GOVERNMENT OF GUJARAT

ROAD & BUILDING DEPARTMENT

Specifications of
Construction of Vasana Village Kalodara Vasana Road to Gajani Sim Vyasana Chakala to Aadadiya Vad to Undel Jahagirpura Joining Road (VRNP) km. 0/000 To 2/760 Ta. :- Khambhat Dist. :- Anand Pkg. No. AND/MMGSY/SCSP/2025-26/22

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 members .....5 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.				Maximum permissible variation from specified profile camber template– 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 snail be trimmed and suitably compacted. Where the same in 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 then 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-ll)
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 arc 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, under-growth, grass and other deleterious matter unsuitable for incorporation in the embankment/subgrade shall be removed between fill lines to the satisfaction of the Engineer. On areas beyond these

limits, 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 10 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 :- Earthwork for embankment including breaking clods, dressing with all lead and lift (including watering and consolidation) (A) From Borrow pits within land width

And

Item No.03 :- 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. 04:- Earthwork in cutting in all sorts of soil and soft murrum including conveying and putting the stuff in spoil bank maintaining minimum distance of five meter between top edge and cutting and toe of spoil bank.

1. The land width required for the roadway, gutter side slopes and catch water gutters shall be cleared of all trees having a girth of 30 cms. and less, loose, stones, vegetation, bushes, stuff and all other objectionable materials. The roots of trees and stuff shall be removed to a depth of 30 cms below the grade formation and slopes and excavation filled up with excavated materials and compacted. All the materials cleared will be the property of Government. Useful materials shall be arranged in convenient stacks along the road boundary or as directed lead, and handed over to the department in convenient sections. Unsuitable materials shall be burnt or otherwise disposed off by the contractor at his own cost without causing any nuisance, inconvenience or damage to the work, property or people in the neighborhood. If the materials are to be disposed off outside the road land, necessary permission from the privet land owners shall be taken, by the contractor and royalty etc. if any paid by him without claiming compensations. In all cases the materials shall be disposed off in a neat manner.

2. After clearing the site, the alignment of the road shall be properly set out true to lines, curves slopes, grades and sections as shown on the plans or directed by the Engineer-in-charge. The contractor shall provide all labour and materials such as lime, strings, pegs, nails, bamboos, stones mortar, concrete etc. required for setting out alignment establishing beech marks and giving profiles. The contractor shall be responsible for maintaining the B. Ms. profiles alignments and other stakes and marks as long as they are required for the work in the opinion of the Engineer. If the contractor defaults in this respect even after the direction by the Engineer within the specified time, they may be restored by the Engineer at the levels etc. If there is any disagreement the contractor shall inform of it in writing to the officer concerned with the specific reference to the section before starting further work. Once the work is started, no cognizance of any complaint shall be taken. Merely not signing of the book shall not be deemed as disagreement.

3. Profiles of the section including the road side gutters to be excavated shall be laid at suitable intervals of 10 m. to 50 m. or other intervals as directed by Engineer to conform to the curved or straight alignment, sections, grades and side slopes. The line out shall be clearly marked and profiles of embankments where excavated Materials are to be used shall set up with the toe line marked on each side. The road way section shall first be excavated in steps. These steps shall be smoothened to the required slop when the excavation reaches the road formation. The contractor shall on no account excavate beyond the slopes or below the specified level or outside the section. it shall not be paid for and the contractor shall be required to fill ups at his own cost such extra excavation in the road portion, with approved materials of the embankment grade in layers, watered and fully compacted to attain maximum density laid down for the embankment in its relevant item. The Engineer may

measurement ridges and dead end to be left at specified intervals or places and kept intact till ordered to be removed for the purposes of check measurements. The cutting shall be finished neatly smooth and evenly to the correct lines, curves, grades if loose, shall be scarified watered and compacted to the same density as the embankment. The section side stops and catch water gutter shall be maintained by the contractor at his own cost in such a way that the formation and gutters will be drained by providing for necessary diversions etc. and not damaged due to obstruction of any drainage. Necessary passages shall be provided for leading away seepage, springs, surface flow or rainwater safely make good to damage at his own cost, If it is necessary in the execution of the work to interrupt existing surface drainage, irrigation channels sewers or under drainage, temporary arrangement shall be provided till Such time as is necessary. The contractor at his own cost shall make good the interrupted drainage and sewer etc. unless separately provided in the tender any damage to the exiting works or work in hand caused as a result of his operations or negligence shall be made good by the contractor at his own cost. Roadside gutters shall be excavated to the specified sections and shall be measured along with the main cutting in cubic meters.

4. If slides occur in the cutting, they shall be removed as ordered by the Engineer. If finished slopes slide into the roadways before the final acceptance of the work, such slides shall be removed by the contractor and shall be paid for at the contract rate for the class of excavation involved provided the slides are not die to any negligence of the contractor. The classification of the material in slides shall conform to its conditions at the time of removal and payment made accordingly regardless of its prior condition. Care shall be taken to see that excavation is arranged in a safe way so that there will be no risk to the workmen by slides, falling materials, boulders and collapsing sides etc.

5. If there is traffic nearby or there are towns and villages in the neighborhood, barricades and or traffic signals shall be provided day and night for the duration of the work in such a way as to prevent accidents. Warning signals shall be displayed at 7mt. from the danger point on both sides giving sufficient warning. If necessary, signalers shall be stationed at each end to regulate traffic where it is heavy. Measures shall be taken to see that the excavation does not affect or damage adjoining structures or property. If there is damage to property, injury to workers, the members of the public, animals etc., due to the negligence of the contractor, he will be responsible and liable to all the consequences including compensation.

