

**Detailed Item Specification**

**Item No:- 01 :**

**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 GRUBING**

**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 300 mm in thickness, rubbish etc., which in the opinion of the Engineer are unsuitable for incorporation in the works, from, the area of road land containing road embankment, drains, cross-drainage structures and such other areas as may be specified on the drawings or by the Engineer. It shall include necessary excavation, backfilling of pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, and disposal of cleared materials. Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these specifications.

**201.2. Preservation of Property/Amenities**

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

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

**201.3. Methods, Tools and Equipments**

Only such methods, tools and equipment as are approved by the Engineer and which will not affect the property to be preserved shall be adopted for the Work. If the area has thick vegetation/roots/trees, a crawler or pneumatic tire 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, under-growth, 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. On areas beyond these limits, trees and stumps required to be removed as directed by the Engineer shall be cut down to 1 m below ground level so that these do not present an unsightly appearance.

All branches of trees extending above the 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 meters shall be suitably treated.

**201.4. Disposal of Materials**

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

Trunks, branches and stumps of trees shall be cleaned of limbs and roots and stacked. Also boulders, stones and other materials usable in road construction shall be neatly

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stacked as directed by the Engineer. Stacking stumps, boulders, stones etc., shall be done at specified spots with all lifts and up to a lead of 1000 m.

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

**201.5. Measurements for Payment**

Clearing and grubbing for road embankment, drains and cross-drainage structures shall be measured on area basis in terms of **Hectare**. 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 up to 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. Removal of stumps left over after trees have been cut by any other agency shall also be considered incidental to the clearing and grubbing operations.

Cutting, including removal of stumps and roots of trees of girth above 300 mm and backfilling to required compaction 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 this purpose, the girth shall be measured at a height of 1 meter above ground or at the top of the stump if the height of the stump is less than one meter from the ground.

**201.6. Rates**

206.6.1 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 in girth as well as stumps left over after cutting of trees carried out by another agency, excavation and back-filling to required density, where necessary and handling, salvaging, piling and disposing of the cleared materials with all lifts and up to a lead of 1000 m.

201.6.2 The Contract unit rate for cutting (including removal of stumps and roots) of trees of girth above 300 mm shall include excavation and backfilling to required compaction, handling, salvaging piling and disposing of the cleared materials with all lifts and up to a lead of 1000 m.

201.6.3. Where a Contract does not include separate items of clearing and grubbing, the same shall be considered incidental to the earth work items and the Contract unit prices for the same shall be considered including clearing and grubbing operations.

The contract rate shall be for a unit of **One Hectare** for completed item as directed.

**Item No:- 02 :**

**Earthwork for embankment including breaking clods, dressing with all lead and lift and including watering rolling and consolidation of subgrade in layers at O.M.C. to required dry density including filling the depression which occur during the process using power roller 8T to 10T.(A) From all lead**

**EMBANKMENT CONSTRUCTION**

**General:**

**Description:** These Specifications shall apply to the construction of embankments including sub grades, earthen shoulders and miscellaneous backfills with approved materials obtained from roadway and drain excavation, borrow pits or other sources. All embankments, sub grades, 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.

**Materials and General Requirements**

**Physical requirements:**

The materials used in embankments, sub grades, earthen shoulders and miscellaneous backfills shall be soil, murrum, 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 sub grade.

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

- (a) Materials from swamps, marshes and bogs;
- (b) Peat, log, stump and perishable material; and 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.

Expansive clay exhibiting marked swell and shrinkage, properties ("free swelling index" exceeding 50 percent 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, sub grade and top 500mm portion of the embankment just below sub grade shall be non-expansive in nature.

Any fill material with a soluble sulphate content exceeding 1.9 grams of sulphate (expressed as SO<sub>3</sub>) per liter 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 cementations materials forming part of the Permanent Works.

Materials with a total sulphate content (expressed as SO<sub>3</sub>) 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.

The size of the coarse material in the mixture of earth shall ordinarily not exceed 75mm when being placed in the embankment and 50 mm when placed in the sub grade. 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.

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

**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 meters height, not subjected to extensive flooding.	not less than 15.2 kN/cu.m.
2.	Embankments exceeding 3 meters height Or embankments of any height subject to Long periods of inundation.	not less than 16.0 kN/cu.m.
3.	Subgrade and earthen 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 materials 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 materials to be used in sub grade should also satisfy design CBR at the dry unit weight Applicable as per Table 300-2.

**General Requirements:**

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 Contract.

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

**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 materials for embankment and sub grade 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.

Borrow pits 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 300m. 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 horizontals 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 therefore.

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, use of plants or sitting 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 program approved by the Engineer. It shall be ensured that the sub grade material when compacted to the density requirements as in Table 300-2 shall yield the design CBR value of the sub grade.

**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.	Sub grade and earthen shoulders	not less than 97
2.	Embankment	Not less than 95
3.	Expansive Clays	
	a) Sub grade and 500mm. portion Just below the sub grade.	not allowed.
	b) Remaining portion of embankment	not less than 90

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

- (i) The values of maximum dry density and optimum 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.

- (ii) The Dry density-moisture content-CBR relationships for light, intermediate and heavy comp active 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 Sub grade.

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

**Construction Operations:**

**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/sub grade shall be marked by fixing batter pegs on both sides at regular intervals as guides before commencing the earthwork. The embankment/sub grade shall be built sufficiently wider than the design dimension so that surplus material may be trimmed, ensuring that the remaining material is to be desired density and the position specified and conforms to the specified side slopes.

**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.

**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.

**Compacting ground supporting embankment/Sub grade:**

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 sub grade level (Top of the sub grade 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 up to a level 0.5m below the sub grade 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 sub grade work shall not proceed until the foundations for embankment/sub grade 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.

**Spreading material in layers and bringing to appropriate moisture content:**

The embankment and sub grade material shall be spread in layers of uniform thickness not exceeding 200mm 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.

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 balding, dicing or barrowing until a 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 sub grade.

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, cutting, another fills and excavations steeper than 1 vertical on 4 horizontals, 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.

**Compaction:** Only the compaction equipment approved by the Engineer shall be employed to compact the different material types encountered during construction. Vibratory rollers 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 power 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.

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 embankments / subgrade / earthen shoulders, further compaction shall be carried out as directed by the Engineer. If in spite 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.

**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.

**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.

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 earlier (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 moisture slightly prior to the application of the topsoil in order to provide satisfactory bond. The depth of the top soil 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.

**Construction of Embankment and subgrade under special conditions.**

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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 horizontals, 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.

**Earthwork for embankment and subgrade to be placed against sloping ground: -**

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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 Clause 309 in proper sequence with the embankment and subgrade work as approved by the Engineer.

**Earthwork over existing road surface: -**

Where the embankment is to be placed over an existing road surface, the work shall be 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 50mm 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 1 m 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 1 m. the existing surface shall be permitted to stay in place without any modification.

**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.

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.

Embankment construction under water:

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 75mm. 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.

**Earthwork for high embankment: -**

In the case of high embankments, the Contractor shall normally use the material from the specified borrow area. In case he desires to use different material for his own convenience, he shall have to carry out necessary soil investigations and redesign the high embankment at his own cost. The 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.



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

Where required, the contractor shall surcharge embankments or other areas of fill with approved material for the periods specified in the Contract. If settlement of surcharged fill results in any surcharging

Material, which is unacceptable for use in the fill being surcharged, laying 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 materials.

**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, wing wall, 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.

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.

**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.

**Subgrade Strength: -**

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.

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 mold fitted with cutting shoe or on remolded samples, compacted to the field density at the field moisture content.

**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 meters 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 quantities 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 measured in 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 and other retaining structures shall be measured as finished work in position in cu.m.

**RATES:**

The Contract unit rates for the items of embankment and subgrade construction shall be payment in full for carrying out the required 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) Setting 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 300mm wide on side slopes of existing embankment and subgrade as applicable;

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- (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 contractor.
- (xi) All labour, material, 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.

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.

The contract rate shall be for a unit **of One Cmt.** For completed item as directed.

**Item No. 03 :-**

**Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts carrying heavy traffic as per IS 458-1991 specifications including setting the pipes in C.M. 1:2 watering and laying (to level or slopes) of class NP3 of following internal diameters. (i) 450mm dia.**

1. This shall consist of furnishing and installing reinforced cement concrete pipe of the type diameter and length required at the location shown on the drawings or as ordered by the Engineer-in-charge.
2. Reinforced concrete pipe shall be of **NP3** type conforming to the requirements of IS: 458 and shall be of dia. as specified in the item. Each consignment of cement concrete pipes shall be inspected, if necessary and approved by the Engineer-in-charge either at the place of manufacture or at the site before their incorporation in the works.  
NP4, NP2 and NP1 pipes are used for R.C.C. pipes. Where the testing of pipes will not be feasible the contractors will have to produce a certificate from the 'manufacturer on company's letter head in the given' hereinafter from.  
Production of such certificate will not however relieve the Contractor from his responsibility of supplying pipes of required standard and will have to bear the loss or damage caused to the work on account of defects found subsequently during execution. It will also be necessary to purchase these pipes from manufacturer having standard equipment's for carrying out various tests as per IS : 458 at his factory.

**Form of Certificate for NP-4, NP-3, NP-2, NP-1 Pipes**

We \_\_\_\_\_  
Manufacturer or R.C.C. Pipes produce R.C.C. pipes as per the requirement of IS : 458 and also carry out the required test at out place, We have acquired equipment's for carrying out test and are prepared to carry out tests at our factory sites. We have experience of manufacturing of pipes of years. The pipes supplied by us to M/S. \_\_\_\_\_.

Satisfy the requirement of IS: 458.

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

Place: \_\_\_\_\_

Manufacturer's Sign \_\_\_\_\_

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

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**Item No:- 04 :**

**Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam (Grade-I) (B.T. Metal of size 45 to 90 mm) specification including spreading in uniform thickness, hand packing , rolling with vibratory roller 80-100 kN static wt. to proper grade and camber, applying and brooming, stone screening/binding materials to fill-up the interstices of coarse aggregate, watering and compacting etc. complete as per Specification.**

Relative Item Specification As per MORTH Section 404

WBM shall be measured as finished work in position in cubic meters.

**Item No:- 05 :**

**Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam (Grade-II) (M.C. Metal of size 40 to 63 mm) specification including spreading in uniform thickness, hand packing , rolling with vibratory roller 80-100 kN static wt. to proper grade and camber, applying and brooming, stone screening/binding materials to fill-up the interstices of coarse aggregate, watering and compacting etc. complete as per Specification. (45 to 63mm size M.C. Metal)**

Relative Item Specification As per MORTH Section 404

WBM shall be measured as finished work in position in cubic meters.

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**Item No:- 06 :**

**Providing and laying Compacted Quarry Spall for side shoulder including carriage of material and spreading on prepared base including compacting as per MOST Specification etc. Complete**

1. The quarry spalls shall be approved quarry as approved by the Ex. Engineer prior to collection. Filling of boxes, shall not be allowed till the metal is broken to the specified site.
2. The quarry spall shall be as uniform in size as possible. The quarry spall shall be hard, tough, solid durable of black trap quarry of close texture, free from decay and weathering. The stone shall be angular and roughly cubical in shape and round elongated or flaky materials shall be rejected. No sound or long rubble or angular chips smaller than specified size shall be allowed.

Grading for quarry spalls

IS: Sieve	Grading - I	Grading - II	Grading - III
75mm	100	-	-
53mm	-	100	-
26.5mm	55-75	50-80	100
9.50 mm	-	-	-
4.75mm	10-30	15-35	25-45
2.36mm	-	-	-
0.425mm	-	-	-
0.075mm	< 10	< 10	< 10
CBR Value	greater than 20	25	20

Material passing through 425 micro sieves for all the three grading when tested according to I.S. 2720 (Part-5) shall have liquid limit and plastic index not more than 25 and 6 respectively.

