

GOVERNMENT OF GUJARAT

ROAD & BUILDING DEPARTMENT

SPECIFICATIONS of

**Construction of Khambhat Golana Road To Sokhda
Panjrapole Road (VRNP) km. 0/000 To 0/300 Ta. :-**

Khambhat Dist. :- Anand Pkg. No. AND

/MMGSY/NORMAL/2025-26/24

GENERAL TECHNICAL SPECIFICATIONS

1.0 General :

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

- (i) length and breadth... 10 mm
 - (ii) height, depth or thickness of earthwork, sub-base, bases, surfacing, and structural members5 mm
 - (iii) areas,0.01 Sq. Metre
 - (iv) cubic contents..... 0.01 cubic metre
- in recording dimensions of work the sequence of length, width and height or depth or thickness shall be followed.

2.0 Measurement of lead for Materials :

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

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

3. Surface Regularity of Sub grade & Pavement Courses :

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

PERMITTED TOLERANCES OF SURFACE REGULARITY FOR PAVEMENT COURSES

Sr. No	Type of Construction	Longitudinal Profile with 3 metre straight edge					Cross Profile
		Maximum Permissible undulation in mm	Maximum number of undulation permitted in any 300m. length exceeding in mm.				
			18	12	10	6	
1	2	3	4	5	6	7	8
1	Earth Sub grade	36	30	-	-	-	15
2	Granular / lime / Cement Stabilised Sub – base.	23	-	30	-	-	12
3	Water Bound Macadam with nominal size metal (20-50)	18	-	-	30	-	8

	mm						
4	Semi – Dense Carpet @	15	-	-	-	20	6

Notes:-

1. These are for machine laid surfaces. If laid manually, due to unavoidable reason, tolerance upto 50 percent above these values in this column may be permitted. However, this relaxation does not apply to the values of maximum undulation for longitudinal and cross profiles mentioned in columns 3 and 8 in the table.
2. Surface evenness requirements in respect of both the longitudinal and cross profiles should be simultaneously satisfied.
3. **Rectification:** Where the surface irregularity of subgrade and the various pavement courses fall outside the specified tolerances, the contractor shall be liable to rectify these in the manner described below and to the satisfaction of the Engineer-in-charge at his own cost.

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

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

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

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

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

(v) Bituminous Constructions : For bituminous constructions, other than wearing course, where the surface is low, the deficiency shall be corrected by adding fresh material and recompaction to specifications.

Where this surface is high, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications. For wearing course, where the surface is high or low; the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications in all cases where the removal and replacement of a bituminous layer is involved, the area treated shall not be less than 5 metre long and not less than 1 lane wide.

4. Quality Control Tests During Construction :

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

5. Tests on Earthwork for Embankment Construction :

5.1 Borrow Material :

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

5.2 Compaction Control :

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

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

- (1)Cement.....
- (2)Sand for masonry.
- (3).....Sand for concrete.
- (4).....Coarse aggregate.
- (5).....Mild Steel...
- (6)High yield strength deformed bars
 - (a) Hot Rolled..... IS : 1139
 - (b) Cold Twisted..... IS : 1786

7. Barrel thickness of pipes of different class shall be as under :

Sr. No.	Internal Diameter of pipe in mm	Barrel thickness (in mm).		
		NP1	NP2	NP2
1	80	25	25	-
2	100	25	25	-
3	150	25	25	-
4	250	25	25	-
5	300	30	30	-
6	350	32	32	75
7	400	32	32	75
8	450	35	35	75
9	500	-	35	75
10	600	-	40	80
11	700	-	40	80
12	800	-	45	90
13	900	-	50	100
14	1000	-	55	100
15	1100	-	60	115
16	1200	-	65	115

STANDARD TECHNICAL SPECIFICATIONS

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

201. CLEARING AND GRUBING

201.1. Scope

This work shall consist of cutting, removing and disposing of all materials such as trees, bushes, shrubs, stumps, roots, grass, weeds, top organic soil not exceeding 300 mm in thickness, rubbish etc., which in the opinion of the Engineer are unsuitable for incorporation in the works, from the area of road land containing road embankment, drains, cross-drainage structures and such other areas as may be specified; on the drawings or by the Engineer. It shall include necessary excavation, backfilling of pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, and disposal of cleared materials. Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these specifications.

201.2. Preservation of Property/Amenities

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

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

201.3. Methods, Tools and Equipments

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

limits, frees and stumps required to be removed as directed by the Engineer shall be cut down to 1 m below ground level so that these do not present an unsightly appearance.

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

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

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

201.4. Disposal of Materials

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

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

201.5. Measurements for Payment

Clearing and grubbing for road embankment, drains and cross-drainage structures shall be measured on area basis in terms of **Hectare**. Clearing and grubbing of borrow areas shall be deemed to be a part of works preparatory to embankment construction and shall be deemed to have been included in the rates quoted for the embankment construction item and no separate payment shall be made for the same. Cutting of trees upto 300 mm in girth including removal of stumps and roots, and trimming of branches of trees extending above the roadway shall be considered incidental to the clearing and grubbing operations. 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 metre above ground or at the top of the stump if the height of the stump is less than one metre from the ground.

201.6. Rates

206.6.1 The Contract unit rates for the various items of clearing and grubbing shall be payment in full for carrying out the required operations including full compensation for all labour, materials, tools, equipment and incidentals necessary to complete the work. These will also include removal of stumps of trees less than 300 mm in girth as well as stumps left over after cutting of trees carried out by another agency, excavation and back-filling to required density, where necessary and handling, salvaging, piling and disposing of the cleared materials with all lifts and up to a lead of 1000 m.

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

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

The Contract Rate shall be for a unit of One Hector basis for completed item work.

Item No. 02 :- Providing and laying 150mm thick Granular sub base in required layer by providing coarse graded materials Grading-II using B.T. M.C. Metal 53.00mm to 26.5mm @ 35%, aggregate 26.50 to 4.75mm @ 45% and Stone dust @ 20% as per Table 400-2 of MORT&H gradation including conveying the materials at site of work, mixing & spreading in to grade and camber, watering & consolidating at OMC with vibratory roller including the cost of material, labours etc. complete.

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

401.2. Materials :

401.2.1. The material to be used for the work shall be natural un-screen gravel. The material shall be free from organic or other deleterious constituents and conform to one of the three grading given in Table 400-1.

While the grading in Table 400-1 are in respect of close-graded granular sub-base materials, one each for maximum particle size of 75 mm, 53 mm and 26.5 mm, the corresponding grading for the corresponded materials for each of the three maximum particle sizes are given at Table 400-2. The grading to be adopted for a project shall be as specified in the Contract.

