

# **TECHNICAL SPECIFICATIONS**

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### **1.0 PREAMBLE:-**

1.1 The Technical Specifications contained herein shall be read in conjunction with the other Bidding Documents as specified in this Volume.

### **1.2 Site Information:-**

1.2.1 The information given here under provided elsewhere is given in good faith by the Employer but the Contractor shall satisfy himself regarding all aspects of site conditions and no claim will be entertained on the plea that the information supplied by the Employer is erroneous or insufficient.

### **2.0 GENERAL REQUIREMENTS:-**

The technical specifications in accordance with which the entire work described herein after shall be constructed and completed by the Contractor shall comprise of the "SPECIFICATION"

2.1 Though "SPECIFICATION" for each item are attached with tender they are based on following.

(1) "SPECIFICATION FOR ROAD AND BRIDGE WORKS" (Fourth REVISION printed in year 2001) issued by the Ministry of Road Transport & Highways (MORT & H), Government of India and Published by the Indian Roads Congress, hereinafter to as MORT & H Specifications.

(2) The General Technical Specifications for Road works.

(3) The General Technical Specifications for Bridge works.

Note:- (2) To (3) are Conventional Specifications Booklets usually attached for (R&B) Works.

2.2 If, a particular clause (which is incorporated in "SPECIFICATION") of specification booklets (1) to (3) above is Amended / Modified/ Added upon then the Amendment/ Modification/Addition shall supersede the relevant clause incorporated in " SPECIFICATION"

2.3 In, so far as Amended / Modified / Added Clause may come in conflict or be inconsistent with any of the provisions of the MORT & H Specifications under reference, the Amended/Modified/ Added Clause and the additional specifications shall always prevail.

2.4 In the absence of any definite provisions on any particular issue in the aforesaid Specifications, reference may be made to the latest codes and specification, of IRC and BIS in that order. Where even these are silent, the construction and completion of the works shall conform to sound engineering practice as approved by the ' Engineer' and , in case of any dispute arising out of the interpretation of the above, the decision of the 'Engineer' shall be final and binding on the Contractor.

**Name of Work :- TASP 2025-26**

**Manmodi Kanchanpada Road km 0/0 To 1/0, Tal. Waghai. Dist. Dang**

### **ITEM WISE SPECIFICATION**

**Item No.1      Clearing and grubbing road land including uprooting rank vegetation, grass bushes, shrubs, saplings and trees girth up to 300 mm removal of stumps of trees cut earlier and disposal of unserviceable materials.(D) By mechanical means in area of thorny jungle.**

**201.1. Scope**

This work shall consist of cutting, removing and disposing of all materials such as trees, bushes, shrubs, stumps, roots, grass, weeds, top organic soil not exceeding 150 mm in thickness, rubbish etc., which in the opinion of the Engineer are unsuitable for incorporation in the works, from, the area of road land containing road embankment, drains, cross-drainage structures and such other areas as may be specified on the drawings or by the Engineer. It shall include necessary excavation, backfilling of pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, and disposal of cleared materials. Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these Specifications.

**201.2. Preservation of Property/Amenities**

Roadside trees, shrubs, any other plants, pole lines, fences, signs, monuments, buildings, pipelines, sewers and all highway facilities within or adjacent to the highway which are not to be disturbed shall be protected from injury or damage. The Contractor shall, provide and install at his own expense, suitable safeguards approved by the Engineer for this purpose.

During clearing and grubbing, the Contractor shall take all adequate precautions against soil erosion, water pollution, etc., and where required, undertake additional works to that effect vide Clause 306. Before start of operations, the Contractor shall submit to the Engineer for approval, his work plan including the procedure to be followed for disposal of waste materials, etc., and the schedules for carrying out temporary and permanent erosion control works as stipulated in Clause 306.3.

**201-3. Methods, Tools and Equipments**

Only such methods, tools and equipment as are approved by the Engineer and which will not affect the property to be preserved shall be adopted for the Work. If the area has thick vegetation/roots/trees, a crawler or pneumatic tyred dozer of adequate capacity may be used for clearance purposes. The dozer shall have ripper attachments for removal of tree stumps. All trees, stumps, etc., falling within excavation and fill lines shall be cut to such depth below ground level that in no case foil within 500 mm of the subgrade. Also, all vegetation such as roots, under-growth, grass and other deleterious matter unsuitable for incorporation in the embankment/subgrade shall be removed between fill lines to the satisfaction of the Engineer. On areas beyond these limits, trees and stumps required to be removed as directed by the Engineer shall be cut down to 1 m below ground level so that these do not present an unsightly appearance.

All branches of trees extending above the trimmed as directed by the Engineer.

All excavations below the general ground level arising out of the removal of trees, stumps, etc., shall be filled with suitable material and compacted thoroughly so as to make the surface at these points conform to the surrounding area.

Ant-hills both above and below the ground, as are liable to collapse and obstruct free subsoil water flow shall be removed and their workings, which may extend to several metres, shall be suitably treated.

#### **201.4. Disposal of Materials**

All materials arising from clearing and grubbing operations shall be the property of Government and shall be disposed of by the Contractor as hereinafter provided or directed by the Engineer.

Trunks, branches and stumps of trees shall be cleaned of limbs and roots and stacked. Also boulders, stones and other materials usable in road construction shall be neatly stacked as directed by the Engineer. Stacking of stumps, boulders, stones etc., shall be done at specified spots with all lead and lift.

All products of clearing and grubbing which, in the opinion of the Engineer, cannot be used or auctioned shall be cleared away from the roadside in a manner as directed by the Engineer. Care shall be taken to see that unsuitable waste materials are disposed of in such a manner that there is no likelihood of these getting mixed up with the materials meant for embankment, subgrade and road construction.

#### **201.5. Measurements for Payment**

Clearing and grubbing for road embankment, drains and cross-drainage structures shall be measured on area basis in terms of hectares. Clearing and grubbing of borrow areas shall be deemed to be a part of works preparatory to embankment construction and shall be deemed to have been included in the rates quoted for the embankment construction item and no separate payment shall be made for the same. Cutting of trees upto 900 mm in girth including removal of stumps and roots, and trimming of branches of trees extending above the roadway shall be considered incidental to the clearing and grubbing operations. Removal of stumps left over after trees have been cut by any other agency shall also be considered incidental to the clearing and grubbing operations.

#### **201.6. Rates**

**201.6.1.** The Contract unit rates for the various items of clearing and grubbing shall be payment in full-for carrying out, the required operations including full compensation for all labour, materials, tools, equipment and incidentals necessary to complete the work. These will also include removal of stumps of trees less than 900 mm in girth as well as stumps left over after cutting of trees carried out by another agency, excavation and back-filling to required density, where necessary, and handling, salvaging, piling and disposing of the cleared materials with all lead and lifts.

**Item No.2      Earth work in cutting in all coats of soil and soft murrum including conveying and putting the stuff in spoil bank maintaining minimum distance of five meter between top edge of cutting and top of spoil bank.**

This work shall consist of Earth work in cutting in all sorts of soil and soft murrum etc. which may be necessary for road side gutter or road formation in accordance with

requirements of these specifications and the lines, grades and cross sections shown in the drawings or as indicated by the Engineer.

1. The land width required for the roadway, gutter side slopes and catch water gutters shall be cleared of all trees 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 or damage to the work, property or people in the neighborhood. If the materials are to be disposed off 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 land width required for the roadway, gutter side slopes and catch water gutters shall be cleared of all trees 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 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 10m. 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 that 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 relevant 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 away 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 into 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 7mt. 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. The useful excavated material shall be used in embankment with all lead and lift and it shall be directly deposited at the required location in specified layers. No handling or conveyance charges shall be paid if the material is temporarily deposited elsewhere and subsequently conveyed to site of deposition. The sequence of operations at convenient places shall be, without interfering with the drainage in any way. If no Government land is available but the excavated useful stuff is to be stacked temporarily before use under the same agreement, the contractor shall make his own arrangements 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.

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 as above.
8. The Contract rate shall be a unit of one cubic meter for the strata mentioned in the item of excavation acceptably completed, limited to the dimensions shown on the plans or as directed by the Engineer. The measurements shall be paid on cross sectional measurements and computing the volumes of earth work in cubic meters by average area method. When the classification of the strata changes, the contractor shall bring this to the notice of the Engineer, who will then verify and if necessary take levels for the changed strata for purpose of measurement.

**Item No. 3    Supplying fixing & joining reinforced concret heavy duty non pressure pipe carrying indian railway standard with collars for culverts carrying heavy traffic as per Indian railway standard specification including setting and joining the pipe in cement mortar 1:2 watering or laying (to level and slope) of I.S.class NP-3 600mm dia internal**

1. The work shall consist of furnishing and installing reinforced cement concrete pipe of the type diameter and length required at the location shown on the drawings or as ordered by the Engineer-in-charge.
2. Reinforced concrete pipe shall be NP-3 type conforming to the requirements of IS: 458 and shall be of 300, 600, 900, 1200 mm internal dia. as specified in the item. Each consignment of cement concrete pipes shall be inspected, if necessary and approved by the Engineer-in-charge, either at the place of manufacture or at the site before their incorporation in the works.

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

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

**FORM OF CERTIFICATE FOR NP3, NP2, NP1 PIPES**

We \_\_\_\_\_ manufacturer of R.C.C. pipes produce R.C.C. pipes as per the requirement of IS: 458 and also carry out the required test at our place.

We have acquired equipments for carrying out test and are prepared to carryout test at our factory sites.

We have experience of manufacturing of pipes of \_\_\_\_\_ years The' pipes supplied by us to M/s. \_\_\_\_\_ satisfy the requirement of IS: 458

Date : \_\_\_\_\_

Place : \_\_\_\_\_ Manufacturer's Sign. \_\_\_\_\_

3. No pipe shall be placed in position until the foundations have been approved by the Engineer-in-charge. Where two or more pipes are to be laid adjacent to each other, they shall be separated by a distance equal to at least half the diameter of the pipe subject to minimum of 450 mm. The laying of pipes on the prepared foundation shall start from the outlet and proceed towards the inlet and be completed to the specified lines and grades. The pipes shall be fitted and matched so that when laid in works they form a culvert with a smooth uniform invert. Any pipe found defective or damaged during laying shall be removed at there cost of Contractor.
4. The pipes shall be jointed either by collar joint or by flush joint. In the former case, the collars shall be of R.C.C., 150 to 200 mm wide and having the same strength as the pipes to be jointed. Caulking space shall be between 13 and 20 mm according to the diameter of the pipes. Caulking material shall be slightly wet mix of cement and sand in the ratio of 1:2 rammed with Caulking irons. Before caulking the collar shall be so placed that its centre coincides with that of pipe and an even annular space is left between the collar and the pipes. Flush joint may be shaped to form a self centering joint with a joining space 13 cm wide. The joining space shall be filled with cement mortar. 1 cement to 2 sand, mixed sufficiently dry to remain in position when forced with a trowel or rammer. Care shall be taken to fill all voids and excess mortar shall be removed. All joints shall be made with care so that their interior surface is smooth and consistent with the interior surface of the pipes. After finishing, the joint shall be kept covered and damp for at least four days.
5. R.C.C. pipe shall be measured along their centre between their inlet and outlet ends in linear meters.
6. The rate for the pipes shall include the cost of pipe including loading, unloading, handling storing laying in position and joining complete.

**Item No.4 Supplying, Stacking and Spreading the Hard Murrum including rolling and watering etc. Complete.**

1. The materials for the purpose shall be of approved quality. Any materials which are found inferior shall be rejected and the contractor shall remove such rejected materials from the site at his own cost. The material shall be approved by the Executive Engineer or his authorized agent.
2. River or nala or sea sand required for the work shall be clear, sound, properly, graded, free from organic materials sill clay etc. and shall be got approved by the Engineer-in-charge. The sand shall be obtained and brought from the source approved by the Engineer-in-charge. The sand shall be well graded. The payment shall be made on Cubic Metre basis.
3. Stacking shall be done by filling in the standard steel boxes, of 2 m x 1.5 m x 0.5 m size which shall be supplied by the Department if available on rent. Otherwise contractor shall



make his own arrangement. No deduction for voids shall be made from (lie grade measurements. Where any doubt exists as to whether the quantity of stacks of murrum in an hectometer is not confirming with the cubic content of the standard pharas (2 x 1,5 x 0,5 M) the same shall be got corrected by the contractor if so ordered by the Engineer-in-charge for which no extra payment shall be claimed by the contractor. If the quantity of murrum in any stack in a particular hectometre is found to be less than the standard measurements viz., 1.5 cmt. The entire collection in the hectometer shall be paid on the basis of His quantity so found. Regular slacks shall be done by the Contractor on a fairly level ground Stacking of the mut-rum sati be done in a manner as erected by the Engineer-in-charge.

4. For road work completed stacking of murrum as per requirement shall be earned out in 2 K.M. length before spreading. The collection shall always, be commenced at one end of the K.M. and be carried continuously toward the other end unless the Engineer-in-charge shall direct otherwise.
5. The payment shall be made on cubic metre basis without deduction for voids. The contractor shall maintain all stacks in regular and proper size till the whole materials are collected, measured and finally accepted by the Department. The spreading of materials shall not be allowed till the materials are fully stacked and completed kilometer wise.
6. The rate includes cost of collection, conveyance to the site with all lead and lift and filling the boxes including all labour, tools, equipment and other incidental expenses.
7. The rate quoted are inclusive of all shall such tools.-duties, fees. royalties, taxes etc.

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

The measurements shall be taken on cubic meter basis.

**Item No.5      Construction of Granular Sub Base by providing coarse graded machine crushed B. T. material satisfying MOST Specification of Grading - I using 53 mm to 26.5 mm @ 30% (M.C. Metal), 26.5 mm to 4.75 mm @ 60% (M.C.Metal), 2.36 mm below @ 10% (Stone Dust) including spreading in uniform layer with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC and compacting with vibratory roller to achieve the desired density with C.B.R. > 30% etc. complete.**

#### **401.1 Scope :**

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

The materials to be used for the work shall be a machine crushed crushed stone aggregate. The material shall be free from organic or other deleterious constituents and confirm to the Table 400.2 grading I.

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

| IS sieve Designation | Percent by weight passing the IS sieve. Grading I |
|----------------------|---|
| 75.0 mm              | 100   |
| 83.0 mm              | -   |
| 26.5 mm              | 55 – 75   |
| 9.5 mm               | -   |
| 4.75 mm              | 10 – 30   |
| 2.365 mm             |   |
| 0.425 mm             |   |
| 0.075 mm             | < 10  |
| CBR Value (Minimum)  | 30  |

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 percent respectively.

#### **401.2.2 Physical requirements:**

The materials shall have a 10 percent fines value of 50 KN or more (for sample in soaked condition) when tested in compliance with B.S.: 812 (Part 111). The water absorption value of the coarse aggregate 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 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 percent.

#### **401.3 Strength of sub-base.**

It shall be ensured prior to actual execution that the material to be used in the sub base satisfies the requirements of CBR and other physical requirements when compacted and finished.

When directed by the Engineer, this shall be verified by performing CBR tests in the laboratory as required on specimens remolded at field dry density and moisture content and any other tests for the "Quality" of materials, as may be necessary.

#### **401.4 Construction Operations:**

##### **401.4.1 Preparation of Sub grade:**

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

##### **401.4.2 Spreading and compacting:**

The sub-base material of grading specified in the Contract shall be spread on the prepared sub grade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation or other means as approved by the Engineer.

When the sub-base material consists of combination of materials mentioned in Clause 401.2.1, of this item 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 of other means approved by the Engineer so that, at the time of compaction, it is from 1 percent above to 2 percent below the optimum moisture content corresponding to IS:2720 (Part 8). While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means like disc barrows, rotavators until the layer is uniformly wet.

Immediately thereafter, rolling shall start. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 KN weight may be used. For a compacted single layer upto 225 mm the compaction shall be done with help of a vibratory roller of minimum 80 to 100 KN static weight with plain drum or pad foot drum or heavy pneumatic tyred roller of minimum 200 to 300 KN weight having a minimum tyre pressure of 0.7 MN/ M<sup>2</sup> or equivalent capacity roller capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional cross fall and super elevation and shall commence at the edges and progress towards the centre for portions having cross fall on both sides each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling, the grade and cross fall (camber) shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 Km per hour. Rolling shall be continued till the density achieved is at least 98 percent 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 of MORT & H specifications. Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900 of MORT & H specifications.