6. All the cutting stuff materials shall be property of Government. When the use full excavated material is to be used in embankment with all lead and all lift, it shall be directly deposited at the required location in specified layers. No handing or conveyance charges shall be paid ff the material is temporarily deposited elsewhere and subsequently conveyed to site of deposition. The sequence of operations at convenient places, without interfering with the drainage in any way. If no Governments land is available but the excavated useful stuff is to be stacked temporally before use under the same agreement, the contractor shall make his own arrangements for the stacking of this material not required for use on embankment or unsuitable materials may be used on his own to uniformly widen

embankment to flatten slopes and to fill-low places in the road land, if so permitted by the Engineer. Material not required for any use whatsoever may be disposed of by the contractor at his own cost in a manner approved by the Engineer. The excavated material shall not be deposited within 3 m. from the top edge of slope or toe of the bank. The land shall be measured from the junction point of cutting and embankment with all lead and lift on either side. The work shall be read as with lead.

7. If the contractor does not wish to utilize the quantity of cutting within the specified lead for any reason, then he may do the embankment work with the earth from other sources (except borrow pits in the length of the road where cutting stuff is to be utilized) but in that case the full or part quantity on acceptable quality stuff for which payment is made or to be made will be deducted from the net quantity of the earth work in the embankment arrived at, within the chainage measured as above.

8. The Contractor rate shall be a unit of one cubic metre for the start mentioned in the wording of the item of excavation acceptably completed, limited to the dimensions shown on the plans or as directed by the Engineer. Excavation shall be measured in its original position by taking linear measurements after its is entirely completed. The quality shall be worked by cross section the average area method. When the classification of the strata changes, the contractor shall bring this to notice of the Engineer, who will then verify and if necessary, take levels for the changes strata for purpose of measurement.

9. Earth work in cutting shall be made in hard soil such as stiff heavy clay, hard shale or compact murrum, requiring grafting tool or pick or both and shovel, closely applied and gravel and rubble stone having maximum diameter direction between 75 and *300* mm and soft conglomerate. The classification of cutting shall be decided by the Engineer-in-charge and his decision shall be binding on the contractor. Mode of measurement shall be measured after removal of ever burden by tucking cross section at suitable intervals in the original position before the work starts and after its completion areas.

   Payment shall be made in **Cubic meter** basis.

   The rate shall include the cost of labour tools to complete the Job.

Item No. 05:- Rolling and watering of earthwork in layers with power roller including filling in depressions which occur during the process.

1. For spreading materials in layers and bringing the appropriate moisture content, the embankment materials shall be spread uniformly over the entire width of the embankment in layers not exceeding 250mm in loose thickness. Successive layers of embankment shall not be placed until the layer under construction has been thoroughly compacted to the requirements set down here under :-

Moisture content of the materials shall be checked at the source of supply and if found less than that specified for compaction, the same, shall be made good either at the source or after spreading the soil in loose thickness for compaction. In the latter case, water shall be sprinkled directly from a hoseline or from a truck mounted water tank, and flooding shall not be permitted under any circumstances.

If the materials delivered to the road bed is too wet it shall be dried, by evaporation and exposure to the sun. till the moisture content is brought done to acceptable standard for compaction Should circumstances arise. Where owing to wet weather, the moisture content cannot be reduced to the required level by the above procedure, work of compaction shall be suspended.

Moisture content of each layer of soil shall be checked in accordance with IST 2720 (Part-ll) and unless otherwise mentioned shall be so adjusted, making due allowance for evaporation losses, that at the time of the compaction it is in the range of 1 percent to 2 percent below the optimum moisture content determined in accordance with ISI (Part-VII). Highly expansive clays shall however be compacted at 2 to 4 percent above the optimum moisture content

After adding the required amount of water, the soil shall be processed by means of harrows, rotary mixers or as otherwise approved until the layer is uniformly wet. Clods or hard lumps of earth shall be broken to have maximum size of 150mm when being placed in the lower layers of the embankment and a maximum size of 60mm when being placed in the top 0.5 meter portion of the embankment below the subgrade.

Hauling equipment shall be dispered uniformly over entire surface of the previously constructed layer to minimize cutting of uneven compaction Where the embankment is to be constructed on low area ground that will not support the weight of trucks of other hauling equipment, the lower part of the fill should be constructed by dumpling successive loads in a uniformly distributed layers of a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers.

2. COMPACTION :

Only compacting equipment approved by the Engineer-in-charge shall be employed to compact the materials. The contractor shall demonstrate the efficiency of the plants he intents to use for carrying out compaction trials.

Each layer of the materials shall be thoroughly compacted to the densities specified in Table 1.2 Table.

1.2 Compaction requirements for embankment.

Sr. No.	Type of Work / materials	Field dry density as per centage of maximum laboratory dry density as per IS:2720(Part-VII)
1.	Top 0.5 meter portion of embankment below subgrade level and shoulders.	Not less than 100.
2.	Other portion of embankment.	Not less than 95
3.	Highly expensive class	85 to 90

Subsequent layers shall be placed only after finished layer has been tested according to M.O.S.T. specification clause 902 and accepted by the Engineer-in-charge.