401.2.2. Physical requirements: The material shall have a 10 per cent fines value of 50 KN or more (for sample in soaked condition) when tested in compliance with BS: 812 (Part 111). The water absorption value of the coarse aggregate shall be determined as per IS: 2386 (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 per cent.

TABLE 400-1. GRADING FOR CLOSE - GRADED GRANULAR SUB-BASE MATERIALS

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

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

IS Sieve Designation	Per cent by weight passing the IS sieve		
	Grading I	Grading II	Grading III
75.0 mm	100	-	—
53.0 mm		100	
26.5 mm	55-75	50-80	100

9.50 mm			
4.75 mm	10-30	15-35	25-45
2.36 mm			
0.425 mm			
0.075 mm	<10	<10	<10
CBR Value (Minimum)	30	25	20

Note: The material passing 425 micron (0.425 mm) sieve for all the three gradings when tested according to IS: 2720 (Part 5) shall have liquid limit and plasticity index not more than 25 and 6 per cent respectively. Not less than 30.

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

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

401.4. Construction Operations

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

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

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

Manual mixing shall be permitted only where the width of lying is not adequate for mechanical operations, as in small-sized jobs. The equipment used for mix-in-place construction shall be a rotator 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, rotators 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 tyred 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 6 the edges and progress towards the centre for portions having cross fall on both sides.

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

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

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

401.6. Arrangements for Traffic: During the period of construction, arrangement of traffic shall be maintained in accordance with Clause 112.

401.7. Measurements for Payment: Granular sub-base shall be measured as finished work in position in cubic meters. The protection of edges of granular sub-base extended over the full formation as shown in the drawing shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

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

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

The contract rate shall be for a unit of one Cubic metre for completed item as directed.

Item No.03 :- Earthwork for embankment including breaking clods, dressing with all lead and lift (including watering and consolidation) (C) From Borrow area with in all lead.

And

Item No.04 :- Earthwork for embankment including breaking clods, dressing with all lead and lift (including watering and consolidation)(D) From Borrow area within 2.0 Km. lead

EMBANKMENT CONSTRUCTION

General:

Description: These Specifications shall apply to the construction of embankments including sub grades, earthen shoulders and miscellaneous backfills with approved materials obtained from roadway and drain excavation, borrow pits or other sources. All embankments, sub grades, earthen shoulders and miscellaneous backfills shall be constructed in accordance with the requirements of these specifications and in conformity with the lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

Materials and General Requirements.

Physical requirements :

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

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

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

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

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

Materials with a total sulphate content (expressed as SO₃) exceeding 0.5 per cent by mass, when tested in accordance with BS: 1377 Test 9 shall not be deposited within 500 mm or other distances described in the contract, of metallic items forming part of the Permanent Works.

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

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.

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

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

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

The Contractor shall obtain representative samples from each of the identified borrow areas and have these tested at the site laboratory following a testing 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.

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 can not 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 inspite of that the specified compaction is not achieved, the material in the soft areas shall be removed and replaced by approved material, compacted to the density requirements and satisfaction of the Engineer.

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 moistured 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:-

- (i) If the existing road surface is of granular or bituminous type and lies within 1 m of the new subgrade level, the same shall be scarified to a depth of 50mm or more if specified, so as to provide ample bond between the old and new material ensuring that at least 500 mm portion below the top of new subgrade level is compacted to the desired density.
- (ii) If the existing road surface is of cement concrete type and lies within 1 m of the new subgrade level the same shall be removed completely.
- (iii) If the level difference between the existing road surface and the new formation level is more than 1 m. the existing surface shall be permitted to stay in place without any modification.

Embankment and subgrade around structures :-

To avoid interference with the construction of abutments, wing walls or return walls of culvert/bridge structures, the Contractor shall, at points to be determined by the Engineer suspend work on embankment forming approaches to such structures, until such time as the construction of the latter is sufficiently advanced to permit the completion of approaches without the risk of damage to the structure.

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

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 remolded samples, compacted to the field density at the field moisture content.

Measurements for Payment:-

Earth embankment/subgrade construction shall be measured separately by taking cross sections at intervals in the original position before the work starts and after its completion and computing the volumes of earthwork in cubic 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 recompacting of ground supporting embankment/subgrade shall be measured in cu.m.

Removal of unsuitable material at embankment/subgrade foundation and replacement with suitable material shall be measured in Cu.m.

Scarifying existing granular/bituminous road surface shall be measured in Square metres.

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

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

RATES:

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

- (i) Cost of arrangement of land as a source of supply of material of required quantity for construction unless provided other wise in the contract.
- (ii) Setting out;
- (iii) Compacting ground supporting embankment/subgrade except where removal and replacement of unsuitable material or loosening and recompacting is involved;
- (iv) Scarifying or cutting continuous horizontal benches 300mm wide on side slopes of existing embankment and subgrade as applicable;
- (v) Cost of watering or drying of material in borrow areas and/or embankment and subgrade during construction as required;
- (vi) Spreading in layers, bringing to appropriate moisture content and compacting to specification requirements;
- (vii) Shaping and dressing top and slopes of the embankment and subgrade including rounding of corners;
- (viii) Restricted working at sites of structures;
- (ix) Working on narrow width of embankment and subgrade;
- (x) Excavation in all soils from borrow pits/designated borrow areas including clearing and grubbing and transporting the material to embankment and subgrade site with all lifts and leads unless otherwise provided for in the contractor.
- (xi) All labour, material, tools, equipment and incidentals necessary to complete the work to the Specifications;
- (xii) Dewatering and
- (xiii) Keeping the embankment/completed formation free of water as per Clause 311.

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

Measurement shall be taken and paid in Cu.m.

Item No. 05 :-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.R road V.R.)

1. Ordinary Kilometer stone shall be of approved quality of precast C.C. 1:2:4 including necessary reinforcement as per IRC type design as specified in the item.
2. The size, manner of fixing, painting and lettering of ordinary Kilometer stone shall conform specification as per IRC – 8 (Type design for Highway kilometer 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 kilometer 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 kilometer 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. 06 : Providing and fixing Hectometer as per I.R.C. type design including painting, lettering etc. complete.(ii) Fixing in C.C. 1:5:10

The work covers the supply, painting, lettering and fixing of Hectometer stone.

The dimensions of the stones and the size, colour, arrangement of letters and scripts shall be as per I.R.C. - 26 type designs. The Hectometer stone shall be precast cement concrete 1:2:4 for which relevant specification shall be followed. The stone shall be bedded into the ground with adequate foundation in C.C. 1:4:8 as indicated in the drawings or in the relevant I.R.C. Specifications or as directed by the Engineer-in-charge. The orientation and location of the stones shall be as indicated in the drawings or in the relevant I.R.C. Specifications or as directed by the Engineer-in-charge.