3. All unsound, weathered or disintegrated stone obtained from the under-surface layer of the quarry or other layers of boulders shall be rejected.
4. Wherever any doubt as to whether above requirement is satisfied in whole or part of the collection it shall be got screened by the Contractor if so, ordered by the Executive Engineer, and for which no extra payment shall be claimed by the contractor
5. Any collection which does not fully satisfy the above requirements is liable to be rejected all together.
6. Regular stacks shall be made by the contractor on a fairly level ground. All the stack shall be marked by white wash immediately on being measured and recorded by the Engineer-in-charge.
7. The rate includes blasting the rock, if any, breaking the quarry spalls, stacking measuring in phrase etc. complete.
8. Stacks shall as per actual requirements and any materials in excess shall have to be transported by the contractor at the places directed by the Executive Engineer at the risk and cost of the contractor.
9. While stacking materials the depositing should commence at one end of the K.M. and carried continuously towards the other end unless the Executive Engineer shall direct otherwise and as a rule measurements shall be taken after metal for half kilometre or Km. has been fully collected. Any fraction of this distance shall not be measured up.
10. The measurements shall be recorded in on Cum. basis on level computing method after rolling and consolidation and shall be paid accordingly.
1. Spreading quarry spalls in grade & camber complete.
  1. The quarry spalls shall be only be allowed to be spread after the written permission of the Executive Engineer is obtained.
  2. The permission for spreading the metal shall be given by the Executive Engineer if
    - (i) The full quantity of a particular mile (kilometre) is completely collected.
    - (ii) The collection of metal-is also completed in the adjoining two miles (Kilometres)
    - (iii) The measurements are recorded in the Measurement book.
  3. Q. S. shall if required, be screened, if containing rubbish dust, grass etc. it shall than be filled in basket & conveyed where required and spread evenly on the prepared surface be given twisting motion to the basket at the time of spreading. The surface shall then (15 m) by means of templates and strings as well as with camber boards and spirit level.



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4. Between the straight length and curves and at the meeting points of the convex and concave portions of the reverse curves, the change in camber of the road, due to super elevations shall be made as well as with camber boards and spirit level.
5. At the time of spreading Q. S. a small quantity (about 4 to 5 percent) of metal as directed, shall be retained at the first instance. It shall be spread later 0:1 after partial consolidated as required to rectify the camber and to fill up the hollows if any. No extra amount shall be paid for this.
6. The surface shall be brought to the required camber which shall be checked at every 50 ft. (15 M) by means off templates of while the necessary of the in between shall tested by strings and corrected as required.
7. The centre line shall first be marked in the sub grade which is properly consolidated and has uniform crabber and grade as required
8. The Q. S. shall be laid for a small length on 25 ft. (8 M.) and then the edge stones shall be laid.
9. Pegs shall be driven on either side of the road and joined with strings true and parallel with a distance between they equal to the width be laid with over metal similarly.
10. The Q. S. shall be laid as close as possible so as to leave minimum possible interstices and voids.
11. Before roiling is allowed on soling the side breams shall be filled up to the top of the soling and at least 3'-0" (1 m.) on either side so as to prevent metal layer getting disturbed at times during rolling. The rate is inclusive of all the operations as stated above.
12. Immediately following the spreading of the coarse aggregates rolling shall be started with three wheeled power rollers of 8 - to - 10 tone capacity or tandem roller or equivalent vibratory roller. The weight of the roller shall depend upon the type of the aggregate and be indicated by Engineer-in-charge.
13. Except on super elevated portions where the roiling shall proceed from inner edge to outer, rolling shall from the edges gradually progressing towards the centre. First the edge / edges shall be compacted with roller running forward and backward. The roller shall then move inward parallel to centre line of the road, in successive passes uniformly lapping preceding tracks by at least one half the width.
14. Rolling shall continue until the aggregate is thoroughly keyed and the creeping of the aggregate a head of the roller is no longer visible. During rolling, slight sprinkling of water may be done, if necessary. Rolling shall not be done when the sub grade is soft or yielding or when it causes a wave like motion in the sub grade or sub base course.
15. The rolled surface shall be checked transversely and longitudinally with templates and any irregularities corrected by loosening the surface, adding or removing necessary amounts of aggregate and re - rolling until the entire surface conform to desired camber and grade. In no case shall the base of screening be permitted to make up depression.
16. The blinding material where it is required to be used shall be applied successively in two or more thin layer at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water, the resulting, slurry swept in with hand brooms or mechanical brooms to fill the voids properly and rolled during which water shall be applied the wheels of the rollers, if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling of voids forms a wave ahead of the wheels of the moving roller.
17. After the final compaction of water bound macadam course, the road shall be allowed to any overnight Next morning hungry spots shall be filled with screenings of binding materials as directed lightly sprinkled with water, if necessary and rolled. No traffic shall be allowed on the road until the macadam has set. The Engineer - in - charge shall have the discretion to stop hauling traffic from using the completed water bound macadam course, if in his opinion, it would cause excessive damage to the surface.
18. Measurements shall be paid as per the measurements of collection less the quantity remained to be spread and on cubic meter basis.
19. The rate includes the cost of screening the Q. S. if any spreading, sectioning, with template and adding reserved quota of metal, while/oiling is in progress for making good hollows and camber.

The contract rate shall be for a unit **of One Cmt.** For completed item as directed.



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	cycles		
6.	Water absorption	IS: 2386 (Part-3)	2 Percent Maximum

\* Aggregates may satisfy requirements for either of the two tests.

\*\* To determine this combined proportion, the flaky stone from representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particle is 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.

Proportioning of materials:

The bitumen content for premixing shall be 1.99 % (percent) by weight of the total mix except when otherwise directed by the Engineer.

The maximum compacted thickness of a layer shall be 100mm.

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

**AGGREGATE GRADING FOR BITUMINOUS GROUT**

IS Sieve Designation	Per cent by weight passing the IS sieve
53.00 mm	100
26.50 mm	75-100
22.40 mm	50-85
13.20 mm	20-40
05.60 mm	5-20
02.80 mm	0-5

Proportioning Materials:

The bitumen content for pre-mixing shall be 1.99% by total weight of mix.

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

Variation in Proportioning of Material:

The contractor shall have the responsibility for ensuring proper proportioning of materials and producing a uniform mix, A variation in binder content +0.3 percent by weight of total mix shall however, the permissible for individual specimen taken for quality control test vide Schedule for Testing of Materials attached herewith / as directed by Engineer-in-Charge, Asphalt VG-30 (60/70) at the rate of 19.90 kg. / MT i.e. 1.99% by weight of the total mix shall be used for mixing.

Construction Operations:

Weather & Seasonal Limitations:

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

Preparation of Base:

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

**Tack Coats:**

A tack-coat as per Clause-503 shall be applied over the base as detailed in item description, bitumen of VG-30 @ 4.0 kg./ 10 Sqmt. on existing BT surface.

Preparation and transport of mix: Bituminous grout mix shall be prepared in a hot mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coated aggregates.

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

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

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

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

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

(e) Suitable auxiliary Bitumen Boiler of Adequate capacity with self-heating arrangement and temperature control device. The boiler should be fitted with temperature indicating instruments.

The temperature of binder at the time of mixing shall be in range of 150 Degree C to 163 degree and that of the aggregate in the range of 155 degree C - 163 degree C provided that the difference in temperature between the binder and aggregate at no time exceeds 14 Degree C.

Mixing shall be thorough to ensure that a homogeneous mixture is obtained in which all particles of the aggregates are coated uniformly and the discharge temperature of mix shall be between 130 Degree C to 160-degree C.

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

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

(a) Loading hoppers and suitable distributing mechanism.

(b) All drives having hydrostatic drive/control.

(c) The machine shall have a hydraulically extendable screed the appropriate width requirement.

(d) The screed shall have tamping and vibrating arrangement for initial compaction to the layer as it is spread without rutting of otherwise marring the surface. It shall have adjustable amplitude and variable frequency.

(e) The paver shall be equipment with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.

(f) The paver shall be fitted with an electronic sensing device for automatic leveling and profile control within the specified tolerances.

(g) The screed shall have the internal heating arrangement.

(h) The paver shall be capable of laying either 2.5 to 4.0 m width or 4.0 to 7.0 m width as stipulated in the Contract.

(i) The paver shall be so designed as to eliminate skidding/slippage of the tyres during operation.

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

The temperature of the mix at the time of laying shall be in the range of 120°C to 160°C. In multi-layer construction, the longitudinal joint in one layer shall offset that in the layer below by about 150 mm. However, the joint in the top-most layer shall be at the lane line of the pavement.

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

Compaction: After the spreading of mix, rolling shall be done by 80 to 100 kN vibratory roller. Rolling shall start as soon as possible after the material has been spread deploying a set of rollers as the rolling is to be completed in limited time frame. The roller shall move at a speed not more than 5 km/h. Rolling shall be done with care to avoid unduly roughening of the pavement surface.

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

The initial or break-down rolling shall be done with 80-100 kN static weight smooth wheel roller (3 wheels or tandem) as soon as it is possible to roll the mix without cracking the surface or having the mix pick up on the roller wheels. The second or intermediate rolling shall follow the break-down rolling with vibratory roller of 80 to 100 kN static weight or pneumatic tyred roller of 150 to 250 kN weight, with minimum 7 wheels and minimum tyre pressure of 0.7 MPa as closely as possible to the paver and be done while the paving mix is still at a temperature that will result in maximum density. The final rolling shall be done while material is still workable enough for removal of roller marks with 60 - 80 kN tandem roller. During the final rolling, vibratory system shall be switched off. The joints and edges shall be rolled with an 80 to 100 kN static roller.

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

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

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

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

The built-up spray grout shall be provided with next surfacing without any delay. If there is to be any delay, the course shall be covered by a seal coat to the requirement of Clause 513 before



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

Arrangement for Traffic: During the period of construction, arrangement of traffic shall be done to Clause 112 of MORTH Specification.

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

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

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

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

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

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

RATE: The contract unit rate for the work shall be payment in full for carrying out the required operations including full compensation for

- (i) Making arrangements for traffic to Clause 112 of MORTH specification except or initial treatment to verge, shoulders and construction of diversion.
- (ii) Preparation of base except for laying of profile corrective course but including filling of potholes.
- (iii) Providing all materials to be incorporated in the work including arrangement for stock yards, all royalties, fees, rents where necessary and all leads and lift.
- (iv) All labour, tools, equipment, plant including installation of hot mix plant, power supply units and all machineries, incidental to complete the work to the specifications.
- (v) Carrying out the work in part widths of the road where directed.
- (vi) Carrying out all tests for control of quality.

The Contract rate shall be for a unit of one M.T. basis for completed item.

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**Item No. 08:**

**Providing and laying 25 mm thick premix asphalt carpet using 0.66 cmt per 1 MT.mix with M.C. stone agg. & VG-30 Bulk for tack coat @ rate of 2.50 kg / 10 smt. & using asphalt VG-30 of 33.60 kg .ie. 3.36 % by Drum Mix Plant & spreading the same by paver finisher with vibratory roller 80 to 100 KN. static wt. incl. providing all equipments tools and plants, fire wood, oil, kerosene, labour charges etc. complete with contractor's own machineries, etc. complete**

Premix Asphalt Carpet using 0.66 cmt aggregate per 1 M.T. of total mix as per MORTH gradation and specification Surfacing using viscosity bitumen or Cutback.

**Scope:** This work shall consist of the preparation, laying and compaction of an open graded premix surfacing material of 25 mm thickness composed of small sized aggregate premixed with a bituminous binder on a previously prepared base, in accordance with the requirements of these specifications, to serve as a wearing course.

**Materials**

**Binder:** - The binder shall be a bitumen of a suitable viscosity grade as specified in the Contract or as directed by the Engineer, and satisfying the requirements of IS:73.

Viscosity Grade (VG) Bitumen Specification as per IS 73 : 2006

Characteristics	VG - 10	VG-20	VG-30	VG-40
Absolute Viscosity 60°C, poises, min	800	1600	2400	3200
Kinematic Viscosity 135°C CSI, min	250	300	350	400
Flash point, C, min	220	220	220	220
Solubility in trichloroethylene, % min	99.0	99.0	99.0	99.0
Penetration at 25°C	80-100	60-80	50-70	40-60
Softening point, C min	40	45	47	50
Test on residue from thin film oven test / RTFOT:				
(A) Viscosity ration at 60°C, max	4.0	4.0	4.0	4.0
(B) Ductility at 25°C, cm, min after thin film over test	75	50	40	25

**Aggregate** - The aggregate shall conform to Clause 504.2.2 except that the water absorption shall be limited to a maximum of 1 percent. The Polished Stone Value, as measured by the test in BS 812- (Part 114), shall not be less than 55.

IS Sieve (mm)	Cumulative Per cent Passing by Weight of Total Aggregate
26.5	100
19	90-100

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13.2	56-88
4.75	16-36
2.36	4-19
0.3	2-10
0.075	0-5
*Bitumen content, % by weight of total mixture	3.3-3.5
Bitumen Penetration Grade	35 to 90

\* For conditions in cooler areas of India or where the per cent passing 0.075 mm sieve is on the higher side of the range, appropriate bitumen contents may be upto 0.5 per cent higher, subject to the approval of the Engineer.

**Proportioning of materials:** - The materials shall be proportioned in accordance with Table 500-23.

**Construction operations**

Weather and seasonal limitations - Clause 501.5.1 shall apply.

**Preparation of surface** - The under lying surface on which the bituminous surfacing is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross-section in accordance with Clause 501. A prime coat where needed shall be applied in accordance with Clause 502 as directed by the Engineer.