When density measurements reveal any soft areas in the embankment further compaction shall be carried out as directed by the Engineer-in-charge. If insite of that the specified compaction is not achieved, the materials in the soft areas shall be removed and replaced by approved materials and compacted to the density requirement to the satisfaction of the Engineer-in-charge.

3. **Measurements for Payment :**

Consolidation of earth embankment construction shall be measured by taking cross section at intervals in the original position before the work starts and after its completion and computing of the volume of earthwork in cubic meters by the method of average and areas. The measurement of fill material from borrow area shall be the difference between the net quantities of suitable materials brought from roadway and drainage excavation. For this purpose it shall be assumed that one cubic meter of suitable materials brought to site from roadway and drainage excavation from one cubic meter of compacted fill and all bulking or shrinkage shall be ignored Stripping including storing and reapplication of top soil shall be measured as volume in **cubic meter.**

4. The contract unit rate includes cost of mechanical roller required for consolidation including all labour, equipments fuel, hire charges, tolls and incidentals necessary.

Item No. 06:- Providing Hard side Shoulder of 100 mm thick for emabankment using quarry spall with all lead and lift and including watering and rolling and consolidation of subgrade in layers including filling the depressions which occur during the process using power roller 80 KN to 100KN Static Weight.

401.1. Scope:

This work shall consist of laying and compacting well-graded Quarry Spall / soil- aggregate material in one or more layers as base or surface course as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

402.2. Definition :

Gravel/ Soil- Aggregate is a mix of stone, sand and fine sized particles used as base or surfacing on a road.

402.3. Materials

402.3.1. The material to be used for the work shall be natural gravel, crushed stone, crushed gravel, crushed slag, moorum, sand or combination thereof depending up on the grading required. The material shall be free from organic or other deleterious constituents and conform to one of the three grading given in Table 400-2 for base course and in Table 400.3 for surface course.

402.3.2. Physical requirements:

[a] When crushed stone/ gravel/ slag is used, the material shall conform to the following requirements.

- Wet Aggregate impact Value (IS:5640) not to exceed 40 and 30 when used in base and surfacing respectively.
- Flakiness Index :)IS: 2386 (Part-1) not to exceed 25 and 20 per cent, when used in base and surfacing respectively.
- In high rain fall, coastal areas and where local soils are salt- infested, If the water absorption value of the course aggregate is greater than 2 percent, the soundness Test shall be carried out onm thee material delivered to the site a per IS:2386 (Part 5).

[i] Loss with Sodium Sulphate, 5 cycles : 12 per cent maximum

[ii] Loss with Magnesium Sulphate, 5 cycles : 18 per cent maximum

- If crushed slag is used, Clause 405.2.5 shall apply.
- If crushed gravel/ shingle is used, not less than 90 per cenet by weight of the gravel/ shingle piexec retained on 4.75 mm sieve shall have at least two fractured faces.

[b] The needed gradation shall be obtained by crushing, screening and blending processes as necessary

[c] Fine aggregate material passing 4.75 mm sieve shall consist of natural aor crushed sand and fine mineral particles.

402.3.3. Base gravel/ Soil aggregate : In addition to the physical requirement in Clause 402.3.2 above the gradation shall conform to the requirement given in Table 400.2, the Liquid Limit when determined according to IS: 2720 (Part 5, Shall not excess 25 and the PI shall not exceed 6..

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

Sieve Size	Per cent by Mass Passing IS sieve Grading Designation		
	Grading I	Grading II	Grading III
53.0 mm	100	---	---

37.5 mm	97-100	100	---
26.5 mm		97-100	100
19.0 mm	67-81		97-100
9.50 mm		56-70	67-79
4.75 mm	33-47	39-53	47-59
0.425 mm	10-19	12-21	12-21
0.075 mm	4-8	4-8	4-8
CBR Value (Minimum)	**25**	**25**	**25**

402.3.4. Surface course gravel/ Soil aggregate : In addition to the physical requirement in Clause 402.3.2 above the gradation & plasiticity index (PI) shall confirm to the requirement given in Table 400.3,

TABLE 400-3. GRADING REQUIREMENTS FOR SURFACE COURSE

IS Sieve Designation	Per cent by weight passing the IS sieve
	Grading I
26.5 mm	100
19.0 mm	97-100
4.75 mm	41-71
0.425 mm	12-28
0.075 mm	9-16
	4-10
CBR Value (Minimum)	**25**

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.

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.

The surface of the sub grade / sub base /base as the case may be. to receive the Gravel/ soil -Aggregate course shall be prepared to the specified lines and cross fall (camber) and made free of dust and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm surface is obtained, if· necessary by sprinkling water. Any irregularities, where predominant, shall he made good by providing appropriate type of profile corrective course (leveling course) to Clause 501 of these Specifications.

401.4.2. Spreading and compacting: The Gravel/ Soil aggregate 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 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 402.3.1, 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 quantifies to variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from I 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/m^2 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 kin per hour.

Rolling shall be continued fill 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.

402.5. Surface Finish and Quality Control of Work:

The surface finish of construction shall conform to the requirements of Clause 1802. Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 1800.

402.6. Arrangements for Traffic: During the period of construction, arrangement of traffic shall be maintained in accordance with Clause 111.

401.7. Measurements for Payment:

Gravel/ Soil Aggregate base / surface course as the case may be, shall be measured as finished work in position in cubic metres.

