

Construction Of C.C Road at Chabsar Approach Road Ch: 0+000 to 1+000 km. Ta.Bavla, Dist: Ahmedabad. (PKG NO. AHD/KISHANPATH/04/2025-26)

ITEM NO 01: Clearing & Grubbing road land including uprooting rank vegetation grass bushes shrubs saplings and trees girth up to 300 mm removal of stumps of trees cut earlier and disposal of unserviceable materials.(C) By Mechanical Means Light Jungle

201. CLEARING AND GRUBBING

201.1. Scope

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

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 soil 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 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 stacked as directed by the Engineer. Stacking of 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 hectares**. Clearing and grubbing of borrow areas shall be deemed to be a part of works preparatory to embankment construction and shall be deemed to have been included in the rates quoted for the embankment construction item and no separate payment shall be made for the same. Cutting of trees 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

201.6.1. The Contract unit rates for the various items of clearing and grubbing shall be payment in full-for carrying out, the required operations including full compensation for all labor, 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.**

ITEM NO 2: Earthwork for embankment including breaking clods, dressing with all lead and lift and including watering rolling and consolidation of subgrade in layer sat O.M.C. to required dry density including filling the depression which occur during the process using power roller 8T to 10T. (E) From Borrow area within 3.0KM. lead

EMBANKMENT CONSTRUCTION

301.1 General

301.1.1 Description:

These specifications shall apply to the construction of embankments, sub-grades, earthen shoulders and miscellaneous back fills with approved material obtained either from excavation for road construction, borrow pits or other sources. All embankments and sub-grades shall be constructed to 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.

301.2 Materials

301.2.1 Physical Requirements :

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

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

- Material from swamps, marshes or bogs
- Peat, log, stump or perishable material; any soil classifies as OL, OI, OLL or Pt in accordance with IS:1498.
- Material susceptible to spontaneous combustions
- Material in a frozen condition and
- Clay of liquid limit exceeding 70 and plasticity index exceeding 45 ; and
- Materials with salts resulting in leaching in the embankment.

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

Any fill material with a soluble sulphate content exceeding 1.9 grams of sulphate (expressed as SO₃) per litre when tested in accordance with BS: 1377 Test 10, but using a 2:1 water-soil ratio shall not be deposited within 500mm. or other distance described in the Contractor, of concrete, cement bound materials or other cementitious materials forming part of the Paramount Works.

Material with a total sulphate content (expressed as SO₃) exceeding 0.5 percent by mass, when tested in accordance with BS:1377 Test 9 shall not be deposited within 500mm, or other distances described in the Contract, or 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 60mm. 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-third 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 SUB-GRADE MATERIALS

Sl. No.	Type of Work	Maximum laboratory dry density when tested as per IS: 2720 (Part-VIII).
1.	Embankments up to 3m. Height, not subjected to extensive flooding.	Not less than 15.2 kN/cu.m.
2.	Embankments exceeding 3 metre height or embankments of any height subject to long periods of inundation.	Not less than 16 kN/cu.m.
3.	Sub-grade and earthen shoulders /verge/backfill	Not less than 17.5 kN/cu.m.

Note:

- 1) This table is not applicable for lightweight fill material e.g. cinder, fly ash etc..
- 2) The material to be used in subgrade shall be non-expansive and shall satisfy design CBR at the specified dry density and moisture content. In case the available material fails to meet the requirement of CBR, use of stabilization method in accordance with Clause 403 and 404 or by any stabilization method approved by the engineer shall be followed.

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 horizontal projected from the edge of the final section of the bank, the maximum depth in any case being limited to 1.5 m. Also no pit shall be dug within the offset width from the toe of the embankment required as per the consideration of stability with a minimum width of 10 m.

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

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 programme 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 Sub-grade

S. No.	Type of work/material	Relative compaction as percentage of max. laboratory dry density as per IS:2720 (Part 8)
1)	Subgrade and earthen shoulders	Not less than 97%
2)	Embankment,	Not less than 95%
3)	Expansive Clays	
	a) Subgrade and 500 mm portion just below the subgrade	Not allowed
	b) Remaining portion of embankment	90-95%

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 leveled to facilitate placement of first layer of embankment, scarified, mixed with water and then compacted by rolling.

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.

Spreading material in layers:

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.

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.

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 horizontal, such faces shall be benched as per Clause 305.4.1 immediately before placing the subsequent fill.

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

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.

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

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

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

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

Where an embankment /subgrade is to be placed against sloping ground, the latter shall be appropriately benched or ploughed/scarified as required in Clause 305.4.1 before placing the embankment/subgrade material. Extra earthwork involved in benching or due to ploughing / scarifying etc. shall be considered incidental to the work.

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

Where the contract requires construction of transverse subsurface drain at the cut-fill interface, work on the same shall be carried out to 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:-

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.

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.

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 up to 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.

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.

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 upto 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 mould fitted with cutting shoe or on remoulded 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 metres by the method of average end areas.

The measurement of fill material from borrow areas shall be the difference between the net quantities of compacted fill and the net 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 cum.

Stripping including storing and reapplication of topsoil shall be measured in cu.m.

Work involving loosening and re-compacting 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:

Cost of arrangement of land as a source of supply of material of required quantity for construction unless provided otherwise in the contract.

Setting out;

Compacting ground supporting embankment/subgrade except where removal and replacement of unsuitable material or loosening and re-compacting is involved;

Scarifying or cutting continuous horizontal benches 300mm wide on side slopes of existing embankment and subgrade as applicable;

Cost of watering or drying of material in borrow areas and/or embankment and subgrade during construction as required;

Spreading in layers, bringing to appropriate moisture content and compacting to specification requirements;

Shaping and dressing top and slopes of the embankment and subgrade including rounding of corners;

Restricted working at sites of structures;

Working on narrow width of embankment and subgrade;

Excavation in all soils from borrow pits/designated borrow areas including clearing and grubbing and transporting the material to embankment and subgrade site with all lifts and leads unless otherwise provided for in the contract.

All labour, material, tools, equipment and incidentals necessary to complete the work to the Specifications;

Dewatering and

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.

Measurement shall be taken and paid in Cmt.