MEASUREMENT OF PAYMENT

The measurement will be taken in Numbers of Hectometer stone **Fixing in C.C. 1:5:10** at site.

RATE

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

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

Item No. 07 : Citizen' s information Board- Providing and fixing of typical MMGSY information board as per instruction. Two ACP sheets of 3 mm thick, of 900 mm x 750mm size fixed at top & bottom duly rivetted with MS angles of 25 x 25 x 5 mm thick M.S angle shall be welded by two vertical M.S angle of 5 mm thick to 75 mm x 75 mm of 12 SWG square tubes posts duly embedded in cement concrete M-15 grade blocks of 600mm x 600mm x 75mm, below ground level. The letters & figure of any shade reflectorised with High Intensity Prismatic Grade Retro Reflective Sheeting of Type 4 as per ASTM D-4956 and latest MORD specifications; All sections of framed posts and steel tube will be painted with primer and two coats of epoxy paints as per drawing Clause 1701 and Annexure 1700.1 (10.16). (A) Class-B High intensity Grade Retro Reflective sheeting

The sign board shall conform to IRC-67-1977 and ninth schedule of the motor vehicle Act. It shall be providing and fixed as directed by the Engineer in charge.

1.2 Traffic Signs having retro-reflective sheeting :

1.2.1 General Requirements :

The retro-reflective sheetings used on the sign shall consist of white or coloured sheeting having a smooth outer surface which has the property of retro-reflection over its entire surface. It shall be weather resistant and show 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/ micro prismatic type. The type of sheeting to be used would depend upon the type, functional hierarchy and importance of the road.

1.2.2 High Intensity Grade Sheeting :

1.2.2.1 Encapsulated Lens Type :

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

TABLE 800-1

ACCEPTABLE MINIMUM CO-EFFICIENT OF RETRO REFLECTIVE FOR HIGH INTENSITY GRADE SHEETING (CANDELAS PER LUX SQUARE METRE).

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

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

1.3.2 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, resulting in a non-exposed lens optical reflecting systems. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro-reflection (determined in accordance with ASTM Standard E-810) as indicated in Table 800-2.

TABLE 800-2

ACCEPTABLE MINIMUM CO-EFFICIENT OF RETRO REFLECTIVE FOR ENGINEERING GRADE SHEETING (CANDELAS PER LUX SQUARE METRE).

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

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

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

1.1.4 For screen-printed transparent coloured areas on white sheeting, the co-efficient of retro-reflection shall not be less than 50% of the values of corresponding colour in Tables 800-1(a), 800-1(b) and 800-2 as applicable.

1.1.5 Cut out messages and borders, wherever used, shall be made out of retro-reflective sheeting (as per Clause 1.1.2) except those in black which shall be of non-reflective sheeting.

1.1.6 **Colour :** Unless otherwise specified, the general colour scheme shall be as stipulated in IS:5 "Colour for Ready Mixed Paints".

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

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

1.1.7 **Adhesives :** The sheeting shall either have a pressure sensitive adhesive of the aggressive-tack type requiring no heat, solvent or other preparation for adhesion to a smooth clean surface, or a tack 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.

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

1.1.9 Fabrication :

1.1.9.1 Surface to be reflectorised shall be prepared to receive the retro-reflective sheeting. The 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.

1.1.9.2 Complete sheets of the material shall be used on the signs except where it is unavoidable. At splices, sheeting with pressure sensitive adhesive shall be overlapped not less than 5 mm. Sheeting with heat-activated adhesives may be spliced with an overlap not less than 5 mm or butted with a gap not exceeding 0.75 mm. Where screen printing with transparent colours is proposed, only but 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.

1.1.10 Warranty Durability : For each lot of sheetings procured, the contractor shall obtain from the manufacturer a 7 years warranty for satisfactory field performance including stipulated retro-reflectance of the sheetings of high intensity grade and a 5 years warranty for the engineering grade and submit the same to the Engineer. In addition, a 7 years and a five years 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 meet all the stipulated requirements and carry the stipulated warranty.

Processed and applied in accordance with recommended procedures, the reflective material shall be weather resistant and following cleaning shall show no appreciable discolouration, cracking, blistering or dimensional change and shall not have less than 50 percent of the specified minimum reflective intensity

values Tables 800-1 and 800-2) when subjected to accelerated weathering for 1000 hours, using type E or EH weatherometer AASHTO Designation M 268).

1.2 **Installation :**

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

1.2.2 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.

1.2.3 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.

1.3 **Measurements for Payment :**

The measurement for standard cautionary, mandatory and information sign shall be in number of different types of signs supplied and fixed as per above details and specifications.

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

1.4 **Rate :**

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

Item No. 08 : 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.

1.1. General

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

1.2. Materials

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

1.3 Hot Applied Thermoplastic Road Marking

1.3.1 General:

- (i) The work under this section consists of marking traffic stripes using a thermoplastic compound meeting the requirements specified herein.
- (ii) The Thermoplastic compound shall be screeded /extruded or to the pavement surface in a molten state by suitable machine capable of controlled preparation and laying with surface application of glass beads at a specific rate. Upon cooling to ambient pavement temperature, it shall be produce an adherent pavement marking of specified thickness and width and capable of resisting deformation by traffic.
- (iii) The colour of the compound shall be white or yellow (IS colour no. 356) as specified in the drawings or as directed by the engineer.

1.3.2 Thermoplastic materials

1.3.2.1 General:

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

1.3.2.2 Requirement:

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:-3.

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**Table 800-3 PROPORTIONS OF CONSTITUTENTS OF MARKING MATERIAL
(Percentage by weight)**

Component	White	Yellow
Binder	18.0 min.	18.0 min.
Glass Beads	30 - 40	30 - 40

Titanium dioxide	10.0 min.	–
Calcium Carbonate and Inert Fillers	42.0max.	See
Yellow pigments	–	Note

Note: Amount of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, provided all other requirement of this specification are

II Properties :

The properties of thermoplastic material, when tested in accordance with ASTM 036/IS-3262 (Part-I) shall be as below:

- A) Luminance:
White: Daylight luminance at 45 degree 65 percent min. as per AASHTO M 249.
- B) Drying time:
When applied at a temperature specification 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
Cracking resistance at low temperature : The material shall show no cracks on application to concrete blocks.
- E) Softening point: 102.5 + 9.5 C as per ASTM 0 36.
- F) Flow resistance: Not more than 25 percent as per AASHTO M 249.

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

III Storage Life : The materials shall meet the requirement of there specifications for period of one year. The thermoplastic material must also melt uniformly with no evidence of skins or un-melted particles for the one year storage period. Any material not meeting the above requirements shall be replaced by the manufacturer / supplier / contractor.