401.8. Rate:

The Contract unit rate for Gravel/ Soil Aggregate base / surface course shall be payment in full for carrying out the required operations including full compensation for all the components listed below.

(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 meter for completed item as directed.

Item No. 07 :- 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 Oven 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 quantifies to variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from I 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/m^2 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 kin per hour.

Rolling shall be continued fill 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. 08 :- Providing and laying 100 mm thick Compacted WBM (Using loose volume, MCBT metal size 45 to 90 mm size) (1.21 Cmt.B.T. Grit 11.2 mm size 0.18 cmt, Stone dust 0.09 Cmt per Total 1 Cmt of Compacted volume) including spreading in uniform thickness, hand packing, rolling with vibratory roller 80 -100 kN static wt. to proper grade and camber, applying and brooming, stone screening/ binding materials to fill-up the interstices of course aggregate watering and compacting etc. complete as per Specification.

And

Item No. 09 :- Providing and laying 150 mm thick in 2- Layer (75+75 mm) Compacted WBM (Using loose volume, MCBT metal size 45 to 63 mm size) (1.21 Cmt.B.T. Grit 11.2 mm size 0.12 cmt, Stone dust 0.06 Cmt per Total 1 Cmt of Compacted volume) including spreading in uniform thickness,hand packing, rolling with vibratory roller 80 - 100 kN static wt. to proper grade and camber, applying and brooming, stone screening/ binding materials to fillup the interstices of course aggregate watering and compacting etc. complete as per Specification.

405.1 Scope

405.1.1 This work shall consist of clean, crushed aggregates mechanically interlocked by rolling and bonding together with screening, binding material where necessary, and water laid on a properly prepared subgrade/sub-base/base or existing pavement, as the case may be and finished in accordance with the requirements of these Specifications and in close conformity with the lines, grades, cross-sections and thickness as per approved plans or as directed by the Engineer.

405.2 Materials

405.2.1 *Coarse aggregates*

Coarse aggregates shall be either crushed or broken stone, crushed slag, overburnt (Jhama) brick aggregates or any other naturally occurring aggregates, such as, kankar and laterite of suitable quality. Materials obtained from rocks, such as, Phyllites, Shales or Slates, etc. shall not be permitted in WBM construction. Materials other than crushed or broken stone and crushed slag shall be used in sub-base courses only. If crushed gravel/shingle is used, not less than 90 percent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in **Table 400.7**. The type and size range of the aggregate shall be specified in the Contract or shall be as specified by the Engineer. If the water absorption value of the coarse aggregate is greater than 2 percent, the Soundness test shall be carried out on the material delivered to site as per IS:2386 (Part 5).

405.2.2 Aggregates, like, brick bats, kankar, laterite, etc. which get softened in presence of water shall be tested for Aggregate Impact Value under wet conditions in accordance with IS:5640

Table 400.7 Physical Requirements of Coarse Aggregates for Water Bound Macadam for Sub-base/Base/Surfacing Courses

Test	Sub-base	Base	Surfacing
Aggregate Impact Value(IS:2386 Part 4 or IS:5640)	Less than 50	Less than 40	Less than 30
Flakiness Index(IS:2386 Part 1)	Less than 30	Less than 25	Less than 20
Soundness Test(IS:2386 Part 1)			
– Loss with Sodium Sulphate	Less than 12%	Less than 12%	Less than 12%
– Loss with Magnesium Sulphate	Less than 18%	Less than 18%	Less than 18%

405.2.3 The requirement of flakiness Index shall be enforced only in the case of crushed or broken stone and crushed slag.

405.2.4 *Crushed or broken stone*

The crushed or broken stone shall be hard, durable and free from excess flat, elongated, soft and disintegrated particles, dirt and other deleterious material.

405.2.5 *Crushed slag*

Crushed slag shall be made from air-cooled blast furnace slag. It shall be of angular shape, reasonably uniform in quality and density and generally free from thin, elongated and soft pieces, dirt or other deleterious materials. The weight of crushed slag shall not be less than 11.2 kN per cum. It shall also comply with the following requirements:

i) Chemical stability: Steel slag shall comply with the requirements of BS: 1047

ii) Water absorption: Max. 10 percent

405.2.6 *Overburnt (Jhama) brick aggregates*

Jhama brick aggregates shall be made from overburnt bricks or brick ballast and be free from dust and other objectionable and deleterious materials.

405.2.7 *Grading requirement of coarse aggregates*

The coarse aggregates shall conform to one of the Gradings given in **Table 400.8** as specified. The use of Grading No.1 shall be restricted to sub-base courses only.

Table 400.8 Grading Requirements of Coarse Aggregates*

Grading Designation	Size Range	ISSieve No.	Passing Percent by Weight
1)	90 mm to 45 mm	125 mm	100
		90 mm	90-100
		63 mm	25-60
		45 mm	0-15
		22.4 mm	0-5
2)	63 mm to 45 mm	75 mm	100

		63 mm	90-100
		53 mm	25-75
		45 mm	0-15
		22.4 mm	0-5
3)	53 mm to 22.4 mm	63 mm	100
		53 mm	95-100
		45 mm	65-90
		22.4 mm	0-10
		11.2 mm	0-5

* (i) The gradings for the aggregate are to be met with before using them for WBM construction. After rolling and compaction of WBM layer, the grading may vary from the specified values.

