

## GENERAL TECHNICAL SPECIFICATION

### 1.0 GENERAL :

All Measurements shall be made in the metric system. Different items of work shall be measured in accordance with the procedures set forth in the relevant sections read in conjunction with General Conditions of Contract. The same shall not however apply in the case of lump-sum items. All measurements and computations unless otherwise indicated, shall be carried nearest to the following limits :

- |  |              |
|--|--------------|
| 1. Length and breadth  | 10 mm        |
| 2. height, depth or thickness of earthwork, sub-base, bases. surfacing, and structural members | 5 mm         |
| 3. Areas   | 0.01 Sq. Mt  |
| 4. Cubic contents  | 0.01 Cu. Mt. |

in recording dimensions of work the sequence of length, width and height or depth or thickness shall be followed.

### 2.0 MEASUREMENT OF LEAD FOR MATERIALS

Where lead is specified in the contract for construction materials. the same shall be measured as described hereunder.

Lead shall be measured over the shortest practicable route and not the one actually taken and the decision of the Engineer-in-charge in this regard shall be taken as final. Distance upto and including 100 meters shall be measured in units of 50 metres, exceeding 100 metres but not exceeding 1 KM, in units of 100 metres, and exceeding 1 Km, in units of 500 metres. The half and greater than half of the units shall be reckoned as one and less than half of the units ignored. In this regard, the source of the material shall be divided into suitable blocks and for each block the distance from the centre of the block to the centre of placing pertaining to that block shall be taken as the lead distance.

### 3.0 SURFACE REGULARITY OF SUBGRADE & PAVEMENT COURSES :

The surface regularity of completed sub-base courses and wearing surfaces in the longitudinal and transverse directions shall be within the tolerances indicated in table below. The longitudinal profile shall be checked with a 3 metre long straight edge, at the middle of each traffic lane along a line parallel to the centre line of the road. The transverse profile shall be checked with a set for three camber boards at intervals of 10 metres.

#### Permitted tolerance of surface regularity for pavement courses

Sr.	Type of Construction	Longitudinal Profile with 3 meter straight edge				Cross Profile	
		Maximum permissible undulation in mm	Maximum number of undulation permitted in any 300 m length exceeding in mm				Maximum permissible variation from specified profile camber template in mm
1	Earth sub-grade	36	30	--	--	--	15
2	Granular lime / Cement Stabilized Sub-base	23	--	30	--	--	12
3	Water Bound Macadam with nominal size metal {20 – 50 mm}	18	--	--	30	--	8
4	Semi Dense carpet @@	18	--	--	--	20	6

Notes :

- @ @ These are for machine laid surfaces. If laid manually, due to unavoidable reason, tolerance upto 50 percent above these values in this column may be permitted. However, this relaxation does not apply to the values of maximum undulation for longitudinal and cross profiles mentioned in columns 3 and 8

in the TABLE.

2 Surface evenness requirements in respect of both the longitudinal and cross profiles should be simultaneously satisfied.

3. Rectification :Where the surface irregularity of sub-grade and the various pavement courses fall outside the specified tolerances, the contractor shall be liable to rectify these in the manner described below and to the satisfaction of the Engineer-in-charge at his own cost.

(i) Sub-grade : Where the surface is high, it shall be trimmed and suitably compacted. Where the same is low, the deficiency shall be corrected by adding fresh material. The degree of compaction and the type of material to be used shall conform to the specified requirements.

(ii) Granular 1 Sub- base : Same as at (i) above except that the degree of compaction and the type of material to be used shall conform to the specified requirements.

(iii) Lime / Cement stabilized soil sub-base : For Lime/ Cement treated materials where the surface is high, the same shall be suitably trimmed while taking care that the material below is not disturbed due to this operation. However, where the surface is low, the same shall be corrected as described herein below.

For cement treated material, when the time elapsed between detection of irregularity and the time of mixing of the material, is less than 2 hours, the surface shall be scarified to a depth of 50 mm, supplemented with freshly mixed material as necessary and recomposed to the relevant specification. When this time is more than 2 hours, the full depth of the layer shall be removed from the pavement and replaced with fresh material, to specification. In either case, the area treated shall not be less than 5 metres long by 2 metres wide. This shall also apply to lime treated material except that the time criterion shall be 3 hours instead of 2 hours.

(iv) Water Bound Macadam Base : Where the surface is high or low, the top 75 mm shall be scarified, reshaped with added material as necessary and re-compacted. The area treated at a place shall not be less than 5 metres long and 2 metres wide.

(V) Bituminous Construction : For bituminous constructions, other than wearing course, where the surface is low, the deficiency shall be corrected by adding fresh material and re-compaction to specifications. Where this surface is high, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications. For wearing course, where the surface is high or low, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications. In all cases where the removal and replacement of a bituminous layer is involved, the area treated shall not be less than 5 metres long and not less than 1 lane wide.

#### **4. QUALITY CONTROL TEST DURING CONSTRUCTION :**

The materials supplied and the works carried out by the Contractor shall conform to the enclosed relevant specifications. For ensuring the requisite quality of construction, the materials and works shall be subjected to quality control test as described hereinafter, by the Engineer-in-charge. The testing frequencies set forth are the desirable minimum and the Engineer-in-charge shall have the full authority to carry out test as frequently as he may deem necessary to satisfy that the materials at work comply with the appropriate specifications. Test procedures for the various quality control tests are indicated in the respective sections of the specification or for certain tests within this section. Where no specific testing procedure is mentioned, the test shall be carried out as per prevalent accepted engineering practice to the directions of the Engineer-in-charge.

#### **5. TESTS ON EARTH WORK OF EMBANKMENT CONSTRUCTION :**

### 5.1 Borrow Material :

<b>a</b>	Sand Content (IS : 2720 Part IV)	Two test per 8000 Cubic metres of soil
<b>b</b>	Plasticity Test (IS : 2720 Part-V)	Each type to be tested. Two tests per 8000 Cubic Metres of soil.
<b>c</b>	Density test (IS : 2720 Part VII)	Each soil type to be tested. Two tests per 8000 Cubic Metres of soil.
<b>d</b>	Moisture Content Test (IS :2720 Part -11)	One test for every 250 Cubic Metres of soil.

### 5.2 Compaction Control :

Control shall be exercised by taking at least one measurement of density for each 1000 square metres of compacted area, or closer as required to yield the minimum number of test results for evaluating day's work on statistical basis. The determination of density shall be accordance with IS : 2720 (Part XXVIII). Test locations shall be chosen only through random sampling techniques. Control shall not be based on the result of any one test but on the mean value of a set of 5-10 density determinations. The number of tests in one set of measurements shall be 5 as long as it is felt that sufficient control over borrow material and the method of compactions is being exercised. If considerable variations are observed between individual density results, the minimum number of tests in one set of measurement shall be increase to 10.. The acceptance of work shall be subject to the condition that the mean dry density equals or exceeds the specified density and the standard deviation for any set of results is below 0.08 gm/cc. However for earthwork in shoulders and in top 500 mm portion of the embankment below the sugared, at least one density measurement shall be taken for every 500 square meters of the compacted area provided further that the number of the tests in each set of measurement shall be at least 10. In other respects, the control shall be similar to that described earlier.

### 6. Following materials shall conform to the Indian Standards shown against them :

- (1) Cement IS : 269
- (2) Sand for masonry IS 2116
- (3) Sand for Concrete IS 383
- (4) Coarse aggregates IS 383
- (5) Mild Steel IS 432
- (6) High yield strength deformed bars
  - (a) Hot Rolled IS : 1139
  - (b) Cold Twisted IS : 1786

### 7. BARREL THICKNESS OF PIPES OF DIFFERENT CLASS SHALL BE AS UNDER

Sr. No.	internal Diameter of pipe in mm	Barrel thickness (in mm)		
		NP <sub>1</sub>	NP <sub>2</sub>	NP <sub>3</sub>
1	80	25	25	--
2	100	25	25	--
3	150	25	25	--
4	250	25	25	--
5	30	30	30	--
6	350	32	32	75
7	400	32	32	75
8	450	35	35	75
9	500	--	35	75

Sr. No.	internal Diameter of pipe in mm	Barrel thickness (in mm)		
		NP <sub>1</sub>	NP <sub>2</sub>	NP <sub>3</sub>
10	600	--	40	80
11	700	--	40	80
12	800	--	45	90
13	900	--	50	100
14	1000	--	55	100
15	1100	--	60	115
16	1200	--	65	115

### SPECIFICATION FOR 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-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-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 shall be as under:

<b>I. S. Sieve Designation</b>	<b>Percentage by weight passing sieve</b>	<b>I. S. Sieve Designation</b>	<b>Percentage by weight passing sieve</b>
--------------------------------	---	--------------------------------	---

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-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	10 mm		40 mm	20 mm	10 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-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. -t56- 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 he 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 he 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.

## **ITEM WISE SPECIFICATIONS**

### **Item No. 1**

**Clearing and Grubbing road land including uprooting rank, vegetation, grass bushes, shrubs, saplings and trees girth up to 250 mm removal of stumps of trees cut earlier and disposal of unseviceable materials and stacking of serviceable materials to be use (A) By mechanical means in area of light jungle**

1. Before starting the work the site shown on plans shall be cleared of all obstructions loose stones and materials, rubbish of all kinds as well as all trees and brush wooden except those marked for prevention, the roots being entirely grubbed up. No trees to be cut down before obtaining permission from Engineer in charge.
2. The stuff obtained from clearance shall be stacked in such a place and in such a manner as ordered by the Engineer in charge and the ground shall be left in a perfectly clean condition.
3. In jungle cleaning, all trees, not specially marked for preventions, bamboos, jungle wood and brush wood shall be cut down their roots rubbed up. All wood and materials available as directed by the Engineer in charge.
4. All holes or hollows, where originally or products by digging up roots shall be carefully filled up with earth well rammed and leveled up neatly as directed.
5. After completion of the work, but before its acceptance, the site shall be cleared of all scaffolding, surplus materials and rubbish etc. as per contract. No extra payment shall be made for site clearance.

**The rate for this item of work shall be for the complete job and shall be paid at the hector rate tendered for the work on completion of the entire work.**

### **Item No - 2**

**Earthwork in cutting including preparing the slope and camber and stacking or utilising the cutting stuff in bank as directed upto 200 Meters from the end of cutting with all lead and lift.(ii) Hard Murrum..**

The land width required for the roadway , gutter side slopes and catch water gutters shall be cleared of all tree having a girth of 30 cms. And less , loose , stones, vegetation , bushes , stumps and all other objectionable materials. The roots of trees and stumps shall be removed to a depth of 30 cms below the grade formation and slopes and excavation filled up with excavated materials and compacted. All the materials cleared will be the property of Government. Useful materials shall be arranged in convenient stacks along the road boundary or as directed at places within 50 mts . Lead and handed over to the department in convenient sections .Unsuitable material shall be burnt or otherwise disposed off by the contractor at his own cost without causing any nuisance, inconvenience of damage to the work , property or people in the neighborhood . If the materials are to be disposed of outside the road land , necessary permission from the private land owners shall be taken by the contractor and royalty etc. If any paid by him without claiming compensations. 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 lines, curves slopes , grades and sections as shown on the plans or directed by the Engineer-in-charge. The contractor shall provide all labour and materials such as lime, strings , pegs , nails , bamboos , stones mortar , concrete etc. required for setting out alignment establishing bench marks and giving profiles . The contractor shall be responsible for maintaining the B. Ms. Profiles alignments and other stakes and marks as long as they are required for the work in the opinion of the Engineer. If the contractor defaults in this respect even after the direction by the Engineer within the specified time, they may be restored by the Engineer at the levels etc. If there is any disagreement the contractor shall inform of it in writing to the officer concerned with the specific reference to the sections before starting further work .Once the work has started , no cognizance of any complaint shall be taken Merely not signing of the book shall not be deemed as disagreement.

**3.** Profiles of the section including the road side gutters to be excavated shall be laid at suitable intervals of 10 m to 50 m. or other intervals as directed by Engineer to conform to the curved or straight alignment, sections, grades and side slopes. The line out shall be clearly marked and profiles of embankments where excavated materials are to be used shall be set up with the toe line marked on each side. The road way section shall first be excavated with vertical side for each lift and the sides slopes for the lift shall be excavated in steps. These steps shall be smoothened to the required slope when the excavation reaches the road formation. The contractor shall on no account excavate beyond the slopes or below the specified grade unless so directed by the Engineer in writing. If excavation is done below the specified level or outside the section, it shall not be paid for and the contractor shall be required to fill up at his own cost such extra excavation in the road portion with approved materials of the embankment grade in layers, watered and fully compacted to attain maximum density laid down for the embankment in its relevance item. The Engineer may require measurement ridges and dead man to be left at specified intervals or places and kept intact till ordered to be removed for the purpose of check measurements. The excavation shall be finished neatly, smoothly, and evenly to the correct lines, curves, grades, if loose shall be scarified, watered and compacted to the same density as the embankment. The section side slopes and catch water gutter shall be maintained by the contractor at his own cost in such a way that the formation and gutters will be drained by providing for necessary diversions etc, and not damaged due to obstruction of any drainage. Necessary passages shall be provided for leading way seepage, springs, surface flow or rainwater safely without damaging the work. If any damage occurs due to default of the contractor in this respect, he shall make good the damage at his own cost. If it is necessary in the execution of the work to interrupt existing surface drainage, irrigation channels, sewers or under drainage, temporary arrangements shall be provided till such time as is necessary. The contractor at his own cost shall make the existing works or work in hand caused as a result of his operations or negligence shall be made good by the contractor at his own cost. Road side gutters shall be excavated to the specified sections and shall be measured along with the main cutting in cubic meters.

**4.** If slides occur in the cutting they shall be removed as ordered by the Engineer. If finished slopes slide in to the roadways before the final acceptance of the work, such slides shall be removed by the contractor and shall be paid for at the contract rate for the class of excavation involved provided the slides are not due to any negligence of the contractor. The classification of the material in slides shall conform to its conditions at the time of removal and payment made accordingly regardless of its prior condition. Care shall be taken to see that excavation is arranged in a safe way so that there will be no risk to the workmen by slides, falling materials, boulders and collapsing sides etc.