IV Reflectorisation : shall be achieved by incorporation of beads the grading and other properties of the beads shall be as specified in clause 803.4.3 of MORT&H specification.

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

The name, trademark or other means of identification of manufacturer. Batch number. Date of manufacture.(Colour (white or yellow).

Maximum application temperature and maximum safe heating temperature.

VI Sampling and testing : The thermoplastic material shall be sampled and tested in accordance with the appropriate ASTM/BS method. The contractor shall furnish to the employer a copy of certified test reports from the manufacturer of the thermoplastic material showing results of all tests specified therein and shall certify that the materials meets all requirements of this specification.

1.3.3 Reflectorizing glass beads:

1.3.3.1 General : The specification covers types of glass beads to be used for to production of reflectorised pavement markings.

Type 1 beads are those which are a constituent of the basic thermoplastic compound vide Table 800-3 and type-2 beads are those which are to be sprayed on the surface vide clause 803.6.3

1.3.3.2 The glass beads shall be transparent, colourless and free from miliness, dark particles and excessive air inclusions. This shall conform to the requirements spelt out in clause 803.4.3.3.

1.3.3.3 Specific requirements

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

TABLE 800-4 GRADATION REQUIREMENT FOR 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 to 10	10 to 30
Below 180 Micron		00 to 15

Roundness : The glass beads shall have a minimum of 70 percent true spires.

Refractive index: The glass beads shall have a minimum refractive index of 1.50.

Free flowing properties: The glass beads shall be free of hard lumps and clusters and shall dispense readily under any conditions suitable for paints striping. They shall pass the free flow test.

1.3.3.4 Test methods : The specific requirement shall be tested with the following methods.

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

II. The requirements of gradation, roundness and refractive index of glass beads and the amount of glass beads obtained from a reputed laboratory showing results of all tests specified therein and shall certify that material meets all requirements of this specification. However, if so required, these tests may be carried out as directed by the engineer.

1.3.4 Application properties of thermoplastic material.

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

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

1.3.5 Preparation:

The materials shall be melted in accordance with the manufacturer's instruction in a heater fitted with a mechanical stirrer to give a smooth consistency to the thermoplastic materials to avoid local overheating. The temperature of the mass shall be within the range specified by the manufacturer and shall on no account be allowed to exceed the maximum temperature started by the manufacturer. The molten material should be used as expeditiously as possible and for thermoplastic materials which has natural binders or is otherwise sensitive to prolonged heating the materials shall be maintained in a molten condition for more than 4 hours.

- ii) After transfer to the laying equipment the material shall be maintained within the temperature range specified by the manufacturer for achieving the desired consistency for laying.
- 1.3.6 Properties of finished road marking:**
The stripe shall not be slippery when wet.
The marking shall not lift from the pavement in freezing weather.
After application and proper drying the stripe shall show no appreciable deformation or discoloration under traffic and under road temperatures up to 60 C.
The marking shall not deteriorate by contact with sodium chloride calcium chloride or oil drippings from traffic.
The stripe of marking shall maintain its original dimension and position.
Cold ductility of the material shall be such as to permit normal movement with the road surface without chipping or cracking.
The colour of yellow marking shall conform to IS colour no. 356 as given in IS : 164.

Reflectorised Paint: Reflectorised paint, if used, shall conform to the specification by the manufacturers and approved by the engineer. Reflectorising glass beads for reflectorising paints where used shall conform to the requirements of clause 803.4.3.

Application

- 1.3.7 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.
- 1.3.8 The thermoplastic materials 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.
- 1.3.9 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 on overlay of new material directly over an old line of compatible material. Such new material shall so bond itself to the old line that no splitting or separation takes place.
Thermoplastic paint shall be applied in intermittent or continuous lines of uniform thickness of at least 2.5 mm unless specified otherwise. Where arrows or letters are to be provided, thermoplastic compound may be hand-sprayed. In addition to the beads included in the material, a further quantity of glass beads of type-2, conforming to the above noted specification shall be sprayed uniformly into a monolayer on to the hot paint line in quick succession of the paint spraying operation. The glass beads shall be applied at the rate of 250 grams per square meter area.
- 1.4.4 The minimum thickness specified is exclusive of surface applied glass beads. The method of thickness measurement shall be in accordance with appendices B and C of BS - 3262 (Part-3)
- 1.4.5 The finished lines shall be free from raggedness 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 of streaks.

1.5 Measurement for Payment:

- 1.5.1 The painted marking shall be measured in sq. meters of actual area marked (excluding the gaps, if any).
- 1.5.2 In respect of markings line directional arrows and lettering, etc. the measurement shall be by numbers.
- 1.5.3 Payment shall be made carried out on **Number** basis.

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

1.7 SPECIAL TERMS AND CONDITIONS FOR THERMOPLAST PAINT WORK:

- (1) Agency should carry out the such type of work by only of thermoplastic paint laying machine (power driven only) with temperature controller and automatic mixing arrangement of glass beads in required proportion.
- (2) After completion of the laying of thermoplastic paint work, two years guarantee for durability and reflectivity as per M.O.R.T.H. specification for road and bridge works clause 803 should be given by the bidder in the writing.
- (3) Guarantee security deposit shall be retained @ 10% of the cost of the item of thermoplast paint from the R.A. bills, which will be released after expiry of guarantee period.
- (4) Agency who carry out the such type of work shall have an experience of carrying out similar type of work.
- (5) Test certificates as per M.O.R.T.H. specification for road and bridge works clause 803.3.2.2 (vi) should be furnished of reputed laboratory before.

Item No. 09 : 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 sign board shall conform to IRC-67-1977 and nineth schedule of the motor vehicle Act. It shallbe providing and fixed as directed by the Engineer in charge.

1.2Traffic Signs having retro-reflective sheeting :

1.2.1 General Requirements :

The retro-reflective sheetings used on the sign shall consist of white or coloured sheeting having a smooth outer surface which has the property of retro-reflection over its entire surface. It shall be weather resistant and show 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/ micro prismatic type. The type of sheeting to be used would depend upon the type, functional hierarchy and importance of the road.

1.2.2 High Intensity Grade Sheeting :

1.2.2.1 Encapsulated Lens Type :

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

TABLE 800-1

ACCEPTABLE MINIMUM CO-EFFICIENT OF RETRO REFLECTIVE FOR HIGH INTENSITY GRADE SHEETING (CANDELAS PER LUX SQUARE METRE).

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

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

1.3.2 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, resulting in a non-exposed lens optical reflecting systems. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro- reflection (determined in accordance with ASTM Standard E-810) as indicated in Table 800-2.