(ii) Engineer may allow ± 5 percent variation from the specified upper and lower limits excluding the first and the last sieve in the gradings.

405.2.8 *Screenings*

Screenings to fill voids in the coarse aggregate shall generally consist of the same material as the coarse aggregate. However, where economic considerations so warrant, predominantly non-plastic material (other than rounded river borne material) may be used for this purpose provided liquid limit and plasticity index of such material are below 20 and 6 respectively and fraction passing 75 micron sieve does not exceed 10 percent. The screenings shall not contain any of the undesirable constituents listed in Clause 301.2.3 which would render it unsuitable as a fill material.

Screenings shall conform to the grading set forth in **Table 400.9**. The details of quantity of screenings required for various grades of stone aggregates are given in **Table 400.10**. The Table also gives the quantities of materials (loose) required for 10 m2 for sub-base/base/surfacing compacted thickness of 100/75 mm.

Table 400.9 Grading for Screenings

Grading Classification	**Size of Screenings**	ISSieve **Designation**	**Percent by Weight Passing the ISSieve**
A	13.2 mm	13.2 mm	100
		11.2 mm	95-100
		5.6 mm	15-35
		180 micron	0-10
B	11.2 mm	11.2 mm	100
		9.5 mm	80-100
		5.6mm	50-70

		180 micron	15-35

The use of screenings shall be omitted in the case of soft aggregates, such as, brick metal, kankar, laterite, etc. as they are likely to get crushed to a certain extent under rollers.

Table 400.10 Approximate Quantities of Coarse Aggregates and Screenings Required for 100/75mm Compacted Thickness of Water Bound Macadam (WBM) Sub-base/Base/surfacing Course for 10 m2 Area

Classification	Size Range	Compacted Thickness	Loose Qty.	Screenin			
				Stone Screening		Crushable Type Suchas	
				Grading Classification& Size	For WBM Sub-base/ Base Course	Grading Classification& Size	Loose Qty.
Grading 1	63 mm to 45	75 mm	0.91 to 1.07	Type A 13.2 mm	0.12 to 0.15	Not uniform	0.22 to 0.24 m3
-do-	-do-	-do-	-do-	Type B 11.2 mm	0.20 to 0.22	-do-	-do-
Grading 2	53 mm to	75 mm	-do-	-do-	0.18 to 0.21	-do-	-do-

*Quantity of stone screenings for surfacing course will be about 80% of the quantity for sub-base/ base course.

405.2.9 *Binding material*

Binding material to be used for water bound macadam as a filler material meant for preventing ravelling, shall comprise of a suitable material approved by the Engineer having a Plasticity Index (PI) value of less than 6 for sub-base/base course and 4 to 10 for surfacing course as determined in accordance with IS:2720 (Part 5).

The quantity of binding material where it is to be used, will depend on the type of screenings and function of WBM. Generally, the quantity required for 75 mm compacted thickness of water bound macadam will be 0.06-0.09 m3/10 m2 for sub-base/base course and 0.10-0.15 m3/10 m2 for surfacing course. For 100 mm compacted thickness of WBM (Grading 1) for sub-base the quantity needed will be 0.08-0.10 m3/10 m2.

The above mentioned quantities should be taken as a guide only, for estimation of quantities for construction, etc.

Application of binding materials may not be necessary when the screenings used are of crushable type.

405.3 Construction Operations

405.3.1 *Preparation of base*

The surface of the subgrade/sub-base/base to receive the water bound macadam course shall be prepared to the specified lines, grade and camber and made free of dust and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm surface is obtained if necessary by sprinkling water.

Where the WBM is to be laid on an existing metalled road, any irregularities, depressions, pot holes shall be repaired and the existing surface rectified to the required grade and camber with suitable material before spreading the coarse aggregate for WBM.

Laying water bound macadam course over an existing bituminous layer shall be avoided since it will cause problems of internal drainage of the pavement at the interface of two courses. The existing thin bituminous wearing course shall be scarified completely before laying the WBM layer.

405.3.2 *Inverted choke*

Where the WBM layer is to be laid directly over the subgrade and the subgrade soil is fine-grained, it is advisable to lay 100 mm intervening layer of screening or coarse sand on top of the fine-grained soil.

405.3.3 *Provision of lateral confinement of aggregates*

While constructing water bound macadam, arrangement shall be made for the lateral confinement of the aggregates. This shall be done by building adjoining shoulders along with water bound macadam layers and following the sequence of operations described in Clause 407.4.1.

The practice of constructing WBM in a trench section excavated in the finished formation shall not be followed. Where the WBM course is to be constructed in narrow widths for widening of an existing pavement, the existing shoulders shall be excavated to their full depth and width upto the subgade level except where widening specifications envisage laying of a stabilized sub-base using in-situ operations in which case the sholders shall be removed upto the sub-base level.

405.3.4 *Spreading coarse aggregates*

The coarse aggregates shall be spread uniformly and evenly upon the prepared subgrade/ sub-base/base to proper profile by using templates placed across the road about 6 m apart, in such quantities that the thickness of each compacted layer is not more than 100 mm for Grading 1 and 75 mm for Grading 2 and 3, as specified in Clause 405.2.5. Aggregates placed at locations which are inaccessible to the spreading equipment, may be spread in one or more layers by any approved means so as to achieve the specified results.