**5.** If there is traffic nearby or if there are towns and villages in the neighborhood, barricades and or traffic signals shall be provided day and night for the duration of the work in such a way as to prevent accidents. Warning signals shall be displayed at 7 mt. from the danger point on both sides giving sufficient warning. If necessary signalers shall be stationed at each end to regulate traffic where it is heavy. Measures shall be taken to see that the excavation does not affect or damage adjoining structures or property. If there is damage to property, injury to workers, the members of the public, animals etc., due to the negligence of the contractor, he will be responsible and liable to all the consequences including compensation.

**6.** All the excavated materials shall be property of Government. When the useful excavated material is to be used in embankment within a lead of 200 metre and all lift, shall be directly deposited at the required location in specified layers. No handling or conveyance charges shall be paid if the materials is temporarily deposited elsewhere and subsequently conveyed to site of deposition. The sequence of operations at convenient places. Without interfering with the drainage in any way. If no Government land is available but the excavated useful stuff is to be stacked temporarily be for use under the same agreement, the contractor shall make his own arrangement for the stacking of this material not required for use on embankment or unsuitable materials may be used on his own to uniformly widen embankment to flatten slopes and to fill low places in the road land, if so permitted by the Engineer. Material not required for any use whatsoever may be disposed off by the contractor at his own cost in a manner approved by the Engineer. The excavated material shall not be deposited within 3 m from the top edge of slope or toe of the bank. The lead shall be measured from the junction point of cutting and embankment up to 200 mt. on either side.

**7.** If the contractor does not wish to utilize the quantity of cutting within the specified lead for any reason then he may do the embankment work with the earth from other sources ( except borrow pits in the length of the road where cutting stuff is to be utilized ) but in that case the full or part quantity on acceptable



quality stuff for which payment is made or to be made will be deducted from the net quantity of the earth work in the embankment arrived at within the chainage measured as above.

**8.** The Contract rate shall be a unit of one cubic metre for the start mentioned in the wording of the item of excavation acceptably completed limited to the dimensions shown on the plans or as directed by the Engineer. Excavation shall be measured in its original positions by taking cross sections before the work starts and after it is entirely completed. The quality shall be worked by the average end area method. When the classification of the strata changes, the contractor shall bring this to notice of the Engineer, who will then verify and if necessary take levels for the changed strata for purpose of measurement.

### **Item No. 3**

**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 50mt. Lead**

1. This work shall consist of excavation, removal and satisfactory disposal of all materials necessary for the construction of widening carriageway in accordance with requirements of these specifications and the lines, grades and cross sections shown in the drawings or as indicated by the Engineer.
2. After the site has been cleared the limits of excavation/ box cutting the road surface shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer.
3. Box cutting shall be carried out in conformity with the directions laid here in under and in a manner approved by the Engineer. The work shall be so done that the suitable materials available from box cutting/ excavation are satisfactorily utilized as directed.
4. The contractor shall not excavate outside the limits of box cutting. Subject to the permitted tolerances, any excess depth/ width excavated beyond the specified levels/ dimensions on the drawings shall be made good at the cost of the contractor with suitable material of characteristics similar to that removed and compacted as directed.
5. Cutting shall be done in proper grade & camber as shown on drawing or as directed. Care must be taken that all slopes are evenly and truly dressed. Cutting shall be done to the exact depth required and shall be as per formation level in proper grade and the camber. If extra depth of cutting is done due to negligence of contractor the same shall be refilled with approved quality of materials duly consolidated to the satisfaction of the Engineer-in-charge (without extra cost).
6. The stuff received from the cutting of existing crust shall be screened on site and stone aggregates shall be stacked at suitable place which shall be reused for modified sub base as directed by the Engineer in charge. The unsuitable materials shall be removed from the site and same shall be used for filling and correcting side slopes of bank and earthwork for embankment as directed by the Engineer in charge with lead up to 50 mtr..
7. The measurement of box cutting shall be taken on level basis & level shall be taken at 30 mt. interval. Volume shall be computed in cubic meters by average area method.
8. The payment shall be made on Cmt. basis.
9. The rate includes cost of all labour, machineries required, cost of carting and spreading the cutting stuff with all lead and lift and leveling the dumping ground/ embankment, rolling and consolidation of subgrade level etc. complete.

#### **Item No - 4**

**Earth work for embankment with selected soil C.B.R. not less than 6.0 including breaking clods, dressing, with all, lead and lift (incl. watering and consolidation) From borrow area with all lead & lift**

1. The land width on which the earth work is to be done shall be cleared off all the trees having girth of 30 cm and less, loose stones, vegetations, bushes, slumps and all other objectionable material shall be arranged in convenient stack along the road boundary or as directed at place within 50 meters lead and handed over to the department in convenient section. Unsuitable material 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 cleaning the site, the alignment of the road shall be properly set out true to line, curves, slopes, graded 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 benchmarks, profiles, alignments and other marks as long as they are required for the work in 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 contractor.

3. When existing embankment is to be widened, continuous horizontal benches, each at least 0.30 meter wide shall be cut into the existing slopes for insuring adequate bond with the fresh embankment material to be added. The material obtained from the cutting of benches can be utilized in the widening of the embankment. Where the width of widened portion, if insufficient to permit the use of rollers. Compaction shall be carried out with the help of tandem / sheep foot rollers, hand rollers, mechanical tampers or other approved plant. 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 the embankment shall be free from trees, slumps, roots, rubbish or any other objectionable materials. Only materials 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 the materials to be used in the construction of embankment shall be made after the soil surveys and investigations are carried out by the department. The embankment shall consist of earth available from road side borrow pits on either side with lead and all lifts and within land width in the manner specified in para 12 below. The road, if any required for the purpose haulage of earth by men, animals or vehicles will be constructed (if not existing) and maintained by the contractor at his own cost. The material satisfying the density requirements given in the table below shall be employed for embankment construction

<b>Type of Work</b>	<b>Laboratory Dry Density when tested as per IS 2720 {Part VII}</b>
Embankment upto 3 meter height	Not less than 1.44 gm/cc
Embankment exceeding 3 meter height or embankment of any height subject to long period of inundation.	Not less than 1.52 gm/cc
Top 0.50 meter of embankment below the subgrade level and shoulder {where earth shoulder are specified}	Not less than 1.65 gm/cc

Field density shall be percentage of laboratory density as recommended by Gujarat Engineering Research Institute.

5. Department will extend all necessary cooperation in helping contractor to get borrow area from nearby Government or Panchayat Land, if available. However, department is not responsible, if no such area is made available to the contractor in that case, contractor will have to make his own arrangement to get borrow area for borrowing earth of the approved quality even by making temporary arrangement with the private land owners.

6. The embankment shall be constructed in uniform layers not exceeding 250mm in loose thickness. The soil shall be spread uniformly over the entire width of the embankment unless otherwise directed by the Engineer in charge. The consolidation including watering and rolling of earthwork shall be carried out by the

contractor. The operation of laying successive layers of earth shall have to suitably \*\*\*\*\* with the consolidation work. If the soil as delivers to the road bed is too wet, it shall be dried by exposure to the sun till the moisture content is acceptable for compaction. 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 45cm of the embankment and a maximum size of 15cm when being placed in the top 45cm of the embankment. The work of next layer shall be allowed only after the first layer below it has been thoroughly compacted to the density specified.

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 material shall have perfect bond with the existing surface. Where the embankment is to be laid over an existing road surface the surface shall be scarified to minimum depth of 5 cm so as to provide ample bond between the old and new material. However when the pavement shall be broken up in place not to exceeding 0.1 mt 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 subgrade level the same shall be scarified to a depth of minimum 50mm so as to provide ample bond between the old and the new material.

8. To avoid interference with the construction of abutment, wing walls or return wall, culvers / bridge structures, the contractor shall at point to be determined by the Engineer in charge, suspend the work on embankment 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, bridges and other structure upto a distance to 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 walls 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 with the laying of fill material. The material used for the filter shall conform to the requirements for filter medium and will be paid extra in the relevant item. Where it may be impracticable to use power roller or other heavy equipment, the compaction shall be carried out by mechanical tampers or other methods approved by the Engineer in charge. Care shall be taken to see that the compaction plant does not hit or come to close to any structural member so as to cause any damage to them.

9. The Embankment shall be finished in conformity with the alignment, levels, cross section and dimensions shown on the plans or as directed by Engineer in charge. Where the alignment of the road is a curve, the top of the embankment shall be formed with the super elevation and the increased width shown on the drawing 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 consolidation of earth work including rolling and watering at OMC as per laboratory requirement shall be carried out by the contractor. The field and laboratory investigations and testing of sample shall be carried out by the department. However, the contractor shall give full co operations and shall be made the charges for labours and collection of samples for testing at authorized Government laboratory. The work of laying of earthwork in layers shall be synchronized with the field and laboratory testing. When density measurements reveal any soft area as in the embankment the Engineer in charge directed that these areas shall be compacted further. If inspire of that, specified compaction is not achieved the materials in the soft areas shall be removed as directed and replaced by the approved materials.

11. The earthwork measurements shall be paid on cross sectional measurements and computing the volumes of earthwork in cubic meter by average area method. The contractor shall sign day to day leveling work and also original cross section, longitudinal section etc., on token of his acceptance. The working section both longitudinal and cross of the ground shall be taken by the Engineer in charge before the actual work is started. The contractor or his authorized representative shall attend day to day leveling 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 the officer concerned with specified reference to the section officer before starting further work. Once the work is started, no cognizance of any complaint will be taken. Merely not signing of level books shall not be deemed as disagreement. The Executive Engineer shall also verify leveling work to the extent of 5% before commencement of earthwork and on finalization. The contractor shall maintain the embankment by filling the rust, raincuts, depressions 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 earthwork. No deduction for shrinkage shall be made from gross measured quantity of compacted earthwork. However the contractor shall have to bear loss of quantity due to all settlement as well as other types of deformations etc., if any, that might have taken place at the time of taking final measurements of this item.

12. The rate of earthwork includes clearing jungles, dogbelling, fixing profiles erecting necessary pillars for stones for bench marks for leveling purpose, excavating earth from borrow areas, breaking clods, conveying and spreading earth in layers with all lead and lift, finishing the entire embankment and incidentals necessary to complete the work to the specifications. The cutting stuff of cutting in ordinary soils, soft murrum, soft rock, hard murrum and hard rock shall be utilized in embankment construction under this item within the lead specified in that particular item. No payment shall be made under this item for the cutting stuff used in the embankment but labour for cutting will be paid as per specifications in that particulars item and only balance quantity of earthwork brought from borrow areas will be paid in this item. **Payment shall be made on Cmt.basis.**

#### **Item no. - : 5**

#### **Rolling and consolidation using vibratory road roller 8 - 10 tonne capacity (incl.watering)(A) Earth work (layer not exceeding 200mm thickness)**

1 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 200mm 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

Mositure content of the materials shall be checked at the source of supply and if found less than that 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 hoseline, or from a truck mounted Water tank, and flooding shall not be permiitted under any circumstances.

If the materials delivered to the road bed is too wet it shall 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 1ST 2720 (Part-II) 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 herd lumps of earth shall' be broken to have maximum Size of 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 meter portion of the embankment below the subgrade

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

Where the embankment is to be constructed on low area ground that will not support the weight of trucks of other hauling equipment, the lower part of the fill be 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

2. COMPACTION Only compacting equipment approved by the Engineer-incharge Shall be employed to compact the materials. The contractor shall demonstrate the efficiency of the plants he intents to use for carrying out compaction trials.

Each layer of the materials shall be thoroughly compacted to the densities specified in Table 1.2 Compaction requirements for embankment.

Sr. No.	Type of Work/ materials	Field dry density as per centage of maximum laboratory dry density as per IS:2720 (Part-VII)
1.	Top 0.5 meter portion of embankment below subgrade level and shoulders.	Not less than 100.
2.	Other portion of embankment.	Not less than 95
3.	Highly expensive class	85 to 90

Subsequent layers shall be placed only after finished layer has been tested according to MOST 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 insite of that the specificated 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.

3 Measurements for Payment Consolidation of earth embankment construction shall be measured by taking cross section at intervals in the original position before the Work starts and after its completion and computing of the volume of earthwork in cubic meters by the method of average areas. The measurement of fill material from borrow area shall be the difference between the net quantities of suitable materials brought from roadway and drainage excavation For this purpose It shall be assumed that one cubic meter of suitable materials brought to site from roadway and drainage excavation from 1 cubic meter of compacted fill and all bulking or shrinkage shall be ignored. Stripping including storing and reapplication of top soil shall be measured as volume In cubic meter

4 The contract unit rate includes cost of mechanical roller required for consolidation including all labour equipments fuel hire charges, tolls, and incidentals necessary. **Payment shall be made on Cmt.basis.**

#### **Item No. 6 :**

**Scarifying /Dismantalling gravelled macadam or bitumen macadam surface 6 cm to 10 cm.depth including stacking useful materials on road side and disposing off remaining stuff.**

- 1.0 The layer of the existing layer B.T.Surface metal/ ling shall be excavated and shall be screened on site of work stacking of metal obtained from screening shall be done by filling in the standard steel boxes of 2m x 1.5 m x 0.5 mt. size which shall be supplied by department if available on rent. Otherwise contractor shall make his own arrangements. No deductions for voids shall be made from the gross measurements. Where any doubt exist as to whether the quantity of stacks of metal in any hectometer is not confirming with cubical content of the standard pharas (2m x 1.5m x 0.5 m) 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 metal in any stack in a particular hectometer is found to be less then 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 metal shall be done in a manner as directed by the Engineer-in-charge.
- 2.0 The remaining material except metal obtained from screening process shall be used in embankment with all lead and lift. It shall be directly deposited at the required location in specified layers. No handling or conveyance charges shall be paid if the materials is temporarily deposited else where and subsequently convey to site of deposition. The sequence of operations should be arranged properly. Material not required for any use whatsoever may be disposed off by the contractor at his own cost in manner approved by the Engineer-in-charge. The material utilised in the embankment will be deducted from the net quantity of earthwork arrived at within the chain age measured.
- 3.0 The payment shall be made on sq.mt. the contractor shall maintain all stacks in regular and proper size till the whole materials shall not be 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.
- 4.0 The rate includes the cost of scarifying macadam, screening, deposting, conveyance with all lead and lift. Filling the boxes including all labour, tools, equipments and all other incidental expenses.