**TABLE 500-23.**

**QUANTITIES OF MATERIALS REQUIRED FOR 10 M<sup>2</sup> OF ROAD SURFACE FOR 20 MM THICK OPEN GRADED PREMIX SURFACING USING VISCOSITY BITUMEN OR CUTBACK**

Aggregates		
a.	Nominal Stone size 13.2 mm (passing 22.4 mm sieve and retained on 11.2 mm sieve)	0.18 m <sup>3</sup>
b.	Nominal Stone size 11.2 mm (passing 13.2 mm sieve and retained on 5.6 mm sieve)	0.09 m <sup>3</sup>
	Total	0.27 m <sup>3</sup>
Binder (quantities in terms of straight run bitumen)		
a.	For 0.18 m <sup>3</sup> of 13.2 mm nominal size stone at 52 kg bitumen per m <sup>3</sup>	9.5 kg
b.	For 0.09 m <sup>3</sup> of 11.2 mm nominal size stone at 56 kg bitumen per m <sup>3</sup>	5.1 kg
	Total	14.6 kg

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**Preparation of premix:** - Hot mix plant of appropriate capacity and type shall be used for the preparation of the mix material. The hot mix plant shall have separate dryer arrangement for heating aggregate.

The temperature of the binder at the time of mixing shall be in the range of 150°C to 163°C and that of the aggregate in the range of 155°C to 163°C provided that the difference in temperature between the binder and aggregate at no time exceeds 14°C. Mixing shall be thorough to ensure that a homogeneous mixture is obtained in which all particles of the aggregates are coated uniformly and the discharge temperature of mix shall be between 130°C and 160°C.

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

**Spreading and rolling** - The pre mixed material shall be spread by suitable means to the desired thickness, grades and cross-fall (camber) making due allowance for any extra quantity required to fill up depressions, if any. The cross-fall should be checked by means of camber boards and irregularities leveled out. Excessive use of blades or rakes should be avoided. As soon as sufficient length of bituminous material has been laid, rolling shall commence with 8-10 tonne rollers, smooth wheel tandem type, or other approved equipment. Rolling shall begin at the edge and progress towards the centre longitudinally, except that on superelevated and uni-directional cambered portions, it shall progress from the lower to upper edge parallel to the centre line of the pavement.

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 and all the roller marks eliminated. In each pass of the roller the preceding track shall be overlapped uniformly by at least 1/3 width. The roller wheels shall be kept damp to prevent the premix from adhering to the wheels.

In no case shall fuel/lubricating oil be used for this purpose. Excess use of water for this purpose shall also be avoided.

Rollers shall not stand on newly laid material. Rolling operations shall be completed on every respect before the temperature of the mix falls below 100°C. Joints along and transverse to the surfacing laid and compacted earlier shall be cut vertically to their full depth so as to expose fresh surface which shall be painted with a thin coat of appropriate binder before the new mix is placed against it.

**Seal coat** - A seal coat conforming to Clause 513 of the type specified in the Contract shall be applied to the surface immediately after laying the surfacing.

**Opening to traffic** - No traffic shall be allowed on the road until the seal coat has been laid. After the seal coat is laid, the road may be opened to traffic according to Clause 513.4.

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

**Arrangements for traffic** - During the period of construction, arrangement of traffic shall be made in accordance with the provisions of Clause 112.

**Measurement for payment** - Open graded premix surfacing shall be measured as finished work, for the area instructed to be covered, in M.T. The area will be the net area covered, and all allowance for wastage and cutting of joints shall be deemed to be included in the rate.

**Rate** - The contract unit rate for open graded premix surfacing 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).

**Open graded premix surfacing using cationic bitumen VG-30**

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**Scope:** This work shall consist of the preparation, laying and compaction of an open graded premix surfacing of 25 mm thickness composed of small sized aggregate premixed with a cationic bitumen emulsion on a previously prepared surface, in accordance with the requirements of these specifications, to serve as a wearing course.

**Materials**

**Binder** - The binder for premix wearing course shall be cationic bitumen emulsion of Medium Setting (MS) grade complying with I.S.8887 and having a bitumen content 65 percent minimum by weight. For liquid seal coat RS grade of Cationic bitumen emulsion shall be used. Where expressly specified in the Contract MS grade emulsion shall be used or otherwise directed by the Engineer. Slow Setting (SS) grade Cationic bitumen Emulsion shall be used for premix seal coat.

**Aggregate:** The requirements of Clause 511.1.2.2 shall apply.

Proportioning of materials

The materials shall be proportioned as quantities given in Tables 500-24 and 500-25.

**TABLE 500-24. QUANTITIES OF AGGREGATE FOR 10M<sup>2</sup> AREA**

A)	Premix Carpet:	
	Coarse aggregate nominal 13.2 mm size; passing IS 22.4 mm sieve and retained on IS 11.2mm sieve	0.18m <sup>3</sup>
	Coarse aggregate nominal 11.2 mm size; passing IS:13.2 mm sieve and retained on IS 5.6mm sieve	0.09m <sup>3</sup>
B)	For sealcoat:	
	Refer to clause 500.13	

**500-25. QUANTITIES OF EMULSION BINDER**

For 10 m<sup>2</sup> area

**A)** For Premix Carpet      20 to 23 kg

**B)** For Seal Coat:

a. For liquid seal coat      12 to 14 kg

b. For premix seal coat      10 to 12 kg



### **Construction operations**

**Weather and seasonal limitations** - Clause 501.5.1 shall apply except that the minimum air temperature for laying shall be 10°C. Cationic bitumen emulsions shall not normally be stored below 0°C

**Preparation of surface** - The underlying surface on which the premix surfacing is to be laid shall be prepared, in accordance with the requirements of Clause 504.3.2 for a newly primed surface and in accordance with Clause 507.4.2 where an existing bituminous surface is to be overlaid.

**Preparation of binder** - Before opening, the cationic bitumen emulsion drums shall be rolled at slow speed, to and fro, at least 5 times, for a distance of about 10 metres, to distribute any storage sedimentation.

**Tack coat:** A tack coat complying with Clause 503 shall be applied over the surface preparatory to laying of the surfacing where specified in the Contract, or directed by the Engineer.

**Preparation of premix** - Premixing of cationic bitumen emulsion and aggregates can be carried out in a suitable mixer such as cold mixing plant as per IS: 5435 (revised) or concrete mixer or by pay loaders in exceptional cases were approved by the Engineer. Where specified in the contract continuous mixing operation shall be done either in batch or continuous hot mix plant suitable for emulsion mixes.

When using concrete mixer for preparing the premix, 0.135 cu.m (0.09 cu.m of 13.2 mm size and 0.045 cu.m of 11.2 mm. size) of aggregates per batch shall be used which quantity will cover 5 sq.m of road surface with 20 mm average thickness.

The aggregates required for one batch should be prepared adjacent to the mixer.

First the coarse aggregate of 13.2 mm size shall be placed into the mixer followed by 5 to 6.5 kg of cationic bitumen emulsion and then the 11.2 mm size aggregate shall be added, followed by 5 to 6.5 kg of cationic bitumen emulsion. After the materials have been mixed thoroughly, the mix shall be immediately transported to the laying site in suitable vehicles. Too much mixing shall be avoided.

When mixed manually by shovels, with the approval of the Engineer, 0.06 cum. of aggregates can be conveniently mixed in one heap, with appropriate quantity of emulsion. It is preferable to make the aggregates damp before mixing as it reduces the effort required for mixing and also helps to get better coating of aggregates. The 13.2 mm size aggregates and emulsion are mixed first and then the 11.2 mm size aggregates and remaining quantity of emulsion are added and mixed. Too much mixing shall be avoided.

**Spreading and rolling:** The premixed cationic bitumen emulsion and aggregates shall be spread within 10 minutes of applying the tack coat. All levelling, raking, etc. should be completed within 20 minutes of the time of mixing.

The mix should be spread uniformly to the desired thickness, grades and crossfall (camber) making due allowance for any extra quantity required to fill up depressions, if any. The cross fall should be checked by means of camber boards and irregularities leveled out. Too much raking is to be avoided.

The rolling shall start immediately after laying the premix. A smooth wheeled tandem roller of 8-10 tonnes shall be used, unless the Engineer, based on the results of laying trials approves other compaction methods, if necessary. While rolling, wheels of roller should be clean and kept moist to prevent the premix from adhering to the wheels. In no case shall fuel/lubricating oil be used for this purpose. Use of water for this purpose shall be strictly limited to an absolute minimum.

Rolling shall commence at the edges and progress towards the centre longitudinally except in the case of superelevated and uni-directional cambered sections where rolling shall be carried out from the lower edge towards the higher edge parallel to the centre line of the road.

After one pass of roller over the whole area, depressions or uncovered spots should be corrected by adding premix material. Rolling shall be continued until the entire surface has been rolled to maximum compaction and all the roller marks eliminated. In each pass of the roller the preceding track shall be overlapped uniformly by at least 1/3 width. Roller(s) shall not stand on newly laid material. Joints both longitudinal and transverse to the road sections laid and compacted earlier, shall be cut vertically to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of binder before the new mix is placed against it.

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**Seal coat:** A seal coat, conforming to Clause 510 or Clause 513, as specified in the Contract, shall be applied 4 to 6 hours after laying the premix carpet.

**Opening to traffic:** Traffic should not be allowed over the premix surface with or without seal coat, for 6 to 8 hours after rolling. In case of single lane roads, traffic shall be allowed onto the surface once it has reached ambient temperature, but speed must be rigorously restricted to not more than 16 km per hour. If any premix material is picked up by vehicle tyres, the spot shall be filled up by new mix. If traffic conditions permit, the road shall not be opened until a full 24 hours after laying.

**Surface finish and quality control:** The surface finish of construction shall conform to the requirements of Clause 902.

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

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

**Measurement for payment:**

Open graded premix carpet shall be measured as finished work, for the area specified to be covered, in square metres at the specified thickness, in cubic metres or in tonnes weight as specified in the contract. 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.

**Rate:**

The contract unit rate for premix carpet and seal coat shall be payment in full for carrying out the required operations including full compensation for all components listed below:

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

The Contract rate shall be for a unit of one **M.T.** basis for completed item.

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**Item No. 09:**

**Providing and laying sealcoat with B.T. aggregate as specified using aggregate at the rate of 0.18 Cu.mt / 10 Sq.M. and bitumen grade VG-30 for mixing with aggregate at the rate of 4.50 % i.e 45 Kg/M.T. of total mix including heating and mixing in drum mix plant and spreading the same with paver finisher and consolidation with vibratory roller including necessary firewood, oil, lubricants, labour charges using contractor's own drum mix plant machineries and equipment, tools etc. complete in accordance with the requirement of specification.**

**1. DESCRIPTION**

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

**2. MATERIALS**

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

**Viscosity Grade (VG) Bitumen Specification as per IS 73: 2006**

Characteristics	VG - 10	VG-20	VG-30	VG-40
Absolute Viscosity 60°C, poises, min	800	1600	2400	3200
Kinematic Viscosity 135°C CSI, min	250	300	350	400
Flash point, C, min	220	220	220	220
Solubility in trichloroethylene, % min	99.0	99.0	99.0	99.0
Penetration at 25°C	80-100	60-80	50-70	40-60
Softening point, C min	40	45	47	50
Test on residue from thin film oven test / RTFOT:				
(A) Viscosity ration at 60°C, max	4.0	4.0	4.0	4.0
(B) Ductility at 25°C, cm, min after thin film over test	75	50	40	25

Coarse aggregates: The coarse aggregate shall consist of crushed stone or crushed gravel.

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

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

2-4 Filter: The filler, where required, shall be an insert material the whole of which passes 600-micron sieve at least 90 percent passing 150 micron sieve and not less than 70 percent passing 75 micron sieve.

The filler shall be cement, stone dust, hydrated lime, fly ash and other non-plastic mineral matter approved by the Engineer-in-charge.

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Aggregate gradation: The mineral aggregates, including mineral filler shall be so graded or combined as to conform to gradings set forth in tables below:

Table: Aggregate gradation Pre-Mix Seal Coat Sieve Designation Percentage by wt passing through Sieve

	For type 'A'	For Type 'B'
12.5 mm	-	100
10 mm	100	70-100
4.75 mm	40-85	20-40
2.35	5-20	5-20
75 microns	0 - 4	0 - 4

Proportioning of materials: The binder content for premixing shall be 45.00

kg per M.T. (4.5% by weight) for mixing aggregate.

The quantities of aggregates shall be sufficient to yield the specified thickness after compaction. The contractor shall get the job-mix formula for the mix approved by the Engineer-in-charge before starting the work.

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

### **3. CONSTRUCTION OPERATIONS**

Weather and seasonal limitation: Premix seal coat shall not be laid during rainy weather or when the base course is damp or wet.