TABLE 800-2

**ACCEPTABLE MINIMUM CO-EFFICIENT OF RETRO REFLECTIVE
FOR ENGINEERING GRADE SHEETING (CANDELAS PER LUX
SQUARE METRE).**

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

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

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

1.1.4 For screen-printed transparent coloured areas on white sheeting, the co-efficient of retro- reflection shall not be less than 50% of the values of corresponding colour in Tables 800-1(a), 800- 1(b) and 800-2 as applicable.

1.1.5 Cut out messages and borders, wherever used, shall be made out of retro-reflective

sheeting (as per Clause 1.1.2) except those in black which shall be of non-reflective sheeting.

1.1.6 **Colour** : Unless otherwise specified, the general colour scheme shall be as stipulated in IS:5"Colour for Ready Mixed Paints".

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

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

1.1.7 **Adhesives** : The sheeting shall either have a pressure sensitive adhesive of the aggressive- tack type requiring no heat, solvent or other preparation for adhesion to a smooth clean surface, or a tack 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. Sheetting with adhesives requiring use of solvents or other preparation for adhesive shall be applied strictly in accordance with the manufacturer's instructions.

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

1.1.9 **Fabrication** :

1.1.9.1 Surface to be reflectorised shall be prepared to receive the retro-reflective sheeting. The 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.

1.1.9.2 Complete sheets of the material shall be used on the signs except where it is unavoidable. At splices, sheeting with pressure sensitive adhesive shall be overlapped not less

than 5 mm. Sheeting with heat-activated adhesives may be spliced with an overlap not less than 5 mm or butted with a gap not exceeding 0.75 mm. Where screen printing with transparent colours is proposed, only but 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.

1.1.10 **Warranty Durability :** For each lot of sheetings procured, the contractor shall obtain from the manufacturer a 7 years warranty for satisfactory field performance including stipulated retro-reflectance of the sheetings of high intensity grade and a 5 years warranty for the engineering grade and submit the same to the Engineer. In addition, a 7 years and a five years 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 meet all the stipulated requirements and carry the stipulated warranty.

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

1.2 Installation :

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

1.2.2 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.

1.2.3 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.

1.3 Measurements for Payment :

The measurement for standard cautionary, mandatory and information sign shall be in number of different types of signs supplied and fixed as per above details and specifications.

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

1.4 Rate :

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

Item No. 10 : Supplying and fixing cat eye (Stimsonite) made out from Acrilo beautille sterine injuction high compressed molding with reflector made of MMC (prismatic type of size 12cm x 6cm x 2.5cm) provided with bituminous adhesive 100g. with each unit for fixing. (High Intensity grade)

1.1 General

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

1.2. Definitions

1.2.1 Description of Terms Specific to this standard

1.2.1.1 Coefficient of luminous intensity (C I L) or specific intensity = the ratio of luminous intensity of the retro-reflector in the direction of observation to luminance at the retro-reflector on a plane perpendicular to the direction of the incident light expressed in terms of Milaca deal as per incident lux (med / Ix).

1.2.1.2 Horizontal entrance angle - the angle in the horizontal plane between the direction of incident light and the normal to the leading edge of the marker.

1.2.1.3 Observation angle - the angle in the reflector between the illumination axis and the observation axis.

1.2.1.4 Retro - reflection - reflection in which the radiation is returned in direction close to the direction from which it came, this property being maintained over wide variations of the direction of incident radiation.

1.2.1.5 Head - that part of a road stud which is above the road surface when the road stud is fixed in position in the road.

1.2.1.6 Upper surface - that part of the external surface of road stud which is visible when the road stud is fixed in position in the road.

1.2.1.7 Anchorage - that part of a road stud which is below the road surface when the road stud is fixed position in the road.

1.3 Material

1. 3. 1 Plastic body of RPM road stud shall be molded from ASA(Acrylic Sterner Acryl nitrite) or HIPS (Impacts polystyrene) or ABS or any other suitable material approved by the Engineer-in-charge. The marker shall support a load of 13635 kg tested in accordance with ASTM D4280.

1. 3. 2 Reflective panels shall consist if number or lenses containing single or dual prismatic cubes capable of providing total internal reflection of the light entering the lens face. Lenses shall be molded of methyl methecrylate conforming to ASTMD 788 or equivalent.

1. 4. Design

1. 4. 1 The slope or retro-reflecting surface shall preferably be 35 + 5 degree to base.

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1. 4. 2 The area of each retro-reflecting surface shall not be less than 13.0 sq. cm.

1. 5. Optical Performance

1. 5. 1 Unidirectional and bi-directional studs.

1. 5. 1. 1 Each reflector or combination of reflectors on each face of the stud shall have a C.I.L. not less than that given in Table 1 or 2 as appropriate.

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

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

White Amber Red

0° U 5° L & R 0.3 " 220 110 44

0° U 10° L & R 0.5 " 120 60 24

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

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

White Amber Red

0° U 6° L & R 0.3 " 20 10 4

0° U 10° L & R 0.5 " 15 7.5 3

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

1. 5. 1. 2 A stud that incorporates one or more corner cube reflectors shall be considered to be included in category 'A'. A stud that incorporates one or more biconvex reflectors shall be considered to be included in category 'B'.

1. 5. 2 Omni - directional studs.

Each omni-directional stud shall have a minimum C.I.L. of not less than 2 med / 1x.

1. 5. 3 Tests

1. 5. 3. 1 Coefficient of luminance intensity can be measured by produced described in ASTM E 809 "Practice for Measuring Photometric Characteristics" or as recommended in BS: 873 - Part 4:1973.

1. 5. 3. 2 Under test conditions, a stud shall not be considered to fail the photometric requirements if the measured C.I.L. at any one position of measurement is less than the values specified in Table 1 or 2 provided that.

(i) The value is not less than 80% of the specified minimum, and

(ii) The average of the left and tight measurements for the specific angle is greater than the specified minimum.

1. 6. Fixing of Reflective Markers

1. 6. 1. Requirements

1. 6. 1. 1 The enveloping profile of the head of the stud shall be smooth and the studs shall not present any sharp edges to traffic.

1. 6. 1. 2 The reflecting portions of the studs shall be free from crevice or ledges where dirt might accumulate.

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1. 6. 1. 3 All road studs shall be legibly marked with the name, trade mark of other means of identification of the manufacture.

1. 6. 1. 4 Marker height shall not exceed 20mm.

1. 6. 1. 5 Marker width shall not exceed 130 mm.

1. 6. 1. 6 The base of the marker shall be flat within 1.3 mm. If the bottom of the marker is configured. The outermost faces of the configurations shall not deviate more than 1.3 mm from a flat surface.

1. 6. 2 Placement

1. 6. 2. 1 The reflective marker shall be fixed to the road surface using the adhesives and the produced recommended by the manufacturer. No nails shall be used to affix the marker as nails are hazardous for the roads.

