does not get damaged due to the addition of excessive quantities of water during construction.

In case of lime treated soil sub-base, construction of water bound macadam on top of it can cause excessive water to flow down to the lime treated sub-base before it has picked up enough strength (is still "green") and thus cause damage to the sub-base layer. The laying of water bound macadam layer in such cases shall be done after the sub-base attains adequate strength, as directed by the Engineer.

**404.3.7. Application of binding material:** After the application of screenings in accordance with Clauses 404.3.5 and 404.3.6. the binding material where it is required to be used (Clause 404.2.7) shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water, the resulting slurry swept in with hand brooms, or mechanical brooms to fill the voids properly, and rolled during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling of voids, forms a wave ahead of the wheels of the moving roller.

**404.3.8. Setting and drying:** After the final compaction of water bound macadam course, the pavement shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings or binding material as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam has set. The Engineer shall have the discretion to stop hauling traffic from using the completed water bound macadam course, if in his opinion it would cause excessive damage to the surface.

The compacted water bound macadam course should be allowed to completely dry and set before the next pavement course is laid over it.

#### **404.4. Surface Finish and Quality Control of Work**

**404.4.1.** The surface finish of construction shall conform to the requirements of Clause 902.

**404.4.2.** Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section, 900.

**404.4.3.** The water bound macadam work shall not be carried out when the



atmospheric temperature is less than 0<sup>0</sup>C in the shade.

**404.4.4. Reconstruction of defective macadam:** The finished surface of water bound macadam shall conform to the tolerance of surface regularity as prescribed in Clause 902. However, where the surface irregularity of the course exceeds the tolerances or where the course is otherwise defective due to sub- grade soil mixing with the aggregates, the course to its full thickness shall be scarified over the affected area, reshaped with added material or removed and replaced with fresh material as applicable and recompacted. In no case shall depressions be filled up with screenings or binding material.

**404.5. Arrangement for Traffic**

During the period of construction, the arrangement of traffic shall be done as per Clause 112.

**404.6. Measurements for payment**

Water bound macadam shall be measured as finished work in position in cubic metres.

**404.7Rate:**

The contract unit rate for water bound macadam sub-base/base course. Shall be payable in full for carrying out the required operations including arrangement of water used in the work as approved by the Engineer including full compensation for all components listed below.

- (i) Making arrangements for traffic to Clause 112 except for initial treatment to verges, shoulders and construction of diversions;
- (ii) Furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lifts;
- (iii) All labour, tools, equipment and incidentals to complete the work to the specifications;
- (iv) Carrying out the work in part widths of road where directed; and
- (v) Carrying out the required tests for quality control.

**Item:-**

**Providing and laying controlled cement concrete M250 and curing complete including the cost of formwork and excluding the cost of reinforcement for reinforced concrete work in Slab using Conplast P21(water reducing concrete admixture at 100 ml per bag of cement & Recon 3 s fiber at 125 gm per bag of cement for C.C.Flooring with trimix vacuum dewatering system including providing and fixing & removing of 'C' channels having 3" x 3" as per required level, slope and thickness of concrete road with surface vibrator and finishing with power floater & trowel light brooming the surface & including cutting & filling of expansion joint as directed by Engineer in charge.**

## Materials

### Water:

- 1.1 Water shall not be salty or brackish and shall be clean, reasonably clear and free objectionable quantities of silt and traces of oil and injurious alkalis, salts, organic matter and other deleterious material which will either weaken the mortar or concrete or cause efflorescence or attack the steel in R.C.C Container for transport, storage and handling of water shall be clean. Water shall conform to the standards specified in I.S.456-1978.
- 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 I.S.269-1976. 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 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 not be used for curing.
- 1.5 Portable water will be generally found suitable for curing mortar or concrete.

### Sand

- 1.0 Sand shall be natural sand, clean, well graded, hard strong durable and gritty particle free from injurious amounts of dust clay, kankar nodules, soft or flaky particles shale, alkali, salts organic matter, loam, mica or another deleterious substance and shall be got approved from the Engineer-in-charge. The sand shall not contain more than 8 percent of silt as determined by field test. If necessary the sand shall be washed to make it clean.
  - 1.1 Coarse Sand : The fineness modulus of coarse sand shall not be less than 2.5 and shall not exceed 3.0.  
The sieve analysis of coarse shall be as under:

I.S.Sieve	Percentage by weight	I.S.Sieve	Percentage by weight
Designation	Passing Sieve	Designation	Passing Sieve
4.75 mm.	100	600 Micron	30-100
2.36 mm.	90 to 100	300 Micron	5-70
1.18 mm.	70-100	150 Micron	0-50

- 6.4 Fine Sand:** The fineness modulus shall not exceed 1.0. The sieve analysis of fine sand shall be as under:

I.S.Sieve	Percentage by weight	I.S.Sieve	Percentage by weight
Designation	Passing Sieve	Designation	Passing Sieve
4.75 mm.	100	600 Micron	40-85
2.36 mm.	100	300 Micron	5-50
1.18 mm.	70-100	150 Micron	0-10

**Cement :**

Cement shall be ordinary Portland slag cement as per I.S. 269-1976 or Portland slag cement as per I.S. 455-1976.

Measurement and storage of materials: measurement and storage of materials shall be done in accordance with the requirements of IS:456:2000.

Admixtures to be used in recommended proportions as per IS:9103 to accelerate / retard setting of concrete, improve workability without impairing strength and durability

**2.0 Basis of Supply**

- 2.1 Depending upon the agreement the ready mix concrete shall be supplied on either of the following basis:

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

- 2.2 When the concrete is manufactured and supplied on the basis of specified strength, the responsibility for the design of mix shall be that of the contractor and the concrete shall confirm to the requirements specified.

- 2.3 Mix design shall be approved by engineer in charge before placing of the concrete. Testing of all materials and produced concrete shall be done as per the relevant IS standards of the concrete.

**3.0 General Requirements**

- 3.1 The minimum quantity of cement and the details regarding proportioning and works control shall be in accordance with IS:456:2000.

- 3.2 The concrete ready mix shall be conforming to relevant IS code manufactured in fully automatic batching plant and transported to site of work in transit mixer for up to all lead & lifthaving continuous agitated mixer.

- 3.3 When a transit mixer is used for transportation of concrete, no extra water should be added to the concrete from else where after initial introduction of mixing water from the batch, except when on arrival at the site of the work, the slump of the concrete is less than that specified: such additional water to bring the slump within required limits shall be injected into that mixer under such pressure and direction of flow that requirements for uniformity are met.

- 3.4 When a transit mixer is used for transporting concrete, the concrete shall be delivered to the site of the work and discharge shall be complete within one and half hour (when the

prevailing atmospheric temperature is at or below 20 degree celcius) of adding the mixing water to the dry mix of cement and aggregate or of adding the cement to the aggregate which ever is earlier.

#### **4.0 Temperature**

- 4.1 The temperature of the concrete at the place and time of delivery shall not less than 5-degree Celsius above the prevailing shade temperature is less than 2.5 degree Celsius and the thermometer reading is falling.

#### **5.0 Sampling and Testing**

- 5.1 General Technical Specifications for Building Works – Item no. 5.3.13, clause no. 3.7 shall be followed.

#### **6.0 Records and Certificates**

The contractor shall keep from the manufacturer batch records of the quantities by mass of all the solid materials, of the total amount of water used in mixing and of the results of all tests. If required by the architect, the contractor shall furnish certificates, at agreed intervals, giving this information.