## **Item No. 7**

**Construction of granular sub base by providing well graded crushed stone material(M.C.Metal 53 to 9.5 mm size 50%,M.C. metal 9.5 to 2.36 mm 20% and stone dust below 2.36mm size 30%) spreading in uniform layes with motor grader on prepared surface,mixing by mix in place method with rotoator at O.M.C. and compacting with three wheeler roller 8 T to 10 T to achieve the desired density complete as per technical specification Close graded Granular sub-base Material as per clause 401 for grading -I well graded sub base material.(150mm thick compacted thickness)**

### **401. GRANULAR SUB-BASE**

#### **401.1. Scope**

This work shall consist of laying and compacting well-graded material on prepared subgrade 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, moorum, 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 400-1.

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 coarse-graded 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 kN or more (for sample in soaked condition) when tested in compliance with BS:812 (Part 111). The water absorption value of the coarse aggregate shall be determined as per IS : 2386 (Pan 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. For 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 MATERIAL**

Sieve Designation	Per cent passing by IS sieve		
	Grading I	Grading II	Grading III
75.0 mm	100	--	--
53.0 mm	80-100	100	--
26.5 mm	55-90	70-100	100
9.50 mm	35-65	50-80	65-95
4.75 mm	25-55	40-65	50-80
2.36 mm	20-40	30-50	40-65
0.425 mm	10-25	15-25	20-35
0.075 mm	3-10	3-10	3-10
CBR Value (Minimum)	30	25	20

**TABLE 400-2. GRADING FOR COARSE GRADED GRANULAR  
SUB-BASE MATERIAL**

Sieve Designation	Per cent passing by IS sieve		
	Grading I	Grading II	Grading III
75.0 mm	100	--	--
53.0 mm	--	100	--
26.5 mm	55-75	50-80	100
9.50 mm	--	--	--
4.75 mm	10-30	15-35	25-45
2.36 mm	--	--	--
0.425 mm	--	--	--
0.075 mm	<10	<10	<10
CBR Value (Minimum)	30	25	20

Note : The material passing 425 micron (0.425 mm) sieve for all the three 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 remoulded 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 subgrade :** Immediately prior to the laying of sub-base, the subgrade 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 subgrade 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 mix-in-place method.

Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small-sized jobs. The equipment used for mix-in-place construction shall be a rotavator 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 & other approved means like disc harrows, rotavators until the layer is uniformly wet.

Immediately thereafter, rolling shall start. If the thickness of the compacted layer does not exceed<sup>1</sup> 100 mm, a smooth wheeled roller of 80 100 kN weight may be used. For a compacted single layer upto 215 mm the compaction shall be done with the help of a vibratory roller minimum 80 to 100 kN static weight with plain drum or pad foot-drum or heavy pneumatic tyred roller of minimum 200 to 250 kN weight a minimum tyre pressure of 0.7 MN/m<sup>2</sup> or equivalent capacity capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall and super-elevation and shall commence at the edges and progress towards the centre for portions having crossfall 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 crossfall (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) malting 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 test for quality control.



### **Item No. 8**

**Providing and laying W.B.M. of M.C. metal of size 45 mm to 90 mm size including 0.27 Cu.M. Stone screening & 0.08 Cu.M. stone dust as filler including spreading, watering & consolidation by vibratory roller 80KN to 100KN static weight. 100 mm thick compacted**

**And**

### **Item No. 9**

**Providing and laying W.B.M. of M.C. metal of size 45 mm to 63 mm size including 0.12 Cu.M. Stone screening & 0.08 Cu.M. stone dust as filler including spreading, watering & consolidation by vibratory roller 80KN to 100KN static weight. 75 mm thick compacted each layer.**

#### **404.1. Scope**

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

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

#### **404.2. Materials**

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

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

Test	Test Method	Requirements
1 * Los Angeles Abrasion value Or * Aggregate Impact value	IS:2386 (Part-4)  IS:2386 (Part-4) or IS:5640**	40 per cent (Max)  30 per cent (Max)
2 Combined Flakiness and Elongation Indices (Total) ***	IS:2386 (Part-1)	30 per cent (Max)

- \* Aggregate may satisfy requirements of either of the two tests.
- \*\* Aggregates like brick metal, kankar, laterite etc. which get softened in presence of water shall be tested for Impact value under wet conditions in accordance with IS: 5640.
- \*\*\* The requirement of flakiness index and elongation index shall be enforced only in the case of crushed broken stone and crushed slag.

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

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

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

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

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

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

Note : The compacted thickness for a layer with Grading 1 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 moorum or gravel (other than rounded river borne material) may be used for this purpose provided liquid

limit and plasticity index of such material are below 20 and 6 respectively and fraction passing 75 micron sieve does not exceed 10 per cent.

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

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

TABLE 400-8. GRADING FOR SCREENINGS

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	0-10
B	11.2 mm	11.2 mm	100
		5.6 mm	90-100
		180 micron	15-35

TABLE 400-9. APPROXIMATE QUANTITIES OF COARSE AGGREGATES AND SCREENINGS REQUIRED FOR 100/75 MM COMPACTED THICKNESS OF WATER BOUND MACADAM (WBM) SLB-BASE/BASE COURSE FOR 10M<sup>2</sup> 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 1.43m <sup>3</sup>	Type A 13.2mm	0.27 to 0.30 m <sup>3</sup>	Not uniform	0.30 to 0.30 m <sup>3</sup>
Grading 2	63 mm to 45mm	75 mm	0.91 to 1.07 m <sup>3</sup>	Type A 13.2mm	0.12 to 0.15 m <sup>3</sup>	-do	0.22 to 0.24 m <sup>3</sup>
-do-	-do-	-do-	-do-	Type B 11.2mm	0.20 to 0.22 m <sup>3</sup>	-do-	-do-
Grading 3	53mm to 22.4mm	75 mm	-do-	-do-	0.18 to 0.21 m <sup>3</sup>	-do-	-do-

**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 of less than 6 as determined in accordance with IS: 2720 (Part-5).

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

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

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

### **404.3. Construction Operations**

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

As far as possible, laying water bound macadam course over an existing thick 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 centre line of the pavement at one metre intervals in the existing road. The directions and depth of furrows shall be such that they provide adequate bondage and also serve to drain water to the existing granular base course beneath the existing thin bituminous surface.

**404.3.2. Inverted choke :** If water bound macadam is to be laid directly over the subgrade, without any other intervening pavement course, a 25 mm course of screenings (Grading B) or coarse sand shall be spread on the prepared subgrade before application of the aggregates is taken up. In case of a fine sand or silty or clayey subgrade, it is advisable to lay 100 mm insulating layer of screening or coarse sand on top of Fine grained soil, the gradation of which will depend upon whether it is intended to act as a drainage layer as well. As a preferred alternative to inverted choke, appropriate geosynthetics performing functions of separation and drainage may be used over the prepared subgrade 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 subgrade/sub-base/ base to proper profile by using templates placed across the road about 6 m apart, in such quantities that the thickness of each compacted layer is not more than 100 mm for Grading 1 and 75 mm for Grading 1 and 3, as specified in Clause 404.2.5. Wherever possible, approved mechanical devices such as aggregate spreader shall be used to spread the aggregates uniformly so as to minimise the need for manual rectification afterwards. Aggregates placed at locations which are inaccessible to the spreading equipment, may be spread in one or more layers by any approved means so as to achieve the specified results.

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

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

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

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

Except on superelevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inward parallel to the centre line of the road, in successive passes uniformly lapping preceding tracks by at least one half width. Rolling shall be discontinued when the aggregates are partially compacted with sufficient void space in them to permit application of screenings. However, where screenings are not to be applied, as in the case of crushed aggregates like brick metal, laterite and kankar, compaction shall be continued until the aggregates are thoroughly keyed. During rolling, slight sprinkling of water may be done, if necessary. Rolling shall not be done when the subgrade is soft or yielding or when it causes a wave-like motion in the subgrade 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 crossfall (camber) and grade. In no case shall the use of screenings be permitted to make up depressions.

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

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

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

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

**The spreading, rolling, and brooming of screenings shall be carried out in only such lengths of the road which could be completed within one day's operation.**

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

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

**404.3.7. Application of binding material:** After the application of screenings in accordance with Clauses 404.3.5 and 404.3.6, the binding material where it is required to be used (Clause 404.2.7) shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water, the resulting slurry swept in with hand brooms, or

mechanical brooms to fill the voids properly, and rolled during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling of voids, form 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 subgrade soil mixing with the aggregates, the course to its full thickness shall be scarified over the affected area, reshaped with added material or removed and replaced with fresh material as applicable and recompacted. In no case shall depressions be filled up with screenings or binding material.

#### **404.5. Arrangement for Traffic**

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

#### **404.6. Measurements for payment**

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

#### **404.7. 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 full compensation for all components listed in Clause 401.8 (i) to (v) including arrangement of water used in the work as approved by the Engineer.

### **Item No. 10**

**Supplying, stacking and spreading quarry spall with all lead and lift and including watering and rolling and consolidation of sub grade in layers at OMC to required dry density including filling depression which occurs during the process using vibratory roller of 80 KN to 100KN (selected quarry spall having CBR value not less than 30.0)**

**1. Scope:-** The work shall consist of constructing shoulder on either side of pavement with quarry spalls with the requirement of these specifications and in conformity with the lines, grades and cross sections shown on the drawings or as directed.

**2. Materials :** Materials shall be Quarry spalls conforming to the requirements as specified below.

**2.1** The quarry spalls to be used for the work shall be free from organic or other deleterious constituent and conform to grading given in Table 2.1

Table 2.1

IS Sieve Designation		Per Cent by weight passing the I S Sieve
53.0	mm	100
26.5	mm	50-80
9.50	mm	
4.75	mm	15-35
2.36	mm	
0.425	mm	
0.075	mm	>10
<b>CBR Value (Minimum)</b>		<b>30</b>

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

## 2.2 Physical requirement:-

The quarry spalls shall have a 10 percent fines value of 50 KN or more (for sample in soaked condition) when tested in compliance with BS: 812 (Part 111). The water absorption value of the quarry spalls shall be determined as per IS: 2386 (Part 3); if this value is greater than 2 percent, the soundness test shall be carried out on the quarry spalls delivered to site as per IS: 383. 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 percent.

## 3. Mode of Measurement and Payment:-

The side shoulder with quarry spalls shall be measured as finished work in position in cubic meters. The finished thickness of work done shall be paid on volume basis.

## Item No. 11

**Providing and laying bituminous grout base course 37.50 mm compacted thi. using B.T. stone aggregates as per required gradation with the Bitumen VG-30 for tack coat @ 2.5 Kg/10 Smt on B.T.Surface and 4.0 Kg/10 Smt on W.B.M.Surfcae and for mixing @ 1.99 % i.e. 19.90 kg./ MT by weight of mix incl. heating and mixing in drum mix plant transporting the mix , spreading the same by pavers finisher and consolidation as per MORTH specification incl. cost of all materials fuels, labors, tools and plant etc. using contractors own drum mix plant etc. comp. etc. comp.**

**Scope:-** The work shall consist of construction 37.5 mm. thick BUSG on a previously prepared base to the requirement of these specifications. Over and above MORT & H Clause 506 specification. The work shall be carried out by premixing the aggregates in drum mix plant & spreading by paver finisher. Payment shall be made on M.T. basis of work done.

### Materials:-

**Binder:-** The binder shall be straight on bitumen of V.G.-30 grade satisfying the requirement of I.S. :73

**Coarse Aggregate:-** The coarse aggregate shall consist of crushed stone. These shall be strong, durable of fairly cubical shape and free from disintegrated pieces, organic or other low porosity and shall satisfy the physical requirement as per Schedule for testing of materials attached herewith / as directed by Engineer-in-charge.

**Fine Aggregate:-** The line aggregate shall consist of crusher run screening, natural sand or mixture of both. These shall be clean, hard, durable, uncoated dry and free injurious soft pr flaky pieces and organic deleterious substances.

**Aggregate Gradation:-** The mineral including mineral shall be so graded to combined as to conform to the grading set forth in table below.

Sieve Size	Percent by Weight aggregate
53.0	100
26.5	75-100
22.4	50-25
13.2	20-40
5.6	5-20
2.8	0-5

**Proportion using Minerals:-** The bitumen content for pre-mixing shall be 1.99 % by total weight of mix. The quantities of aggregate to be used shall be sufficient to yield the specified thickness after compaction.

**Variation in Proportioning of Material:-** The contractor shall have the responsibility for ensuring proper proportioning of materials and producing a uniform mix. A variation in binder content  $\pm 0.3$  percent by weight of total mix shall however, be permissible for individual specimen taken for quality control test vide Schedule for Testing of Materials attached herewith / as directed Engineer in charge Asphalt VG-30 at rate of 19.90 Kg / MT i.e. 1.99% by weight of the total mix shall be used for mixing.

#### **Construction Operations:-**

**Weather and Seasonal Limitations:-** The work of laying shall not be taken up during rainy or foggy weather or when the base course is damp or wet or during dust storm or when the atmospheric temperature in shade is  $10^{\circ}$  C or less.

**Preparation of Base:-** The base on which B.S.G. is to be laid shall be prepared shaped and conditioned to the specified lines, grade and cross sections in accordance with Clause 501 and a priming coat where needed shall be applied in accordance with Clause 502 as directed by Engineer in charge.

**Tack coats:-** A tack coat as per Clause 503 shall be applied over the base as detailed in item description.

**Bitumen V.G.-30 Grade @ 2.50 Kg / 10 Sq.mt. on existing B.T. surface & 4 Kg / 10 Smt. on WBM surface.**

#### **Preparation of Transportation of Mix:-**

Mix shall be prepared in Drum mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coated aggregates.

The plant shall be drum mix type. The plant shall co-ordinate set of essential units capable of producing uniform mix within the job mix formula as such laid down in Appendix-A.

(A) In case of drum mix plant the cold feed system shall have variable speed conveyors / or other suitable devices for regulating the accurate proportion of aggregates in to even flow automatically from a control operation / control cabin.

(B) Bitumen control unit:- Capable of measuring / metering and spraying required quantity of bitumen at specified temperature with automatic synchronization of bitumen and aggregate feed.

(C) Filter system:- A fines feeder system suitable to receive bagged or bulk supply of filler materials and its incorporation to the mix in the correct quantity shall be necessary auxiliary.