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

Tack coat (if applied): Application of binder: Binder shall be rapid setting emulsion shall be used and approved by the Engineer-in-charge and sprayed on the base at the rate specified hereafter. The rate of spread in terms of straight run emulsion shall be 2.50 kg per 10 square metre area for an existing bitumen treated surface. The binder shall be applied uniformly with the aid of sprayers. The tack coat shall be applied just ahead of the oncoming bituminous construction.

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

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

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

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

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

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

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

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

#### **4. OPENING TO TRAFFIC**

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

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

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

#### **6. ARRANGEMENT FOR TRAFFIC**

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

#### **7. MEASUREMENT FOR PAYMENT**

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

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

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

Weigh of mix materials will be done in presence of responsible person, not less than the rank of supervisor of Department, Deputy Executive Engineer or Assistant Engineer or Addl. Assistant Engineer if so authorized.

Record of each dumper will be maintained separately in bound and numbered register which will be maintained by the departmental representatives and signed by the contractor. Proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site. The location of the kilometer, hectometer in which individual dumper are unloaded will be recorded carefully.

#### **8. RATE**

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

The Contract rate shall be for a unit of one M.T. basis for completed item.



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**Item No:- 10 :**

**Construction of Granular Sub Base (GSB) by providing M.C. coarse graded material of grading-I, 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 MORTH specification.**

Relative Item Specification As per MORTH Section 401

WBM shall be measured as finished work in position in cubic meters.

**Item No:- 11 :**

**Providing and filling in foundation with ordinary cement concrete M- 100 mix including formwork, vibrating, ramming and curing complete. (A) Foundation and plinth**

The concrete shall be of **M-100 grade**, prepared using **approved quality cement, clean coarse sand and graded coarse aggregate**, in correct proportions to achieve the specified strength. All materials shall conform to relevant Indian Standards and shall be free from deleterious substances.

The work shall include **necessary formwork / shuttering**, properly designed, erected and supported to true line, level and plumb, ensuring required shape, size and dimensions of foundation and plinth concrete. Formwork shall be sufficiently rigid to withstand pressure of concrete without deformation and shall be removed carefully after setting, without damaging the concrete surface.

Concrete shall be **mixed, placed and compacted properly by vibrating and/or ramming**, ensuring dense and homogeneous concrete, free from honeycombing, voids or segregation. Placement shall be done in layers of suitable thickness and completed before initial setting of concrete.

After placing and finishing, the concrete shall be **cured adequately** for the specified period by ponding, wet coverings or other approved methods to achieve required strength and durability.

All labour, tools, tackles, formwork, mixing, placing, compacting, curing, handling of materials and all incidental works required for completion of the item shall be included.

The rate shall be **inclusive of cost of cement, aggregates, water, formwork, labour, machinery, vibrating, ramming, curing and all incidental charges**, complete.

**Payment shall be made per cubic metre (Cum) of M-100 concrete actually laid in foundation and plinth**, complete in all respects and approved by the Engineer-in-Charge.

The work shall be executed strictly as per **relevant IS codes, specifications and instructions of the Engineer-in-Charge**, and shall be completed to the **full satisfaction of the Engineer-in-Charge**.

**Item No:- 12 :**

**Providing and laying controlled cement concrete M-30 and curing complete including compacting with surface mechanical vibrator, mechanical floater, channelling formwork, grooving including providing dowel bar, tie bar, expansion joint and construction joint including filling asphalt filler joint as per instruction of Engineer in charge**

The concrete shall be **design mix M-30**, produced using approved quality **cement, fine aggregate, coarse aggregate and potable water**, conforming to relevant Indian Standards. The mix shall be designed to achieve the specified strength, durability and workability, and shall be produced under controlled conditions, either at batching plant or site, as approved.

Concrete shall be **placed, spread and compacted properly** using **surface mechanical vibrators** to ensure dense, homogeneous concrete, free from honeycombing, segregation or voids. Adequate care shall be taken during placing to maintain required thickness, line, level and slope.

After compaction, the concrete surface shall be **finished using mechanical floater**, achieving a smooth, even and uniform finish, suitable for the intended use. Any excess laitance shall be removed and edges shall be finished neatly.

The work shall include **providing and fixing necessary formwork / channeling formwork**, properly aligned and supported, to maintain true shape, size and alignment of the concrete. Formwork shall be strong enough to withstand concrete pressure and shall be removed carefully without damaging the concrete.

The work shall also include **grooving of concrete surface**, wherever specified, to control cracking and improve performance, as per drawings or instructions of the Engineer-in-Charge.

The concrete shall be provided with **dowel bars and tie bars** of approved diameter, length and spacing, correctly positioned and aligned to ensure load transfer and continuity across joints. Proper sleeves or caps shall be provided for dowel bars where required.

**Expansion joints and construction joints** shall be provided at locations shown in drawings or as directed. Expansion joints shall be filled with **approved asphalt filler joint material**, properly placed and sealed to prevent ingress of water and debris.

After completion of finishing operations, the concrete shall be **cured adequately** for the specified period using approved curing methods such as ponding, wet coverings, curing compounds or continuous sprinkling, to ensure proper strength development and durability.

All labour, materials, tools, tackles, formwork, joint materials, dowel bars, tie bars, grooving, compaction, finishing and curing required for completion of the work shall be included.

The rate shall be **inclusive of cost of materials, batching, mixing, laying, compacting, surface finishing, formwork, joints, dowel bars, tie bars, asphalt filler, curing and all incidental charges**, complete.

**Payment shall be made per cubic metre (Cum) of M-30 controlled cement concrete actually laid**, complete in all respects and approved by the Engineer-in-Charge.

The work shall be executed strictly as per **relevant IS codes, specifications and instructions of the Engineer-in-Charge**, and shall be completed to the **full satisfaction of the Engineer-in-Charge**.

**Item No. 13 :**

**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 Micro Prismatic Grade retro reflective sheeting of Type-11 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.6mtr long stand post of 75 x 75 x 6mm as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC 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) Engineering Grade (VR)g

**Detailed Technical Specifications for Sign Board**

**1.1 Scope**

The work shall consist of the 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 foundation shall be of M 15 Grade as per MORT&H 5<sup>TH</sup> REVISION 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 requirement of IS: 1786 unless otherwise shown on the drawing.

**1.2.3 Bolts, Nuts, 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 panels shall be fabricated on aluminum sheet, aluminum composite panel, fiber glass sheeting, or sheet molding compound. Aluminum sheets used for sign boards shall be of smooth, hard and corrosion resistant aluminum alloy conforming to IS: 736-Material Designation 24345 or

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1900. Aluminum Composite Material (ACM) sheets shall be sandwiched construction with a thermoplastic core of Low Density Polyethylene (LDPE) between two thick skins/sheets of aluminum with overall thickness and 3 mm or 4 mm (as specified in the Contract), and aluminum skin of thickness 0.5 mm and 0.3 mm respectively on both sides.

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

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

Sl No.	Description	Specification for 4mm	
		Standard test	Acceptable value
<b>A</b>	<b>Mechanical Properties of ACM</b>		
<b>1</b>	Peel off strength with retro reflective sheeting. (Drum Peel Test)	ASTM D903	Min. 4 N/mm
<b>2</b>	Tensile strength	ASTM E8	Min. 40 N/mm <sup>2</sup>
<b>3</b>	0.2% Proof Stress	ASTM E8	Min. 34 N/mm <sup>2</sup>
<b>4</b>	Elongation	ASTM E8	Min. 6 %
<b>5</b>	Flexural strength	ASTM 393	Min. 130 N/mm <sup>2</sup>
<b>6</b>	Flexural Modulus	ASTM 393	Min. 44.00 N/mm <sup>2</sup>
<b>7</b>	Shear strength with Punch shear test	ASTM 732	Min. 30 N/mm <sup>2</sup>
<b>B</b>	<b>Properties of Aluminium Skin</b>		
<b>1</b>	Tensile strength (Rm)	ASTM E8	Min. 65 N/mm <sup>2</sup>
<b>2</b>	Modulus of elasticity	ASTM E8	Min. 70,000 N/mm <sup>2</sup>
<b>3</b>	Elongation	ASTM E8	A50 Min. 2%
<b>4</b>	0.2 % Proof Stress	ASTM E8	Min. 10 N/mm <sup>2</sup>

### 1.2.6 Plate Thickness

Shoulder mounted ground signs with a maximum side dimension not exceeding 600 mm shall not be less than 2.0 mm thick with Aluminum and 4 mm thick with Aluminum Composite Material. All other signs be at least 2 mm thick with Aluminum and 4 mm thick with Aluminum 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.

**1.2.7** 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 sign shall consist of the white or colored sheeting having a smooth outer surface which has the property of retro-reflection over its entire surface.

It shall be weather-resistant and show color fastness. It shall be new and unused and shall show no evidence of cracking, scaling, and pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate of having tested the sheeting for co-efficient of retro-reflection, day/night time color luminous, shrinkage, flexibility, linear removal, adhesion, impact resistance, specular gloss and fungus resistance and its having passed these tests shall be obtained from a Government Laboratory/Institute, by the manufacturer of the sheeting. The retro-

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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 high intensity retro reflective sheeting shall be of encapsulated lens type consisting of spherical glass lens, elements adhered to a synthetic resin and encapsulated by a flexible, transparent waterproof plastic having a smooth surface or as an unmetallised micro prismatic reflective material element. 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 800-2**.

**Table 800-2 Acceptable Minimum Coefficient of Retro-reflection for Type III High Intensity Grade Sheetting (Type III) (Encapsulated Lens Type)  
(Candelas per Lux per Square Metre)**

Observation Angle in Degrees	Entrance Angle in Degrees	White	Yellow	Orange	Green	Red	Blue	Brown
0.1° <sup>B</sup>	-4°	300	200	120	54	54	24	14
0.1° <sup>B</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
0.5°	+30°	65	45	25	10	10	5.0	3.5

A minimum of Coefficient of Retro-reflection (RA)  $\text{cd}/\text{fc}/\text{ft}^2$  ( $\text{cd}/\text{lx}/\text{m}^2$ ).

B 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.

#### 1.3.3 High Intensity Micro-Prismatic Grade Sheetting (HIP) (Type IV)

This sheetting shall be of high intensity retro-reflective sheetting made of micro-prismatic 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 coefficient of retro-reflection (determined in accordance with ASTM D: 4956-09) as indicated in **Table 800-3**.

**Table 800-3 Acceptable Minimum Coefficient of Retro-Reflection for High Intensity Micro-prismatic Grade Sheetting (Type IV)  
(Candelas per Lux per Square Metre)**

Observation	Entrance	White	Yellow	Orange	Green	Red	Blue	Brown
0.1° <sup>B</sup>	-4°	500	380	200	70	90	42	25
0.1° <sup>B</sup>	+30°	240	175	94	32	42	20	12
0.2°	-4°	360	270	145	50	65	30	18
0.2°	+30°	170	135	68	25	30	14	8.5
0.5°	-4°	150	110	60	21	27	13	7.5
0.5°	+30°	72	54	28	10	13	6	3.5

A Minimum Coefficient of Retro reflection (RA)  $\text{cd}/\text{fc}/\text{ft}^2$  ( $\text{cd}/\text{lx}/\text{m}^2$ ).

B 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 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 E 810) as indicated in Table 800-4.

#### 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 E 810) as indicated in Table 800-5.

**Table 800-4: Acceptable Minimum Co-efficient of Retro-Reflection for Prismatic Grade Sheeting (Type VIII) (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>A</sup>	-4°	1000	750	375	100	150	45	30	800	600	300
0.1° <sup>B</sup>	+30°	460	345	175	46	69	21	14	370	280	135
0.2°	-4°	700	525	265	70	105	32	21	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

A Minimum Coefficient of Retro reflection ( $R^A$ )  $\text{cd}/\text{fc}/\text{ft}^2$  ( $\text{cd}/\text{lx}/\text{m}^2$ ).

B 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.

**Table 800-5 Acceptable Minimum Coefficient of Retro-reflection for Prismatic Grade Sheeting (Type IX) (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>A</sup>	-4°	600	500	250	66	130	30	530	400	200
0.1° <sup>B</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 ( $RA$ )  $\text{cd}/\text{fc}/\text{ft}^2$  ( $\text{cd}/\text{lx}/\text{m}^2$ ).

B 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)**

A 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 E 810) as indicated in Table 800-6.

**Table 800-6 Acceptable Minimum Coefficient of Retro-reflection for Prismatic Grade Sheeting (Type XI)<sup>1</sup> (Candelas per Lux per Square Metre)**

Observation Angle	Entrance Angle	white	Yellow	Orange	Green	Red	Blue	Brown	Florescent yellow-Green	Florescent yellow	Florescent Orange
0.1° <sup>B</sup>	-4°	830	620	290	83	125	37	25	660	500	250
0.1° <sup>B</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

A Minimum Coefficient of Retro-reflection (RA)  $\frac{\text{cd}}{\text{fc/ft}^2}$  ( $\frac{\text{cd}}{\text{lx-m}^2}$ ).