#### **7.0 Concrete Manufactured And Supplied On The Basis Of Specified Strength**

- 7.1 The contractor shall supply the following information for guidance of the manufacturer:
- a) The type of cement to be used
  - b) MSA
  - c) Type of admixture to be used, if specified
  - d) Min. acceptable strength
  - e) Slump of concrete or compacting factor
  - f) Ages at which the test cubes or beams are to be tested, and the frequency and number of test to be made
  - g) Any other requirement
- 7.2 Tolerances: Unless otherwise agreed to between the architect and the contractor, the concrete shall be deemed to comply with the requirements of this standard, if the results of tests where applicable lie within the tolerance specified below.
- 7.2.1 Consistency of workability: The slump average of two test) shall not differ from the specified value by  $\pm 10\text{mm}$  for a specified slump of 75mm. The compacting factor average of two tests shall be within  $\pm 0.03$  of the value specified. If any other method of determining consistency to be used, a suitable tolerance shall be agreed to between the purchaser and the manufacturer. The test for consistency or workability shall be completed within 15 minutes of the time of receipt of the ready mix concrete at the site.
- 7.2.2 Aggregate- When tested in accordance with IS 2386 (part-I)-1963, the quantity of aggregate larger than the max. size specified by the purchaser shall not exceed 5% of the qty. of coarse aggregate and all such excess shall pass through sieve of next higher size

#### **(B) Formwork**

##### **8.0 Materials**

- 8.1 Shuttering of ordinary timber planking shall be conform to M26.
- 8.2 The dimensions of scantling and battens shall conform to the design. The strength of the wood shall not be less than that assumed in the design.

8.3 Contractors shall design the formwork and get it approved by the Engineer-in charge.

**9.0 Workmanship:**

9.1 The formwork shall conform to the shape, lines and dimensions as shown on the drawings and shall be so constructed so as to remain sufficiently rigid and water-tight, during the placement and compaction of the concrete. Adequate arrangement shall be made by the Contractor to safe guard against any settlement of the formwork during the course of concreting and after concreting. The formwork of shuttering, centering, scaffolding, bracing, etc. shall be as per the design and shall be made from shuttering plywood with batten/ steel plates and steel supporting system. Supporting system shall be carried out with cup lock system / steel props and span / H frames and span / Doca formwork as approved by Architect.

9.2 **Cleaning & Treatment of Forms :** All rubbish, particularly chipping, shaving and saw dust shall be removed from the interior of the form before the concrete is placed and the formwork in contact with concrete shall be cleaned thoroughly. The surface shall be coated with approved shuttering release agent as directed by Engineer Incharge or Architect. Care shall be taken that the coating is not applied on the construction joints surface and steel reinforcement bars.

9.3 **Stripping Time:** In normal circumstances and where ordinary portland cement is used, formwork may be struck after expiry of the following periods:

- (a) Sides of walls columns and vertical faces of beams 16 to 24 hours.
- (b) Slab soffit (props to be refixed immediately after removal of formwork) 3 days
- (c) Beam soffits (Props left under) 7 days.
- (d) Removal of props for slabs -
  - (i) Slabs spanning upto 4.5 m. 7 days.
  - (ii) Slabs spanning over 4.5 m. 14 days.
- (e) Removal of props to beams and Arches -
  - (i) Spanning upto 6 m. 14 days.
  - (ii) Spanning over 6 m. 21 Days.

9.4 **Procedure while removing the formwork:** All formwork shall be removed without such shocks or vibrations as would damage the reinforced concrete surface. Before the soffit formwork and struts are removed, the soffits and the concrete surface shall be exposed where necessary, in order to ascertain that the concrete has sufficiently hardened.

**9.5 Centering**

9.5.1 The centering to be provided shall be got approved. It shall be sufficiently strong to ensure absolute safety of the formwork and concrete work before, during and after pouring concrete till it achieved full strength. Watch should be kept to see that behavior of centering and formwork is satisfactory during concreting. Erection should also be such that it would allow removal of forms in proper sequence without damaging either the concrete or the forms to be removed.

9.5.2 The props of centering shall be provided on firm foundation or base of sufficient strength to carry the loads, without any settlement. Wedges shall be provided at the

- base of the fixed prop (wooden and steel) for its easy removal. Props shall be adequately braced to withstand the lateral forces.
- 9.5.3 The centering and formwork shall be inspected and approved by the Engineer-in-charge, before concreting. But this will not relieve the Contractor of his responsibility for strength; adequacy and safety of formwork and centering. If there is a failure of formwork or centering, the Contractor shall be responsible for the damages to the work, injury to life and damage to property.
- 9.5.4 For exposed RCC walls, columns and beams, the shuttering plates on either side shall be bolted with tie rods made from spring coils on either side, welded with two nos 8mm MS rods. PVC cone shall be placed on either side of the tie rod. The whole tie rod assembly along-with PVC cone shall be placed/fixed with special type of bolts on either side of the shuttering plates. Length of the tie rod along-with PVC cone shall be equal to the width / thickness of the element to be shuttered. Holes of PVC cones shall be filled with rich cement mortar of matching exterior surface.
- 9.6 Scaffolding :**
- 9.7.1 All scaffolding, hoisting arrangements and ladders, etc. required for facilitating of concreting shall be provided and removed on completion work by Contractor, at his own expense. The scaffolding, hoisting arrangement, ladders etc. shall be strong enough to withstand all live, dead and impact loads expected to act and shall be subject to the approval of the Architect and Engineer-in-charge. However, Contractor shall be solely responsible for the safety of the scaffolding, hoisting arrangement, ladders, work and workmen, etc.
- 9.7.2 The scaffolding, hoisting arrangements and ladders shall allow easy approach to the work spot and afford easy inspection.
- 9.8 Reuse :**
- 9.8.1 Before re-use, all forms shall be inspected by the Engineer-in-charge and their suitability shall be ascertained. If, any of the forms are found to be unsuitable, they shall be immediately removed from the site. The forms ascertained for re-use, shall be scarred, cleaned, and joints gone over and repaired, wherever required. The inside surface shall be retreated to prevent adhesion to concrete.
- 10.0 Mode of Measurement**
- 10.1 The concrete work shall be measured in length, breadth and depth as specified on drawing or as directed, correct upto nearest centimeters and cubical content shall be worked out nearest centimeter and cubical content shall be worked out nearest upto two places or decimals.
- 10.2 General Technical Specifications for Building Works – Item no. 5.3.13, clause no. 4.0 shall be followed.
- 10.3 The rate shall be inclusive of chemical admixture like plasticizer etc. No additional payment shall be paid on this account.
- 10.4 The rate should be including pumping of RMC from transit mixer to site of laying, curing, cleaning the site etc. No additional payment shall be paid on this account.
- 10.5 The rate of item is inclusive of cost of cement, up to all lead & lift from plant to site, octroi, transportation, all other taxes, pumping, pouring, curing etc. complete.
- 10.6 The rate shall be for a unit of one Sqmt.

**Item:-**

**Excavation for foundation upto 1.5 m depth including sorting out and stacking of useful materials and disposing off the excavated stuff upto 50 Meter lead. (A) Loose or Soft Soil**

**1.0. General**

1.1. Any soil which generally yields to the application of pickaxes and shovels, phawaras rakes or any such ordinary excavating implement or organic soil, gravel silt, sand turf loam, clay, peat etc., fall under this category

**2.0. Clearing the site**

2.1. The site on which the structure is to be built shall be cleared, and all obstructions loose stone, materials and rubbish of all kind bush wood and trees shall be removed as directed. The materials so obtained shall be property of the Government and shall be conveyed and stacked as directed within 50 m lead. The roots of the trees coming in the sides shall be cut and coated with a hot asphalt

2.2. The rate of side clearance is deemed to be included in the rate of earth work for which no extra will be paid.

**3.0. Setting out**

After clearing the site the centre lines will be given, by the Engineer-in-charge. The contractor shall assume full responsibility for alignment, elevation and dimension of each and all parts of the work. Contractor shall supply labour materials, etc. required for setting out the reference marks and bench marks and shall maintain them as long as required and directed.

**4.0. Excavation**

The excavation in foundation shall be carried out in true line and level and shall have the width and depth as shown in the drawings or as directed. The contractor shall do the necessary shoring and shutting or providing necessary slopes to a safe angle, at his own cost. The payment for such precautionary measures shall be paid separately if not specified. The bottom of the excavated area shall be leveled both longitudinally and transversely as directed by removing and watering as required. No. earth filling will be allowed for bringing it to level. If by mistake or any excavation is made deeper or wider than, that shown on the plan or directed. The extra depth or width shall be made up with concrete of same proportion as specified for the foundation concrete at the cost of the contractor. The excavation up to 1.5 m depth shall be measured under this item.

**5.0. Disposal of the excavated stuff**

5.1. The excavated stuff of the selected type shall be used in filling the trenches and plinth or leveling the ground in layers including ramming and watering etc.