(D) Dust Control:- A suitable built in dust control equipment for the dryer to contain the exhaust of fine dust in to atmosphere for environmental control, wherever so specified by the Engineer.

(E) Suitable auxiliary bitumen boiler of adequate with the self heating arrangement and temperature control device. The boiler should be fitted with temperature indicating instruction.

The temperature of binder at the time of mixing shall be in the range of  $150^{\circ}$  C to  $165^{\circ}$  C and that of the aggregate in the range of  $150^{\circ}$  C to  $170^{\circ}$  C provided that the difference in the temperature between the binder and aggregate at no time exceeds  $14^{\circ}$  C.

Mixing shall be through to ensure that a homogenous mixture is obtained in which all particles of the aggregates are coated uniformly and the discharge temperature of mix shall be between  $150^{\circ}$  C to  $160^{\circ}$  C.

The mix shall be transported from the mixing plant to the point of use in suitable tipper vehicles. The vehicles employed for transport shall be clean and be covered in transit if so directed by the Engineer. Any tipper causing excessive segregation of materials by its spring suspension or other contributing factor of that which shows undue shall be removed from the work until such conditions are corrected.

#### **Spreading :-**

The mix transferred from the tipper at site to the paver shall be spread immediately by means of self propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix true to the specified lines, grades and cross sections. The paver finisher shall have the following essential features.



- a) Loading hoppers and suitable distributing mechanism.
- b) All drives having hydrostatic drive / control
- c) The machine shall have hydraulically extendable screed for appropriate width requirement.
- d) The screed shall have temping and vibrating arrangement for initial compaction to the layer as it is spread without rutting or otherwise marring the surface. It shall have adjustable amplitude and variable frequency.
- e) The paver shall be equipped with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.
- f) The paver shall be fitted with an electronic sensing device for automatic leveling and profile control within the specified tolerances.
- g) The screen shall have the internal heating arrangement.
- h) The paver shall be capable of laying either 2.5 to 4.0 mt. width or 4.0 to 7.0 mt. width as stipulated in the contract.
- i) The paver shall be so designed as to eliminate skidding / slippage of the tyres during operation

However in restricted locations and in narrow width, where the available plant cannot be operated in the opinion of the Engineer, he may permit manual laying of the mix.

The temperature of the mix at the time of laying shall be in the range of 100° C to 125° C. in the multi layer construction, the longitudinal joint in one layer shall offset that in the layer below by about 150 mm. However, the joint in the top most layer shall be at the lane line of the pavement.

Longitudinal joints and edges shall be constructed true to the delineating line parallel to the center line of the road. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with drum bitumen before placing fresh materials. Longitudinal and transverse joints shall be offset by a least 250 mm from the those in the lower courses and the joint on the top most layer shall not be allowed to fall within the wheel path. All transverse joint shall be cut vertically to the full thickness of the previously laid mix with asphalt cutter. Pavement breaker and surface painted with Drum bitumen before placing fresh material, longitudinal joint shall be preferably Drum joints. Cold longitudinal joints shall be properly heated with joint heater to attain a suitable temperature of about 80°C before laying of adjacent material.

#### **Compaction:-**

After the spreading mix, rolling shall be done by 8T to 10T rollers or other approved equipment. Rolling shall start as soon as possible after the material has been spread deploying set of rollers as the rolling is to be completed in limited time frame. The roller shall move at a speed not more than 5 Km/ HR. Rolling shall be done with care to avoid undue roughening of the pavement surface.

Rolling of the longitudinal joints shall be done immediately behind the paving operation. After this the rolling shall commence at the edges and progress towards the center longitudinal except that in super elevated and uni directional cambered portions. It shall progress from the lower to the upper edge parallel to the centre line of the pavement.

The initial break down rolling shall be done with 8T to 10T. Static weight smooth wheel roller (3 wheel or tandem), as soon as it is possible to roll the mix without cracking the surface or having the mix pick up on the roller wheels. The second of intermediate rolling shall follow the break down rolling with vibratory roller of 80 to 100 KN static weight of pneumatic tyred roller of 150 to 200 KN weight, with minimum 7 wheels and minimum tyre pressure of 0.7 mpa as closely as possible to the paver and be done while the paver mix is still at a temperature that will result in maximum density. The final rolling shall be done while materials is still workable enough for removal of roller marks with 60-80 KN tandem roller. During the final rolling, vibratory system shall be switches off. The joints and edges shall be rolled with a 80to 100 KN static roller.

When the roller has passed over the whole area once. Any high spots or depressions, which become apparent shall be corrected by removing or adding mix material. The rolling shall then be continued till the entire surface has been rolled to 95 percent of the average laboratory density. (Obtained for Marshall specimens compacted as defined in Table 500-100) There is no crushing of aggregates and all rollers marks have been eliminated, each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. The roller wheel shall be kept damp, if necessary to avoid bituminous material from sticking to the wheels and being picked up. In no case shall fuel, lubricating oil be used for this purpose nor excessive water poured on the wheels.

Rolling operation shall be completed in every respect before the temperature of the mix falls below 100°C.

Roller(s) shall not stand on newly laid material while there is a risk that surface will be deformed there by. The edges along and transverse of the BSG laid and compacted earlier shall be cut to their full depth so as to

expose fresh surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against it.

**Surface Finish and Quality Control of Work:-**

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

The mix shall be converted with either the next pavement course or wearing course. As the case may be without any delay. If there is to be any delay, the course shall be covered by seal coat to the requirement of clause 513 before allowing any traffic over it. The seal coat in such case shall be considered incidental to the work and shall not be paid for separately.

**Arrangement of Traffic:-** During the period of construction of arrangement of traffic shall be done to clause 112.

**Measurement for payment:-**

**The payment shall be made on the tonnage basis of the weight of mix of aggregates and bitumen for this purpose.** The contractor shall have to install a weigh bridge of suitable capacity for the purpose of weight of dumpers at suitable place at his own cost as directed. Weight of empty and weight of loaded dumper will be recorded in bound and numbered register on plant site. Department will be free to get some loaded dumpers test checked at other weight bridge. Weight bridge will be periodically got calibrated and verified from weight and measure authorities.

For the purpose of application of tack coat, if the theoretical area as per sanctioned estimate for basis of tone differs with actual area of work done in the field, the reduction in or addition for payment shall have to be exceed respectively.

Weight of mix materials will be done in presence of responsible person, not less than rank of supervisor of department and the measurements shall be recorded by the Deputy Executive or Assistant Engineer or Addl. Assistant Engineer. If so authorised. Record of each dumper will be maintained separately in bound and numbered register, which will be maintained by the departmental representatives and signed by the contractor, proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site. The location of the kilometer, hectometer and meter in which individual dumper are unloaded be recorded carefully.

**Rates:-** The contract unit rate for B.S.G. work shall be payment in full for carrying out the required operations including full compensations for:-

- (i) Making arrangement to traffic to clause 112 except for initial treatment to the shoulders and constructions of diversions.
- (ii) Preparation of base except for laying of profile corrective course but including filling of potholes.
- (iii) Providing all materials to be incorporated in the work including arrangement for stock yards. All royalties, fees, rents where necessary and all lead and lift.
- (iv) All labour, tools, equipment, plants including installation of Drum mix plant paver supply units and all machineries, incidentals to complete the work to the specifications.
- (v) Carrying out the work in part widths of the road where directed.
- (vi) Carrying out all tests for control of quality

**Item No. 12**

**Providing and laying 37.5 mm thick compacted B.M. using stone chips 0.66 Cum / 1 M.Ton mix as per gradation with Bitumen V.G.-30 for tack coat @ 2.50 kg. / 10 Smt. on B.T. surface and for mixing @ 34 kg/M.Ton (I.e. 3.40% of mix) including heating the and aggregate by contineous batching drum mix plant, transporting and mixed matrrial and spreading the same by paver finisher and consolidation by vibratory roller of 80 KN to 100 Kn static weight including the cost of labour oil, lubricants etc. using contractors own machineries and plant.**

**Scope :-** The work shall consist of construction one layer of 37.5 mm thick B.M. on a previously prepared base to the requirement of theses specifications

**Materials :-**

**Binder :-** The binder shall be straight run bitumen of **V.G-30 grade** satisfying the requirement of I.S. : 73.

**Coarse Aggregate :-** The coarse aggregate shall consist of crushed stone, crushed gravel. These shall be strong, durable of fairly cubical shape and free from disintegrated pieces, organic or other low porosity

and shall satisfy the physical requirement as per Schedule for Testing of Materials attached herewith / as directed by Engineer in Charge.

**Fine Aggregate :-** The fine aggregate shall consist of crusher run screening, natural sand or mixture of both. These shall be clean, hard, durable, uncoated dry and free injurious soft or flaky pieces and organic deleterious substances.

**Aggregate Gradation:-**

The mineral including mineral shall be so graded to combined as to conform to the grading set forth in table below.

**Bituminous. Macadam**

Sieve Size	Percent by Weight aggregate
26.5	100%
19.0	90-100%
13.2	56-88%
4.75	16-36%
2.36	4-19%
0.90	2-10%
0.075	0-8%

**Proportioning Materials :-**

The bitumen content for pre-mixing shall be 3.4% by weight of the total mix

The quantities of aggregate to be used shall be sufficient to yield the specified thickness after compaction.

**Variation in Proportioning of Material :-**

The contractor shall have the responsibility for ensuring proper proportioning of materials and producing a uniform mix. A variation in binder content  $\pm 0.3$  percent by weight of total mix shall however, be permissible for individual specimen taken for quality control test vide Schedule for Testing of Materials attached herewith / as directed Engineer in Charge

**Construction Operations:-**

**1 Preparation of base :** The surface on which the tack coat is to be applied shall be cleaned of dust and extraneous material before the application of the binder by using mechanical broom or any other approved equipment / method as specified by the Engineer

**2 Application of binder :** Binder may be heated to the temperature appropriate to the grade of bitumen used and approved by the engineer and sprayed on the base at the rate specified in item of work. The normal range of spraying temperature for bitumen V.G-30 grade. It shall be the responsibility of the contractor to carefully handle the inflammable bituminous material so as to safeguard against any fire mishap. The binder shall be applied uniformly with the aid of either self propelled or towed bitumen pressure sprayer with self heating arrangement and spraying bar with nozzles having constant volume or pressure system, capable of spraying bitumen at specified rate and temperature so as to provide a uniformly unbroken spread of bitumen. Work should be planned so that no more than the necessary tack coat for the day's operation is placed on the surface. After application and prior to succeeding construction allow the tack coat to cure, without being disturbed, until the water/ cutter has completely evaporated as determined by Engineer.

**3. Quality control of work :** Control on the quality of material and works shall be exercised by the Engineer in charge in accordance with section 900 of MORTH specification.

**4. Arrangement of traffic:** During the period of application of binder for tack coat the arrangement of traffic shall be done to MORD specification clause 112 of MORTH Specification.

**5. Mode of measurement and payment:**

The payment shall be made on sq.mt basis of for rate of application as specified in tender item. The rate is inclusive of cost of asphalt, tools and plants required for applying binder.

**504.3.3. Tack Coat:** A tack coat in accordance with Clause 503 shall be applied as specified in the Contract or as directed by the Engineer. **For Tack coat Bitumen V.G.-30 Grade shall be used.**

**Weather and Seasonal Limitations:-**

The work of laying shall not be taken up during rainy or foggy weather or when the base course is damp or wet or during dust storm or when the atmospheric temperature in shade is 10°C or less.

**Preparation of Base:-**

The base on which bituminous macadam is to be laid shall be prepared shaped and conditioned to the specified lines, grade and cross sections in accordance with Clause 501 and a priming coat where needed shall be applied in accordance with Clause 502 as directed by Engineer in charge.

**Preparation and Transportation of Mix:-**

Bituminous macadam mix shall be prepared in hot mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coated aggregates

The plant shall be drum mix type. The plant shall co-ordinate set of essential units capable of producing uniform mix within the job mix formula as such as laid down in Appendix A

(A) In case of drum mix plant the cold feed system shall have variable speed conveyors / or other suitable devices for regulating the accurate proportion of aggregates in to even flow automatically from a control operation / Control cabin.

(B) Bitumen control Unit:- Capable of measuring /metering and spraying required quantity of bitumen at specified temperature with automatic synchronization of bitumen and aggregate feed.

(C) Filler system :- A fines feeder system suitable to receive bagged or bulk supply of filler materials and its incorporation to the mix in the correct quantity shall be necessary auxiliary

(D) Dust Control – A suitable built in dust control Equipment for the dryer to contain the exhaust of fine dust in to atmosphere for environmental control, wherever so specified by the Engineer.

(E) Suitable auxiliary bitumen boiler of adequate with the self heating arrangement and temperature control device. The boiler should be fitted with temperature indicating instruction.

The temperature of binder at the time of mixing shall be in the range of 150°C. to 165°C. and that of the aggregate in the range of 150°C. to 170°C. provided that the difference in the temperature between the binder and aggregate at no time exceeds 14°C.

Mixing shall be through to ensure that a homogenous mixture is obtained in which all particles of the aggregates are coated uniformly and the discharge temperature of mix shall be between 150°C. to 160°C.

The mix shall be transported from the mixing plant to the point of use in suitable tipper vehicles. The vehicles employed for transport shall be clean and be covered in transit if so directed by the Engineer. Any tipper causing excessive segregation of materials by its spring suspension or other contributing factors of that which shows undue shall be removed from the work until such conditions are corrected.

**Spreading :-**

The mix transferred from the tipper at site to the paver shall be spread immediately by means of self propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix true to the specified lines, grades and cross sections. The paver finisher shall have the following essential features.

- a). Loading hoppers and suitable distributing mechanism
- b). All drives having hydrostatic drive / control
- c). The machine shall have hydraulically extendable screed for appropriate width requirement.

- d). The screed shall temping and vibrating arrangement for initial compaction to the layer as it is spread without rutting or otherwise marring the surface. It shall have adjustable amplitude and variable frequency.
- e). The paver shall be equipped with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.
- f). The paver shall be fitted with an electronic sensing device for automatic leveling and profile control within the specified tolerances.
- g). The screen shall have the internal heating arrangement.
- h). The paver shall be capable of laying either 2.5 to 4.0 mt. width or 4.0 to 7.0 mt. width as stipulated in the contract.
- i). The paver shall be so designed as to eliminate skidding / slippage of the tyres during operation.