1. 6. 2. 2 Regardless of the type of adhesive used. The markers shall not be fixed if the pavement is not surface dry and on new asphalt concrete surfacing unit the surfacing has been opened to traffic for a period of not less than 14 hours.

1. 6. 2. 3 The portions of the highway surface, to which the marker is to be bonded by the adhesive, shall be free of dirt, curing compound, grease, oil, moisture, loose or unsound layers, paint and any other material which would adversely affect the bond of the adhesive.

1. 6. 2. 4 Use a wire brush, if necessary to loosen and remove dirt. Then brush or blow clean.

1. 6. 2. 5 The adhesive shall be placed uniformly on the cleaned pavement surface or on the bottom of the marker in a quantity sufficient to result in complete coverage of the area of contact of the marker with no voids present and with a slight excess after the marker has been lightly pressed in place.

1. 6. 2. 6 For epoxy installations, excess adhesive around the edge of the marker, excess adhesive on the pavement and adhesive on the exposed surfaces of the markers shall be immediately removed. Soft rags moistened with mineral spirits or kerosene may be used, if necessary to remove adhesive from exposed faces of pavement markers.

1. 7. Warranty and durability.

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

1. 8 Measurement for Payment

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

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

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1. 9 Rate

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

The contract rate shall be for a unit of One Number basis for completed items.

Item No.11 :- MMGSY "LOGO" Board : Providing and fixing of MMGSY 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 embedded in cement concrete M15 grade block of 450x450x600mm below ground level. The height of the bottom of the lower plate will be 1200mm from normal ground level. 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 item shall be executed as per the Signage Guideline for Mukhya Mantri Gram Sadak Yojna (MMGSY) attached herewith and Specifications for Figure : 1 & 2 are followed clause 1 to 1.13 are applicable. This item is including fixing on side with CC M-150 and all relected item for completed the item satisfactorily as per specification & warranty Certificate for such item.

The Contract Rate shall be for a unit of One Number basis for completed item work.

Item No.12 :- MMGSY Project Information Board: Providing and fixing of typical PMGSY Project informatory sign board with Logo as per 1700 of MORD specifications and drawing. The board will be a composite unit consisting of Three Plates ACM (Aluminum Composite Material), material specifications as per clause 17001.3. The top most plate will be of 3mm ACM in diamond shape of 600x600mm size, riveted with MS angle iron frame of 25mmx25mmx5mm size on back on edges. The middle 4mm ACM plate of will be 1200x150mm size riveted with MS angle iron frame of 25mmx25mmx5mm size on back on edges. The main 4mm ACM lower most plate will be 1500mmx600mm size, riveted with MS angle iron frame of 25mmx25mmx5mm size. Riveting of all the sheets over angle and flat iron frame will be done neatly to have plain surface on one side. The angle iron frame of lower most plate and flat iron frame of the middle plate will be welded to two nos. 75mm x75mm (12 SWG) sheet tubes posts placed at 1125mm apart centre to centre. the top of the middle plate will be flushed with the top of 75mm dia medium steel tube posts and these posts will be 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 and the bottom of the middle plate will be 100mm above the top level of the lower most plate. the diamond shaped plate mounted over flat angle iron frame will be connected to middle plate by square steel section of 47mmx47mm, thickness 12SWG having a spacing of 100mm between the diamond shaped plate and middle plate and this square section will be riveted to the bottom point of the diamond shaped plate. 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 Signage Guide and as directed by Engineer-In-charge. . A warranty for 5 years for the Retro reflective sheeting for Class-A respectively, from original manufacturer shall be submitted by contractor.

1. Specification of **Item no G-1** Separated sheet attached shall be followed for the execution of item except the size of Upper plat of Information board made out of 3 mm aluminum sheet size is 60 x 60 cms rectangle and Middle plat of Logo sign board made out of 4 mm aluminum sheet size is 120 x 15 cms rectangle and lower plat of Logo sign board made out of 4 mm aluminum sheet size is 150 x 60 cms rectangle instead of size 60 X 45 cm rectangle or as directed by Engineer in Charge.

2. **Fixing in C.C. M-15**

Specification same as **Item no G-2** above except that the Kilometer stone shall be fixed in C.C. M-15 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.

The Contract Rate shall be for a unit of One Number basis for completed item work

Item No. 13 :- Providing and filling in foundation with ordinary Cement concrete M-100 mix and providing necessary vertical pin headers including formwork, vibrating, ramming and curing complete.

1. In case of ordinary concrete, mix is not required to be designed by preliminary tests and proportions of cement. Fine 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 100 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 Liters)				
1	2	3	4	5
Ordinary	Litres			Litres
M-100	1:3:6	300	General 1:2 for fine aggregate to Coarse aggregate by	34
M-150	1:2:4	220		32

M-200	1:1.1/2:3	160	volume but subject to a upper limit of 1:1.1/2 & a lower limit of 1:3.	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 ofwork.

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

For heavily reinforced concrete members as in the case of ribs of main beams, nominal maximum size of aggregate shall usually be restricted to 5 mm. less than the minimum lateral clear distance between the main bars or 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 othersubstances. 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 coarse and fine aggregate and cement then shall be mixed thoroughly by turning over to get a mixture of uniform color. 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 form work and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer-in-charge has been obtained.

14. If concreting is not started 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 brush, 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 its laying but the curing of concrete shall be continued for a minimum period of 14 days.
18. Form work shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Formwork shall however be delivered into following two district categories :-

(1) Shuttering i.e. form 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 of substantial rigid construction and shuttering shall be true to shape and dimensions shown on the drawings. All bolts and reverts shall be counter-sunk and well ground to provide a smooth, plane surface.

19. Forms shall be mortar tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports. They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribed lines occurring during and after placing the concrete. Screw jacks 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.
20. The inside surface of forms shall except in the case of permanent form work or where otherwise agreed to by the engineer-in-charge be coated with an approved material to prevent adhesion of concrete to the form work. Release agents shall be applied strictly in accordance with the manufacture's instruction and shall not be allowed to come into contact with any reinforcement of prestressing tendons 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 form work of concrete which will be visible in the finished works.
21. Special measures shall be taken to ensure that the framework does not hinder the shrinkage of concrete because without these cracking could occur before the form work is removed. Wherever applicable arrangement must be made to ensure that the form 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.
22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any form 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 may 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 equal 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 form work shall be

removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to avoid any shock or vibrations. Supports shall be removed in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with 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. How ever 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 when ever 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 is not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber, kapachi or metal pieces shall not be used for this purpose. Concreting of important structural members shall always be done in the presence and under the supervision of departmental person not below the rank of 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 cumt. basis of the finished work.

Item No.14 :- Providing and laying Cement concrete M-200 with curing including compacting with surface mechanical vibrator, Mechanical floater, channeling form work, Grooving & filling the joints with filler materials etc complete.

