

SPECIFICATION OF MATERIALS

M-1 Water:

1.1 Water shall not be salty or brackish and shall be clean, reasonably clear and free from objectionable quantities of silt and traces of oil and injurious 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 LS. 456-1978.

1.2. If required by 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 LS. 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. Potable 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 white 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 LS. 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 ground 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 affected 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 other 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 sand shall be as under:

| I. S. Sieve Designation | Percentage by weight passing sieve | I. S. Sieve Designation | Percentage by weight passing sieve |
|--------------------------------|---|--------------------------------|---|
| 4.75 mm. | 100 | 600 Micron | 30 – 10 |
| 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 Designation | Percentage by weight passing sieve | I. S. Sieve Designation | Percentage by weight 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 up to 100 mm. mark. The clean water shall be added up to 150 mm. mark. The mixture shall be stirred 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 to bring 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 Designation | Percentage by weight passing through sieve |
|-------------------------------|---|
| 12.50 mm | 100 % |
| 10.00 mm | 85 – 100 % |
| 4.75 mm | 0 – 20 % |
| 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 built-up 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:

| I.S. Sieve Designation | Percentage passing |
|------------------------|--------------------|
| 20 mm | 100 |
| 10 mm | 86 |
| 4.75 mm | 70 |
| 2.36 mm | 52 |

M-10 Lime Mortar:

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

Sand shall conform to specification M-6.

10.2. Proportion of Mix:

10.2.1. Mortar shall consist of such proportions of slaked lime and sand as may be specified in 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 grind for the 180 revolutions with 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 shall conform to specification M-3. Sand shall conform to M-6. 11.2. Proportion of Mix:

11.2.1: Cement and sand shall be mixed to specified proportion, sand being measured by measuring boxes. The proportion of cement will be by volume on the basis of 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 deleterious extraneous material shall get mixed with mortar or mortar shall flow out. While mixing, the water shall be gradually added and thoroughly mixed to form a stiff plastic mass of uniform colour so that each particle of sand shall be completely covered with a film of wet cement. The water cement ratio shall be adopted as directed.

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

M-12 Stone Coarse Aggregate for Nominal Mix Concrete:

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

| I. S. Sieve Designation | Percentage passing for single sized aggregates of Nominal size | | | I. S. Sieve Designation | Percentage passing for single sized aggregates of Nominal size | | |
|----------------------------|---|----------|----------|----------------------------|---|-------|-------|
| | 40 mm | 20 mm | 40 mm | | 40 mm | 20 mm | 40 mm |
| 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 | 2.35 mm. | --- | --- | --- |
| 16 mm. | --- | --- | 85 – 100 | | | | |

Note: This percentage may be varied 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 Aggregate:

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 dense brick. It shall be homogeneous in texture roughly cubical in 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 under burnt or over burnt brick bats shall not be allowed.

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

M-15 Brick:

15.1. The bricks shall be hand or machine molded 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 molded 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" x 4 3/8 " x 2 3/4 ") i.e. 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 $\pm 1/8$ " (3.0 mm) Width $\pm 1/16$ " (1.50 mm) Height $\pm 1/6$ " (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. 3495 (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 Kg. /Sq.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 of tested quality. It shall also comply with relevant part of I.S. -156- 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 up to 100 mm. length and weight payable worked out at the rate specified below:

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

M-19 High Yield Strength Steel Deformed Bars:

19.1. High yield strength steel deformed bars be 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 Wires:

20.1. The high tensile wires for the use in pre stressed concrete work shall confirm 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 carborandum.

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 on being uncoiled.

M-21 Mild Steel Binding Wires:

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. 280-1972.

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

M-22 Structural Steel:

22.1 All structural steel shall conform to 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 be free from loose mill 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 manufacturers shall be obtained according to I.S. 226-1975 and other relevant Indian Standards.

M-26 Shuttering:

26.1. The shuttering shall be either of wooden planking of 30 mm minimum thickness with or without steel lining or of steel plates stiffened by steel angles. The shuttering shall be supported on battens and beams and props of vertical bellies properly cross braced together so as to make the centering rigid. In places of bulged 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 diameters 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. lay 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 solution 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 metre (1 in 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-Pre-Molded Filler:

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 pre molded bituminous joint filler.

27.2 Pre molded 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-molded joint filler shall be 25 mm. unless otherwise specified.

27.4 Pre molded bituminous joint filler shall conform to I.S. 1838-1961

M-44 Paints:

44.1 (A) Oil paints:

44.1.1 Oil paints shall be of the specified colour and shade, and, approved. The ready mixed paint shall only be used. However, if ready mixed paint or specified 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 with following general requirements:

(i) Paint shall not show excessive setting in a freshly opened full can and shall easily be redispressed with a paddle to a smooth homogeneous state. The paint shall show no curdling, 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 manufacturers 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.

S P E C I F I C A T I O N

It.:- Earthwork for embankment including breaking clods, dressing with all lead and lift and including watering rolling and consolidation of sub grade in layers at O.M.C. to required dry density including filling the depressions which occur during the process using power roller 8 T to 10T. From borrow area with all lead & lift.

1. The land width on which the earth work is to be done shall be cleared of all trees having a girth 30 cm. and less, loose stones; vegetation, bushes, stumps and all other objectionable materials. All the materials cleared will be the property of Government. Useful material shall be arranged in convenient stacks along the road boundary or as directed at places within 50 metres lead, and handed over to the department in convenient section. Unsuitable materials shall be burnt or otherwise disposed off by the contractor at his own cost without causing any nuisance; inconvenience or damage to the works property or people in the neighborhood. In all cases, the materials shall be disposed off in a neat manner.

2. After clearing; the site, the alignment of the road shall be properly set out true to line, curves, slopes, grades and sections as shown on the plan or directed by the Engineer-in-charge. The contractor shall provide all labours and materials such as lime, strings, pegs, nails, bamboos, stone, mortar, concrete, etc. required for setting out, establishing. Bench Marks and giving profiles: The contractor shall be responsible for maintaining the B.Ms. profiles alignment and other marks as long as they are required for the Work on the opinion of the Engineer-in-charge. If the contractor defaults in this respect they may be restored by the department at the cost of the contractor.

3. When an existing, embankment is to be widened, continuous, horizontal benches, each at least 0.3 metre wide shall be cut into the existing slope for ensuring adequate bond with the fresh embankment materials to be added. The material obtained from the cutting of benches can be utilized in the widening of the embankment. The dumping of material from trucks for widening operations shall be avoided except in difficult circumstances when the extra width is too narrow to permit the movement of any other type of hauling equipment.

4. The soil to be used for embankment shall be free from trees stumps, roots, rubbish or any other objectionable materials. Only material considered suitable by the Engineer-in-charge shall be used for the construction and that considered unsuitable other disposed off as directed by him. The selection of the materials to be used in the construction of embankment shall be made after soil surveys and investigations carried out by the Department. The embankment shall consist of earth available from road-side borrow pits on either side with all lead and all lifts and within land width in the manner specified in Para 11 below. The road, if any required for the purpose of haulage of earth by men, animals or vehicles will be constructed. (If not existing) and maintained by the contractor at his own cost.

5. Department will extend all necessary co-operation in helping contractor to get borrow area from nearby Government of Panchayat land; if available. However, department is not responsible if not such area is made available to the contractor and in the case contractor will have to make his own arrangement to get borrow area for borrowing earth of the quantity even by making temporary arrangement with the private land owners.

6. The embankment shall be constructed in uniform layers not exceeding 250 mm in loose thickness. The soil shall be spread uniformly over the entire width of the embankment, unless otherwise directed by the Engineer-in-charge. All clods of hard lumps of earth shall be broken to have maximum size of 15 cm: when being placed in the embankment and a maximum of size 5 cm when being placed in the top 45 cm of the embankment, the work of next layer shall be allowed only after the first layer below it has been thoroughly compacted.

7. Where an embankment is to be placed on sloping ground, the surface of the ground shall be benched in the steps of trenches or broken up in such a manner that the new material shall have perfect bond with the existing surface. Where the embankment is to be placed over an existing road surface, the surface shall be scarified to minimum depth of a 5 cm. so as to provide ample bond between the old and new material. However when the embankment is to be placed over an old concrete pavement and lies within 1 metre of new sub grade level, the pavement shall be broken up in pieces not to exceed 0.1 m and may be left under the new embankment. If the existing road surface is of granular or bituminous type and lies within 1 mt of the new sub grade level, the same

shall be scarified to a depth of minimum 50 mm. so as to provide ample bond between the old and the new material.

8. To avoid interference with the construction of abutment, wing walls of culverts/bridge structures, the contractor shall, at point to be determined by the Engineer-in-charge, suspend work on embankments forming approaches to such structures, until such time as the construction of the latter is sufficiently advanced to permit the completion of approaches without the risk of interference or damage to the bridge work. Unless directed otherwise, the filling ground culverts, bridge and other structures up to a distance of twice the height of the embankment from the back of the embankment shall be carried out independent of the work on the main embankment. The fill material shall not be placed against any abutment or wing wall unless permission has been given by the Engineer-in-charge but in any case not until the concrete or masonry has been in position for 14 days, the embankment shall be brought up simultaneously in equal layers on each side of the structure to avoid displacement and unequal pressure. The sequence of work in this regard shall be got approved from the Engineer-in-charge. Where the provision of any filter medium is specified behind the abutment, the same shall be laid in layers with the laying of fill material. The material used for the filter shall conform to the requirements for filler medium and will be paid extra in the relevant item.

9. The embankment shall be finished in conformity with the alignment, levels, and cross sections and dimension shown on the plans or as directed by Engineer-in-charge. Where the alignment of the road is in a curve, the top of the embankment shall be formed with the super elevation and the increased width shown on the drawings or as the Engineer in-charge may direct. Finishing operations shall include the work of shaping and dressing the shoulders, road bed and the side slopes to conform the cross section.

10. The earthwork measurements shall be paid on cross sectional measurements and computing the volumes of earthwork in cubic metres by average area method. The contractor shall sign day to day levelling work and also original cross sections, longitudinal section etc, in token of his acceptance. The working sections both longitudinal and cross of the ground shall be taken by the Engineer-in-charge before the actual work has started. The contractor or his authorised representative shall attend day to day levelling work and sign with date the field book daily, in token of his acceptance. If there is any disagreement, the contractor shall inform of it in writing to the officer concerned with specific reference to the sections before starting further work. Once the work is started, no cognizance of any complaint will be taken merely not signing of level book shall not be deemed as disagreement. The Executive Engineer shall also verify levelling work to the extent of 5% before commencement of earth work and on finalization. The contractor shall maintain the embankment by filling in ruts, rain cuts depression due to shrinkage etc to proper formation and grade till this item is finally measured and accepted by the Department. The measurements shall be taken on compacted earth work. Deduction of 15% for shrinkage shall be made from gross measured quantity is measured before first monsoon and 10% if measured after one or more monsoon have been passed over the earth embankment. However the contractor shall have to bear loss of deformations etc. if any due to all settlements as well as other type of deformations etc. if any that might have taken place at the time of taking final measurement of item.

11. If usable approved material is available within the land width of road, the same shall be permitted for use in the road embankment subject to the following conditions:

- (i) The borrow pits will be so excavated as to from a road side longitudinal gutter to drain the water, interrupted by such gutter.
- (ii) The width of the drain shall be restricted to 1.5 Mts. only. The depth will be restricted to such grade so as to drain the water efficiently. All balance quantity of earth shall be brought from distant borrow areas only.
- (iii) If there is top layer of black cotton or other objectionable soils; the same shall be removed and disposed off elsewhere and usable material found at the lower level will only be used in the earthen embankment, if the contractor choose to utilize this material.
- (iv) The drain should be aligned along the boundary of the land width of the road. Not pit, other than this drain, shall be dug within 5 metres of toe to the final section of the road embankment.
- (v) No borrow pits shall be allowed in the length in which earth obtained from cutting from cutting is specified to be used in embankment.