However in restricted locations and in narrow width, where the available plant can not be operation in the opinion of the Engineer, he may permit manual laying of the mix.

The temperature of the mix at the time of laying shall be in the range of 100°C. to 125°C. in the multi layer construction, the longitudinal joint in one layer shall offset that in the layer below by about 150mm. However, the joint in the top most layer shall be at the lane line of the pavement.

Longitudinal joints and edges shall be constructed true to the delineating line parallel to the center line of the road. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with Drum bitumen before placing fresh materials. Longitudinal and transverse joints shall be offset by at least 250mm from the those in the lower courses and the joint on the top most layer shall not be allowed to fall within the wheel path. All transverse joint shall be cut vertically to the full thickness of the previously laid mix with asphalt cutter. Pavement breaker and surface painted with Drum bitumen before placing fresh material, longitudinal joint shall be preferably Drum joints. Cold longitudinal joints shall be properly heated with joint heater to attain a suitable temperature of about 80°C. before laying of adjacent material.

#### Compaction.:-

After the spreading of mix, rolling shall be done by 8T to 10T rollers or other approved equipment. Rolling shall start as soon as possible after the material has been spread deploying set of rollers as the rolling is to be completed in limited tile frame. The roller shall move at a speed not more than 5 Km / Hr. Rolling shall be done with care to avoid undue roughening of the pavement surface.

Rolling of the longitudinal joints shall be done immediately behind the paving operation. After this the rolling shall commence at the edges and progress towards the center longitudinal except that in super elevated and uni directional cambered portions. It shall progress from the lower to the upper edge parallel to the center line of the pavement.

The initial break down rolling shall be done with 8T to 10T. Static weight smooth wheel roller (3 wheel or tendem), as soon as it is possible to roll the mix without cracking the surface or having the mix pick up on the roller wheels. The second of intermediate rolling shall follow the break down rolling with vibratory roller of 80 to 100KN static weight or pneumatic tyred roller of 150 to 200 KN weight, with minimum 7 wheels and minimum tyre pressure of 0.7 mpa as closely as possible to the paver and be done while the paving mix is still at a temperature that will result in maximum density. The final rolling shall be done while materials is still workable enough for removal of roller marks with 60-80 KN tendem roller. During the final rolling, vibratory system shall be switches off. The joints and edges shall be rolled with a 80 to 100 KN static roller.

When the roller has passed over the whole area once. Any high spots or depressions, which become apparent shall be corrected by removing or adding mix material. The rolling shall than be continued till the entire surface has been rolled to 95 percent of the average laboratory density. {Obtained for Marshall specimens compacted as defined in Table 500-10}. There is no crushing of aggregates and all roller marks have been eliminated, each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. The roller wheel shall be kept damp, if necessary to avoid bituminous material from sticking to the wheels and being picked up. In no case shall fuel, lubricating oil be used for this purpose nor excessive water poured on the wheels.

Rolling operation shall be completed in every respect before the temperature of the mix falls below 100°C

Roller(s) shall not stand on newly laid material while there is a risk that surface will be deformed there by. The edges along and transverse of the bituminous macadam laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against it.

Surface Finish and Quality Control of Work :-

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

The bituminous macadam shall be covered with either the next pavement course or wearing course. As the case may be without any delay. If there is to be any delay, the course shall be covered by seal coat to the requirement of Clause 513 before allowing any traffic over it. The seal coat in such case shall be considered incidental to the work and shall not be paid for separately.

Arrangement of Traffic:- During the period of construction arrangement of traffic shall be done to Clause-112

Measurement for payment:- **The payment shall be made on the tonnage basis of the weight of mix of aggregates and bitumen for this purpose.** The contractor shall have to install a weight bridge of suitable capacity for the purpose of weightment of dumpers at suitable place at his cost as directed. Weight of empty and weight of loaded dumper will be recorded in bound and numbered register on plant site. Department will be free to get some loaded dumpers test checked at other weight bridge. Weight bridge will be periodically got calibrated and verified from weight and measure authorities.

For the purpose of application of tack coat, if the theoretical area as per sanctioned estimate for basis of tone differs with the actual area of work done in the field, the reduction in or addition to payment shall have to be exceeded respectively.

Weight of mix materials will be done in presence of responsible person, not less than rank of supervisor of department and the measurements shall be recorded by the Deputy Executive or Assistant Engineer or Addl. Assistant Engineer. If so authorised. Record of each dumper will be maintained separately in bound and numbered register, which will be maintained by the departmental representatives and signed by the contractor, proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site. The location of the kilometer, hectometer and meter in which individual dumper are unloaded be recorded carefully

Rates:- The contract unit rate for B.M. work shall be payment in full for carrying out the required operations including full compensations for :-

- (i) Making arrangement for traffic to clause 112 except for initial treatment to verge shoulders and constructions of diversions.
- (ii) Preparation of base except for laying of profile corrective course but including filling of potholes
- (iii) Providing all materials to be incorporated in the work including arrangement for stock yards. All Royalties, fees, rents where necessary and all lead and lift.
- (iv) All labour, tools, equipment, plants including installation of Drum mix plant paver supply units and all machineries, incidentals to complete the work to the specifications.
- (v) Carrying out the work in part widths of the road where directed.
- (vi) Carrying out all tests for control of quality

### Item No. 13

**Providing and laying bituminous sealcoat with stone chips 6 to 10mm size 0.24 cmt /10 smt. i.e. using 0.66 cmt agg.per M.T. mix using asphalt V.G.-30 @ of 4.50 % of mix inc. heating the asphalt and agg. By continuous batching hot mix plant and paver finisher and consolidating by vibratory roller incl. providing equipments, tools, plants, firewood ,oil, kerosene, labour charges etc, comp, using the contractor's own machinery.**

#### 1 DESCRIPTION

The work shall consist of construction of premix seal coat as wearing course, on a previously prepared base, to the requirement of these specification.

#### 2. MATERIALS:-

##### 2.1 Binder :-

The binder shall be straight run bitumen of V.G.-30 grade satisfying the requirement of IS:73. The actual grade of the binder to be used shall be decided by the Engineer-in-charge and it shall have to be brought by contractor to the site at his own cost unless otherwise specified in schedule 'A'.

##### 2.2 Coarse aggregates :

The coarse aggregate shall consist of crushed stone or crushed gravel. These shall be clean, durable, of cubical shape, free disintegrated pieces, organic or other deleterious matter and adherent coatings. The aggregates shall preferably be hydrophobic and of low porosity and shall satisfy the physical requirements set forth in Table given in Item No. 18 Para 2. Except that the upper limit for water absorption value shall be one percent.

##### 2.3 Fine aggregates :

The fine aggregates shall consist of crusher run screenings, natural sand or a mixture of both. These shall be clean, hard, durable, uncoated, dry and free from injurious, soft or flaky pieces and organic or deleterious substances.

##### 2.4 Filler :

The filler where required, shall be an inert material the whole of which passes 600 micron sieve at least 90 percent passing 150 micron sieve and not less than 70 percent passing 75 micron sieve. The filler shall be cement, stone dust, hydrated lime, fly ash and other non-plastic mineral matter approved by the Engineer in Charge

##### 2.5 Aggregate gradation :

The mineral aggregates, including mineral filler, shall be so graded or combined as to conform to grading set forth below

The gradation for Sealcoat {Type C} should be followed as stated hereunder instead of Para 2.5 of Item

Stone Chips for Type C Seal Coat : The stone chips shall consist of angular fragment of clean, hard and durable rock of uniform quality throughout. The stone chips shall be free of soft or disintegrated organic or other deleterious matter and shall be of 6.7 mm size defined as 100 percent passing through 9.5mm sieve and retained on 2.36 mm sieve. The quantity used for spreading shall be **0.18 Cu.M. per 10 Sq.Mt.area./ 0.24 Cu.M. per 10 Sq.Mt.** The chips shall satisfy the quality requirement in Table 500.3 {M.O.R. T. & H.} except that the upper limit for water absorption value shall be 1 percent

##### 2.6 Proportioning of materials :

The binder content for premixing shall be 45.00 kg per M.T. (4.50% by weight) for mixing aggregate.

The quantities of aggregates shall be sufficient to yield the specified thickness after compaction.

The contractor shall get the job-mix formula for the mix approved by the Engineer-in-charge before starting work.

##### 2.7 Variation in Proportioning of material :

The Contractor shall have the responsibility of ensuring proper proportioning of materials in accordance with the approved job mix formula and producing a uniform mix' A variation in binder content of  $\pm 0.3$  percent by weight of total mix shall, however, be permissible in individual specimen taken for quality control tests vide MOST Specification Section 900.

### **3. CONSTRUCTION OPERATIONS**

#### **3.1 Weather and seasonal limitation :**

Premix seal coat shall not be laid during rainy weather or when base course is damp or wet.

#### **3.2. Preparation of base :**

The base on which premix seal coat is to be laid shall be prepared shaped and conditioned to the specified, lines, grade and cross section in accordance with MOST specification MOST Spe. Clause 601 as directed by the Engineer-in-charge: The surface shall be thoroughly swept and spreaded clean and free of dust and foreign matter.

#### **3.3 Preparation of the mix:**

Drum mix plant of adequate capacity and capable of producing a proper and uniform quality shall be used for preparing the mix. The plant should be continuous type having a coordinated set essential units such as dryer for heating the aggregates; device for feeding by weight or volume the required quantities of aggregates, a binder heating and control unit for metering out the correct quantity of heated binder together with a paddle mixer for intimately mixing of the binder and aggregates. For details regarding Drum mix plant Annexure 'A' may be referred.

The temperature of binder at the time of mixing shall be in the range of 150° C - 177° C and aggregates in range of 150° C - 163° C provided also that at no time shall the difference in temperature of the aggregates and binder exceed 14° C.

Mixing shall be throughout to ensure that a homogeneous mixture is obtained in which all the particles of the mineral aggregates are coated uniformly.

The mix shall be transported from the mixing plant to the point of use in suitable vehicles. The vehicles employed for transport shall be clean and be covered over in the transit if so directed by the Engineer-in-charge.

#### **3.4 Spreading :**

The mix, transported from the hot mix plant to the site, shall be spread by means of self propelled mechanical paver with suitable screens capable of spreading, tamping and finishing the mix, true to specified grade, line and cross sections. The temperature of mix at the time of laying shall be in the range of 121° C - 163° C.

Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of road, Longitudinal joints shall be offset by at least 150 mm from those in the binder course. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material. .

#### **3.5 Rolling:**

Immediately after the spreading of mix, it shall be thoroughly compacted by rolling with a set rollers moving at a speed not exceeding 5km per hour. The initial or break-down rolling shall be with 8-12 tonne three wheeled rollers and the surface finished by final rolling with 8-10 tonne tandem rollers, or suitable pneumatic rollers. Rolling temperature shall not be less than 100°C in any case the rolling shall be completed the temperature of mix falls about 80°C.

The roller wheels shall be kept damp to prevent the mix adhering to them but in no case shall fuel lubricating oil be used for this purpose. Rolling shall commence longitudinally from the edge and progress towards the centre except that at super elevated portions, it shall progress from the lower to upper. edges parallel to the centre line of the pavement. The roller should proceed on the fresh material with rear or fixed wheel leading so as to minimize the pushing of the mix and each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass Rolling shall continue until the entire surface has been roller to compaction and all the roller marks eliminated.



#### 4. OPENING TO TRAFFIC

Traffic may be allowed immediately after completion of the final rolling when the mix has cooled down to the surrounding temperature.

#### 5. SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to the requirements of most specification MORD Spe. Clause 901 Control on the quality of material and works shall be exercised by the Engineer-in-charge in accordance with MOST Specification MORD Spe. Clause 902.

#### 6. ARRANGEMENT FOR TRAFFIC

The provision of MOST Specification MORD Spe. Clause 105 shall apply as regards the flow to traffic during construction.

#### 7. MEASUREMENT FOR PAYMENT

The payment shall be made on the tonnage basis of the weight of mix of aggregates and bitumen. For this purpose the contractor shall have to install a weigh bridge of suitable capacity for the purpose of weighing of dumpers at suitable place at his cost as directed. Weight of empty dumper and weight of loaded dumper will be recorded in bound and numbered register on plant side.

Department will be free to get some loaded, dumper test checked at other weigh bridge. Weigh bridge will be periodically got calibrated and verified from weight and measure authorities.

For the purpose of application of tack coat if the theoretical area as per sanctioned estimate for basis of tonne differs with the actual area of work done in the field, then the reduction in or addition to payment shall have to be effected to the contractor on proportionate basis depending upon the area reduced or exceeded respectively.

Weigh of mix materials will be done in presence of responsible person, not less than the rank of supervisor of Department, Deputy Executive Engineer or Assistant Engineer or Addl. Assistant Engineer if so authorized. Record of each dumper will be maintained separately inbound and numbered register which will be maintained by the departmental representatives and signed by the contractor. Proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site. The location of the kilometer, hectometer in Which individual dumper are unloaded will be recorded carefully.

**8. RATE:** The Contract unit rate for seal coat shall be for payment for carrying out the required operations including full compensation for all components listed in MOST Specification MORD Spe. Clause 503.7

#### **Item No. 14**

**Providing and filling in foundation with ordinary Cement concrete M-100 mix and providing necessary vertical pin headers including formwork, vibrating, ramming and curing complete.**

1. 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 tables below for different grades of concrete designated as ordinary M100, M150, M200 and M250.

2. IN the designation of a concrete mix, letter "M" refers to the mix and the number the specified 28 days work cube compressive strength of that mix on 150mm cubes expressed in Kg/Cm<sup>2</sup>.

3. The ordinary concrete mix shall generally be specified by volume. For cement which normally comes in bags and issued by weight, volume shall be worked out taking 50 Kg. of cement as 0.035 Cu.M. in volume. While measuring aggregates 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}

3. Ingredient required for ordinary cement concrete containing one 50 Kg. bag of cement for different proportions of mix shall be as given the table below.