1.0 Materials 1.1 Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Grit shall conform to M-8. Coarse aggregate shall conform M-12.

1.2 The shuttering to be provided shall be of ordinary timber plank and shall conform to M-26.

1.3 The dimensions of scantlings and battens shall conform to the design. The strength of the wood shall not be less than that assumed in the design.

2.0 General 2.1 The concrete mix shall be designed from preliminary tests. The proportion of the concrete mix shall be 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm. nominal size) by weight of concrete work shall have exposed concrete surface or as specified in the item.

2.2 The proportioning of cement and aggregates shall be done by weight and necessary precautions shall be taken in the production to ensure that the required work cube strength is attained and maintained. The controlled concrete shall be in grades of M-100, M-150, M- 200, M-250, M-300, M-350 & M-400 with prefix controlled added to it. The letter M refers to mix and the numbers specify 28 days works cube compressive strength of 250 mm. cubes of the mix expressed in Kg./cm.

2.3 The proportion of cement, sand and coarse aggregate shall be determined of weight. The weight batch machine shall be used for maintaining proper control over the proportion of aggregates as per mix design. The strength requirements of different grades of concrete shall be as under:

2.4 In the designation of concrete mix, letter 'M' refers to the mix and the number to the specified 28 days works cubs compressive strength of that mix on 250 mm. cubes, expressed in kg/cm² where ordinary Portland cement conforming to IS : 269 or Portland blast furnace cement Conforming to IS: 455 is used, the compressive strength requirements for various grades of concrete shall be as given below on the next page :-

Grade of Concrete Compressive works test strength in kg/cm² 20m 150 mm. cubes, conducted in accordance with IS.: 516

Min. at 7 days Min. at 28 days M 100	70	100
M 150	100	150
M 200	135	200
M 250	170	250
M 300	200	300
M 350	235	350
M 400	270	400
M 450	300	450

2.4 In the designation of concrete mix, letter 'M' refers to the mix and the number to the specified 28 days works cubs compressive strength of that mix on 250 mm. cubes, expressed in kg/cm² where ordinary Portland cement conforming to IS : 269 or Portland blast furnace cement Conforming to IS: 455 is used, the compressive strength requirements for various grades of concrete shall be as given below on the next page :-

Note:- 1.0 In all cases the in all cases, the 28 days compressive strength specified in the above Table shall along be the criterion for acceptance or rejection of the concrete.

2.0 Where the strength of a concrete mix, as indicated by tests, lies in between the strength for any two grades specified in the above Table such concrete shall be classified for all purposes as concrete belonging to the lower or the two grades between which its strength lies.

3.0 Concrete mix shall be designed on the basis of preliminary test so as attain strength at least per cent higher than that required on work tests. The proportions for ingredients chose shall be such that concrete has adequate workability for conditions prevailing on the work in question and can be properly compacted with the mean available, Except where it can be shown to the satisfaction of the Engineer-in-charge that supply of properly graded aggregate of uniform quality can be maintained till the completion of work, grading of aggregate should be controlled by containing the coarse aggregates in different sizes and bleeding them in the right proportions as required aggregates of different sizes shall be stocked in separate stock piles. Required quantity of material shall be stock piled several hours, preferable a day, before use. Grading of coarse and fine aggregate shall be checked as frequently as possible, frequency for a given job being determined by the Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in preliminary tests.

4.0 In proportioning concrete, the quantity of both cement and aggregate shall be determined reasonable number of bags shall be weighed separately to check the net weight. Where cement is weighted from bulk stocks at site and not by bags if shall be weighed separately from the aggregates. Water shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be a maintained in a clean and serviceable condition. Their accuracy shall be periodically checked.

5.0 It is most important to keep the specified water-cement ratio constant and at its correct value. To this end, moisture content in both fine and coarse aggregates shall be determined by the Engineer-in-charge according to the-weather conditions. The amount of mixing water shall then be adjusted to compensate for variations in the moisture cement. For the determination of moisture content in the aggregates, IS L 2386 (part-III) shall be referred to Suitable adjustments shall also be made in the weights of aggregates to allow for the variation in weights of aggregates due to variation in their moisture content. Minimum quantity of cement to be used in controlled concrete shall not be less than 210 kg. per cubic meter in plain concrete and not less than 300 kg/per cubic meter in reinforced concrete structural members. The minimum quantity of cement for pre-stressed concrete work shall not less than 360 kg/per cubic meter of concrete nor shall it more than 540 kg/per cubic Meter of concrete

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

No.	Item of Construction	Max nominal size of coarse aggregate
1	RCC well curb, well steining	40 mm
2	Well cap solid type piers	63 mm
3	Abutment, wing wall, pier cap	40
4	RCC in cross girder, desk slab, wearing coarse, kerb, approach slab	20 mm

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

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

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

9.0 Cement shall be stored above the ground level in perfectly dry and watertight sheds. Wherever bulk storage containers are used their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months. The aggregates shall be stored in such a way as to prevent admixture of foreign materials. Different sizes of fine or coarse intermixing the materials.

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

11.0 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 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.

12.0 Mixer which have been out of use more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to be the Engineer-in-charge, the first batch of concrete from the mixer shall contain only two thirds of normal quantity of coarse aggregate. Mixing plant shall be thoroughly cleaned before enhancing from one type of cement to another.

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

14.0 If concreting is not started within 24 hours of the approval being given. It shall have to be obtained again from the Engineer-in-charge. Concreting 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 design agitators, operating continuously when this time shall be within 3 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to be the Engineer-in-charge Concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 meter when internal vibrator are used not exceeding 0.30 meter in all other cases.

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

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

17.0 Immediately after compaction, concrete shall be protected against harmful effects of weather including rain, running water, shocks, vibration, traffic, rapid temperature changes, frost and drying out process. It shall be covered with wet sacking, Hessian or other similar absorbent material approved by the Engineer-in-charge

soon after the initial set, and shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonry work *over* the foundation concrete may be started after 48 hours of its laying but the curing of concrete shall be continued for a minimum period of 14 days,

18.0 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 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.

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

20 The inside surface of shuttering shall; except in the case of permanent form work or where otherwise agreed to be the Engineer-in-charge be coated with an approved materials to prevent adhesion of concrete to the form work. Release agents shall be applied strictly in accordance with the manufacture's Instructions and shall not be allowed to come into contact with any reinforcement or pre-stressing tendons and anchorages. Different release agent shall not be used in form work for concrete which will be visible in the finished works.