#### **401.6 Arrangements for Traffic:**

During the period of construction, arrangement of traffic shall be maintained in accordance with Clause 112 of MORT & H specifications.

#### **401.7 Measurements for Payment:**

Granular sub base shall be paid as finished work in position on cross sectional measurements and computing the volume of GSB work in cubic meters by average area method.

The protection of edges of granular sub base extended over the full formation as shown in the drawing shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

#### **401.8 Rate:**

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

- [i] Making arrangements for traffic to Clause 112 as above 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 lift.
- [iii] All labour, tools, equipment and incidentals to complete the work to the specifications.
- [iv] Carrying out the work in part widths of road where directed, and
- [v] Carrying out the required tests for quality control.

**Item No.6 Providing & laying 50 mm. thick compacted Bituminous Macadam with using Emulsion RS1 for tack coat at 2.50 Kg / 10 Sq.Mt. using stone aggregate as per gradation and asphalt grade VG-30 at 3.40 % by weight of total mix hot laid process with drum mix plant including consolidation with vibrating roller including operating plant and machinery cost of asphalt, fuel, oil, lubricant and labour charges etc. complete.**

#### **Scope :-**

This work shall consist of bituminous construction in a course having 50 mm thickness course of compacted crushed aggregates premixed with a bituminous binder on a previously prepared base to the requirements of these specification.

#### **504.2 Materials :-**

##### **504.2.1 Bitumen:-**

The bitumen shall be paving bitumen of Viscosity grade (VG-30) complying with Indian Standard specification for "Paving Bitumen" IS:73.

##### **504.2.2 Coarse aggregates:-**

The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on the 2.36 mm sieve. They shall be clean, hard, durable of cubical shape, free from dust and soft or friable matter, organic or other deleterious matter. Where the contractor's selected source of aggregates have poor affinity for bitumen, as a condition for the approval of that source, the bitumen shall be treated with approved anti-stripping agents as per the manufacturer's recommendations, without additional payment. Before approval of the source the aggregate shall be tested for stripping.

The aggregates shall satisfy the physical requirements set forth in Table 500-3 as under.

**Table 500.3 Physical, Requirements for Coarse aggregates for bituminous Macadam**

| <b>Property</b> | <b>Test</b>                               | <b>Specification</b>            |
|-----------------|---|---------------------------------|
| Cleanliness     | Grain Size analysis                       | Max. 5% passing 0.075 mm sieve. |
| Particle shape  | Flakiness and Elongation Index (Combined) | Max. 30%                        |
| Strength        | Los Angeles Abrasion Value                | Max. 40%                        |

| Property          | Test   | Specification                |
|-------------------|--|------------------------------|
|                   | Aggregate Impact Value                               | Max. 30%                     |
| Durability        | Soundness Sodium Sulphate                            | Max. 12%                     |
|                   | Magnesium Sulphate                                   | Max. 18%                     |
| Water Absorption  | Water Absorption                                     | Max. 2%                      |
| Stripping         | Coating and stripping of Bitumen aggregate Mixtures. | Minimum retained coating 95% |
| Water Sensitivity | Retained Tensile Strength                            | Minimum 80%                  |

**Notes :-**

- [1] IS: 2386 Part – 1
- [2] IS: 2386 Part – 1 [the elongation test to be done only on non-flaky aggregate in the sample]
- [3] IS: 2386 Part – 4
- [4] IS: 2386 Part – 5
- [5] IS: 2386 Part – 3
- [6] IS: 6241
- [7] The water sensitivity test is only to be carried out if the minimum retained coating in the stripping test is less than 95 %

\*\*\* Aggregate may satisfy requirements of either of these two tests.

Where crushed gravel is proposed for use as aggregate not less than 90% by weight of the crushed material retained of the 4.75 mm sieve shall have at least two fractured faces.

**504.2.3 Fine aggregates:-**

Fine aggregates shall consist of crushed or naturally occurring material or a combination of the two passing 2.36 mm sieve and retained on 75 micron sieve. They shall be clean hard, durable, dry and free from dust, and soft or friable matter, organic or other deleterious matter.

**504.2.4 Aggregate grading and binder content:-**

When tested in accordance with IS : 2386 Part-1 (wet sieving method) the combined aggregate grading for the particular mixture shall fall within the limits type and quantity of bitumen and appropriate thickness are also indicated for each mixture type.

**504.2.5 Proportioning of material:-**

The aggregates shall be proportioned and blended to produce a uniform mixture complying with the requirements of Table 500-4. The binder content shall be within a tolerance of  $\pm 0.3$  % by weight of total mixture when individual specimens are taken for quality control tests in accordance with the provisions of Section 900.

**Table 500.4 Composition of Bituminous Macadam**

| Mix designation        | Grading-2  |
|------------------------|--|
| Nominal aggregate size | 19 mm  |
| layer thickness        | 50 mm  |
| IS : Sieve [MM]        | Cumulative % by weight of total aggregate passing. |
| 26.5                   | 100  |
| 19                     | 90 – 100   |

|  |         |
|--|---------|
| 13.2   | 56 – 88 |
| 4.75   | 16 – 36 |
| 2.36   | 4 – 19  |
| 0.3  | 2 – 10  |
| 0.075  | 0 – 8   |
| Bitumen content % by weight of total mixture | 3.40    |
| Bitumen Grade                                | (VG-30) |

**Note :-** Appropriate bitumen contents for conditions in cooler areas of India may be upto 0.5% higher subject to the approval of the Engineer.

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

#### **504.3.1 Weather and seasonal limitations:-**

Laying shall be suspended while free standing water is present on the surface to be covered or during rain, fog and dust storms. After rain the bituminous surface, prime or tack coat, shall be blow off with a high pressure air jet to remove excess moisture or the surface left to dry before laying shall start, laying of bituminous mixtures shall not be carried out when the air temperature at the surface on which it is to be laid is below 10<sup>0</sup> C or when the wind speed at any temperature exceeds 40 K.M./H at 2 Mt. height unless specifically approved by the Engineer.

#### **504.3.2 Preparation of the base :-**

The base on which bituminous macadam is to be laid shall be prepared shaped and compacted to the required profile in accordance with Clauses-501.8 and 902.3 as appropriate and a prime coat, shall be applied in accordance with Clause-502 where specified or as directed by the Engineer.

### **501.8 Preparation of Surface:-**

#### **504.8.1 Scope:-**

This work shall consist of preparing an existing granular or black topped surface bituminous course. The work shall be performed on such widths and lengths as shown on the drawings or as instructed by the Engineer. The existing surface shall be firm and clean and treated with prime or tack coat as shown on the drawings as otherwise stated in the contract.

#### **504.3.3 Tack coat:-**

A tack coat in accordance with Clause-503 shall be applied as required by the contract documents or as directed by the Engineer.

### **503 Tack Coat:-**

#### **503.1 Scope:-**

This work shall consist of the application of a single coat of Emulsion RS1 on prepared surface preparatory to the superimposition of a bituminous mix, when specified in the contrast or instructed by the engineer.

#### **503.2 Materials:-**

##### **503.2.1 Binder:-**

The binder used for tack coat shall be paving Emulsion RS1 complying with Indian Standard specification for “Paving Bitumen” IS:73.

#### **503.3 Weather and Seasonal Limitations:-**

Bituminous material shall not be applied to a wet surface or during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 10<sup>0</sup> C.

#### **503.4 Construction:-**

##### **503.4.1 Equipment:-**

The tack coat distributor shall be a self propelled or towed bitumen pressure sprayer equipped for spraying the material uniformly at a specified rate, hand spraying of small areas, inaccessible to the distributor in narrow strips, shall be sprayed with a pressure hand sprayer or as directed by the Engineer.

##### **503.4.2 Preparation of base:-**

The surface on which the tack coat is to be applied shall be clean and free from dust, dirt and any extraneous material and otherwise prepared in accordance with the requirements of Clauses-501.8 & 513 as appropriate. Immediately before the application of the tack coat the surface shall be swept clean with a mechanical broom and high-pressure air jet or by other means as directed by the Engineer.

##### **503.4.3 Application of tack coat :- (as per IRC - 16 - 2008)**

The application of tack coat shall be at 2.5 Kg/ 10 Sq.mt. as specified in the contract and shall be applied uniformly. If rate of application of tack coat is not specified in the contract then it shall be at the rate specified in Table 500.2. The normal range of spraying.

**Table 500.2 Rate of application of Tack Coat.**

| <b>Type of Surface</b>                     | <b>Quantity of liquid bituminous material K.G. / Sq. Mt. Area.</b> |
|--|--|
| [1] Normal bituminous surface.             | 0.20 to 0.25   |
| [2] Dry and hungry bituminous surfaces.    | 0.25 to 0.30   |
| [3] Granular surfaces treated with primer. | 0.25 to 0.30   |
| [4] Non Bituminous surface.                | 0.35 to 0.40   |
| (a) Granular base (not primed)             |  |
| (b) Cement concrete pavement.              | 0.30 to 0.35   |

The method of application of the tack coat will depend on the type of equipment to be used size of nozzles, pressure at the spray bar, and speed of forward movement. The contractor shall demonstrate at a spraying trial that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

#### **504.3.4 Preparation and transportation of the mixture :-**

##### **501.3 Mixing:-**

Premixed bituminous materials, including bituminous macadam dense bituminous macadam semi dense bituminous concrete and bituminous concrete and bituminous concrete, shall be prepared in a hot mix plant of adequate capacity and bituminous concrete, shall be prepared in a hot mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coating aggregates. Appropriate mixing temperatures can be found in 500.5 of these specifications, the difference in temperature between the binder and aggregate should at no time exceed 14<sup>0</sup> C. In order to ensure uniform quality of the mix and belief writing of aggregates, the hot mix plant shall be calibrated from time to time.

If a continuous mixing plant is to be used for mixing the bituminous bound macadam, the Contractor Must demonstrate by laboratory analysis that the cold feed combined grading is within the grading limits specified for the bituminous bound material. In the case of a designed job mix, the bitumen and filter content shall be derived using this combined grading. Further debits she available in the Manual for Construction and Supervision of bituminous works.

#### **501.4 Transporting:-**

Bituminous materials shall be transported in clean insulated vehicles, and unless other wise agreed by the Engineer, shall be covered while in transit or awaiting tipping, Subject to the approval of am Engineer, a thin coating of diesel or lubricating oil may be applied to the interior of the vehicle to prevent sticking and to facilitate discharge of the material.

#### **504.3.5 Spreading:-**

Except in areas where a mechanical paver cannot access, bituminous materials shall be spread, levelled and tamped by an approved self propelled paving machine. As soon as possible after arrival at site, the materials shall be supplied continuously to the paver and laid without delay.

The rate of delivery of material to the paver shall be regulated to enable the paver to operate continuously. The travel rate of as paver, and its method of operations shall be adjusted to ensure an even and uniform flow of bituminous material across the screed, free from dragging, tearing and segregation of the material. In areas with restricted space where a mechanical paver cannot be used, the material shall be spread, raked and leveled with suitable by hand tools by experienced staff and compacted to the satisfactions of the Engineer.

The minimum thickness of material laid in each paver pass shall be in accordance with the minimum values given in the relevant parts of these specifications. When laying binder course or wearing course approaching an expansion joint of a structure, machine laying shall stop 300 mm short of the joint. The remainder of the pavement upto the joint and the corresponding area beyond it, shall be laid by hand, and the joint or joint cavity shall be kept clear of surfacing material.

Bituminous material with temperature proofing systems, unless precautions against heat damage have been approved by the Engineer.

Hand placing of pre mixed bituminous materials shall only be permitted in the following circumstances.

- [i] For laying regulating course of irregular shape and varying thickness.
- [ii] In confined spaces where it is impracticable for a paver to operate.
- [iii] For foot Ways.
- [iv] At the approaches to expansion joints at bridge viaducts or other structures.
- [v] For laying mastic asphalt in accordance with clause 515 as below.
- [vi] For filling of path holes.
- [vii] Where directed by the Engineer.

Manual spreading of pre mixed wearing course material or the addition of such material by hand spreading to the paved area, for adjustment of level shall only be permitted in the following circumstances.

- [1] At the edge of the layers of material and at gullies and manholes.
- [2] At the approaches to expansion joints at bridges, viaducts or other structures.



[3] As directed by the Engineer.

**Table 500.5 Manufacturing and Rolling Temperatures.**

| <b>Penetration</b> | <b>Bitumen Mixing [C]</b> | <b>Aggregate Mixing [C]</b> | <b>Mixed Material [C]</b> | <b>Rolling [C]</b> | <b>Laving [C]</b> |
|--------------------|---------------------------|-----------------------------|---------------------------|--------------------|-------------------|
| 35                 | 106-170                   | 160-175                     | 170<br>Maximum            | 100<br>Maximum     | 130<br>Maximum    |
| 65                 | 150-165                   | 150-170                     | 165<br>Maximum            | 90 Maximum         | 125<br>Maximum    |
| 90                 | 140-160                   | 140-165                     | 155<br>Maximum            | 80 Maximum         | 115<br>Maximum    |

#### **504.3.6 Rolling:-**

Compaction shall be carried out in accordance with the provisions of Clauses 501.6 and 501.7 as below.

#### **501.6 Compaction:-**

Bituminous materials shall be laid and compacted in layers which enable the specified thickness, surface level, regularity requirements and compaction to be achieved.

Compaction of bituminous materials shall commence as soon as possible after laying. Compaction shall be substantially completed before the temperature falls below the minimum rolling temperatures stated in the relevant part of these specifications. Rolling of the longitudinal joints shall be done immediately behind the paving operation.

After this rolling shall commence at the edges and progress towards the center longitudinally except that on super elevated and unidirectional compared portion, it shall progress from the lower to the upper edge parallel to the center line of the pavement. Rolling shall continue until all roller marks have been removed from the surface. All deficiencies in the surface after laying shall be made good by the attendants behind the paver before initial rolling is commenced. The initial or breakdown rolling shall be done with 8-10 tonnes dead weight smooth wheeled roller. The immediate rolling shall be done with 8-10 tonnes dead weight or vibratory roller or with a pneumatic tired roller of 12 to 15 tonnes weight having nine wheels, with tire pressure of at least 5.6 K.G./Sq.Mt. The finish rolling shall be done with 6 to 8 tonnes smooth wheeled tandem rollers.

Where compaction is to be determined by density of the requirements to prove the performance of rollers shall apply in order to demonstrate that the specified density can be achieved. In such cases the contractor shall nominate the plant and the method by which he intends to achieve the specified level of compaction and finish at temperatures above the minimum specified rolling temperature. Laying trials shall then demonstrate the acceptability of the plant and method used.

Bituminous materials shall be rolled in a longitudinal direction with the driven rolls nearest the paver. The rollers shall first compact material adjacent to joints and then work from the lower to the upper side of the layer, overlapping on successive passes by at least one-third of the width of the rear roller in the case of a pneumatic-tired roller, at least the nominal width of 300 mm.

In portions with super elevated and un-directional camber, after the edge has been roller, the roller shall progress from the lower to the upper edge.

Roller should move at a speed of not more than 5 K.M./ H. The roller shall not be permitted to stand on pavement which has not been fully compacted and necessary precautions shall be taken to prevent dropping of oil, grease, petrol or other foreign matter on the pavement either when the rollers are operating or standing. The wheels of rollers shall be kept moist with water and the spray system provided with the machine shall be in good working order, to prevent the mixture from adhering to the wheels. Only sufficient moisture to prevent adhesion between the wheels of rollers and the mixture should be used. Surplus water shall not be allowed to stand on the partially compacted pavement.

**501.7 Joints:** - Where longitudinal joints are made in pre-mixed bituminous materials, the materials shall be fully compacted and the joint made flush in one of the following ways, only method [iii] shall be used for transverse joints.

