

**Name of work:** - 3054 R & B Cleaning, Repair and Strengthening of various road and supply of machinery, labour and material to maintain the various road Gandhinagar Section under Gandhinagar District Sub Division, District Gandhinagar

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

**Item No.1**      **Clearing and grubbing road land** including uprooting rank vegetation grass bushes, shrubs, sapling and trees girth up to 300 mm removal of stumps of trees cut earlier and disposal of unserviceable materials

**(C) By mechanical means in area of light jungle**

### **201 CLEARING AND GRUBBING**

#### **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 with all leads and lights. 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 cost, 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 Equipment**

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 these fall within 500 mm of the sub grade. Also, all vegetation such as roots, undergrowth, grass and other deleterious matter unsuitable for incorporation in the embankment/sub grade shall be removed between fill lines to the satisfaction of the Engineer. All branches of trees extending above the roadway shall be 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 taken over and shall be disposed of by the Contractor with all leads and lifts. The rates deemed to include credit towards value of usable materials and salvage value of unusable materials. The offset price of cut trees and stumps as per guidelines/ estimates of State Forest Department shall be deducted from the amount due to the Contractor and deposited with the State Forest Department. The rate is deemed to account for this off-set price also.

#### **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 300 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. Cutting of trees, excluding removal of stumps and roots of trees of girth above 300 mm shall be measured in terms of number according to the sizes given below :-

- i) Above 300 mm to 600 mm
- ii) Above 600 mm to 900 mm
- iii) Above 900 mm to 1800 mm
- iv) Above 1800 mm

Removal of stumps and roots including backfilling with suitable material to required compaction shall be a separate item and shall be measured in terms of number according to the sizes given below:-

- i) Above 300 mm to 600 mm
- ii) Above 600 mm to 900 mm

iii) Above 900 mm to 1800 mm

iv) Above 1800 mm

For the purpose of cutting of trees and removal of roots and stumps, the girth shall be measured at a height of 1 metre above ground or at the top of the stump if the height of the stump is less than one metre from the ground.

## **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 300 mm girth excavation and back-filling to required density, where necessary, and handling, giving credit towards salvage value disposing of the cleared materials with all lifts and leads. Ground levels shall be taken prior to and after clearing and grubbing. Levels taken prior to clearing and grubbing shall be the base level and will be accordingly used for computation of quantity of material arising due to clearing and grubbing, including the computation of unsuitable material, if any, which may be required to be removed as per the approval of the Engineer. The levels taken subsequent to clearing and grubbing shall be the base level for computation of earthwork for embankment. Clearing and grubbing shall be restricted to 150 mm only for payment purpose. Where clearing and grubbing is done a level beyond 150 mm, the excess excavation shall be made good as per Clause 301.3.3 and 301.6 to the satisfaction of the Engineer prior to taking up earthwork. This shall not be paid and shall be treated as part of clearing and grubbing.

**201.6.2** The Contract unit rate for cutting trees of girth above 300 mm shall include handling, giving credit towards salvage value disposing of the cleared materials with all lifts and leads.

**201.6.3** The Contract unit rate for removal of stumps and roots of trees girth above 300 mm shall include excavation and backfilling

with suitable material to required compaction, handling, giving credit towards salvage value disposing of the cleared materials with all lifts and leads.

**201.6.4** The Contract unit rate is deemed to include credit towards value of usable materials and salvage value of unusable materials. The off-set price of cut trees and stumps as per guidelines/ estimates of State Forest Department shall be deducted from the amount due to the Contractor and deposited with the State Forest Department. The rate is deemed to account for this off-set price also.

**201.6.5** Where a Contract does not include separate items of clearing and grubbing, the same shall be considered incidental to the earthwork items and the Contract unit prices for the same shall be considered as including clearing and grubbing operations.

**Measurements for Payment:**

**The rate shall be for a unit of one Hector.**

**Item No.2      Preparing surface by Brushing with wire brushes for removing caked mud etc. sweeping with brooms and finally fanning the cleaned surface with gunny bags to remove all loose dirt etc.**

**(ii) Black top surface.**

This work shall consist of cleaning the black topped surface near central verge and side shoulder is required width as per instruction of Engineer in charge. And all such loose and disintegrated materials shall be removed from site as per instruction. Excavated earth stuff shall be dressed on side shoulder as per the instruction.

The contract unit rate for clearing the road surface shall be measured in Sqm.

**Measurements for Payment:**

**The rate shall be for a unit of one Square meter.**

**Item No.3**

**Box cutting the road to proper slope and camber** for making a base for road work including removing the excavated stuff and (Refilling same) depositing on road in layer wise, side slope as directed up to 50mt. lead etc. complete.

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

The rate is inclusive of cutting in all soil and Murrum including removal of all shrubs, jungle cutting, cutting stuff in slopes, side drain bank etc complete. This item also includes the clearing the sides and demarking the line as per requirement and cutting out the existing trees on the road side, no extra payment will be paid for at the time of preparing final bill, the road formation in embankment and cutting shall have be perfect condition true to

grade, camber and side slope duly dressed and damages due to rain cuts etc., during entire working period shall have to be done by the contractor. The work taken in length shall be completed in all respects viz. width, grades, camber, side drains, side slopes etc. and measurements for incomplete work shall not be taken otherwise.

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

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

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

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

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

**The rate shall be for a unit of one Cubic Meter.**

#### **Item No.4**

**Earthwork for embankment** including breaking clods, dressing with all lead and lift (excluding watering and consolidation)

**(E) From Borrow area within 3.0 Km. lead**

### **305. EMBANKMENT CONSTRUCTION**

#### **305.1. General**

**305.1.1. Description:** These Specifications shall apply to the construction of embankments including subgrades, earthen

shoulders and miscellaneous backfills with approved material obtained from roadway and drain excavation, borrow pits or other sources. All embankments, subgrades, earthen shoulders and miscellaneous backfills shall be constructed in accordance with the requirements of these Specifications and in conformity with the lines, grades, and cross-sections shown on the drawings or as directed by the Engineer.

### **305.2. Materials and General Requirements**

#### **305.2.1. Physical requirements:**

**305.2.1.1.** The materials used in embankments, subgrades, earthen shoulders and miscellaneous backfills shall be soil, moorum, gravel, a mixture of these or any other material approved by the Engineer. Such materials shall be free of logs, stumps, roots, rubbish or any other ingredient likely to deteriorate or affect the stability of the embankment/ subgrade.

The following types of material shall be considered unsuitable for embankment:

- (a) Materials from swamps, marshes and bogs;
- (b) Peat, tog, stump and perishable material; any soil that classifies as OL, OI, OH or Pt in accordance with IS: 1498;
- (c) Materials susceptible to spontaneous combustion;
- (d) Materials in a frozen condition;
- (e) Clay having liquid limit exceeding 70 and plasticity index exceeding 45; and
- (f) Materials with salts resulting in leaching in the embankment.

**305.2.1.2.** Expansive clay exhibiting marked swell and shrinkage properties ("free swelling index" exceeding 50 per cent when tested as per IS: 2720- Part 40) shall not be used as a fill material. Where an expansive clay with acceptable "free swelling index" value is used as a fill material, subgrade and top 500 mm portion of the embankment just below subgrade shall be non-expansive in nature.



**305.2.1.3.** Any fill material with a soluble sulphate content exceeding 1.9 grams of sulphate (expressed as  $\text{SO}_3$ ) per litre when tested in accordance with BS : 1377 Test 10, but using a 2:1 water-soil ratio shall not be deposited within 500 mm or other distance described in the Contract, of concrete, cement bound materials or other cementitious materials forming part of the Permanent Works.

Materials with a total sulphate content (expressed as  $\text{SO}_3$ ) exceeding 0.5 per cent by mass, when tested in accordance with BS : 1377 Test 9 shall not be deposited within 500 mm, or other distances described in the Contract, of metallic items forming part of the Permanent Works.

**305.2.1.4.** The size of the coarse material in the mixture of earth shall ordinarily not exceed 75 mm when being placed in the embankment and 50 mm when placed in the subgrade. However, the Engineer may at his discretion permit the use of material coarser than this also if he is satisfied that the same will not present any difficulty as regards the placement of fill material and its compaction to the requirements of these Specifications. The maximum particle size shall not be more than two-thirds of the compacted layer thickness.

**305.2.1.5.** Ordinarily, only the materials satisfying the density requirements given in Table 300-1 shall be employed for the construction of the embankment and the subgrade.

TABLE 300-1. DENSITY REQUIREMENTS OF EMBANKMENT AND SUBGRADE MATERIALS

S. No.	Type of Work	Maximum laboratory dry unit weight when tested as per IS: 2720 (Part 8)
1.	Embankments up to 3 metres height, not subjected to extensive flooding.	Not less than 15.2 kN/cu.m.
2.	Embankments exceeding 3 metres height or embankments of any height	Not less than 16.0 kN/cu.m.

subject to long periods of  
inundation

- |    |   |                             |
|----|---|-----------------------------|
| 3. | Subgrade and earthen<br>shoulders/verges/backfill | Not less than 17.5 kN/cu.m. |
|----|---|-----------------------------|
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Notes: (1) This Table is not applicable for lightweight fill material e.g. cinder, fly ash etc.

(2) The Engineer may relax these requirements at his discretion taking into account the availability of materials for construction and other relevant factors.

(3) The material to be used in subgrade should also satisfy design CBR at the dry unit weight applicable as per Table 300-2.

#### **305.2.2. General requirements:**

**305.2.2.1.** The materials for embankment shall be obtained from approved sources with preference given to materials becoming available from nearby roadway excavation or any other excavation under the same.

The work shall be so planned and executed that the best available materials are saved for the subgrade and the embankment portion just below the subgrade.

**305.2.2.2. Borrow materials:** Where the materials are to be obtained from designated borrow areas, the location, size and shape of these areas shall be as indicated by the Engineer and the same shall not be opened without his written permission. Where specific borrow areas are not designated by the Employer/the Engineer, arrangement for locating the source of supply of material for embankment and subgrade as well as compliance to environmental requirements in respect of excavation and borrow areas as stipulated, from time to time by the Ministry of Environment and Forests, Government of India and the local bodies, as applicable, shall be the sole responsibility of the Contractor.

Borrowpits along the road shall be discouraged. If permitted by the Engineer, these shall not be dug continuously. Ridges of not less than 8 m width should be left at intervals not exceeding 300 m. Small drains shall be cut through the ridges to facilitate drainage. The depth of the pits shall be so regulated that their bottom does not cut an imaginary line having a slope of 1 vertical to 4 horizontal projected from the edge of the final section of the bank, the maximum depth in any case being limited to 1.5 m. Also, no pit shall be dug within the offset width from the toe of the embankment required as per the consideration of stability with a minimum width of 10 m.

Haulage of material to embankments or other areas of fill shall proceed only when sufficient spreading and compaction plant is operating at the place of deposition.

No excavated acceptable material other than surplus to requirements of the Contract shall be removed from the site. Should the Contractor be permitted to remove acceptable material from the site to suit his operational procedure, then he shall make good any consequent deficit of material arising therefrom.

Where the excavation reveals a combination of acceptable and unacceptable materials, the Contractor shall, unless otherwise agreed by the Engineer, carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the permanent works without contamination by the unacceptable materials. The acceptable materials shall be stockpiled separately.

The Contractor shall ensure that he does not adversely affect the Stability of excavation or fills by the methods of stockpiling materials, IBC of plants or siting of temporary buildings or structures.

The Contractor shall obtain representative samples from each of the identified borrow areas and have these tested at the site laboratory following a testing programme approved by the Engineer. It shall be ensured that the subgrade material when compacted to the density

requirements as in Table 300-2 shall yield the design CBR value of the subgrade.

**TABLE 300-2. COMPACTION REQUIREMENTS FOR EMBANKMENT AND SUBGRADE**

Type of work/ material	Relative compaction as percentage of max. laboratory dry density as per IS: 2720 (Part 8)
1. Subgrade and earthen shoulders	Not less than 97% Not less than 95%
2. Embankment	
3. Expansive Clays	Not allowed
a) Subgrade and 500 mm portion just below the subgrade	Not less than 90
b) Remaining portion of embankment	

The Contractor shall at least 7 working days before commencement of compaction submit the following to the Engineer for approval:

(i) The value of maximum dry density and optimum moisture content obtained in accordance with IS: 2720 (Part 7) or (Part 8), as the case may be, appropriate for each of the fill materials he intends to use.

(ii) A graph of density plotted against moisture content from which each of the values in (i) above of maximum dry density and optimum moisture content were determined.

(iii) The Dry density-moisture content -CBR relationships for light, intermediate and heavy compactive efforts (light corresponding to IS: 2720 (Part 7), heavy corresponding to IS: 2720 (Part 8) and intermediate in-between the two) for each of the fill materials he intends to use in the subgrade.

Once the above information has been approved by the Engineer, it shall form the basis for compaction.

### 305.3. Construction Operations

**305.3.1. Setting out:** After the site has been cleared to Clause 201, the work shall be set out to Clause 301.3.1. The limits of embankment/subgrade shall be marked by fixing batter pegs on both at regular intervals as guides before commencing the earthwork, embankment/subgrade shall be built sufficiently wider than the design dimension so that surplus material may be trimmed, ensuring that the remaining material is to the desired density and in position specified and conforms to the specified side slopes.