B 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.

#### **1.3.5 Adhesives**

The sheeting shall have a pressure-sensitive adhesive of the aggressive-tack type requiring no heat, solvent 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 aluminum sheeting shall be de-greased either by acid or hot alkaline etching and all scale/dust removed to obtain a smooth plain surface before the application of retro-reflective sheeting. If the surface is rough, approved surface primer may be used. After cleaning, metal shall not be handled, except by suitable device or clean canvas gloves, between all cleaning and preparation operation and application of reflective sheeting/primer. There shall be no opportunity for metal to come in contact with grease, oil or other contaminants prior to the application of retro-reflective sheeting. Complete sheets of the material shall be used on the signs except where it is unavoidable. At splices, sheeting with pressure-sensitive adhesives shall be overlapped not less than 5 mm. 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 Messages/Borders**

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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 informatory 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 coefficient of retro-reflection shall not be less than 50 percent of the values of corresponding colour in Tables 800-2 to 800-8 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 Color for Signs**

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

**1.3.8.2** Except in the case of railway level crossing signs the sing posts shall be painted in 250 mm side bands, alternately black and white. The lowest band next to be 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 800-7 and comply with the luminance factor when measured asper ASTM D-4956.

**Table 800-7: Colour Specified Limits (Daytime)**

Colour	1		2		3		4		Daytime Luminance Factor (Y %)	
	x	y	x	y	X	y	x	y	Min.	Max.
White	0.303	0.300	0.368	0.366	0.340	0.393	0.274	0.329	15	--
Yellow	0.498	0.412	0.557	0.442	0.479	0.520	0.438	0.472	24	45
Green <sup>B</sup>	0.026	0.399	0.166	0.364	0.286	0.446	0.207	0.771	2.5	11
Red	0.648	0.351	0.735	0.265	0.629	0.281	0.565	0.346	2.5	11
Blue <sup>B</sup>	0.140	0.035	0.244	0.210	0.190	0.255	0.065	0.216	1	10
Orange	0.558	0.352	0.636	0.364	0.570	0.429	0.506	0.404	12	30
Brown	0.430	0.340	0.610	0.390	0.550	0.450	0.430	0.390	1	6
Fluorescent Yellow-Green	0.387	0.610	0.369	0.546	0.428	0.496	0.460	0.540	60	--
Fluorescent Yellow	0.479	0.520	0.446	0.483	0.512	0.421	0.557	0.442	45	--
Fluorescent Orange	0.583	0.416	0.535	0.400	0.595	0.351	0.645	0.355	25	--

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

**1.3.8.4** The Regulatory/Prohibitory and warning signs shall be provided with white background and red border. The legend/ symbol for these signs shall be in black colour. The Mandatory sign shall be provided with Blue background and white Symbol/letter.

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

**1.3.9 Refurbishment**

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Where existing signs are specified for refurbishment, the sheeting shall have a semi-rigid aluminium backing or materials as per Clause 801.2.5, pre-coated with aggressive-tack type pressure sensitive adhesive. The adhesive shall be suitable for the type of material used for the sign and should thoroughly bond with that material.

**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 Sizes of Letters**

<b>Design Speed (kmph)</b>	<b>Minimum 'x' Height of the Letters (mm)</b>	<b>Minimum Sight Distance / Clear visibility distance (m)</b>	<b>Maximum Distance from Centre Line (m)</b>
40	100	45	12
50	125	50	14
65	150	60	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-4 of IRC.67 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 Expressway, 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 upper case letters only.

**1.3.10.3** Letter size on definition plates attached with normal sized signs should be 100 mm or 150 mm. In the case of small signs, it should be 100 mm. Where the message is long, as for instance in "NO PARKING" and "NO STOPPING" signs, the message may be broken into two lines and 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 manufacturer a ten year warranty for satisfactory field performance including stipulated retro-reflectance of the retro-reflective sheeting of micro-prismatic sheeting and a seven-year 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 their bonding to the retro-reflective sheeting. The Contractor/supplier shall also furnish the LOT numbers and certification that the signs and materials supplied against the assigned work meets all the stipulated requirements and carry the stipulated warranty and that the contractor/supplier is the authorized converter of the particular sheeting.

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

A certificate in original shall be given by the sheeting manufacturer that its offered retro-reflective sheeting has been tested for various parameters such as co-efficient of retro-reflection, day/night time colour and luminance, shrinkage, flexibility, linear removal, adhesion, impact resistance, specular gloss and fungus resistance; the tests shall be carried out by a Government Laboratory in accordance with 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 sq.m 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 (including its back side) and supports, other than the reflective portion and G.I. posts shall be thoroughly de-scaled, cleaned, primed and painted with two coats of epoxy/ fibre glass/ powder coated paint. Any part of support 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. 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 measurement of standard cautionary, mandatory and information signs shall be in numbers of different types of signs supplied and fixed, while for direction and place identification signs, these shall be measured in **One Number**.

#### **1.6 Rate**

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

**Contractor/ Agency shall produce the warranty certificate as per mention in item.**

**The contract rate shall be for a unit of One Number. For completed item as directed.**

**Item No. 14 :-**

**Facility Informatory Sign :-**Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 80 x 60 cms rectangular as per design of IRC-67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ;reflectorised with Micro Prismatic Grade retro reflectivesheeting of Type-11 as per ASTM D- 4956 and latest M.O.S.T.Specifications; 3.6mtr long stand post of 75 x 75 x 6mm as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol foreach board shall be as per theinstruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg.including excavation, curing etc.complete under the supervision of engineer in charge. A 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

1. The relevant specification of **Item No. 13** shall be applied to this item.  
**Size:** as given in Item description, **Fixing:** as given in Item description
2. Measurement of the payment shall be made in numbers of sign board supplied & fixed.
3. The Contract unit rate shall be payment in full for the cost of making the road sign board as per item description, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications.

**Contractor/ Agency shall produce the warranty certificate as per mention in item.**  
**The contract rate shall be for a unit of One Number. For completed item as directed.**

**Item No. 15 :-**

**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 rated 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 reflective sheeting of Type-11 as per ASTM D-4956 and latest M.O.S.T. Specifications; 3.6mtr long stand post of 75 x 75 x 6mm 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) Engineering Grade (VR)g1.

1. The relevant specification of **Item No. 13** shall be applied to this item.  
**Size:** as given in Item description, **Fixing:** as given in Item description
2. Measurement of the payment shall be made in numbers of sign board supplied & fixed.
3. The Contract unit rate shall be payment in full for the cost of making the road sign board as per item description, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications.

**Contractor/ Agency shall produce the warranty certificate as per mention in item.**  
**The contract rate shall be for a unit of One Number. For completed item as directed.**

**Item No. 16 :-**

**STOP Sign :-**Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 90 cms Octagone 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 reflective sheeting of Type- 11 as per ASTM D-4956 and latest M.O.S.T. Specifications; 3.6mtr long stand post of 75 x 75 x 6mm as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC 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) Engineering Grade (VR)g

1. The relevant specification of **Item No. 13** shall be applied to this item.  
**Size:** as given in Item description, **Fixing:** as given in Item description
2. Measurement of the payment shall be made in numbers of sign board supplied & fixed.
3. The Contract unit rate shall be payment in full for the cost of making the road sign board as per item description, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications.

**Contractor/ Agency shall produce the warranty certificate as per mention in item.**  
**The contract rate shall be for a unit of One Number. For completed item as directed.**

**Item No:- 17 :**

**Providing and fixing pre cast C.C. M-150 indicator stone with necessary reinforcement as per I.R.C. type design in including painting, lettering etc. complete. (ii) Fixing in C.C. 1:5:10**

Indicator stone shall be of approved quality and shall be either black Rajula stone or of precast 1:4:8 R.C.C. as specified in the item.

The size, manner of fixing, painting and lettering of Indicator stone shall conform specification as per I.R.C.- 26) The fixing of Guard stone shall be carried out in ordinary concrete of grade specified in the item using in C.C.1:5:10.

**MEASUREMENT OF PAYMENT**

The measurement for payment shall be made per No. of Indicator stone fixed in position.

**RATE**

Unit rate for Indicator stone includes the cost of all materials, labour, tools, fixing, finishing curing, lettering and painting and all other incidental costs necessary to complete the work to these specifications as directed by the Engineer-in-charge.

Payment shall be made carried out on **number basis**.



**Item No:- 18 :**

**Providing and fixing ordinary kilometer stone of precast cc 1:2:4 including necessary reinforcement as per IRC type desing and Fixing in cc 1:4:8 including painting and lettering etc. complete**

Ordinary Kilometer stone shall be of approved quality and shall be either black Rajula stone or of precast 1:2:4 R.C.C. as specified in the item.

The size, manner of fixing, painting and lettering of ordinary Kilometer stone shall conform specification as per I.R.C.-8 (Type design for Highway kilometer stones). The fixing of ordinary Kilometer stone shall be carried out in ordinary concrete of grade specified in the item using in C.C. 1:4:8.

**MEASUREMENT OF PAYMENT**

The measurement for payment shall be made per No. of ordinary Kilometre stone fixed in position.

**RATE**

Unit rate for ordinary Kilometer stone includes the cost of all materials, labour, tools, fixing, finishing curing, lettering and painting and all other incidental costs necessary to complete the work to these specifications as directed by the Engineer-in-charge.

Payment shall be made carried out on **number basis**.

**Item No. 19 :-**

**Chevron sign :-Providing and fixing sign boards made out of 1.5mm aluminium sheet / 3mm ACP (Aluminum composite Panel); size 60x50 cm 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 reflective sheeting of Type- 11 as per ASTM D-4956 and latest M.O.S.T. Specifications; 3.3 mtr long stand post of 75 x 75 x 6mm as required and frame fabricated from suitable size iron angle of 50 x 50 x5mm; 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 10 years for the Retro reflective sheeting from originaa manufacturer & a certified copy of 3 year outdoor exposure test report from third party est lab for the product offered shall be submitted by contractor. (A) Engineering Grade (VR)g**

1. The relevant specification of **Item No. 13** shall be applied to this item.  
**Size:** as given in Item description, **Fixing:** as given in Item description
2. Measurement of the payment shall be made in numbers of sign board supplied & fixed.
3. The Contract unit rate shall be payment in full for the cost of making the road sign board as per item description, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications.

**Contractor/ Agency shall produce the warranty certificate as per mention in item.**

**The contract rate shall be for a unit of One Number. For completed item as directed.**

**Item No. 20 :-**

**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 reflective 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 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) Engineering Grade (VR)g

1. The relevant specification of **Item No. 13** shall be applied to this item.  
**Size:** as given in Item description, **Fixing:** as given in Item description
2. Measurement of the payment shall be made in numbers of sign board supplied & fixed.
3. The Contract unit rate shall be payment in full for the cost of making the road sign board as per item description, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications.

**Contractor/ Agency shall produce the warranty certificate as per mention in item.**  
**The contract rate shall be for a unit of One Number. For completed item as directed.**

**Item No:- 21:**

**Providing and fixing pre cast C.C. M-150 hectometer stone with necessary reinforcements per I.R.C. type design including painting, lettering etc. complete (ii) Fixing in C.C. 1:5:10**

Hectometer stone shall be of approved quality and shall be either black Rajula stone or of precast 1:4:8 R.C.C. as specified in the item.

The size, manner of fixing, painting and lettering of hectometer stone shall conform specification as per I.R.C. - 26) The fixing of hectometer stone shall be carried out in ordinary concrete of grade specified in the item using in C.C.1:5:10.

**MEASUREMENT OF PAYMENT**

The measurement for payment shall be made per No. of Hectometer stone fixed in position.

**RATE**

Unit rate for Hectometer stone includes the cost of all materials, labour, tools, fixing, finishing curing, lettering and painting and all other incidental costs necessary to complete the work to these specifications as directed by the Engineer-in-charge.

Payment shall be made carried out on **number basis**.

**Item No. 22 :-**

**Route Marker sign :-**Providing and fixing sign boards made out of 2.0 mm aluminium sheet / 4 mm ACP (Aluminum composite Panel); size 60x45 cm rectangular plus 30x25cm additional plate 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 reflective sheeting of Type-11 as per ASTM D-4956 and latest M.O.S.T. Specifications; 3.6 mtr long stand post of 75 x 75 x 6mm as required and frame fabricated from suitable size iron angle of 35x 35 x 3mm; painted with best quality epoxy coatings in black and white bends. the details of symbol or inscription /numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 Cms. for each leg. including excavation, curing etc. complete under the supervision of engineer in charge. A warranty for 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) Engineering Grade (VR)g

1. The relevant specification of **Item No. 13** shall be applied to this item.  
**Size:** as given in Item description, **Fixing:** as given in Item description
2. Measurement of the payment shall be made in numbers of sign board supplied & fixed.
3. The Contract unit rate shall be payment in full for the cost of making the road sign board as per item description, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications.