- [1] By beating the joints with an approved joint heater when the adjacent width is being laid but without cutting back or coating with binder. The heater shall raise the temperature of the full depth of material to within the specified range of minimum rolling temperature and maximum temperature at any stage for the material for a width not less than 75 mm. The contractor shall have equipment available for use in the event of a heater break down to form joints by method [iii].
- [2] By using two or more pavers operating in echelon, where this is practicable, and in sufficient proximity for adjacent widths to be fully compacted by continuous rolling.
- [3] By cutting back the exposed joint for a distance equal to the specified layer thickness, to a vertical face discarding all loosened material and coating the vertical face completely with 80/100 penetration grade hot bitumen or cold applied bitumen or polymer modified adhesive bitumen tape with a minimum thickness of 2 mm before the adjacent width is laid.

All joints shall be offset at least 300 mm from parallel joints in the layer beneath or as directed and in a layout approved by the Engineer. Joints in the wearing course shall coincide with either the lane edge or the lane marking which ever is appropriate. Longitudinal joints shall not be situated in wheel track zones.

Rolling shall be continued until the specified density is achieved or where no density is specified, until there is not further movement under the roller. The required frequency of testing is defined in Clause-903.

#### **504.4 Surface finish and Quality control of work :-**

The surface finish of the complicated construction shall conform to the requirements of Clause-902 as under. For control of the quality of materials supplied and the works carried out the relevant provisions of sections 900 of MORT & H shall apply.

**901.1** All materials to be used all methods adopted and all performed shall be strictly in accordance with the requirements of these specifications. The contractor shall set up a field laboratory at locations approved by the Engineer and equip the same with adequate equipment and personnel in order to carry out all required tests and Quality Control work as per specifications and/or as directed by the Engineer. The internal layout of the laboratory shall be as per Clause-121 and/or as directed by the Engineer. The list of

equipment and the facilities to be provided shall be got approved from the Engineer in advance.

- 901.2** The contractor's laboratory should be manned by a quarried materials Engineer/Civil Engineer assisted by experienced technicians and the set up should be got approved by the Engineer.
- 901.3** The contractor shall carry out quality control tests on the materials and work to the frequency stipulated in subsequent paragraphs. In the absence of clear indications about method aid or frequency of tests for any item, the instructions of the Engineer shall be followed.
- 901.4** For satisfying himself about the quality of the materials and work, will also be conducted by the Engineer [by himself, by his Quality Control units or by any other agencies deemed fit by him], generally to the frequency set forth hereunder. Additional tests may also be conducted where in the opinion of the Engineer, need for such test exists.
- 901.5** The Contractor shall provide co-operation and assistance in obtaining the samples for tests and carrying out the field tests as required by the Engineer from time to time. This may include provision of labour, attendants, assistance in packing and dispatching and any other assistance considered necessary in connection with the tests.
- 901.6** For work of embankment, Sub-grade and pavement construction of subsequent layer of same or other material over the finished layer shall be done after obtaining permission from the Engineer. Similar permission from the Engineer shall be obtained in respect of all other items a work prior to proceeding with the stage of construction.
- 901.7** The contractor shall carry out modifications in the procedure of work, if found necessary as directed by the Engineer during the inspection. Works falling short of quality shall be rectified/ redone by the contractor at his own cost and defective work shall also be removed from the site of works by the contractor at his own cost.
- 901.8** The cost of laboratory building including services, essential supplied like water, electricity, sanitary services and their maintenance and cost of all equipments, tools, materials, labour and incidentals to perform tests and other operations of quality control according to the Specification requirements shall be deemed to be incidental to the work and no extra payment shall be made for the same.
- 901.9** For testing of samples of soils/soil mixes, granular materials, mixes bituminous materials and mixes aggregates, etc. sample in the required quantity and form shall be supplied to the Engineer by the Contractor at his own cost.
- 901.10** For cement, bitumen, mild steel, and similar other material where essential tests are to be carried out at the manufacturer's plants or at laboratories other than the site laboratory, the cost of samples, sampling testing and furnishing of test certificates shall be borne by the contractor. He shall also furnish the test certificate to the Engineer.
- 901.11** For testing of cement concrete at site during construction arrangements for supply of samples, sampling, testing and supply of test results shall be made by the Contractor as per the frequency and number of tests specified in the Handbook of Quality Control for Construction of Roads and Run ways [I.R.C.: SP -11 and relevant IS codes or relevant clauses of these specifications. The cost of which shall be borne by the Contractor.
- 901.12** The method of sampling and testing materials shall be as required by the "Hand book of Quality Control for Construction of Road & Runways" [IRC Sp. 11] and the MOST specifications. Where they are contradicting the provisions in these modifications shall

be followed. More they are silent, sound engineering practices shall be adopted. The sampling and testing procedure to be used as approved by this Engineer and his decision shall be final and binding on the Contractor.

**901.13 Defective Materials:-**

All materials which the Engineer/his representative has determined as not conforming to the requirements of the Contract shall be rejected whether in place or not they shall be removed immediately from the site as directed. Materials, which have been subsequently connected, shall not be used in the work unless approval is accorded in writing by the Engineer. Upon failure of the Contractor to comply with any order of the Engineer/his representative, given under this Clause, this Engineer/his representative shall have authority to cause the removal of rejected material and to deduct the removal cost there of from any payments due to the Contractor.

**901.14 Imported Materials:-**

At the time of submission of tender, the Contractor shall furnish a list of materials finished products manufactured, produced or fabricated outside India which he proposed to use in the work. The Contractor shall not be entitled to extension of time for acts or events occurring outside India and it shall be the Contractor's responsibility to make timely delivery to the job site of all such materials obtained from outside India.

The materials imported from outside India shall conform to the relevant specifications of the Contract. In case where materials/finished products are not covered by the Specifications in the Contract, the details of Specifications proposed to be followed and the testing procedures as well as laboratories/establishments where tests are to be carried out shall be specifically brought out and agreed to in the Contract.

The Contractor shall furnish to the Engineer a certificate of compliance of the tests carried out. In addition, certified mill test reports clearly identified to the lot of materials shall be furnished at the contractor's cost.

**902 Control of alignment, level and surface regularity :-**

**902.1 General:-**

All works performed shall conform to the lines, grades cross sections and dimensions shown on the drawings or as directed by the Engineer subject to the permitted tolerances described herein after.

**902.2 Horizontal Alignment**

Horizontal alignments shall be reckoned with respect to the center line of the center line of the carriage way as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of +10 mm there from. The corresponding tolerance for edges of the road way and lower layers of pavement shall be -25 mm.

**902.3 Surface level :-**

The levels of the sub grade and different pavement courses as constructed shall not vary from those calculated with reference to the longitudinal and cross profile of the road shown on the drawings or as directed by the Engineer beyond the tolerances mentioned in Table 900.1.

**Table 900.1 Tolerances in Surface Levels**

|     |                  |                    |
|-----|------------------|--------------------|
| [1] | Sub grade.       | + 20 mm<br>- 25 mm |
| [2] | Sub-base + 10 mm |                    |

|     |   |  |
|-----|---|--|
|     | [a] Flexible pavement<br>[b] Concrete pavement. (Dry lean concrete or rolled concreted)   | - 20 mm<br>- 10 mm   |
| [3] | Base course for flexible pavement.<br>[a] Bituminous course.<br><br>[b] Other than bituminous<br>[I] Machine laid.<br><br>[II] Manually laid. | + 6 mm<br>- 6 mm<br>+ 10 mm<br>- 10 mm<br>- 15 mm<br>- 15 mm |
| [4] | Wearing course for flexible pavement.<br>[a] Machine laid.<br><br>[II] Manually laid.   | - 6 mm<br>6 mm<br>- 10 mm<br>10 mm                           |
| [5] | Cement concrete pavement.   | - 5 mm<br>6 mm   |

\* This may not exceed – 8 mm at 0.30 cm from the edges.

Provided however that the negative tolerance for wearing course shall not be permitted in conjunction with the positive tolerance for base course if the thickness of the former is thereby reduced by more than 6 mm for flexible pavements and 5 mm for concrete pavements.

For checking compliance with the above requirement for sub grade, sub base and base courses, measurements of the surface levels shall be taken on a grid of points placed at 6.25 Mt. longitudinally and 3.5 Mt. transversely. For any 10 consecutive measurements taken longitudinally or transversely, not more than one measurement shall be permitted to exceed the tolerance as above, this one measurement being not in excess of 5 mm above the permitted tolerance.

For checking the compliance with the above requirement for bituminous wearing courses and concrete pavements, measurement of the surface levels shall be taken on a grid of points spaced at 6.25 Mt. along the length and at 0.5 Mt. from the edges and at the center of the pavement. In any length of pavement compliance shall be deemed to be met for the final road surface only if the tolerance given above is satisfied for any point on the surface.

#### **902.5 Surface Regularity of Pavement Courses :-**

The longitudinal profile shall be checked with a 3 Mt. Long straight edge/moving straight edge as directed by the Engineer at the middle of each traffic lane along a line parallel to the center line of the road

The maximum permitted number of surface irregularities shall be as per Table 900.2

**Table 900.2 Maximum Permitted Number of Surface Irregularities.**

| Surface of carriage ways and paved. |           | Surface of lays, service areas and all bituminous base courses shoulders. |    |      |    |      |    |      |    |
|-------------------------------------|-----------|---|----|------|----|------|----|------|----|
| Irregularity                        |           | 4 mm  |    | 7 mm |    | 4 mm |    | 7 mm |    |
| Length [Mt.]                        |           | 300   | 75 | 300  | 75 | 300  | 75 | 300  | 75 |
| National                            | Highways/ | 20  | 9  | 2    | 1  | 40   | 18 | 4    | 2  |
| Expressways.                        |           |   |    |      |    |      |    |      |    |

|                                |    |    |   |   |    |    |   |   |
|--------------------------------|----|----|---|---|----|----|---|---|
| <b>Road of lower Category*</b> | 40 | 18 | 4 | 2 | 60 | 27 | 6 | 3 |
|--------------------------------|----|----|---|---|----|----|---|---|

\* Category of each section of road as described in the contract.

The maximum allowable difference between the road surfaced and under side of a 3 Mt. straight edge when placed parallel with or at right angles to the center line of the road at points decided by the Engineer shall be:

|   |         |
|---|---------|
| For pavement surface [bituminous and cement concrete] | = 3 mm  |
| For bituminous base courses.                          | = 6 mm  |
| For granular sub base/base course                     | = 8 mm  |
| For sub base under concrete pavements.                | = 10 mm |

#### **902.5 Rectification:-**

Where the surface regularity of sub grade and the various pavement courses fall outside the specified tolerance the contractor shall be liable to rectify these in the manner described below and to the satisfaction of the Engineer.

#### **Bituminous Constructions:-**

For bituminous construction other than wearing course where the surface is low the deficiency shall be corrected by adding fresh materials over a suitable tack coat if needed and recomputing to specification. Where the 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 4 Mt. In length and not less than 3.5 Mt. widths.

#### **903 Quality Control Tests during Construction**

##### **903.1 General:-**

The materials supplied and the works carried out by the contractor shall conform to the specifications of MOST Clause 903.

##### **504.5 Protection of the Layer:-**

The bituminous macadam shall be covered with either the next pavement course of wearing course as the case may be within a maximum of 48 Hours. If there is to any delay the course shall be covered by MSS before opening to any traffic to the requirements of Specifications as per Item No.11 of this contract. The MSS in such cases shall be considered incidental to the work and shall not be paid for separately.

##### **504.6 Arrangements for traffic:-**

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112 as below.

#### **112. Arrangement for Traffic during construction:-**

##### **112.1 General:-**

The contractor shall at all times carry out work on the highway to a manner creating least interference to the flow of traffic while consistent with the satisfactory execution of the same. For all work involving improvements to the existing highway the contractor shall in accordance with the directives of the Engineer provide and maintain during execution of the work a passage for traffic either along a part of the existing carriageway under improvement or along a temporary diversion constructed to the highway. The contractor shall take prior approval of the Engineer regarding traffic arrangements during construction.

**112.2** Passage of Traffic along a part of the Existing Carriageway under Improvement. For widening strengthening existing carriageway where part width of the existing carriageway is proposed to be used for passage of traffic, treated shoulders shall be provided on the side on which work is not in progress. The treatment to the shoulder shall consist of providing at least 150 mm thick granular base course covered with bituminous surface dressing in a width of at least 1.5 Mt. and the surface shall be maintained throughout the period during which traffic uses the same to the satisfaction of the Engineer. The continuous length in which such work shall be carried out would be limited normally to 500 m at a place. However where work is allowed by the Engineer in charge stretches passing places at least 20 Mt. long with additional paved width of 2.5 Mt. shall be provided at every 0.5 K.M. intervals.

In case of widening existing two lanes to four lane, the additional two lanes would be constructed first and the traffic diverted to it and only thereafter the required treatment to the existing carriageway would be carried out. However in case where on the request of the contractor, work on existing two lane carriageway is allowed by the Engineer with traffic using part of the existing carriageway, stipulations as in para above shall apply.

After obtaining permission of the Engineer, the treated shoulder shall be dismantled, the debris disposed of and the area cleared as per the direction of the Engineer.

**112.3 Passage of Traffic along a Temporary Diversion:-**

In stretches where it is not possible to pass the traffic on part width of the carriageway, a temporary diversion shall be constructed with 7 Mt. carriageway and 2.5 earthen shoulders on each side (total width of road way 12 Mt.) with the following provision for road crust in the 7 Mt. width.

- [i] 200mm [compacted] granular sub-base.
- [ii] 225mm [compacted] granular base course and
- [iii] Premix carpet with seal coat/Mix seal surfacing.

The alignment and longitudinal section of diversion including junctions and temporary cross drainage provision shall be as approved by the Engineer.

**112.4 Traffic Safety and Control :-**

The contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the highway under improvement, before taking up any construction, as agreed phased programme for the diversion of traffic on the highway shall be drawn up in consultation with the Engineer.

The barricades erected on either side of the carriageway portion of the carriageway closed to traffic, shall be of strong design to resist violation and painted with alternate black and white stripes. Red lanterns or warning lights of similar type shall be mounted on the barricades at night and kept lit throughout from sunset to sunrise.

At the points where traffic is to deviate from its normal path [whether on temporary diversion or part width of the carriageway] the channel for traffic shall be clearly marked with the aid of pavement markings, painted drums or a similar device to

the directions of the Engineer. At night, the passage shall be delineated with lanterns or other suitable light source.

One way traffic operation shall be established whenever the traffic is to be passed over part of the carriageway inadequate for two lane traffic. This shall be done with the help of temporary traffic signals or flagmen kept positioned on opposite sides during all hours. For regulation of traffic, the flagmen shall be equipped with red and green flags and lanterns/lifts.

On both sides, suitable regulatory/warning signs as approved by the Engineer shall be installed for the guidance of road users. On each approach, at least two signs shall be put up, one close to the point where transition of carriageway begins and the other 120 Mt. away. The sign shall be of approved design and of refractory type, if so directed by the Engineer.

#### **112.5 Maintenance of Diversions and Traffic Control Devices :-**

Signs, lights, barriers and other traffic control devices as well the riding surface of diversions shall be maintained in a satisfactory condition till such time they are required as directed by the Engineer. The temporary travelled way shall be kept free of dust by frequent application of water, if necessary.

All arrangements for traffic during construction including provision of temporary cross drainage structures, if required, and treated shoulder as described in Clause 112.2 including their maintenance, dismantling and clearing debris, where necessary, shall be considered as incidental to the works and shall be the Contractor's responsibility.

#### **504.7 Measurement for Payment:-**

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

Department will be free to get some loaded dumpers 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 basic 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 pro-rata basis depending upon the area reduced or exceeded respectively.

Weight of mix materials will be done in presence of responsible person, not less than the rank of Supervisor of Department and the measurements shall be recorded by the Deputy Executive Engineer or Assistant Engineer or Additional Assistant Engineer, if so authorized. Record of each dumper will be mentioned separately in bond and numbered register which will be maintained by the Department representatives and signed by the contractor. Proper gate pass system shall be established for the vehicle coming to the plant site and going from the site. The location of the K.M. hectometre and meter in which individual dumpers are unloaded shall be recorded carefully.

#### **504.8 Rate :-**



The contract unit rate for bituminous macadam shall be payment in full for carrying out the required operations as specified. The rate shall include for all components listed below.