**305.3.2. Dewatering:** If the foundation of the embankment is in an area with stagnant water, and in the opinion of the Engineer it is feasible to remove it, the same shall be removed by bailing out or pumping, as directed by the Engineer and the area of the embankment foundation shall be kept dry. Care shall be taken to discharge the drained water so as not to cause damage to the works, crops or any other property. Due to any negligence on the part of the Contractor, if any such damage is caused, it shall be the sole responsibility of the Contractor to repair/restore it to original condition or compensate the damage at his own cost.

If the embankment is to be constructed under water, Clause 305.4.6 shall apply.

**305.3.3. Stripping and storing topsoil:** In localities where most of the available embankment materials are not conducive to plant growth, or when so directed by the Engineer, the topsoil from all areas of cutting and from all areas to be covered by embankment foundation shall be stripped to specified depths not exceeding 150 mm and stored in stockpiles of height not exceeding 2 m for covering embankment slopes, cut slopes and other disturbed areas where re-vegetation is desired. Topsoil shall not be unnecessarily trafficked either before stripping or when in a stockpile. Stockpiles shall not be surcharged or otherwise loaded and multiple handling shall be kept to a minimum.

**305.3.4.** Compacting ground supporting embankment/subgrade: Where necessary, the original ground shall be levelled to facilitate placement of first layer of embankment, scarified, mixed with water and then compacted by rolling so as to achieve minimum dry density as given in Table 300-2.

In case where the difference between the subgrade level (top of the subgrade on which pavement rests) and ground level is less than 0.5 m and the ground does not have 97 per cent relative compaction with respect to the dry density as given in Table 300-2, the ground shall be loosened upto a level 0.5 m below the subgrade level, watered and compacted in layers in accordance with Clauses 305.3.5 and 305.3.6 to not less than 97 per cent of dry density as given in Table 300-2.

Where so directed by the Engineer, any unsuitable material occurring in the embankment foundation shall be removed and replaced by approved materials laid in layers to the required degree of compaction.

Embankment or subgrade work shall not proceed until the foundations for embankment/subgrade have been inspected by the Engineer for satisfactory condition and approved.

Any foundation treatment specified for embankments especially high embankments, resting on suspect foundations as revealed by borehole logs shall be carried out in a manner and to the depth as desired by the Engineer. Where the ground on which an embankment is to be built has any of the material types (a) to (f) in Clause 305.2.1, at least 500 mm of such material must be removed and replaced by acceptable fill material before embankment construction commences.

**305.3.5.** Spreading material in layers and bringing to appropriate moisture content

**305.3.5.1.** The embankment and subgrade material shall be spread in layers of uniform thickness not exceeding 200 mm compacted

thickness over the entire width of embankment by mechanical means, finished by a motor grader and compacted as per Clause 305.3.6. The motor grader blade shall have hydraulic control suitable for initial adjustment and maintain the same so as to achieve the specific slope and grade. Successive layers shall not be placed until the layer under construction has been thoroughly compacted to the specified requirements as in Table 300-2 and got approved by the Engineer. Each compacted layer shall be finished parallel to the final cross-section of the embankment.

**305.3.5.2.** Moisture content of the material shall be checked at the site of placement prior to commencement of compaction; if found to be out of agreed limits, the same shall be made good. Where water is required to be added in such constructions, water shall be sprinkled from a water tanker fitted with sprinkler capable of applying water uniformly with a controllable rate of flow to variable widths of surface but without any flooding. The water shall be added uniformly and thoroughly mixed in soil by blading, discing or harrowing until uniform moisture content is obtained throughout the depth of the layer.

If the material delivered to the roadbed is too wet, it shall be dried, by aeration and exposure to the sun, till the moisture content is acceptable for compaction. Should circumstances arise, where owing to wet weather, the moisture content cannot be reduced to the required amount by the above procedure, compaction work shall be suspended.

Moisture content of each layer of soil shall be checked in accordance with IS: 2720 (Part 2), and unless otherwise mentioned, shall be so adjusted, making due allowance for evaporation losses, that at the time of compaction it is in the range of 1 per cent above to 2 per cent below the optimum moisture content determined in accordance with IS: 2720 (Part 7) or IS:2720 (Part 8) as the case may be. Expansive clays shall however, be compacted at moisture content corresponding to the specified dry density, but on the wet

side of the optimum moisture content obtained from the laboratory compaction curve.

After adding the required amount of water, the soil shall be processed by means of graders, harrows, rotary mixers or as otherwise approved by the Engineer until the layer is uniformly wet. Clods or hard lumps of earth shall be broken to have a maximum size of 75 mm when being placed in the embankment and a maximum size of 50 mm when being placed in the subgrade.

**305.3.5.3.** Embankment and other areas of fill shall, unless otherwise required in the Contract or permitted by the Engineer, be constructed evenly over their full width and their fullest possible extent and the Contractor shall control and direct construction plant and other vehicular traffic uniformly over them. Damage by construction plant and other vehicular traffic shall be made good by the Contractor with material having the same characteristics and strength as the material had before it was damaged.

Embankments and other areas of unsupported fills shall not be constructed with steeper side slopes, or to greater widths than those shown in the Contract, except to permit adequate compaction at the edges before trimming back, or to obtain the final profile following any settlement of the fill and the underlying material.

Whenever fill is to be deposited against the face of a natural slope, or sloping earthworks face including embankments, cuttings, other fills and excavations steeper than 1 vertical on 4 horizontal, such faces shall be benched as per Clause 305.4.1 immediately before placing the subsequent fill.

All permanent faces of side slopes of embankments and other areas of fill formed shall, subsequent to any trimming operations, be reworked and sealed to the satisfaction of the Engineer by tracking a tracked vehicle, considered suitable by the Engineer, on the slope or any other method approved by the Engineer.



**305.3.6. Compaction:** Only the compaction equipment approved by the Engineer shall be employed to compact the different material types encountered during construction. Smooth wheeled, vibratory, pneumatic tyred, sheep foot or pad foot rollers, etc. of suitable size and capacity as approved by the Engineer shall be used for the different types and grades of materials required to be compacted either individually or in suitable combinations.

The compaction shall be done with the help of vibratory roller of 80 to 100 kN static weight with plain or pad foot drum or heavy pneumatic tyred roller of adequate capacity capable of achieving required compaction.

The Contractor shall demonstrate the efficacy of the equipment he intends to use by carrying out compaction trials. The procedure to be adopted for these site trials shall first be submitted to the Engineer for approval.

Earthmoving plant shall not be accepted as compaction equipment nor shall the use of a lighter category of plant to provide any preliminary compaction to assist the use of heavier plant be taken into account.

Each layer of the material shall be thoroughly compacted to the densities specified in Table 300-2. Subsequent layers shall be placed only after the finished layer has been tested according to Clause 903.2.2 and accepted by the Engineer. The Engineer may permit measurement of field dry density by a nuclear moisture/density gauge used in accordance with agreed procedure and the gauge is calibrated to provide results identical to that obtained from tests in accordance with IS: 2720 (Part 28). A record of the same shall be maintained by the Contractor.

When density measurements reveal any soft areas in the embankment/subgrade/earthen shoulders, further compaction shall be carried out as directed by the Engineer. If inspite of that the specified compaction is not achieved, the material in the soft areas shall be removed and replaced by approved material, compacted to the density requirements and satisfaction of the Engineer.

**305.3.7. Drainage:** The surface of the embankment/subgrade at all times during construction shall be maintained at such a cross fall (not flatter than that required for effective drainage of an earthen surface) as will shed water and prevent ponding.

**305.3.8. Repairing of damages caused by rain/spillage of water:** The soil in the affected portion shall be removed in such areas as directed by the Engineer before next layer is laid and refilled in layers and compacted using appropriate mechanical means such as small vibratory roller, plate compactor or power rammer to achieve the required density in accordance with Clause 305.3.6. If the cut is not sufficiently wide for use of required mechanical means for compaction the same shall be widened suitably to permit their use for proper compaction. Tests shall be carried out as directed by the Engineer to ascertain the density requirements of the repaired area. The work of repairing the damages including widening of the cut, if any, shall be carried out by the Contractor at his own cost, including the arranging of machinery/equipment for the purpose.

**305.3.9. Finishing operations:** Finishing operations shall include the work of shaping and dressing the shoulders/verge/roadbed and side slopes to conform to the alignment, levels, cross-sections and dimensions shown on the drawings or as directed by the Engineer subject to the surface tolerance described in Clause 902. Both the upper and lower ends of the side slopes shall be rounded off to improve appearance and to merge the embankment with the adjacent terrain.

The topsoil, removed and conserved carrier (Clause 301.3.2 and 305.3.3) shall be spread over the fill slopes as per directions of the Engineer to facilitate the growth of vegetation. Slopes shall be roughened and moistened slightly prior to the application of the topsoil in order to provide satisfactory bond. The depth of the topsoil shall be sufficient to sustain plant growth, the usual thickness being from 75 mm to 150 mm.

Where directed, the slopes shall be turfed with sods in accordance with Clause 307. If seeding and mulching of slopes is prescribed, this shall be done to the requirement of Clause 308.

When earthwork operations have been substantially completed, the road area shall be cleared of all debris, and ugly scars in the construction area responsible for objectionable appearance eliminated.

#### **305.4. Construction of Embankment and Subgrade under Special Conditions**

##### **305.4.1. Earthwork for widening existing road embankment:**

When an existing embankment and/or subgrade is to be widened and its slopes are steeper than 1 vertical on 4 horizontal, continuous horizontal benches, each at least 300 mm wide, shall be cut into the old slope for ensuring adequate bond with the fresh embankment/subgrade material to be added. The material obtained from cutting of benches could be utilized in the widening of the embankment/subgrade. However, when the existing slope against which the fresh material is to be placed is flatter than 1 vertical on 4 horizontal, the slope surface may only be ploughed or scarified instead of resorting to benching.

Where the width of the widened portions is insufficient to permit the use of conventional rollers, compaction shall be carried out with the help of small vibratory rollers/plate compactors/power rammers or any other appropriate equipment approved by the Engineer. End dumping of material from trucks for widening operations shall be avoided except in difficult circumstances when the extra width is too narrow to permit the movement of any other types of hauling equipment.

##### **305.4.2. Earthwork for embankment and subgrade to be placed against sloping ground :**

Where an embankment/subgrade is to be placed against sloping ground, the latter shall be appropriately

benched or ploughed/scarified as required in Clause 305.4.1 before placing the embankment/subgrade material. Extra earthwork involved in benching or due to ploughing/scarifying etc. shall be considered incidental to the work.

For wet conditions, benches with slightly inward fall and subsoil drains at the lowest point shall be provided as per the drawings, before the fill is placed against sloping ground.

Where the Contract requires construction of transverse subsurface drain at the cut-fill interface, work on the same shall be carried out to s 309 in proper sequence with the embankment and subgrade work; approved by the Engineer.

**305.4.3. Earthwork over existing road surface:** Where the embankment is to be placed over an existing road surface, the work shall carried out as indicated below:

(i) If the existing road surface is of granular or bituminous type and lies within 1 m of the new subgrade level, the same shall be scarified to a depth of 50 mm or more if specified, so as to provide ample bond between the old and new material ensuring that at least 500 mm portion below the top of new subgrade level is compacted to the desired density.

(ii) If the existing road surface is of cement concrete type and lies within 1m of the new subgrade level the same shall be removed completely.

(iii) If the level difference between the existing road surface and the new formation level is more than 1m, the existing surface shall be permitted to stay in place without any modification.

**305.4.4. Embankment and subgrade around structures:** To avoid interference with the construction of abutments, wing walls or return walls of culvert/bridge structures, the Contractor shall, at points to be determined by the Engineer suspend work on embankment forming approaches to such structures, until such time

as the construction of the latter is sufficiently advanced to permit the completion of approaches without the risk of damage to the structure.

Unless directed otherwise, the filling around culverts, bridges and other structures upto a distance of twice the height of the road from the back of the abutment shall be carried out independent of the work on the main embankment. The fill material shall not be placed against any abutment or wing wall, unless permission has been given by the Engineer but in any case not until the concrete or masonry has been in position for 14 days. The embankment and subgrade shall be brought up simultaneously in equal layers on each side of the structure to avoid displacement and unequal pressure. The sequence of work in this regard shall be got approved from the Engineer.

The material used for backfill shall not be an organic soil or highly plastic clay having plasticity index and liquid limit more than 20 and 40 respectively when tested according to IS : 2720 (Part 5). Filling behind abutments and wing walls for all structures shall conform to the general guidelines given in Appendix 6 of IRC:78 (Standard Specifications and Code of Practice for Road Bridges-Section VII) in respect of the type of material, the extent of backfill, its laying and compaction etc. The fill material shall be deposited in horizontal layers in loose thickness and compacted thoroughly to the requirements of Table 300-2.

Where the provision of any filter medium is specified behind the abutment, the same shall be laid in layers simultaneously with the laying of fill material. The material used for filter shall conform to the requirements for filter medium spelt out in Clause 2502/309.3.2 (B) unless otherwise specified in the Contract.

Where it may be impracticable to use conventional rollers, the compaction shall be carried out by appropriate mechanical means such as small vibratory roller, plate compactor or power rammer. Care shall be taken to see that the compaction equipment does not hit or

come too close to any structural member so as to cause any damage to them or excessive pressure against the structure.