**Contractor/ Agency shall produce the warranty certificate as per mention in item.**  
**The contract rate shall be for a unit of One Number. For completed item as directed.**

**Item No. 23 :-**

**Village Name Sign :-**Providing and fixing sign boards made out of 2mm aluminium sheet/ 4mm ACP (Aluminum composite Panel); size 90x60 cms. rectangular as per design of IRC-67-2012. Pre treated with 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 reflective sheeting of Type-11 as per ASTM D-4956 and latest M.O.S.T. Specifications; 3.3mtr long stand post of 75 x 75 x 6mm as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with best quality epoxy coatings in black and white bends. The details of symbol or inscription/letters / 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 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) Engineering Grade (VR)g

1. The relevant specification of **Item No. 13** shall be applied to this item.  
**Size:** as given in Item description, **Fixing:** as given in Item description
2. Measurement of the payment shall be made in numbers of sign board supplied & fixed.
3. The Contract unit rate shall be payment in full for the cost of making the road sign board as per item description, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications.

**Contractor/ Agency shall produce the warranty certificate as per mention in item.**  
**The contract rate shall be for a unit of One Number. For completed item as directed.**

**Item No. 24 :-**

Road marking with hot applied thermoplastic paints with reflectorising glass beads on bitumin surface providing and laying a hot applied thermoplastic compound 2.5 mm thick including reflectorising glass beads @ 250gms per sqm area, thickness of 2.5mm is excluding of surface applied glass beds as per IRC:35-2015. The finished surface to be level, uniform and free from streaks and holes. zebra patta /bump patta lane/center line/ edge line/cut patta. The white color marking should provide liminance coefficinnet 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 2 years.

**ROAD MARKINGS**

**4. HOT APPLIED THERMOPLASTIC ROAD MARKING**

**4.1 Thermoplastic Material**

**4.1.1 General**

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

- I. The work under this section consists of marking traffic stripes using a thermoplastic compound meeting the requirements specified herein.
- II. The thermoplastic compound shall be screened /extruded on to the pavement surface in a molten state by suitable machine capable of controlled preparation and laying with surface application of glass beads at a specific rate. Upon cooling to ambient pavement temperature, it shall produce an adherent pavement marking of specified thickness and width and capable of resisting deformation by traffic.
- III. The color of the compound shall be white or yellow (IS color No. 356) as specified in the drawings or as directed by the Engineer.
- IV. Where the compound is to be applied to cement concrete pavement, a scaling primer is recommended by the manufacturer, shall be applied to the pavement in advance of placing of the stripes to ensure proper bonding of the compound. On new concrete surface any laitance and/or curing compound shall be removed before the markings are applied.

**803.4.1.2 Requirements:**

- I. **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 800-9.

**TABLE 800-9 PROPORTIONS OF CONSTITUENTS OF MARKING MATERIAL**

<b>(Percentage by weight)</b>		
<b>Component</b>	<b>White</b>	<b>Yellow</b>
Binder	18.0 min.	18.0 min.
Glass Beads	30-30	30-30
Titanium Dioxide	10.0 Min.	-----
Calcium Carbonate and Inert Fillers	42.0 Max.	See Note Below
Yellow Pigments	-----	See Note Below

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

- II. **Properties:** The properties of thermoplastic material, when tested in accordance with ASTM D36/BS-3262-(Part I), shall be as below:
  - i) **Luminance:** White: Daylight luminance at 45°-65 percent min. as per AASHTO M249  
Yellow: Daylight luminance at 45°-45 percent min. as per AASHTO M24
  - ii) **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.

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- iii) Skid resistance: not less than 45 as per BS: 6044.
- iv) Cracking resistance at low temperature: The material shall show no cracks on application to concrete blocks.
- v) Softening point: 102.5°C ± 9.5°C as per ASTM D 36.
- vi) Yellowness index (for white thermoplastic paint): not more than 0.12 as per AASHTOM249
- III. **Storage life:** The material shall meet the requirements of these Specifications for a period of one year. The thermoplastic material must also melt uniformly with no evidence of skins or unmelted particles for the one year storage period. Any material not meeting the above requirements shall be replaced by the manufacturer/supplier/ Contractor.
- IV. **Reflectorisation:** Shall be achieved by incorporation of beads, the grading and other properties of the beads shall be as specified in Clause 803.4.2.
- V. **Marking :** Each container of the thermoplastic material shall be clearly and indelibly marked with the following information:
  - i) The name, trade mark or other means of identification of manufacturer
  - ii) Batch number
  - iii) Date of manufacture
  - iv) Colour (white or yellow)
  - v) Maximum application temperature and maximum safe heating temperature.
- VI. **Sampling and Testing:** The thermoplastic material shall be sampled and tested in accordance with the appropriate ASTM/BS method. The Contractor shall furnish to the Engineer 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.

#### **4.2 Reflectorizing Glass Beads**

##### **4.2.1 General**

This Specification covers two types of glass beads to be used for the production of reflectorized pavement markings.

Type 1 beads are those which are a constituent of the basic thermoplastic compound vide Table 800-9 and Type 2 beads are those which are to be sprayed on the surface vide Clause 803.6.4.

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

These shall conform to the requirements spelt out in Clause 803.4.2.3.

##### **4.2.3 Specific Requirements**

- a) **Gradation:** The glass beads shall meet the gradation requirements for the two types as given in Table 800-10.

**Table 800-10: Gradation Requirements for Glass Beads**

Sieve Size	Per cent retained	
	Type 1	Type 2
1.18 mm	0 To 3	-----
850 micron	5 To 20	0 To 5
600 micron	-----	5 To 20
425 micron	65 To 95	-----
300 micron	-----	30 To 75
180 micron	0 To 10	10 To 30
Below 180 micron	-----	1. To 15

- b) **Roundness:** The glass beads shall have a minimum of 70 percent 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.

##### **4.2.4 Test Methods**

The specific requirements shall be tested with the following methods:

- I. Free-flow test: Spread 100 grams of beads evenly in a 100 mm diameter glass dish. Place the dish in a 250 mm inside diameter desiccator which is filled within 25 mm of the top of a desiccator plate with sulphuric acid water solution (specific gravity 1.10). Cover the desiccator and let it stand for 4 hours at 20°C to 29°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 free of lumps and clusters and shall flow freely through the funnel.
- II. The requirements of gradation, roundness and refractive index of glass beads and the amount of glass beads in the compound shall be tested as per BS: 6088 and BS: 3262 (Part I).
- III. The Contractor shall furnish to the Engineer 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 these Specifications. However, if so required, these tests may be carried out as directed by the Engineer.

#### **4.3 Application Properties of Thermoplastic Material**

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

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

#### **4.4 Preparation**

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

#### **5 Reflectorized Paint**

Reflectorized paint, if used, shall conform to the Specification by the manufacturers and approved by the Engineer. Reflectorizing glass beads for reflectorizing paints where used shall conform to the requirements of Clause 803.4.2.

#### **6 Application**

**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.

**6.2** 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.

**6.3** 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.

**6.4** 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. 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 meter area.

**6.5** 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).

**6.6** The markings shall be done to accuracy within the tolerances given below:

- a) Width of lines and other markings shall not deviate from the specified width by more than 5 percent.
- b) The position of lines, letters, figures, arrows and other markings shall not deviate from the position specified by more than 20 mm
- c) The alignment of any edge of a longitudinal line shall not deviate from the specified alignment by more than 10 mm in 15 m.
- d) The length of segment of broken longitudinal lines shall not deviate from the specified length by more than 150 mm.

In broken lines, the length of segment and the gap between segments shall be as indicated on the drawings; if these lengths are altered by the Engineer, the ratio of the lengths of the painted sections shall remain the same.

### **6.7 Properties of Finished Road Markings**

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.

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

### **6.8 Measurements for Payment**

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

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

## **6.9 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.

**Contractor/ Agency shall produce the warranty certificate as per mention in item.**

**The contract rate shall be for a unit of one Square meter basis of complete item.**

### **Item No. 25 :-**

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

### **Detailed Technical Specifications for Molded Twin Shanks Cat Eye / road Stud / RPM**

#### **1 Scope**

The work shall cover the providing and fixing of reflective pavement marker (RPM) or road stud, a device which is bonded to or anchored within the road surface, for lane marking and delineation for night-time visibility, as specified in the Contract.

#### **2 Material**

**2.1** Plastic body of RPM/road stud shall be moulded from ASA (Acrylic Styrene Acrylonitrile) or HIPS (Hi-impact Polystyrene) or Acrylonitrile Butadiene Styrene (ABS) or any other suitable material approved by the Engineer. The markers shall support a load of 13,635 kg tested in accordance with ASTM D 4280.

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

#### **3 Design**

The slope or retro-reflecting surface shall preferably be  $35 \pm 5^\circ$  to base and the area of each retro-reflecting surface shall not be less than 13.0 sq.cm.

#### **4 Optical Performance**

##### **4.1 Unidirectional and Bi-directional Studs**

Each reflector or combination of reflectors on each face of the stud shall have a Coefficient of Luminous Intensity (C.I.L.). Not less than that given in Tables 800-13 or 800-14 as appropriate.

##### **4.2 Omni-directional Studs**

Each Omni-directional stud shall have a C.I.L. of not less than 2 mcd/lx.

**Table 800-13: Minimum C.I.L. Values for Category 'A' Studs**

Entrance Angle	Observation Angle	C.I.L. in mcd/lx		
		White	Amber	Red
0° U 5° L&R	0.3°	220	110	44
0° U 10° L&R	0.5°	120	60	24

**Table 800-14: Minimum C.I.L. Values for Category 'B' Studs**

Entrance Angle	Observation Angle	C.I.L. in mcd/lx		
		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:

1. The entrance angle of 0° U corresponds to the normal aspect of the reflectors when the reflecting road stud is installed in horizontal road surface.
2. The stud incorporating one or more corner cube reflectors shall be included in Category 'A'. The stud incorporating one or more bi-convex reflectors shall be included in Category 'B'.

## **804.5 Tests**

**5.1** Co-efficient of luminance intensity can be measured by procedure described in ASTM E 809 "Practice for Measuring Photometric Characteristics" or as recommended in BS: 873-Part 4: 1973.

**5.2** Under test conditions, a stud shall not be considered to fail the photometric requirements if the measured C.I.L. at any one position of measurement is less than the values specified in Tables 800-13 or 800-14 provided that

- i) The value is not less than 80 percent of the specified minimum, and
- ii) The average of the left and right measurements for the specific angle is Greater than the specified minimum.

## **6 Solar Powered Road Markers (Solar Studs)**

The solar studs shall be made of Aluminum alloy and poly carbonate material which shall be absolutely weather resistant and strong enough to support a load of 13,635 kg tested in accordance with ASTM D4280. Its colour may be white, red, yellow, green or blue or combination as directed by the Engineer. Its water resistance shall meet the requirements of IP 65 in accordance with IS: 12063:1987 Category 2 for protection against water ingress. The dimensions of solar studs shall not be less than 100 mm x 100 mm x 10 mm. It shall have super bright LEDs so as to provide long visibility from a distance of more than 800 m. Its flashing rate shall not be less than 1 Hz. It should be able to give the prescribed performance in the temperature range of -40°C to +55°C. Its life shall be not less than 3 years.

## **7 Fixing of Reflective Markers**

### **7.1 Requirements**

The enveloping profile of the head of the stud shall be smooth and the studs shall not present any sharp edges to traffic. The reflecting portions of the studs shall be free from crevices or ledges where dirt might accumulate. Marker height shall not be less than 10 mm and shall not exceed 20 mm. and its width shall not exceed 130 mm. The base of the marker shall be flat within 1.3 mm. If the bottom of the marker is configured, the outermost faces of the configurations shall not deviate more than 1.3 mm from a flat surface. All road studs shall be legibly marked with the name, trade mark or other means of identification of the manufacturer.

### **7.2 Placement**

The reflective marker shall be fixed to the road surface using the adhesives and the procedure recommended by the manufacturer. No nails shall be used to affix the marker so that they do not pose safety hazard on the roads. Regardless of the type of adhesive used, the markers shall not be fixed if the pavement is not surface dry and on new asphalt concrete surfacing until the surfacing has been opened to traffic for a period of not less than 14 hours. The portions of the highway surface, to which the marker is to be bonded by the adhesive, shall be free of dirt, curing compound, grease, oil, moisture, loose or unsound layers, paint and any other material which would adversely affect the bond of the adhesive.