5.2. The balance of the excavated quantity shall be removed by the contractor from the site of work to a place as directed with lead up to 50 M. and all lift.

**6.0. Mode of measurements & payment**

6.1. The measurement of excavation in trenches for foundation shall be made according to the sections of trenches shown on the drawing or as per sections given by the Engineer-in-charge. No payment shall be made for surplus excavation made in excess of above requirements or due to stopping and sloping back as found necessary on account of conditions of soil and requirements of safety.

6.2. The rate shall be for a unit of one cubic meter

**Item:-**

**Providing TMT Bar FE 500/500D reinforcement for R.C.C. work including bending, binding and placing in position complete upto floor two level (upto 10 ton)**

**1.0. MATERIALS:**

**1.1. High yield Strength Steel Deformed Bars :**

1.1.1 High yield strength steel deformed bars are either cold twisted or hot rolled, shall conform to I.S. 1739-1966 and I.S.1139-1966 respectively.

1.1.2 Other provision and requirements shall conform to specification NO. M-18 for Mild steel bars

**1.2. Mild Steel Binding Wire :**

1.2.1 The mild steel wire shall be of 1.63 mm or 1.22 mm. (16 or 18 gauge) diameter and shall conform to I.S. 280-197.

1.2.2 The use of black wire be permitted for binding reinforcement bars. It shall be free from rust, Oil paint, grease, looser mill scale or any other undesirable coating which may prevent adhesion of cement mortar.

**2.0. WORKMANSHIP :**

2.1. The work shall consist of furnishing and placing reinforcement to the shape and dimensions shows as on the drawings or as directed.

2.2. Steel shall be clean and free from rust and loose mill scale at the time of fixing in position and subsequent concreting.

2.3. Reinforcing steel shall conform accurately to the dimensions given in the bar bending schedules shown on relevant drawings. Bars shall be bent cold to specified shape and dimensions or as directed using a proper bar bender, operated by hand or power to attain proper radius of bends. Bars shall not be bent or straightened in a manner that will injure the material. Bars bent during transport or handling shall be straightened before being used on the work. They shall not be heated to facilitate bending. Unless otherwise specified, a 'U' type hook at the end of each bar shall invariably be provided to main reinforcement. The radius of the bend shall not be less than twice the diameter of the round bar and the length of straight part of the bar beyond the end of the curve shall be at least four times the diameter of the round bar. In case of bars which are not round and in case of deformed bars, the diameter shall be taken as the diameter of circle having an equivalent effective area. The hooks shall be suitably encased to prevent any splitting of the concrete.

2.4. All the reinforcement bars shall be accurately placed in exact position shown on the drawing and shall be securely held in position during, metal hangers, supporting wires or other approved devices at sufficiently close intervals,. Bars shall not be allowed to sag between supports nor displaced during concreting or any other operations of the work. All devices used for positioning shall be of non-corrodible material. Wooden and metal supports shall not extend to the surface of concrete, except where shown on drawings. Placing of broken stone or brick and wooden blocks shall not be allowed. Pieces of broken stone or brick and wooden blocks shall not be used. Layers of bars shall be separated by spacer bars, precast mortar blocks or other approved devices. reinforcement after being placed in position shall be maintained in a clean condition until completely embedded in concrete. Special care shall be exercised to prevent any displacement of reinforcement in concrete already placed. To prevent reinforcement



from corrosion, concrete cover shall be provided as indicated on drawings. All the bars producing from concrete and to which other bars are to be spliced and which are likely to be exposed for a period exceeding 10 days shall be protected by a thick coat of neat cement grout.

- 2.5. Bars crossing each other where required shall be secured by binding wires (annealed) of size not less than 1 mm in such manner that they do not slip over each other at the time of fixing and concreting.
- 2.6. As far as possible, bars of full length shall be used. In case this is not possible, overlapping of bars shall be done directed. When practicable, overlapping bars shall not touch each other, but be kept apart by 25 mm or 1.25 mm times the maximum size of the coarse aggregate whichever is greater by concrete between them. Where not feasible, overlapping bars shall be bound with annealed wires not less than 1 mm thick twisted tight. The overlaps shall be staggered for different bars and located at points along the span where neither shear nor bending movement is maximum.
- 2.7. Whenever indicated on the drawings or desired by the Engineer-in-charge, bars shall be joined by couplings which shall have a cross-section sufficient to transmit the full stresses of bars. The ends of the bars that are joined by coupling shall be upset for sufficient length so that the effective cross section at the base of threads is not less than normal cross-section of the bar. Threads shall be standard threads. Steel for coupling shall conform to I.S. 226
- 2.8. When permitted or specified on the drawings, joints of reinforcement bars shall be butt-welded so as to transmit their full stresses. Welded joints shall preferably be located at points when steel will not be subject to more than 75 percent of the maximum permissible stresses and welds so staggered that at any one section not more than 20 percent of the rods are welded. Only electric arc welding using a process which excludes air from the molten metal and conforms to any or all other special provisions for the work shall be accepted. Suitable means shall be provided for holding bars securely in position during welding. It shall be ensured that no voids are left in welding and when welding is done in two or three stages, previous surface shall be cleaned properly. Ends of the bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before welding. Only competent welders shall be employed on the work. The M.S. electrodes used for welding shall conform to I.S. 814. Welded pieces of reinforcement shall be tested. Specimen shall be taken from the actual site and their number and frequency of test shall be as directed.
- 2.9. The above specifications shall be followed except that the cold twisted steel bars shall be used with or without hooks and the ends. Deformed bars without hooks shall however comply with relevant anchorage requirements.

**3.0 Mode of measurement and payment :**

- 3.1 For the purpose of calculation consumption, wastage shall both be permitted beyond 5 percent. Excess consumption over 5 % will be charged at penal rate
- 3.2 Reinforcement shall be measured in length including overlaps, separately for different diameters as actually used in the works. Where welding or coupling is resorted to in place of lap joints such joints shall be measured for a length as equivalent length of overlap as per design requirement. From the length so measured, the weight of reinforcement shall be calculated in tones on the same basis as per M-18 even though steel is supplied to the contractor by the department on actual weight Length

shall include hooks at the ends. Wastage and annealed steel wire for binding shall not be measured and the cost of these items shall be deemed to be included in the rate for reinforcement.

**3.3** The rate shall be for a unit of One Kg.

**Item:-**

**Providing and fixing pre-cast Rubber Dye inter locking concrete block 60mm thick with grade of concrete M250 pneumatic compressed by mechanically pressed and as per approved design including 75mm Sand layer for levelling and filling the joint with sand in proper line and level etc complete.**

**Material :**

Water shall confirm to M-1, sand shall confirm to M-6, Cement shall confirm to M-3. 80mm thick with grade of concrete M400 and pneumatic compressed by mechanically pressed paver block of "ALCOCK" or equivalent make of approved colour & shape having abrasion value not more than 2mm and water absorption not more than 6%.

**Workmanship :**

Subgrade shall be cleaned, leveled, wetted and rammed as directed. 75mm thick layer of dry sand shall be spread over it. paver block of approved colour, shape and size, shall be laid in different pattern/design as shown in the drawing or as directed by Consulting Architect/Engineer-in-charge as directed on top, pressed, tapped gently to bring it in line and level and inter lock with others. The joint shall be as fine as possible. The finished surface shall be true to levels and slopes as directed. Necessary testing of blocks is to be carried out.

**Mode of Measurement and Payments :**

The rate shall include the cost of all materials and labour involved in all the operations described above. The Paver block flooring shall be measured in square metres correct to two places of decimal, length and breadth shall be measured correct to a centimeter. The rate shall be for a unit of one sq. meter.

**Item:-**

**Providing and fixing pre-cast concrete kerb stone of gray cement based concrete block 30cm length, 30cm height and 15cm thick of M250 grade concrete as per approved design and including excavation for fixing in proper line and level, filling the joint with C:M 1:3 (1cement:3fine sand )etc complete.**

**1.0 Material:**

Water shall confirm to M-1, sand shall confirm to M-6, Cement shall confirm to M-3. Pre-cast concrete kerb stone of gray cement based concrete block 35cm length, 30cm height and 15cm thick of M250 grade concrete approved shape.