**305.4.5. Construction of embankment over ground incapable of supporting construction equipment:** Where embankment is to be constructed across ground which will not support the weight of repeated heavy loads of construction equipment the first layer of the fill may be constructed by placing successive loads of material in a uniformly distributed layer of a minimum thickness required to support the construction equipment as permitted by the Engineer. The Contractor, if so desired by him, may also use suitable geosynthetic material to increase the bearing capacity of the foundation. This exception to normal procedure will not be permitted where, in the opinion of the Engineer, the embankments could be constructed in the approved manner over such ground by the use of lighter or modified equipment after proper ditching and drainage have been provided. Where this exception is permitted, the selection of the material and the construction procedure to obtain an acceptable layer shall be the responsibility of the Contractor. The cost of providing suitable traffic conditions for construction equipment over any area of the Contract will be the responsibility of the Contractor and no extra payment will be made to him. The remainder of the embankment shall be constructed as specified in Clause 305.3.

**305.4.6. Embankment construction underwater:** Where filling or backfilling is to be placed under water, only acceptable granular material or rock shall be used unless otherwise approved by the Engineer. Acceptable granular material shall consist of graded, hard durable particles with maximum particle size not exceeding 75 mm. The material should be non-plastic having uniformity coefficient of not less than 10. The material placed in open water shall be deposited by end tipping without compaction.

**305.4.7. Earthwork for high embankment :** In the case of high embankments, the Contractor shall normally use the material the specified borrow area. In case he desires to use different for his own convenience, he shall have to carry out necessary investigations and redesign the high embankment at his own cost. Contractor shall then furnish the soil test data and design of high embankment for approval of the Engineer, who reserves the right to accept or reject it.

If necessary, stage construction of fills and any controlled rates; shall be carried out in accordance with the Contract including of instruments and its monitoring.

Where required, the Contractor shall surcharge embankments or other of fill with approved material for the periods specified in the ct. If settlement of surcharged fill results in any surcharging material, which is unacceptable for use in the fill being surcharged, lying below formation level, the Contractor shall remove the unacceptable material and dispose it as per direction of the Engineer. He shall then bring the resultant level up to formation level with acceptable material.

**305.4.8. Settlement period:** Where settlement period is specified in the Contract, the embankment shall remain in place for the required settlement period before excavating for abutment, wingwall, retaining wall, footings, etc., or driving foundation piles. The duration of the required settlement period at each location shall be as provided for in the Contract or as directed by the Engineer.

### **305.5. Plying of Traffic**

Construction and other vehicular traffic shall not use the prepared surface of the embankment and/or subgrade without the prior permission of the Engineer. Any damage arising out of such use shall, however, be made good by the Contractor at his own expense as directed by the Engineer.

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

The surface finish of construction of subgrade shall conform to the requirements of Clause 902. Control on the quality of materials and works shall be exercised in accordance with Clause 903.

### **305.7. Subgrade Strength**

**305.7.1.** It shall be ensured prior to actual execution that the borrow area material to be used in the subgrade satisfies the requirements of design CBR.

**305.7.2.** Subgrade shall be compacted and finished to the design strength consistent with other physical requirements. The actual laboratory CBR values of constructed subgrade shall be determined on undisturbed samples cut out from the compacted subgrade in CBR mould fitted with cutting shoe or on remoulded samples, compacted to the field density at the field moisture content.

### **305.8. Measurements for Payment**

Earth embankment/subgrade construction shall be measured separately by taking cross sections at intervals in the original position before the work starts and after its completion and computing the volumes of earthwork in cubic metres by the method of average end areas.

The measurement of fill material from borrow areas shall be the difference between the net quantities of compacted fill and the net of suitable material brought from roadway and drainage excavation. For this purpose, it shall be assumed that one cu.m. of suitable material brought to site from road and drainage excavation forms one cu.m. of compacted fill and all bulking or shrinkage shall be ignored. Construction of embankment under water shall be measured in cu.m. Construction of high embankment with specified material and in specified manner shall be measured in cu.m. Stripping including storing and reapplication of topsoil shall be measure cu.m. Work involving loosening and recompacting of



ground supporting embankment/ subgrade shall be measured in cu. m. Removal of unsuitable material at embankment/subgrade foundation and replacement with suitable material shall be measured in cu.m. Scarifying existing granular/bituminous road surface shall be measured in square metres.

Dismantling and removal of existing cement concrete pavement shall be measured vide Clause 202.6.

Filter medium and backfill material behind abutments, wing walls Other retaining structures shall be measured as finished work in position in cu.m.

### **305.9. Rates**

**305.9.1.** The Contract unit rates for the items of embankment and construction shall be payment in full for carrying out the operations including full compensation for:

- (i) Cost of arrangement of land as a source of supply of material of required quantity for construction unless provided otherwise in the Contract;
- (ii) Selling out;
- (iii) Compacting ground supporting embankment/subgrade except where removal and replacement of unsuitable material or loosening and recompacting is involved;
- (iv) Scarifying or cutting continuous horizontal benches 300 mm wide on side slopes of existing embankment and subgrade as applicable;
- (v) Cost of watering or drying of material in borrow areas and/or embankment and subgrade during construction as required;
- (vi) Spreading in layers, bringing to appropriate moisture content and compacting to Specification requirements;
- (vii) Shaping and dressing top and slopes of the embankment and subgrade including rounding of corners;
- (viii) Restricted working at sites of structures;
- (ix) Working on narrow width of embankment and subgrade;

- (x) Excavation in all soils from borrow pits/designated borrow areas including clearing and grubbing and transporting the material to embankment and subgrade site with all lifts and leads unless otherwise provided for in the Contract;
- (xi) All labour, materials, tools, equipment and incidentals necessary to complete the work to the Specifications;
- (xii) Dewatering; and
- (xiii) Keeping the embankment/completed formation free of water as per Clause 311.

**305.9.2.** In case the Contract unit rate specified is not inclusive of all leads, the unit rate for transporting material beyond the initial lead, as specified in the Contract for construction of embankment and subgrade shall be inclusive of full compensation for all labour, equipment, tools and incidentals necessary on account of the additional haul or transportation involved beyond the specified initial lead.

**305.9.3.** Clause 301.9.5 shall apply as regards Contract unit rates for items of stripping and storing top soil and of reapplication of topsoil.

**305.9.4.** Clause 301.9.2 shall apply as regards Contract unit rate for the item of loosening and recompacting the embankment/subgrade foundation.

**305.9.5.** Clauses 301.9.1 and 305.8 shall apply as regards Contract rates for items of removal of unsuitable material and replacement with suitable material respectively.

**305.9.6.** The Contract unit rate for scarifying existing granular/bituminous road surface 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. This will also comprise of handling, salvaging, stacking and disposing of the dismantled materials within all lifts and upto a lead of 1000 m or as otherwise specified.

305.9.7. Clause 202.7 shall apply as regards Contract unit rate for dismantling and removal of existing cement concrete pavement.

305.9.8. The Contract unit rate for providing and laying filter material behind abutments shall be payment in full for carrying out the required operations including all materials, labour, tools, equipment and incidentals to complete the work to Specifications.

305.9.9. Clause 305.4.6 shall apply as regards Contract unit rate for construction of embankment under water.

305.9.10. Clause 305.4.7 shall apply as regards Contract unit rate for construction of high embankment. It shall include cost of instrumentation, its monitoring and settlement period, where specified in the Contract or directed by the Engineer.

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

**The rate shall be for a unit of one Cubic Metre.**

##### **Item No.5**

Providing & laying surface painting with applying VG-40 grade and spraying asphalt with spray set fitted on mechanical bouzer using bitumen at the rate of 5.0 Kg./10 Sqm. On B.T. surface incl. cleaning the surface and flushing the stone dust at 0.30 cmt/10 smt. and rolling with smooth wheeled and penumatic roller and brushingetc. complete.

#### **502. PRIME COAT/ ASPHALT-VG-40 OVER ANY SURFACE**

##### **502.1. Scope**

This work shall consist of the application of a single coat of low viscosity liquid bituminous material to a porous granular surface preparatory to the superimposition of bituminous treatment or mix. the work shall be carried out on a previously prepared granular/ stabilized surface to clause 501.8.

##### **502.2. Materials**

**502.2.1. Primer:** The primer shall be cationic bitumen asphalt VG-30 grade conforming to IS:8887 or medium curing cut back bitumen conforming to IS:217 or as specified in the contract.

**502.2.2. Quality of VG-40 bitumen for various types of granular surface shall be as given in table 500-3.**

**TABLE 500-3. Quality of bitumen emulsion for various types of granular surfaces.**

Type of surface	Rate of spray (Kg/Sqm.)
WMM/WBM	2.5-5.0
Stabilized soil bases/crusher run macadam	5.0-7.0

**502.2.3. Cutback for primer** shall not be prepared at the site. Type and quantity of cutback bitumen for various types of granular surface shall be as given in Table 500-4.

**Table 500-4: type and quantity of cutback bitumen for various types of granular surface**

Type of surface	Type of cutback	Rate of spray (Kg/Sqm.)
WMM/WBM	MC 30	0.6-0.9
Stabilized soil bases/crusher run macadam	MC 70	0.9-1.2

**502.4.** The correct quantity of primer shall be decided by the engineer and shall be such that it can be absorbed by the surface

without causing run-off of excessive primer and to achieve desired penetration of about 8-10 mm.

### **502.3 Weather and seasonal limitations**

Primer shall not be applied during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 100 C. cut back bitumen as primer shall not be applied to a wet surface. surfaces which are to receive emulsion primer should be damp, but no free or standing water shall be present. surface can be just wet by very light sprinkling of water.

### **502.4 Construction**

#### **502.4.1 Equipment**

The primer shall be applied by a self-propelled or lowed bitumen pressure sprayer equipped for spraying the material uniformly at specified rates and temperatures, Hand spraying shall not be allowed except in small areas, in accessible to the distributor, or in narrow strips where primer shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

**502.4.2. Preparation of road surface:** The granular surface to be primed shall be swept clean of dust power brooms or mechanical sweepers and made free from dust. All loose material and other foreign material shall be removed completely. If soil/moorum binder has been used in the WBM surface, part of this should be brushed and removed to a depth of about 2 mm so to achieve good penetration.

**502.4.3. Application of bituminous primer:** After preparation of the road surface as per clause 502.4.2, the primer shall be sprayed uniformly at the specified rate. The method for application of the primer 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.

#### **502.5. Quality Control of Work**

For control of the quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

#### **502.6. Arrangements for Traffic**

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

#### **502.7. Measurement for Payment**

Prime coat/ asphalt VG-40 shall be measured in terms of surface area of application in square metres.

#### **502.8. Rate**

The contract unit rate for prime coat shall be payment in full carrying out the required operations including full compensation for all components listed in Clause 401.7 (i) to (v) and as applicable to the work specified in these Specifications.

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

**The rate shall be for a unit of one Square Meter.**

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

**Engaging Unskilled Labour** for all type of work as and when required daily as directed by Engineer in Charge.

The contractor shall supply labour for miscellaneous works as required. For safety measure it is essential to provide safety board. Traffic bollards etc. as required. if any accident occur during the work without safety measure contractor is

responsible for the same.

The contractor should as far as possible, obtain his requirement from the nearest employment exchange so as to utilize the local employment potential, if there are no local employment exchange or such exchanges are not able to provide the required labour locally suitable labourers should be utilized to the maximum extent possible.

The contractor should have to supply labour with necessary tools (For e.g. Powda, Tagara, Trikam, dhriya, danti, axe etc. as instructed by Engr. in charge.)

Fair wages shall be provided as per clause No.50.

Local labor on normal rates shall be as per clause No.54.

Vaccination to laborers shall be as per clause No.56.

Camp facilities to workers as per clause No.57.

Gum boots, hand gloves, masks etc to laborer shall be as per clause No.58.

The Measurement shall be made on supply of labour Number per day. The unit rate is applicable for shift of 8 Hours reduction in rate will be made according to actual hours for which labours engaged minimum 4 (Four) hours shift will be counted.

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

**The rate shall be for a unit of one Number.**

#### **Item No.7**

**Construction of granular Sub base by providing coarse graded material gravel using size 53mm to 26.5 mm @ 35%, 26.5 mm to 4.75 mm @ 45% and coarse sand @ 20% spreading in uniform layers 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 complete as per Clause 401.2 Table 400.1 **grade-III.**

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

##### **401.1 Scope**

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

##### **401.2 Materials**

**401.2.1** The material to be used for the work shall be natural sand, crushed gravel, crushed stone, or combination thereof depending upon the grading required. The material shall be free from organic or other deleterious constituents and shall conform to the quality standards as prescribed in the specifications. Table 400-1 prescribes four gradings for Granular Sub-Base (GSB). Gradings I and II in Table 400-1 are well graded granular sub-base materials. These can be used at locations where drainage requirement are not predominant. Gradings III and IV are gap graded and addresses to the concern of the drainage requirements. These can be used at location experiencing heavy rainfall, flooding etc. Cases where GSB is to be provided in two layers, it is recommended to adopt either grading III or grading IV for lower layer and either grading I or grading II for upper layer. Minimum thickness of lower layer at locations where drainage requirements are predominant shall not be less than 200 mm. The grading to be adopted for a project shall be as specified in the Contract.

**401.2.2** Physical requirements: The material shall have a 10 percent fines value of 50kN or more (for sample in soaked condition) when tested in compliance with IS: 2386 (Part IV) 1963. 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 Gradings II and IV materials, the CBR shall be determined at the density and moisture content likely to be developed in the field.