ITEM NO: 3 Construction of Grannular sub base of in by providing GSB Gr - I coarse graded material using B.T Metal 26.5mm to 53 mm @ 35 % ,26.5mm to 4.75mm 45% & Below 2.36mm 20 % in uniform layer with motor grader on prepared surface mxing by mix in place method with vibratory roller to achive the desired density complete as per close 401.

Scope: -

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

Materials: -

The material to be used for the work shall be natural sand, murrum, gravel, crushed stone depending upon the grading required. Materials like crushed slag, crushed concrete brick metal & kanker may be allowed only with the specific approval of the Engineer.

Maximum particle size of the corresponding gradings for the natural sand, murrum, gravel, crushed stone materials are given at Table 400-2. The grading to be adopted for a project shall be as specified in the Contract.

Physical requirements: -

The materials shall have a 10 percent lines value of 50 kN or more (for sample in soaked condition) when tested in compliance with BS:812(Part 111). The water absorption value of the coarse aggregate shall be determined as per IS: 2386 (Part 3), if this value is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS: 383. For Grading II and III materials, the CBR shall be determined at the density and moisture content likely to be developed in equilibrium conditions which shall be taken as being the density relating to a uniform air voids content of 5 percent.

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

IS Sieve

Percent by weight passing the IS Sieve

Designation	-----		
	Grading I	Grading II	Grading III
75.0 mm	100	-	-
53.0 mm		100	
26.5 mm	55-75	50-80	400
9.50 mm			
4.75 mm	10-30	15-35	25-45
2.36 mm			
0.425 mm			
0.075 mm	<10	<10	<10
CBR Value	30	25	20
(Minimum)			

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

Strength of sub-base: -

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

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

Construction Operations:

Preparation of subgrade: -

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

Spreading and compacting:

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

When the sub-base material consists of combination of materials mentioned in Clause 401.2.1 mixing shall be done mechanically by the mix-in-place method.

Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations as in small sized jobs. The equipment used for mix-in-place construction shall be a rotavator or similar approved

equipment capable of mixing the material to the desired degree. If so desired by the Engineer, trial runs with the equipment shall be carried out to establish its suitability for the work.

Moisture content of the loose material shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from 1 per cent above to 2 per cent below the optimum moisture content corresponding to IS: 2720 (Part 8). While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means like disc harrows, rotavators until the layer is uniformly wet.

Immediately thereafter, rolling shall start. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer up to 225 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight with plain drum or pad foot-drum or heavy pneumatic tired roller of minimum 200 to 300 kN weight having a minimum tyre pressure of 0.7 MN/m² or equivalent capacity roller capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional cross fall and super elevation and shall commence at the edges and progress towards the center for portions having cross fall on both sides.

Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling, the grade and cross fall (Camber) shall be checked and any high spots or depressions which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 Km. Per hour.

Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry density for the material determined as per IS:2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

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.

Arrangements for Traffic: -

During the period of construction, arrangement of traffic shall be maintained in accordance with clause 112.

Measurements for payment: -

During sub-base shall be measured as finished work in position in cubic meters.

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

RATE: -

The contract unit rate for natural sand, murrum, gravel, crushed stone shall be payment in full for carrying out the required operations including full compensation for

- (i) making arrangements for traffic to Clause 112 except for initial treatment to verges, shoulders and construction of diversions,
- (ii) furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lifts
- (iii) all labour, tools, machineries, equipment and incidentals to complete the work to the specifications,
- (iv) carrying out the work in part widths of road where directed and
- (v) carrying out the required tests for quality control.

ITEM NO: 4 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) 450 mm dia.

SCOPE

This work shall consist of furnishing and installing reinforced cement concrete pipes, of the type, diameter and length as per design and details and at locations shown on the drawings or as ordered by the Engineer and in accordance with the requirements of these Specifications.

MATERIALS

Each consignment of cement concrete pipes shall be inspected, tested, if necessary and approved by the Engineer either at the place of manufacture or at the site before their incorporation in the works.

EXCAVATION FOR PIPE

The foundation bed for pipe culverts shall be excavated true to the lines and grades shown on the drawings or as directed by the Engineer. The pipes shall be placed in shallow excavation of the natural ground or in open trenches cut in existing embankments, taken down to levels as shown on the drawings. In case of high embankments where the height of fill is more than three times the external diameter of the pipe, the embankment shall first be built to an elevation above the top of the pipe equal to the external diameter of the pipe, and to width on each side of the pipe of not less than five times the diameter of pipe, after which a trench shall be excavated and the pipe shall be laid.

Where trenching is involved, its width on either side of the pipe shall be a minimum of 150 mm or one-fourth of the diameter of the pipe whichever is more and shall not be more than one-third the diameter of the pipe. The sides of the trench shall be as nearly vertical as possible.

The pipe shall be placed where the ground for the foundation is reasonably firm. Installation of pipes under existing bridges or culverts shall be avoided as far as possible. When during excavation the material encountered is soft, spongy or other unstable soil, and unless other special construction methods are called for on the drawings or in special provisions, such unsuitable material shall be removed to such depth, width and length as directed by the Engineer. The excavation shall then be backfilled with approved granular material which shall be properly shaped and thoroughly compacted upto the specified level.

Where bed-rock or boulder strata are encountered, excavation shall be taken down to atleast 200 mm below the bottom level of the pipe with prior permission of the Engineer and all rock/boulders in this area be removed and the space filled with approved earth, free from stone or fragmented material, shaped to the requirements and thoroughly compacted to provide adequate support for the pipe.

Trenches shall be kept free from water until the pipes are installed and the joints have hardened.

BEDDING FOR PIPE

The bedding surface shall provide a firm foundation of uniform density throughout the length of the culvert, shall conform to the specified levels and grade, and shall be of one of the following two types as specified on the drawings :

- i) **First Class Bedding:** Under first class bedding, the pipe shall be evenly bedded on a continuous layer of well compacted approved granular material, shaped concentrically to fit the lower part of the pipe exterior for atleast ten percent of its overall height or as otherwise shown on the drawings. The bedding material shall be well graded sand or another granular material passing 5.6 mm sieve suitably compacted/rammed. The compacted thickness of the bedding layer shall be as shown on the drawings and in no case shall it be less than 75 mm.
- ii) **Concrete Cradle Bedding :** When indicated on the drawings or directed by the Engineer, the pipe shall be bedded in a cradle constructed of concrete having a mix not leaner than M 15 conforming to Section 1700. The shape and dimensions of the cradle shall be as indicated on the drawings. The pipes shall be laid on the concrete bedding before the concrete has set.