**2.0 Workmanship:**

Subgrade shall be cleaned, leveled, wetted and rammed as directed. kerb stone of approved colour, shape and size, shall be laid in different pattern/design as shown in

the drawing or as directed by Consulting Architect/Engineer in charge as directed on top, pressed, tapped gently to bring it in line and level and inter lock with others. The joint shall be as fine as possible. The finished surface shall be true to levels and slopes as directed. Necessary testing of blocks is to be carried out.

### **3.0 Mode of Measurement and Payments :**

The rate shall include the cost of all materials and labour involved in all the operations described above. The rate shall be for a unit of running meter

#### **Item:-**

**Applying priming coat over kerb stone surface after and including preparing the surface by thoroughly cleaning ,oil,grease ,dirt and other foreign matter and scoured with brushes fine steel wood.scrapers and send paper with ready mixed priming paint brushing red lead. and Painting two coats enamel paint.**

#### **Material: -**

The ready mixed paint shall conform to General Technical Specification booklet item N.44 . The ready mixed paint brushing gloss, semigloss shall conform to I.S. 129 – 1962 & I.S. 117 – 1964.

#### **Workmanship: -**

The relevant specifications of Item No.: - 19.71 shall be followed for general & application of paint except that ready mixed paint brushing, oil gloss & semi- gloss shall be used of approved color & shade instead of enamel Paint.

#### **Preparation of Surface :**

The surface shall be thoroughly cleaned of all dust, dirt, mortar croppings& other foreign matter before it is to be applied.

The surface spoiled by smoke soot shall be scraped with steel wire brushes or steel scrapers or shall be rubbed with over burnt surkhi bats. The surface shall be than broomed to remove all dirt, dust & shall be washed with clean water.

Oil or Grease spots shall be removed by suitable chemical & smooth surface shall be rubbed with wire brushes.All unsound portion of the surface plaster shall be removed to full depth of plaster in rectangular patches & plastered again after racking the masonry joints properly. Such portion shall be wetted & allowed to dry. They shall be given one coat of paint. All unnecessary nails shall be removed, the holes cracks patches etc. shall be made good with materials similar in composition to the surface to be prepared.

#### **Mode of Measurement & Payment: -**

The new steel & other metal surface shall be measured under this item.

All the work shall be measured net in the decimal system as executed subject to the following limits unless otherwise stated hereinafter: -

- (a) Dimensions shall be measured to the nearest 0.01 Meter.
- (b) Areas shall be measured to the nearest 0.01 Sq.Meter.

No deductions shall be made for the openings not exceeding 0.5 sq.mt. Each & no addition shall be made for painting to beadings, moldings, edges, jambs, soffits, etc. of

such opening. In case of fabricated structural steel & ironwork, priming coat of paint shall be included with fabrication. In case of trusses if measured in Sq. mt. Compound girders, stanchions, lattices, girder & similar work, actual area shall be measured in Sq.Mt. & no extra shall be paid for painting on bolts, heads, nuts, washers. etc. No addition shall be made to the weight calculated for the purpose of measurements of steel & iron works for painter applied on shop or at site.

The different surfaces shall be grouped into one general item, areas of uneven surfaces being converted into equivalent plain areas in accordance with the table given annexure II for payment.

The rate excludes the cost of priming coat. The rate shall be for a unit of one sq. mt.

**Item:-**

**Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts carrying heavy traffic as per IS 458-1991 specifications including setting the pipes in C.M. 1:2 watering and laying (to level or slopes) of class NP3 of following internal diameters.(iii) 600mm dia.**

**1.0 Materials :** The reinforced concrete light duty non-pressure pipes of specified diameter shall conform to I.S.458-1971.

**2.0. Workmanship**

**2.1.** The relevant specifications of item No. 24.1. A shall be followed for work of trenches except that the excavation in trenches shall be for reinforced concrete pipes of specified diameter.

**2.2 Laying**

**2.2.1.** The pipes shall be lowered into the trenches carefully. Mechanical appliances may be used. Where necessary pipe shall be laid in straight lines or with easy curves and true to line and gradient as specified. The laying of pipe shall proceed upgrade of a slope. In the pipe spigot and socket joints, the socket ends shall face upstream. In case of pipes with joints to be made with loose collars, the collars shall be slipped on before the next pipe is laid.

**2.2.2.** In case where the foundation conditions are unusual such as the proximity of trees or holes, under existing or proposed all round in 150 mm. thick cement concrete 1:5; 10 (1 cement: 5 fine sand : 10 graded stone aggregate 40 mm. nominal size) or compacted sand or gravel:

**2.2.3.** In case where the natural foundation is inadequate the pipes shall be laid either in concrete cradle, supported on proper foundations or on any other suitably designed structure. If concrete bedding is used, the depth of concrete below bottom of the pipe shall be at least 1/4th of the internal diameter of the pipe subject to a minimum of 100 mm. and a maximum 300 mm. The concrete shall be extended up the sides of the pipe at least to a distance of 1/4th of the outside diameter for pipes 300 mm. and over in diameter.

**2.2.4.** The pipes shall be laid in the concrete bedding before the concrete has set. Pipes laid in trenches in earth shall be bedded evenly and firmly and as far as up to the haunches of the pipe as to safely transmit the load expected from the back fill through the pipe to the bed. This shall be done either by excavating the bottom of

the trenches to fit the curve of the pipe or by compacting the earth under a round curve of the pipe to form an even bed, Necessary provision shall be made for joints wherever required.

### **2.3. Jointing**

- 2.3.1.** The joints shall be done by slipping the collar over and clear of the end of the pipe. The recess of the end of the pipe shall be filled with jute braiding in hot bitumen. The new pipe shall then be brought forward until the bitumen ring in recess of first pipe is set into the recess of the second pipe. The process shall be repeated for two or three pipes which shall then jacked up so as to thoroughly compress the bitumen. The quantity of jute and bitumen shall be just enough to fill the recess when pressed hard by jacking, care being taken that no offset of the jute braiding shall be visible either outside or inside of pipe. The collar shall then be set up over the joints covering equally both the pipe and leaving, an even caulking space all round. Cement and sand mortar: 1: 1.1/2 shall then be well punched or pressed home with a caulking tool within this caulking space. Care shall be taken that the underside of the joints is properly filled with mortar.

### **2.4. Curing**

- 2.4.1.** Every joints shall be kept wet for about 10 days for maturing. The section of the pipe line laid and jointed shall be covered immediately to protect from weather effects. Minimum bore of 100 mm. is considered adequate.
- 2.4.2.** The joints shall be left exposed for observation.

### **2.5 Testing of Joints :**

- 2.5.1.** The testing of joints shall be done as per relevant specifications of item No. 24.1 (A) **except that** the testing of reinforced concrete pipes shall be done.

### **3.0. Mode of measurements & payment**

- 3.1.** The relevant specifications of item 24.1 .(A) shall be followed except that the rate includes for laying to level or slope in trenches etc. (measured separately), making the joints a; Seated and testing to stand the water test.
- 3.2.** The measurements shall be net without any allowance for cutting and waste. The length of bends, junctions and other connections (measured along the centre line) shall be included in the total length of the pipes, the connections being numbered afterwards and paid for extra over pipes.
- 3.3.** The size of bend, junctions, etc, shall suit the size of pipe. The bore (internal diameter of pipe) shall be the criterion for payment.)
- 3.4.** Nothing extra shall be paid separately for the use of mechanical appliances, where necessary, as described above.
- 3.5.** The rate shall be for a unit of One running meter.