12. For spreading materials in layers and bringing the appropriate moisture content, the embankment materials shall be spread uniformly over the entire width of the embankment in layers not exceeding 250mm in loose thickness. Successive layers of embankment shall not be placed until the layer under construction has been thoroughly compacted to the requirements set down hereunder:

Moisture content of the materials shall be checked at the source of supply and if found less than the specified for compaction, the same, shall be made good either at the source or after spreading the soil in loose thickness for compaction. In the latter case, water shall be sprinkled directly from a hose line or from a truck mounted water tank; and flooding shall not be permitted under any circumstances.

If the materials delivered to the road bed is too wet it shall be dried, by evaporation and exposure to the sun, till the moisture content is brought down to acceptable standard for compaction. Should circumstances arise, where owing to wet weather, the moisture content cannot be reduced to the required level by the above procedure, work of compaction shall be suspended:

Moisture content of each layer of soil shall be checked in accordance with IST 2720 (Part-11) and unless otherwise mentioned shall be so adjusted, making due allowance for evaporation losses, that at the time of the compaction it is in the range of 1 percent to 2 percent below the optimum moisture content determined in accordance with IS; (Part-VII). Highly expansive clays shall however be compacted at 2 to 4 percent above the optimum moisture content.

After nodding the required amount of water, the soil shall be processed by means of horrows, rotary mixers or as otherwise approved until the layer is uniformly wet.

Clods or hard lumps of earth shall be broken to have maximum size to 150mm when being placed in the lower layers of the embankment and a maximum size of 60mm when being placed in the top 0.5 metre portion of the embankment below the sub grade.

Hauling equipment shall be moved uniformly over entire surface of the previously constructed layer to minimize cutting of uneven compaction.

Where the embankment is to be constructed on low area ground that will not support the weight of truck or other hauling equipment, the lower part of the fill should be constructed by dumping successive loads in a uniformly distributed layers of a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers.

13. COMPACTION: Only compacting equipment approved by the Engineer-in-charge shall be employed to compact the materials. The contractor shall demonstrate the efficiency of the plants he intends to use for carrying out compaction trials. Each layer of the materials shall be thoroughly compacted to the densities specified in Table 1.2.

Table 1.2 Compaction requirements for embankment.

| Sr. No. | Type of Work / Materials | Field by density as per centage of maximum laboratory dry density as per IS: 2720 (Pt. VII) |
|---------|--|---|
| 1. | Top 0.5 metre portion of embankment below sub grade level and shoulders. | Not less than 100. |
| 2. | Other portion of embankment | Not less than 95. |
| 3. | Highly expansive class. | 85 To 90 |

Subsequent layers shall be placed only after finished layer has been tested according to M.O.S.T. specification clause 902 and accepted by the Engineer-in-charge.

When density measurements reveal any soft areas in the embankment further compaction shall be carried out as directed by the Engineer-in-charge: If in spite of that the specific compaction is not achieved, the materials in the soft areas shall be removed and replaced by approved materials and compacted to the density requirement, to the satisfaction of the Engineer-in-charge.

The contract unit rate includes cost of vibratory roller required for consolidation including all labour equipments fuel, hire charges, tolls, and incidentals necessary.

14. The rate of earthwork includes, clearing jungles, dog belling, fixing profiles, erecting necessary pillars for stones for bench marks for levelling purpose, excavating-earth from borrow areas, breaking clods, conveying and spreading earth in layers with all lead and lift, and watering and consolidation of the same as specified above and finishing the entire embankment and incidentals necessary to complete the work to the specifications. The cutting stuff of cutting in ordinary soil, soft Murrum, soft rock, hard Murrum and hard rock shall be utilized in embankment construction under this item within the lead specified in the particular, item. No payment shall be made under this item for the cutting stuff used in embankment but labour for cutting will be paid as per specifications in the particular item, and only balance quantity of earthwork brought from borrow areas will be paid in this item.

It.: - 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 up to 50 m 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.

It.: - Providing & Laying compacted G.S.B.150 mm thick of unscreened gravel including spreading, watering & consolidation by vibratory roller etc. complete

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 given 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.

**TABLE 400-1 GRADING FOR CLOSE-GRADED GRANULAR
SUB-BASE MATERIALS**

| IS Sieve Designation | Per cent by weight passing the IS sieve Grading III |
|-----------------------------|--|
| 75.0 mm | -- |
| 53.0 mm | - |
| 26.5 mm | 100 |
| 9.50 mm | 65-95 |
| 4.75 mm | 50-80 |
| 2.36 mm | 40-65 |
| 0.425 mm | 20-35 |
| 0.075 mm | 3-10 |
| CBR Value (Minimum) | 20 |

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 lying 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 quantifies 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/m² 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 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 plan widths of road where directed
- (v) Carrying out the required tests for quality control.

It.:- Providing & Laying and spreading and compacting granular material / hard Murrum (with C.B.R. not less than 10) including spreading uniform layers and compacting with power roller etc. complete.

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 gradings 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 corresponding materials for each of the three maximum particle sizes are given in 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 cent fines value of 50 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 not less than 10 as per item description.

TABLE 400-2 GRADING FOR COARSE GRADED GRANULAR SUB-BASE MATERIALS

| IS Sieve Designation | Per cent by weight passing the IS sieve Grading III |
|-----------------------------|--|
| 75.0 mm | -- |
| 53.0 mm | -- |
| 26.5 mm | 100 |
| 9.50 mm | -- |
| 4.75 mm | 25-45 |
| 2.36 mm | -- |
| 0.425 mm | -- |
| 0.075 mm | <10 |
| CBR Value (Minimum) | 20 |

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 lying 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/m² 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 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 lane widths of road where directed
- (v) Carrying out the required tests for quality control.

It.: - 11 Road Marking with Hot Applied Thermoplastic compound with Reflectorising Glass Bends on Bituminous surface Providing and laying of hot applied thermoplastic compound 2.5mm 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. The Finished surface to be level uniform and free from streaks and holes.

803. ROAD MARKINGS

803.1. General The color, width and layout of road markings shall be in accordance with the Code of Practice for Road Markings with paints, IRC : 35, and as specified in the drawings or as directed by the Engineer.

803.2. Materials Road markings shall be of ordinary road marking paint, hot applied thermoplastic compound, or reflectorised paint as specified in the item and the material shall meet the requirements as specified below.

803.3. Ordinary Road Marking Paint

803.3.1. Ordinary paint used for road marking shall conform to. Grade I as per IS: 164.

803.3.2. The road marking shall preferably be laid with appropriate road marking machinery.

803.3.3. Laying thickness of road marking paint shall be as specified by the Engineer.

803.4. HOT APPLIED THERMOPLASTIC ROAD MARKING

803.4.1. General:

- (i) The work under this section consists of marking traffic stripes using a thermoplastic compound meeting the requirements specified herein.
- (ii) The thermoplastic compound shall be screened /extruded on to the pavement surface in a molten state by suitable machine capable of controlled preparation and laying with surface application of

glass beads at a specific rate. Upon cooling to ambient pavement temperature, it shall produce an adherent pavement marking of specified thickness and width and capable of resisting deformation by traffic.

- (iii) The color of the compound shall be white or yellow (IS color No. 356) as specified in the drawings or as directed by the Engineer.
- (iv) Where the compound is to be applied to cement concrete pavement, a scaling primer is recommended by the manufacturer, shall be applied to the pavement in advance of placing of the stripes to ensure proper bonding of the compound. On new concrete surface any laitance and/or curing compound shall be removed before the markings are applied.

803.4.2. Thermoplastic Material

803.4.2.1. General: The thermoplastic material shall be homogeneously composed of aggregate, pigment, resins and glass reflectorising beads.

803.4.2.2. Requirements

- (1) **Composition:** The pigment, beads, and aggregate shall be uniformly dispersed in the resin. The material shall be free from all skins, dirt and foreign objects and shall comply with requirements indicated in Table 800-3.

TABLE 900-3 PROPORTIONS OF CONSTITUENTS OF MARKING MATERIAL
(Percentage by weight)

| Component | White | Yellow |
|-------------------------------------|-----------|-----------|
| Binder | 18.0 min. | 18.0 min. |
| Glass Beads | 30-40 | 30-40 |
| Titanium Dioxide | 10.0 Min. | ----- |
| Calcium Carbonate and Inert Fillers | 42.0 Max. | See |
| Yellow Pigments | ----- | Note |

Note: Amount of yellow pigment calcium carbonate and inert fillers shall be at the option of the manufacturer, provided all other requirements of this Specification are met.

- (II) **Properties:** The properties of thermoplastic material, when tested in accordance with ASTM D36/BS-3262- (Paint 1), shall be as below:

(a) Luminance:

White: Daylight luminance at 45 degrees-65 per cent min. as per AASHTO M 249

Yellow: Daylight luminance at 45 degrees-45 per cent min. as per AASHTO M 249

- (b) **Drying time:** When applied at a temperature specified by the manufacturer and to the required thickness, the material shall set to be traffic in not more than 15 minutes.

- (c) **Skid resistance:** not less than 45 as per BS 6044.

- (d) **Cracking resistance at low temperature:** The material shall show no cracks on application to concrete blocks.

- (e) **Softening point:** 102.5 ± 9.50 C as per AASTM D 36.

- (f) **Flow resistance:** Not more than 25 per cent as per AASHTO M 249.

- (g) **Yellowness Index (for white thermoplastic paint):** not more than 0.12 as per AASHTO M 249

- (III) **Storage life:** The material shall meet the requirements of these Specifications for a period of one year. The thermoplastic material must also melt uniformly with no evidence of skins or unmelted particles for the one year storage period. Any material not meeting the above requirements "I am replaced by the manufacturer/ supplier/Contractor.

- (iv) **Reflectorisation:** Shall be achieved by incorporation of beads. the grading and other properties of the beads shall be as specified in Clause 803.4.3.

- (v) **Marking:** Each container of the thermoplastic material shall be clearly and indelibly marked with the following information:

1. The name, trade mark or other means of identification of manufacturer, 2. Batch number, 3. Date of manufacture, 4. Color (white or yellow) & 5. Maximum application temperature and maximum safe beating temperature.

- (vi) **Sampling and testing:** The thermoplastic material shall be sampled and tested in accordance with the appropriate ASTM/BS method. The Contractor shall furnish to the Employer a copy of certified test reports from the manufacturers of the thermoplastic material showing results of all tests specified herein and shall certify that the material meets all requirements of this Specification.

803.4.3. Reflectorising glass beads

803.4. 3.1. General: This Specification covers two types of glass beads to be used for the production of reflectorised pavement markings.

Type I beads -are those which are a constituent of the basic thermoplastic compound vide Table 800-3 and **Type 2** beads are those which are to be sprayed on the surface vide Clause 803.6.3.

803.4.3.2. The glass beads shall be transparent, colour less and free from milkiness, dark particles and excessive air inclusions.

These shall conform to the requirements spelt out in Clause 803.4.3.3.

803.4.3.3. Specific requirements

A. Gradation: The glass beads shall meet the gradation requirements for the two types as given in Table 800-4.

TABLE 800-4 GRADATION REQUIREMENTS FOR GLASS BEAD
Per cent retained

| Sieve size | ----- | |
|------------------|----------|----------|
| | Type I | Type 2 |
| 1.18 mm | 0 to 3 | ----- |
| 850 micron | 5 to 20 | 0 to 5 |
| 600 -do- | ---- | 5 to 20 |
| 425 -do- | 65 to 95 | ----- |
| 300 -do- | ----- | 30 to 75 |
| 180 -do- | 0 to 10 | 10 to 30 |
| below 180 micron | ----- | 0 to 15 |

B. Roundness: The glass beads shall have a minimum of 70 per cent true spheres.

C. Reflective index: The glass beads shall have a minimum reflective index of 1.50.

D. Free flowing properties: The glass beads shall be free of hard lumps and clusters and shall dispense readily under any conditions suitable for paint striping. They shall pass the free flow-test.