LAYING OF PIPE

No pipe shall be laid in position until the foundation has been approved by the Engineer. 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 a minimum of 450 mm. The arrangement for lifting, loading and unloading concrete pipes from factory/yard and at site shall be such that the pipes do not suffer any undue structural strain, any damage due to fall or impact. The arrangement may be got approved by the Engineer.

Similarly, the arrangement for lowering the pipe in the bed shall be got approved by the Engineer. It may be with tripod-pulley arrangement or simply by manual labour in a manner that the pipe is placed in the proper position without damage.

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. In case of use of pipes with bell-mouth, the belled end shall face upstream. The pipes shall be fitted and matched so that when laid in work, they form a culvert with a smooth uniform invert.

Any pipe found defective or damaged during laying shall be removed at the cost of the Contractor.

JOINTING

The pipes shall be jointed either by collarjoint or by flush joint. In the former case, the collars shall be of RCC 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 pipe. 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 center coincides with the joint and an even annular space is left between the collar and the pipe.

Flush joint may be internal flush joint or external flush joint. In either case, the ends of the pipes shall be specially shaped to form a self centering joint with a jointing space 13 mm wide. The jointing space shall be filled with cement mortar, 1 cement to 2 sand, mixed sufficiently dry to remain in position when forced with a trowel or rammer. Care shall be taken to fill all voids and excess mortar shall be removed.

For jointing pipe lines under light hydraulic pressure, the recess at the end of the pipe shall be filled with jute braiding dipped in hot bitumen or other suitable approved compound. Pipes shall be so jointed that the bitumen ring of one pipe shall set into the recess of the next pipe. The ring shall be thoroughly compressed by jacking or by any other suitable method.

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.

BACK FILLING

Trenches shall be backfilled immediately after the pipes have been laid and the jointing material has hardened. The backfill soil shall be clean, free from boulders, large roots, excessive amounts of sods or other vegetable matter, and lumps and shall be approved by the Engineer. Backfilling upto 300 mm above the top of the pipe shall be carefully done and the soil thoroughly rammed, tamped or vibrated in layers not exceeding 150 mm, particular care being taken to thoroughly consolidate the materials under the haunches of the pipe. Approved pneumatic or light mechanical tamping equipment can be used.

Filling of the trench shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressures do not occur.

In case of high embankment, after filling the trench upto the top of the pipe in the above said manner, a loose fill of a depth equal to external diameter of the pipe shall be placed over the pipe before further layers are added and compacted.

OPENING TO TRAFFIC

No traffic shall be permitted to cross the pipes unless height of filling above the top of the pipes is atleast 600 mm.

MEASUREMENTS FOR PAYMENT

RCC pipe shall be measured as complete work in Running metres along its length between the inlet and outlet ends.

RATE

The Contract unit rate for the RCC pipe shall include the cost of pipes including loading, unloading, hauling, handling, storing, laying in position and jointing and all ancillary works such as excavation, bedding for pipes, backfilling, and incidental costs to complete the work as per these specifications

ITEM NO: 5 Providing and laying cement concrete 1:4:8 (1-Cement : 4- coarse sand : 8- hand broken stone aggregates 40 mm nominal size) and curing complete excluding cost of formwork in (A)Foundation and Plinth

1. In case of ordinary concrete, mix is not required to be designed by preliminary tests and proportions of cement, fine aggregate and coarse aggregates are specified by volume as given in table below for different four grades designated as ordinary M-100, M-150, M-200 and M-250.
2. In the designation of a concrete mix letter M refers to the mix and the number to the specified 28 days works cube compressive strength of that mix on 150 mm cubes expressed in kg. /cm.
3. The ordinary concrete mix shall generally be specified by volume for cement which normally comes in bags and is used by weight, volume shall be worked out taking 50 kg. of cement as 0.035 cubic meter in volume. While measuring aggregate by volume, stacking, ramming or hammering shall not be done proportioning of sand be as per its dry volume. In case it is dam, allowance for bulking shall be made as per IS: 2386 (Part-III).
4. In gradients required for ordinary / concrete containing one 50 kg. bag of cement for different proportions of mix shall be as given in Table below.

TABLE

Grade of concrete	Mix by volume	Total quantity of dry aggregates by volume per 50 kg. cement to be taken as sum aggregate of the individual volumes of fine & coarse aggregates, maximum	Proportion of fine aggregate to coarse aggregate	Quantity of water per 50 kg. of cement max.
(1 cubic metre: 1000 Litres)				
1	2	3	4	5
Ordinary	Litres			Litres
M-100	1:3:6	300	General 1:2 for fine aggregate to Coarse aggregate by volume but subject to a upper limit of 1:1.1/2 & a lower limit of 1:3.	34
M-150	1:2:4	220		32
M-200	1:1.1/2:3	160		30
M-250	1:1:2	100		27

Note: - The proportion of the aggregates shall be adjusted from upper limit to lower limit progress grading of the final aggregate becomes finer and the maximum size of coarse aggregate becomes larger.

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

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

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

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

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

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

7. All materials shall be stored as to prevent their deterioration or intrusion of their quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-charge shall not be used in the work

8. Cement shall be store above the ground level in perfectly dry and watertight sheds and shall be stocked not more than eight bags high. Wherever bulk storage containers are used. their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months. Cement more than 3 to 4 months old shall invariably be tested to ascertain that R satisfies the ascertain requirements. The aggregates shall be stored in such a way as to prevent admixture of foreign materials. Different sizes of the fine or coarse aggregate shall be stored in separate stock piles sufficiently removed from each other to prevent intermixing the materials.

9. The water for mixing shall be portable water to the satisfaction of the Engineer-in-charge. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the job.

10. For all work concrete shall be mixed in a mechanical mixer which along with other accessories shall be kept in first class working condition and so maintained throughout the construction. Mixing shall be continued till materials are uniformly distributed and uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate shows complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.