### **Item:-**

**Constructing manhole with R.C.C TOP slab in 1:2:4 mix (1 cement :2 coarse sand :4 graded stone aggregate 20mm nominal size), foundation concrete 1:3:6 mix (1Cement : 3 coarse sand :6 brick bats 40 to 50 mm size ), inside plastering 15 mm thick with cement mortar 1:5 ( 1 cement : 5 coarse sand ) finished with a floating coat of neat cement and making channels in cement concrete 1:2:4 ( 1 cement : 2**

**coarse sand : 4 stone aggregates 20 mm nominal size ) finished smooth complete including curing and testing (i) Inside size 900mm x 1200mm and 1.50 m deep including precast FRC frame and cover (A) ith 230 mm thick walls of brick masonry using brick having crushing strength not less than 35Kg/Smt in cement mortar 1:5 ( 1 cement : 5 coarse sand ) (2) B- type depth 1.50m**

**( 2) B - Type depth 1.50 m**

**(B) 1.7 meter**

**(C.) 1.90 meter**

**Extra rate for constructing B.B. masonry for every additional depth of 0.1 M. or Part thereof over item No. 24.27 (I) for depth from 0.9M to 1.5M.**

**1.0.** Materials : Water shall conform to M-1. Cement shall conform to M-6. Burnt bricks shall conform to M-15. Brick bats of 40 to 50 mm. size shall conform to M-14. Stone coarse aggregate of 20 mm. nominal size shall conform to M-12. Grit shall conform to M-8. Cement mortar of specified proportion shall conform to M-11. The cast iron manhole cover of 560 mm. dia. with frame shall conform to I.S. 1726-1966.

**2.0.** Workmanship

**2.1.** The manholes of different types and sizes as specified shall be constructed in sewer line at such places and to such levels and dimension as shown in drawings of as directed.

**2.2.** The manholes shall be built on a bed of cement concrete 1:3:6 (1 cement : 3 coarse sand : 6 brick bats) (40)to 50 mm. nominal size) to the thickness of the bed concrete shall be 15 cms. for manhole up to 1. M. depth and 20 cms. for manholes over meter and up to over meter and up to 2 meters, depth and 30 cms. for manholes o greater depth.

**2.2.2.** Projection of bed concrete beyond the masonry wall shall be 15 cms.

**2.3.** Walls

**2.3.1.** The walls of manhole shall be carried out with burnt bricks using having bricks. crushing strength not less than 35 Kg/Cms in C.M. 2 in C.M. 1:5 (1 cement : 5 coarse sand). The thickness of brick masonry wall shall be 230 mm. The jointing face of such .brick shall be well buttered with cement mortar before laying so as to ensure a full joints.

**2.4.** Plaster

**2.4.1.** The inside of waits shall be plastered 15 mm. thick with C.M. 1:5 (1 cement : 5 coarse sand) and finished with floating coat of neat cement. All angles shall be rounded to 7.50 cms. radius and all rendered internal surfaces shall have hard impervious finish obtained by using a steel trowel. The external joints of masonry shall be finished smooth.

**2.5.** Channels & Benching

**2.5.1.** Channels shall be semicircular in the bottom half and of diameter equal to the sewer. Above the horizontal diameter, the sides shall be extended vertically to the same level as the crown of the out going pipe and the top edge shall be suitably rounded off. The branch channels snail also be similarly constructed with respect to the benching but at their junction with the main channel an appropriate fall suitably rounded off in the direction of flow 'he main channel shall be given.

**2.5.2.** The channel and benching shall be done in C.C. 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm. nominal size) rising at a slop in line from edges of channel. The channels of the bottom of the chamber shall be plastered with C.M. 1:2 (1 cement : 2 coarse sand) and steel troweled smooth.

**2.6. Cover slab:**

**2.6.1.** The cover slab of R.C.C. 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm. nominal size) 15 cms. thick reinforced with 10 mm. bars at 15 cms. C/C both ways, surface and edges finished fair. Full bearing equal to the width to the width of wall shall be given to the slab on all sides. The frame of manhole cover shall be embedded firmly in R.C.C. slab so that the top of the frame remains flush with the top of R.C.C. slab.

**2.7. Testing:**

**2.7.1.** Manhole shall be tested by filling with water to a depth not exceeding 1.2 M. as directed.

**2.7.2.** After completion of work, manhole cover shall be sealed by means of thick grease.

**3.0. Mode of measurements and payment**

**3.1.** The depth of manholes shall be distance between the top of the manhole cover and the invert level of the main drain. The rate includes all labours, materials, tools, and plant etc. required for satisfactory completion of this item as directed above.

**3.2.** The rate shall be for a unit of the One number.

**Item:-**

**Cautionary Warning Sign :-Providing and fixing sing boards made out of 2mm aluminium sheet; size 90 x 90 x 90 cms. equilateral triangle as per design of IRC- 67-1977. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ;reflectorised with retro reflectivesheeting as per latest M.O.S.T.Specifications; 3.1m long stand postand frame fabricated from suitable sizeiron angle of 35 x 35 x 3mm, 75 x 75 x 6mm as required; painted with bestquality epoxy coatings in black andwhite bends. The details of symbol foreach board shall be as per theinstruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg.including excavation, curing etc.complete under the supervision of engineer in charge.(A) Engineer Grade**

**GENERAL:-**

The color, configuration, size and location of all traffic signs for highways other than Expressways\* shall be in accordance with the Code of Practice for Road Signs, - IRC - 67 or as shown on the drawings. For Expressways, the size of the signs, letters and their placement shall be as specified in the Contract drawings and relevant Specifications. In the absence of any details or for any missing details, the signs shall be provided as directed by the Engineer.

The signs shall be either reflectorised or non - reflectorised as shown on the drawings or as directed by the Engineer. When they are of reflectorised type, they shall be of retro-reflectorised type and made of encapsulated lens type reflective

sheeting vide Clause 801-3, fixed over Aluminium sheeting as per these Specifications.

In general, cautionary and mandatory signs shall be fabricated through process of screen printing. In regard to informatory signs with inscriptions, either the message could be printed over the reflective sheeting, or cut letters of non-reflective black sheeting used for the purpose which must be bonded. Well on the base sheeting as directed by the Engineer.

**MATERIALS :-**

The various materials and fabrication of the traffic signs shall conform to the following requirements.

**CONCRETE :-**

Concrete shall be of the grade shown on the Contract drawings or otherwise as directed by the Engineer.

**REINFORCING STEEL :-**

Reinforcing steel shall conform to the requirement of IS : 1786 unless otherwise shown on the drawing.

**Bolts, nuts, washers :**

High strength bolts shall conform to IS : 1367 where as precision bolts, nuts, etc., shall conform to IS : 1364.

**PLATES AND SUPPORTS :-**

Plates and support sections for the, sign posts shall conform – to IS : 226 and IS : 2062 or any other relevant IS Specifications.

**ALUMINIUM :-**

Aluminium sheets used for sign boards shall be of smooth, hard and corrosion resistant aluminum alloy conforming to IS : 736 – Material designation 24345 or 1900.

Signs with a maximum side dimension not exceeding 600 mm shall not be less than 1.5 mm thick. All others shall be at least 2 mm thick. The thickness of the sheet shall be related to the size of the sign and its support and shall be such that it does not bend or deform under the prevailing wind and other loads.

In respect of sign sizes not covered by IRC – 67, the structural details ( thickness, etc.) shall be as per the approved drawings.

**GENERAL REQUIREMENTS :-**

The retro-reflective sheeting used on the sign shall consist of the white or coloured sheeting having a smooth outer surface which has the property of retro-reflection over its entire surface. It shall be weather – resistant and show colour fastness. It shall be new and unused and shall show no evidence of cracking, scaling, and pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate of having tested the sheeting for these properties in an unprotected outdoor exposure facing the sun for two years and its having passed these tests shall



be obtained from a reputed laboratory, by the manufacturer of the sheeting. The reflective sheeting shall be either of Engineering Grade material with enclosed lens or of High Intensity Grade with encapsulated lens. The type of the sheeting to be used would depend upon the type, functional hierarchy and importance of the road.

**High intensity grade sheeting :**

This sheeting shall be of encapsulated lens type consisting of spherical glass lens, elements adhered to a synthetic resin and encapsulated by a flexible, transparent water-proof plastic having a smooth surface. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM Standard E : 810) as indicated in Table 800-1.