The spreading shall be done from stockpiles along the side of the roadway or directly from vehicles. No segregation of large or fine aggregates shall be allowed and the coarse aggregate as spread shall be of uniform gradation with no pockets of fine material.

The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregates as may be required. The surface shall be checked frequently with a straight edge while spreading and rolling so as to ensure a finished surface as per approved drawings.

The coarse aggregates shall not normally be spread more than 3 days in advance of the subsequent construction operations.

405.3.5 *Rolling*

Immediately following the spreading of the coarse aggregate, rolling shall be started with three wheeled power rollers of 80 to 100 kN capacity or tandem or vibratory rollers of 80 to 100 kN static weight.

Except on superelevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inward parallel to the centre line of the road, in successive passes uniformly lapping preceding tracks by at least one half width.

Rolling shall be discontinued when the aggregates are partially compacted with sufficient void space in them to permit application of screenings. However, where screenings are not to be applied, as in the case of crushed aggregates, like, brick metal, laterite and kankar, compaction shall be continued until the aggregates are thoroughly keyed. During rolling, slight sprinkling of water may be done, if necessary. Rolling shall not be done when the subgrade is soft or yielding or when it causes a wave-like motion in the subgrade or sub-base course.

The rolled surface shall be checked transversely with templates and longitudinally with 3m straight edge. Any irregularities, exceeding the maximum permissible limits, shall be corrected by loosening the surface, adding or removing necessary amount of aggregates and re-rolling until the entire surface conforms to desired camber and grade. In no case shall the use of screenings be permitted to make up depressions.

Material which gets crushed excessively during compaction or becomes segregated shall be removed and replaced with suitable aggregates.

It shall be ensured that shoulders are built up simultaneously along with water bound macadam courses, in accordance with the procedure given in Clause 407.4.1.

405.3.6 *Application of screenings*

After the coarse aggregate has been rolled to Clause 405.3.5, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregate. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motions of hand shovels or by mechanical spreaders, or directly from tipper with suitable grit spreading arrangement. Tipper operating for spreading the screenings shall be so driven as not to disturb the coarse aggregate.

The screenings shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms, hand-

brooms or both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregate.

The spreading, rolling, and brooming of screenings shall be carried out in only such lengths of the road which could be completed within one day's operation.

405.3.7 *Sprinkling of water and grouting*

After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and to distribute them evenly. The sprinkling, sweeping and rolling operation shall be continued, with additional screenings applied as necessary until the coarse aggregate has been thoroughly keyed, well-bonded and firmly set in its full depth and a grout has been formed of screenings. Care shall be taken to see that the base or subgrade does not get damaged due to the addition of excessive quantities of water during construction.

In case of lime treated soil sub-base, construction of water bound macadam on top of it shall be done after the sub-base has been cured and has attained adequate strength, as directed by the Engineer.

405.3.8 *Application of binding material*

After the application of screenings in accordance with Clauses 405.3.6 and 405.3.7, the binding material where it is required to be used (Clause 405.2.9), shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water, the resulting slurry swept in with hand brooms, or mechanical brooms to fill the voids properly, and rolled during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling of voids, forms a wave ahead of the wheels of the moving roller.

405.3.9 *Setting and drying*

After the final compaction of water bound macadam course, the pavement shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings or binding material as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam has set. The Engineer shall have the discretion to stop hauling traffic from using the completed water bound macadam course, if in his opinion it would cause excessive damage to the surface.

The compacted water bound macadam course should be allowed to completely dry and set before the next pavement course is laid over it.

405.4 Surface Finish and Quality Control of Work

405.4.1 The surface finish of construction shall conform to the requirements of Section 1800.

405.4.2 Control on the quality of material and works shall be exercised by the Engineer in accordance with Section 1800.

405.4.3 The water bound macadam work shall not be carried out when the atmospheric temperature is less than 10°C in the shade.

405.4.4 *Reconstruction of defective macadam*

The finished surface of water bound macadam shall conform to the tolerance of surface regularity as prescribed in Section 1800. However, where the surface irregularity of the course exceeds the tolerances or where the course is otherwise defective due to subgrade soil mixing with the aggregates, the course to its full thickness shall be scarified over the affected area, reshaped with added material or removed and replaced with fresh material as applicable and recompacted. The area treated shall not be less than 10 sqm. In no case shall depressions be filled up with screenings or binding material.

405.5 Arrangement for Traffic

During the period of construction, the arrangements for traffic shall be provided and maintained as per Section 100.

405.6 Measurements for Payment

Water bound macadam shall be measured as finished work in position in cubic metres.

405.7 Rate

The Contract unit rate for water bound macadam sub-base/base/surfacing course shall be payable in full for carrying out the required operations including full compensation for all components listed in Clause 401.7 including arrangements of water used in the work as approved by the Engineer.

Item No.10 :- 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 NP3 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 placeof 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 form 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 out 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 diametre 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 from a culvert with a smooth uniform invert. Any pipe found defective or damaged during laying shall be removed at there cost of Contractor.