11. When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons, it shall be done on a smooth watertight platform large enough to allow efficient. Turning over of the ingredients of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material shall get mixed with concrete nor does the mixing water flow out. Cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregate. Which shall also be spread in a layer of uniform thickness on the mixing platform? Dry course and fine aggregate and cement then shall be mixed thoroughly by turning over to get a mixture of uniform colour. Enough water shall then be added gradually through a nose and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 percent above that specified.

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

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

14. If concreting is not started with 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-charge. Concreting then shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried in properly designed agitators, operating continuously, when this time shall be within 2 hours of the addition of cement to the mix

and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to by the Engineer-in-charge, concrete shall be disposed in horizontal layer to a compacted depth of not more than 0.45 metre when internal vibrators are used and not exceeding 0.30 metre in all other cases.

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

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

17. Immediately after compaction concrete shall be protected against harmful effects of weather including rain, running water shocks, vibrations due to traffic, rapid temperature changes. Fast drying put process, it shall be covered with wet sacking Hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set. It shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonry work over the foundation concrete may be started after 48 hours of it's laying but the curing of concrete shall be continued for a minimum period of 14 days. Form work shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Formwork shall however be delivered into following two district categories: -

(1) Shuttering i.e. from work required for forming the concrete

(2) Scaffolding i.e. formwork required for supporting shuttering.

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

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

19. The inside surface of forms shall except in the case of permanent from work or where otherwise agreed to by the engineer-in-charge be coated with an approved material to prevent adhesion of concrete to the from work. Release agents shall be applied strictly in accordance with the manufacture's instruction and shall not be allowed to come into contact with any reinforcement of prestressing tendons a and anchorage shall be applied strictly in accordance with the manufacturers instruction and shall not be allowed to come into contact with any reinforcement of prestressing tendons and anchorage. Different release agents shall not be used in from work of concrete which will be visible in the finished works.

20. Special measures shall be taken to ensure that the framework does no hinder the shrinkage of concrete because without these cracking could occur before the from work is removed. Wherever applicable arrangement must be made to ensure that the from does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons. The formwork should take due account of the calculated amount of positive or negative camber so as to ensure the correct final shape of the structures having regard to the deformation of false work, scaffolding or propping and the instantaneous deformation due to various causes affecting prestressed structures. Where there are re-entrant angles in the concrete section, the formwork should be removed at these sections as soon as possible after the concrete has set in order to avoid cracking due to shrinking of concrete. Formwork shall be tight enough to prevent any appreciable loss of cement during vibrations. Suitable tolerances should be provided in the formwork, immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the Engineer-in- charge due notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength alignment and general fitness, but such inspection shall not relieve the contractor of his responsibility for safety of machinery materials and for results obtained.

21. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any for work. While fixing the time for removal of formworks. Due consideration shall be given to local condition, Character of the structure, the weather and other condition that influence the setting of concrete the removal of The load supporting of soffit forms any commence when concrete has attained strength and of the materials used in the mix. Where field operations are controlled by the strength test of concrete, the removal of the load supporting of soffit forms may commence when concrete has attained strength equalto at least twice the stress to which the concrete will be subject at the time of striking props including the effect of any further addition of loads. When field operations are not controlled by strength test of concrete the vertical forms of beams, columns and walls may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 days respectively. All from work shall be removed without causing any damage to the concrete. Canterng shall be gradually and uniformly lowered in such a manner as to avoid any stock or vibrations. Supports shall be removed in such a manner as to

permit the contract the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortars. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to reuse the framework R shall be cleaned and made good to the satisfaction of the Engineer-in-charge.

23 Immediately after the removal of forms, all exposed bars or bolts passing through the Cement concrete member and used for shuttering or any other purpose shall be cut inside the Cement Concrete member to a depth of at least 25 mm. below the surface of the concrete and the resulting holes filled by cement mortar. All fins cause by from joints, all cavities produced by the removal of from ties and all other holes and depressions, honeycomb spots, broken edges or corner and other defects shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete with mortar or cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry a consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surface which has been pointed shall be kept moist for a period of 24 hours. If rock, pockets / honeycombs, in the opinion of the Engineer-in-charge are of such extent of and character as to affect materially or to endanger the life of the strength or the steel reinforcement he may declare the concrete defective and require the removal and replacement of the portions of the structure affected.

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

	Type of Work	Slump where vibrator is used	Slump where vibrator is not used
1	Mass conc. In RCC, foundation footing and retaining walls	10 to 25 mm	80 mm
2	Beam slab and column with simply reinforced	25 to 40 mm	100 to 120 mm
3	Thin RCC section or congested steel	40 to 50 mm	125 to 150 mm

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

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

less than the specified strength, provided the lowest value is not less than 85 percent of the specified strength.

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

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

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

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

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

ITEM NO: 6 Providing and casting in site Controlled cement concrete M-250 for average 200 mm thick as directed including compacting with surface mechanical screed vibrating, mechanical floater, chennaling form work and grooving including filling asphalt filer joint Excluding dowel bar, tie bar expansion, construction and contruction joint as per insruction engineer in charge.

Specification as per Item No.05

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

ITEM NO: 7 Providing and fixing ordinary Kilometer stone of precast C.C. 1:2:4 including necessary reinforcement as per I.R.C. type design in C.C. 1:4:8 including painting,lettering etc. complete (For O.D. road V.R.)

1. Ordinary Kilometre stone shall be of approved quality of including necessary reinforcement as per IRC type design as specified in the item.
2. The size, manner of fixing, painting and lettering of ordinary Kilometre stone shall conform specification as per IRC – 8 (Type design for Highway kilometre stones). The fixing of KM stone shall be carried out in ordinary payment shall be made per No. of KM stone fixed in position.
3. Fixing in C.C. 1:4:8

The ordinary kilometre stone shall be fixed in C.C. 1:4:8 which will consist of one part of cement, four part of good sand and eight parts of good brick bats, Rate includes all labour and curing etc. necessary for concrete.

4. Unit rate for ordinary kilometre stone includes the cost of all materials labour, tools, fixing finishing curing lettering and painting as directed by the Engineer- in-charge.

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

ITEM NO: 8 Providing and fixing Pre Cast Hectometer as per I.R.C. type design including painting, lettering etc. complete.(ii) Fixing in C.C. 1:5:10.