**TABLE 800-1. ACCEPTABLE MINIMUM COEFFICIENT OF RETRO-REFLECTION FOR HIGH INTENSITY GRADE SHEETING (CANDELAS PER LUX PER SQUARE METRE)**

Observation angle (In degrees)	Entrance Angle (in degrees)	White	Yellow	Orange	Green/ Red	Blue
0.2	-4	250	170	100	45	20
0.2	+30	150	100	60	25	11
0.5	-4	95	62	30	15	7.5
0.5	+30	65	45	25	10	5.0

When totally wet, the sheeting shall not show less than 90 per cent of the values of retro-reflectance indicated in Table 800-1. At the end of 7 years, the sheeting shall retain at least 75 per cent of its original retro-reflectance.

**MESSAGES / BOARDERS :-**

The messages ( legends, letters, numerals etc. ) and borders shall either be screen printed or of cut-outs. Screen printing shall be processed and finished with materials and in a manner specified by the sheeting manufacturer. Cut outs shall be of materials as specified by the sheeting manufacturer and shall be bonded with the sheeting in the manner specified by the manufacturer.

For screen – printed transparent coloured areas on white sheeting. The co-efficient of retro-reflection shall not be less than 50 per cent of the values of corresponding colour in Tables 800 – 1 and 800 – 2, as applicable.

Cut-out messages and borders, wherever used, shall be made out of retro-reflective sheeting ( as per Clause 801.3.2 or 801.3.3. as applicable), except those in black which shall be of non – reflective sheeting.

**COLOUR :-**

Unless otherwise specified, the general colour scheme shall be as stipulated in IS : 5 “ Colour for Ready Mixed Paints”.

Blue	-	is	Colour	No. 166: French Blue
Red	-	is	Colour	No. 537: Signal Red

Green	-	is	Colour	No. 284: India Green
Orange	-	IS	Colour	No. 591: Deep Orange.

The Colours shall be durable and uniform in acceptable hue when viewed in day light or under normal headlights at night.

#### **ADHESIVES :-**

The Sheeting shall either have a pressure sensitive adhesive of the aggressive – tack type requiring no heat, solvent or other preparation for adhesion to a smooth clean surface, or a tack free adhesive activated by heat, applied in a heat – vacuum applicator, in a manner recommended by the sheeting manufacturer. The adhesive shall be protected by an easily removable liner (removable by peeling without soaking in water or other solvent ) and shall be suitable for the type of material of the base plate used for the sign. The adhesive shall form a durable bond to smooth, corrosion and weather resistant surface of the base plate such that it shall not be possible to remove the sheeting from the sign base in one piece by use of sharp instrument. In case of pressure sensitive adhesive sheeting, the sheeting shall be – applied in accordance with the manufacturer’s Specifications. Sheeting with adhesives requiring use of solvents or other preparation for adhesive shall be applied strictly in accordance with the manufacturer’s instructions.

#### **REFURBISHMENT :-**

Where existing signs are specified for refurbishment, the sheeting shall have a semi-rigid aluminum backing pre-coated with aggressive-tack ‘type pressure sensitive adhesive. The adhesive shall be suitable for the type of material used for the sign and should thoroughly bond with that material.

#### **FABRICATION :-**

Surface to be reflectorised shall be effectively prepared to receive the retro-reflective sheeting. The aluminium sheeting shall be de-greased-either by acid or hot alkaline etching and all scale, / dust removed to obtain a smooth plain surface before the application of retro reflective sheeting. If the surface is rough, approved surface primer may be used. After cleaning, metal shall not be handled, except by suitable device – or clean canvas gloves, between all cleaning and preparation operation and application of reflective sheeting / primer . There shall be no opportunity for metal to come in contact with grease, oil or other contaminants prior to the application of retro-reflective sheeting.

Complete sheets of the material shall be used. On the signs except where it is unavoidable, at Splices, sheeting with pressure sensitive adhesives shall be overlapped not less than 5 mm . Sheeting with heat – activated adhesives may be spliced with an overlap not less than 5 mm or butted – with a gap not exceeding 0.75 mm. Where screen printing with transparent colours is proposed, only butt jointing shall be used. The material shall cover the sign surface evenly and shall be free from twists, cracks and folds. Cut-outs to produce legends and borders shall be bonded with the sheeting in the manner specified by the manufacturer.

**WARRANTY AND DURABILITY :-**

The Contractor shall obtain from the manufacturer a seven – year warranty for satisfactory field performance including stipulated retro-reflectance of the retro-reflective sheeting of high intensity grade and a five year warranty for the adhesive sheeting of engineering grade, and submit the same to the Engineer. In addition, a seven year and a five year warranty for satisfactory in field performance of the finished sign with retro-reflective sheeting of high intensity grade and engineering grade respectively, inclusive of the screen Printed or cut out letters / legends and their bonding to the retro-reflective sheeting shall be obtained from the Contractor / supplier and passed on to the Engineer. The Contractor / Supplier shall also furnish a certification that the signs and materials supplied against the assigned work meets all the stipulated requirements and carry the stipulated warranty.

Processed and applied in accordance with recommended procedures, the reflective material shall be weather resistant and, following cleaning, shall show no appreciable discoloration, cracking, blistering or dimensional change and shall not have less than 50 per cent of the specified minimum reflective intensity values (Tables 800 – 1 and 800 – 2 ) when subjected to accelerated weathering for 1000 hours, using type E or EH W batherometer (AASHTO Designation M 268 ).

**INSTALLATION :-**

Sign posts, their foundations and sign mountings shall be so constructed as to hold these in a proper and permanent position against the normal storm wind loads or displacement by vandalism. Normally, signs with an area up to 0.9 Sq. in. shall be mounted on a single post, and for greater area two or more supports shall be provided. Sign supports may be of mild steel, reinforced concrete or galvanized iron (G.I.) Post-end(s) shall be firmly fixed to the ground by means of properly designed foundation. The work of foundation shall conform to relevant Specifications as specified.

All components of signs and supports, other than the reflective portion and G.I. posts shall be thoroughly discaled, cleaned, primed and painted with two coats of epoxy paint, Any part of mild steel (M.S.) post below ground shall be painted with three coats of red lead paint.

The signs shall be fixed to the posts by welding in the case of steel posts and by bolts and washers, of suitable size in the case of reinforced concrete or G.I. Posts. After the nuts have been tightened. The tails of the bolts shall be furred over with a hammer to prevent removal.

**MEASUREMENTS FOR PAYMENT:-**

The measurement of standard cautionary, mandatory and information signs shall be in numbers of different types of signs supplied and fixed, while for direction and place identification signs, these shall be measured by area in square meters.

**RATE :-**

The Contract unit rate shall be payment in full for the cost of making the road sign, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications. The contract rate shall be for a unit of one number. The payment shall be made on **No** basis of work done.

**Item:-**

**Informatory Signs :-**Providing and fixing sing boards made out of 2mm aluminium sheet; size 80 x 60cms. rectangle as per the design of IRC-67-1977 pre treated with phospheting process & acid teching; coated with one coat of epoxyprimer and two coats of best qualityepoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. specifications; 3.1m long stand postand frame fabricated from suitable sizeiron angle of 35 x 35 x 3mm75x75x6mm as required; painted with best qualityepoxy coatings in black and whitebends. the details of symbol for eachboard shall details of symbol for eachboard shall be as per the instruction ofengineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x45 x 60cms. for each leg. including excavation curing tec. complete under the supervision of engineer in charge.(A) Engineer Grade

All specification shall be as per item no.22 Size of plate ,angle lettring shall be as specified in item & M.O.R.T.&H. specification.

**801.4 RATE:-**

The Contract unit rate shall be payment in full for the cost of making the road sign, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications. The contract rate shall be for a unit of one number. The payment shall be made on **No** basis of work done.

**Item:-**

**STOP SIGN:-**Providing and fixing sing boards made out of 2mm aluminium sheet; size 90 x 90cms. rectangle as per the design of IRC-67-1977 pre treated with phospheting process & acid teching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm 75x75x6mm as required; painted with best quality epoxy coatings in black and white bends. the details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing tec. complete under the supervision of engineer in charge.(A) Engineer Grade

All specification shall be as per item no.22 Size of plate ,angle lettring shall be as specified in item & M.O.R.T.&H. specification.

**801.5 RATE:-**

The Contract unit rate shall be payment in full for the cost of making the road sign, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications. The contract rate shall be for a unit of one number. The payment shall be made on **No** basis of work done.