803.4.3.4. Test methods: The specific requirements shall be tested with the following methods:

- (i) Free-flow test: Spread 100 grams of beads evenly in a 100 mm diameter glass dish. Place the (fish in a 250 nun inside diameter desiccators which is filled within 25 mm of the top of a desiccator's plate with sulphuric acid water solution (specific gravity 1. 10). Cover the desiccators and lot it stud for 4 hours at 20 to 29 degree C. Remove sample from desiccators, transfer beads to a pan and inspect for lumps or clusters. Then pour beads into a clean, dry glass funnel having a 100 nun stem and 6 nun orifices, if necessary initiate flow by lightly tapping the funnel. The glass spheres shall be essentially free of lumps and clusters and shall flow freely through the funnel.
- (ii) The requirements of gradation, roundness and refractive index of glass beads and the amount of glass beads in the compound shall be tested as per BS 6088 and BS 3262 (Part 1).
- (iii) The Contractor shall furnish to the Employer a copy of certified test reports from the manufacturer of glass beads obtained from a reputed laboratory showing results of all tests specified herein and shall certify that the material meets all requirements of this Specification. However if so required these tests may be carried out as directed by the Engineer.

803.4.4. Application properties of thermoplastic material

803.4.4.1. The thermoplastic material shall readily get screened / extruded at temperatures specified by the manufacturers for respective method of application to produce a line of specified thickness which shall be continuous and uniform in shape having clear and sharp edges.

803.4.4.2. The material upon heating to application temperatures shall not exude fumes, which are toxic, obnoxious or injurious to persons or property.

803.4.5. Preparation:

- (i) The material shall be melted in accordance with the manufacturer's instructions in a heater fitted with a mechanical stirrer to give a smooth consistency to the thermoplastic material to avoid local overheating. The temperature of the mass shall be within the range specified by the manufacturer, and shall on no account be allowed to exceed the maximum temperature stated by the manufacturer. The molten material should be used as expeditiously as possible and for thermoplastic material which has natural binders or is otherwise sensitive to prolonged heating, the material shall not be maintained in a molten condition for more than 4 hours.
- (ii) After transfer to the laying equipment, the material shall be maintained within the temperature range specified by the manufacturer for achieving the desired consistency for laying.

803.4.6. Properties of finished road marking

- (a) The stripe shall not be slippery when wet.
- (b) The marking shall not lift from the pavement in freezing weather.
- (c) After application and proper drying, the stripe shall show no appreciable deformation or discoloration under traffic and under road temperatures up to 60 degree centigrade.
- (d) The marking shall not deteriorate by contact with sodium chloride, calcium chloride or oil drippings from traffic.
- (e) The stripe or marking shall maintain its original dimensions and position. Cold ductility of the material shall be such as to permit normal movement with the road surface without chopping or cracking.
- (f) The color of yellow marking shall conform to IS Color No. 356 as given in IS: 164.

803.5. Reflectorised Paint

Reflectorised paint, if used, shall conform to the Specification by the manufacturers and approved by the Engineer. Reflectorising glass beads for reflectorising paints where used shall conform to the requirement of Clause 803.4.3.

803.6. Application

803.6.1. Marking shall be done by machine. For locations where painting cannot be done by machine, approved manual methods shall be used with prior approval of the Engineer. The Contractor shall maintain control over traffic while painting operations are in progress so as to cause minimum inconvenience to traffic compatible with protecting the workmen.

803.6.2. The thermoplastic material shall be applied hot either by screening or extrusion process. After transfer to the laying apparatus, the material shall be laid at a temperature within the range specified by the manufacturer for the particular method of laying being used. The paint shall be applied using a screed or extrusion machine.

803.6.3. The pavement temperature shall not be less than 10°C during application. All surfaces to be marked shall be thoroughly cleaned of all dust, dirt grease, oil and all other foreign matter before application of the paint.

The material, when formed into traffic stripes, must be readily renewable by placing an overlay of new material directly over an old line of compatible material. Such new material shall so bond itself to the old line that no splitting or separation takes place.

Thermoplastic paint shall be applied in intermittent or continuous lines of uniform thickness of at least 2.5 mm unless specified otherwise. Where arrows or letters are to be provided, thermoplastic compound may be hand-sprayed. In addition to the beads included in the material, a further quantity of glass beads of Type 2, conforming to the above noted Specification shall be sprayed uniformly into a mono-layer on to the hot

paint line in quick succession of the paint spraying operation. The glass beads shall be applied at the rate of 250 grams per square metre area.

803.6.4. The minimum thickness specified is exclusive of surface applied glass beads. The method of thickness measurement shall be in accordance with Appendices B and C of BS - 3262 (Part 3).

803.6.5. The finished lines shall be free from ruggedness on sides and ends and be parallel to the general alignment of the carriageway. The upper surface of the lines shall be level, uniform and free from streaks.

803.7. Measurements for Payment

803.7.1. The painted markings shall be measured in sq. metre of actual area marked (excluding the gaps, if any).

803.7.2. In respect of markings like directional arrows and lettering, etc., the measurement shall be by numbers.

803.8. Rate

The Contract unit rate for road markings shall be payment in full compensation for furnishing a labour, materials, tools, equipment, including all incidental costs necessary for carrying out the work at the site conforming to these Specifications complete as per the approved drawing(s) or as directed by the Engineer and all other incidental costs necessary to complete the work to these Specifications.

It.: - Providing and laying utility cross duct pipe of 250mm to 450 mm dia. Hume pipe NP-2 class with collars including setting and joining the pipe in C.M. 1:2 watering and laying in slopes of I.S. class as per detailed drawing and direction of Engineer in charge.

[A] The work shall consist of excavation of trench up to 3.0 Mtr. or required depth and furnishing and installing reinforced cement concrete pipe of the type dia metre and length required at the location shown on the drawings or as ordered by the Engineer-in-charge.

[B] Excavation for trench cutting to lay utility cross duct pipe of 250 mm to 450 mm diameter shall be carried out as below:

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 cm 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 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 hot asphalt.

2.2 The rate of site clearance is damaged be included in the rate of earthwork for which no extra will be paid.

3.0 Setting out: After clearing the site, the center 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 tractor shall assume full responsibility for alignment elevation and dimension of each and all parts of the work. Contractor shall supply labourers, 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 strutting 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 levelled 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 other reason excavation is made deeper or wider 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 3 m. depth shall be carried out as above.

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 levelling 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 with all lead and lift.

[C] Supplying & Fixing R.C.C. NP-2 Pipe for utility cross duct shall be carried out as below:

1. The work shall consist of furnishing and installing reinforced cement concrete pipe of the type diameter and length required at the location shown on the drawings or as ordered by the Engineer-in-charge.

2. Reinforced concrete pipe shall be NP3 type conforming to the requirements of I.S. 458 and shall be of dia as specified in the item. Each consignment of cement concrete pipes shall be inspected, if necessary and approved by the Engineer-in-charge, either at the place of manufacture or at the site before their incorporation in the works.

NP3, NP2, NP1 pipes are used for R. C. C. pipes where testing of pipes. Where testing of pipes will not be feasible the contractors will have to produce a certificate from the manufacturers on company's letter head the given hereinafter form.

Production of such certificate will not however relieve the contractor from his responsibility of supplying pipes of required standard and will have to bear the loss or damage caused to the work on account of defects found subsequently during the execution. It will also be necessary to purchase these pipes from manufacturer having standard equipments for carrying out various test as per IS : 458 at his factory.

FORM OF CERTIFICATE FOR NP2 PIPES

We _____ manufacturer of R.C.C. pipes produce R.C.C. pipes as per the requirement of IS: 458 and also carry out the required test at our place. We have acquired equipments for carrying out test and are prepared to carrying out test at our factory sites.

We have experience of manufacturing of pipes of _____ years. The pipes supplied by us to M/s. _____ satisfy the requirement of I.S. 458.

Date: _____

Place: _____

Manufacturer's Sign: - _____

3. No pipe shall be placed in position until the foundations have been approved by the Engineer-in-charge. Where two or more pipes are to be laid adjacent to each other, they shall be separated by a distance equal to at least half the diameter of the pipe subject to minimum of 450 mm. The laying of pipes on the prepared foundation shall start from the outlet and proceed towards the inlet and be completed to the specified lines and grades. The pipes shall be fitted and matched so that when laid in work they form a culvert with a smooth uniform invert: Any pipe found defective or damaged during laying be removed at the cost of Contractor.

4. The pipes shall be jointed either by collar joint or by flush joint. In the former case, the collars shall be of R.C.C., 150 to 200 mm wide and having the same strength as the pipes to be jointed. Caulking space shall be between 13 and 20 mm according to the diameter of the pipes. Caulking material shall be slightly wet mix of cement and sand in ratio of 1:2 rammed with caulking irons: Before caulking the collar shall be so placed that its centre coincides with that of pipe and even annular space is left between the collar and the pipes. Flush joint may be shaped to form a self centering joint with a joining space 13 mm wide. The jointed space shall be filled with cement mortar 1 cement to 2 sand, mixed sufficiently dry to remain in position when forced with a trowel or rammer. Care shall be taken to fill all voids and excess mortar shall be removed. All joints shall be made with care so that their interior

surface is smooth and consistent with the interior surface of the pipes. After finishing, the joints shall be kept covered and damp for at least four days.

[D] Utility Cross Duct R.C.C. NP- 2 pipes shall be measured along their centre between their inlet and outlet ends in linear metres.

[E] The rate for Utility Cross Duct with R.C.C. NP- 2 pipes shall include the cost of Excavation for trench to lay pipe at required depth as directed, cost of pipe including loading, unloading, handling storing laying in position and joining complete.

The payment shall be made on Rmt. basis for completed item as per item description or as directed.

It.:- Demolition of brick work and stone masonry including stacking of serviceable materials and disposal of unserviceable materials with all lead and lift (ii) in cement mortar.

1.0 Workmanship:

The relevant specifications as below shall be followed except that here demolition of brick or stone masonry in lime or cement mortar is to be done.

1.1. The demolition shall consist of demolition of one or more parts of the building as specified or shown in the drawings. Demolition implies taking up or down or breaking tap. This shall consist of demolishing whole or part of work including all relevant items as specified or shown in the drawings.

1.2. The demolition shall always be planned before hand and shall be done in reverse order of the one in which the structure was constructed. This scheme shall be got approved from the Engineer-in-charge before starting the work. This however will not absolve the, contractor from the responsibility of proper and safe demolition.

1.3. Necessary dropping, shoring and under pinning shall be provided for the safety of the adjoining work or property, which is to be left intact, before Dismantling and demolishing is taken up and the work shall be carried out in such a way that no damages is caused to the adjoining property.

1.4. Wherever required, temporary enclosures or partitions shall also be provided. Necessary precautions shall be taken to keep the dust nuisance down as and where necessary.

1.5. Dismantling shall be commenced in a systematic manner, All materials which are likely to be damaged by dropping from a height or demolishing roof, masonry etc. shall be carefully dismantled first. The dismantled articles shall be properly stacked as directed.

1.6. All materials obtained from demolition shall be the property of Government unless otherwise specified and shall be kept in safe custody until handed over to the Engineer-in-charge.

1.7. Any serviceable materials, obtained during Dismantling or demolition shall be separated out and stacked properly as directed, with all lead and lift. All unserviceable materials, rubbish etc. shall be stacked as directed by the Engineer-in-charge.