- (i) Making arrangements for traffic to clause 112 except for initial treatment to verge, shoulders and construction of diversions.
- (ii) Preparation of the surface to revive the materials.
- (iii) Providing all materials to be incorporated in the work including arrangement for stock yards. All royalties, fees rents where necessary and all leads and lifts.
- (iv) Mixing transporting, laying and compacting the mix as specified.
- (v) All labour, tools equipment, plant including installation of hot mix plant, power supply units and all machinery incidentals to complete the work to this specification.
- (vi) Carrying out the work in part widths of the road where directed.
- (vii) Carrying out all tests for control of quality, and
- (viii) The rate shall cover the provision of bitumen at the rate specified in the contract, with the provision that the variation in actual percentage of bitumen used will be assessed and the payment adjusted accordingly.
- (ix) The rate for premixed material is to include for all wastage in cutting of joints etc.
- (x) The rates are to include for all necessary testing mix design transporting and testing of samples, and cores. If there is not a project specific: laboratory, the contractor must arrange to carry out all necessary testing at an outside laboratory approved by the Engineer, and all costs incurred are deemed to be included in the rate quoted for the material.

The cost of all plant and laying trials as specified to prove the mixing and laying methods is deemed, to be included in the contractor's rates for the materials

The payment shall be made on M.T. basis

**Item No.7 Providing & laying 25 mm. thick SDBC using B.T. stone chips as per MORTH gradation and specification with asphalt VG-30 at the rate of 50.00 kg. / M.Tone of total wt. for mix i.e. (5.00 % ) by weight of total mix of bitumen including mixing aggregates & asphalt by continuous batching drum mix plant & spreading the same by paver finisher including rolling & consolidation with 10 - 12 tonnes vibratory roller & providing tools 7 plants, fire wood, oil, kerosene, labour charges using contractor's own machineries etc. complete.**

This work shall consist of construction in a single course of semi-dense bituminous concrete binder/wearing course on a previously prepared bituminous base to the requirements of the specifications.

#### 511.2 **Materials**

511.2.1 Binder :

511.2.2 Aggregates :

504.1.1.1 The aggregates shall consist of crushed stone, crushed gravel/shingle or other stones. They shall be clean, strong, durable of fairly cubical shape and free from disintegrated pieces, organic or other deleterious matters and adherent coating. The aggregates shall preferably be hydrophobic and of low porosity. If hydrophilic

aggregates are to be used the bitumen shall preferably be treated with anti stripping agents of approved quality in suitable doses as per Appendix-5. The aggregates shall satisfy the physical requirements set forth in Table 500-3.

**TABLE : 500-3**

**PHYSICAL REQUIREMENT OF AGGREGATE FOR BITUMINOUS  
MACADAM**

| SR. no. | Test  | Test method      | Requirement                |
|---------|---|------------------|----------------------------|
| 1.      | Los Angeles Abrasion Value *                        | IS:2386 (Part 4) | 40%<br>Maximum             |
| 2.      | Aggregate Impact Value *                            | IS:2386 (Part 4) | 30%<br>Maximum             |
| 3.      | Flakiness and Elongation Indices (total) **         | IS:2386 (Part I) | 30%<br>Maximum             |
| 4.      | Coating and Stripping of Bitumen Aggregate Mixtures | AASHTO T 182     | Minm. retained coating 95% |
| 5.      | Sounders :  | IS:2386 (Part-5) |                            |
|         | i) Loss with Sodium Sulphate 5 Cycles               |                  | 12% maxm.                  |
|         | ii) Loss with Magnesium Sulphate 5 Cycles           |                  | 18% maxm.                  |
| 6.      | Water absorption                                    | IS:2386 (Part-3) | 2% Maximum                 |

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

511.2.3 \*\* The determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non-flaky) stone metal. Elongation index is flakiness index and elongation index so found are added up.

511.2.4 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 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 11.20 kN. per m<sup>3</sup> and the percentage of glossy material shall not be more than 20. It should also comply with the following requirements :

- i) Chemical stability To comply with requirements of appendix of BS 1047.
- ii) Sulphur Content Maximum 2 percent
- iii) Water absorption Maximum 10 percent

511.2.5 Course Aggregates :  
Shall be as above applying.

The Stone Polishing Value as measured by BS:812 (Part-114) shall not be less than 55. The aggregates shall satisfy the physical requirements as given in Table 500-3 except that the maximum value of water absorption upto a maximum of 2 per cent may be permitted in exceptional cases only.

511.2.6 Fine Aggregates :

Fine aggregates shall be the fraction passing 2.36 mm. sieve and retained on 75 micron sieve, consisting of crusher run screenings, natural sand or a mixture of both. These shall be clean, hard, durable, uncoated, dry and free from any injurious, soft or flaky pieces and organic or other deleterious substances.

511.2.7 Filler :

Filler shall consist of finely divided mineral matter such as rock dust, hydrated lime or cement as approved by the Engineer.

The filler shall be graded within the following limits :

| IS Sieve   | Percent passing by Weight |
|------------|---------------------------|
| 600 micron | 100                       |
| 300 micron | 95-100                    |
| 75 micron  | 85-100                    |

The filler shall be free from organic impurities and have a Plasticity Index not greater than 4. The Plasticity Index requirement shall not apply if filler is cement or lime. When the coarse aggregate is gravel 2 percent by mass of total aggregate of portland cement or hydrated lime shall be added and the percentage of fine aggregate reduce accordingly. Cement or hydrated lime is not required when the gravel is limestone.

511.2.8 Aggregates Gradation :

The mineral aggregates including filler shall be so graded or combined as to conform to the grading set forth in Table 500-20.

**TABLE : 500-20**

**AGGREGATES GRADATION FO SEMI-DENSE BITUMINOUS CONCRETE**

| IS Sieve Designation | Per cent by Weight Passing the IS Sieve |             |             |
|----------------------|---|-------------|-------------|
|                      | Grading - 1                             | Grading – 2 | Grading – 3 |
| 22.4 mm              | --                                      | 100         | 100         |
| 13.2 mm.             | 100                                     | 85 – 100    | 79 – 100    |
| 11.2 mm.             | 88 – 100                                | 70 – 92     | 68 – 90     |
| 5.6 mm.              | 42 – 64                                 | 42 – 64     | 33 – 55     |

|            |         |         |         |
|------------|---------|---------|---------|
| 2.8 mm.    | 22 – 38 | 22 – 38 | 22 – 38 |
| 710 micron | 11 – 24 | 11 – 24 | 6 – 22  |
| 355 micron | 7 – 18  | 7 – 18  | 4 – 14  |
| 180 micron | 5 – 13  | 5 – 13  | 2 – 9   |
| 90 micron  | 3 – 9   | 3 – 9   | 0 – 5   |

**Note :** Grading 1 shall be adopted for 25mm. compacted thickness and Grading 2/3 for higher thickness.

### 511.3 Mix Design

#### 511.3.1 Requirements of Mix :

Semi-dense bituminous concrete mix shall be properly designed so as to satisfy the criteria laid down in Table 500-21.

**TABLE : 500-21**

#### **REQUIREMENTS OF SEMI-DENSE BITUMINOUS CONCRETE MIX**

|  |  |
|--|--|
| 1. Marshall Stability (ASTM Designation : D 1559) determined on Marshall specimens compacted with 75 compaction blows on each end. | 820 kg. (1800 lbs) minimum.  |
| 2. Marshall flow (mm)  | 2 – 4  |
| 3. Per Cent Air voids in mix   | 3 – 5  |
| 4. per cent air voids in mineral aggregate (VMA) Minimum   | 13 – 15<br>(for 13.2 mm. max size)<br><br>11 – 13<br>(for 22.4 mm. max size) |
| 5. Percentage voids in mineral aggregates filled with bitumen (VFB)  | 65 – 75  |
| 6. Binder content, percent by weight of mix  | Not less than 4.0 per cent   |

**Note :** 1. Higher stability values consistent with other requirements should be achieved as far as possible.

2. At bus stops, packing areas and roundabouts near minimum flow value should be adopted.

3. Attempt should be to have well graded aggregates and the per cent voids in the mix closer to the lower limit.

#### 511.3.2 Binder Content :

The binder content shall be so fixed as to achieve the requirements of the mixer set forth in Table 500-21 Marshall Method for arriving at the binder content shall be adopted.

#### 511.3.3 Job Mix Formula :

The Contractor shall intimate to the Engineer in writing, at least 20 days before the start of the work, the job mix formula proposed to be used by him for the work and shall give the following details :

- i) Source and location of all materials
- ii) Proportions of all materials expressed as follows where each is applicable :
  - a) Binder, as percentage by weight of total mix;
  - b) Coarse Aggregate / Fine Aggregate / Mineral Filler, as percentage by weight of total aggregate including mineral filler.
- iii) A single definite percentage passing each sieve for the mixed aggregate
- iv) The results of test enumerated in Table : 500-10 as obtained by the Contractor
- v) Test results of physical characteristics of aggregates to be used.
- vi) Mixing temperature and compacting temperature.

While working out the job mix formula, the Contractor shall ensure that it is based on a correct and truly representative sample of the materials that will actually be used in the work and that the mix and its different ingredients satisfy the physical and strength requirements of these specifications.

Approval of the job mix formula shall be based on independent testing by the Engineer for which samples of all ingredients of the mix shall be furnished by the Contractor as required by the former.

The approved job mix formula shall remain effective unless and until modified by the Engineer. Should a change in the source of materials be proposed, a new job mix formula shall be established and got approved from the Engineer before actually using the materials.

#### 511.2.1 Permissible Variation From Job Mix Formula

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. The permissible variations of the individual percentages of the various ingredients in the actual mix from the job mix formula may be within the limits as specified in Table 500-22. These variations are intended to apply to individual specimens taken for quality control tests vide Section 900.

**TABLE : 500-22**

#### **PERMISSIBLE VARIATIONS FROM JOB MIX FORMULA**

| Sl. No. | Description of Ingredient                           | Permissible variation by weight of total mix in percentage. |
|---------|---|---|
| 1.      | Aggregate passing 13.2 mm. sieve and larger sieve.  | $\pm 8$   |
| 2.      | Aggregate passing 11.2 mm. sieve and 5.6 mm. sieve. | $\pm 7$   |

|    |   |                          |
|----|---|--------------------------|
| 3. | Aggregate passing 2.8 mm. sieve and 1.4 mm. sieve.      | $\pm 6$                  |
| 4. | Aggregate passing 710 micron sieve and 355 micron sieve | $\pm 5$                  |
| 5. | Aggregate passing 180 micron sieve                      | $\pm 4$                  |
| 6. | Aggregate passing 90 micron sieve                       | $\pm 2$                  |
| 7. | Bitumen   | $\pm 0.3$                |
| 8. | Mixing Temperature                                      | $\pm 10^{\circ}\text{C}$ |

### 511.3 Construction Operations

511.3.1 Weather and Seasonal Limitations :

511.3.2 Requirement of Mix :

Apart from conformity with grading and quality requirements of individual ingredients, the mix shall meet the requirements set out in Table 500-10.

**TABLE 500-10**

### **REQUIREMENTS OF DENSE BITUMINOUS MACADAM MIX**

| Sr. No. | Description   | Requirement              |
|---------|---|--------------------------|
| 1.      | Marshall stability (ASTM Designation D-1559) determined on Marshall Specimens compacted by 75 compaction blows on each end. | 820 Kg (1800 lb) Minimum |
| 2.      | Marshall flow (mm)  | 2 – 4                    |
| 3.      | Percent Air Voids   | 3 – 5                    |
| 4.      | Minimum voids in mineral aggregates (VMA)   | 10% - 12%                |
| 5.      | Percent voids in mineral aggregates filled by bitumen (VFB)   | 65- 75                   |
| 6       | Binder content percent by weight of total mix   | Not less than 4%         |

511.3.3 Preparation of Base :

The base on which semi-dense bituminous concrete is to be laid shall be prepared, shaped and conditioned to the specified lines, grades and cross-sections in accordance with Clause 501 or as directed by the Engineer.

511.3.4 Teak Coat :

This work shall consist of application of single coat of low viscosity liquid bituminous material to an existing road surface preparatory to another bituminous construction over it.

### 503.2 Materials

Binder : The binder used for tack coat shall be s bituminous emulsion or cutback as specified in the Contract.

### 503.3 Construction Operation

#### 503.3.1 Preparation of Base :

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

#### 503.3.2 Application of Binder :

Binder shall be heated to the temperature appropriate to the grade of cutback used and approved by the Engineer and sprayed on the base at the rate specified in Table 500-2. The normal range of spraying temperature for a bituminous emulsion shall be 20<sup>0</sup>C-60<sup>0</sup>C and for a cutback 50<sup>0</sup>C-80<sup>0</sup>C if RC-70/MC-70 grade is used. It shall be the responsibility of the Contractor to carefully handle the inflammable bituminous cutback material so as a safeguard against any fire mishap. The binder shall be applied uniformly with the aid of either self propelled or rowed bitumen pressure sprayer with self heating arrangement and spraying bar with nozzles having constant volume or pressure system, capable of spraying bitumen at specified rates 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 the Engineer.

**TABLE 500-2**

**RATE OF APPLICATION OF TACK COAT**

| Type of Surface                            | Bitumen Quantity in Kg. per 10 sq.m. area |
|--|---|
| i) Normal Bituminous Surfaces              | 2.0 to 2.5                                |
| ii) Dry and hungry Bituminous Surfaces     | 2.5 to 3.0                                |
| iii) Granular surfaces treated with primer | 2.5 to 3.0                                |
| iv) Non Bituminous Surfaces:               | 3.5 to 4.0                                |
| a) Granular base (not primed)              | 3.0 to 3.5                                |
| b) Cement Concrete Pavement                |   |

Note : There is no need to apply a tack coat on a freshly laid bituminous course if the subsequent bituminous course is overlaid immediately without opening it to traffic

### 503.4 Quality Control of Work

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

### 503.5 Arrangements for Traffic

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

#### 511.3.5 Preparation of Mix :

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.

#### 511.3.6 Spreading of Mix :

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 a seal coat to the requirement of Clause 513 before allowing any traffic over it. The seal coat in such cases shall be considered incidental to the work and shall not be paid for separately.

#### 511.3.7 Rolling :

After the spreading of mix by paver, it shall be thoroughly compacted by rolling with a set of rollers moving at a speed not more than 5 km. per hour, immediately following close to the paver. Generally the initial or breakdown rolling shall be done with 80-100 kN static weight smooth-wheeled roller. The intermediate rolling shall be done with 80-100 kN static weight vibrator roller or with a pneumatic tyred roller of 150-250 kN weight having a tyre pressure of at least 0.7 MPa. The finish rolling shall be done with 60-80 kN weight smooth wheeled tandem roller. All the compaction operations, i.e., breakdown rolling and intermediate rolling can be accomplished by using vibratory tandem roller of 80-100 kN static weight. During initial break-down rolling and finish rolling, shall be established after trial compaction as approved by the Engineer. Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected at once as specified and/or removed and made good. The rollers shall not be permitted to stand on pavement which has not been fully compacted and where temperature is still more than 70°C. Necessary precautions shall be taken to prevent dropping of oil, grease, petrol or other foreign matter on the pavement either when the rollers are operating or standing.

The wheels of roller shall be kept moist to prevent the mix from adhering to them. But in no case shall fuel/lubricating oil be used for this purpose nor excessive water poured on the wheels. Rolling shall commence longitudinally from edge and proceed towards the centre, except that on superelevated portions; it shall progress from the lower to upper edge parallel to the centre line of the pavement. The roller shall proceed on the fresh material with rear or fixed wheel leading so as to minimise the pushing of the mix and each pass of the roller shall overlap the preceding one by half the width of the rear wheel.

Rolling shall be continued till the density achieved is atleast 98 per cent of that of laboratory Marshall Specimen (compacted as defined in Table 500-10) and all roller marks are eliminated. Skin patching of an area that has been rolled will not be permitted. Rolling operations shall be completed in all respects before the temperature of the mix falls below 100°C.