**Item:-**

**Direction sign (Junction board):-**Providing and fixing sign boards made out of 2mm aluminium sheet; size 244 x 122cms. rectangle as as per the design of IRC-671977 pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; Letters and numerals should be as per IRC-30-1968, 3.1m long (2 nos) stand post and frame fabricated from suitable size iron angle of 50 x 50 x 5mm 75x75x6mm as required; painted with best quality epoxy coatings in black and white bands. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade

All specification shall be as per item no.22 Size of plate ,angle lettering shall be as specified in item & M.O.R.T.&H. specification.

**801.6 RATE:-**

The Contract unit rate shall be payment in full for the cost of making the road sign, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications. The contract rate shall be for a unit of one number. The payment shall be made on **No** basis of work done.

**Item:-**

**Kerb guard sign board (small) :-**Providing & Fixing sign boards made out of 2mm aluminium sheet, size 240 x 30 cms in U shape; as per the attached drawing pre treated with phosphating process & acid etching. coated with one coat of epoxy primer and two coats of best quality epoxy paint reflectorised with retro sheeting as per latest M.O.S.T. Specifications; stand post and frame fabricated from iron angle of 50x50x5mm, 10mm sq. bar as required, painted with best quality epoxy coating the fixing at site shall be in 1:2:4 CC block of size 45 x 45x 60cms for each leg, including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade.

All specification shall be as per item no.22 Size of plate ,angle lettering shall be as specified in item & M.O.R.T.&H. specification.

**801.7 RATE:-**

The Contract unit rate shall be payment in full for the cost of making the road sign, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications. The contract rate shall be for a unit of one number.

**Item:-**

**Road Marking Providing and laying of Hot applied Thermoplastic compound 2.5 mm thick including Reflectorising Glass Beads @ 250 gms per sqm area, thickness of 2.5 mm is exclusive of surface applied glass beads as per IRC : 35 & finished surface to be level, uniform and free from streaks and holes. (As per Government letter No.SOR 102003/94/S-1/ Dated.20-7-2004)**

**General**

Reflective pavement marker (R P M) or road stud is device which is bonded to or anchored within the road surface for lane marking and delineation for night - time visibility. It reflects incident light in directions close to the direction from which it came.

**1.2. Definitions****1.2.1 Description of Terms Specific to this standard**

- 1.2.1.1** Coefficient of luminous intensity ( C I L ) or specific intensity = the ratio of luminous intensity of the retro-reflector in the direction of observation to luminance at the retro-reflector on a plane perpendicular to the direction of the incident light expressed in terms of Milca deal as per incident lux ( med / lx).
- 1.2.1.2** Horizontal entrance angle - the angle in the horizontal plane between the direction of incident light and the normal to the leading edge of the marker.
- 1.2.1.3** Observation angle - the angle in the reflector between the illumination axis and the observation axis.
- 1.2.1.4** Retro - reflection - reflection in which the radiation is returned in direction close to the direction from which it came, this property being maintained over wide variations of the direction of incident radiation.
- 1.2.1.5** Head - that part of a road stud which is above the road surface when the road stud is fixed in position in the road.
- 1.2.1.6** Upper surface - that part of the external surface of road stud which is visible when the road stud is fixed in position in the road.
- 1.2.1.7** Anchorage - that part of a road stud which is below the road surface when the road stud is fixed position in the road.

**1.3 Material**

- 1.3.1** Plastic body of RPM road stud shall be molded from ASA(Acrylic Sterner Acryl nitrite) or HIPS ( Impacts polystyrene) or ABS or any other suitable material approved by the Engineer-in-charge. The marker shall support a load of 13635 kg tested in accordance with ASTM D4280.
- 1.3.2** Reflective panels shall consist if number or lenses containing single or dual prismatic cubes capable of providing total internal reflection of the light entering the lens face. Lenses shall be molded of methyl methacrylate conforming to ASTM D 788 or equivalent.

**1.4. Design**

- 1.4.1** The slope or retro-reflecting surface shall preferably be  $35 \pm 5$  degree to base.
- 1.4.2** The area of each retro-reflecting surface shall not be less than 13.0 sq. cm.

**1.5. Optical Performance**

- 1.5.1** **Unidirectional and bi-directional studs.**

- 1. 5. 1. 1** Each reflector or combination of reflectors on each face of the stud shall have a C.I.L. not less than that given in Table 1 or 2 as appropriate.

**Table 1 Minimum C.I.L Values for Category 'A' studs.**

Entrance angle Observation angle	C. I. L. in med 1 x		
	White	Amber	Red
0" U 5" L & R 0.3 "	220	110	44
0" U 10" L & R 0.5 "	120	60	24

**Table 1 Minimum C.I.L Values for Category 'B' studs.**

Entrance angle Observation angle	C. I. L. in med 1 x		
	White	Amber	Red
0" U 6" L & R 0.3 "	20	10	4
0" U 10" L & R 0.5 "	15	7.5	3

**Note:** *The entrance angle of 0"U corresponds to the normal aspect of the reflectors when the reflecting road stud is installed in horizontal road surface.*

- 1. 5. 1. 2** A stud that incorporates one or more corner cube reflectors shall be considered to be included in category 'A'. A stud that incorporates one or more biconvex reflectors shall be considered to be included in category 'B'.

**1. 5. 2 Omni - directional studs.**

Each omni-directional stud shall have a minimum C.I.L. of not less than 2 med / 1x.

**1. 5. 3 Tests**

- 1. 5. 3. 1** Coefficient of luminance intensity can be measured by produced described in ASTM E 809 "Practice for Measuring Photometric Characteristics" or as recommended in BS: 873 - Part 4:1973.

- 1. 5. 3. 2** Under test conditions, a stud shall not be considered to fail the photometric requirements if the measured C.I.L. at any one position of measurement is less than the values specified in Table 1 or 2 provided that.

- ( i ) The value is not less than 80% of the specified minimum, and
- ( ii ) The average of the left and tight measurements for the specific angle is greater than the specified minimum.

**1. 6. Fixing of Reflective Markers**

**1. 6. 1. Requirements**

- 1. 6. 1. 1** The enveloping profile of the head of the stud shall be smooth and the studs shall not present any sharp edges to traffic.
- 1. 6. 1. 2** The reflecting portions of the studs shall be free from crevice or ledges where dirt might accumulate.
- 1. 6. 1. 3** All road studs shall be legibly marked with the name, trade mark of other means of identification of the manufacture.
- 1. 6. 1. 4** Marker height shall not exceed 20mm.
- 1. 6. 1. 5** Marker width shall not exceed 130 mm.
- 1. 6. 1. 6** The base of the marker shall be flat within 1.3 mm. If the bottom of the marker is configured. The outermost faces of the configurations shall not deviate more than 1.3 mm from a flat surface.

**1. 6. 2 Placement**

- 1. 6. 2. 1** The reflective marker shall be fixed to the road surface using the adhesives and the produced recommended by the manufacturer. No nails shall be used to affix the marker as nails are hazardous for the roads.
- 1. 6. 2. 2** Regardless of the type of adhesive used. The markers shall not be fixed if the pavement is not surface dry and on new asphalt concrete surfacing unit the surfacing has been opened to traffic for a period of not less than 14 hours.
- 1. 6. 2. 3** The portions of the highway surface, to which the marker is to be bonded by the adhesive, shall be free of dirt, curing compound, grease, oil, moisture, loose of unsound layers, paint and any other material which would adversely affect the bond of the adhesive.
- 1. 6. 2. 4** Use a wire brush, if necessary to loosen and remove dirt. Then brush or blow clean.
- 1. 6. 2. 5** The adhesive shall be places uniformly on the cleaned pavement surface or on the bottom of the marker in a quantity sufficient to result in complete coverage of the area of contact of the marker with no voids present and with a slight excess after the marker has been lightly pressed in place.
- 1. 6. 2. 6** For epoxy installations, excess adhesive around the edge of the marker, excess adhesive on the pavement and adhesive on the exposed surfaces of the markers shall be immediately removed. Soft rags moistened with mineral spirits or kerosene may be used, if necessary to remove adhesive from exposed faces of pavement markers.