1) The work shall be carried out as per the item of ordinary kilometre stone except that the size of Hectometer stone shall be smaller than that of ordinary kilometre stone as per I.R.C. 26 (Type design lor 200 meter stones) and fixing shall be in earth. The measurement for payment as well as the operations included in the unit rate shall be as per ordinary kilometers stone.

(2) **Fixing in C. C. 1:5:10** Specification same as 11 (1) above except that the indicator stone shall be fixed in C.C. 1:5:10 which will consist of one part of cement, five part of good sand and ten parts of good brick bats. Rate includes all labour and curing etc. necessary for concrete. Measurement & Payment shall be made of No. Basis.

ITEM NO: 9 Providing and fixing guard stone as per I.R.C. type design including white washing etc. complete.(ii) Fixing in Earth.

The guard stone shall be approved quality as per I.R.C. type design and of 20 x 15 cm. size and its length shall not be less than 75 cms. The top portion shall be rounded. The top 38 cms. shall be chiseled dressed on all sides. The size, shape and dimensions of the guard stone shall be exact and shall be neatly dressed and finished.

The guard stone shall be fixed in earth. Rate includes all labour & curing etc. necessary for work. The exposed part of the guard stone shall be given three coats of white wash. Any excavation necessary for fixing to guard stones shall be done by the contractor at his own cost. The measurement for payment shall be per Number of guard stone fixed in position.

RATE

The contract unit rate for Guard Stones shall be payment in full compensation for furnishing all labour, materials including providing necessary reinforcement, tools, equipment and making the stones white washing and fixing at site and all other incidental, taxes, costs, necessary to complete the work to these specifications.

Payment shall be made carried out on Number basis.

ITEM NO: 10 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 coefficinet on cemend road shall be min 130 mcd/m2/lux and Asphalt road shall be min 100 mcd/m2/lux during the service life during the day time. The marking should meet the performance criteria for night time reflectivity, wet reflectivity and skid resistance as mentioned in the section-15 of IRC 35-2015. Warranty for the Retro reflectivity should be two years.

803.1 Scope:

The work shall consist of providing road markings of specified width, layout and design using paint of the required specifications as given in the Contract and as per guidelines contained in from IRC: 35 -1997.

803.2 Materials:

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

803.4 Hot Applied Thermoplastic Road Marking

803.4.1 Thermoplastic Material

803.4.1.1 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.

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 (Percentage by weight)

Component	White	Yellow
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 O36/BS-3262-(Part I), shall be as below:

a) Luminance:

White: Daylight luminance at 45°-65 percent min. as per AASHTO M249

Yellow: Daylight luminance at 45°-45 percent min. as per AASHTO. M 249

b) Drying time:

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

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

d) Cracking resistance at low temperature:

The material shall show no cracks on application to concrete blocks

e) Softening point: 102.5°C ± 9.5°C as per ASTM D 36.

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

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

i) **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.

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

- 1) The name, trade mark or other means of identification of manufacturer
- 2) Batch number
- 3) Date of manufacturer
- 4) Colour (White or Yellow)
- 5) Maximum application temperature and maximum safe heating temperature

iii) 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.

803.4.2 ReflectORIZING Glass Beads

803.4.2.1 General

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

803.4.2.2 The glass beads shall be transparent, colorless and free from milky, dark particles and excessive air inclusions. These shall conform to the requirements spelt out in Clause 803.4.2.3.

803.4.2.3 Specification 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	Percent 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	0-10	10 to 30
Below 180 micron	-	0 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.

803.4.2.4 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.

803.4.3 Application Properties of Thermoplastic Material

803.4.3.1

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.

803.4.3.2

The material upon heating to application temperatures shall not exude fumes, the material upon heating to application temperatures shall not exude fumes.

803.4.4 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.

803.5 Reflectorised Paint

Reflectorised paint, if used, shall conform to the Specification by the manufacturers and approved by the Engineer. Reflectorising

glass beads for reflectorising paints where used shall conform to the requirements of Clause 803.4.2.

803.6 Application

803.6.1

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

803.6.2

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

803.6.3

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.

803.6.4

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 metre area.

803.6.5

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 IS:3262 (Part 3).

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

- i) Width of lines and other markings shall not deviate from the specified width by more than 5 percent.
 - ii) The position of lines, letters, figures, arrows and other markings shall not deviate from the position specified by more than 20 mm
 - iii) The alignment of any edge of a longitudinal line shall not deviate from the specified alignment by more than 10 mm in 15 m.
 - iv) 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.

803.6.7 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.

803.6.8 Measurements for Payment

803.6.8.1

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

803.6.9 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.

ITEM NO: 11 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.

General

The colour, configuration, size and location of Cat eye reflector for highways other than Expressways shall be in accordance with the code of Practice for Road Signs, IRC:67 or as shown on the drawings or as directed by the Engineer.

The Cat eye reflector shall be reflectorised as shown on the drawings or as directed by the Engineer. It shall be of retro-reflectorised type and made of encapsulated lens type reflective sheeting vide Clause 801.3, fixed over aluminium sheeting as per these specifications.

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

1.2 Materials:

The various materials and fabrication of the Cat eye reflector shall conform to the following requirements.

The adhesive materials shall be of standard quality and it shall be high resistance quality against heavy moving vehicles.

The materials shall be used for the body of the Cat eye reflector is of high-density PVC materials.

The dimensions and size of the Cat eye reflector shall be as per IS standard. The retro- reflective sheeting used on the cat-eye 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 colour fastness. It shall be new and unused and shall show no evidence of cracking, scaling, pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate of having tested the sheeting for these properties in an unprotected outdoor exposure facing the sun for two years and its having passed these tests shall be obtained from a reputed laboratory, by the manufacturer of the sheeting. The reflective sheeting shall be either of Engineering Grade material with enclosed lens or of High Intensity Grade with encapsulated lens. The type of the sheeting to be used would depend upon the type, functional hierarchy and importance of the road.