1.8. On completion of work, the site shall be cleared of all debris rubbish and cleaned as directed.

2.0. Mode of measurements & payment:

2.1. Measurements of all work except hidden work shall be taken before demolition or dismantling and no allowance for increase in bulk shall be allowed. The demolition of brick work shall be measured under this item. Specification for deduction for voids, openings etc. shall be on same basis as that employed for construction of work.

2.2. All work shall be measured in decimal system as fixed in its place subject to the following limits, unless otherwise stated hereinafter: (a) Dimensions shall be measured to the nearest 0.01 mt. (b) Area shall be worked out to the nearest 0.01 sq. mt. (c) Cubical connection shall be worked out to the nearest 0.01 Cu. m.

2.3. The rate shall include cost of all labour involved and tools used in demolishing and dismantling including scaffolding. The rate shall also include the charges for separating out and stacking the serviceable materials properly and disposing the unserviceable materials with all lead and lift. The rate also includes for temporary storing for the safety of the portion not required to be pulled down or of adjoining property and providing temporary enclosures or partitions where considered necessary.

2.4. The rate shall be for a unit of one cubic metre.

It.: - Excavation for foundation up to 1.5 M Depth including sorting out and stacking of useful materials and disposing of the excavated stuff with all lead & lift in 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 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 hot asphalt.

2.2 The rate of site clearance is damaged be included in the rate of earthwork for which no extra will be paid.

3.0 Setting out: After clearing the site, the center 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 labourers, 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 strutting 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 levelled 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 other reason excavation is made deeper or wider than 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 levelling 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 measurement and 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 slopping 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 metre.

It.: - Providing and laying cement concrete 1:3:6 (1 Cement : 3 coarse sand : 6 Crushed stone aggregates 20 mm nominal size) and curing complete including cost of form work in (A) Wall Caps / Copings

1.0 Materials:

1.1 Water shall conform to M-1. Sand shall conform to M-b. Cement shall conform to M-3. Stone aggregate 20 mm nominal size shall conform to M-12 for concrete work of Wall caps / copings.

2.0 Workmanship:

2.1. General:

2.1.1. Before starting concrete bed of foundation trenches shall be cleared of all loose materials, leveled, watered and rammed as directed.

2.2. Proportion of Mix:

2.2.1. The Proportion of cement, sand and coarse aggregate shall be one part of cement, 3 parts of sand, 6 parts of stone aggregates and shall be measured by volume.

2.3. Mixing:

2.3.1. The concrete shall be mixed in a mechanical mixer at the site of work. Hand mixing may however be allowed for smaller quantity of work if approved by the Engineer-in-charge. When hand mixing is permitted by the Engineer-in-charge in case of break-down of machineries and in the interest of the work, it shall be carried out on water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. However in such cases 10 % more cement than otherwise required shall have to be used without any extra cost. The mixing in mechanical mixer shall be done for a period 1 to 2 minutes. The quantity of water shall be sufficient to produce a dense concrete of required workability for the purpose.

2.4. Transporting & placing the concrete:

2.4.1. The concrete shall be handled from the place of mixing to the final position in not more than 15 minutes by the method as directed and shall be placed into its final position, compacted and finished within 30 minutes of mixing with water i.e. before the setting commences.

2.4.2. The concrete shall be laid in layers of 15 cms to 20 cms.

2.5 Compacting:

2.5.1 The concrete shall be rammed with heavy iron rammers and rapidly to get the required compaction and to allow all the interstices to be filled with mortar.

2.6 Curing:

2.6.1 After the final set, the concrete shall be kept continuously wet, if required by ponding for a period of not less than 7 days from the date of placement.

2.7 Mode of measurement and Payment:

2.7.1 The concrete shall be measured for its length breadth and depth, limiting dimensions to that specified on plan or as directed.

2.7.2. The rate shall be for a unit of one cubic meter, including cost of necessary formwork to be provided as directed by Engineer-in-charge

It.:- Providing Thermo Mechanically Treated bars (T.M.T.) conforming to I.S. 1786 FE 415 for R.C.C. work including, bending, Binding and placing in position complete up to for two level.

1.0. GENERAL

This work shall consist of furnishing and placing coated, or uncoated TMT or high strength deformed reinforcement, bars (intentioned) of the shape and dimensions shown on the drawings and conforming to these Specifications or as approved by the Engineer in charge.

2.0. MATERIAL

2.1. TMT Bars

Reinforcements may be either TMT/medium tensile steel or high strength deformed bars. They may be uncoated or coated 'with epoxy or with approved protective coatings.

2.2. TMT bars reinforcement for RCC work shall conform to IS 1786 FE-415 and shall be of tested quality. It shall also comply with relevant part of IS 456-1966

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

2.4. All steel shall be procured from original producers no re-rolled steel shall be incorporated in the work

2.5. Only new steel shall be delivered to the site every bar shall be inspected before placing to its position and defective brittle or burnt bar shall be discarded cracked ends of bars shall be discarded

3.0. Pitch

3.1. Distance between bars shall be as specified in drawings and as directed by the Engineer in Charge. all bars shall be placed at an accurate distance from each other and shall be bind tightly to maintain the desired pitch Suitable means shall be provided for holding bars securely in position

4.0. Binding wire

4.1. Mild steel binding wire shall be of 1.63 mm or 1.22 mm (16 to 18 gauge diameter and shall conform IS 280-1972

4.2. The use of black wire will be permitted for binding reinforcement bars. It shall be free from dirt, paint, grease or oil, oil scale or loose or thick rust and any other undesirable coating which may prevent adhesion of cement mortar at the time of binding

4.3. Only new binding wire shall be delivered to the site all binding wire shall be inspected before binding to its position and defective brittle, rusted, used wire, shall be discarded

5.0. PROTECTION OF REINFORCEMENT

5.1. Uncoated reinforcing steel shall be protected from rusting or chloride contamination. Reinforcements shall be free from rust, mortar, loose mill scale, grease, oil or paints. This may be ensured either by using reinforcement fresh from the factory or thoroughly cleaning all reinforcement to remove rust using any suitable method such as sand blasting, mechanical wire brushing, etc. as directed by the Engineer. Reinforcements shall be stored on bricks, racks or platforms and above the ground in a clean and dry condition and shall be suitably marked to facilitate inspection and identification.

5.2. Portions of uncoated reinforcing steel and dowels projecting from concrete shall be protected within one week after initial placing of concrete with a brush coat of neat cement mixed with water to a consistency, of thick paint. This coating shall be removed by lightly tapping with a hammer or other tool not more than one week before placing of the adjacent pour of concrete. Coated reinforcing steel shall be protected against damage to the coating. If the coating on the bars is damaged during transportation or handling and cannot be repaired, the same shall be rejected.

6.0. Workmanship

6.1. The work shall consist of furnishing and placing reinforcement to the shape and dimensions shown as on the drawings or as directed by The Engineer in charge.

6.2. Reinforcing steel shall conform accurate to the dimensions given in the bar bending schedules shown on relevant drawing

7.0. BENDING OF REINFORCEMENT

7.1. Bar bend g schedule shall be furnished by the Contractor and got approved by the Engineer before start of work.

7.2. Reinforcing steel shall conform to the dimensions and shapes given in the approved Bar bending Schedules.

7.3. Bars shall be bent cold to the specified shape and dimensions or directed by the Engineer using a proper bar bender operated by hand power to obtain the correct radius of bends and shape. Bars, shall not be bent or straightened in a manner that will damage parent material or the coating bars bent during transport or handling shall, be straightened before being used on work and shall not be heated to facilitate straightening.

8.0. PLACING OF REINFORCEMENT

8.1. The reinforcement cage should generally be fabricated in the yard at ground level, and then shifted and placed in position. The reinforcement shall be placed strictly, in accordance with the drawings and shall be assembled in position, only when structure is otherwise ready for placing of concrete. Prolonged time gap, between assembling of reinforcements and casting of concrete, which may result in rust formation on the surface, shall not be permitted.

8.2. Reinforcement bars shall be placed accurately in position as shown on the drawings. The bars, crossing one another shall be tied together at every intersection with binding wire (annealed), conforming to IS:280 to make the skeleton of the reinforcement rigid such that the reinforcement does not get displaced during placing of concrete, or any other operation. The diameter of binding wire shall not be less than 1 mm.

8.3. Bars shall be kept in. position usually by the following methods:

In case of beam and slab construction, industrially produced polymer cover blocks of thickness equal to the specified cover shall be placed between the bars and formwork subject to satisfactory evidence that the polymer composition is not harmful to concrete and reinforcement. Cover blocks made of concrete may be permitted by the Engineer, provided they have the same strength and specification as those of the member.

8.4. In case of dowels for Columns and walls the vertical reinforcement shall be kept in position by means of timber templates with slots in them accurately, or with cover blocks tied to the Reinforcement. Timber templates shall be removed after the concreting has progressed up to a level just below their location.

8.5. Layers of reinforcements shall be separated by spacer bars at approximately One meter intervals. The minimum diameter of spacer bars shall be 12 mm or: equal to maximum size of main reinforcement or maximum size of coarse aggregate, whichever is greater. Horizontal reinforcement shall not be, allowed to sag between supports.

8.6. Necessary stays, blocks, metal chairs, spacers, metal hangers, supporting wires etc, or other subsidiary, reinforcement shall be provided to fix the reinforcements firmly in its correct position.

8.7. Use of pebbles, broken stone, metal pipe, brick, mortar or wooden blocks etc as devices for positioning reinforcement shall not be permitted.

8.8. Bars coated with epoxy or any other approved protective coating shall be placed on supports that do not damage the coating. Supports shall be installed in a manner such that planes of weakness are not created in hardened concrete. The coated reinforcing steel shall be held in place by use of plastic or plastic coated binding wires especially manufactured for the purpose.

8.9. Placing and fixing of reinforcement shall be inspected and approved by the Engineer before concrete is deposited.

9.0. Lapping

9.1. All reinforcement shall be furnished in full lengths as indicated on the drawing. No splicing of bars, except where shown on the drawing; will be permitted without approval of the Engineer. The lengths of the splice shall be as indicated on drawing or as approved by the Engineer. Where practicable, overlapping bars shall not touch each other, and shall be kept apart by 25 mm or 1 1/4 times the maximum size of coarse aggregate, whichever is greater. If this is not feasible, overlapping bars shall be bound with annealed steel binding wire, not less than 1 mm diameter and twisted tight in such a manner as to maintain minimum clear cover to the reinforcement from the concrete surface. Lapped splices shall be staggered or located at points, along the span where stresses are low.

10.0 Welding

10.1 Splicing by welding of reinforcement will be permitted only if detailed on the drawing or approved by the Engineer. Weld shall develop an ultimate strength equal to or greater than that of the bars connected.

10.2. While welding may be permitted for TMT reinforcing bars conforming to IS: 432, welding of deformed bars conforming to IS: 1786 shall in general be prohibited. Welding may be permitted in case of bars of other than S 240 grade including special. Welding grade of S 415 grade bars conforming to IS: 1786, for which necessary chemical analysis has been secured and the carbon equivalent (CE) calculated from the chemical composition using the formula: $CE = C + Mn + Cr + Mg + V + Ni + Cu$ 6 5 15 is 0.4 or less.

10.3. The method of welding shall conform to IS: 2751 and IS: 9417 and to any supplemental specifications to the satisfaction of the Engineer

10.4. Bars shall be bent cold to the specified shape and dimensions or as directed by Engineer in charge using the proper bender tool, 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 in the work. Bars shall not be heated to facilitate bending.

10.5. 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 the straight part of the bar beyond the end of the curve shall be at least four times of 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 spitting of the concrete.