#### 511.4 Opening to Traffic

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

#### 511.5 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.

#### **511.6 Arrangement for Traffic :**

The contractor shall at all times carry out work on the highway in a manner creating least interference to the flow of traffic while consistent with the satisfactory execution of the same. For all works involving improvements to the existing highway, the Contractor shall, in accordance with the directives of the Engineer provide and maintain, during the execution of the work, a passage for traffic either along a part of the existing carriageway under improvement, or along a temporary diversion constructed close to the highway. The Contractor shall take prior approval of the Engineer regarding traffic arrangements during construction.

#### **Passage of Traffic along Part of the Existing Carriageway Under Improvement**

For widening/strengthening existing carriageway where part width of the existing carriageway is proposed to be used for passage of traffic, treated shoulders shall be provided on the side on which work is not in progress. The treatment to the shoulder shall consist of providing atleast 150mm thick granular base course covered with bituminous surface dressing in a width of atleast 1.5 metre and the surface shall be maintained throughout the period during which traffic uses the same to the satisfaction of the Engineer. The continuous length in which such work shall be carried out would be limited normally to 500 metre at a place. However, where work is allowed by the Engineer in longer stretches passing places atleast 20 metre long with additional paved width of 2.5 metre shall be provided at every half a km interval.

In case of widening existing two lanes to four lanes the additional two lanes would be constructed first and the traffic diverted to it and only thereafter the required treatment to the existing carriageway would be carried out. However, in case where on the request of the Contractor work on existing two lane carriageway is allowed by the Engineer with traffic using part of the existing carriageway stipulated as in para above shall apply.

After obtaining permission of the Engineer, the treated shoulder shall be dismantled, the debris disposed of and the area cleared as per the direction of the Engineer.

#### **Passage of traffic along a temporary diversion :**

In stretches where it is not possible to pass the traffic on part width of the carriageway, a temporary diversion shall be constructed with 7 metre carriageway and 2.5 metre earthen shoulders on each side (total width of roadway 12 metre) with the following pro

- i. 200mm (compacted) granular sub-base ;
- ii. 225mm (compacted) granular base course; and
- iii. Premix carpet with seal coat/Mix Seal Surfacing

The alignment and longitudinal section of diversion including junctions and temporary cross drainage provision shall be as approved by the Engineer.

#### **Traffic Safety and Control**

The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings,

flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the highway under improvement. Before taking up any construction, an agreed phased programme for the diversion of traffic on the highway shall be drawn up in consultation with the Engineer.

The barricades erected on either side of the carriageway portion of the carriageway closed to traffic, shall be of strong design to resist violation, and painted with alternate black and white strips. Red lanterns or warning lights of similar type shall be mounted on the barricades at night and kept lit throughout from sunset to sunrise.

At the points where traffic is to deviate from its normal path (whether on temporary diversion or part width of the carriageway) the channel for traffic shall be clearly marked with the aid of pavement markings, painted drums or a similar device to the directions of the Engineer. At night, the passage shall be delineated with lanterns or other suitable light source.

One-way traffic operation shall be established whenever the traffic is to be passed over part of the carriageway inadequate for two-lane traffic. This shall be done with the help of flagmen kept positioned on opposite sides during all hours. For regulation of traffic, the flagmen shall be equipped with red and green flags and lanterns/lights.

On both sides, suitable regulatory/warning signs as approved/directed by the Engineer shall be installed for the guidance of roadusers. On each approach, at least two signs shall be put-up, one close to the point where transition of carriageway begins and the other 120 metres away. The signs shall be of approved design and of reflectory type if so directed by the Engineer.

## **MAINTENANCE OF DIVERSIONS AND TRAFFIC CONTROL DEVICES**

Signs, lights, barriers and other traffic control devices, as well as the riding surface of diversions shall be maintained in satisfactory condition till such time they are required as directed by the Engineer. The temporary travelled way shall be kept free of dust by frequent applications of water, if necessary.

### **511.7 Measurements for Payment :**

Semi-dense bituminous concrete shall be measured as finished work in cubic metres or tonnes as directed by the Engineer.

### **511.8 Rate :**

The contract unit rate for semi-dense bituminous concrete shall be payment in full for carrying out the required operations including full compensation for all components listed to Clause 504.8 (i) to (vi). The rate shall cover the provision of bitumen in the mix at 4.5 percent of the weight of the total mix, with the provision that the variation of quantity of bitumen will be assessed and the payment adjusted as per the rate of bitumen coated.

**Item No.8 Providing and laying asphalt painting on B.T. surface with bitumen VG-30 at rate 5.00Kg / 10Sq.mt. including spreading stone dust for painting surface at rate of 0.03 cu.mt. / 10 sq.mt**

**1 Scope :-**

This work shall consist of the application of a single coat of bitumen (VG-30) grade to an existing bituminous road surface in accordance with the following specifications.

**2 Materials :-**

**2.1 Bitumen :-** The bitumen used for asphalt painting shall be (VG-30) grade complying with IS: 73

**2.2 Stone Dust :-**

**2.2.1.** This shall be obtained from crushing hard black trap or equivalent. It shall not contain more than 8% of silt as determined by field test will measuring cylinder. The method of determining silt contents by fields test is given as under :

**2.2.2.** A sample of stone dust to be tested shall be placed without drying in 200 mm. measuring cylinder. The quantity of the sample shall be such that it fills the cylinder up to 100 mm. mark. The clean water shall be added up to 150 mm. mark. The mixture shall be stirred vigorously and the content allowed to settle for 3 hours.

**2.2.3.** The height of silt, visible as settled layer above the stone dust shall be expressed as percentage of the height of the stone dust below The stone dust containing more than 8% silt shall be washed so as to bring the content within the allowable limit.

**2.2.4.** The fineness modules of stone dust shall not be less than 1.80

**3 Weather and Seasonal Limitations :-**

Bituminous material shall not be applied to a wet surface or during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less then 10<sup>0</sup> C.

**4 Construction :-**

**4.1 Equipment :-**

The asphalt painting shall be applied through a distributor and it shall be a self propelled or towed bitumen pressure sprayer equipped for spraying the material uniformly at a specified rate, hand spraying of small areas, inaccessible to the distributor in narrow strips, shall be sprayed with a pressure hand sprayer or as directed by the Engineer.

**4.2 Preparation of base :-**

The surface on which the asphalt painting is to be applied shall be clean and free from dust, dirt and any extraneous material and other wise prepared in accordance with the requirements of Clauses-501.8 & 513 of MORT & H as appropriate. Immediately before the application of the asphalt painting the surface shall be swept clean with a mechanical broom and high-pressure air jet or by other means as directed by the Engineer.

**4.3 Application of asphalt painting :-**

The application of asphalt for painting shall be at 5.0 Kg/ 10 Sq.mt. as specified in the contract and shall be applied uniformly. The asphalt shall be heated in the tanker and the temperature of the asphalt at the time of spraying shall be in the range of 150<sup>0</sup>C -177<sup>0</sup>C.

The method of application of the tack coat will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar, and speed of forward movement. The contractor shall demonstrate a spraying trial that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

### 5.0 Spreading of Stone Dust

Soon after the spraying of asphalt, the stone dust shall be spread evenly with a twisting motion of baskets at the rate of 0.03Cum/10 Sqm. The entire surface shall be broomed to ensure uniform application of the stone dust. While the traffic is allowed on the painted surface and at later stage if additional stone dust is required, it shall be carried out by the contractor without any extra payment.

### 6.0 Opening to Traffic :-

Traffic may be allowed immediately after completion of flushing of stone dust on asphalt painted surface.

### 7.0 Arrangement of Traffic :-

The provision of MOST Specification Clause 112 shall apply as regards the flow of traffic during construction.

### 8.0 Mode of Measurement & Payment :

The Item shall be measured and paid as finished work in Square meters. The rates shall include the cost of all materials, labour, equipments etc. involved in all the operations described above. The rate shall be for a unit of one sq. meter.

### Item No.9 Providing and casting in situ ordinary cement concrete M-300 for average 75 mm thick wearing coat laid as directed including tamping ,vibrating, finishing, curing and filling in joints with bitumen 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 table below for different grades of concrete designated as ordinary M. 100, M. 150, M.200 and M.250.
2. In the designation of a concrete mix, Letter "M" refers to the mix and the number the specified 28 days works cube compressive strength of that mix on 150 mm. cubes expressed in kg./cm<sup>2</sup>.
3. The ordinary concrete mix shall generally be specified by volume. For cement which normally comes in bags and is used by weight, volume shall be worked out taking 50 kg. of cement as 0.035 cubic metre in volume. While measuring aggregate by volume, shaking, ramming or hammering shall not. be done. Proportioning of sand shall be as per its dry volume. In case it is dump, allowance for "bulking" shall be made as per IS: 2386 (Part-III).
4. Ingredients required for ordinary concrete containing one 50 Kg. bag of cement of different proportions of mix shall be as given in Table below

**TABLE**

| 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 | Proportion of fine aggregate to coarse aggregate | Quantity of water per 50 Kg. of cement max. |
|-------------------|---------------|---|--|---|
|-------------------|---------------|---|--|---|

| of fine and coarse aggregates max. |            |     |  |         |
|------------------------------------|------------|-----|--|---------|
| 1                                  | 2          | 3   | 4  | 5       |
| (1 Cubic metre = 1000 Liters)      |            |     |  |         |
| Ordinary                           | Liters     |     | General 1:2 for fine aggregate to coarse aggregate by volume but subject to a upper limit of 1 : 1. 1/2 & a lower limit of 1 : 3 | Liters. |
| M.100                              | 1 :3:6     | 300 |  | 34      |
| M.150                              | 1:2:4      | 220 |  | 32      |
| M.200                              | 1:1. 1/2:3 | 160 |  | 30      |
| M.250                              | 1:1:2      | 100 |  | 27      |

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

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

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

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

| Sr. No. | Item of construction   | Maximum nominal size of coarse aggregate |
|---------|--|--|
| (i)     | RCC well curb , R.C.C well staining and RCC piles                                    | 40 mm.                                   |
| (ii)    | R.C.C. well staining   | 63 mm.                                   |
| (iii)   | Well cap or pile cap; solid type piers, abutment and wing-walls, and their pier caps | 40 mm.                                   |
| (iv)    | R.C.C. works in cross girders deck slab, wearing                                     | 20 mm.                                   |

coarse, kerb, light posts blast walls, approach slab etc.  
and hollow type piers abutments, wing-walls and their pier caps.

- (v) R.C.C. bearings. 20 mm.
- (vi) For any other item of construction not covered As specified on the drawing

by items (i) to (v)

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's maximum size of aggregate shall usually be restricted to 5 mm. less than the minimum lateral clear distance between the main bars or 5 mm. less than the minimum cover to the reinforcement, whichever is the smaller.
6. Fine aggregate shall be clean, hard coarse sand. It shall be free from dust and such other substances. The sand be got approved by the Engineer-in-charge.
  7. All materials shall be stored as to prevent their deterioration or intrusion of their quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-charge shall not be used in the works.
  8. Cement shall be stored above the ground level in perfectly dry and water tight sheds. Wherever bulk storage containers are used, their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months. The aggregate shall be stored in such a way as to prevent admixture of foreign materials. Different size of fine or coarse aggregate shall be stored in separate stock-piles sufficiently away from the each other to prevent intermixing the materials.
  9. The water for mixing shall be potable water to satisfaction of the Engineer-in-charge. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the job.
  10. For all work concrete shall be mixed in a mechanical mixer which along with other accessories shall be kept in first class working condition and so maintained throughout the construction. Mixing shall be continued till materials are uniformly distributed and uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate show complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.
  11. When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons. It shall be done on a smooth watertight platform large enough to allow efficient turning over of the ingredients of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material shall get mixed with concrete nor does the mixing water flow out. Cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregate. Which shall also be spread in a layer of uniform thickness on the mixing platform. Dry coarse and fine aggregate and cement shall then be mixed thoroughly by turning over to get a mixture of uniform colour. Enough water shall then be added gradually through a rose can and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 percent above that specified.
  12. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to be the Engineer-in-

charge, the first batch of concrete from the mixer shall contain only two thirds of normal quantity of coarse aggregate. Mixing plant shall be thoroughly cleaned before changing from one type of cement to another.

13. The method of transporting and placing concrete shall be approved by the Engineer-in-charge. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes places. All form work and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer-in-charge has been obtained.
14. If concreting is not started within 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-charge. Concreting being given, it shall proceed continuously over the area between construction joint. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried in properly design agitators, operating continuously, when this time shall be within 2 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to be the Engineer-in-charge, concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 metre when internal vibrators are used and not exceeding 0.30 metre 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 metres. When trucking or chutes are used they shall be kept clean and used in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept, clean, thoroughly wetted and covered with a 13 mm. thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. , Where concrete has not fully hardened, all laitance shall be removed by scrubbing the well surface with wire or bristle brushes, care being taken to avoid dislodgement of any particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150 mm. in thickness, and shall be well rammed against old work particular attention being given to corners and close spots.
16. All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrators unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting under water, where vibrators cannot be used. Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event of break downs.
17. Immediately after compaction, concrete shall be protected against harmful effects of weather, including rain, running water, shocks, vibration, traffic, rapid temperature changes, frost and driving out process. It shall be covered with wet sacking, Hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set, and shall be kept continuously wet for a period of not less than 14 days from the date of placement. 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. Form work shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Form work shall however be divided into following two distinct categories :
  - (1) Shuttering i.e., form work required for forming the concrete.
  - (2) Scaffolding i.e., form-work required for supporting shuttering.

Forms for shuttering shall be constructed only in metal suitably lined. Forms for scaffolding shall be constructed of metal or timber. Both shuttering and scaffolding shall be of substantial rigid construction and shuttering shall be true to shape and dimensions shown on the drawings. All bolts and rivets shall be counter-sunk and well ground to provide a smooth, plane surface. '
19. Forms shall be mortar-tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports,. They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribed lines occurring during and after placing the concrete. Screw jacks or hard wood wedges where required shall be provided to make up any settlement in the formwork either before or during the placing of concrete. Suitable camber shall be provided in horizontal members of structure, especially in long spans to counteract the effects of any fixed axis as to provide for such camber. Forms shall be so constructed as to be removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections. Unless otherwise specified or directed, chamfers or fillets of sizes 25 mm x 25 mm shall be provided at all angles of formwork to avoid sharp corners.
20. The inside surfaces of shuttering shall, except in the case of permanent form work or where otherwise agreed to by the Engineer-in-charge, be coated with an approved material to prevent adhesion of concrete to the form work. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not be allowed to come into contact with any reinforcement or prestressing tendons and anchorages. Different release agents shall not be used in form work for concrete which will be visible in the finished works.
21. Special measures shall be taken to ensure that the form work does not hinder the shrinkage of concrete because without these cracking could occur before the form work is removed. Wherever applicable arrangements must be made to ensure that the form work does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons. The form work should take due account of the calculated amount of positive or negative camber so as to ensure the correct final shape of the structures having regard to the deformation of a false work, scaffolding or propping and the instantaneous or deferred deformation due to various causes affecting prestressed structures. Where there are re-entrant angles in the concrete sections the form work should be removed at those sections as soon as possible after the concrete has set in order to avoid cracking due to shrinkage of concrete. Formwork shall be tight enough to prevent any appreciable loss of cement during vibrations, suitable tolerances should be provided in the form work. Immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the Engineer-in-charge due notice before 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, materials and



for results obtained.