High intensity grade sheeting's: This sheeting shall be of encapsulated lens type consisting of spherical glass lens, elements adhered to a synthetic resin and encapsulated by a flexible, transparent water-proof plastic having a smooth surface. The retro-reflective surface after cleaning with soap and water and in. dry condition shall have the minimum co-efficient of retro-reflection determined in accordance with ASTM Standard E:810).TABLE 800.1

ACCEPTABLE MINIMUM CO-EFFICIENT OF RETRO-REFLECTIONFORHIGHINTENSITYGRADESHEETING

[CANDEL AS PER LUX PER SQUARE METRE]

Observa- tion (in degree)	Entrance angle (in degree)	White	Yellow	Orange	Green/ Red	Blue
0 .2	-4	250	170	100	45	20

2	+ 30	150	100	60	25	1.1
0.5	- 4	95	62	30	15	7.5
5	+ 30	65	45	25	10	5.0

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

Engineer grade sheetings : This sheeting shall be of enclosed lens type consisting of microscopic lens elements embedded beneath the surface of a smooth, flexible, transparent, water proof plastic, resulting in a non-exposed lens optical reflecting system. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection determined in accordance with ASTM Standard E:810) as indicated in Table 800.2.

TABLE 800.2

**ACCEPTABLE MINIMUM CO-EFFICIENT OF
RETRO-REFLECTION FOR HIGH INTENSITY GRADE SHEETING**

[CANDEL AS PER LUX PER SQUARE METRE]

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

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

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

1.4 INSTALLATION:

The Cat eye (stimsonite) reflector shall be installed directly on road surface, after cleaning completely by removing all dust and other foreign materials from the surface of the road.

1.5 MEASUREMENT FOR PAYMENT:

The measurement shall be in numbers, these shall be measured in No.

1.6 RATE :

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

ITEM NO: 12 Chevron sign :-Providing and fixing sign boards made out of 1.5mm aluminium sheet / 3mm ACP (Aluminum composite Panel); size 60x50cm rectangular as per design of IRC-67-2012. Pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.3 mtr long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of35x35x3mm; painted with bestquality 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 blockof size 45 x 45 x 60 Cms. for each leg including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor.
(A) Class-B Type-4 Retro Reflective sheeting

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 -2010.

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

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

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

801.2. Materials

The various materials and fabrication of the traffic signs shall conform to the following requirements otherwise shown on the drawing.

801.2.1 Concrete

Concrete for foundation shall be of M 15 grade as per section 1700 or the grade shown on the drawings or otherwise as directed by the engineer.

801.2.2 Reinforcing steel

Reinforcing steel shall confirm to the requirement of IS:1786 unless otherwise shown on the drawing.

801.2.3.

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

801.2.4 Plates and supports:

Plates and support sections for the signposts shall conform to IS: 226and IS: 2062or any other relevant IS Specifications.

801.2.5 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 1900. Aluminum Composite Material (ACM) sheets shall be sandwiched construction with a thermoplastic core of Low Density Polyethylene (LOPE) 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 accordanc'.3 with the test methods mentioned against each of them.

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

Sr.No.	Description	Specification	
		Standard Test	Acceptable Value

A	Mechanical Properties of ACM		
1	Peel off strength with retro reflective sheeting (Drum Peel Test)	ASTM D903	Min. 4 N/mm
2	Tensile strength	ASTM E8	Min 40 N/mm2
3	0.2% Proof Stress	ASTM E8	Min. 34 N/mm2
4	Elongation	ASTM E8	Min. 6%
5	Flexural strength	ASTM 393	Min. 130 N/mm2
6	Flexural Modulus	ASTM 393	Min. 44 N/mm2
7	Shear strength with punch shear test	ASTM 732	
B	Properties of Aluminium Skin		
1	Tensile strength	ASTM E8	Min. 65 N/mm2
2	Modulus of elasticity	ASTM E8	Min. 70000 N/mm2
3	Elongation	ASTM E8	A50 Min. 2%
4	0.2% Proof Stress	ASTM E8	Min. 10 N/mm2

801.2.6. Plate Thickness

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

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

801.3. Traffic Signs Having Retro-reflective Sheeting

801.3.1. General requirements: The retro-reflective sheeting used on the sign shall consist of the white or coloured sheeting having a smooth outer surface which has' the property of retro-reflection over its entire surface. It shall be weather-resistant and show colour fastness. It shall be new and unused and shall outdoor exposure facing the sun for two years and its having passed these tests shall be obtained from a reputed laboratory, by the manufacturer of the sheeting. The reflective sheeting shall be either of Engineering Grade material with enclosed lens or of High Intensity Grade with encapsulated lens. The type of the sheeting to be used would depend upon the type, functional hierarchy and importance of the road.

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

TABLE 800-2. Acceptable Minimum Co-efficient of Retro-Reflection for High Intensity Grade Sheeting (Type III) (Encapsulated Lens Type) (Candles Per Lux Per Square Metre)

Observation Angle in Degrees	Entrance Angle in Degrees	White	Yellow	Orange	Green	Red	Blue	Brown
0.1 ^{0B}	(-4 ⁰)	300	200	120	54	54	24	14
0.1 ^{0B}	(+30 ⁰)	180	120	72	32	32	14	10
0.2 ⁰	(-4 ⁰)	150	170	100	45	45	20	12
0.2 ⁰	(+30 ⁰)	95	100	60	25	25	11	8.5
0.5 ⁰	(-4 ⁰)	65	62	30	15	15	7.5	5
0.5 ⁰	(+30 ⁰)	65	45	25	10	10	5	3.5

A. Minimum of coefficient of Retro-reflection (RA)

B. Values for 0.1⁰ observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order. When totally wet, the sheeting shall show not less than 90%, of the values of retro reflectance indicated in above Table. At the end of 7 years, the sheeting shall retain at least 80 % of its original retro-reflection.

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

TABLE 800-3. ACCEPTABLE MINIMUM COEFFICIENT OF RETRO-REFLECTION FOR ENGINEERING GRADE SHEETING (CANDELAS PER LUX PER SQUARE METRE)

Observation Angle in Degrees	Entrance Angle in Degrees	White	Yellow	Orange	Green	Red	Blue	Brown
0.1 ^{0B}	(-4 ⁰)	500	380	200	70	90	42	25
0.1 ^{0B}	(+30 ⁰)	240	175	94	32	42	20	12
0.2 ⁰	(-4 ⁰)	360	270	145	50	65	30	18
0.2 ⁰	(+30 ⁰)	170	135	68	25	30	14	8.5
0.5 ⁰	(-4 ⁰)	150	110	60	21	27	13	7.5
0.5 ⁰	(+30 ⁰)	72	54	28	10	13	6	3.5

- A. Minimum of coefficient of Retro-reflection (RA)
- 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%, of the values of retro reflectance indicated in above Table. At the end of 7 years, the sheeting shall retain at least 80 % of its original retro-reflectance.