#### 401.3 Strength of Sub-Base

It shall be ensured prior to actual execution that the material to be used in the sub-base satisfies the requirements of CBR and other physical requirements when compacted and finished. When directed by the Engineer, this shall be verified by performing CBR tests in the laboratory as required on specimens remoulded at field dry density and moisture content.

**Table 400-1 Grading for Granular Sub-base Materials**

IS Sieve Designation	Percent by weight passing the IS sieve			
	Grading I	Grading II	Grading III	Grading IV
75.0 mm	100	—	100	—
53.0 mm	80-100	100	100	—
26.5 mm	55 -90	70-100	55-75	50-80
9.50 mm	35-65	50-80	—	—
4.75 mm	25 - 55	40-65	10-30	15-35
2.36 mm	20- 40	30-50	—	—
0.425 mm	10-15	10- 15	—	—
0.075 mm	<5	< 5	< 5	< 5
CBR Value (Minimum) 30	25	25	30	25

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

#### **401.4 Construction Operations**

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

**401.4.2 Spreading and compacting:** The sub-base material of grading specified in the Contract shall be spread on the prepared subgrade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation or other means as approved by the Engineer. When the sub-base material consists of combination of materials mentioned in Clause 401.2.1, mixing shall be done mechanically. Mixing shall be done in a separate yard by pugmill or other approved mechanical means so as to issue homogenous & uniform mix. Moisture content of the loose material shall be checked in accordance with IS: 2720 (Part 2) and suitably adjusted by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from 1 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 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 200 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight with plain drum or pad foot-drum or heavy pneumatic tyred roller of minimum 200 to 300 kN weight having a minimum tyre pressure of 0.7 MPa

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 crossfall and super-elevation shall commence at the edges and progress towards the centre for portions having crossfall on both sides.

Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour. Rolling shall be continued till the density achieved is at least 98 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. Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

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

During the period of construction, arrangements for the traffic shall be provided and maintained in accordance with Clause 112.

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

Granular sub-base shall be measured as finished work in position in cubic metres. The protection of edges of granular sub-base extended over the full formation as shown in the drawing shall be

considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

#### **401.8 Rate**

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

- i) Making arrangements for traffic to Clause 112 except for initial treatment to verges, shoulders and construction of diversions;
- ii) Furnishing all materials to be incorporated in the work including all royalties, fees, rents where applicable with all leads and lifts;
- iii) Royalties, fees, rents where applicable with all leads and lifts; 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.

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

**The rate shall be for a unit of one Cubic Meter.**

#### **Item No.8**

Providing, Laying, spreading and compacting graded stone aggregates to **Wet Mix Macadam** as per MORT & H specification including premixing the material with water at OMC in mechanical mix plant, carriage of mixed material by tippers to site, laying in uniform layers with paver in sub base / base course on well prepared surface and compacting with vibratory roller to achieve the desired density.

#### **406 WET MIX MACADAM SUB-BASE/BASE**

##### **406.1 Scope**

This work shall consist of laying and compacting clean, crushed, graded aggregate and granular material, premixed with water, to a

dense mass on a prepared sub-grade/subbase/base or existing pavement as the case may be in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as necessary to lines, grades and cross-sections shown on the approved drawings or as directed by the Engineer.

The thickness of a single compacted Wet Mix Macadam layer shall not be less than 75 mm. When vibrating or other approved types of compacting equipment are used, the compacted depth of a single layer of the sub-base course may be upto 200 mm with the approval of the Engineer.

## 406.2 Materials

### 406.2.1 Aggregates

**406.2.1.1 Physical requirements:** Coarse aggregates shall be crushed stone. If crushed gravel/shingle is used, not less than 90 percent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table 400-9. If the water absorption value of the coarse aggregate is greater than 2 percent, the soundness test shall be carried out on the material delivered to site as per IS: 2386 (Part-5).

**406.2.1.2 Grading requirements:** The aggregates shall conform to the grading given in Table 400-10.

Table 400-9 Physical Requirements of Coarse Aggregates for Wet Mix Macadam for Sub-base/Base Courses

S. No.	Test	Test Method	Requirements
1.	Los Angeles Abrasion value	IS:2386 (Part-4)	40 percent (Max.)
	Aggregate Impact value	IS:2386 (Part-4) or IS:5640	30 percent (Max.)
2.	Combined Flakiness and Elongation indices (Total)	IS:2386 (Part-1)	40 percent (Max.)*

\* To 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 weight of elongated particles divided by total non-flaky particles. The values of flakiness index and elongation index so found are added up.

**Table 400-10 Grading Requirements of Aggregates for Wet Mix Macadam**

Material finer than 425 micron shall have Plasticity Index (PI) not

IS Sieve Designation	Per cent by weight passing the IS Sieve	
	Grade 1 layer thickness $\geq$ 100mm	Grade 2 < 100 mm
53.00 mm	100	
45.00 mm	95 - 100	
26.50 mm	-	100
22.40 mm	60 - 80	50-100
11.20 mm	40 - 60	-
4.75 mm	25 - 40	35-55
2.36 mm	15 - 30	-
600.00 micron	8 - 22	10-30
75.00 micron	0 - 5	2-5

exceeding 6.

The final gradation approved within these limits shall be graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa.

#### 406.3 Construction Operations

**406.3.1 Preparation of base:** Clause 404.3.1 shall apply.

**406.3.2 Provision of lateral confinement of aggregates:** While constructing wet mix macadam, arrangement shall be made for the lateral confinement of wet mix. This shall be done by laying materials in adjoining shoulders along with that of wet mix macadam layer and following the sequence of operations described in Clause 407.4.1.

**406.3.3 Preparation of mix:** Wet Mix Macadam shall be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced/ positive mixing arrangement like pugmill or pan type mixer or concrete batching plant. The plant shall have following features:

- i) Cold aggregates with minimum four bin feeders with variable speed motor
- ii) Vibrating screen for removal of oversize aggregates
- iii) Conveyor Belt
- iv) Controlled system for addition of water
- v) Forced/positive mixing arrangement like pug-mill or pan type
- vi) Anti-segregation hydraulically operated gob/surge hopper
- vii) Centralized control panel for sequential operation of various devices and precise process control
- viii) Safety devices

Optimum moisture for mixing shall be determined in accordance with IS: 2720 (Part-8) after replacing the aggregate fraction retained on 22.4 mm sieve with material of 4.75 mm to 22.4 mm size. While adding water, due allowance should be made for evaporation losses. However, at the time of compaction, water in the wet mix should not vary from the optimum value by more than agreed limits. The mixed material should be uniformly wet and no segregation should be permitted.

**406.3.4 Spreading of mix:** Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared sub-grade/sub-base/base in required quantities. In no case shall these

be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed stretch be permitted.

The mix may be spread by a paver finisher. The paver finisher shall be self-propelled, of reputed make, proven design and adequate capacity with following features:-

- i) Tractor unit shall have crawler tracks or pneumatic tyre.
- ii) Racks provide greater traction and suitable to work on soft or loose sub-bases and laying large width up to 10 m or more. Wheeled paver is faster and normally preferred to work on hard surfaces with width up to 8 m.
- iii) Material distribution system comprising of hopper, two conveyor belts each working independently, conveyor speed adjustable with limit switches and auger system easily capable of raising and lowering; to provide a smooth uninterrupted material flow for different layer thicknesses from the tipper to the screed.
- iv) Hydraulically operated telescopic screed for paving width up to 8.5 m and fixed screed beyond this. The screed shall have tamping and vibrating arrangement for initial compaction of the layer.
- v) The drive shall be hydrostatic with infinite variable speed.
- vi) Automatic leveling control system with electronic sensing device to maintain mat thickness and cross slope of mat during laying procedure.

In exceptional cases where it is not possible for the paver to be utilized, mechanical means like motor grader may be used with the prior approval of the Engineer. The motor grader shall be capable of spreading the material uniformly all over the surface. For portions where mechanical means cannot be used, manual means as approved by the Engineer shall be used only in restricted areas.

The surface of the aggregate shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate as may be required. The layer may be tested by depth



blocks during construction. No segregation of larger and fine particles should be allowed. The aggregates as spread should be of uniform gradation with no pockets of fine materials.

The Engineer may permit manual mixing and /or laying of wet mix macadam where small quantity of wet mix macadam is to be executed. Manual mixing/laying in inaccessible/ remote locations and in situations where use of machinery is not feasible can also be permitted. Where manual mixing/laying is intended to be permitted, the same shall be indicated in the Contract.

**406.3.5 Compaction:** After the mix has been laid to the required thickness, grade and crossfall/camber the same shall be uniformly compacted to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 200 mm, a smooth wheel roller of 80 to 100kN weight may be used. For a compacted single layer upto 200 mm, the compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 kN with on amplitude not exceeding 0.7 mm or equivalent capacity roller. The speed of the roller shall not exceed 5 km/h.

In portions having unidirectional cross fall/superelevation, rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the center line of the road, uniformly over-lapping each preceding track by at least one-third width until the entire surface has been rolled. Alternate trips of the roller shall be terminated in stops at least 1 m away from any preceding stop.

In portions in camber, rolling should begin at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall then progress gradually towards the center parallel to the center line of the road uniformly

overlapping each of the preceding track by at least one-third width until the entire surface has been rolled.

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.

Along forms, kerbs, walls or other places not accessible to the roller, the mixture shall be thoroughly compacted with mechanical tampers or a plate compactor. Skin patching of an area without scarifying the surface to permit proper bonding of the added material shall not be permitted.

Rolling should not be done when the sub-grade is soft or yielding or when it causes a wave-like motion in the sub-base/base course or sub-grade. If irregularities develop during rolling which exceed 12 mm when tested with a 3 m straight edge, the surface should be loosened and premixed material added or removed as required before rolling again so as to achieve a uniform surface conforming to the desired grade and crossfall. In no case shall the use of unmixed material be permitted to make up the depressions.

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material as determined by the method outlined in IS:2720 (Part-8).

After completion, the surface of any finished layer shall be well-closed, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of the layer and recompacted.

**406.3.6 Setting and drying:** After final compaction of wet mix macadam course, the road shall be allowed to dry for 24 hours.

#### **406.4 Opening to Traffic**

No vehicular traffic of any kind should be allowed on the finished wet mix macadam surface.

#### **406.5 Surface Finish and Quality Control of Work**

**406.5.1 Surface evenness:** The surface finish of construction shall conform to the requirements of Clause 902.

**406.5.2 Quality control:** Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

#### **406.6 Rectification of Surface Irregularity**

Where the surface irregularity of the wet mix macadam course exceeds the permissible tolerances or where the course is otherwise defective due to sub-grade soil getting mixed with the aggregates, the full thickness of the layer shall be scarified over the affected area, re-shaped with added premixed material or removed and replaced with fresh premixed material as applicable and recompact in accordance with Clause 406.3. The area treated in the aforesaid manner shall not be less than 5 m long and 2 m wide. In no case shall depressions be filled up with unmixed and ungraded material or fines.

#### **406.7 Arrangement for Traffic**

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

#### **406.8 Measurements for Payment**

Wet mix macadam shall be measured as finished work in position in cubic metres.

#### **406.9 Rate**

The Contract unit rate for wet mix macadam shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 401.8.

**Measurements for Payment:**

**The rate shall be for a unit of one Cubic Meter.**

**Item No.9** Providing and laying **20mm thick mix seal surfacing** using stone chips & Aggregate as per MORT & H specification gradation using asphalt VG-40 grade for mixing @ 50.90 kg/MT ie. 5.09% of total weight of the mix including heating the aggregate & Asphalt in continuous batching drum mix plant and spreading the same by paver finishing & consolidation with vibratory roller & flushing stone dust @ 0.30 Cum/ 100 Smt. Including providing all materials tools & plants fire wood, oil, kerosene, labour etc. complete using contractor's own machinery drum mix plant & paver finisher etc. complete.

**509. MIXED SEAL SURFACING**

**509.1. Scope**

**509.1.1.** This work shall consist of the preparation, laying and compaction of a close-graded premix surfacing material of 20 mm thickness composed of graded aggregates premixed with a bituminous binder on a previously prepared surface, in accordance with the requirements of these Specifications, to serve as a wearing course.

**509.1.2.** Close graded premix surfacing shall be of Type A or Type B as specified in the Contract documents.

**509.2. Materials**

**509.2.1. Binder:** The provisions of Clause 511.1.2.1 shall apply

**509.2.2. Coarse aggregates:** The provisions of Clause 511.1.2.2 shall apply.

**509.2.3. Fine aggregates:** The fine aggregates shall consist of crushed rock quarry sands, natural gravel / sand or a mixture of both. These shall be clean, hard, durable, un-coated, mineral particles, dry and free from injurious, soft or flaky particles and organic or deleterious substances.

**509.2.4. Aggregate gradation:** The coarse and fine aggregates shall be so graded or combined as to conform to one or the other gradings shown in Table 500-26, as specified in the contract.