4 The pipes shall be jointed either by collar joint or by flush joint in the former case the collars shall be of R.C.C. 150 to 200 mm. wide and having the same strength as the pipes to be jointed. Caulking space shall be between 13 and 20 mm. according to the diametre 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 from 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, handing, 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. 11 :- **Providing and laying Builtup spray grout base 37.50 mm thick in Single layer using asphalt grade VG 30 for tackcoat on WBM surface @ 4.00 kg / 10 smt, and using B.T. stone aggregates as per MORT & H gradation and specification with the asphalt of VG-30 grade at the rate of 1.99% i.e.19.90 Kg./M.T. including heating and mixing asphalt and aggregate by continuous drum mix plant, transporting the mix, and spreading the same by paver finisher and consolidation by vibrator roller of 80 to 100 KN Static WT including cost of all materials, fuel, labours, tools and plant etc using contractor's own machinaries etc. complete.**

506.1. Scope

This work shall consist of a single-layer composite construction of compacted crushed coarse aggregates with application of bituminous binder after each layer, and with key aggregates placed on top of the layer, in accordance with the requirements of these Specifications, to serve as a base course and in conformity with the lines, grades and cross-sections shown on the drawings or as directed by the Engineer. The thickness of the course shall be 37.50 mm.

Built-up spray grout shall be used in a single course in a pavement structure.

506.2. Materials

506.2.1. Bitumen: Clause 504.2. 1. Shall apply. The bitumen shall be paving bitumen of penetration

grade 80/100 complying with Indian Standard specification for "Paving Bitumen" IS: 73.

Where permitted by the Engineer, an appropriate grade of emulsion complying with IS 8887 may be used .

506.2 .2. Aggregates: The coarse aggregate shall conform to MOST Specification Clause 504.2.2.

The aggregates shall consist of crushed stone, crushed gravel/shingle or other stones. They shall be clean, strong, durable, of fairly cubical shape and free from disintegrated pieces, organic or other deleterious matter and adherent coating. If crushed shingle/gravel is used, not less than 90 per cent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall preferably be hydrophobic and of low porosity. If hydrophilic aggregates are to be used, the bitumen shall preferably be treated with anti-stripping agents of approved quality in suitable dose as Appendix-5.

The aggregates shall satisfy the physical requirements set forth in Table 500.3.

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

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

TABLE 500.3 : PHYSICAL REQUIREMENTS FOR AGGREGATES

Test	Test Method	Requirement
Los Angles Abrasion Value*	IS – 2386 (Part – 4)	40 Percent Maximum
Aggregate Impact Value*	IS – 2386 (Part – 4)	30 Percent Maximum
Flakiness and Elongation Index**	IS – 2386 (Part – 1)	30 Percent Maximum

Stripping Value	IS – 6241	25 Percent Maximum
Water Absorption	IS – 2386 (Part – 3)	2 Percent Maximum
Coating and stripping of bitumen aggregates mixtures	AAShtot-182	Minimum retained Coating 95 Percent
Soundness: (I) Loss with sodium Sulphate (II) Loss with magnesium Sulphate	IS-2386 (Part-V) 5 Cycles IS-2386 (Part-V) 5 Cycles Retained Tensile Strength	 12 Percent Maximum 18 Percent Maximum

Property	**Test**	**Specification**
Cleanliness	Grain Size Analysis	Max 5% passing 0.075mm sieve
Particle shape	Flakiness Index	Max. 25 per cent
Strength	Aggregate Impact Value	Max. 30 per cent
Durability	Soundness Sodium Sulphate Magnesium Sulphate	 Max. 12 per cent Max. 18 per cent
Water Absorption	Water absorption	Max. 2 per cent
Stripping	Coating and stripping of bitumen aggregate mixtures	Min. retained coating 95 %
Water Sensitivity	Retained Tensile Strength	Minimum 80%

Notes:

1. IS:2386 Part 1
2. IS:2386 Part 4*
3. IS:2386 Part 5
4. IS:2386 Part 3
5. IS:6241

Water sensitivity test is only to be carried out if the minimum retained coating in the stripping test is less than 95%

* Aggregates may satisfy requirements or either of these two tests.

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

The aggregate shall satisfy the physical requirements set out in Table 500-3. The coarse and key aggregates: for built-up spray grout shall conform to the grading given in Table 500-7.

TABLE 500-7

GRADING REQUIREMENTS OF COARSE AND KEY AGGREGATES FOR BUILT-UP SPRAY GROUT

IS Sieve	Per cent by weight passing the Sieve	
Designation	**Coarse Aggregate**	**Key Aggregate**
53.0 mm	**100**	**-**
26.5 mm	**75 - 100**	**-**
22.4 mm	**50 - 85**	**100**
13.2 mm	**20 - 40**	**40-75**
5.6 mm	**05 – 20**	**0-20**
2.8 mm	**0-5**	**0-5**

506.3. Construction Operations

506.3.1. Weather and seasonal limitations: The provisions of MOST Specification Clause 504.3.1 shall apply. Laying of bituminous mixtures shall not be carried out when the air temperature at the surface
over which it is to be laid is below 10 C or when the wind speed at any temperatures exceeds 40 km/hr at 2 m height unless specifically approved by the Engineer. Laying shall be suspended while free-standing water is present on the surface to be covered, or during rain, fog and dust storms. After rain, the surface shall be left to dry before laying shall start.

506.3.2. Equipment: The provisions of Clause 505.3.2 shall apply A mechanical broom, compressor, self-propelled or trailed bitumen heater/distributor and 80 to 100 KN smooth steel-wheeled roller ,Vibratory roller are required.