10.6. All reinforcement bars shall be accurately placed in exact position shown on the drawings and shall be securely held in position during placing of concrete by annealed binding wire not less than 1 mm in size and by using say blocks or metal chairs spacers, metal hangers, supporting wires or other approved devices at sufficiently close intervals, Bars shall not be allowed to sag between supports not displaced during concreting or any other operations of the work All devices used for positioning shall be of not corrodible material wooden and metal supports shall not extended to the surface of the concrete, except where shown in drawings. Placing bars on layers of freshly laid concrete as the work progresses for adjusting bar spacing shall not be allowed. Pieces of broken stone or brick and wooden blocs shall not be used Layers of bars shall be separated by spacer bars pre-cast mortar blocks or other approved devices. Reinforcement after bending 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 form corrosion, concrete cover shall be provided as indicated on drawings. All bars protruding from concrete and to which other bars are to be sliced and which are likely to be exposed for a period exceeding 10 days shall be protected by a thick coat of neat cement grout

10.7. Bars crossing each other where required shall be secured by binding wire (annealed) of size not less than 1 mm in such a manner that they do not slip over at the time of fixing and concreting.

10.7. As far possible bars of full length shall be used In case this is not possible, overlapping of bars shall be done as directed by the Engineer in charge When practicable overlapping bars shall not touch each other, but be kept apart by 25 mm Where no 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 sheer not bending moments is maximum.

10.8. Whenever indicated on drawing or desired the Engineer in charge bars shall be jointed by coupling which shall have a cross section sufficient to transmit the full stresses of bars The end of the bars that are jointed by coupling shall be upset for sufficient length so that the effective cross section at the base of threads is not less than the normal cross section of the bar. Threads shall be standards threads Steel for coupling shall conform to IS 226.

10.8. When permitted or specified on the drawings joints of reinforcement bars shall 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 are welding using a process which excludes air form the molten metal and conforms to any or 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 bars shall be cleaned of all loose scale rust stages 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 IS 814 Welded pieces of reinforcement shall be tested. Specimen shall be taken form the actual site and their number shall frequency to test shall be as directed by the Engineer in charge

11.0 MODE OF MEASUREMENTS & PAYMENT

11.1. For the purpose of payment the bar shall be measured correct up to 10 mm length and weight payable works out at the rate specified below

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

11.1. Excess consumption over 5% will be charged at penal rate.

11.2. Reinforcement shall be measured in length including overlaps, separately for different diameters as actually used in the work. Where welding or coupling is resorted to, in place lap joints, such joints shall be measured for payment 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 of as per table given above 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.

11.3. The rate for reinforcement includes cost of steel binding wires, its carting from Department Store to work site with all leads and lifts (in case of it is supplied by department), cutting, bending, placing in position, binding and fixing in position as shown on the drawings and as directed. It shall also include all devices for keeping reinforcement in approved position, cost of joining as per approved method and all wastage and spacer bars.

11.4. The rate shall be for a unit of One Kg.

It.:- Filling in plinth with sand under floors including watering ramming, consolidating and dressing etc. complete.

1.0 Workmanship:

1.1 The Sand to be used for filling shall be free from salts, organic or other foreign matter. All clods of earth shall be broken

1.2 As soon as the work in foundation has been completed and measured, the site of foundation shall be cleared of all debris, brick bats, mortar dropping etc. and filled with earth in layers not exceeding 20 Cms. Each layer shall be adequately watered, rammed and consolidated before the succeeding layer is laid. The earth shall be rammed with iron rammers where feasible and with the butt ends of crow-bars, where rammer cannot be used.

1.3 The plinth shall be similarly filled with earth in layers not exceeding 20 Cms. adequately watered and consolidated by ramming with iron or wooden rammers. When filling reaches finished level, the surface shall be flooded with water for at least 24 hours and allowed to dry and then rammed and consolidated.

1.4 The finished level of filling shall be kept to shape intended to be given to floor.

1.5 In case of large heavy duty flooring like factory flooring, the consolidation may be done by power rollers, where so specified. The extent of consolidation required shall also be as specified.

1.6 The excavated stuff of the selected type shall be allowed to be used in filling the trenches and plinth. Under no circumstances black cotton soil be used for filling the plinth.

2.0. Mode of measurement and payment:

2.1. The payment shall be made for filling in plinth and trenches. No deduction shall be made for shrinkage or voids, if consolidated as instructed above.

2.2. The rate shall be for a unit of one cubic metre.

It.:- Providing 15 mm thick cement plaster in single coat on brick/concrete wall for interior plastering up to floor two level finished even and smooth in (i) cement mortar 1:3 (1 cement: 3 sand) including finishing with a floating coat of neat cement slurry & White washing with lime on wall surfaces (Three coats) to give an even shade including thoroughly brooming the surface to remove all dirt, dust, mortar drops and other foreign matter.

[A] Combined Thickness of Plaster shall be 15mm, and the work shall be carried out as below:

1.0 Materials:

1.1 Water M-1. The cement mortar of proportion 1:3 shall conform to M-13.

2.0 Workmanship:

2.1 Scaffolding: Wooden ballies, bamboos, planks, treatles and other scaffolding shall be sound. These shall be properly examined before erection and use. Stage scaffolding shall be provided for ceiling plaster which shall be independent of the walls.

2.2 Preparation of back-ground:

2.2.1 The surface shall be cleaned of all dust, loose mortar droppings, traces of algae, efflorescence and other foreign matter by water or by brushing. Smooth surface shall be roughened by wire brushing if it is not hard and by racking if it is hard. In case of concrete surface, if a chemical retarder has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off

and care shall be taken that none of the retarders is left on the surface. Trimming of projections on brick/concrete surface where necessary shall be carried out to get an even surface.

2.2.2 Raking of joints in case of masonry where necessary shall be allowed to dry out for sufficient period before carrying out the plaster work.

2.2.3 The work shall not be soaked but only damped evenly before applying the plaster. If the surface becomes dry such area shall be moistened again.

2.2.4 For external plaster, the plastering operation shall be started from top floor and carried downwards. For internal plaster, the plastering operations may be started wherever the building frame and cladding work are ready and the temporary supporting ceiling resting on the wall of the floor have been removed. Ceiling plaster shall be completed before starting plaster to walls.

2.3 Applications of plaster:

2.3.1 The plaster about 15 x 15 cms shall be first applied horizontally and vertically at not more than 2 metres intervals over the entire surface to serve as gauge. The surfaces of these gauges shall be truly in plane of the finished plastered surface. The mortar shall then be applied in uniform surface slightly more than the specified thickness, and then brought to a true surface by working a wooden straight edge reaching across the gauges with small upward and sideways movement at a time. Finally the surface shall be finished off true with a trowel or wooden float according as a smooth or a smooth granular texture is required. Excessive trowelling or overworking the float shall be avoided. All corners, arises, angles and junctions be truly vertical or horizontal as the case may be and shall be carefully finished. Rounding or chamfering corners, arises junctions etc. shall be carried out with proper templates to the size required.

2.3.2 Cement plaster shall be used within half an hour after addition of wafer. Any mortar or plaster is partially set shall be rejected and removed forthwith from the site.

2.3.3 In suspending the work at the end of the day, the plaster shall be left out clean to the line both horizontally and vertically. When recommencing the plaster, the edges of the old work shall be scraped clean and wetted with cement putty before plaster is applied to the adjacent areas to enable the two to properly join together. Plastering work shall be closed at the end of the day on the body of the wall and nearer than 15 cm. to any corners or arises. Horizontal joints in plaster work shall not also occur on parapet tops and copings as these invariably lead to leakage. No portion of the surface shall be left out initially to be packed up later on.

2.3.4 Each coat shall be kept damp continuously till the next coat is applied or for a minimum period of 7 days. Moistening shall commence as soon as plaster is hardened sufficiently. Soaking of walls shall be avoided and only as much water as can be readily absorbed shall be used, excessive evaporation on the sunny or windward side of building in hot air or dry weather shall be prevented by hanging mattings or gunny bags on the outside of the plaster and keeping them wet.

[B] Finishing with a floating coat of neat cement slurry as below:

1.0 Materials & Workmanship:

1.1 The relevant specifications of 15mm thick plaster shall be followed for materials and workmanship except that this work is only of providing smooth-cement finish with floating coat of neat cement slurry.

1.2 The coat of cement and fine sand mortar of proportion 1:1 (1.5 mm thick about) shall be applied to the plastered surface with a trowel to provide uniform texture while the base coat is still plastic.

1.3 In any continuous face of wall the finishing treatment should be carried out continuously and clay to day braked made to coincide with architectural breaks in order to avoid unsightly junctions.

1.4 Curing: All the plaster work shall be kept damp continuously for a period of 7 days.

[C] White washing with lime on wall surfaces (Three coats) as below:

1.0. Materials:

1.1 The clearcolle shall be made from glue and boiling water by Mixing 1 kg mixture shall be suitable tinted where required for use under coloured distemper if directed. Glue shall conform to I.S. 852 - 1969 (Specifications for animal glue).

1.2 Lime used shall be freshly burnt class 'C' Lime (fat lime) and white in colour conforming to I.S. 712 - 1973 / Water shall conform to M-1 Best quality of gum shall be used in the preparation of white wash. Alternative blue or indigo: This shall conform to I.S. 55 - 1970 for points, and shall be used for preparation of wash. Pigments: Mineral Colours, not affected by lime shall be used in preparing colour wash.

2.0 Workmanship:

2.1. Preparation of white wash solution

Surface already white or colour. The fat lime shall be slaked at site and shall be mixed and stirred with about five liters of water for 1 kg of unslaked lime to make a thin cream. This shall be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth; 4 Kg of gum dissolved in hot water shall be added to each cubic metre of lime cream. Small quantity of ultramarine blunt (Up to 3 gms per kg of lime) shall also be added to the last two coats of white wash solution and the whole solution shall be stirred thoroughly before use.

2.1 Preparation of surface:

2.2.1 The surface shall be thoroughly cleaned of all dust, dirt, mortar croppings and other foreign matter before white wash is to be applied.

2.2.2 The surface spoiled by smoke soot shall be scraped with steel wire brusher or steel scrapers or shall be rubbed with over-burnt surkhi or brick bats. The surface shall be then broomed to remove all dust, dirt and shall be washed with clean water.

2.2.3 Oil or grease spots shall be removed by suitable chemical and smooth surface shall be rubbed with wire brushes.

2.2.4 All unsound portion of the surface plaster shall be removed to full depth of plaster in rectangular patches and plastered again after raking the masonry joints properly. Such portion shall be wetted and allowed to dry. They shall then be given one coat of white wash.

2.2.5 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.

2.3 Scaffolding:

Wherever scaffolding is necessary it shall be erected in such a way that as far as possible on part of scaffolding shall rest against the surface to be white or colour washed. A properly secured strong and well tied suspended platform (Zoola) may be used for white washing. Where ladders are used, pieces of old gunny bags shall be tied at top and bottom to prevent scratches to the floors and walls. For white washing of ceilings proper stage scaffolding shall be erected where necessary.

2.4 Application of white wash:

2.4.1 On the surface so prepared the white wash shall be applied with 'Moon' brush. The first stroke of the brush shall be from top downwards, another from bottom upwards over the first stroke and similarly one stroke from the right another from the left, over the first stroke brush before it dries. This will form one coat. Each coat shall be allowed to dry before next coat is applied. Number of coats as specified in item shall be applied. It shall present smooth and uniform finish free from brush marks and it should not come off easily when rubbed with finger.

2.4.2 Splashing and dropping if any on the doors and windows, ventilators etc. shall be removed and the surface cleaned.

2.4.3 Priming and Alkali resistant treatments, scraping of surface washing etc. surface spoiled by smoke soot removed of oil and grease spots treatment for infection with efflorescence moulds moss, fungi, algae and lichen and patch repairs to plaster wherever done shall not be paid extra.

3.0 Mode of measurements & payment:

3.1 The rate shall include the cost of all materials, labour and scaffolding etc. involved in the operations described under workmanship.