**TABLE 500-26. AGGREGATE GRADATION**

IS Sieve Designation (mm)	Cumulative per total weight of total aggregate passing	
	Type A	Type B
13.2mm	--	100
11.2mm	100	88-100
5.6mm	52-88	31-52
2.8mm	14-38	5-25
0.090 mm	0-5	0-5

**509.2.5. Proportioning of materials:** The total quantity of aggregates used for Type A or B close-graded premix surfacing shall be 0.27 cubic metre per 10 square metre area. The quantity of binder used for premixing in terms of straight-run bitumen shall be 22.0 kg and 19.0 kg per 10 square metre area for Type A and Type B surfacing respectively.

### **509.3. Construction Operations**

The provisions of Clause 511.1.3.1 through 511.1.3.5 shall apply.

#### **509.4. Opening to Traffic**

Traffic may be allowed after completion of the final rolling when the mix has cooled down to the surrounding temperature. Excessive traffic speeds should not be permitted.

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

The surface finish of construction shall conform to the requirements of Clause 902. For control on the quality of materials supplied and the works carried out, the relevant provisions of Section 900 shall apply.

#### **509.6. Arrangements for Traffic**

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

#### **509.7. Measurements for Payment**

Close-graded premix surfacing, Type A or B shall be measured as finished work, for the area specified to be covered, in square metres at a specified thickness. The area will be the net area covered, and all allowances for wastage and cutting of joints shall be deemed to be included in the rate.

#### **509.8. Rate**

The contract unit rate for close-graded premix surfacing, Type A or B shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 501.8.8.2. (i) to (xi).

#### **Scope:**

This work shall consist of laying and compacting mix seal surfacing in a single course composed of suitable aggregates premixed with a bituminous binder on a previously prepared base,

in accordance with the requirements of these specifications, to serve as wearing course.

**Materials:**

**Binder:**

The binder shall be bitumen grade of VG-40 grade complying IS; 73.

**Coarse Aggregates:**

The aggregates shall consist of crushed stone, crushed gravel/single or other stones. The shall be clean strong, durable of fairly cubical shape and free from Disintegrated pieces, organic or other deleterious matter and adherent coating. if crushed shingle/gravel in used, not less than 90 percent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall preferably hydrophobic and of low porosity.

The aggregates shall satisfy the physical requirements set forth in Table given below:

**Table 500.3**  
**Physical Requirements of Aggregates For Mix Seal Surfacing.**

Sr. No.	Property	Test	Specification
1	Cleanliness	Grain size Analysis	Max.5% passing 0.075mm sieve Max. 30%
2	Particle shape	Flakiness and elongation index (combined)	Max. 30%
3	Strength	Los agleles abrasion Value	Max. 40%

4	Durability	Aggregate impact Value soundness Sodium sulphate Magnesium sulphate	Max. 30%  Max. 12% Max. 18%
5	Water absorption	Water Absorption	Max. 2%
6	Stripping	Coating and stripping of bitumen aggregate mixtures	Minimum retained Coating 95%
7	Water sensitivity	Retained tensile strength.	Min 80%

➤ Aggregates may satisfy requirements of either of the two tests.

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

#### **Fine Aggregate:**

The fine aggregates shall consist of crusher run screening natural gravel/sand or mixture of both, These shall be clean, hard, durable, uncoated, dry and free from injurious, soft or flaky pieces and organic or deleterious sub stress.

#### **Aggregates gradation:**

The coarse and fine aggregate shall be so graded or combine as to confirm to the grading set forth in table given below:

**Table**



### **Aggregates Gradation For Mix seal Surfacing**

I.S. Sieve Designation	Percentage by Weight passing the sieve. For type A- Mix Seal Surfacing
11.2 mm	100
5.6 mm	52-88
2.8 mm	14-38
90 micron	0-5

#### **Proportioning of Material:**

The quantity of binder used for premixing in terms of straight run bitumen grade shall be 50.90 kgs. per M.T. of mix for type A surfacing.

#### **Construction Operations:**

#### **Weather and Seasonal Limitations:**

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

#### **Preparation of Base:**

The base on which M.S.S. is to be laid shall be prepared, shaped and conditioned to the specified line, grades and cross sections in accordance with Most specification Clause 501 as directed by the Engineer-in-charge. The surface shall be thoroughly swept and scraped clean and free of dust and foreign matter.

#### **Preparation of Premix:**

Hot mix plant of appropriate capacity and type shall be used for the preparation of mix materials. Hot mix plant shall have separate dryer arrangement of reheating aggregates and pug mill aggregate and binder. All the condition stated in specialization for bituminous macadam for plant and mixing shall apply.

The temperature of binder at the time of mixing shall be in the range of 155 °C to 163 °C and that aggregate in the range of 155 °C to 163 °C provided that the difference in temperature between the binder and aggregates at no time difference in temperature between the binder and aggregate at no time exceeds 14 °C. Mixing shall be thought to ensure that a homogeneous mixture is obtained in which all practical of the aggregates are coated uniformly and the discharge temperature of mix shall be between 130 °C to 160 °C.

The mix shall be immediately transported from the mixer to the point use in suitable vehicles or wheel barrows. The vehicles employed for transport shall clean and the mix being transported covered and transit if so directed by the Engineer.

#### **Spreading and Rolling:**

##### **Spreading:**

The mix transported from the Hot mix plant to the site shall be by means of self propelled mechanical paver with suitable screeds capable of spreading, temping and finishing the mixture to the specified grade line and cross sections. The temperature of mix at the time of laying shall be in the range in 131 °C to 160 °C.

##### **Rolling:**

As soon as sufficient length of bituminous materials has been laid, rolling shall commence with 8 to 10 Tones Rollers preferably of smooth wheel tarm den type, or other approved equipment, rolling shall begin at the edge and progress toward the centre longitudinally. Except that on the superheated and unidirectional cambered portions, it shall progress from the low or upper edge parallel to the centre line of the payment.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding premixed materials. Rolling shall then be

continued until the entire surface has been rolled to impaction and all the roller marks eliminated. In each pass of the roller wheels shall be kept damp to prevent the premix from adhering to the wheels and being picked up. In no case fuel/lubricating oil be user for this purpose. Excess use of water for this purpose shall be avoided.

Rollers shall not stand newly laid materials while there is arise that it will be deformed thereby. Rolling operations shall be completed in every respect before the temperature of the mix falls below 100 °C

The edges along and transfers of the carpet laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against in.

Minimum two rollers shall be deployed however the number of rollers shall be increased in accordance with he quantity executed per day as directed by Engineer in charge.

**Opening to traffic:**

Traffic may be allowed after completion of the final rolling when the mix has cooled down to the surrounding temperature and surface shall be flushed by sand or stone dust properly as directed by the Engineer-in-charge as his own cost by the contractor.

**Surface finish and quality control of work:**

The surface finish of cost shall confirm to the requirement clause 902 of MOST book of specification for road and bridges work (fifth division)

Control on the material and works shall be exercised by the Engineer in charge in accordance with most specification Section-900 (fifth Revision) Stone dust or screened sand shall be collected and spread over the finished rolled B.T. surface as directed by the engineer-in-charge at his own cost by the contractor.

**Arrangement for Traffic:**

The provision of clause 112 of most specification for Road and Bridges works, fifth revision apply as regards flow of traffic during construction.

**Measurement for Payment:**

The payment shall be made on the tonnage basis of the weight of mix of aggregates and bitumen in M.T. as provided in contract. The contractor shall have to install a weight bridge of suitable capacity for the purpose of weighing of dumpers at suitable place on plant site at his cost as directed weight of loaded dumper will be recovered in bound and numbers register on plant site.

Department will be free to get some loaded dumpers test checked at other weight than rank of supervisor of department and the measurements shall be recorded by the Deputy Executive Engineer or Assistant Engineer or Addl. Assistant Engineer, if so authorized in bound and numbered registered which will be maintained by the departmental representatives and signed by the contractor proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site.

Which individual dumpers are in loaded shall be recorded carefully.

**Rates**

The contract unit rate for the mix seal surfacing shall be payment in full for carrying out the required operations including full compensation for, all components listed below.

- (a) Making arrangements for traffic to Clasue-112 except for initial treatment to verge. Shoulders and construction of diversions.
- (b) Preparation of base except for laying of profile corrective course but including filling of diversion.
- (C) 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.
- (d) All labour, tools, equipment, plant in part width of the road where direction.
- (e) Carrying out work in part width of the where directed.
- (f) Carrying out all tests for control of quality.

**Measurements for Payment:**

**The rate shall be for a unit of one Metric Tonne.**

**Item No.10**

**Road marking** with hot applied thermoplastic paints with reflectorising glass beads on bitumen 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 liminance coefficient on cemend road shall be min 130 mcd/m2/lux and Asphalt road shall be min 100 mcd/m2/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.

### **803. ROAD MARKINGS**

#### **General**

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

#### **803.2. Materials**

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

#### **803.3. Ordinary Road Marking Paint**

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

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

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

#### **803.4. Hot Applied Thermoplastic Road Marking**

##### **803.4.1. General:**

(i) The work under this section consists of marking traffic stripes using a thermoplastic compound meeting the requirements specified herein.

(ii) The thermoplastic compound shall be screeded/extruded on to the pavement surface in a molten state by suitable machine capable of controlled preparation and laying with surface application of glass beads at a specific rate. Upon cooling to ambient pavement temperature, it shall produce an adherent pavement marking of

specified thickness and width and capable of resisting deformation by traffic\*

(iii) The colour of the compound shall be white or yellow (IS colour No. 356) as specified in the drawings or as directed by the Engineer.

(iv) Where the compound is to be applied to cement concrete pavement, a sealing primer as recommended by the manufacturer, shall be applied to the pavement in advance of placing of the stripes to ensure proper bonding of the compound. On new concrete surface any laitance and/or curing compound shall be removed before the markings are applied.

#### **803.4.2. Thermoplastic Material**

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

#### **803.4.2.2. Requirements:**

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

**TABLE 800-3. PROPORTIONS OF CONSTITUENTS OF MARKING MATERIAL**

(Percentage by weight)

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

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

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

**Luminance:**

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

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

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

**Skid resistance:** not less than 45 as per BS 6044.

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

**Softening point:** 102.5 to 9.5° C as per ASTM D 36.

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

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

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

**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.

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



The name, trade mark or other means of identification of manufacturer

Batch number

Date of manufacture

Colour (white or yellow)

Maximum application temperature and maximum safe heating temperature

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

#### **803.4.3. Reflectorising glass beads**

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

Type 1 beads are these which are a constituent of the basic thermoplastic compound vide Table 800-3 and Type 1 beads are those which are to be sprayed on the surface vide Clause 803.6.3.

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

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

#### **803.4.3.3. Specific requirements**

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

**TABLE 800-4. GRADATION REQUIREMENTS FOR GLASS BEADS.**

Sieve size	Percent retained	
	Type1	Type2
1.18 mm	0 to 3	.
850 micron	5 to 20	0 to 5
600 -do-	-	5 to 20
425 -do-	65 to 95	-
300 -do-	-	30 to 75
180 -do-	0 to 10	10 to 30
below 180 micron		0 to 15

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

**C. 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 conditions suitable for paint striping. They shall pass the free flow test.

**803.4:3.4. Test methods:** The specific requirements shall be tested with the following methods:

Free-flow test: Spread 100 grams of beads evenly in a 100 mm diameter glass dish. Place the dish in a 250mm inside diameter desiccator which is filled within 25 mm of the top of a desiccator plate with sulphuric acid water solution (specific gravity 1.10). Cover the desiccator and let it stand for 4 hours at 20 to 29 degree C. Remove sample from desiccator, transfer beads to a pan and inspect for lumps or clusters. Then pour beads into a clean, dry glass funnel having a 100 mm stem and 6 mm orifice. If necessary, initiate flow by lightly tapping the funnel. The glass spheres shall be essentially free of lumps and clusters and shall flow freely through the funnel. The requirements of gradation, roundness and refractive index of

glass beads and the amount of glass beads in the compound shall be tested as per BS 6088 and BS 3262 (Part I).

The Contractor shall furnish to the Employer a copy of certified test reports from the manufacturer of glass beads obtained from a reputed laboratory showing results of all tests specified herein and shall certify that the material meets all requirements of this Specification. However, if so required, these tests may be carried out as directed by the Engineer.

#### **803.4.4. Application properties of thermoplastic material**

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

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

#### **803.4.5. Preparation:**

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

After transfer to the laying equipment, the material shall be maintained within the temperature range specified by the manufacturer for achieving the desired consistency for laying.

#### **803.4.6. Properties of finished road marking:**

The stripe shall not be slippery when wet.

The marking shall not lift from the pavement in freezing weather. After application and proper drying, the stripe shall show no appreciable deformation or discolouration under traffic and under road temperatures upto 60°C.

The marking shall not deteriorate by contact with sodium chloride, calcium chloride or oil drippings from traffic.

The stripe or marking shall maintain its original dimensions and position. Cold ductility of the material shall be such as to permit normal movement with the road surface without chopping or cracking.

The colour of yellow marking shall conform to IS Colour No. 356 as given in IS:164.

#### **803.5. Reflectorised Paint**

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

#### **803.6. Application**

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

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

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

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

Thermoplastic paint shall be applied in intermittent or continuous lines of uniform thickness of at least 2.5 mm unless specified otherwise. Where arrows or letters are to be provided, thermoplastic compound may be hand-sprayed. In addition to the beads included in the material, a further quantity of glass beads of Type 2, conforming to the above noted Specification shall be sprayed uniformly into a mono-layer on to the hot paint line in quick succession of the paint spraying operation. The glass beads shall be applied at the rate of 250 grams per square metre area.