22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any formwork. While fixing the time for removal of formwork, due consideration shall be given to local conditions, character of the structure, the weather and other conditions that influence the setting of concrete and of the materials used in the mix. Where field operations are controlled by strength tests of concrete, the removal of the load-supporting or soffit forms may commence when concrete has attained strength equal to at least twice the stress to which the concrete will be subjected at the time of striking props including the effect of any further addition of loads. When field operations are not controlled by strength tests of concrete the vertical forms of beams, columns and walls may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 days respectively. All formwork shall be removed without causing any damage to the concrete. Canting shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted, they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to reuse the formwork, it shall be cleaned and made good to the satisfaction of the Engineer-in-charge.
23. Immediately after the removal of forms, all exposed bars or bolts passing through the Cement concrete member and used for shuttering or any other purpose shall be cut inside the cement concrete member to a depth of at least 25 mm. below the surface of the concrete and the resulting holes be filled by cement mortar. All fins caused by form joints, all cavities. produced by the removal of form ties and all other holes and depressions, honey comb spots, broken edges or corners and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry as consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces which have been pointed shall be kept moist for a period of twenty four hours. If rock pockets/honeycombs, in the opinion of the Engineer-in-charge are of such an extent or character as to affect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of the structure affected.
24. In the case of reinforced concrete work workability shall be such that that concrete surrounds and properly grips all reinforcement. The degree of consistency, which shall depend upon the nature of work and methods of vibration of concrete, shall be determined by regular slump tests. Following slump shall be adopted for different types of works.

| Type of Work                             | Slumps                   |                              |
|--|--------------------------|------------------------------|
|  | Where vibrators are used | Where vibrators are not used |
| (i) Mass concrete in R.C.C. foundations, | 10 mm to                 | 80mm.                        |

|       |   |                  |                    |
|-------|---|------------------|--------------------|
|       | footings and retaining walls                        | 25 mm.           |                    |
| (ii)  | Beams, slabs and columns simply reinforced.         | 25 mm. to 40 mm. | 100 mm. to 120 mm. |
| (iii) | Thin R.C.C. section or section with congested steel | 40 mm. to 50 mm. | 125 mm. to 150 mm. |

25. Works strength tests shall be made in accordance with IS: 516. Each test shall be conducted on ten specimens five of which shall be tested at seven days and the remaining five at 28 days. The samples of concrete shall be taken on each day of concreting and cubes shall be made at the rate of 01.18 for every 5 cubic metre of concrete or a part thereof. However, if concreting done in a day is less than 15 cubic meter the minimum number of cubes can be reduced to 6 with, the specific permission of the Engineer-in-charge. Similar works tests shall be carried out whenever the quality and grading of materials is charged irrespective of the quantity, of 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 at cubes cast for each day shall not be less than the specified works cube-strength, 20 per cent of the cubes cast for each day may have values less than the specified strength, provided the lowest value is not less than 85 per cent of the specifies strength.
27. R.C.C. Work shall have exposed concrete surface. Centring design and its erection shall approved by he Engineer-in-charge. One carpenter with helper will invariably be kept present throughout the period of concreting. Movement of labour and other persons shall be totally prohibited over reinforcement laid in position for access to different parts, suitable mobile platforms shall provided so that steel reinforcement in position is not disturbed. For ensuring proper cover, motor blocks of suitable size shall be cast 'and tied to the reinforcement. Timber, kapchi or metal pieces shall not be used for this purpose. Concreting of important structural members shall always be done in the presence and under the supervision of depart metal person not below the rank of Astd. Engineer/Addi-Astd. Engineer Overseer or as instructed by the Engineer-in-charge. After removal of form work checks that concrete produced is of good quality. Plastering shall not be allowed to the expressed faces of concrete.
28. In reinforced concrete the volume occupied by reinforcement shall not be deducted. The slab shall be measured as running continuously through and the beam as the portion below the slab.
29. All necessary labour, materials, equipment, etc., for sampling, preparing test cubes, curing etc., shall be provided by the Contractor. Testing of the materials and concrete may be arranged by the Engineer-in-charge in an approved laboratory at the cost or the contractor.
30. The payment will be made on cmt. basis of the finished walk.
31. The unit rate for concrete shall include the cost of all materials, labour, tools and plan required for mixing, placing in position, vibrating and compacting finishing as per directions of the Engineer-in-charge, curing and all other incidental expenses for producing concrete of specified strength to complete the structure or its components as

show on the drawings and according to these specifications. The rate shall also include the cost of making/fixing and removing of all centres and forms required for the work. be final and binding on the Contractor.

**Item No.10 Providing and fixing in position FE 500D TMT bar reinforcement including cutting, bending and tying complete as per detailed drawings. (A) R.C.C. Kerb. (B) R.C.C. Footpath.(C) R.C.C. Approach slab.(D) Wearing Coat.**

**1601. DESCRIPTION**

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

**1602. GENERAL**

Steel for reinforcement shall meet with the requirements of IS 1786:2008.

**1603. PROTECTION OF REINFORCEMENT**

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

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

**1604. BENDING OF REINFORCEMENT**

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

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

Bars shall be bent cold to the specified shape and dimensions or as directed by the Engineer using a proper bar bender, operated by hand or power to obtain the correct radii of bends and shape.

Bars shall not be bent or straightened in a manner that will damage the parent material or the coating.

Bars bent during transport or handling shall be straightened before being used on work and shall not be heated to facilitate straightening.

**1605. PLACING OF REINFORCEMENT**

The reinforcement cage should generally be fabricated in the yard at ground level and

thenshifted and placed in position. The reinforcement shall be placed strictly in accordance with the drawings and shall be assembled in position only when the structure is otherwise ready for placing of concrete. Prolonged time gap between assembling of reinforcements and casting of concrete, which may remit in rust formation on the surface, shall not be permitted.

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

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

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

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

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

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

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

Bar coated with epoxy or any other approved protective coating shall be placed on supports that do not damage the coating. Supports shall be installed in manner such that point of weakness is not created in hardened concrete. The coated reinforcing bar shall be held in place by use of plastic or plastic coated binding wires especially manufactured for the purpose. Reference shall be made to Section 1000 for other requirements.

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

## **1606. BAR SPLICES**

### **1606.1.Lapping**

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

## 1606.2.Welding

### 1606.2.1.

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

### 1606.2.2.

While welding may be permitted for mild steel reinforcing bars conforming to IS:432, welding of deformed bars conforming to IS:1786 shall in general be prohibited. Welding may be permitted in case of bars of other than S 240 grade including special welding grade of S 41S grade bars conforming to IS: 1786, for which necessary chemical analysis has been secured and the carbon equivalent (CE) calculated from the chemical composition using the formula :

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mg + V}{5} + \frac{Ni + Cu}{15} \text{ is 0.4 or less}$$

**1606.2.3.** The method of welding shall conform to IS:2751 and IS:9417 and to any supplemental specifications to the satisfaction of the Engineer.

Welding may be carried out by metal arc welding process. Oxy-acetylene welding shall not be permissible. Any other process may be used subject to the approval of the Engineer and necessary additional requirements to ensure satisfactory joint performance. Precautions on over heating, choice of electrode, selection of correct current in arc welding etc., should be strictly observed.

All bars shall be butt welded except for smaller diameter bars (diameter of less than 20 mm) which may be lap welded. Single-V or Double-V butt joints may generally be used. For vertical bars single bevel or double bevel joints may be used.

Welded joints shall be located well away from bends and not less than twice the bar diameter away from a bend.

Generally, shop welding in controlled conditions is to be preferred, where feasible. Site welding where necessary shall, however, be permitted when the facilities, equipment, process, consumables, operators, welding procedure are adequate to produce and maintain uniform quality at par with that attainable in shop welding to the satisfaction of the Engineer.

Joint welding procedures which are to be employed shall invariably be established by a procedure specification. All welders and welding operators to be employed shall have to be qualified by tests prescribed in IS:2751. Inspection of welds shall conform to IS:822 and destructive or non-destructive testing may be undertaken when deemed necessary. Joints with weld defects detected by visual inspection or dimensional check inspection shall not 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. When welding is done in 2 or 3 stages, previous surface shall be cleaned properly. Bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before carrying out welding. Only competent and experienced welders shall be employed on the work with the approval of the Engineer. No welding shall be done on coated bars.

M.S. electrodes used for welding shall conform to IS:814.

**1606.2.4.** Welded joints shall preferably be located at points where steel will not be subject to more than 75 per cent of the maximum permissible stresses and welds so staggered that at any one section, not more than 20 per cent of the bars are welded.

**1606.2.5.** Welded pieces of reinforcement shall be 'tested. Specimens shall be taken from the site and the number and frequency of tests shall be as directed by the Engineer.

**1606.3. Mechanical Coupling of Bars**

Bars may be joined with approved patented mechanical devices as indicated on the drawing or as approved by the Engineer e.g. by special grade steel sleeves swagged on to bars in end to end contact or by screwed couplers. In case such devices are permitted by the Engineer, they shall develop at least 125 per cent of the characteristic strength of the reinforcement bar.

**1607. TESTING AND ACCEPTANCE**

The material shall be tested in accordance with relevant IS specifications and necessary test certificates shall be furnished. The fabrication, furnishing and placing of reinforcement shall be in accordance with these specifications and shall be checked and accepted, by the Engineer.

**1608. MEASUREMENTS FOR PAYMENT**

Reinforcement shall be measured in length including hooks, if any, separately for different diameters as actually used in work, excluding overlaps. From the length so measured, the weight of reinforcement shall be calculated in **M.T.** on the basis of 15:1732. Wastage, overlaps, couplings, welded joints, spacer bars, chairs, stays, hangers and annealed steel wire or other methods for binding and placing shall not be measured and cost of these items shall be deemed to be included in. the rates for reinforcement

**1609. RATE**

The contract unit rate for coated/uncoated reinforcement shall cover the cost of material, fabricating, transporting\* storing, bending, placing, binding and fixing in position as shown on the drawings as per these specifications and as directed by the Engineer, including all labour, equipment, supplies, incidentals, sampling, testing and supervision.

The unit rate for coated reinforcement shall be deemed to also include cost of all material, labour, tools and plant, royalty, transportation and expertise required to carry out the work. The rate shall also cover sampling, testing and supervision required for the work.

Payment shall be made on **M.T.** basis.

**Item No.11 Providing and fixing ordinary kilometer stone of precast C.C. 1:2:4 including necessary reinforcement as per I.R.C. type design in C.C. 1:4:8 including lettering and painting etc. complete. (For OD.R. & V.R.)**

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 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 gravel.
3. The measurement for payment shall be made per No. of K.M. stone fixed in position.
4. 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.

**Item No.12 Providing and fixing Hectometer stone as per I.R.C. type design including lettering and painting etc. complete. (ii) Fixing in C.C. 1:5:10**

1. Hectometer stone shall be of approved quality and as per I.R.C. 26 (Type design for 200 meter stones) and 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 machine crushed metal 40 mm nominal size. Rate includes all labour and curing etc. necessary for concrete.
2. The measurement for payment shall be made per No. of Hectometer stone fixed in position.
3. Unit rate for hectometer stone includes the cost of all materials, labour, tools, fixing, finishing curing, lettering and painting as directed by the Engineer-in-charge.

**Item No.13    Informatory signs: Providing and fixing sing boards made out of 2mm aluminium sheet; size 80 x 60cms. rectangle as per the design of IRC-67-1977 pre treated with phospheting process & acid teching; coated with one coat of epoxyprimer and two coats of best qualityepoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand postand frame fabricated from suitable sizeiron angle of 35 x 35 x 3mm75x75x6mm as required; painted with best qualityepoxy coatings in black and whitebends. the details of symbol for eachboard shall details of symbol for eachboard shall be as per the instruction ofengineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x45 x 60cms. for each leg. including excavation curing tec. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)..**

### **801.1 GENERAL**

801.1.1 The colour, configuration, size and location of all traffic signs for highways other than Expressways shall be in accordance with Code of Practice for Road Signs, IRC:67 or as shown on the drawings. For Expressways, the size of signs, letters and their placement shall be as specified in the Contract drawings and relevant specifications. In the absence of any details or for any missing details, the signs shall be provided as directed by the Engineer. The Aluminum sheet size to be fixed shall be as specified in the Item.

801.1.2 The signs shall be reflectorised type and made of encapsulated lens type reflective sheeting vide Clause 801.3, fixed over aluminium sheeting as per these Specifications.

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

**801.2 MATERIALS :-** The various materials and fabrication of the traffic signs shall conform to the following requirements :

**801.2.1 Concrete :** Concrete shall be of the grade shown on the contract drawings or otherwise as directed by the Engineer.

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

**801.2.3 Bolts, nuts, washers:** High strength bolts shall conform to IS: 1367 whereas precision bolts, nuts, etc. shall conform to IS: 1364.

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

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

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

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

### **801.3 TRAFFIC SIGNS HAVING 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, 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.

**801.3.3 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-81 0) as indicated in Table 800-2.

*Table 800 – 2*

ACCEPTABLE MINIMUM COEFFICIENT OF RETRO-REFLECTION FOR  
ENGINEERING 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                          | 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 least 50 per cent 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 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 scheme 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 ct, 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 degreased 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 1 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 to 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 discolouration, 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 upto 0.9 sq.m. shall be mounted on a single post, and for greater area two or more supports shall be provided. Sign supports may be of mild steel, reinforced concrete or galvanized iron (G.I.) Post end(s) shall be firmly fixed to the ground by means of properly designed foundation. The work of foundation shall conform to relevant specifications as specified.

**801.4.2** All components of signs and supports, other than the reflective portion and G.I. posts shall be thoroughly descaled, 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 G.I. 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 information signs shall be in numbers sign board supplied and fixed.

**801.6RATE**

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

**Item No.14 Village name/ Bump Ahead sign :-Providing and fixing sing boards made out of 2mm aluminium sheet; size 90 x 60cms. 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 reflective sheeting as per latest M.O.S.T. Specifications; Letters and numerals should be as per IRC-30-1968, 3.1m long (2 nos) stand post and frame fabricated from suitable size iron angle of 50 x 50 x 5mm 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 work of providing and fixing Village Name board shall be executed as per relevant specifications of **Item No. 13** of this contract. The measurement shall be in numbers of board supplied and fixed in position.

- Item No.15** 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.**

**General :-**

**Hot Applied Thermoplastic Road Marking.**

- (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 be 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 (IS : colour No. 356) as specified in drawings or as directed by the Engineer.
- (iv) Where the compound is to be applied to cement concrete pavement sealing primer as recommended by the manufacture, 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 marking are applied.

**THERMOPLASTIC MATERIALS GENERAL :**

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

**REQUIREMENT :**

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

**Table 800 – 3 PROPORTIONS OF CONSTITUENTS OF MARKING MATERIAL  
(percentage by weight)**

| Component                           | White      | Yellow     |
|-------------------------------------|------------|------------|
| Binder                              | 18.00 min. | 18.00 min. |
| Glass Beads                         | 30 – 40    | 30 – 40    |
| Titanium Dioxide                    | 10.00 min. | - - -      |
| Calcium Carbonate and Inert Fillers | 42.00 max  | See Note   |
| Yellow Pigments                     | - - -      | - do -     |

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

II Properties : The properties of thermoplastic material, when tested in accordance with ASTM D36/ BX-3262- (Pa. T1) shall be as below :

**A) Luminance :**

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

B) Drying time : When applied at a temperature specification by the manufactures 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 :  $102.5 \div 9.5$  as per ASTM D 36.

F) Flow resistance : Not more than 25 per cent as per AASHTO M 249.

G) Yellowness index (for white thermoplastic paint) not more than 0.12 as per AASHTOM 249.

III Storage life : The materials shall meet the requirement of there Specifications for period of one year. The thermoplastic material must also melt uniformly with no evidence of skins of un-melted 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 Clause 803.4.3 of MORT & H Specification.

V Marking : Each container of the thermoplastic material shall be clearly and indelibly marked with the following information.

1. The name, trademark or other means of identification of manufacturer.
2. Batch number.
3. Date of manufacture.
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 report from the manufacturer of the thermoplastic material showing results of all tests specified therein and shall certify that the materials meets all requirements of this Specification.

### **REFLECTORIZING GLASS BEADS**

GENERAL : This Specification covers two types of glass beads to be used for to production of reflectorised pavement markings. Type 1 beads are those which are a constituent of the basic thermoplastic compound vide Table 800 – 3 and type – 2 beads are those which are to be sprayed on the surface vide Clause 803.6.3.

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

These shall conform to the requirements spelt out in clause 5.4.3.3.

**SPECIFIC REQUIREMENTS. A GRADATION :**

The glass beads shall meet the gradation requirements for the two types as given in Table 800 – 4.

**TABLE 800-4 GRADATION REQUIREMENT FOR GLASSBEADS**

| Sieve Size       | Per Cent Retained |           |
|------------------|-------------------|-----------|
|                  | Table – 1         | Table – 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 15   |

**B. ROUNDNESS :**

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

**C. REFRACTIVE INDEX :**

The glass beads shall have a minimum refractive 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 condition suitable for paints striping. They shall pass the free flow-test.

**TEST METHODS :**

The specific requirement shall be tested with the following methods.