Grade	of	Mix	by	Total Quantity of dry aggregates	Proportion	of	fine	Quantity
-------	----	-----	----	----------------------------------	------------	----	------	----------

Concrete	Volume	by volume per 50 Kg. of cement to be taken as sum of the individual volumes of fine and coarse aggregates mix	aggregates to coarse aggregates	of water per 5 Kg. of cement max.
Ordinary	Liter	One Cubic meter = 1000 liters		Liter
M100	1:3:6	250	General 1:2 for fine agg. To coarse agg. By volumes but subject to a upper limit of 1 : 1 ½ & a lower limit of 1:3	34
M150	1:2:4	220		32
M200	1:1 ½ : 3	160		30
M250	1:1:2	100		27

Note :- The proportion 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 aggregates becomes larger.

Example : For an average grading of fine aggregates (that is zone II or IS 383-1963) the proportions shall be 1 : 1 ½ 1:2 and 1:3 for maximum size of aggregates 10mm, 20mm and 40mm respectively (after carrying out sieve analysis).

Note : 2 A mix leaner than the M100 (1:3:6)m may be used for non structural parts, if provided in the contract, in such case grading of aggregates shall be by volume. Other requirement for mixing and placing & curing shall be the same.

5. Following shall be the maximum nominal size of coarse aggregates for the different items of work

Sr. No.	Item of Construction	Maximum nominal size of coarse aggregates
1.	R.C.C. Well curbs, R.C.C. well staining and R.C.C. piles	40mm
2.	R.C.C. well staining	63mm
3.	Well cap or pile cap, solid type piers, abutment and wing walls and other pier caps	40mm
4.	R.C.C. work in cross girders, deck slab, wearing course, kerb, light post, blast walls, approach slab, etc. and hollow type piers, abutments, wing walls, and their pier cap	20mm
5.	R.C.C. bearings	20mm
6.	For any other items of construction not covered by Item 1 to 4.	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 be usually be restricted to 5mm less than the minimum cover to the reinforcement which is the smaller.

6. Fine aggregates shall be clean hard, coarse sand. It shall be free from dust and such other substance. The sand be got approved by the Engineer in charge.

7. All materials shall be stored as to prevent their deterioration or destruction 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 watertight 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 one very 3 to 4 months. The aggregates shall be stored in such a way as to prevent admixture of foreign materials different sizes of the fine or coarse aggregates shall be stored in separate stock piles sufficiently removed from each other to prevent inter mixing of the materials.

9. The water for mixing shall be potable water to satisfaction of the Engineer in charge. The quality 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 aggregates 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 on a smooth watertight platform large enough to allow efficient turning over of the ingredient of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material shall be mixed with concrete nor does the mixing water flow out. Cement in required numbers of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregates, which shall also be spread in layers of uniform thickness on the mixing platform. Dry coarse and fine aggregates and cement shall then be mixed thoroughly by turning over to get a mixture of uniform colour, enough water shall then be gradually added thoroughly by and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 percent above that specified.

12. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in new batch. Unless otherwise agreed to by the Engineer in charge, the first batch of concrete from the mixer shall contain only two thirds of normal quantity of coarse aggregates. Mixing plant shall be thoroughly cleaned before changing from one type cement to another.

13. The method of transporting and placing concrete shall be approved by the Engineer in charge. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes place. All formwork 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 laid 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 depth of not more than 45 minutes 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 trunking or chutes are used they shall be kept clean and used in such a way as to avoid segregation. When concreting has to resume on surface which has hardened it shall be roughened swept, clean thoroughly wetted and covered with a 13mm thick layer of mortar composed of cement and sand in the same ratios as in the concrete mix itself. This 13mm 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 wall surface with wire or bristly brushed, 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 150mm in thickness and shall be well rammed against old work particular attention being given to corner and close spots.

16. All concrete shall be compacted to produce a dense homogenous mass with the assistance of vibrators unless otherwise permitted by the Engineer in charge for exceptional cases such as concrete 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 breakdowns.

17. Immediately after compaction, concrete shall be protected against harmful effect of weather including rains, running water, shocks, vibration, traffic, rapid temperature changes, frost and drying 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 not less than 14 days from the date of placement. Masonry 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. Formwork shall include all temporary or permanent forms required for forming the concrete together with all temporary construction required for their support. Formwork shall however be divided into following two distinct categories.

1. Shuttering i.e. formwork required for forming the concrete
2. Scaffolding i.e. formwork required for supporting shuttering.

Forms for shuttering shall be constructed only in metal suitably line. 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 dimension shown on the drawings. All bolts and rivets shall be countersunk and well ground to provide a smooth plane surface.

19. Forms shall be made 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 prescribed line occurring during and after the placing of concrete. Screw jack 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 member of structure, specially in long spans so counteract the effect of any fixed camber 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 section. Unless otherwise specified or directed, chamfers or fillets of size 25mm x 25mm 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 formwork or where otherwise agreed to by the Engineer in charge be coated with an approved material to prevent adhesion of concrete to the formwork. 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 prestressing tendons and anchorages. Different release agents shall not be used in formwork for concrete which will be visible in the finished work.

21. Special measures shall be taken to ensure that the formwork does not hinder or shrinkage or concrete because without these cracking could occur before the formwork is removed. Where ever applicable arrangements must be made to ensure that the formwork does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons. The formwork should take due account of the calculated amount of positive or negative camber so as to ensure the correct final shape for the structure having regard to the deformation of a false work, scaffolding or propping and the instantaneous or deferred deformation due to various causes affecting prestressed structures. Where there are re-entrant angles in the concrete sections the formwork 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. Formwork shall be tight enough to prevent any appreciable loss of cement during vibrations, suitable tolerance allowed. Contractor shall give the Engineer in charge due notice before placing 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, material and results obtained.

22. The Engineer in charge shall be informed in advance by the contractor of his intentions to strike any formwork. While fixing the time for removal of formwork due consideration shall be given to local condition, 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 the 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 wall 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 stress 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 permanent embedded metal part shall have less than 25mm cover to the finished concrete surface. Where it is intended to refuse 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 members and used for shuttering or any other purpose shall be cut inside the cement concrete member to a depth of at least 25mm 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 the form ties and all other holes and depressions, honeycomb 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 sue. Considerable pressure shall be applied in filling and pointing to ensure through filling in all voids. Surface which have been pointed shall be kept moist for a periods 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 lime of the steel reinforcement he may declare the concrete defective and required the removal and replacement of the portion of the structure affected.

24. In the case of reinforcement 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 slumps tests. Following slump shall be adopted for different type of works.

	Type of work	Slumps	
		Where vibrator are used	Where vibrator are not used
(i)	Mass concrete in RCC foundations, footing and retaining walls.	10mm to 25mm	80 mm
(ii)	Beams, slab and columns simply reinforced.	25mm to 40 mm	100mm to 120 mm
(iii)	Thin RCC section or section with congested	40mm to 50mm	125mm to 150mm

25. Works strength test 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 sample of concrete shall be taken on each day of concreting and cubes shall be made at the rate of one for every 5 Cu.M. of concrete or a part thereof. However if concreting done in a day is less than t15 Cu.M. the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer in charge. Similar works test shall be carried out whenever the quality and grading of materials is charges irrespective of the quantity concrete proud. 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 work cub strength 20 percent of the cubes cast for each day may have values less than the specified strength, provided the lowest value is not less than 85 percent of the specific strength.

27. R.C.C. work shall have exposed concrete surfaces. Centering design and its erection shall approved by the 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 kapachi 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 Assistant Engineer /

Addi. Asst. Engineer, Overseer or as instructed by the Engineer in charge. After removal 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 labours, materials, equipment etc for sampling preparing test cubes, curing etc. comp. 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 contractor

**30 The payment shall be made on Cu.M. basis for the finished work.**

31. The unit rate for concrete shall include the cost of all materials, labour, tools and plant required for mixing, placing in position, vibrating and compacting, finishing as per the 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 shown 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.

#### **Item No.- 15**

**Proving and laying cement concrete Grade M20 (1-cement : 1.5 sand : 3.0 coarse agg. Of 20mm nominal size) for CC road and curring etc. comp. incl. cost of form work. Finishing the cement concrete road by Tri-mix process inclusive of labour charges for trimix vacume dewatering process on cement conc. road by using vacume dewatering pump, surface floater, including channelling and making grooves & rough finish to surface, providing expansion joint, construction joint incl. filling the joint with asphalt filler as per direction by engineer in charge as per specification.**

1. 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 tables below for different grades of concrete designated as ordinary M100, M150, M200 and M250.

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 150mm cubes expressed in Kg/Cm<sup>2</sup>.

3. The ordinary concrete mix shall generally be specified by volume. For cement which normally comes in bags and issued by weight, volume shall be worked out taking 50 Kg. of cement as 0.035 Cu.M. In volume. While measuring aggregates 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}

3. Ingredient required for ordinary cement concrete containing one 50 Kg. bag of cement for different proportions of mix shall be as given the table below.

Grade of Concrete	Mix by Volume	Total Quantity of dry aggregates by volume per 50 Kg. of cement to be taken as sum of the individual volumes of fine and coarse aggregates mix	Proportion of fine aggregates to coarse aggregates	Quantity of water per 5 Kg. of cement max.
Ordinary	Liter	One Cubic meter = 1000 liters		Liter
M100	1:3:6	250	General 1:2 for fine agg. To coarse agg. By volumes but subject fo a upper limit of 1 : 1 ½ & a lower limit of 1:3	34
M150	1:2:4	220		32
M200	1:1 ½ : 3	160		30
M250	1:1:2	100		27

Note :- The proportion 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 aggregates becomes larger.

Example : For an average grading of fine aggregates (that is zone II or IS 383-1963) the proportions shall be 1 : 1 ½ : 1:2 and 1:3 for maximum size of aggregates 10mm, 20mm and 40mm respectively (after carrying out sieve analysis).

Note : 2 A mix leaner than M100 (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 requirement for mixing and placing & curing shall be the same.

#### 5. Following shall be the maximum nominal size of coarse aggregates for the different items of work

Sr. No.	Item of Construction	Maximum nominal size of coarse aggregates
1.	R.C.C. Well curbs, R.C.C. well staining and R.C.C. piles	40mm
2.	R.C.C. well staining	63mm
3.	Well cap or pile cap, solid type piers, abutment and wing walls and other pier caps	40mm
4.	R.C.C. work in cross girders, deck slab, wearing course, kerb, light post, blast walls, approach slab, etc. and hollow type piers, abutments, wing walls, and their pier cap	20mm
5.	R.C.C. bearings	20mm
6.	For any other items of construction not covered by Item 1 to 4.	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 be usually be restricted to 5mm less than the minimum cover to the reinforcement which is the smaller.

6. Fine aggregates shall be clean hard, coarse sand. It shall be free from dust and such other substance. The sand be got approved by the Engineer in charge.

7. All materials shall be stored as to prevent their deterioration or destruction 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 watertight 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 one very 3 to 4 months. The aggregates shall be stored in such a way as to prevent admixture of foreign materials different sizes of the fine or coarse aggregates shall be stored in separate stock piles sufficiently removed from each other to prevent inter mixing of the materials.

9. The water for mixing shall be potable water to satisfaction of the Engineer in charge. The quality 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 color of the entire mass is obtained and each individual particle of the coarse aggregates 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 on a smooth watertight platform large enough to allow efficient turning over of the ingredient of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material shall be mixed with concrete nor does the mixing water flow out. Cement in required

numbers of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregates, which shall also be spread in layers of uniform thickness on the mixing platform. Dry coarse and fine aggregates and cement shall then be mixed thoroughly by turning over to get a mixture of uniform color, enough water shall then be gradually thoroughly by and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 percent above that specified.

12. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in 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 aggregates. Mixing plant shall be thoroughly cleaned before changing from one type cement to another.

13. The method of transporting and placing concrete shall be approved by the Engineer in charge. Concrete shall be so transported and place that no contamination, segregation or loss of its constituent material takes place. All formwork 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 laced 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 depth of not more than 45 minutes 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 resumed on surface which has hardened it shall be roughened swept, clean thoroughly wetted and covered with a 13mm thick layer of mortar composed of cement and sand in the same ratios as in the concrete mix itself. This 13mm 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 wall surface with wire or bristly brushed, 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 150mm in thickness and shall be well rammed against old work particular attention being given to corner and close spots.

16. All concrete shall be compacted to produce a dense homogenous mass with the assistance of vibrators unless otherwise permitted by the Engineer in charge for exceptional cases such as concrete 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 breakdowns.

17. Immediately after compaction, concrete shall be protected against harmful effect of weather including rains, 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 periods not less than 14 days from the date of placement. Masonry work over the foundation concrete may be started after 48 hours of it's laying but the curing of concrete shall be continued for a minimum period of 14 days.

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

1. Shuttering i.e. formwork required for forming the concrete
2. Scaffolding i.e. formwork required for supporting shuttering.

Forms for shuttering shall be constructed only in metal suitably line. 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 dimension 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 prescribed line occurring during and after the placing of the concrete. Screw jack 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 member of structure, especially in long spans so counteract the effect 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 section. Unless otherwise specified or directed, chamfers or fillets of size 25mm x 25mm 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 formwork or where otherwise agreed to by the Engineer in charge be coated with an approved material to prevent adhesion of concrete to the formwork. 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 prestressing tendons and anchorages. Different release agents shall not be used in formwork for concrete which will be visible in the finished work.

21. Special measures shall be taken to ensure that the formwork does not hinder or shrinkage or concrete because without these cracking could occur before the formwork is removed. Where ever applicable arrangements must be made to ensure that the formwork does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons. The formwork should take due account of the calculated amount of positive or negative camber so as to ensure the correct final shape for the structure having regard to the deformation of a false work, scaffolding or propping and the instantaneous or deferred deformation due to various causes affecting prestressed structures. Where there are re-entrant angles in the concrete sections the formwork 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. Formwork shall be tight enough to prevent any appreciable loss of cement during vibrations, suitable tolerance cleaned. Contractor shall give the Engineer in charge due notice before placing 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, material and results obtained.

22. The Engineer in charge shall be informed in advance by the contractor of his intentions to strike any formwork. While fixing the time for removal of formwork due consideration shall be given to local condition, 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 the 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 wall 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 stress 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 permanent embedded metal part shall have less than 25mm 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 members and used for shuttering or any other purpose shall be cut inside the cement concrete member to a depth of at least 25mm 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 the form ties and all other holes and depressions, honeycomb 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 sue. Considerable pressure shall be applied in filling and pointing to ensure through filling in all voids. Surface which have been pointed shall be kept moist for periods 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 lime of the steel reinforcement he may declare the concrete defective and required the removal and replacement of the portion of the structure affected.