3.2 All plastering shall be measured in square metres unless, otherwise specified. Length, breadth or height shall be measured correct to a centimeter.

3.3 Thickness of the plaster shall be exclusive of the thickness of the key i.e. grooves or open joints in brick work, stone work etc. or space between laths. Thickness of plaster shall be average thickness with minimum 10 mm. at any point on this surface.

3.4 This item includes plastering up to floor two level.

3.5. The measurement of wall plastering shall be taken between the walls or partition (dimensions before plastering being taken) for length and from the top of floor or skirting to ceiling for height. Depth of cover of cornices if any shall be deducted.

3.6 Soffits of stairs shall be measured as plastering on ceilings. Flowing soffits shall be measured separately.

3.7. For jambs, soffits, sills etc. for openings not exceeding 0.5 sq. mt each in area for ends of joints, beams, posts, girders, steps, etc. not exceeding 0.5 sq. mt each in area and for openings exceeding 0.5 sq. mt and not exceeding 3.00 sq. mt. in each area deductions and additions shall be made in the following manner.

(a) No deductions shall be made for ends of joints, beams, posts etc. and openings not exceeding 0.5 sq. mt each and no addition shall be made for reveals, jambs, soffits, sills etc. of these opening for finish to plaster around ends of joints, beams posts etc.

(b) Deduction for openings exceeding 0.5 sq. mt but not exceeding 3 sq. mt each shall be made as follows and no addition shall be made for reveals, jambs, soffits, sills etc. of these openings.

(i) When both faces of all walls are plastered with same plaster, deduction shall be made for one face only.

(ii) When two faces of wall are plastered with different types of plasters or if one faces is plastered and the other pointed, deductions shall be made from the plaster or pointing on the side of frame for door, window etc. on which width of reveals is less than that on the other side but no deductions shall be made on the other side. Where width of reveals on both faces of all is equal, deductions of 50% of area of opening on each face shall be made from area of plaster and/or pointing as the case may be.

3.8. For openings having door frames equal to projecting beyond the thickness of wall, full deduction for opening shall be made from each plastered face of the wall.

3.9. In case of openings of area above 3 sq. mt. each, deduction shall be made for opening but jambs, soffits and sills shall be measured.

The Payment shall be made on Sq.mt basis for complete item or as directed by Engineer-in-charge.

It.:- Providing and fixing ordinary Kilometer Stone of precast C.C. 1:2:4 including necessary reinforcement as per I.R.C. type design fixing in C.C. 1:4:8 including letter and paints etc. complete (For N. H., S. H. and M. D. R.)

1. Kilometer stone shall be of approved quality and shall be either black Rajula stone or of precast 1:2:4 R.C.C. as specified in the item.
2. The size, manner of fixing, painting and lettering of K.M. stone shall conform specification as per I.R.C. - 8 (Type design for Highway kilometer stones). The fixing of K.M. store shall be carried cut in ordinary concrete of grade specified in the item using hand broken metal field metal or grave. The measurement for payment shall be made per No. of K.M. stone fixed in position.
3. Unit rate for kilometer stone includes the cost of all materials, labour, tools, fixing, finishing curing, lettering and painting as directed by the Engineer-in-charge.

The Payment shall be made on No. basis for complete item.

It.:- Providing and Laying spreading and compacting specified sand (C B R not less than 10%) below sub coarse including carriage of materials spreading manually on prepared base and comported with vibrators roller to achieve desire density including all materials, labour and machinery etc. complete.

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**, 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 gradings 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 gradings for the corresponded materials for each of the three maximum particle sizes are given 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 cent fines value of 50 or more (for sample in soaked condition) when tested in compliance with BS: 812 (Part 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: 383 FBR Grading II and III materials, the CBR shall be determined at dry 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.

TABLE 400-1 GRADING FOR CLOSE-GRADED GRANULAR SUB-BASE MATERIALS

| IS Sieve Designation | Per cent by weight passing the IS sieve Grading III |
|----------------------------|---|
| 75.0 mm | -- |
| 53.0 mm | - |
| 26.5 mm | 100 |
| 9.50 mm | 65-95 |
| 4.75 mm | 50-80 |
| 2.36 mm | 40-65 |
| 0.425 mm | 20-35 |
| 0.075 mm | 3-10 |
| CBR Value (Minimum) | 20 |

TABLE 400-2 GRADING FOR COARSE GRADED GRANULAR SUB-BASE MATERIALS

| IS Sieve Designation | Per cent by weight passing the IS sieve Grading III |
|----------------------------|---|
| 75.0 mm | -- |
| 53.0 mm | -- |
| 26.5 mm | 100 |
| 9.50 mm | -- |
| 4.75 mm | 25-45 |
| 2.36 mm | -- |
| 0.425 mm | -- |
| 0.075 mm | <10 |
| CBR Value (Minimum) | 20 |

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 lying 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/m² 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 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-, and
- (v) Carrying out the required tests for quality control.

It.:- Providing & Laying compacted W.B.M. 100 mm thick of machine crushed B.T. metal of size 40 mm to 63mm with using 25 % stone screenings as filler and binding material 0.08 Cum / 10 Smt including spreading, watering & consolidation by vibratory roller etc. complete.

For This item Specifications of It. No. 404 from M.O.R.T. & H. Specifications for Road and Bridge Works shall be followed as below.

404.1 Scope: 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 it 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 bituminous surface and water bound macadam.

404.2 Materials:-

404.2.1 Coarse aggregates: Coarse aggregates shall be either crushed or broken stone of BT type only. 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 percent, the soundness test shall be carried out on the material delivered to site as per IS: 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 materials.

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: 5640** | 40 percent (Max) 30 percent (Max) |
| 2. | Combined Flakiness and Elongation indices (Total) *** | IS: 2386 (PART-I) | 30 percent (Max) |

* Aggregate may satisfy requirements of either of the two tests.

** Aggregates like brick metal, kankar, literate 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 M3 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 Grading given in Table 400-7 as specified, provided; however, the use of Grading No.1 shall be restricted to sub-base course only.

TABLE 400-7. GRADING REQUIREMENTS OF COARSE AGGREGATES

| Grading No. | Size Range | IS sieve Designation | Percent by Weight Passing. |
|-------------|----------------|----------------------|----------------------------|
| 1. | 90mm to 45 mm | 125mm | 100 |
| | | 90mm | 90-100 |
| | | 63mm | 25-60 |
| | | 45mm | 0-15 |
| | | 22.4mm | 0-5 |
| 2. | 63mm To 45mm | 90mm | 100 |
| | | 63mm | 90-100 |
| | | 53mm | 25-75 |
| | | 45mm | 0-15 |
| | | 22.4mm | 0-5 |
| 3. | 53mm To 22.4mm | 63mm | 100 |
| | | 53mm | 95-100 |
| | | 45mm | 65-90 |
| | | 22.4mm | 0-10 |
| | | 11.2mm | 0-5 |

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 Murrum 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 m² 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

| Grading Classification | Size of Screenings | Is Sieve Designation | Per cent by weight passing the IS Sieve |
|------------------------|--------------------|----------------------|---|
| A | 13.2 mm | 13.2 mm | 100 |
| | | 11.2 mm | 95 – 100 |
| | | 5.6 mm | 15 – 35 |
| | | 180 Micron | 0 – 15 |
| 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 10M² AREA

| Classification | Size Range | Compacted thickness | Loose Qty. | Screenings | |
|----------------|------------|---------------------|------------|-----------------|---|
| | | | | Stone Screening | Crushable Type such as Moorum or Gravel |

| | | | | Grading Classification & Size | For. WBM Sub-base / base course (Loose quantity) | Grading Classification & Size | Loose Qty. |
|-----------|---------------------|--------|--------------------------------|--|---|--|--------------------------------|
| Grading 1 | 90 mm to 45 mm | 100 mm | 1.21 to 1.43 m ³ | Type A 13.2 mm | 0.27 to 0.30 m ³ | Not uniform | 0.30 to 0.32 m ³ |
| Grading 2 | 63 mm to 45 mm | 75 mm | 0.91 to 1.07 m ³ | Type A 13.2 mm | 0.12 to 0.15 m ³ | Not uniform | 0.22 to 0.24 m ³ |
| Grading 2 | 63 mm to 45 mm | 75 mm | 0.91 to 1.07 m ³ | Type B 11.2 mm | 0.20 to 0.22 m ³ | Not uniform | 0.22 to 0.24 m ³ |
| Grading 3 | 53 mm to 22.4 mm | 75 mm | 0.91 to 1.07 m ³ | Type B 11.2 mm | 0.18 to 0.21 m ³ | Not uniform | 0.22 to 0.24 m ³ |

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 m³/10 m² and 0.08-0.10 m³/10 m² 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 swatter. Any sub-base/base/surface irregularities, where predominant, shall be made good by providing appropriate type of profile corrective course (leveling course) to Clause 501 of these Specifications.

As far as possible, laying water bound macadam course over an existing thick bituminous 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 bituminous 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 bituminous surface by cutting 50 mm x 50 mm furrows at an angle of 45 degrees to the center 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 bituminous 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 min 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 plated across the road about 6m apart, in such quantities that the thickness of each compacted layer is not more than 150mm. Wherever possible, approved spread the aggregates uniformly so as to minimize 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 rollers of 80 to 100 KN capacity 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 center. First the edge/ edges shall be compacted with roller running forward and backward. The roller shall then move inward parallel to the center line of the road, in successive passes uniformly lapping preceding tracks by at least one half widths.

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 aggregate 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 cause 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 screening 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 course as per Clause 407.4.1.

404.3.5 Application of Screenings: After the coarse aggregate has been rolled, 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 screening shall be applied at a slow and uniform rate 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.

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-bounded and firmly set in its full depth and a grout has been formed of screening. 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 layer 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°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 recomputed. In no case shall decisions be filled up with screenings or binding materials.

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.

404.7 Rate: 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.

It.: - Filling in foundation and plinth with Murrum or selected soil in layers of 20cm thickness including watering ramming and consolidating etc. complete

The work shall be carried out as per this Tender Item No. 18 except that the work shall be carried out for filling in foundation and plinth using Murrum or selected soil.

For collection of Murrum relevant specifications of this Tender Item No. 100 shall be followed.

The contract rate shall be for a unit of One Cmt. of completed item.

It.: Watering of earth work as directed

- 1.0** For spreading materials in layers and bringing the appropriate moisture content, the embankment materials shall be spread uniformly over the entire width of the embankment in layers not exceeding 250 mm in thickness. Successive layers of embankment shall not be placed until the layer under construction has been thoroughly compacted to the requirements set down hereunder:-

Moisture content of the materials shall be checked at the source of supply and if found less than the specified for compaction, the same, shall be made good either at the source or after spreading the soil in loose thickness for compaction. In the latter case, water shall be sprinkled directly from a hose line or from a truck mounted water tank, and watering shall not be permitted under any circumstances.

If the materials delivered to the road bed is too wet it shall be bedded, by evaporation and exposure to the sun, till the moisture content is brought down to acceptable standard for compaction. Should circumstances arise, where owing to wet weather, the moisture content cannot be reduced to the required level by the above procedure, work of compaction shall be suspended.

Moisture content of each layer of soil shall be checked in accordance with ISI 2720 (Part-11) and unless otherwise mentioned shall be so adjusted, making due allowance for evaporation losses, that at the time of the compaction it is in the range of 1 percent to 2 percent below the optimum moisture content determined in accordance with ISI (Part-VII). Highly expansive clays shall however be compacted at 2 to 4 percent above the optimum moisture content.

After adding the required amount of water, the soil shall be processed by means of harrows, rotary mixers or as otherwise approved until the layer is uniformly wet.

Clods or hard lumps of earth shall be broken to have maximum size of 150mm when being placed in the lower layers of the embankment and maximum size of 60 mm when being placed in the top 0.5 metre portion of the embankment below the sub grade.