801.3.4. Prismatic Grade Sheeting

801.3.4 Prismatic Grade Sheeting (Type VIII)

801.3.4.1 Prismatic Grade Sheeting

The reflective sheeting shall be retro reflective sheeting made of micro prismatic retro reflective material. The retro reflective surface, after clearing with soap and water and in dry condition shall have the minimum co-efficient of retro reflection (determined in accordance with ASTM E810) as indicated in Table 800-4.

801.3.4.2 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 clearing with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM E810) as indicated in Table 800-5.

TABLE 800-4. ACCEPTABLE MINIMUM COEFFICIENT OF RETRO-REFLECTION FOR PRISMATIC GRADE SHEETING (Type VI) (CANDELAS PER LUX PER SQUARE METRE)

Observation Angle in Degrees	Entrance Angle in Degrees	White	Yellow	Orange	Green	Red	Blue	Brown	Fluorescent Yellow/Green	Fluorescent Yellow	Fluorescent Orange
0.1 ^{0B}	(-4 ⁰)	1000	750	375	100	150	45	30	800	600	300
0.1 ^{0B}	(+30 ⁰)	460	345	175	46	69	21	14	370	280	135
0.2 ⁰	(-4 ⁰)	700	525	265	70	105	32	21	560	420	210
0.2 ⁰	(+30 ⁰)	325	245	120	33	49	15	10	260	200	95
0.5 ⁰	(-4 ⁰)	250	190	94	25	38	11	7.5	200	150	75
0.5 ⁰	(+30 ⁰)	115	86	43	12	17	5	3.5	92	69	35

- A. Minimum of coefficient of Retro-reflection (R^A) cd/fc/ft² (cd-lx-1m²)
- 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%, of the values of retro reflectance indicated in above Table. At the end of 7 years, the sheeting shall retain at least 80 % 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 in Degrees	Entrance Angle in Degrees	White	Yellow	Orange	Green	Red	Blue	Fluorescent Yellow/Green	Fluorescent Yellow	Fluorescent Orange
0.1 ^{0B}	(-4 ⁰)	600	500	250	66	130	130	530	400	200
0.1 ^{0B}	(+30 ⁰)	370	280	140	37	74	17	300	220	110
0.2 ⁰	(-4 ⁰)	380	285	145	38	76	17	300	230	115

0.2 ⁰	(+30 ⁰)	215	162	82	22	43	10	170	130	65
0.5 ⁰	(-4 ⁰)	240	180	90	24	48	11	190	145	72
0.5 ⁰	(+30 ⁰)	135	100	50	14	27	6	110	81	41
1.0 ⁰	(-4 ⁰)	80	60	30	8	16	3.6	64	48	24
1.0 ⁰	(+30 ⁰)	45	34	17	4.5	9	2	36	27	14

- A. Minimum of coefficient of Retro-reflection (R^A) cd/fc/ft² (cd-lx-lm²)
- 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%, of the values of retro reflectance indicated in above Table. At the end of 10 years, the sheeting shall retain at least 80 % of its original retro-reflectance.

801.3.4.3 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 clearing 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 A (Type XI) (CANDELAS PER LUX PER SQUARE METRE)

Observation Angle in Degrees	Entrance Angle in Degrees	White	Yellow	Orange	Green	Red	Blue	Brown	Fluorescent Yellow/Green	Fluorescent Yellow	Fluorescent Orange
0.1 ^{0B}	(-4 ⁰)	830	620	290	83	125	37	25	660	500	250
0.1 ^{0B}	(+30 ⁰)	325	245	115	33	50	15	10	260	200	100
0.2 ⁰	(-4 ⁰)	580	435	200	58	87	26	17	460	350	175
0.2 ⁰	(+30 ⁰)	220	165	77	22	33	10	7	180	130	66
0.5 ⁰	(-4 ⁰)	420	315	150	42	63	19	13	340	250	125
0.5 ⁰	(+30 ⁰)	150	110	53	15	23	7	5	120	90	45
1.0 ⁰	(-4 ⁰)	120	90	42	12	18	5	4	96	72	36
1.0 ⁰	(+30 ⁰)	45	34	16	5	7	2	1	36	27	14

- A. Minimum of coefficient of Retro-reflection (R^A) cd/fc/ft² (cd-lx-lm²)
- 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%, of the values of retro reflectance indicated in above Table. At the end of 10 years, the sheeting shall retain at least 80 % of its original retro-reflectance.

801.3.5.

Adhesives: The sheeting shall either have pressure-sensitive adhesive of the aggressive-tack type requiring no heat, solvent or other preparation for adhesion to a smooth clean surface, or a tack free adhesive activated by heat, applied in a heat-vacuum applicator, in a manner recommended by the sheeting manufacturer. The adhesive shall be protected by an easily removable liner (removable by peeling without soaking in water or other solvent) and shall be suitable for the type of material of the base plate used for the sign. The adhesive shall form a durable bond to smooth, corrosion and weather resistant surface of the base plate such that it shall not be possible to remove the sheeting from the sign base in one piece by use of sharp instrument. In case of pressure-sensitive adhesive sheeting, the sheeting shall be applied in accordance with the manufacturer's Specifications. Sheeting with adhesives requiring use of solvents or other preparation for adhesive shall be applied strictly in accordance with the manufacturer's instructions.

801.3.6. Fabrication:

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

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

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

801.3.7 Messages/ Borders

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

boards, the messages (legends, letters, numerals etc.) and borders shall be cut out from durable transparent overlay film or cut-out from the same reflective sheeting only. Cut-outs shall be from durable transparent overlay materials as specified by the sheeting manufacturer and shall be bonded with the sheeting in the manner specified by the manufacturer. For screen-printed transparent colored 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.

801.3.8 Colour of signs

801.3.8.1

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

801.3.8.2

Except in the case of railway level crossing signs the sign posts shall be painted in 250 mm side bands, alternately black and white. The lowest band next to the ground shall be in black.