21. Special measure shall be taken to ensure that the form does not hinder the shrinkage of concrete because without these cracking could occur before the form work is removed. Wherever applicable arrangement must be made to ensure that the form work does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons. The formwork should take due account of the calculated amount of positive or negative camber so also ensure the correct final shape of the structure having regard to the deformation due of false work, scaffolding or propping and the instantaneous or deferred deformation due to various causes affecting pre-stressed structures. Where they are re- entrain angles in the concrete sections the form work should be removed at these sections as soon as possible after the concrete has set in order to avoid cracking due to shrinkage of concrete. Form work shall be tight enough to prevent any appreciable loss of cement during vibrations Suitable tolerance 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 men, machinery, materials and for results obtained.

22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any formwork. While fixing the time for removal of for work, due consideration shall be given to local conditions that influence the setting of Concrete and of concrete and of the materials used in the mix. Where filled operations are controlled by strength tests of concrete the removal of the load supporting of soffit forms may commence when concrete has attained strengthening props including the effect or any further additional of loads. When field operations are not controlled by strength tests of concrete the vertical forms of beams, columns and wall may be removed after 2 days, Tile props of slabs and beams may be removed after 14 and 21 days respectively. All formwork shall be removed without causing any damage to the concrete. Centering shall

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

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

24. In the case of reinforced concrete work, workability shall be such that the concrete surrounds and properly grips all reinforcement. The degree of consistency, which shall depend upon the nature of work and methods of vibration of concrete shall be determined by regular slump 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 wall	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. For controlled concrete preliminary tests shall consist of three sets of separate tests and in each set, tests shall be conducted on six specimens, Not more than one set of six specimens shall be made on any particular day of the six specimen in each set, three shall be tested at seven days and the remaining three at 28 days. The preliminary tests at 27 days are intended only to indicate the strength likely to be attained at 28 days. Work 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 when ever the quality and grading of materials is changed irrespective of the quantity of concrete poured, The number of specimens may be suitably increased as deemed necessary by the Engineer-in-charge when procedure 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 per cent of the specified strength.

27. R.C.C. work shall have exposed concrete surface. Centering design and its erection shall be approved by the Engineer-in-charge. One carpenter with helper will invariably be kept throughout the period of concreting. Movement of labour and other persons shall be totally prohibited over reinforcement laid in position. For access to different parts, suitable mobile platforms shall be provided so that steel reinforcement in position is not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber, 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 voids 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 cumt. basis of the finished work.

Item No.15 :- Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts including setting and joining the pipes in C.M. 1:2 watering and laying (To level of slops of I.S. 458 / 1971 Class NP4 of following internal diameter. (i) 300 mm dia.

1. This shall consist of furnishing and installing reinforced cement concrete pipe of the type diameter and length required at the location shown on the drawings or as ordered by the Engineer-in-charge.
2. Reinforced concrete pipe shall be of NP-4 type conforming to the requirements of IS : 458 and shall be of dia. as specified in the item. Each consignment of cement concrete pipes shall be inspected, if necessary and approved by the Engineer-in-charge either at the place of manufacture or at the site before their incorporation in the works.
NP3, NP2 and NP1 pipes are used for R.C.C. Pipes. Where the testing of pipes will not be feasible the contractors will have to produce a certificate from the manufacturer on company's letter head in the given hereinafter from.

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

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

We _____

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

M/S. _____.

Satisfy the requirement of

IS:458.Date: _____ Place: _____

Manufacturer's Sign _____

3. No pipes shall be placed in position until the foundations have been approved by the

Engineer-in charge. Where two or more pipes are to be laid adjacent to each other, they shall be separated by a distance equal to at least half the diameter of the pipe subject to minimum of 1200 mm. The laying of pipes on the prepared foundation shall start from the

outlet and proceed towards the inlet and be completed to the specified lines and grades. The pipes shall be fitted and matched so that when laid in works they form a culvert with a smooth uniform invert. Any pipe found defective or damaged during laying shall be removed at the cost of Contractor.

4. The pipes shall be jointed either by collar joint or by flush joint in the former case the collars shall be of R.C.C. 150 to 200 mm. wide and having the same strength as the pipes to be jointed. Caulking space shall be between 13 and 20 mm. according to the diameter of the pipes caulking material shall be slightly wet mix of cement and sand in the ratio of 1:2 rammed with caulking irons. Before caulking the collar shall be so placed that its centre coincides with that of pipes and an even annular space is left between the collar and the pipes. Flush joint may be shaped to form a self centering joint with a joining space 13 cm wide. The joining space shall be filled with cement mortar 1:2 (1 cement : 2 sand) mixed sufficiently dry to remain in position when forced with a trowel or rammer. Care shall be taken to fill all voids and excess mortar shall be removed. All joints shall be made with care so that their interior surface is smooth and consistent with the interior surface of the pipes. After finishing, the joint shall be kept covered and damp for at least four days.
5. R. C. C. pipes shall be measured along their centre between their inlet and outlet ends in linear metres.
6. The rate for the pipes shall include the cost of pipe including loading, unloading, handling, storing laying in position and joining complete.
7. The rate shall be for a unit of one **running meter**
8. The payment will be made on running meter basis of the finished work\

Item No. 16 : Informatory Signs :-Providing and fixing sing boards made out of 2mm aluminium sheet; size 80 x 60cms. rectangle as per the design of IRC-67-1977 pre treated with phospheting process & acid teching; coated with one coat of epoxyprimer and two coats of best qualityepoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand postand frame fabricated from suitable sizeiron angle of 35 x 35 x 3mm75x75x6mm as required; painted with best qualityepoxy coatings in black and whitebends. the details of symbol for eachboard shall details of symbol for eachboard shall be as per the instruction ofengineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x45 x 60cms. for each leg. including excavation curing tec. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)...

The relevant specification of Item No. 09 shall be followed for the execution for the work is Providing and fixing sing boards made out of 2mm aluminium sheet; size 80 x 60cms. rectangle as per the design of IRC-67-1977 pre treated with phospheting process & acid teching; coated with one coat of epoxyprimer and two coats of best qualityepoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand postand frame fabricated from suitable sizeiron angle of 35 x 35 x 3mm75x75x6mm as required; painted with best qualityepoxy coatings in black and whitebends. the details of symbol for eachboard shall details of symbol for eachboard shall be as per the instruction ofengineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x45 x 60cms. for each leg. including excavation curing tec. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)...

The payment will be made on Number basis of the finished work

Item No. 17 : Direction sign (Junction board):-Providing and fixing sing boards made out of 2mm aluminium sheet; size 244 x 122cms. 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 75x75x6mm as required; painted with best quality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)...

The relevant specification of Item No. 09 shall be followed for the execution for the work is Providing and fixing sing boards made out of 2mm aluminium sheet; size 244 x 122cms. 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 75x75x6mm as required; painted with best quality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)...

The payment will be made on Number basis of the finished work