- I Free-flow test : Spread 100grams of beads evenly in a 100 mm diameter glass dish. Place the dish in a 250 mm inside diameter desiccators which is filled within 25 mm of the top of a desiccators plate with sulphur acid water solution (specific gravity 1.10) Cover the desiccators and let it stand for 4 hours at 20 to 29 degree C. Remove Sample from desiccators, transfer beads to a pan and inspect for lumps or clusters. Then pour beads into a clean dry glass funnel having a 100 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.
- II The requirements of gradation, roundness and refractive index of glass beads and the amount of glass beads in the compound shall be tested as per BS 6088 and BS 3262 (Part 1).
- III The Contractor shall furnish to the Employer a copy of certified test report from the manufacturer of glass beads obtained from a reputed laboratory showing results of all tests specified therein and shall certify that material meets all requirements of this Specification. However, if so required, these tests may be carried out as directed by the Engineer in charge.

**APPLICATION PROPERTIES OF THERMOPLASTIC MATERIAL**

The thermoplastic materials shall readily get screed / 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 materials upon heating to application temperatures shall not exude fumes which are toxic. Obnoxious or injurious to persons property.

**PREPARATION :**

- i) The material shall be melted in accordance with the manufacturer's instructions in a heater fitted with a mechanical stirrer to give a smooth consistency to the thermoplastic materials 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 materials. Which has natural binders or is otherwise sensitive to prolonged heating the materials shall 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 MARKING :**

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

**REFLECTORISED PAINT :**

Reflectorised paint, if used shall conform to the specification by the manufacturers and approved by the engineer. Reflectorising glass beads for reflectorising paints where used shall conform to the requirements of Clause 5.3.

**APPLICATION**

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

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

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

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

Thermoplastic paint shall be applied in intermittent of contibeous 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 quick succession of the paint spraying operation. The glass beads shall be applied at the rate of 250 grams per square meter area.

The minimum thickness specified in 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).

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 steaks.

#### MEASUREMENT FOR PAYMENT.

The painted marking shall be measured in sq. meters of actual area marked (excluding the gaps. If any).

In respect of markings line directional arrows and lettering. Etc., the measurement shall be in Square meter basis.

#### Rate

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

- Item No.16 Cat Eye / Road Stud / RPM: Supplying of Molded Twin Shanks Raised Pavement arkers made of polycarbonate and ABS moulded body and reflective panels with micro prismatic lens capable of providing total internal reflection of the light entering the lens face and shall support a load of 13635 kgs. tested in accordance to ASTM D 4280 Type H and complying to Specifications of Category A of MORTH Circular No RW/NH/33023/10-97 DO III Dt 11.06. 1997. The height, width and length shall not exceed 20mm, 130 mm and 130 mm and with minimum reflective area of 13 Sqcm on each side and the slope to the base shall be 35 +/- 5 degree. The strength of detachment of the integrated cylindrical shanks, (of diameter not less than 19 +/- 2 mm and height not less than 30 +/- 2 mm) from the body is to be a minimum value of 500 Kgf. Fixing will be by drilling holes on the road for the shanks to go inside, without nails and using epoxy resin based adhesive as per manufacturers recommendation and The color of the marker should be as per the IRC 35-2015 and as directed by Engineer-in-charge.**

#### 1.1 General

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



## 1.2 Definitions

### 1.2.1 Description of Terms Specific to this standard

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

## 1.3 Material

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

## 1.4 Design

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

## 1.5 Optical Performance

### 1.5.1 Unidirectional and bi-directional studs

- 1.5.1.1** Each reflector or combination of reflectors on each face of the stud shall have a CIL not less than given in Table 1 or 2 as appropriate.

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

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

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

| Entrance angle | Observation angle | C.I.L. in med 1 x |
|----------------|-------------------|-------------------|
|----------------|-------------------|-------------------|

|                |      | White | Amber | Red |
|----------------|------|-------|-------|-----|
| 0" U 6" L & R  | 0.3" | 20    | 10    | 4   |
| 0" U 10" L & R | 0.5" | 15    | 7.5   | 3   |

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

**1.5.1.2** A stud that incorporates one or more corner cube reflectors shall be considered to be included in category "A". A stud that incorporates one or more biconvex reflectors shall be considered to be included in category "B".

### **1.5.2 Omni – directional studs**

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

### **1.5.3 Tests**

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

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

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

## **1.6 Fixing of Reflective Markers**

### **1.6.1 Requirements**

**1.6.1.1** The enveloping profile of the head of the stud shall be smooth and the studs shall not present any sharp edges to traffic.

**1.6.1.2** The reflecting portions of the studs shall be free from crevice or ledges where dirt might accumulate.

**1.6.1.3** All road studs shall be legibly marked with the name, trade mark or other means of identification of the manufacture.

**1.6.1.4** Marker height shall not exceed 20 mm.

**1.6.1.5** Marker width shall not exceed 130 mm.

**1.6.1.6** The base of the marker shall be flat within 1.3 mm. If the bottom of the marker is configured. The outermost faces of the configurations shall not deviate more than 1.3 mm from a flat surface.

### **1.6.2 Placement**

**1.6.2.1** The reflective marker shall be fixed to the road surface using the adhesives and the produced recommended by the manufacturer. No nails shall be used to affix the marker as nails are hazardous for the roads.

**1.6.2.2** Regardless of the type of adhesive used. The markers shall not be fixed if the pavement is not surface dry and on new asphalt concrete surfacing unit the surfacing has been opened to traffic for a period of not less than 14 hours.

**1.6.2.3** The portions of the highway surface, to which the marker is to be bonded by the adhesive, shall be free of dirt, curing compound, grease, oil, moisture, loose or unsound layers, paint and any other material which would adversely affect the bond of the adhesive.

**1.6.2.4** Use a wire brush, if necessary to loosen and remove dirt. Then brush or blow clean.

**1.6.2.5** The adhesive shall be placed uniformly on the cleaned pavement surface or on the bottom to the marker in a quantity sufficient to result in complete coverage of the area of contact of the marker with no voids present and with a slight excess after the marker has been lightly pressed in place.

**1.6.2.6** For epoxy installations, excess adhesive around the edge of the marker, excess adhesive on the pavement and adhesive on the exposed surfaces of the markers shall be immediately removed. Soft rags moistened with mineral spirits or kerosene may be used as necessary to remove adhesive from exposed faces of pavement marker.

## **1.7 Warranty and durability**

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

## **1.8 Measurement for Payment**

The measurement of Cats eye shall be in numbers of markers supplied and fixed.

## **1.9 Rate**

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

**Item No.17 Hazard Marker Sign :-Providing and fixing sign boards made out of 2mm aluminium sheet; size 90 x 30cms. rectangle as per the design/drawing attached (IRC) pretreated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm & 50 x 50 x 5mm painted with best quality epoxy coatings The fixing at site shall be in 1:2:4 CC block of size 45x45x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade.....**

## **801.1 GENERAL**

**801.1.1** The colour, configuration, size and location of all traffic signs for highways other than Express ways shall be in accordance with Code of Practice for Road Signs, IRC:67 or as shown on the drawings. For Expressways, the size of signs, letters and their placement shall be as specified in the Contract drawings and relevant specifications. In the absence of any details or for any missing details, the signs shall be provided as directed by the Engineer. The Aluminum sheet size to be fixed shall be as specified in the Item.

801.1.2 The signs shall be either reflectorised or non-reflectorised as shown on the drawing or as directed by the Engineer. When they are of reflectorised type, they shall be of retro-reflectorised type and made of encapsulated lens type reflective sheeting vide Clause 801.3, fixed over aluminium sheeting as per these Specifications.

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

## **801.2 MATERIALS**

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

**801.2.1 Concrete :** Concrete shall be of the grade shown on the contract drawings or otherwise as directed by the Engineer.

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

**801.2.3 Bolts, nuts, washers:** High strength bolts shall conform to IS: 1367 whereas precision bolts, nuts, etc. shall conform to IS: 1364.

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

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

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

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

## **801.3 TRAFFIC SIGNS HAVING 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, 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 Sheetting :** This sheet 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 CO-EFFICIENT OF RETRO REFLECTION FOR HIGH  
INTENSITY GRADE SHEETING  
(CANDELAS PER LUX PER SQUARE METRE)**

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

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

**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-81 0) as indicated in Table 800-2.

**Table 800 – 2**

**ACCEPTABLE MINIMUM COEFFICIENT OF RETRO-REFLECTION FOR  
ENGINEERING GRADE SHEETING  
(CANDELAS PER LUX PER SQUARE METRE)**

| Observation<br>angle<br>(in<br>degrees) | Entrance<br>(in<br>Angle<br>(in<br>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 least 50 per cent 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 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 scheme 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 ct, 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 degreased 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 1 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 to 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 discolouration, 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 upto 0.9 sq.m. shall be mounted on a single post, and for greater area two or more supports shall be provided. Sign supports may be of mild steel, reinforced concrete or galvanized iron (G.I.) Post end(s) shall be firmly fixed to the ground by means of properly designed foundation. The work of foundation shall conform to relevant specifications as specified.

**801.4.2** All components of signs and supports, other than the reflective portion and G.I. posts shall be thoroughly descaled, 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 G.I. 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 or signs supplied and fixed.

#### **801.6 RATE**

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

**Item No.18    Excavation for foundation up to 1.5m depth including sorting out and stacking of useful material and disposing off the excavated stuff as directed by Engineer in charge with all lead and lift in (2) Dense or hard Soil.**

1. Excavation for structures shall consist of the removal of material for the construction of foundations for bridges, culverts, retaining walls, headwalls, cut off walls, pipe culverts and other similar structures, in accordance with the requirements, of these specifications and the lines and dimensions shown on the drawings or as indicated by the Engineer-in-charge. The work shall include all necessary sheeting, shoring, bracing, draining and pumping and the removal of all logs, stumps, shrubs, and other deleterious matter and obstruction necessary for the foundations, trimming bottoms of excavations; back filling and clearing up the site and the disposal of all surplus material.
2. After the site has been cleared the limits of excavation shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer-in-charge. The contractor shall provide all labour, survey instruments and materials such as strings, pegs nails bamboos, stones, lime, mortar, concrete etc. required in connection with the string out of works and the establishment of bench mark, centre line stones and other marks and stakes as long as in the opinion of the Engineer-in-charge, they are required for the work.
3. Excavation shall be taken to the width of the lowest step of the footing. The contractor at his own expense shall put up necessary shoring, strutting and planking or cut slopes to a safer angle or both with due regard to the safety of personal and works and to the satisfaction of the Engineer-in-charge.
4. The depth to which the excavation is to be carried out shall be as shown on the drawings, unless the type of material encountered is such as to require changes, in which case the depth shall be as ordered by the Engineer-in-charge.
5. Where water is met with in excavation due to stream flow, seepage, springs, rain or other reasons, the contractor shall take adequate measures such as bailing .pumping, to keep the foundation trenches dry when so required and to protect the green concrete/masonry against damage by erosion or sudden rising of water level. The methods to be adopted in this regard and other details thereof shall be left to the choice of the contractor but subject to approval of the Engineer-in-charge. Approval of the Engineer-in-charge shall, however not relieve the contractor of the responsibility for the adequacy of dewatering, and production arrangements and for the quality and safety of the works.
6. Pumping from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of movement of water through any fresh concrete. No. pumping shall be permitted during the placing of concrete or for any period of at least 24 hours thereafter, unless it is done from a suitable sump separated from the concrete work by a water tight wall or other similar means.
7. The bottom of the foundation shall be leveled both longitudinally and transversely or stepped as directed by the Engineer-in-charge. Before footing is laid, the surface shall be slightly watered and rammed. In the event of excavation having been made deeper than that shown on the drawings or as otherwise ordered by the Engineer-in-charge, the extra depth shall be made up with concrete or masonry of the foundation grade at the cost of



the contractor. Ordinary filling shall not be used for the purpose to bring the foundation to level. If there are any slips or blows in the excavation, these nail be removed by the contractor at his own cost.

8. Near towns, villages and all frequented places, trenches and foundation pits shall be securely fenced, provided with proper caution signs and marked with red lights at night to avoid accidents. The contractor shall take adequate protective measures to see that the excavation operations do not affect or damage adjoining structures.
9. Backfilling shall be done with approved materials after concrete or masonry is fully set and carried out in such a way as not to cause undue thrust on any part of the structure. All space between foundation masonry or concrete and the sides of excavation shall be refilled to the original surface, making due allowance for settlement in 250 mm. loose layers, which shall be watered and compacted.
10. All the excavated materials shall be the property of the Government. Where the excavated materials are to be used in the construction of embankment, it shall be directly deposited at the required location, with all lead as directed.
11. All useful materials not intended for use in the bank, shall be stacked neatly on Government land as directed by the Engineer-in-charge with all lead. Unsuitable and surplus materials not intended for use shall be disposed off as directed by the Engineer-in-charge.
12. Excavation for structures shall be measured in cubic meters for each class of materials encountered, limited to the dimensions shown on the drawing or as directed by the Engineer-in-charge. Excavation over increased width cutting of slopes, shoring, shuttering and planking shall be deemed as convenience for the contractor in executing the work and shall not be measured and paid for separately.
13. The contract unit rate for the items of excavation for structures shall be paid in full for carrying out the required operations including :-
  1. Setting out and fixing bench marks and centre lines stones.
  2. Construction of necessary shoring and bracing and their subsequent removal.
  3. Removal of all logs, stumps, Grubs and other deleterious matter and obstructions for placing the foundations including trimming of bottoms of excavations;
  4. Foundation sealing, dewatering including pumping;
  5. Backfilling, Clearing up the site and disposal of all surplus material within all lifts and lead;
  6. All labour, materials, tools equipment, safeguards and incidentals necessary to complete the work to the specification.
14. Excavation shall be for dense or hard soil such as vegetation or organic soil, turf, sand, silt, loam, clay, mud, black cotton soil, soft shale or soft murrum, and similar material which yields to the ordinary application of pick and shovel, or other ordinary digging equipment. Removal of gravel or any other nodular material having diameter in any one direction not exceeding 75 mm. occurring in such strata shall be deemed to be covered under this category. The classification of excavation shall be decided by the Engineer-in-charge and his decision shall be final and binding on the contractor.

**Item No.19 Providing & filling in foundation with ordinary cement concrete M 100 mix and providing necessary vertical pin headers including formwork vibrating ramming & curing complete.**

Ordinary cement concrete of specified Grade i.e. cement concrete M-100 shall be carried out in accordance with the following relevant 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 table below for different grades of concrete designated as ordinary M. 100, M. 150, M.200 and M.250.
2. In the designation of a concrete mix, letter "M" refers to the mix and the number the specified 28 days works cube compressive strength of that mix on 150 mm. cubes expressed in kg/cm<sup>2</sup>.
3. The ordinary concrete mix shall generally be specified by volume. For cement which normally comes in bags and is used by weight, volume shall be worked out taking 50 kg. of cement as 0.035 cubic meter in volume. While measuring aggregate by volume, shaking, ramming or hammering shall not be done. Proportioning of sand shall be as per its dry volume. In case it is dump, allowance for "bulking" shall be made as per IS : 2386 (Part-III).
4. Ingredients required for ordinary concrete containing one 50 Kg. bag of cement of different proportions of mix shall be as given in Table below.

**TABLE**

| 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 | Proportion of fine aggregate to coarse aggregate   | Quantity of water per 50 kg. of cement max. |
|--------------------------------------|---------------|---|--|---|
| 1                                    | 2             | 3   | 4  | 5   |
| <b>(1 Cubic meter = 1000 liters)</b> |               |   |  |   |
| Ordinary                             | Liters        |   |  | Liters                                      |
| M.100                                | 1:3:6         | 300   | General 1:2 for fine aggregate to coarse aggregate by volume but subject to a upper limit of 1:1. ½ & a lower limit of 1:3 | 34  |
| M.150                                | 1:2:4         | 220   |  | 32  |
| M.200                                | 1:1.1/2:3     | 160   |  | 30  |
| M.250                                | 1:1:2         | 100   |  | 27  |

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

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

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

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

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

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

6. Fine aggregate shall be clean, hard, coarse sand. It shall be free from dust and such other substances. The sand be got approved by the Engineer-in-charge.
7. All materials shall be stored as to prevent their deterioration or intrusion of their quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-charge shall not be used in the works.
8. Cement shall be stored above the ground level in perfectly dry and water tight sheds. Wherever bulk storage containers are used, their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months. The aggregate shall be stored in such a way as to prevent admixture of foreign materials. Different size of fine or coarse aggregate shall be stored in separate stock-piles sufficiently away from the each other to prevent intermixing the materials.
9. The water for mixing shall be potable water to satisfaction of the Engineer-in-charge. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the job.
10. For all work concrete shall be mixed in a mechanical mixer which along with other accessories shall be kept in first class working condition and so maintained throughout the construction. Mixing shall be continued till materials are uniformly distributed and uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate show complete coating of mortar containing its proportionate amount of

cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.