24. In the case of reinforcement 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 slumps tests. Following slump shall be adopted for different type of works.

	Type of work	Slumps	
		Where vibrator are used	Where vibrator are not used
(i)	Mass concrete in RCC foundations, fotting and retaining walls.	10mm to 25mm	80 mm
(ii)	Beams, slab and columns simply reinforced.	25mm to 40 mm	100mm to 120 mm
(iii)	Thin RCC section or section with congested	40mm to 50mm	125mm to 150mm

25. Works strength test 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 sample of concrete shall be taken on each day of concreting and cubes shall be made at the rate of one for every 5 Cu.M. of concrete or a part thereof. However if concreting done in a day is less than t15 Cu.M. the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer in charge. Similar works test shall be carried out whenever the quality and grading of materials is charges irrespective of the quantity concrete proud. 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 work cub strength 20 percent of the cubes cast for each day may have values less than the specified strength, provided the lowest value is not less than 85 percent of the specific strength.

27. R.C.C. work shall have exposed concrete surfaces. Centering design and its erection shall approved by the 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 kapachi 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 Assistant Engineer / Addi. Asst. Engineer, Overseer or as instructed by the Engineer in charge. After removal work checks that concrete produced is of good quality. Plastering shall not be allowed to the expressed faces of concrete.

~~28. Recron 3s 125 gram shall be added to per bag (50 Kg) of cement in concrete.~~

## **28 Tremix process ( Vaccume dewatering service ) on cement concrete road surface :**

Providing extra labour charges for tremix (vaccum dewatering service) process on C. C. road surface by using vaccum dewatering pump, floater surface vibrator making groves on surface as instruction incl. leveling etc. complete.

28.1. Working Method :

## Concrete Placing

Concrete can be placed & distributed by transit mixer, or else sufficient man power is required it is important to distributed the concrete evenly & as near the final level as possible.

### 28.2 Poker Vibration :

As a first step, concrete is vibrated with as immersion vibrator in order to remove, entrapped air & voids & make the concrete homogeneous. Please ensure that the areas close to channels & stop ends carefully vibrated. Do not distributed the concrete with the poker vibration along with the surface vibration.

### 28.3. Surface Vibration :

Surface Vibration should always start as soon as there is enough concrete in front of surface vibrator. Two passes with surface vibrator are required. During the first pass, concrete must be distributed evenly in front of surface vibrator. There should be a roll of concrete of about 10-20 mm in front of leading beam along the entire length of the vibrator. When the concrete has been placed and vibrated to a length of the vibrator. When the concrete has been placed and vibrated to a length of about 5 mm. the second pass is carried out. The machine should be pulled at a speed of maximum 1 mtr. / min and without interruption 'avoid finings' on the surface Keep the surface of the channel. Clean from concrete.

### 28.4. Vacuum Processing :

Please the filter pads as soon as the sufficient concrete surface is vibrated. Please note that the vacuum dewatering process must start within 30 minutes front the time of starting concrete pouring. Filter pads are placed in such away that there is at least 100 mm fresh concrete visible around the filter pads on all four sides. Filter should be overlapped with each other by at least 250 mm. (all filter are marked with black line to ensure proper overlapping).

The recesses or other obstacles within the area to be vacuum processed must be covered & sealed using polythene sheet before the filter pads are placed. If the obstacles are flush with the surface level or above. Filter pad must be found.

The rolled top cover is placed centrally on the filter pads. It is rolled out in such a way that it covers all filter pads & exposed concrete on the sides of the filter pads. Please note that the exposed concrete will ensure perfect sealing of the cover from the top.

Connect the central pipe of the top cover to the suction hose which in turn is connected to the vacuum pumps. When the pump is started vacuum will be created between the top cover & filter pads. Excess water will be taken in to the vacuum pump tank & discharged. Normal suction cycle is 1-1.5 min. per 10 mm of concrete thickness, Guidelines for selecting dewatering time (a) normal condition are shown in the following table.

Thickness in		Dewatering Time (min.)
MM	Inch	
50	2	7
100	4	15
125	6	20
150	8	30
200	10	40
250	12	45

Please note that dewatering time largely depends upon ambient conditions viz. Temperature, humidity, etc. During the course of dewatering. The concrete surface gradually hardens & can be felt from the top of the top cover. The extent of hardness achieved by the concrete decides when to stop dewatering process.

When the vacuum processing is over the cover is rolled up to 100 mm so that the sides of the filter pads are visible. This will remove the water that may have remained on the concrete surface. Filter pads & in the section hose. After about 30 seconds, the top cover is rolled completely & vacuum pump is switched off simultaneously. The suction hose & the top cover pipe are disconnected. Do not run the pump while the ball valve is open as likely that small aggregate are sucked in to the pump due to vacuum. The entire process is repeated on the next concrete panel.

After first patch in any / given panel is dewatered, care should be taken while piecing filter pad on the concrete surface next to the dewatered concrete. First filter pad should start from the edges of last filter pad of the previously dewatered concrete. The remaining filter pads then shall be placed as explained above.

While repeating dewatering process subsequently, in order that top cover should get proper sealing against the side already vacuum processed, it should be rolled out at least 250 mm over the vacuum dewatered area. Before spreading the top cover on the dewatered area, it is essential to give one pass of skim floater (with disc) along the edges of the dewatered concrete. The concrete surface will become wet as some will come on the top surface. This will provide the necessary sealing. Subsequently roll out top cover completely. Check that there are no wrinkles on the top cover.

#### 28.5. Floating :

The first finishing operation is floating where floating disc is used. Only the part that can not be reached by skim floater are floated by hand. Care should be taken while floating. Near channels & edges. The skim floater is run over the channel up to disc center in order to avoid unevenness at the joint. All four sides of dewatered panel must be floated first central area is to be floated later. Any corrections, if required are to be at this stage with the concrete collected at the time of raking only. Never use any cement paste.

Mixture of cement & sand or fresh for patchwork. Such material will pool off will leave black patches after the concrete floor is brought to use

Normally two passes with disc with the skim floater operating at higher speed are sufficient for the skid free surfaces. This pass of skim floater should be given, perpendicular to the previous pass. Please note that the floating operation brings up certain amount of water to the surface. This moisture helps in carrying out finishing operation.

#### 28.6. Trowel ling

Trowel ling is carried out with the same machine running on trowel ling blades. Normally, two pass of trowel ling blades are required for the smooth surface finish. However, the number of passes can be decided depending upon the surface finish required. The first trowel ling operation can start after the about 30 minutes after the final floating operation & surface is sufficiently dry. This pass is to be made using low speed & minimum blade angle. Please also use the lower speed when trowel ling near the channels, from edges obstacles etc. Blade angle & the speed can be increased for subsequent passes to achieve smoother surface finish.

28.7. Curing : Concrete has to be protected from rapid drying which may result in cracking. Curing can be done by ponding, covering with plastic sheet or gunny bags. In any method, the surface should be always kept wet with water. Curing can also be done by application of curing compound. Curing must be done for at-least 7 days.

### Intermixing of Topping

**First Pass :** You can start the work when Topping has darkened because of the moisture from the under using concrete. The Topping material is worked with care into concrete surface with a skim floater equipped with a disc.

### Intermixing of Topping

**Second Pass :** Check the surface flatness with straight edge and work the topping material into concrete as the first time.

### Power trowel ling

**First Pass :** The first trowel ling is carried out as a normal power – trowel ling.

At the time of final power – trowel ling, surplus concrete must be off from the rails and stop ends.

There must not be damage at the rails when the floor is finished

29. 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.

30. All necessary labours, materials, equipment etc for sampling preparing test cubes, curing etc. comp. 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 contractor

31 The payment shall be made on Cu.M. basis for the finished work.

32. The unit rate for concrete shall include the cost of all materials, labour, tools and plant required for mixing, placing in position, vibrating and compacting, finishing as per the 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 shown 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.

#### **Item No. 16**

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

The work include P & L. in position / HYSD / Mild Steel / Thermo – Mechanically Treated bar of the following grade.

Grade Designation	Bar Type Conforming to governing IS specification	Characteristic strength Fy MPa	Elastic Modulus GPa
S 415 & 500 D	IS 1786 High yield strength deformed bar	415 & 500	200
S 240	IS 432 Part II	240	

#### **TMT Bar**

**415 /500 D TMT Bar shall conform to min 415/500 MPa yield strength. Tensile strength of min 500 MPa and elongation percentage min 32. The chemical composition of bars shall be as below:-**

	<b>Max</b>
Carbon	0.25
Sulphur	0.05
Phosphorus	0.05
Sulphur & Phosphorus	0.01

1. All steel shall be procured from original producers, no re-rolled steel shall be incorporated in the work. Only new steel bars shall delivered to the site, Every bar shall be inspected before assembling in the work and defective brittle or brunt bar shall be discarded Cracked ends of bars shall be discarded.
2. The work shall consist of furnishing and placing reinforcement of the shape and dimensions shown on the drawings or as directed by the Engineer in charge.
3. Steel shall be clean and free from loose rust and loose mill scale at the time of fixing in position and subsequent concreting .Steel shall apply treatment of anticorrosive with powder of polymer base material before use.
4. Reinforcing steel conform accurately to the dimensions given in Bar bending schedules shown on relevant drawings. Bars shall be bent cold to the specified shape and dimensions or as directed by the Engineer in charge using a proper bar bender operated by hand or power to attain proper radius of bends. Bars shall not be bent or straightened in a manner that will injure the material. Bars bent during transport or handling shall be straightened before being used on work they shall be not heated to facilitate bending. Unless otherwise specified a 'U' type hook at the end of each bar shall invariably provided. 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 the diameter of the round bar. In the case of bars which are not round and in the case of deformed bars ten diameter shall be taken as the diameter of circle

having an equivalent effective area. The hooks shall be suitably encased to prevent any splitting of the concrete.

5. 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 conforming to IS: 280 and by using stay blocks or metal chairs, spacers, metal hangers supporting wires or other approved device at sufficiently close intervals. Bars will not be allowed to sag between supports nor displaced during concreting or any other operation of the work. All devices used for positioning shall be of non corrodible material wooden and metal supports will not extent to the surface of concrete except where shown on the drawings, placing bars on layers of freshly laid concrete laid concrete as the work progresses for adjusting bar spacing will not be allowed pieces of broken stone or brick and wooden blocks shall not be used layers of bars shall be separated by spacer bars precast mortar blocks or other approved devices. Reinforcement after being placed in position shall be maintained in a clean condition until completely embedded in concrete. Special care shall be exercised to prevent any displacement of reinforcement in concrete already placed. To protect reinforcement from corrosion concrete cover shall be provided as indicated on the drawings. All bars pronuding from concrete and to which other bars are to be spliced and which are likely to be exposed for an indefinite period shall be protected by a thick coat of neat cement grout.

6. Bars crossing each other where required, shall be secured by binding wire (annealed) of size not less than 1 mm and conforming to IS:280, in such a manner that they do not slip over each other at the time of fixing and concreting.

7. As far as 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 of 25 mm or 1.25 times the maximum size of the coarse aggregate whichever is greater by concrete between them where not feasible overlapping bars shall be bound with annealed steel wire, not less than 1 mm thickness twisted tight. The overlaps shall be staggered for different bars and located at points along the span where neither sphere not bending moment is a normal.

8. Whenever indicated on the drawings of desired by the Engineer-in-charge bar shall be jointed by couplings which shall have a cross-section sufficient to transits the full stresses of bars. The ends of the bars that are jointed by coplings shall be upset for a 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 standard white worth threads steel for coupling shall conform to IS :226

9. When permitted or specified on the drawings joints of reinforcement bars shall be butt welded so as to transmit their full stresses welded joints shall preferably be located at points where steel 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 metal and conforms to any or all other special provisions for the work will be accepted suitable means shall be provided for holding the bars securely in position during welding. It must be ensured that no voids are left in welding and when welding is done in 2 or 3 stages, previous scale, rust, grease, paint and other foreign matter before welding shall conform to IS 814 welded pieces of reinforcement shall be tested specimen shall be taken from the actual site and their number and frequency of tests shall be as directed by the Engineer – in – charge.

10. Reinforcement shall be measured in length excluding overlaps, separately for different diameters as actually used in the work, where welding or coupling is restored in place of lap-joints such joints shall be measured for payment as the equivalent length of over-lap as paver design requirement, From the length so measured the weight of reinforcement shall be calculated in tones on the same basis of IS : 1732. Length shall include hooks at ends wastage and anneakled steel wire for binding shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement.

11. Rates for reinforcement shall include cost of all steels carrying to work site and cutting, bending , placing, binding and fixing in position as shown on the drawings and as directed by the Engineer – in – Charge. It shall also include cost of all devices for keeping reinforcement in approved position cost of joint age as per approved methods and all wastage and spacer bars.

9. Reinforcement shall be measured in length as per Govt Circular No.PDW-10-2017-01-C Dt.15-02-2019 as actually used in the work, where wildlife or coupling is restored to, in place of lap-joints, such joints shall be measured for payment as the, equivalent length of over-lap as per design requirement. From the length so measured the weight of reinforcement shall be calculated in tonnes on the same basis of IS: 1732 even though steel is supplied to the contractor by the Departmental actual weighrntent. Length

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

**10. Rate for reinforcement shall include cost of cutting, bending, placing, binding and fixing in position. The unit of T.M.T. bar shall be measured on Kg.basis.**

#### **Item No. 17**

**Providing and fixing ordinary kilometer stone of pre-cast 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.**

1. Kilometer stone shall be of approved quality and shall be 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. stone shall be carried out 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.**

#### **Item No. 18**

**Providing and fixing hectometer as per I.R.C. type design including painting, lettering etc. complete. (ii) Fixing in C.C. 1:5:10**

The work shall be carried out as per the item of ordinary kilometer stone except that the size of hectometer stone shall be smaller than that of ordinary kilometer stone as per I.R.C. 26 (Type design for 200 metre stones) and fixing shall be in C.C. 1:5:10 which will consist of one part of cement, five part of good sand and ten parts of good brick bats. The measurement for payment as well as the operations included in the unit rate shall be as per ordinary kilometers stone. Rate includes all labour and curing etc. necessary for concrete.