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

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

### **803.7. Measurements for Payment**

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

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

### **803.8. Rate**

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

Detailed specification as per attached copy.

**Measurements for Payment:**

**The rate shall be for a unit of one square Meter.**

**Item No.11**

**Cat Eye/ Road Stud/RPM:** Supplying Raised Pavement Markers made of polycarbonate and ABS moulded body and reflective panels with Micro prismatic lens (No Glass bead 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 Dt 11.06. 1997. The height, width and length shall not exceed 20 mm, 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 body of the marker should have finger grip for easy and accurate placement and application with epoxy/bituminous Adhesive as recommended by the manufacturer of the marker. 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 (R P M ) or road stud is device which is bonded to or anchored within the road surface for lane marking and delineation for night time visibility. It reflects incident light in directions close to the direction for which it came.

## 1.2

### **Definitions**

#### 1.2.1

Description of terms specific to this standard

##### 1.2.1.1

Coefficient of luminous intensity ( C I L ) or specific intensity = the ratio of luminous intensity of the retro reflector in the direction of observatory 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 indent 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 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 when the road stud is fixed position in the road;

**1.3**

**Material**

**1.3.1**

Plastic body of RPM road stud shall be molded from ASA (Acrylicstyrene actylonitrile) 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 D 4280

**1.3.2**

Reflective panels shall consist of number of lenses containing single or dual prismatic cubes capable of providing total internal reflection the light entering the lens face lenses shall be molded of methyl methacrylate conforming to ASTM D 788 or equivalent.

**1.4**

**Design**

**1.4.1**

The slope of 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 sqmt.

**1.5**

**Optical performance**

**1.5.1.1**

Unidirectional and bi directional studs

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

Table 1 min. CIL 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 min. CIL vales 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 reflectors when the reflecting 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 bi directional reflectors shall be considered to be included in Category 'B'

## 1.5.2 Omni directional studs

Each omni directional stud shall have a min. CIL of not less than med 1 x

## 1.5.3 Tests

- 1.5.3.1 Coefficient of luminance intensity can be measured by produce described in ASTM 809 " Practice for Measuring Photometric characteristics" or as recommended in BS 879 part 4:1973.

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 necessary to remove adhesive from exposed faces of pavement markers.

## **1.7 Warranty and durability**

The contractor shall obtain from the manufacturer a two year warranty for contractor held performance including stipulated retro reflectance of the reflecting panel and sub of the same to the Engineer in charge. 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, damage get worn out or low their reflectivity compared to stipulated standards, the contractor would be required to replace all such marker within 15 days of the intimation from the Engineer at his own cost and with no extra remuneration to be paid for such works.

## **1.8 Measurement for Payment:**

The measurement of reflective road markers shall be in number of diff. types of marker supplied and fixed.

## **1.9 Rate**

The contract unit rate for reflective road marker shall be payment in full compensation for furnishing all labor, materials, 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 by the Engineer.

Detailed specification as per attached copy.

**Measurements for Payment:**

**The rate shall be for a unit of one Number.**

**Item No.12**

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

**(B) Class-B Type-4 Retro Reflective sheeting**

**Annexure-I**

**[Detailed Technical Specifications for Sign Board Items]**

## **1) Material & Manufacturing:**

### **1.1 Scope**

The work shall consist of fabrication, supply and installation of ground mounted traffic signs on roads. The details of the signs shall be as shown in the drawings and in conformity with the code of practice for Road signs, IRC 67-2012.

### **1.2 Materials**

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

#### **1.2.1 Concrete:**

Concrete for the foundation shall be of M15 Grade as per section 1700 or the grade shown on the drawings or otherwise as directed by the Engineer.

#### **1.2.2 Reinforcing Steel**

Reinforcing steel shall conform to the requirements of IS: 1786 unless otherwise shown on the drawings.

#### **1.2.3 Bolts, Nuts and Washers**

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

#### **1.2.4 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.

#### **1.2.5 Substrate**

Sign panel shall be fabricated on Aluminium sheet, aluminium composite panel, fibre glass sheeting, or sheet moulding compound. Aluminium sheets

used for sign boards shall be of smooth, hard and corrosion resistance alluminium alloy conforming to IS: 736-Material Designation 24345 or 1900. Alluminium composite Material (ACM) sheets shall be sandwiched construction with a thermoplastic core of Low Density Polyethylene (LDPE) between two thick skins/sheets of aluminium with overall thickness of 3mm or 4mm (as specified in the contract), and aluminium skin thickness 0.5mm and 0.3mm respectively on both the sides.

The mechanical proportion of ACM and that of aluminium skin shall conform to the requirements given in the table 800-1, when tested in accordance with the test methods mentioned against each of them.

**Table 800-1: Specifications for Aluminium Composite Material (ACM)**

Sr. No.	Description	Specification for 40 mm		Specification for 3 mm
		Standard Test	Acceptable Value	Acceptable Vale
<b>A</b>	<b>Mechanical Properties of ACM</b>			
1	Peel / off strength with retro reflective sheeting. (Drum Peel Test)	ASTM D903	Min. 4 N/mm	Min. 4 N/mm
2	Tensile Strength	ASTM E8	Min. 40 N/mm <sup>2</sup>	Min. 30 N/mm <sup>2</sup>
3	0.2% Proof Stress	ASTM E8	Min 34 N/mm <sup>2</sup>	Min. 34 N/mm <sup>2</sup>
4	Elongation	ASTM E8	Min. 6%	Min. 5%
5	Flexural Strength	ASTM C393	Min. 130 N/mm <sup>2</sup>	Min. 120 N/mm <sup>2</sup>
6	Shear Strength with punch shear test	ASTM D732	Min. 18 N/mm <sup>2</sup>	Min. 18 N/mm <sup>2</sup>
<b>B</b>	<b>Properties of Alluminium skin</b>			

1	Tensile strength (Rm)	ASTM E8	<i>Min. 150 N/mm<sup>2</sup></i>	<i>Min. 130 N/mm<sup>2</sup></i>
2	Modulus of Elasticity	ASTM E8	<i>Min. 70000 N/mm<sup>2</sup></i>	<i>Min. 70000 N/mm<sup>2</sup></i>
3	Elongation	ASTM E8	<i>A<sub>50</sub> Min. 2%</i>	<i>A<sub>50</sub> Min. 2%</i>
4	0.2% Proof Stress	ASTM E8	<i>Min. 110 N/mm<sup>2</sup></i>	<i>Min. 110 N/mm<sup>2</sup></i>

### 1.2.6 Plate Thickness

Shoulder mounted ground signs with a maximum side dimension not exceeding 600 mm shall not be less than 1.5mm thick Aluminium and 3 mm thick with Aluminium Composite Material. All other signs shall be at least 2 mm thick Aluminium and 4 mm thick with Aluminium Composite Material. 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 prevailing wind and other loads.

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

## 1.3 Traffic signs having Retro Reflective Sheeting

### 1.3.1 General Requirements

The retro reflective sheeting used on the signs shall consist of 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 exhibit colour fastness. It shall be new and unused and show no evidence of cracking, scaling, and pitting, blistering, edge lifting or curling and shall have negligible shrinkage

or expansion. A certificate of having the sheeting tested for coefficient of retro reflection, daytime colour and luminance, shrinkage, flexibility, liner removal, adhesion, impact resistance, specular gloss and fungus resistance, 3 years outdoor weathering and its having passed these tests shall be obtained from International / Government laboratory / Institute by the manufacturer of the sheeting. The reflective sheeting shall be either of Engineering Grade material with enclosed lens, High Intensity Grade with encapsulated lens or Micro-Prismatic Grade retro reflective element material as given in Clauses 801.3.2 to 801.3.7. Guidance on the recommended application of each class of sheeting may be taken from IRC-67.

### **1.3.2 High Intensity Grade Sheetting**

#### **1.3.2.1 High Intensity Grade (Type III)**

This sheeting shall be of encapsulated lens type consisting of spherical glass lens, elements adhered to a synthetic resin and encapsulated by a flexible, transparent water-proof plastic having a smooth surface or as an unmetallised micro prismatic reflective material elements. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro-reflection (determined with ASTM D:4956-09) as indicated in Table 800-2.

**Table 800-2**

**Acceptable Minimum Coefficient of Retro-reflection for Type III High Intensity Grade Sheetting<sup>A</sup> (Encapsulated Lens Type)**

**(Candelas Per Lux Per Square Metre)**

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown
0.1 <sup>0B</sup>	-4°	300	200	120	54	54	24	14
0.1 <sup>0B</sup>	+30°	180	120	72	32	32	14	10
0.2°	-4°	250	170	100	45	45	20	12
0.2°	+30°	150	100	60	25	25	11	8.5
0.5°	-4°	95	62	30	15	15	7.5	5
0.5°	+30°	65	45	25	10	10	5.0	3.5

<sup>A</sup> Minimum Coefficient of Retro reflection ( $R_A$ )  
( $\text{cd.lx}^{-1}.\text{m}^{-2}$ ).

<sup>B</sup>Values for 0.1° observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order. When totally wet, the sheeting shall show not less than 90 percent, of the values of retro reflectance indicated in above Table. At the end of 7 years, the sheeting shall retain at least 80 percent of its original retro-reflectance.

#### 1.3.2.2 High Intensity Micro-Prismatic Grade Sheeting (HIP) (Type IV):

This sheeting shall be of high intensity retro-reflective sheeting made of micro-prism at it retro-reflective element material coated with pressure sensitive adhesive. 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 D 4956-09ias indicated in Table 800-3.

**Table 800-3 Acceptable Minimum Coefficient of Retro-Reflection  
for  
Type IV High Intensity Micro-prismatic Grade Sheeting<sup>A</sup>  
(Candelas Per Lux Per Square Metre)**



Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown	Fluorescent Yellow-Green	Fluorescent Yellow	Fluorescent Orange
0.1 <sup>OB</sup>	-4°	500	380	200	70	90	42	25	400	300	150
0.1 <sup>OB</sup>	+30°	240	175	94	32	42	20	12	185	140	70
0.2°	-4°	360	27	145	50	65	30	18	290	220	105
0.2°	+30°	170	135	68	25	30	14	8.5	135	100	50
0.5°	-4°	150	110	60	21	27	13	7.5	120	90	45
0.5°	+30°	72	54	28	10	13	6	3.5	55	40	22

<sup>A</sup> Minimum Coefficient of Retro reflection ( $R_A$ ) ( $\text{cd.lx}^{-1}.\text{m}^{-2}$ ).

<sup>B</sup>Values for 0.1° observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order. When totally wet, the sheeting shall show not less than 90 percent of the values of retro reflection indicated in above Tale. At the end of 7 years, the sheeting shall retain at least 80 percent of its original retro-reflectance.

### 1.3.4 Prismatic Grade Sheeting

#### 1.3.4.1 Prismatic Grade Sheeting (Type VIII)

The reflective sheeting shall be retro reflective sheeting made of micro prismatic retro reflective material. 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 D: 4956-09) as indicated in Table 800-4.

**Table 800-4 Acceptable Minimum Coefficient of Retro-reflection for Type VIII Prismatic Grade Sheeting<sup>A</sup>**  
(Candelas Per Lux Per Square Metre)

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown	Fluorescent Yellow-Green	Fluorescent Yellow	Fluorescent Orange
0.1 <sup>OB</sup>	-4°	1000	750	375	100	150	45	30	800	600	300
0.1 <sup>OB</sup>	+30°	460	345	175	46	69	21	14	370	280	135
0.2°	-4°	700	525	265	70	105	32	321	560	420	210
0.2°	+30°	325	245	120	33	49	15	10	260	200	95
0.5°	-4°	250	190	94	25	38	11	7.5	200	150	75
0.5°	+30°	115	86	43	12	17	5	3.5	92	69	35

<sup>A</sup> Minimum Coefficient of Retro reflection ( $R_A$ ) (cd.lx<sup>-1</sup>.m<sup>-2</sup>).

<sup>A</sup>Values for 0.1° observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order. When totally wet, the sheeting shall show not less than 90 percent of the values of retro reflection indicated in above Table. At the end of 10 years, the sheeting shall retain at least 80 percent of its original retro-reflectance

#### 1.3.4.2 Prismatic Grade Sheeting (Type IX)

The reflective sheeting shall be retro reflective sheeting made of micro prismatic retro reflective material. 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 D 4956-09) as indicated in Table 800-5.

**Table 800-5 Acceptable Minimum Coefficient of Retro-reflection  
for Type IX Prismatic Grade Sheeting<sup>A</sup>**

**(Candelas Per Lux Per Square Metre)**

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Fluorescent Yellow-Green	Fluorescent Yellow	Fluorescent Orange
0.1 <sup>OB</sup>	-4°	660	550	250	66	130	30	530	400	200
0.1 <sup>OB</sup>	+30°	370	280	140	37	74	17	300	220	110
0.2°	-4°	380	285	145	38	76	17	300	230	115
0.2°	+30°	215	162	82	22	43	10	170	130	65
0.5°	-4°	240	180	90	24	48	11	190	145	72
0.5°	+30°	135	100	50	14	27	6	110	81	41
1.0°	-4°	80	60	30	8	16	3.6	64	48	24
1.0°	+30°	45	34	17	4.5	9.0	2	36	27	14

A Minimum Coefficient of Retro reflection ( $R_A$ ) (cd.lx<sup>-1</sup>.m<sup>2</sup>).