801.3.8.3

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 as per 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	0.3	0.368	0.366	0.34	0.393	0.274	0.329	15	-
Yellow	0.498	0.412	0.557	0.442	0.479	0.52	0.438	0.472	24	45
Green	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	0.140	0.035	0.244	0.21	0.19	0.255	0.065	0.216	1	10
Orange	0.558	0.352	0.636	0.364	0.57	0.429	0.506	0.404	12	30
Brown	0.43	0.34	0.61	0.390	0.55	0.45	0.43	0.39	1	6
Fluorescent Yellow-Green	0.387	0.61	0.369	0.546	0.428	0.496	0.46	0.54	60	-
Fluorescent Yellow	0.479	0.52	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	-

801.3.8.4

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.

801.3.8.5

The colours chosen for informative 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.

801.3.9 Refurbishment

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.

801.3.10 Sizes of letters

801.3.10.1 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

Design Speed (Km./hr.)	Minimum 'x' height of the letters (mm)	Minimum Sight distance/ Clear visibility distance (m)	Maximum distance from centre line (m)
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, 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.

801.3.10.2

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.

801.3.10.3

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.

801.3.11. Warranty and durability:

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

Processed and applied in accordance with recommended procedures, the reflective material shall be weather resistant and, following cleaning, shall show no appreciable discoloration, cracking, blistering or dimensional change and shall not have less than 80 per cent of the specified minimum reflective intensity values (Tables 800-1 and 800-2) when subjected to accelerated weathering for 1000 hours, using type E or EH Weather meter (AASHTO Designation M 268).

801.4. Installation

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

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

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

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

801.5. Measurements for Payment

The measurement of standard cautionary, mandatory and information signs shall be in numbers of different types of signs supplied and fixed, while for direction and place identification signs, these shall be measured by area in square meters.

The mode of Measurement shall be made in Number basis.

The description of Item shall be self-specification of work shall be carried as per IRC and drawing supplied by engineer in charge.

801.6. Rate

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

A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3-year outdoor

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

The Measurement & Payment shall be made of No. Basis

ITEM NO: 13 Cautionary Warning Sign :-Providing and fixing sing boards made out of 2mm aluminium sheet; size 90 x 90 x 90 cms. equilateral triangle as per design of IRC-67-1977. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ;reflectorised with retro reflectivesheeting as per latest M.O.S.T.Specifications; 3.1m long stand postand frame fabricated from suitable sizeiron angle of 35 x 35 x 3mm, 75 x 75 x 6mm as required; painted with bestquality epoxy coatings in black andwhite 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) Engineer Grade(VR).

The specification of **Item No. 12** shall be followed for the execution of this item except the size of **Cautionary Warning sign board** As Per Item Description.

Use Engineering grade Retro Reflective sheet as per instruction of EIC.

The Measurement & Payment shall be made of No. Basis.

ITEM NO: 14 Village name/ Bump Ahead sign :-Providing and fixing sing boards made out of 2mm aluminium sheet; size 90 x 60cms. rectangle as as per the design of IRC-67-1977 pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; Letters and numerals should be as per IRC-30-1968, 3.1m long (2 nos) stand post and frame fabricated from suitable size iron angle of 50 x 50 x 5mm painted with best quality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR).

The specification of **Item No. 12** shall be followed for the execution of this item except the size of **Village name sign board** As Per Item Description.

Use Engineer grade Retro Reflective sheet as per instruction of EIC.

The Measurement & Payment shall be made of No. Basis.

ITEM NO: 15 Regulatory/Mandatory signs :-Providing and fixing sing boards made out of 2mm aluminium sheet; size 60cms. diameter circle as per the design of IRC-67-1977 pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm 75x75x6mm as required; 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 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR).

The specification of **Item No. 12** shall be followed for the execution of this item except the size of **Regulatory/Mandatory sign board** As Per Item Description.

Use Engineer grade grade Retro Reflective sheet as per instruction of EIC.

The Measurement & Payment shall be made of No. Basis.

ITEM NO: 16 Direction (Junction) Sign :-Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 244x122 cms. rectangular as per design of IRC-67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 4.0mtr (2 Nos.) long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 50x50x5mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg including excavation, curing etc.complete under the supervision of engineer in charge. (A) engineering grade.

The specification of **Item No. 12** shall be followed for the execution of this item except the size of **Direction Junction sign board** As Per Item Description.

Use Engineer grade grade Retro Reflective sheet as per instruction of EIC.

The Measurement & Payment shall be made of No. Basis.

ITEM NO: 17 STOP SIGN:-Providing and fixing sing boards made out of 2mm aluminium sheet; size 90 x 90cms. rectangle as per the design of IRC-67-1977 pre treated with phospheting process & acid teching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm 75x75x6mm as required; 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 60cms. for each leg. including excavation curing tec. complete under the supervision of engineer in charge.(A) Engineer Grade(VR).

The specification of **Item No. 12** shall be followed for the execution of this item except the size of **Stop sign board** As Per Item Description.

Use Engineer grade grade Retro Reflective sheet as per instruction of EIC.

The Measurement & Payment shall be made of No. Basis.

ITEM NO: 18 Hazard Marker Sign :-Providing and fixing sing boards made out of 2mm aluminium sheet; size 90 x 30cms. rectangle as as per the design/drawing attached (IRC) pretreated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm & 50 x 50 x 5mm painted with best quality epoxy coatings The fixing at site shall be in 1:2:4 CC block of size 45x45x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR).

The specification of **Item No. 12** shall be followed for the execution of this item except the size of **Hazard Marker sign board** As Per Item Description.

Use Engineer grade grade Retro Reflective sheet as per instruction of EIC.

The Measurement & Payment shall be made of No. Basis.

ITEM NO: 19 "KISANPATH LOGO" Board : Providing and fixing of KISANPATH 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. MMGSY 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 MMGSY 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.

The specification of **Item No. 12** shall be followed for the execution of this item except the size of **Kishanpath Logo sign board** As Per Item Description.

Use Type 1 Class A Retro Reflective sheet as per instruction of EIC.

The Measurement & Payment shall be made of No. Basis.

**Executive Engineer
R.& B. (P) Division
Ahmedabad**