11. When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons. It shall be done on a smooth watertight platform large enough to allow efficient turning over of the ingredients of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material shall get mixed with concrete nor does the mixing water flow out. Cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregate, which shall also be spread in a layer of uniform thickness on the mixing platform. Dry coarse and fine aggregate and cement shall then be mixed thoroughly by turning over to get a mixture of uniform colour. Enough water shall then be added gradually through a rose can and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 per cent above that specified.
12. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to be the Engineer-in-charge, the first batch of concrete from the mixer shall contain only two thirds of normal quantity of coarse aggregate. Mixing plant shall be thoroughly cleaned before changing from one type of cement to another.
13. The method of transporting and placing concrete shall be approved by the Engineer-in-charge. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes place. All form work and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer-in-charge has been obtained.
14. If concreting is not started within 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-charge. Concreting being given, it shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried in properly design agitators, operating continuously, when this time shall be within 2 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to be the Engineer-in-charge, concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 meter when internal vibrators are used and not exceeding 0.30 meter in all other cases.
15. Unless otherwise agreed to by the Engineer-in-charge concrete shall not be dropped into place from a height exceeding 2 meters. When trucking or chutes are used they shall be kept clean and used in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept, clean, thoroughly wetted and covered with a 13 mm. thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of any particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. The first layer of concrete to be placed on this surface

shall not exceed 150 mm. in thickness, and shall be well rammed against old work particular attention being given to corners and close spots.

16. All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting under water, where vibrators can not be used. Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event of break downs.
17. Immediately after compaction, concrete shall be protected against harmful effects of weather, including rain, running water, shocks, vibration, traffic, rapid temperature changes, frost and driving out process. It shall be covered with wet sacking, hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set, and shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonary work over the foundation concrete may be started after 48 hours of its laying but the curing of concrete shall be continued for a minimum period of 14 days.
18. Form work shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Form work shall however be divided into following two distinct categories :-
  - (1) Shuttering i.e., form work required for forming the concrete.
  - (2) Scaffolding i.e., form-work required for supporting shuttering.

Forms for shuttering shall be constructed only in metal suitably lined. Forms for scaffolding shall be constructed of metal or timber. Both shuttering and scaffolding shall be of substantial-rigid construction and shuttering shall be true to shape and dimensions shown on the drawings. All bolts and rivets shall be counter-sunk and well ground to provide a smooth, plane surface.
19. Forms shall be mortar-tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports, They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribe lines occurring during and after placing the concrete. Screw jacks or hard wood wedges where required shall be provided to make up any settlement in the formwork either before or during the placing of concrete. Suitable camber shall be provided in horizontal members of structure, specially in long spans to counteract the effects of any fixed as to provide for such camber. Forms shall be so constructed as to be removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections. Unless otherwise specified or directed, chambers or fillets of sizes 25 mm x 25 mm shall be provided at all angles of formwork to avoid sharp corners.
20. The inside surfaces of shuttering shall, except in the case of permanent form work or where otherwise agreed to by the Engineer-in- charge, be coated with an approved material to prevent adhesion of concrete to the form work. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not be allowed to come into contact with any reinforcement or pre-stressing tendons and anchorages. Different release agents shall not be used in form work for concrete which will be visible in the finished works.
21. Special measures shall be taken to ensure that the form work does not hinder the shrinkage of concrete because without these cracking could occur before the from work is removed. Where ever applicable arrangements must be made to ensure that the form

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

22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any formwork. While fixing the time for removal of formwork, due consideration shall be given to local conditions, character of the structure, the weather and other conditions that influence the setting of concrete and of the materials used in the mix. Where field operations are controlled by strength tests of concrete, the removal of the load-supporting or soffit forms may commence when concrete has attained strength equal to at least twice the stress to which the concrete will be subjected at the time of striking props including the effect of any further addition of loads. When field operations are not controlled by strength tests of concrete the vertical forms of beams, columns and walls may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 days respectively. All formwork shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted, they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to reuse the formwork, it shall be cleaned and made good to the satisfaction of the Engineer-in-charge.
23. Immediately after the removal of forms, all exposed bars or bolts passing through the Cement concrete member and used for shuttering or any other purpose shall be cut inside the cement concrete member to a depth of at least 25 mm. below the surface of the concrete and the resulting holes be filled by cement mortar. All fins caused by form joints, all cavities produced by the removal of form ties and all other holes and depressions, honey comb spots, broken edges or corners and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry as consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces which have been pointed shall be kept moist for a period of twenty four hours. If rock pockets/honeycombs, in the opinion of the Engineer-in-charge are of such an extent or character as to affect the strength of the structure materially or to

endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of the structure affected.

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

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

25. Works strength tests shall be made in accordance with IS : 516. Each test shall be conducted on ten specimens, five of which shall be tested at seven days and the remaining five at 28 days. The samples of concrete shall be taken on each day of concreting and cubes shall be made at the rate of one for every 5 cubic meter of concrete or a part thereof. However, if concreting done in a day is less than 15 cubic meter, the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer-in-charge. Similar works tests shall be carried out whenever the quality and grading of materials is changed irrespective of the quantity of concrete poured. The number of specimens may be suitably increased as deemed necessary by the Engineer-in-charge when procedure of tests given above reveal a poor quality of concrete and in other special cases.
26. The average strength of the group of cubes cast for each day shall not be less than the specified works cube-strength. 20 per cent of the cubes cast for each day may have values less than the specified strength, provided the lowest value is not less than 85 per cent of the specified strength.
27. R.C.C. work shall have exposed concrete surface. Centering design and its erection shall be 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 be provided so that steel reinforcement in position is not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber, kapchi or metal pieces shall not be used for this purpose. Concreting of important structural members shall always be done in the presence and under the supervision of departmental person not below the rank of Asstt. Engineer/Addl. Asstt. Engineer, Overseer or as instructed by the Engineer-in-charge. After removal of form work checks that concrete produced is of good quality plastering shall not be allowed to the exposed faces of concrete.
28. In reinforced concrete the volume occupied by reinforcement shall not be deducted. The slab shall be measured as running continuously through and the beam as the portion below the slab.

29. All necessary labour, materials, equipment, etc., for sampling, preparing test cubes, curing etc., shall be provided by the Contractor. Testing of the materials and concrete may be arranged by the Engineer-in-charge in an approved laboratory at the cost of the contractor.
30. The payment will be made on cmt. basis of the finished work.
31. The unit rate for concrete shall include the cost of all materials, labour, tools and plan required for mixing, placing in position, vibrating and compacting finishing as-per directions of the Engineer-in-charge, curing and all other incidental expenses for producing concrete of specified strength to complete the structure or its components as show on the drawings and according to these specifications. The rate shall also include the cost of making/fixing and removing of all centers and forms required for the work.

**Item No.20 Providing & filling in foundation with ordinary cement concrete M 150 mix and providing necessary vertical pin headers including formwork vibrating ramming & curing complete.**

This work shall consist of providing and filling in foundation with ordinary cement concrete M.150 mix and shall be carried out as per relevant detailed specification of **Item No. 19** of this contract. The payment will be made on Cum basis of the finished work.

**Item No.21 Supplying fixing & joining reinforced concret heavy duty non pressure pipe carrying indian railway standard with collars for culverts carrying heavy traffic as per Indian railway standard specification including setting and joining the pipe in cement mortar 1:2 watering or laying (to level and slope )of I.S.class NP-3 900mm dia internal**

This work shall consist of **Supplying fixing & joining reinforced concret heavy duty non pressure pipe** and shall be carried out as per relevant detailed specification of **Item No. 3** of this contract. The payment will be made on Cum basis of the finished work.

**Item No.22 Providing and fixing Guard stone as per I.R.C. type design including white washing etc. complete (II) Fixing in C.C. 1:5:10**

1. The guard stone shall be of approved quality and of 20 cm x 15 cm. size and its length shall not be less than 75 cms. The top portion shall be rounded. The top 38 cm. shall be chisel dressed on all sides. The size, shape and dimensions of the guard stones shall be exact and shall be neatly dressed and finished.
2. The guard stone shall be fixed in position as directed by the Engineer-in-charge in earth. The exposed part of the guard stones shall be given three coats of white wash. Any excavation necessary for fixing of the guard stones shall be done by the contractor at his own cost. The measurement for payment shall be per number of guard stone fixed in position.
3. Unit rate of guard stone includes the cost of all materials, labours, tools, fixing & white washing as directed by the Engineer-in-charge.



Signature of the contractor

Executive Engineer,  
Panchayat (R&B) Division  
Dang

**- : SCHEDULE FOR TESTING OF MATERIALS :-**

For ensuring quality control and workmanship Various tests prescribed below for materials shall be taken at periodical intervals as stipulated below. The materials shall be got tested at Government recognized Laboratory (R&B) or field Laboratory of GERI (R&B) for which 1% of the estimated amount put to tender shall be recovered from the contractor from the RA bills and final bills and the testing charges shall be paid to the GERI by the Government . However if the charges increase over 1% no excess recovery shall be made from the contractor as per resolution of B & C department dated 10th May 1985 vide TNC/ 1085/ (4)/ S

| It. No.<br>as per<br>schedule<br>"B" | Brief<br>description<br>of materials<br>to be tested   | Qty of<br>material | Prescription of test<br>which shall be<br>carried out   | Frequency at which test<br>shall be carried out   | Total No<br>of test to<br>be<br>taken. |
|--------------------------------------|--|--------------------|---|---|--|
| 1]                                   | Coarse<br>Aggregate<br>40 to 63 H.B.<br>40 to 63 M.C<br>25 to 40 M.C<br>12 to 20<br>M.C.<br>40 mm<br>20 mm |                    | - Gradation test<br><br>- Impact value<br>- Flakiness and<br>elongation   | 1 to 100 cm      1 test<br><br>100 to 500 cm      3 test<br>500 to 1500 cm      5 test<br>1500 to 5000 cm      7 test<br>Minimum 1 test/<br>work  |  |
| 2]                                   | Grit 6 to 10   |                    | - Stripping value   | As above  |  |
| 3]                                   | Granular<br>materials  |                    | - Gradation<br>- Atterbeg limits  | As above  |  |
| 4]                                   | Murum  |                    | - P I Value   | One test per 50 cum.  |  |
| 5]                                   | Sand/ quarry<br>spall  |                    | - Silt content<br>- Gradation<br>- CBR test   | One test per work/ season<br>One test per 200 cmt.<br>One test per work   |  |
| 6]                                   | Asphalt  |                    | 1 Penetration test<br>as per IS 1203<br>2 Ductility test as<br>per IS 1208<br>3 Specific gravity<br>test as per IS<br>1202<br>4 Softening point<br>test as per IS<br>1204<br>5 Viscosity test as<br>per IS 1206 | 1 to 10 tanker      1 test<br>11 to 20 tanker      2 test<br>21 to 50 "      3 test<br>51 to 100 "      4 test<br>Remaining every 50"      1 test |  |
| 7]                                   | Cement   |                    | - Consistency<br>- Setting time<br>- Compressive<br>strength<br>- Fineness  | Up to 50 MT      1 test<br>100 MT      2 test<br>200 MT      3 test<br>300 MT      4 test<br>500 MT      5 test                                   |  |

|     |  |  |   |   |   |  |
|-----|--|--|---|---|---|--|
|     |  |  | - Chemical analysis<br>- Soundness  | 800 MT<br>1300 MT<br><br>and 8 test for larger consignment  | 6 test<br>7 test                          |  |
| 8]  | CC Cubes<br>C.C. 1:3:6<br><br>M-150<br>M-100 |  | - Compressive Strength<br>(I.S. 519 – 1959)   | 1 to 5 cms<br>6 to 15 cms<br><br>16 to 20 cms<br>21 to 50 cms<br>51 and above<br>(For each additional 50 m <sup>3</sup> or part thereof)  | 1 No<br>2 No<br><br>3 No<br>4 No<br>4 + 1 |  |
| 9]  | Water  |  | - Chemical test   | Once for approval of source of supply   |   |  |
| 10] | Steel  |  | - Tensile Strength<br>- Yield Stress<br>- Elongation<br>- Size  | 1 test/ 40 tonnes/ per category   |   |  |
| 11] | Bricks                                       |  | - Water absorption<br>- Efflorence<br>- Size<br>- Compressive Strength  | 1 test per 50,000 bricks  |   |  |
| 12] | Prime coat/<br>Tack coat                     |  | - Quality of binder<br><br>- Binder temperature for application<br>- Rate of spread of binder   | Number of samples per lot and test as per IS:73<br>At regular close intervals<br><br>Two test per 500 m <sup>2</sup> and not less than two test per day   |   |  |
| 13] | Carpet and Seal coat mix/ B.M/ M.S.S.        |  | - Quality of binder<br><br>- Grading<br><br>- Temperature of binder<br>- Binder content vide 45 IMD 2172<br><br>- Rate of spread of mix materials | Number of samples per lot and test as per IS:73<br>1 test on individual contents and mix aggregate from the dryer for each 100 tonnes of mix subject to minimum of two test per plant per day<br>At regular close intervals<br><br>One test for each 100 tonnes of mix subject to mini. of Two per day<br>Regular control through checks on layer thickness |   |  |

|     |                     |  |  |   |  |
|-----|---------------------|--|--|---|--|
| 14] | Granular Sub-base   |  | <ul style="list-style-type: none"> <li>- Gradation</li> <li>- Atterberg limits</li> <li>- Moisture content prior to compaction</li> <li>- Density of compacted layer</li> <li>- Deleterious constituents</li> <li>- C.B.R.</li> </ul>                                      | <p>As mentioned under serial number 3</p> <p>As mentioned under serial number 3</p> <p>As mentioned under serial number 3</p> <p>One test per 500 m<sup>2</sup></p> <p>As required</p> <p>As required</p>     |  |
| 15] | Wet Mix Macadam     |  | <ul style="list-style-type: none"> <li>- Aggregate Impact Value</li> <li>- Grading</li> <li>- Flakiness and Elongation Index</li> <li>- Atterberg limits of portion of aggregate passing 425 micron sieve</li> <li>- Density of compacted layer</li> </ul>                 | <p>As mentioned under serial number 1</p> <p>As mentioned under serial number 1</p> <p>As mentioned under serial number 1</p> <p>As mentioned under serial number 3</p> <p>One test per 500 m<sup>2</sup></p> |  |
| 16] | Water Bound Macadam |  | <ul style="list-style-type: none"> <li>- Aggregate Impact Value</li> <li>- Grading</li> <li>- Flakiness Index and Elongation index</li> <li>- Atterberg limits of binding material</li> <li>- Atterberg limits of portion of aggregate passing 425 micron sieve</li> </ul> | <p>As mentioned under serial number 1</p> <p>As mentioned under serial No.1 As mentioned under serial number 1</p> <p>As mentioned under serial number 1</p> <p>As mentioned under serial number 1</p>        |  |

The Number of tests will be as per Manual of quality control or latest Govt. G.R./Circular and it will be considered final

The contractor shall have to pay 1% of the estimated cost put to tender towards all testing of materials and the same shall be deducted from their bills for the works.

Testing charges of GERI shall be borne by Govt. No refund be made nor extra charges over 1% shall be recoverable from the contractor.

If directed by the Engineer in charge, the materials intended to be used for the work but not included in the above schedule shall also be got tested at Government recognized Laboratory or field Laboratory.

Signature of Contractor

Executive Engineer  
Panchayat (R&B) Division  
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