<sup>B</sup>Values for 0.1° observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order. When totally wet, the sheeting shall show not less than 90 percent of the values, of retro reflection indicated in above Table. At the end of 10 years, the sheeting shall retain at least 80 percent of its original retro-reflectance.

#### 1.3.4.3 Prismatic Grade Sheeting (Type XI)

Retro reflective sheeting typically manufactured as a cube corner. The reflective sheeting shall be retro reflective sheeting made of micro prismatic retro reflective material. 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 D 4956-09) as indicated in Table 800-6.

**Table 800-6 Acceptable Minimum Coefficient of Retro-reflection for Type XI Prismatic Grade Sheeting<sup>A</sup>**  
(Candelas per Lux per Square Metre)

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown	Fluorescent Yellow	Fluorescent Yellow	Fluorescent Orange
0.1 <sup>OB</sup>	-4°	830	620	290	83	125	37	25	660	500	250
0.1 <sup>OB</sup>	+30°	325	245	115	33	50	15	10	260	200	100
0.2°	-4°	580	435	200	58	87	26	17	460	350	175
0.2°	+30°	220	165	77	22	33	10	7	180	130	66
0.5°	-4°	420	315	150	42	63	19	13	340	250	125
0.5°	+30°	150	110	53	15	23	7	5	120	90	45
1.0°	-4°	120	90	42	12	18	5	4	96	72	36
1.0°	+30°	45	34	16	5	7	2	1	36	27	14

<sup>A</sup> Minimum Coefficient of Retro reflection ( $R_A$ ) (cd.lx<sup>-1</sup>.m<sup>2</sup>).

<sup>A</sup>Values for 0.10 observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order. When totally wet, the sheeting shall show not less than 90 percent of the values, of retro reflection indicated in above Table. At the end of 10 years, the sheeting shall retain least 80 percent of its original retro-reflectance.

### 1.3.5 Adhesive

The sheeting shall have a pressure-sensitive adhesive of the aggressive-tack type requiring no heat, solvent or other preparation for adhesion to a smooth clean surface, 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. The sheeting shall be applied in accordance with the manufacturer's specifications.

### **1.3.6 Fabrication**

Surface to be reflectorized 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. Complete sheets of the material shall be used on the signs except where it is unavoidable. At splices, sheeting with pressure-sensitive adhesives shall be overlapped not less than 5 mm. Where screen printing with transparent colours is proposed, only butt joint 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.

### **1.3.7 Message / Border**

The messages (legends, letters, numerals, etc.) and borders shall either be screen-printed or of cut out from durable transparent overlay or cut out from the same type of reflective sheeting for the cautionary/mandatory sign boards. Screen printing shall be processed and finished with materials and in a manner specified by the sheeting manufacturer. For the informative and other sign boards, the messages (legends, letters, numerals etc.) and borders shall be cut out from durable transparent overlay film or cut-out from the same reflective sheeting only. Cut-outs shall be from durable transparent overlay materials as specified by the sheeting manufacturer and shall be bonded with the sheeting in the manner specified by the manufacturer. For screen-printed transparent

coloured areas on white sheeting, the co-efficient of retro-reflection shall not be less than 50 per cent of the corresponding values in Tables 800-2 to 800-6 as applicable. Cut-out messages and borders, wherever used, shall be either made out of retro-reflective sheeting or made out of durable transparent overlay except those in black which shall be of non-reflective sheeting or opaque in case of durable transparent overlay.

### **1.3.8 Colour for signs**

**1.3.8.1** Signs shall be provided with retro-reflective sheeting and / or overlay film / screening ink as shown on the detailed drawings. The reverse side of all signs shall be painted grey.

**1.3.8.2** Except in the case of railway level crossing signs (for which the colour scheme is given later) the sign posts shall be painted in 250 mm wide bands, alternately black and white. The lowest band next to the ground shall be in black.

**1.3.8.3** The colour of the material shall be located within the area defined by the chromaticity coordinates in Table 8.1 and comply with the luminance factor in Table 800-7 when measured as per ASTM D: 4956-09.

Table 8.1 Specification Limits (Daytime) <sup>A</sup>								
Colour	1		2		3		4	
	X	Y	X	Y	X	Y	X	Y
White	0.303	0.300	0.368	0.366	0.340	0.393	0.274	0.329
Yellow	0.498	0.412	0.557	0.442	0.479	0.520	0.438	0.472
Green <sup>B</sup>	0.026	0.399	0.166	0.364	0.286	0.446	0.207	0.771
Red	0.748	0.351	0.735	0.275	0.629	0.281	0.565	0.346
Blue <sup>B</sup>	0.140	0.035	0.244	0.210	0.190	0.255	0.065	0.216
Orange	0.558	0.352	0.636	0.364	0.570	0.429	0.506	0.404
Brown	0.430	0.340	0.610	0.390	0.550	0.450	0.430	0.390
Fluorescent Yellow-Green	0.387	0.610	0.369	0.546	0.428	0.496	0.460	0.540
Fluorescent Yellow	0.479	0.520	0.446	0.483	0.512	0.421	0.557	0.442
Fluorescent Orange	0.583	0.416	0.535	0.400	0.595	0.3521	0.645	0.355

The colour shall be durable and uniform in acceptable have when viewed in day light or under normal highlights at night.

**1.3.8.4** The mandatory and warning signs shall be provided with white background and red border. The legend/symbol for these signs shall be in black.

**1.3.8.5** The colours chosen for informatory or guide signs shall be distinct for different categories of roads. For National Highways and State Highways, these signs shall be of green background with white borders, legends and word messages. For Expressways these signs shall be of blue background with white border, legends and word messages.

### 1.3.9 Refurbishments

Where existing signs are specified for refurbishments, the sheeting shall have semi-rigid aluminium backing or materials as per clause 1.2.5, pre-coated with aggressive tack type pressure sensitive adhesive. The adhesive shall be suitable for the type of material used for the signs and should thoroughly bond with that material.

### 1.3.10 Sizes of Letters

**1.3.10.1** Letter size should be chosen with due regard to the speed, classification and location of the road, so that the sign is of adequate size for legibility but without being too large or obtrusive. The size of the letter, in terms of x-height, to be chosen as per the design speed is given in Table 800-8.

**Table 800-8 Acceptable Limits for Size of Letters and Visibility Distance**

Design Speed (kmph)	Minimum 'x' Height of the Letter (mm)	Minimum Sight Distance / Clear Visibility distance (m)	Maximum Distance from Center Line (m)
40	100	45	12
50	125	50	14
65	150	650	16
80	250	80	21
100	300	90	24
120	400	115	32

The thickness of the letters and their relation to the x-height, the width and the heights are indicated in Table IV(a) of the Annexure-IV to facilitate the design of the informatory signs and definition plates.

**1.3.10.2** For advance direction signs on non-urban roads, the letter size ('x' height) should be minimum of 150 mm for National and State Highways and 100 mm for other roads. In case of overhead signs, the size ('x' height) of letters may be minimum 300 mm. Thickness of the letter could be varied from 1/6 to 1/5 of the letter 'x' size. The size of the initial uppercase letter shall be 1-1/3 times x-height. In urban areas, letter size shall be 100 mm on all directional signs. For easy and better comprehension, the word



messages shall be written in initial upper case letter followed by lower case letters.

**1.3.10.3** Letter size on definition plates attached with normal sized signs should be 100 mm or 15C. In the case of small signs, it should be 100 mm. Where the message is long, as for instance it "NO PARKING" and "NO STOPPING" signs, the message may be broken with two lines and the size of letters may be varied in the lines so that the definition plate is not too large. The lettering on definition plates will be all in upper case letters.

### **1.3.11 Warranty and Durability**

The Contractor shall obtain from the original manufacturer of the Retro Reflective sheeting for period of ten (10) years warranty for satisfactory field performance including stipulated retro reflectance of Micro-Prismatic sheeting and a Seven years warranty for High Intensity Grade and submit the same to the Engineer. The warranty shall be inclusive of the screen printed or cut out letters/legends and bonding to the retro reflective sheeting. The contractor shall also furnish LOT numbers and certificate that the signs and material supplied against the assigned work meet all the stipulated requirement! and carry the stipulated warranty and the contractor/supplier is the authorized converter of the particular sheeting.

All the signs shall be dated during the fabrication with indelible marking to indicate the start the warranty. The warranty shall also cover the replacement obligation by the sheeting manufacture as well as contractor for replacement/repair/restoration of the retro reflective efficiency.

A certificate in original shall be given by the manufacturer of the sheeting that its offered retro- reflective sheeting has been tested for various parameters such as co-efficient of retro reflection,

day/night time color and luminance, shrinkage, flexibility, liner removal, adhesion, impact resistance, specular gloss and fungus resistance.; the tests shall be carried out by a Government laboratory in accordance with the various ASTM procedures and the results must show that the sheeting has passed the requirements for all the above mentioned parameters. A copy of the test reports shall be attached with the certificate.

## **1.4 Installation**

### **1.4.1**

The traffic signs shall be mounted on support posts, which may be of GI pipes conforming to IS 1239, Rectangular Hollow Section conforming to IS 4923 or square hollow Section conforming to IS 3589. Sign posts, their foundations and sign mountings shall be so constructed as to hold these in a proper and permanent position against the normal storm wind loads or displacement by vandalism. Normally, signs with an area up to 0.9 square metre shall be mounted on a single post and for greater area, two or more supports shall be provided. 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.

**1.4.2** All components of signs and supports, other than the reflective portion of GI posts shall be thoroughly de sealed, cleaned, primed and painted with two coats of epoxy paint. Any part of post below ground shall be painted with protective paint.

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

## **1.5 Measurement for Payment**

The Unit shall be on number basis or per no. As applicable.

### **1.6 Rate**

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

### **Measurements for Payment:**

**The rate shall be for a unit of one Number.**

#### **Item No.13**

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

outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor.

**(B) Class-B Type-4 Retro Reflective sheeting.**

The Specification of Item No.12 shall be followed and details shall as mention in the item & as directed by engineer in charge.

**Measurements for Payment:**

**The rate shall be for a unit of one Number.**

**Item No.14**

**Hazard Marker Sign:-** Providing and fixing sign boards made out of 2.0 mm aluminium sheet / 4 mm ACP (Aluminum composite Panel); size 90x30 cms. Rectangular as per design of IRC-67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with Micro Prismatic Grade retro effective sheeting of Type-11 as per ASTM D-4956 and latest M.O.S.T. Specifications; 1.8mtr long stand post of 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with best quality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 Cms. for each leg including excavation, curing etc. complete under the supervision of engineer in charge. A warranty for 10 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor

exposure test report from third party test lab for the product offered shall be submitted by contractor.

**(A) Class-C Type-11 Retro Reflective sheeting**

The Specification of Item No.12 shall be followed and details shall as mention in the item & as directed by engineer in charge.

**Measurements for Payment:**

**The rate shall be for a unit of one Number.**

**Item No.15**      **Sign board per Square Meter :-** Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 1 meter x 1meter as per design of IRC-67- 2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflective sheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T. Specifications; 4 mtr long stand post (2 Nos.) of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 50x50x5mm; painted with best quality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 Cms. for each leg including excavation, curing etc.

complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) **Class-B Type-4 Retro Reflective sheeting**

The Specification of Item No.12 shall be followed and details shall as mention in the item & as directed by engineer in charge.

**Measurements for Payment:**

**The rate shall be for a unit of one Square Meter.**

**Item No.16**      **Painting two coats** (excluding priming coat) on previously painted steel and other metal surface with enamel paint, brushing to give an even shade including cleaning the surface of all dirt, dust and other foreign matter.

**1.0. Materials:**

Synthetic enamel paint shall conform to I. S. 1932-1964.

**2.0 Workmanship**

**2.1 General:** The materials required for work of painting work shall be obtained directly from approved manufacturers or approved dealer and brought to the site in maker's drums, kegs, etc. with seal unbroken.

2.1.2. All materials not in actual use shall be kept properly protected, lids of containers shall be kept closed and surface of paint in open or partially open containers covered with a thin layer of turpentine to prevent formation of skin. The materials which have

become state or flat due to improper and long storage shall not be used. The paint shall be stirred thoroughly in its container before pouring into small containers. While applying also, the paint shall be continuously stirred in smaller container. No left over paint shall be put back into stock tins. When not in use the containers shall be kept properly closed.

2.1.3. If for any reasons, thinning is necessary, the brand of thinner recommended by the manufacturer shall be used.

2.1.4. The surface to be painted shall be thoroughly cleaned and dusted. All rust, dirt and grease shall be thoroughly removed before painting is started. No painting on exterior or other exposed parts of the work shall be carried out in wet, damp or otherwise unfavourable weather and all the surfaces shall be thoroughly dry before painting work is started.

## **2.2 Application of paint:**

2.2.1 Brushing operations are to be adjusted to the speeding capacity advised by the manufacture of particular paint. The paint shall be applied evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternately in opposite directions two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing any laying off will constitute one coat.

2.2.2. Each coat shall be allowed to dry completely and lightly rubbed with very fine grade of sand-paper and loose particles brushed off before next coat is applied. Each coat shall vary slightly in shade and shall be got approved from Engineer-in-charge before next coat is started.

2.2.3 Each coat except the last coat shall be lightly rubbed down with sand-paper of fine pumice stone and cleaned of dust before the next coat is applied. No hair marks from the brush or clogging

of paint puddles in the corners of panels, angles of moulding etc. shall be left on the work.