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

### **7.3 Warranty and Durability**

The contractor shall submit a two year warranty for satisfactory field performance including stipulated retro-reflectance of the reflecting panel, to the Engineer. In addition, a two year warranty for satisfactory infield performance of the finished road marker shall also be given by the contractor who carries out the work of fixing of reflective road markers. In case the markers are displaced, damaged, get worn out or lose their reflectivity compared to stipulated standards, the contractor would be required to replace all such markers within 15 days of the intimation from the Engineer, at his own cost.

## **8 Measurement for Payment**

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

## **9 Rate**

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

**The contract rate shall be for a unit of Nos. For completed item as directed.**

**Item No. 26 :-**

**Providing and fixing Junction board of M.S. plates and angles as per standard I.R.C. design including fixing in C.C. 1:4:8 with necessary excavation painting figuring and lettering on board etc. complete.**

1. The relevant specification of **Item No. 13** shall be applied to this item.  
**Size:** as given in Item description, **Fixing:** as given in Item description
2. Measurement of the payment shall be made in numbers of sign board supplied & fixed.
3. The Contract unit rate shall be payment in full for the cost of making the road sign board as per item description, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications.

**Contractor/ Agency shall produce the warranty certificate as per mention in item.  
The contract rate shall be for a unit of One Number. For completed item as directed.**

**Item No. 27 :-**

**Citizen' s information Board- Providing and fixing of typical information board as per instruction. Two MS plates of 1.6 mm thick, of 900 mm x 750mm size fixed at top & bottom duly welded with MS angles of 25 x 25 x 5 mm thick M.S plate shall be welded by two vertical M.S flats & four horizontal M.S flats 5 mm thick to 75 mm x 75 mm of 12 SWG square tubes posts duly embedded in cement concrete M-15 grade blocks of 600mm x 600mm x 75mm, below ground level. Painting New letters & figure of any shade with ready mixed synthetic enamel paint of superior quality in required shade and colour, All sections of framed posts and steel tube will be painted with primer and two coats of epoxy paints as per drawing Clause 1701 and Annexure 1700.1 (10.16)**

1. The relevant specification of **Item No. 13 Same** shall be applied to this item & separate sheet also attached.  
**Size:** as given in Item description, **Fixing:** as given in Item description
2. Measurement of the payment shall be made in numbers of sign board supplied & fixed.
3. The Contract unit rate shall be payment in full for the cost of making the road sign board as per item description, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications.

**Contractor/ Agency shall produce the warranty certificate as per mention in item.  
The contract rate shall be for a unit of One Number. For completed item as directed.**

**Item No. 28 :-**

"LOGO" Board : Providing and fixing of LOGO informatory sign board with Logo as per section 1700 of MORD specifications and drawing. The board will be a composite unit consisting of Two Plates of ACM (Aluminum Composite Material), material specifications as per clause 17001.3. The top most plate will be of 3mm ACP in diamond shape of 600x600mm size, riveted with MS angle iron frame of 25mmx25mmx5mm size on back on edges. The Lower plate will be of 4mm ACP of 1100x300mm size riveted with MS angle iron frame of 25mmx25mmx5mm size on back on edges. Riveting of all the sheets over angle and flat iron frame will be done neatly to have plain surface on one side. The angle iron frame of Both the plates will be welded to a 75mm x75mmx6mm Mild steel post at Centre and this post will be embeded in cement concrete M15 grade block of 450x450x600mm below ground level. The height of the bottom of the lower plate will be 1200mm from normal ground level. The spacing between the diamond shaped plate and Lower Plate is kept 150mm. logo, letters and numerals on the ACM should be made up of Retro Reflective sheeting of Type-1 AEGP Class-A grade as per the latest MORD section 1700 and IRC 67-2012 specifications. All the section of the frame and posts shall be painted with primer and two coats of epoxy paint. The design, painting and lettering shall be done as per the Logo sign Design and as directed by Engineer in-charge. A warranty for 5 years for the Retro reflective sheeting for Type-1 Class-A from original manufacturer shall be submitted by contractor.

1. The relevant specification of **Item No. 13** shall be applied to this item & separate sheet also attached.  
**Size:** as given in Item description, **Fixing:** as given in Item description
2. Measurement of the payment shall be made in numbers of sign board supplied & fixed.
3. The Contract unit rate shall be payment in full for the cost of making the road sign board as per item description, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications.

**Contractor/ Agency shall produce the warranty certificate as per mention in item.**  
**The contract rate shall be for a unit of One Number. For completed item as directed.**



**Item No. 29 :-**

**Project Information Board: Providing and fixing of typical Project informatory sign board with Logo as per 1700 of MORD specifications and drawing. The board will be a composite unit consisting of Three Plates ACM (Aluminum Composite Material), material specifications as per clause 17001.3. The top most plate will be of 3mm ACM in diamond shape of 600x600mm size, riveted with MS angle iron frame of 25mmx25mmx5mm size on back on edges. The middle 4mm ACM plate of will be 1200x150mm size riveted with MS angle iron frame of 25mmx25mmx5mm size on back on edges. The main 4mm ACM lower most plate will be 1500mmx600mm size, riveted with MS angle iron frame of 25mmx25mmx5mm size. Riveting of all the sheets over angle and flat iron frame will be done neatly to have plain surface on one side. The angle iron frame of lower most plate and flat iron frame of the middle plate will be welded to two nos. 75mm x75mm (12 SWG) sheet tubes posts placed at 1125mm apart centre to centre. the top of the middle plate will be flushed with the top of 75mm dia medium steel tube posts and these posts will be embedded in cement concrete M15 grade block of 450x450x600mm below ground level. The height of the bottom of the lower plate will be 1200mm from normal ground level and the bottom of the middle plate will be 100mm above the top level of the lower most plate. the diamond shaped plate mounted over flat angle iron frame will be connected to middle plate by square steel section of 47mmx47mm, thickness 12SWG having a spacing of 100mm between the diamond shaped plate and middle plate and this square section will be riveted to the bottom point of the diamond shaped plate. logo, letters and numerals on the ACM should be made up of Retro Reflective sheeting of Type-1 AEGP Class-A grade as per the latest MORD section 1700 and IRC 67-2012 specifications. All the section of the frame and posts shall be painted with primer and two coats of epoxy paint. The design, painting and lettering shall be done as per the Signage Guide and as directed by Engineer-In-charge. . A warranty for 5 years for the Retro reflective sheeting for Class-A respectively, from original manufacturer shall be submitted by contractor.**

1. The relevant specification of **Item No. 13** shall be applied to this item & separate sheet also attached.

**Size:** as given in Item description, **Fixing:** as given in Item description

2. Measurement of the payment shall be made in numbers of sign board supplied & fixed.
3. The Contract unit rate shall be payment in full for the cost of making the road sign board as per item description, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications.

**Contractor/ Agency shall produce the warranty certificate as per mention in item.  
The contract rate shall be for a unit of One Number. For completed item as directed.**

**Item No. 30 :-**

**Excavation for foundation upto all depth including sorting out and stacking of useful materials and disposing of the excavated stuff upto all lead (A) Dense or Hard soil.**

The excavation shall be carried out in **dense or hard soil**, including breaking of soil using manual or mechanical means as required. Excavation shall be done to the correct **lines, levels, widths and depths**, ensuring firm and undisturbed bottom suitable for foundation works.

The work shall include **sorting out of excavated materials**, stacking of **useful materials** such as soil suitable for backfilling or reuse, neatly at designated places, and **disposing of surplus or unsuitable excavated material** to approved dumping locations, including **all leads and lifts**, as directed by the Engineer-in-Charge.

Excavation shall be done carefully to avoid over-excavation. Any excess excavation beyond the specified dimensions shall be made good at the contractor's cost using approved material and method, without any extra payment.

The sides of excavation shall be properly dressed, and where required, necessary **shoring, strutting or protection** shall be provided to prevent collapse of sides. The bottom of excavation shall be leveled, rammed and prepared properly before laying foundation concrete.

The work shall include **dewatering**, if required, to keep the excavation dry during execution. Necessary precautions shall be taken to ensure safety of nearby structures, services and workers.

All labour, tools, tackles, machinery, sorting, stacking, disposal, leads, lifts and incidental works required for completing the excavation shall be included.

The rate shall be **inclusive of cost of excavation in dense or hard soil, handling, sorting, stacking of useful materials, disposal of surplus material with all leads and lifts, labour, tools, tackles and all incidental charges**, complete.

**Payment shall be made per cubic metre (Cum) of excavation actually carried out in dense or hard soil**, measured as per specifications and approved by the Engineer-in-Charge.

The work shall be executed strictly as per **relevant IS codes, specifications and instructions of the Engineer-in-Charge**, and shall be completed to the **full satisfaction of the Engineer-in-Charge**.

**Item No. 31 :-**

**Providing and filling in foundation with ordinary cement concrete M- 150 mix and providing necessary vertical pin headers including formwork, vibrating, ramming and curing complete.**

The concrete shall be of **M-150 grade**, prepared using approved quality **cement, clean coarse sand and graded coarse aggregate** in proper proportions to achieve the specified strength. All materials shall conform to relevant Indian Standards and shall be free from deleterious substances.

The work shall include **providing and fixing necessary vertical pin headers**, dowels or holding pins, wherever required, correctly positioned, aligned and embedded in concrete, as per drawings or as directed by the Engineer-in-Charge, to ensure proper bonding and anchorage with adjoining structural elements.

The work shall also include **necessary formwork / shuttering**, properly erected, aligned and supported to true line, level and plumb, capable of withstanding the pressure of concrete without deformation. Formwork shall be removed carefully after concrete has gained sufficient strength, without damaging the concrete surface.

Concrete shall be **mixed, placed and compacted properly** using **mechanical vibrators and/or ramming**, ensuring dense, homogeneous concrete, free from honeycombing, voids or segregation. Placement shall be carried out continuously to avoid cold joints.

After placing and finishing, the concrete shall be **cured adequately** for the specified period by ponding, wet coverings or other approved curing methods, to achieve required strength and durability.

All labour, materials, tools, tackles, formwork, vertical pin headers, mixing, placing, compacting, curing and incidental works required for completing the item shall be included in the scope of work.

The rate shall be **inclusive of cost of cement, aggregates, water, vertical pin headers, formwork, labour, machinery, vibrating, ramming, curing and all incidental charges**, complete.

**Payment shall be made per cubic metre (Cum) of M-150 concrete actually laid in foundation**, complete in all respects and approved by the Engineer-in-Charge.

The work shall be executed strictly as per **relevant IS codes, specifications and instructions of the Engineer-in-Charge**, and shall be completed to the **full satisfaction of the Engineer-in-Charge**.

**Item No. 32 :-**

**Providing and fixing in position FE 500D TMT bar reinforcement including cutting, bending and tying complete as per detailed drawings. (C) R.C.C. slab , wall etc complete**

**1601. Description:**

This work shall consist of furnishing and placing coated or uncoated mild steel or high strength deformed reinforcement bars of the shape and dimensions shown on the drawings and conforming to these Specifications or as approved by the Engineer.

**1602. General:**

Steel for reinforcement shall meet the requirements of Section 1000 of these specifications.

Reinforcements may be either mild steel or high strength deformed bars. They may be uncoated or coated with epoxy.

**1603. Protection of Reinforcement:**

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

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

In case of fusion bonded epoxy coated reinforcement or hot dipped galvanized bars used, reference shall be made Clause 1010.3.2 of Section 1000 of these specifications.

**1604. Bending of Reinforcement:**

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

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

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

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

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

**1605. Placing of Reinforcement:**

- a) The reinforcement cage should generally be fabricated in the yard at ground level and then shifted and placed in position. The reinforcement shall be placed strictly in accordance with the drawings and shall be assembled in position only when the structure is otherwise ready for placing of concrete. Prolonged time gap between assembling of reinforcements and casting of concrete, which may remit in rust formation on the surface, shall not be permitted.
- b) Reinforcement bars shall be placed accurately in position as shown on the drawings. The bars, crossing one another shall be tied together at every intersection with binding wire (annealed), conforming to IS: 280 to make the skeleton of the reinforcement rigid such that the reinforcement does not get displaced during placing of concrete, or any other operation. The diameter of binding wire shall not be less than 1 mm.