Hauling equipment shall be dispersed uniformly over entire surface of the previously constructed layer to minimize cutting of uneven compaction.

Where the embankment is to be constructed on low area ground that will not support the weight of truck or other hauling equipment, the lower part of the fill should be constructed by dumping successive loads in a uniformly distributed layers of a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers.

It.:- Collecting carting and stacking coarse sand including filling boxes etc. complete.

- 1.0 The materials for the purpose shall be of approved quality. Any materials which are found inferior shall be rejected and the contractor shall remove such rejected materials from the site at his own cost. The material shall be approved by the Executive Engineer or his authorized agent.
- 2.0 River or Nala or Sea sand required for the work shall be clear, sound, properly, graded, free from organic materials silt clay etc. and shall be got approved by the Engineer-in-charge. The sand shall be obtained and brought from the source approved by Engineer-in-charge. The sand shall be well graded. The payment shall be made on Cubic Metre basis.
- 3.0 Stacking shall be done by filling in the standard steel boxes of 2 m X 1.5 X 0.5 m size which shall be supplied by the Department if available on rent. Otherwise contractor shall make his own arrangement. No deduction for voids shall be made from the grade measurements. Where any doubt exists as to whether the quantity of stacks of Murrum in an hectometer is not confirming with the cubic content of the standard Pharms (2 X 1.5 X 0.5 M) the same shall be got corrected by the contractor if so ordered by the Engineer-in-charge for which no extra payment shall be claimed by the contractor. If the quantity of Murrum in any stack in a particular hectometer is found to be less than the standard measurements viz., 1.5 cmt the entire collection in the hectometer shall be paid on the basis of the quantity so found. Regular stacks shall be done by the Contractor on a fairly level ground. Stacking of the Murrum shall be done in a manner as directed by the Engineer-in-charge.
- 4.0 For road work completed stacking of Murrum as per requirement shall be carried out 2 Km. length before spreading. The collection shall always, be commenced at one end of the Km. and be carried continuously toward the other end unless the Engineer-in-charge shall direct otherwise.
- 5.0 The payment shall be made on cubic metre basis without deduction for voids. The contractor shall maintain all stacks in regular and proper size till the whole materials are collected, measured and finally accepted by the

Department. The spreading of materials shall not be allowed till the materials are fully stacked and completed kilometer wise.

- 6.0 The rate includes cost of collection, conveyance to the site with all ahead and lift and filling the boxes including all labour, tools, equipment and other incidental expenses.

The sand to be used as crust shall be as per C.B.R. Report.

The measurements shall be taken on cubic metre basis.

It.: - 99 Collecting carting and stacking B.T., M.C. Metal 20mm To 50mm including filling boxes etc. complete.

- 1.0 The field of M.C. metal shall be of approved quarry as shown on the quarry chart as well as approved by the Executive Engineer prior to collection.
- 2.0 The M.C. metal shall be hard, tough, sound, durable, black trap field metal of close texture, free from decay and weathering. Each piece of the stone shall be angular and roughly cubical in shape and round elongated or flaky material shall be rejected. No round or oblong pebbles or angular chips larger or smaller than specified size be allowed.
- 3.0 All unsound, weathered or disintegrated stone obtained from the upper surface layer of the quarry or other layer of boulders shall be rejected. The physical requirement for standard size metal shall conform to the test results indicated in Para 3 of item 4
- 4.0 M.C. metal shall be as nearly uniform in size as possible and shall conform to following minimum requirements of passing through the rings:

| Sieve Size | Percentage passing through |
|------------|----------------------------|
| 63 mm | 100 |
| 50 mm | 95 – 100 |
| 40 mm | 35 – 70 |
| 20 mm | 0 – 10 |

- 5.0 Wherever and doubt exists as to whether the above requirements are satisfied while or part, the collection of M.C. metal shall be got screened by the contractor if so ordered by the Executive Engineer and for which no extra payments shall be claimed by the contractor.
- 6.0 Any collection which does not fully satisfy the above requirements is liable to be rejected altogether.
- 7.0 Stacking shall be done by filling in the standard steel pharas of 2.00 X 1.50 X 0.50 metre and no deduction of voids shall be claimed by the contractor.
- 8.0 Regular stacks shall be done by the contractors on a fairly level ground. All the stacks shall be marked by white wash immediate on being measured and recorded by the Engineer-in-charge.
- 9.0 The rate includes blasting the rock, if any, breaking the metal, stacking, measuring in pharas etc. complete.

It. : - Collecting carting and stacking Murrum including filling boxes etc. complete.

- 1.0 Materials for the purpose shall be of approved quality. Any material which is found inferior shall be rejected and the contractor shall remove such rejected materials from the site at his own cost. The Materials shall be collected from quarries approved by the Executive Engineer. The materials shall be granular and gritty.
- 2.0 The materials shall be got approved by the Executive Engineer prior to collection on site. It shall be free from all rubbish, dust and any organic materials as well as clods of bank cotton soils. Materials shall not be allowed to be collected from within the road boundary. materials to be used as crust and for side shoulders shall be as per C.B.R. report and that to be used as blindage in W.B.M. road construction shall have P.I. value of less than 6 as

determined in accordance with IS 2720 (Part-V). The materials to be used should be got tested prior to use in road construction. Testing shall be borne by the contractor.

- 3.0 River or Nala or Sea sand required for the work shall be clear, sound, properly, graded, free from organic materials silt clay etc. and shall be got approved by the Engineer-in-charge. The sand shall be obtained and brought from the source approved by Engineer-in-charge. The sand shall be well graded. The payment shall be made on Cubic Metre basis.
- 4.0 Stacking shall be done by filling in the standard steel boxes of 2 m X 1.5 X 0.5 m size which shall be supplied by the Department if available on rent. Otherwise contractor shall make his own arrangement. No deduction for voids shall be made from the grade measurements. Where any doubt exists as to whether the quantity of stacks of Murrum in an hectometer is not confirming with the cubic content of the standard Pharms (2 X 1.5 X 0.5 M) the same shall be got corrected by the contractor if so ordered by the Engineer-in-charge for which no extra payment shall be claimed by the contractor. If the quantity of Murrum in any stack in a particular hectometer is found to be less than the standard measurements viz., 1.5 cmt. the entire collection in the hectometer shall be paid on the basis of the quantity so found. Regular stacks shall be done by the Contractor on a fairly level ground. Stacking of the Murrum shall be done in a manner as directed by the Engineer-in-charge.
- 5.0 For road work completed stacking of Murrum as per requirement shall be carried out 2 Km. length before spreading. The collection shall always, be commenced at one end of the Km. and be carried continuously toward the other end unless the Engineer-in-charge shall direct otherwise.
- 6.0 The payment shall be made on cubic metre basis without deduction for voids. The contractor shall maintain all stacks in regular and proper size till the whole materials are collected, measured and finally accepted by the Department. The spreading of materials shall not be allowed till the materials are fully stacked and completed kilometer wise.
- 7.0 The rate includes cost of collection, conveyance to the site with all ahead and lift and filling the boxes including all labour, tools, equipment and other incidental expenses.
- 8.0 The rate quoted is inclusive of all such tools, duties, fees, royalties, tax etc.

It.- Spreading the stone aggregates for soiling and W.B.M. including filling the interstices forming the surface to required camber and gradient. (excluding Spreading of blindage).

- 1.0 Metal shall not be spread without permission of the Engineer-in-charge. Metal should be spread under careful supervision by trained coolies. Contractor shall see the uniform spreading as per collection of metal is done. The contractor shall spread the metal fully from the stacks without keeping any balance unless directed by the Engineer-in-charge to keep some stack in balance for making good unevenness or depressions during rolling works. To ensure that the material is spread to the required thickness, the road surface shall be marked out in to length over which the contents of heaps are to be spread. The bounds of earth or Murrum (one on either side) shall be laid with a distance between them equal to the width of road to be medaled and shall be enough to prevent the loose metal from spreading during consolidation as well as to retain water used for consolidation. Payment for bunds will be made in the respective item.
- 2.0 The metal (including old metal) shall be screened and rubbish, dust, grass shall be removed and spread evenly on the prepared surface in grade and camber by using board etc. so as ensure that the surface is true to camber and grade. At least two cambers by using camber boards shall be in use at site. The surface shall be checked at every 50 ft. by means of template while the correctness of the camber in between shall be tested by string corrected as required. Between the straight lengths and the curves in camber of road to super elevation shall be made very gradually as may be directed by the Engineer-in-charge.
- 3.0 The spreading of metal shall precede only 200 mt. (max.) advance of the rolling operations. The collection and spreading of the metal shall be carried out in one and the same kilometer.
- 4.0 At the time of rolling all surface irregularities, hollows, depressions, humps etc. shall be straight. The spreading of metal the above operations with all lead and lift except consolidation.

It.: - 103 Rolling and consolidating water bound macadam (except literate and kankar) including watering not exceeding 150mm thickness (Main layer including binding materials) including filling in depression which occurs during the process. (B) With power roller exceeding 8 tonne and not exceeding 12 tonne.

1. Immediately following the spreading of the coarse aggregates rolling shall be with three wheeled power rollers of 8 to 10 tonne capacity or tandem roller or equivalent vibratory roller. The weight of the roller shall depend upon the types of the aggregate and be indicated by Engineer-in-charge.
2. Except on super elevated portions where the rolling shall proceed from inner edge to 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 inwards parallel to centre line of the road, in successive passes uniformly lapping proceeding by at least one half the width.
3. Rolling shall continue until the aggregate is thoroughly keyed and the creeping of the aggregate ahead of the roller is no longer, visible. 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.
4. The rolled surface shall be checked transversely and longitudinal with templates and any irregularities corrected by loosening the surface, adding or removing necessary amounts of aggregate and re rolling until; the entire surface conforms to desired camber and grade. In no case shall the use of screening be permitted to make up depression.
5. The blindage material where it is required to be used 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 shall be 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 moving roller.
6. After the final compaction of water bound macadam course the road shall be allowed to dry overnight. Next morning hungry spots shall be filled screenings of binding materials as directed, lightly sprinkled with water if necessary and rolled no traffic shall be, allowed on the road until macadam has set. The Engineer-in-charge shall have the discretion to stop hauling traffic from using the macadam has set. The Engineer-in-charge shall have the discretion damage to the surface.
7. Payment will be made on Smt. basis of the finished work and shall include cost of watering, rent of machinery cost fuel, wages of drivers and cleaners and Murrum bund etc.

Item-15 : Providing & laying controlled cement concrete M-250 & curing complete excluding the cost of reinforcement foundation & mass concrete

Cement concrete M25 mix with machine crushed stone aggregate 20 mm nominal size mechanically mixed and vibrated in foundation

1. Ordinary cement concrete of specified Grade shall be carried out in accordance with the following specification.

In case of ordinary concrete, mix is not required to be designed by preliminary tests and proportions of cement, fine aggregates and coarse aggregates are specified by volume as given in table below for different grades of concrete designated as ordinary M. 100, M. 150, M.200 and M.250.

2. In the designation of a concrete mix, letter "M" refers to the mix and the number the specified 28 days works cube compressive strength of that mix on 150 mm. cubes expressed in kg/cm².

3. The ordinary concrete mix shall generally be specified by volume. For cement which normally comes in bags and is used by weight, volume shall be worked out taking 50 kg. of cement as 0.035 cubic meter in volume. While measuring aggregate by volume, shaking, ramming or hammering shall not be done. Proportioning of sand shall be as per its dry volume. In case it is dump, allowance for "bulking" shall be made as per IS : 2386 (Part-III).