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

#### **Item No. 19**

**Providing fixing Indicator stone of approved stone as per I.R.C. type design in c.c. 1:4:8 including white washing etc. complete. (ii) Fixing in C.C. 1:5:10**

Indicator stones shall be of approved quality and of the size 20 cm x 20 cm. its length shall not be less than 80 cms. The top, 38 cm shall be chisel dressed on all sides. The size, shape and dimension of the indicator stone shall be exact and stones shall be neatly dressed and finished before fixing. The indicator stones shall be fixed firmly in position in embankment or cutting as the case may be. The exposed part of the indicator stone shall be one by the contractor at his own cost. The measurement for payment shall be per number of indicator stone fixed in position.

The indicator stone shall be fixed in C.C.1:5:10 which will consist of one part of cement five part of good sand and ten parts of good brick bats. Rate includes all labour and during etc. necessary for concrete

2. Unit rate indicator stone includes the cost of all materials, labour tools, fixing and white washing as directed by the Engineer-in-charge.
- 3.0 The measurement for payment as well as operations included in the unit rate shall be as per item of sign boards.

#### 4.0. Payment shall made on unit No Basis.

##### Item No. 20

**Facility Informatory Sign :-**Providing and fixing sign boards with made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 80 x 60 cms. rectangular as per design of IRC-67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.6mtr long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting

##### 801.3.1. General requirements:

The retro-reflective sheeting used on the sign shall consist of the white or coloured sheeting having a smooth outer surface which has the property of retro-reflection over its entire surface. It shall be weather-resistant and show colour fastness. It shall be new and unused and shall show no evidence of cracking, scaling, and pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate of having tested the sheeting for these properties in an unprotected outdoor exposure facing the sun for two years and its having passed these tests shall be obtained from a reputed laboratory, by the manufacturer of the sheeting. The reflective sheeting shall be either of Engineering Grade material with enclosed lens or of High Intensity Grade with encapsulated lens. The type of the sheeting to be used would depend upon the type, functional hierarchy and importance of the road.

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

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

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

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



**801.3.3. Engineering grade sheeting:** This sheeting shall be of enclosed lens type consisting of microscopic lens elements embedded beneath the surface of a smooth, flexible, transparent, water-proof plastic, resulting in a non-exposed lens optical reflecting system. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro-reflection (determined in accordance with ASTM Standard: E-810) as indicated in Table 800-2.

**TABLE 800-2 ACCEPTABLE MINIMUM COEFFICIENT OF RETRO-REFLECTION FOR HIGH INTENSITY GRADE SHEETING (CANDELAS / LUX PER SQUARE METRE)**

Observation angle (in degrees)	Entrance angle (in degrees)	White	Yellow	Orange	Green	Red	Blue
0.2	-4	70	50	25	9.0	14.5	4.0
0.2	+30	30	22	7.0	3.5	6.0	1.7
0.5	-4	30	25	13.5	4.5	7.5	2.0
0.5	+30	15	13	4.0	2.2	3.0	0.8

When totally wet, the sheeting shall not show less than 90 per cent of the values, of retro-reflection indicated in Table 800-2. At the end of 5 years, the sheeting shall retain at loss 50 % of its original retro-reflectance.

#### **801.3.4. Messages/borders:**

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

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

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

#### **801.3.7. Colour:**

Unless otherwise specified, the general colour schbm6 shall be as stipulated in IS 5 "Colour for Ready Mixed Paints", viz.

- Blue - is Colour No. 166: French Blue
- Red - is Colour No. 537: Signal Red
- Green - is Colour No. 284: India Green
- Orange - IS Colour No. 591: Deep Orange.

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

#### **801.3.8. Adhesives:**

The sheeting shall either have a pressure sensitive adhesive of the aggressive-tack type requiring no heat, solvent or other preparation for adhesion to a smooth clean surface, or a tack free adhesive activated by heat, applied in a heat-vacuum applicator, in a manner recommended by the sheeting manufacturer. The adhesive shall be protected by an easily removable liner (removable by peeling without soaking in water or

other solvent) and shall be suitable for the type of material of the base plate used for the sign. The adhesive shall form a durable bond to smooth, corrosion and weather resistant surface of the base plate such that it shall not be possible to remove the sheeting from the sign base in one piece by use of sharp instrument. In case of pressure-sensitive adhesive sheeting, the sheeting shall be - applied in accordance with the manufacturer's Specifications. Sheeting with adhesives requiring use of solvents or other preparation for adhesive shall be applied strictly in accordance with the manufacturer's instructions.

#### **801.3.9. Refurbishment:**

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

#### **801.3.10. Fabrication:**

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

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

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

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

#### **801.4. Installation:**

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

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

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

**801.5: Measurements for Payment:**

The measurement of standard cautionary, mandatory and information signs shall be in numbers of different types of signs supplied and fixed. Payment shall made on no.basis.

**801.6. Rate**

The Contract unit rate shall be payment in full for the cost of making the informatory cum logo sign board as per item description, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications.

**Item No. 21**

**Citizen Information Board:-**Providing and fixing sing boards made out of 2mm aluminium sheet; size 180 x 120cms. rectangle as as per the design of IRC-67-1977 pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro refiective sheeting as per latest M.O.S.T. Specifications; Letters and numerals should be as per IRC-30-1968, 3.1m long (2 nos) stand post and frame fabricated from suitable size iron angle of 50 x 50 x 5mm 75x75x6mm as required; painted with best quality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)

The Specification for this Item shall be applicable as per Item No.20. Payment shall be made on No.basis

**Item No. 22**

**Cautionary Warning Sign :-**Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 90 x 90 x 90 cms. equilateral triangle as per design of IRC-67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro refiectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.6mtr long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective

The Specification for this Item shall be applicable as per Item No.20. Payment shall be made on No.basis

#### **Item No. 23**

**Give Way Sign :-**Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 90 x 90 x 90 cms. equilateral triangle as per design of IRC-67-2012. Pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.6mtr long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting

The Specification for this Item shall be applicable as per Item No.20. Payment shall be made on No.basis

#### **Item No. 24**

**Direction (Junction) Sign :-**Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 244x122 cms. rectangular as per design of IRC-67-2012. Pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 4.0mtr (2 Nos.) long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 50x50x5mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting.

The Specification for this Item shall be applicable as per Item No.20. Payment shall be made on No.basis

#### **Item No. 25**

**STOP Sign :-**Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 90 cms. Octagonal as per design of IRC-67-2012. Pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.6mtr long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting.

The Specification for this Item shall be applicable as per Item No.20. Payment shall be made on No.basis

**Item No. 26**

Village name Sign :-Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 90x60 cms. rectangular as per design of IRC-67-2012. Pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflective sheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.3mtr long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with best quality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 Cms. for each leg including excavation, curing etc. complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting

The Specification for this Item shall be applicable as per Item No.20. Payment shall be made on No.basis

**Item No. 27**

Road marking with hot applied thermoplastic paints with reflectorising glass beads on bitumin surface providing and laying a hot applied thermoplastic compound 2.5 mm thick including reflectorising glass beads @ 250gms per sqm area, thickness of 2.5mm is excluding of surface applied glass beds as per IRC:35-2015. The finished surface to be level, uniform and free from streaks and holes. zebra patta /bump patta lane/center line/ edge line/cut patta. The white color marking should provide luminance coefficient on cement road shall be min 130 mcd/m<sup>2</sup>/lux and Asphalt road shall be min 100 mcd/m<sup>2</sup>/lux during the service life during the day time. The marking should meet the performance criteria for night time reflectivity, wet reflectivity and skid resistance as mentioned in the section-15 of IRC 35-2015. Warranty for the Retro reflectivity should be two years.

**ROAD MARKINGS :-**

General :-The colour, width and layout of road markings shall be in accordance with the Code of Practice for Road Markings with paints, IRC : 35 - 2015, and as specified in the drawings or as directed by the Engineer.

**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.

**Hot Applied Thermoplastic Road Marking :-****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 colour of the compound shall be white or yellow OS colour 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

**Thermoplastic Material:**

General:- The thermoplastic material shall be homogeneously composed of aggregate, pigment, resins and glass reflectorizing beads

**Requirements:-**

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 below:

Table : 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.	Refer Note
Yellow Pigments	--	Refer 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.

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

(i)(a) Luminance:-

White: Day light luminance at 45 degree-65 per cent min. as per AASHTO M-249

Yellow: Day light 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 bear 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;±9.5 degree C as per ASTM D-36.

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

(ii) 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 shall be 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 Reflectorising glass beads.

(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 manufacturer
4. Colour (white or yellow)
5. Maximum application temperature and maximum safe heating 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.

#### REFLECTORISING GLASS BEADS:-

General:- This specification covers two types of glass beads to be used for the production of reflectorised pavement markings.

Type-1 beads are those which are a constituent of the basic thermoplastic compound vide above table and beads are those which are to be sprayed on the surface vide Clause table.

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

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

**Specific requirements:-**

- (A) Gradation:- The glass beads shall meet the Gradation requirements for the two types as given table below:

**GRADATION REQUIREMENTS FOR GLASS BEADS**

Sieve Size	Per Cent retained	
	Type-1	Type-2
1.18 mm	0 to 3	--
850 Micron	5 to 20	0 to 5
600 Micron	--	5 to 20
425 Micron	65 to 95	
300 Micron	--	30 to 75
180 Micron	0 to 10	10 to 30
below 180 Micron	---	0 to 5

(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.

**Test Methods: The specific requirements shall be tested with the following methods:**

- Free flow test: Spread 100 grams of beads evenly in a 100 mm diameter glass dish. Place the dish in a 250 mm inside diameter desiccator which is filled within 25 mm of the top of a desiccator plate with sulphuric acid water solution. Cover the desiccator and let it stand for 4 hours at 20 to 29 degree C. Remove sample from desiccator, transfer beads to a pan and inspect for lumps or clusters. Then pour beads into a clean, dry glass funnel having a 100 mm stem and 6 mm orifice. 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.
- 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 3262 (Part-I).
- 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.

**Application properties of thermoplastic material:-**

The thermoplastic material shall readily get screeded/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. The material upon heating to application temperatures, shall not exude fumes, which are toxic, obnoxious or injurious to persons or property.

**Preparation:-**

- 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.

**Properties of finished road making:-**

- (a) The stripe shall not be slippery when wet.
- (b) The making shall not lift from the pave in freezing weather.
- (c) After application and proper drying, the stripe shall show no appreciable deformation or discolouration under traffic and under road temperatures upto 60 degree C.
- (d) The marking shall not deteriorate by contact with sodium chloride, calcium chloride or oil drippings from traffic.
- (e) The stipe 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 colour of yellow marking shall conform to IS Colour No.356 as given in IS-164.

**APPLICATION:**

- i) Marking shall be done by machine. For locations where painting cannot be done 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.
- ii) The thermoplastic material shall be applied hot either by screeding on 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.
- iii) The pavement temperature shall not be less than 10 degree C during application. All surfaces to be marked shall be thoroughly cleaned of all dust, dirt, grease, oil and all other foreign material before application of the paint.
- iv) 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 places.
- v) 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 meter area.
- vi) 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).
- vii) 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 upper surface of the lines shall be level, uniform and free from streaks.

**Marking:-** Marking like lane markings, centre line marking and edge line marking shall be done strictly as prescribed in IRC-35-2015

**Performance Criteria**

The performance criteria given below are applicable for the white color pavement markings only.

1. Daytime Visibility: The luminance co-efficient under diffuse illumination  $Q_d$  for road marking on
  - a. Cement Road, shall be min of 130 mcd/m<sup>2</sup>/lux during the expected life service time
  - b. Asphalt Road, shall be min of 100 mcd/m<sup>2</sup>/lux during the expected life service time
2. Nighttime Visibility:
  - i) Dry Retro Reflection



Dry retroreflectivity shall be compliant with Table 15.1 of IRC 35-2015 and measured in accordance with the method described in Annexure E of IRC 35-2015.

Table: 15.1 Initial and Min. performance for Dry retro reflectivity during nighttime

S.No.	Design Speed	RL Retro Reflectivity (mcd/m <sup>2</sup> /lux)	
		Initial (7 days)	Min Threshold Level (TL) and warranty Period Required upto 2 years
1	Up to 65	200	80
2	65-100	250	120
3	Above 100	350	150

**MEASUREMENTS AND PAYMENT:-**

The painted marking shall be measured in **Square Meters (Sq.Mtr.)** of actual area marked (excluding the gaps, if any). In respect of marking like directional arrows and lettering etc, the measurement shall be by numbers. Contractor shall have to submit the manufacture test certificate before starting the work at no extra cost. Contractor shall have to submit the test report of both thermoplastic paint and glass beads from approved laboratory for paint & glass beads at no extra cost before producing bill and then after on end when asked.

**Rate:-**

The contract unit rate for road markings shall be payment in full compensation for furnishing all 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 drawings or as directed by the Engineer and all other incidental costs necessary to complete the work to these specification.

**❑ Special Requirement for Hot Applied Thermoplastic Marking and Audible Vibratory Profile Marking Application on Road**

1. The application of Hot Applied Thermoplastic and Audible Vibratory marking must be done with Either Fully Automatic or Semi-Automatic Application Machine only. No Manual Machine is allowed to use for the application of the Thermoplastic marking.
2. The Applicator must have their own machines for Thermoplastic profile Marking, and the proof of ownership to be submitted to the Authority for source approval.
3. The Applicator should be either Manufacturer or authorized by the original manufacturer of the Material. The applicator should submit such authorization certificate to the Authority for the approval before commencing the work.
4. The manufacture should be ISO certified organization and the copy of the certificate should be submitted to the Authority.
5. Performance Criteria: Material should be confirming to MoRTH specification and test Certificate should be submitted as per the IRC 35-2015 for the reflectivity and luminance test time to time.
6. The Applicator should organize onsite testing for the reflectivity performance with reflectometer initially at 7 days and afterwards at interval of every 6 months up to 2Years. And performance should meet IRC 35-2015 criteria.

7. The Applicator should submit in original warranty for satisfactory in field performance as laid down in IRC 35-2015 for the period of 2 years. The warranty should be in original and jointly signed by the original manufacture and authorized applicator.

**Signature of  
contractor**

**Deputy Executive Engineer  
Panchayat R. & B. Sub Division  
Dayapar-Kachchh**

**Executive Engineer  
Panchayat R. & B. Division  
Bhuj-Kachchh**