**1. 7. Warranty and durability.**

The contractor shall obtain from the manufacturer a two year warranty for satisfactory field performance including stipulated retro-reflectance of the reflecting panel and submit the same to the Engineer. In addition, a two year warranty for satisfactory infield performance of the finished road marker shall also be given by the contractor who carried out the work of fixing of reflective road markers. In case the markers are displaced, damaged, get worn out or lose their reflectivity compared to stipulated standards, the contractor would be required to replace all such markers within 15 days of the intimation from the Engineer at his own cost and with no extra remuneration to be paid for such works.

**1. 8 Measurement for Payment**

The measurement of reflective road markers shall be in numbers of different types of markers supplied and fixed.

**1. 9 Rate**

The contract unit rate for reflective road markers shall be payment in full compensation for furnishing all labour, material, tools, equipment including incidental costs necessary for carrying out the work at side conforming to the specifications complete as per approved drawings or as directed by the Engineer.



**Item:-**

**Supplying and fixing cat eye (Stimsonite) made out from Acrilo beaultile sterine injuction high compressed molding with reflector made of MMC (prismatic type of size 12cm x 6cm x 2.5cm) provided with bituminous adhesive 100g. with each unit for fixing. (Engineer grade)**

**General**

Reflective pavement marker (R P M) or road stud is device which is bonded to or anchored within the road surface for lane marking and delineation for night - time visibility. It reflects incident light in directions close to the direction from which it came.

**1.2. Definitions****1.2.1 Description of Terms Specific to this standard**

- 1.2.1.1** Coefficient of luminous intensity ( C I L ) or specific intensity = the ratio of luminous intensity of the retro-reflector in the direction of observation to luminance at the retro-reflector on a plane perpendicular to the direction of the incident light expressed in terms of Milaca deal as per incident lux ( med / lx).
- 1.2.1.2** Horizontal entrance angle - the angle in the horizontal plane between the direction of incident light and the normal to the leading edge of the marker.
- 1.2.1.3** Observation angle - the angle in the reflector between the illumination axis and the observation axis.
- 1.2.1.4** Retro - reflection - reflection in which the radiation is returned in direction close to the direction from which it came, this property being maintained over wide variations of the direction of incident radiation.
- 1.2.1.5** Head - that part of a road stud which is above the road surface when the road stud is fixed in position in the road.
- 1.2.1.6** Upper surface - that part of the external surface of road stud which is visible when the road stud is fixed in position in the road.
- 1.2.1.7** Anchorage - that part of a road stud which is below the road surface when the road stud is fixed position in the road.

**1.3 Material**

- 1.3.1** Plastic body of RPM road stud shall be molded from ASA(Acrylic Sterner Acryl nitrite) or HIPS ( Impacts polystyrene) or ABS or any other suitable material approved by the Engineer-in-charge. The marker shall support a load of 13635 kg tested in accordance with ASTM D4280.
- 1.3.2** Reflective panels shall consist if number or lenses containing single or dual prismatic cubes capable of providing total internal reflection of the light entering the lens face. Lenses shall be molded of methyl methecrylate conforming to ASTMD 788 or equivalent.

**1.4. Design**

- 1.4.1** The slope or retro-reflecting surface shall preferably be  $35 \pm 5$  degree to base.
- 1.4.2** The area of each retro-reflecting surface shall not be less than 13.0 sq. cm.

## 1. 5. Optical Performance

### 1. 5. 1 Unidirectional and bi-directional studs.

1. 5. 1. 1 Each reflector or combination of reflectors on each face of the stud shall have a C.I.L. not less than that given in Table 1 or 2 as appropriate.

**Table 1 Minimum C.I.L Values for Category 'A' studs.**

Entrance angle	Observation angle	C. I. L. in med 1 x		
		White	Amber	Red
0" U 5" L & R	0.3 "	220	110	44
0" U 10" L & R	0.5 "	120	60	24

**Table 1 Minimum C.I.L Values for Category 'B' studs.**

Entrance angle	Observation angle	C. I. L. in med 1 x		
		White	Amber	Red
0" U 6" L & R	0.3 "	20	10	4
0" U 10" L & R	0.5 "	15	7.5	3

**Note:** The entrance angle of 0"U corresponds to the normal aspect of the reflectors when the reflecting road stud is installed in horizontal road surface.

1. 5. 1. 2 A stud that incorporates one or more corner cube reflectors shall be considered to be included in category 'A'. A stud that incorporates one or more biconvex reflectors shall be considered to be included in category 'B'.

### 1. 5. 2 Omni - directional studs.

Each omni-directional stud shall have a minimum C.I.L. of not less than 2 med / 1x.

### 1. 5. 3 Tests

1. 5. 3. 1 Coefficient of luminance intensity can be measured by produced described in ASTM E 809 "Practice for Measuring Photometric Characteristics" or as recommended in BS: 873 - Part 4:1973.

1. 5. 3. 2 Under test conditions, a stud shall not be considered to fail the photometric requirements if the measured C.I.L. at any one position of measurement is less than the values specified in Table 1 or 2 provided that.

- ( i ) The value is not less than 80% of the specified minimum, and
- ( ii ) The average of the left and tight measurements for the specific angle is greater than the specified minimum.

## 1. 6. Fixing of Reflective Markers

### 1. 6. 1. Requirements

1. 6. 1. 1 The enveloping profile of the head of the stud shall be smooth and the studs shall not present any sharp edges to traffic.
1. 6. 1. 2 The reflecting portions of the studs shall be free from crevice or ledges where dirt might accumulate.
1. 6. 1. 3 All road studs shall be legibly marked with the name, trade mark of other means of identification of the manufacture.
1. 6. 1. 4 Marker height shall not exceed 20mm.
1. 6. 1. 5 Marker width shall not exceed 130 mm.
1. 6. 1. 6 The base of the marker shall be flat within 1.3 mm. If the bottom of the marker is configured. The outermost faces of the configurations shall not deviate more than 1.3 mm from a flat surface.

### 1. 6. 2 Placement

- 1. 6. 2. 1** The reflective marker shall be fixed to the road surface using the adhesives and the produced recommended by the manufacturer. No nails shall be used to affix the marker as nails are hazardous for the roads.
- 1. 6. 2. 2** Regardless of the type of adhesive used. The markers shall not be fixed if the pavement is not surface dry and on new asphalt concrete surfacing unit the surfacing has been opened to traffic for a period of not less than 14 hours.
- 1. 6. 2. 3** The portions of the highway surface, to which the marker is to be bonded by the adhesive, shall be free of dirt, curing compound, grease, oil, moisture, loose of unsound layers, paint and any other material which would adversely affect the bond of the adhesive.
- 1. 6. 2. 4** Use a wire brush, if necessary to loosen and remove dirt. Then brush or blow clean.
- 1. 6. 2. 5** The adhesive shall be places uniformly on the cleaned pavement surface or on the bottom of the marker in a quantity sufficient to result in complete coverage of the area of contact of the marker with no voids present and with a slight excess after the marker has been lightly pressed in place.
- 1. 6. 2. 6** For epoxy installations, excess adhesive around the edge of the marker, excess adhesive on the pavement and adhesive on the exposed surfaces of the markers shall be immediately removed. Soft rags moistened with mineral spirits or kerosene may be used, if necessary to remove adhesive from exposed faces of pavement markers.

**1. 7. Warranty and durability.**

The contractor shall obtain from the manufacturer a two year warranty for satisfactory field performance including stipulated retro-reflectance of the reflecting panel and submit the same to the Engineer. In addition, a two year warranty for satisfactory infield performance of the finished road marker shall also be given by the contractor who carried out the work of fixing of reflective road markers. In case the markers are displaced, damaged, get worn out or lose their reflectivity compared to stipulated standards, the contractor would be required to replace all such markers within 15 days of the intimation from the Engineer at his own cost and with no extra remuneration to be paid for such works.

**1. 8 Measurement for Payment**

The measurement of reflective road markers shall be in numbers of different types of markers supplied and fixed.

**1. 9 Rate**

The contract unit rate for reflective road markers shall be payment in full compensation for furnishing all labour, material, tools, equipment including incidental costs necessary for carrying out the work at side conforming to the specifications complete as per approved drawings or as directed by the Engineer.