4. Ingredients required for ordinary concrete containing one 50 Kg. bag of cement of different proportions of mix shall be as given in Table below.

| Grade of Concrete | Mix By Volume | Total Quantity of dry aggregates by volume 50 Kg. of cement, to be taken as sum of individual volumes of fine and coarse aggregates max | Proportion of fine aggregate to coarse aggregate | Quantity of water per 50 kg. of cement max. |
|-------------------------------|---------------|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| (1 Cubic meter = 1000 liters) | | | | |
| Ordinary | Liters | | General 1:2 for fine aggregate to coarse aggregate by volume but subject to a | Liters |
| M.100 | 1:3:6 | 300 | | 34 |
| M.150 | 1:2:4 | 220 | | 32 |
| M.200 | 1:1.1/2 | 160 | | 30 |

| | | | |
|-------|-------|-----|----------------|
| | :3 | | upper limit of |
| M.250 | 1:1:2 | 100 | 1:1. ½ & a 27 |
| | | | lower limit of |
| | | | 1:3 |

NOTE-1 The proportions of the aggregates shall be adjusted from upper limit to lower limit progressively as the grading of the fine aggregates becomes finer & the maximum size of coarse aggregate becomes larger.

Example- For an average grading of fine aggregate (that is Zone II of IS : 383-1963) the proportions shall be 1: 11/2, 1:2 and 1:3 for maximum size of aggregates 10 mm, 20 mm. and 40 mm. respectively (after carrying out sieve analysis).

Note-2A mix leaner than M.100 (1:3:6) may be used for non- structural parts, if provided in the contract. In such case grading of aggregates shall be by volume. Other requirements for mixing, placing & curing shall be the same.

Following shall be the maximum nominal size of coarse aggregate for the different items of work:

| Sr. No | Item of Construction | Maximum nominal size of Coarse aggregate |
|--------|---|---|
| (i) | R.C.C. well curb R.C.C. well staining and R.C.C. Piles | 40 mm |
| (ii) | R.C.C. well staining | 63 mm |
| (iii) | Well cap or pile cap; solid type piers, abutment and wing-walls, and their pier caps | 40 mm |
| (iv) | R.C.C. works in cross girders deck slab, wearing coats, kerb, light posts, blast walls, approach slab etc. and hollow type piers, abutments, wing-walls and their pier caps | 20 mm |
| (v) | R.C.C. bearings. | 20 mm. |
| (vi) | For any other item of construction not covered by items (i) to (v) | As specified on the drawing or as desired by the Engineer-In-charge in case it is not specified on drawing. |

For heavily reinforced concrete members as in the case of ribs of main beams nominal maximum size of aggregate shall usually be restricted to 5 mm. less than the minimum lateral clear distance between the main bars or 5 mm. less than the minimum cover to the reinforcement, whichever is the smaller.

6. Fine aggregate shall be clean, hard, coarse sand. It shall be free from dust and such other substances. The sand be got approved by the Engineer-in-charge.
7. All materials shall be stored as to prevent their deterioration or intrusion of their quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-charge shall not be used in the works.
8. Cement shall be stored above the ground level in perfectly dry and water tight sheds. Wherever bulk storage containers are used, their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months. The aggregate shall be stored in such a way as to prevent admixture of foreign materials. Different size of fine or coarse aggregate shall be stored in separate stock-piles sufficiently away from the each other to prevent intermixing the materials.
9. The water for mixing shall be potable water to satisfaction of the Engineer-in-charge. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the job.
10. For all work concrete shall be mixed in a mechanical mixer which along with other accessories shall be kept in first class working condition and so maintained throughout the construction. Mixing shall be continued till materials are uniformly distributed and uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate show complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.
11. When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons. It shall be done en a smooth watertight platform large enough to allow efficient turning over of the ingredients of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material shall get mixed with concrete nor does the mixing water flow out. Cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregate, which shall also be spread in a layer of uniform thickness on the mixing platform. Dry coarse and fine aggregate and cement shall then be mixed thoroughly by turning over to get a mixture of uniform colour. Enough water shall then be added gradually through a rose can and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 per cent above that specified.
12. Mixers which have been-out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to be the Engineer-in-charge, the first batch of concrete from the mixer shall contain only two thirds of normal quantity of coarse aggregate. Mixing plant shall be thoroughly cleaned before changing from one type of cement to another.

13. The method of transporting and placing concrete shall be approved by the Engineering-in-charge. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes places. All form work and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer-in-charge has been obtained.

14. If concreting is not started within 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-charge. Concreting being given, it shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried in properly design agitators, operating continuously, when this time shall be within 2 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to be the Engineer-in-charge, concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 meter when internal vibrators are used and not exceeding 0.30 meter in all other cases.

15. Unless otherwise agreed to by the Engineer-in-charge concrete shall not be dropped into place from a height exceeding 2 meters. When trucking or chutes are used they shall be kept clean and used in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept, clean, thoroughly wetted and covered with a 13 mm. thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of any particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150 mm. in thickness, and shall be well rammed against old work particular attention being given to corners and close spots.

16. All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting under water, where vibrators can not be used. Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event of break downs.

17. Immediately after compaction, concrete shall be protected against harmful effects of weather, including rain, running water, shocks, vibration, traffic, rapid temperature

changes, frost and driving out process. It shall be covered with wet sacking, hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set, and shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonary work over the foundation concrete may be started after 48 hours of its laying but the curing of concrete shall be continued for a minimum period of 14 days.

18. Form work shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Form work shall however be divided into following two distinct categories:-

- (1) Shuttering i.e., form work required for forming the concrete.
- (2) Scaffolding i.e., form-work required for supporting shuttering.

Forms for shuttering shall be constructed only in metal suitably lined. Forms for scaffolding shall be constructed of metal or timber. Both shuttering and scaffolding shall be of substantial-rigid construction and shuttering shall be true to shape and dimensions shown on the drawings. All bolts and rivets shall be counter-sunk and well ground to provide a smooth, plane surface.

19. Forms shall be mortar-tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports, They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribe lines occurring during and after placing the concrete. Screw jacks or hard wood wedges where required shall be provided to make up any settlement in the formwork either before or during the placing of concrete. Suitable camber shall be provided in horizontal members of structure, specially in long spans to counteract the effects of any fixed as to provide for such camber. Forms shall be so constructed as to be removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections. Unless otherwise specified or directed, chambers or fillets of sizes 25 mm x 25 mm shall be provided at all angles of formwork to avoid sharp corners.

20. The inside surfaces of shuttering shall, except in the case of permanent form work or where otherwise agreed to by the Engineer-in- charge, be coated with an approved material to prevent adhesion of concrete to the form work. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not be allowed to come into contact with any reinforcement or pre-stressing tendons and anchorages. Different release agents shall not be used in form work for concrete which will be visible in the finished works.

21. Special measures shall be taken to ensure that the form work does not hinder the shrinkage of concrete because without these cracking could occur before the form work is removed. Where ever applicable arrangements must be made to ensure that the form work does not restrain the shortening and hogging of the beams or slabs during

tensioning of the tendon's. The form work should take due account of the calculated amount of positive or negative camber so as to ensure the correct final shape of the structures having regard to the deformation of a false work, scaffolding or propping and the instantaneous or deferred deformation due to various causes affecting pre-stressed structures. Where there are re-entrant angles in the concrete sections the form work should be removed, at those sections as soon as possible after the concrete has set in order to avoid cracking due to shrinkage of concrete. Form work shall be tight enough to prevent any appreciable loss of cement during vibrations, suitable tolerances should be provided in the form work. Immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the Engineer-in-charge due notice before pouring any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength alignment and general fitness, but such inspection shall not relieve the contractor of his responsibility for safety of men, machinery, materials and for results obtained.

22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any formwork. While fixing the time for removal of formwork, due consideration shall be given to local conditions, character of the structure, the weather and other conditions that influence the setting of concrete and of the materials used in the mix. Where field operations are controlled by strength tests of concrete, the removal of the load-supporting or soffit forms may commence when concrete has attained strength equal to at least twice the stress to which the concrete will be subjected at the time of striking props including the effect of any further addition of loads. When field operations are not controlled by strength tests of concrete the vertical forms of beams, columns and walls may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 days respectively. All formwork shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted, they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to reuse the formwork, it shall be cleaned and made good to the satisfaction, of the Engineer-in-charge.

23. Immediately after the removal of forms, all exposed bars or bolts passing through the Cement concrete member and used for shuttering or any other purpose shall be cut inside the cement concrete member to a depth of at least 25 mm. below the surface of the concrete and the resulting holes be filled by cement mortar. All fins caused by form joints, all cavities produced by the removal of form ties and all other holes and depressions, honey comb spots, broken edges or corners and other defects, shall be

thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry as consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces which have been pointed shall be kept moist for a period of twenty four hours. If rock pockets/honeycombs, in the opinion of the Engineer-in-charge are of such an extent or character as to affect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of the structure affected.

24. In the case of reinforced concrete work workability shall be such that the concrete surrounds and properly grips all reinforcement. The degree of consistency, which shall depend upon the nature of work and methods of vibration of concrete shall be determined by regular slump tests. Following slump shall be adopted for different types of works.

| Type of Work | Slumps | |
|--|--------------------------|------------------------------|
| | Where vibrators are used | Where vibrators are not used |
| 1 Mass concrete in RCC foundations, footings and retaining walls | 10 mm to 25 mm | 80 mm |
| 2 Beams, slabs and columns simply reinforced. | 25mm to 40 mm | 100 to 120 mm |
| 3 Thin R.C.C. section or section with congested steel | 40 mm to 50 mm 50 mm | 125 mm to 150 mm 150 mm |

25. Works strength tests shall be made in accordance with IS : 516. Each test shall be conducted on ten specimens, five of which shall be tested at seven days and the remaining five at 28 days. The samples of concrete shall be taken on each day of concreting and cubes shall be made at the rate of one for every 5 cubic meter of concrete or a part thereof. However, if concreting done in a day is less than 15 cubic meter, the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer-in-charge. Similar works tests shall be carried out whenever the quality and grading of materials is changed irrespective of the quantity of concrete poured. The number of specimens may be suitably increased as deemed necessary by the Engineer-in-charge when procedure of tests given above reveal a poor quality of concrete and in other special cases.

26. The average strength of the group of cubes cast for each day shall not be less than the specified works cube-strength. 20 per cent of the cubes cast for each day may

have values less than the specified strength, provided the lowest value is not less than 85 per cent of the specifies strength.

27 R.C.C. work shall have exposed concrete surface. Centering design and its erection shall approved by he Engineer-in-charge. One carpenter with helper will invariably be kept present throughout the period of concreting. Movement of labour and other persons shall be totally prohibited over reinforcement laid in position. For access to different parts, suitable mobile platforms shall provided so that steel reinforcement in position is not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber, kapchi or metal pieces shall not be used for this purpose. Concreting of important structural members shall always be done in the presence and under the supervision of departmental person not below the rank of Asstt. Engineer/ Addi. Asstt. Engineer Overseer or as instructed by the Engineer-in-charge. After removal of form work checks that concrete produced is of good quality plastering shall not be allowed to the expressed faces of concrete.

28. In reinforced concrete the volume occupied by reinforcement shall not be deducted. The slab shall be measured as running continuously through and the beam as the portion below the slab.

29. All necessary labour, materials, equipment, etc., for sampling, preparing test cubes, curing etc., shall be provided by the Contractor. Testing of the materials and concrete may be arranged by the Engineer-in-charge in an approved laboratory at the cost of the contractor.

30. The payment will be made on cmt. basis of the finished work.

31. The unit rate for concrete shall include the cost of all materials, labour, tools and plan required for mixing, placing in position, vibrating and compacting finishing as-per directions of the Engineer-in-charge, curing and all other incidental expenses for producing concrete of specified strength to complete the structure or its components as show on the drawings and according to these specifications. The rate shall also include the cost of making/fixing and removing of all centers and forms required for the work.