- c) Bars shall be kept in position usually by the following methods:
- i) In case of beam and slab construction, industrially produced polymer cover blocks of thickness equal to the specified cover shall be placed between the bars and formwork subject to satisfactory evidence that the polymer composition is not harmful to concrete and reinforcement. Cover blocks made of concrete may be permitted by the Engineer, provided they have the same strength and specification as those of the member.
  - ii) In case of dowels for columns and walls, the vertical reinforcement shall be kept in position by means of timber templates with slots cut in them accurately, or with cover blocks tied to the reinforcement. Timber templates shall be removed after the concreting has progressed up to a level just below their location.
  - iii) Layers of reinforcements shall be separated by spacer bars at approximately one-meter intervals. The minimum diameter of spacer bars shall be 12 mm or equal to maximum size of main reinforcement or maximum size of coarse aggregate, whichever is greater. Horizontal reinforcement shall not be allowed to sag between supports.
  - iv) Necessary stays, blocks, metal chain, spacers, metal hangers, supporting wires etc. or other subsidiary reinforcement shall be provided to fix the reinforcements firmly in its correct position.
  - v) Use of pebbles broken stone, metal pipe, brick, mortar or wooden blocks etc., as devices for positioning reinforcement shall not be permitted.
- d) Bars coated with epoxy shall be placed on supports that do not damage the coating. Supports shall be installed in a manner such that planet of weakness is not created in hardened concrete. The coated reinforcing steel shall be held in place by use of plastic or plastic coated binding wires especially manufactured for the purpose. Refer Section 1000 of these specifications for other requirements.
- e) Placing and fixing of reinforcement shall be inspected and approved by the Engineer before concreting is commenced.

#### **1606. Bar Splices:**

##### **1606.1. Lapping**

All reinforcement shall be furnished in full lengths as indicated on the drawing. No splicing of bars, except where shown on the drawing, shall be permitted without approval of the Engineer. The lengths of the splice shall be as indicated on drawing or as approved by the Engineer. Where practicable, overlapping bars shall not touch each other, and shall be kept apart by 25 mm or 1.25 times the maximum size of coarse aggregate, whichever is greater. If this is not feasible, overlapping bars shall be bound with annealed steel binding wire not less than 1 mm diameter and twisted tight in such a manner as to maintain minimum clear cover to the reinforcement from the concrete surface. Lapped splices shall be staggered or located at points along the span where stresses are low.

##### **1606.2. Welding**

**1606.2.1.** Splicing by welding of reinforcement will be permitted only if detailed on the drawing or approved by the Engineer. Weld shall develop an ultimate strength equal to or greater than that of the bars connected.

**1606.2.2.** While welding may be permitted for mild steel reinforcing bars conforming to IS: 432, welding of deformed bars conforming to IS: 1786 shall in general be prohibited. Welding may be permitted in case of bars of other than Fe 240 grade including special welding grade of Fe 500D grade bars conforming to IS: 1786, for which necessary chemical analysis has been secured and the carbon equivalent (CE) calculated from the chemical composition using the formula:

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mg + V}{5} + \frac{Ni + Cu}{15}$$

is 0.4 or less

**1606.2.3.** The method of welding shall conform to IS: 2751 and IS: 9417, any supplemental specifications and clause 1904.8 of these Specifications to the satisfaction of the Engineer.

Welding may be carried out by metal arc welding process. Oxy-acetylene welding shall not be permissible. Any other process may be used subject to the approval of the Engineer and

necessary additional requirements to ensure satisfactory joint performance. Precautions on overheating, choice of electrode, selection of correct current in arc welding etc., should be strictly observed.

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

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

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

Joint welding procedures which are to be employed shall invariably be established by a procedure specification. All welders and welding operators to be employed shall be qualified by tests prescribed in IS: 2751. Inspection of welds shall conform to IS: 822 and destructive or non-destructive testing may be undertaken when deemed necessary. Joints with weld defects detected by visual inspection or dimensional check inspection shall not be accepted.

Suitable means shall be provided for holding the bars securely in position during welding. It must be ensured that no voids are left in welding. When welding is done in two or three stages, the surface shall be cleaned properly after each stage. Bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before carrying out welding. Only competent and experienced welders shall be employed on the work with the approval of the Engineer. No welding shall be done on coated bars.

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

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

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

### **1606.3. Mechanical Couplers and Anchorages:**

#### **1606.3.1 Mechanical Couplers:**

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

#### **1606.3.2 Anchorages:**

Bars may be anchored with approved patented mechanical anchorages as indicated on the drawing or as approved by the Engineer. The anchorages shall be connected to the reinforcing bar by the use of taper thread system. The anchorage shall be capable of developing the characteristic strength of reinforcement without damage to concrete and shall have sufficient diameter and width to develop adequate shear cone strength. The connection shall develop 125% of the characteristic strength of reinforcement bar.

### **1607. Testing and Acceptance:**

The material shall be tested in accordance with relevant IS specifications and necessary test certificates shall be furnished. Additional tests, if required, will be got carried out by the Contractor at his own cost.

The supply, fabrication and placing of reinforcement shall be in accordance with these specifications and shall be as checked and accepted, by the Engineer.

Manufacturer's test certificate regarding compliance with Indian Standards for each lot of steel, shall be obtained and submitted to the Engineer. If required by the Engineer, the Contractor shall carry out confirmatory tests in the presence of a person authorized by the Engineer. Cost of these tests shall be borne by the Contractor. The sampling and testing procedure shall be as laid down



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in IS: 1786. If any test piece selected from a lot fails, no re-testing shall be done and the lot shall be rejected.

**1608. Measurements for Payment:**

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

**1609. Rate:**

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

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

IS: 1732: 1989

**Table 1 Dimensions, Sectional Areas and Mass of Hot-Rolled Round Steel Bars  
(Clauses 3.1, 4.1 and 4.1.1)**

Designation (1)	Diameter mm (2)	Sectional Area cm <sup>2</sup> (3)	Mass Per Meter Kg (4)
ISRO 5	5.0	0.196	0.154
ISRO 6	6.0	0.283	0.222
ISRO 8	8.0	0.503	0.395
ISRO 10	10.0	0.785	0.617
ISRO 14	14.0	1.54	1.21
ISRO 16	16.0	2.01	1.58
ISRO 18	18.0	2.54	2.00
ISRO 20	20.0	3.14	2.47
ISRO 22	22.0	3.80	2.98
ISRO 25	25.0	4.91	3.85
ISRO 28	28.0	6.16	4.83
ISRO 30	30.0	7.07	5.55
ISRO 32	32.0	8.04	6.31
ISRO 35	35.0	9.62	7.55
ISRO 40	40.0	12.6	9.85
ISRO 45	45.0	15.9	12.5
ISRO 50	50.0	19.6	15.4
ISRO 55	55.0	23.8	18.7
ISRO 60	60.0	28.3	22.2
ISRO 65	65.0	33.2	26.0
ISRO 70	70.0	38.5	30.2
ISRO 75	75.0	44.2	34.7
ISRO 80	80.0	50.3	39.5
ISRO 90	90.0	63.6	49.9
ISRO 100	100.0	78.5	61.7
ISRO 110	110.0	95.0	74.6
ISRO 120	120.0	113	88.8
ISRO 140	140.0	154	121

**Table 2 Dimensions, Sectional Areas and Mass of Hot-Rolled Round Steel Bars  
(Clauses 3.1, 4.1 and 4.1.1)**

Designation (1)	Side Width mm (2)	Sectional Area cm <sup>2</sup> (3)	Mass Per Meter Kg (4)
ISSQ 5	5.0	0.25	0.196
ISSQ 6	6.0	0.36	0.283
ISSQ 8	8.0	0.64	0.502
ISSQ 10	10.0	1.00	0.785
ISSQ 14	14.0	1.96	1.54
ISSQ 16	16.0	2.56	2.01
ISSQ 18	18.0	3.24	2.54
ISSQ 20	20.0	4.00	3.14
ISSQ 22	22.0	4.84	3.80
ISSQ 25	25.0	6.25	4.91
ISSQ 30	30.0	9.00	7.06
ISSQ 35	35.0	12.2	9.58
ISSQ 40	40.0	16.0	12.6
ISSQ 50	50.0	25.0	19.6
ISSQ 60	60.0	36.0	28.3
ISSQ 70	70.0	49.0	38.5
ISSQ 80	80.0	64.0	50.2
ISSQ 100	100.0	100	78.5
ISSQ 120	120.0	144	113

**4.1.1** The cross-sectional area of round and square steel bars is given in Tables 1 and 2 respectively for information. The values have been rounded off to three significant figures.

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ISRO 160	160.0	201	158	<b>5.1</b> The rolling and cutting tolerances for the steel bars shall be in accordance with IS:1852:1985
ISRO 180	180.0	254	200	
ISRO 200	200.0	314	247	

11.4 The contract rate shall be for a unit of one Kilogram for completed item of work as above.

**Item No. 33 : -**

**Providing and laying Weep hole in abutment and return by using PVC. pipe of 100 mm dia including laying in proper grade and joining complete etc as per details specification .**

The weep holes in the masonry and returns shall be provided of **P.V.C. pipes of 100 mm** dia. The pipe shall be fixed of suitable length & in full thickness of the masonry / concrete work. Necessary C.I. grating shall be provided on back side of abutment & returns on the inlet of opening of weep holes.

Materials the **P.V.C. pipes of 100mm dia.**

The Asbestos cement pipe of diameters specified in description of the item shall conform to I.S. 1626-1900. The interior of pipe shall have a smooth finish, regular surface & regular internal diameter.

The tolerance in all dim. Shall be as per IS 1926-Part-I 1980.

The grating shall be of C.I. 100 mm. dia. & per IRC specification.

The weep holes shall be provided 1 meter C/C shall be placed in staggered. After laying weep holes, it shall be clear of earth and other materials from its complete length.

The rate shall be paid on **Number** basis.

**Item No. 34 :-**

**White washing with lime on wall surface (two coats) to give an even shade including thoroughly booming the surface to remove all dirt, dust; mortar drops and other foreign matter**

Before application of white wash, the wall surface shall be **thoroughly cleaned and broomed** to remove all **dust, dirt, loose mortar, grease, mortar drops and other foreign matter**. Any unevenness or defects on the surface shall be made good prior to application to ensure uniform finish.

The white wash shall be prepared from **freshly slaked lime of approved quality**, mixed with clean water in correct proportions to obtain a smooth, uniform consistency. Suitable approved additives, if required, shall be mixed to improve adhesion and durability.

The white wash shall be applied evenly over the prepared surface using approved methods such as brushing or spraying, ensuring **uniform shade and smooth finish**. After the first coat has dried properly, the **second coat** shall be applied to achieve a consistent and even appearance, free from streaks, patches or discoloration.

Adequate time shall be allowed between coats for drying. Finished surfaces shall be protected from rain, dust and damage during drying period.

All labour, materials, preparation of surface, scaffolding, tools, tackles and incidental works required for completing the item shall be included.

The rate shall be **inclusive of cost of lime, water, surface preparation, application of two coats, labour, tools, tackles, scaffolding and all incidental charges**, complete.

**Payment shall be made per square metre (Sq.m.) of wall surface actually white washed with two coats**, complete in all respects and approved by the Engineer-in-Charge.

The work shall be carried out strictly as per **standard specifications and instructions of the Engineer-in-Charge**, and shall be completed to the **full satisfaction of the Engineer-in-Charge**.

**Item No. 35 :-**

**Supplying and fixing reinforced concrete heavy duty non pres-sure pipes with collars for culverts incl. Setting and joining the pipes in C.M. 1:2 watering & laying (two level or slope ) of 900mm dia. NP3 pipe internal diametre of IS 458 / 1971**

1. The relevant specification of **Item No. 03** shall be applied to this item.
2. Measurement of the payment shall be made in running meter basis.

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**Item No. 36 :-**

**Providing and filling sand below R.C.C. raft in layers including ramming and watering complete.**

The sand shall be of **approved quality**, clean, well-graded, free from clay, silt, organic matter or other deleterious materials. The sand shall be obtained from approved source and shall be suitable for filling below R.C.C. raft foundation.

The sand filling shall be carried out in **uniform layers of suitable thickness**, each layer being **thoroughly watered and compacted by ramming or approved mechanical means** to achieve proper compaction and uniform density. Care shall be taken to ensure even filling and required level throughout the area.

Filling shall be done to the required thickness, line and level as shown in the drawings or as directed by the Engineer-in-Charge. Any unevenness shall be corrected and the surface shall be properly leveled and compacted before laying of R.C.C. raft.

All labour, materials, watering, ramming, tools, tackles and incidental works required for completing the filling shall be included in the scope of work.

The rate shall be **inclusive of cost of sand, transportation, handling, filling in layers, watering, ramming, compaction, labour, tools, tackles and all incidental charges**, complete.

**Payment shall be made per cubic metre (Cum) of sand filling actually executed below R.C.C. raft**, complete in all respects and approved by the Engineer-in-Charge.

The work shall be executed strictly as per **relevant specifications and instructions of the Engineer-in-Charge**, and shall be completed to the **full satisfaction of the Engineer-in-Charge**.

**Dated Signature of  
the Contractor.**

**Deputy Executive Engineer,  
R&B (P) Sub-Division,  
Nadiad**

**Executive Engineer  
R&B (P) Division,  
Nadiad.**