2.2.4. Special care shall be taken while painting over bolts, nuts, rivets, overlaps etc. Approved best quality brushes shall be used.

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

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

for mode of measurements and payment. The rate is excluding priming coat.

3.4. The rate shall be for a unit of One sq. metre.

**Item No.17**      **Finishing wall with weather proof exterior emulsion paint on wall surface (two coats)** to give an required shape even shade after thoroughly brushing the surface to remove all dirt, and remains of loose powdered materials.etc complete

#### **1.0      Materials :**

Water shall conform to M-1 and acrylic paint shall conform to its supplier's Specification.

#### **2.0      Workmanship:**

##### **2.1      General:-**

2.1.1. The materials required for work of painting work shall be obtained directly from approved manufacturers or approved dealer and brought to the site in maker's drums, cage etc. with seal unbroken.

2.1.2 All materials not in actual use shall be kept properly protected, lid of containers shall be kept closed and surface of paint in open or partially open containers



covered with a thin layer of water to prevent formation of skin. The materials, which have become stale or flat due to improper and long storage shall not be used. The paint shall be stirred thoroughly in its container before pouring into small containers. While applying also, The paint shall be continuously stirred in smaller container. No left over paint shall be put back into stock tins when not in use. The paint shall be stirred thoroughly in its container before pouring into small containers.

2.1.3. If for any reasons, thinning is necessary, water shall be added as per supplier's instructions.

2.1.4. The surface to be painted shall be thoroughly cleaned and dusted. All rust, dirt and grease shall be thoroughly removed before painting is started. No painting on exterior or other exposed parts of the work shall be carried out in wet, damp or otherwise unfavorable weather and all the surfaces shall be thoroughly dry before painting work is started.

## **2.2 Scaffolding:**

Wherever scaffolding is necessary, it shall be erected in such a way that as far as possible no part of scaffolding shall rest against the surface to be white or colour washed. A properly secured, strong and well tied suspended platform (zoola) may be used of white washing. Where ladders are used, pieces of old gunny bags shall be tied at top and bottom to prevent scratches to the floors and walls. For white washing of ceilings, proper stage scaffolding shall be erected where necessary. Also while painting the ceiling; the floor area shall be covered properly with plastic so that the flooring is not spoiled.

### **2.3 Preparation of surface:**

All unnecessary nails, hooks etc. shall be removed. Pitting in plaster shall be made good with plaster again and papered with a fine grade sand paper and made smooth. The surface affected by moulds, moss, fungi, algae lichens. Efflorescence etc. shall be treated in accordance with IS: 2395(Part -1)-1966.

### **2.4 Preparation of Mix:**

This shall be done as per the manufacturer's instructions, The thinning of emulsion is to be done with water and not with turpentine. the quality of thinner to be added to shall be as per manufacturer's instructions.

### **2.5 Application:**

2.5.1 Before pouring into small containers for use of applying, the paint shall be stirred thoroughly in its container. also the paint shall be continuously stirred in the smaller container, so that its consistency is kept uniform.

2.5.2 The paint shall be laid on evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternately. in opposite directions two or three times and then finally brushing lightly in direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat. No hair marks from the brush or clogging of paint puddles in the corners of panels, angles of moldings etc. shall be left on the work.

2.5.3 On the newly plastered surface, the first coat shall be applied with 100% dilution and second and third coat shall

be applied with 40% dilution or as per the supplier's instructions. The second or subsequent coat shall not be started until the presiding coat has become sufficiently hard to resist marking of the brush being used.

## **2.6 Precautions:**

(a) Old brushes if they are to be used with paints, shall be completely dried of turpentine or oil paint by washing in warm soap water, Brushes shall be quickly washed in water immediately after use and shall be kept immersed in water during break periods to prevent the paint from hardening on the brush.

(b) In the preparation of walls for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes etc.

(c) Splashes on floors etc. shall be cleaned out without delay, as they will be difficult to remove after hardening.

(d) Washing of surfaces treated with emulsion paint shall not be done within 3 to 4 weeks of application.

## **2.7 Protective Measure:**

The surface of doors, windows, ventilators, floors, articles of furniture etc. and such other part of the building not to be painted shall be protected from being splashed upon. Such surface shall be cleaned of paint splashed, if any immediately after completing the painting, at not extra cost.

## **3.0 MODE OF MEASUREMENT & PAYMENT:-**

3.1 For mode of measurement latest version of IS 1200 shall be followed. All the work shall be measured in the decimal system as under:

(a) Dimension shall be measured to the nearest 0.01M.

(B) Area in individual items shall be worked out to the nearest 0.01M<sup>2</sup>

3.2 All works shall be measured in sq.mt; in jambs, soffits, sills etc. and for opening not exceeding 0.5<sup>2</sup> each in area, for ends of joists, posts, beams, girders, steps, etc. not exceeding 0.5<sup>2</sup> each in area and for openings exceeding 0.5m<sup>2</sup> and not exceeding 3.0m<sup>2</sup> each in area, deduction and additions shall be made as under:-

1) No deduction shall be made for ends of joists, beams, posts, etc. and for openings not exceeding 0.5m<sup>2</sup> each. No addition shall be made for reveals jambs, soffits, sills etc. of these openings nor for finish around ends of joists, beams, posts etc.

2) Deduction for opening exceeding 0.5m<sup>2</sup> but not exceeding 3.0m<sup>2</sup> each shall be made as follows and no addition shall be made for reveals jambs, soffits etc. of these opening.

(A) When both the faces of walls are provided with the same finish, deduction shall be made for one face only.

(B) When each face of wall is provided with a different finish, deduction shall be made for that side of frame for door, windows, etc. on which width of reveals is less than that of the other side. Where width of reveals on both faces of wall are equal, deduction of 50% of area of opening on each face shall be made from total area of finish.

(C) When only one face of wall is treated and the other face is not treated. full deduction shall be made if when width of reveal on the treated side is less than what on the untreated side, but if the width of reveals is equal or more than in the untreated side, but if the width of reveals is equal or more than on the untreated side neither

deduction nor additions to be made for reveals jambs, soffits.

3) In case of area of openings deduction shall be made for opening but jambs, soffits, shall be measured.

4) No deduction shall be made for attachment such as casing, conduits, pipe electric wiring and the like.

3.3 Corrugated surface shall be measured flat as fixed and not girth. The quantities measured shall be increased by the following percentage and the resultant shall be included with the general areas

- |   |     |
|---|-----|
| (A) Corrugated steel sheets.                          | 14% |
| (B) Corrugated A. C. Sheets.                          | 20% |
| (C) Semi corrugated A. C. sheets                      | 10% |
| (D) Nainital pattern roof (Plain sheeting with rolls) | 10% |
| (E) Nainital pattern roof (with corrugated sheets)    | 25% |

3.4 Cornices and other wall features, when they are picked out in a different finish/ color shall be girthed and included in the general area.

3.5 The rate shall include the cost of all materials, lab our, scaffolding, protective measure etc. required for the above specified operation, at all floors, at any height, in any position. Priming and Alkali resistant treatments scrapping of surface washing etc. surface spoiled by smoke soot, removal of oil and grease spots, treatments for infection will not be paid extra. This shall also include conveyance, delivery, handling, unloading, storing work etc.

3.6 **The rate shall be for a unit of one sq.mt.**

**Item No.18**

Providing Sona Geru and Lime on Tree of road side as directed by engineer in charge. (A)  
Girth Upto 300 mm

The tress on which geru & lime patta shall apply to cleaned with wire brushes. After cleaning the trees lime and geru shall be applied in two coats as directed. Geru shall be applied up to 0.90 meter from iron bottom of trees and lime shall be applied in width of 0.30 meter. patta above the geru applied on trees.

The payment shall be made on one nos. basis actual work done.

**Measurements for Payment:**

**The rate shall be for a unit of one Number**

**Item No.19**      Providing Sona Geru and Lime on Tree of road side as directed by engineer in charge. (A)  
**Girth Above 300 mm**

The Specification of Item No.18 shall be followed and details shall as mention in the item & as directed by engineer in charge.

**Measurements for Payment:**

**The rate shall be for a unit of one Number.**

**Item No.20**      **Type - A, "W" : Metal Beam Crash Barrier**  
(Providing and erecting a "W" metal beam crash barrier comprising of 3 mm thick corrugated sheet metal beam rail, 70 cm above road/ground level, fixed on ISMC series channel vertical post, 150 x 75 x 5 mm spaced 2 m centre to centre, 1.8 m high, 1.1 m below ground/road level, all steel parts and fitments to be galvanised by hot dip process, all fittings to conform to IS:1367 and IS:1364, metal beam rail to be fixed on the vertical post with a spacer of channel section 150 x 75 x 5

mm, 330 mm long complete as per clause 810)

## **810. METAL BEAM CRASH BARRIER**

### **810.1. General**

**810.1.1.** This work shall consist of furnishing and erection of metal beam crash barrier of dimensions and at locations as shown on the drawing (s) or as directed by the Engineer.

**810.1.2.** Metal beam crash barrier shall generally be located on approaches to bridge structures, at locations where the embankment height is more than 3 metres and at horizontal curves.

### **810.2. Materials**

**810.2.1.** Metal beam rail shall be corrugated sheet steel beams of the class, type, section and thickness indicated on the plans. Railing posts shall be made of steel of the section, weight and length as shown on the plans. All complete steel rail elements, terminal sections, posts, bolts, nuts, hardware and other steel fittings shall be galvanised. All elements of the railing shall be free from abrasions, rough or sharp edges and shall not be kinked, twisted or bent. As per item description.

**810.2.2.** Steel beam elements and terminal sections shall be galvanised (zinc coated, 0.55 kg per square metre, minimum single spot) unless otherwise specified. The galvanising on all other steel parts shall conform to the relevant IS Specifications. All fittings (bolts, nuts, washers) shall conform to the IS: 1367 and IS: 1364. All galvanizing shall be done after fabrication.

**810.2.3.** Concrete for bedding and anchor assembly shall conform to Section 1700 of these Specifications.

### **810.3. Construction Operations**

**810.3.1.** The line and grade of railing shall be true to that shown on the plans. The railing shall be carefully adjusted prior to fixing in place, to ensure proper matching at abutting joints and correct alignment and camber throughout their length. Holes for

field connections shall be drilled with the railing in place in the structure at proper grade and alignment.

**810.3.2.** Unless otherwise specified on the drawing, railing steel posts shall be given one shop coat of paint (primer) and three coats of paint on structural steel after erection, if the sections are not galvanised. Any part of assembly below ground shall be painted with three coats of red lead paint.

**810.3.3.** Splices and end connections shall be of the type and designs specified or shown on the plans and shall be of such strength as to develop full design strength of the rail elements.

#### **810.4. Installation of Posts**

**810.4.1.** Holes shall be dug or drilled to the depth indicated on the plans or posts may be driven by approved methods and equipment, provided these are erected in proper position and are free from distortion and burring or any other damage.

**810.4.2.** All post holes that are dug or drilled shall be of such size as will permit proper setting of the posts and allow sufficient room for backfilling and tapping.

**810.4.3.** Holes shall be backfilled with selected earth or stable materials in layers not exceeding 100 mm thickness and each layer shall be thoroughly tamped and rammed. When backfilling and tamping are completed, the posts or anchors shall be held securely in place.

**810.4.4.** Post holes that are drilled in rock and holes for anchor posts shall be backfilled with concrete.

**810.4.5.** Posts for metal beam guardrails on bridges shall be bolted to the structure as detailed on the plans. The anchor bolts shall be set to proper location and elevation with templates and carefully checked.

#### **810.5. Erection**

**810.5.1.** All guardrail anchors shall be set and attachments made and placed as indicated on the plans or as directed by the Engineer.



**810.5.2.** All bolts or clips used for fastening the guardrail or fittings to the posts shall be drawn up tightly. Each bolt shall have sufficient length to extend at least 6 mm through and beyond, the full nut, except where such extensions might interfere with or endanger traffic in which case the bolts shall be cut off flush with the nut.

**810.5.3.** All railings shall be erected, drawn and adjusted so that the longitudinal tension will be uniform throughout the entire length of the rail.

#### **810.6. Tolerance**

The posts shall be vertical with a tolerance not exceeding 6 mm in a length of 3 metre. The railing barrier shall be erected true to line and grade.

#### **810.7. Measurements for Payment**

**810.7.1.** Metal beam railing barriers will be measured by linear metre of completed length as per plans and accepted in place. Terminals/ anchors of various types shall be paid for by numbers.

**810.7.2.** No measurement for payment shall be made for projections or anchors beyond the end posts except as noted above. Furnishing and placing anchor bolts and/or devices for guard rail posts on bridges shall be considered incidental to the construction and the costs thereof shall be included in the price for other items of construction.

**810.7.3.** No measurement for payment will be made for excavation or backfilling performed in connection with this construction.

#### **810.8. Rate**

The Contract unit rate shall include full compensation for furnishing of labour, materials, tools, equipments and incidental costs necessary for doing all the work involved in constructing the

metal beam railing barrier complete in place in all respects as per these Specifications.

**Measurements for Payment:**

**The rate shall be for a unit of one Running Meter.**

Dated Signature  
of the Contractor

Executive Engineer,  
Capital Project Division No.3,  
Gandhinagar.