506.3.3. Preparation of Base: The base on which the built-up spray grout course is to be laid shall be prepared, shaped and compacted to the specified lines, grades and cross-sections in accordance with MOST Specification Clauses 501 and 502 as appropriate. A prime coat shall be applied in accordance with Clause 502 with approved primer as directed by the Engineer

506.3.4. Tack coat: A tack coat of bitumen VG -30 shall be 4.**0Kg/10Smt** applied in accordance with the procedure described in MOST Specification Clause 503, as directed by the Engineer in charge.

506.3.5. Aggregate grading and binder content: When tested in accordance with IS: 2386 Part I (wet sieving method), the combined aggregate grading for the particular mixture shall fall within the limits shown in Table 500-7 for the grading specified in the Contract. The type and quantity of bitumen, and appropriate thickness, are also indicated for each mixture type. The bitumen for mixing shall be at the rate of **19.90 Kg. / M. T.**

506.3.6. Proportioning of material: The aggregates shall be proportioned and blended to produce a uniform mixture complying with the requirements of Table 500-7. The binder content shall be within a tolerance of ± 0.3 per cent by weight of total mixture when individual specimens are taken for quality control tests in accordance with the provisions of Section 900.

506.3.7. Preparation and transportation of the mixture: The provisions of Clauses 501.3 and 501.4 shall apply. Mix Material shall be prepared in a hot mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coated aggregates.

Appropriate mixing temperatures are given in Table 500.7 of these Specifications; the difference in temperature between
the binder and aggregate should at no time exceed 14 C. In order to ensure uniform quality of the mix and better coating of aggregates, the hot mix plant shall be calibrated from time to time. A batch type or continuous type or a spot mixer may be used for preparation of mix as decided by the Engineer. If a continuous mixing plant is to be used for mixing, the Contractor must demonstrate by laboratory analysis that cold feed combined grading is within permissible grading limits and binder content is in compliance to job mix formula. The maximum permitted variation in binder content shall be 0.3 per cent.
Mix Material shall be transported in clean insulated vehicles and unless otherwise agreed by the Engineer, shall be covered while in transit or awaiting tipping. Subject to the approval of the Engineer, a thin coating of diesel or lubricating oil may be applied to the interior of the vehicles to prevent sticking and to facilitate discharge of the material. Any tipper causing excessive segregation of materials by its spring suspension or other contributing factors or that which shows undue delay shall be removed from the work until such conditions are corrected.
506.3.8. Spreading: The provisions of Clauses 501.5.3 shall apply. Except in areas where a mechanical Paver cannot access, premixed bituminous macadam shall be spread, leveled, and tamped by an approved self-propelled paving machine. As soon as possible, after arrival at site, the materials shall be supplied continuously to the Paver and laid without delay.
The rate of delivery of material to the Paver shall be regulated to enable the Paver to operate continuously. The travel rate of the Paver and its method of operation shall be adjusted to ensure an even and uniform flow of bituminous material across the screed, free from dragging, tearing and segregation of the material. In areas with restricted space where a mechanical Paver cannot be used, the material shall be spread, raked and leveled with suitable hand tools by experienced staff and compacted to the satisfaction of the Engineer.
However, in restricted locations and in narrow widths where the available plant cannot be operated in the opinion of the Engineer, he may permit manual laying of the mix.
506.3.9. Rolling: Compaction shall be carried out in accordance with the provisions of Clauses 501.6 and 501.7.
Rolling shall be continued until-the specified density is achieved, or where no density is specified, until there is no further movement under the roller. The required frequency of testing is defined in Clause 903.
After the spreading of mix, rolling shall be done by 80 to 100 KN static weight rollers or other approved equipment. Rolling shall start as soon as possible after the material has been spread deploying a set of rollers as the rolling is to be completed in limited time frame. The roller shall move at a speed not more than 5 km/hr. Rolling shall be done with care to avoid unduly roughening of the pavement surface.

Rolling shall commence at the edges and progress towards the centre longitudinally except that on super elevated and uni-directional cambered portions, it shall progress from the lower to the upper edge parallel to the centerline of the pavement.
The initial or break-down rolling shall be done with 80 to 100 KN static weight rollers, as soon as it is possible to roll the mix without cracking the surface or having the mix pick up on the roller wheels. The second or intermediate rolling shall follow the break-down rolling with vibratory roller of 80 to 100 KN static weight or a suitable pneumatic tyred roller as closely as possible to the Paver and be done while the paving mix is still at a temperature that will result in maximum density. The final rolling shall be done while material is still workable, as per the temperatures given in Table 500.5. The joints and edges shall be rolled with an 80 to 100 KN static weight roller.
When the roller has passed over the whole are once, any high spots or depressions which become apparent shall be corrected by removing or adding mix material. The rolling shall then be continued till there is no crushing of aggregates and all roller marks have been eliminated. Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. The roller wheel shall be kept damp if necessary to avoid bituminous material from sticking to the wheels and being picked up. In no case shall fuel, lubricating oil be neither used for this purpose, nor

excessive water poured on the wheels. The initial wetting of the roller wheels should be done outside the compaction area.

Rolling operations shall be completed in every respect before the temperature of the mix falls below the rolling temperature given in Table 500.5.

TABLE 500.5 : MANUFACTURING AND ROLLING TEMPERATURES

Bitumen Penetration	Bitumen Mixing(°C)	Aggregate Mixing(°C)	Mixed Material (°C)	Laying (°C)	Rolling (°C)
35	160-170	160-175	170 maximum	140 minimum	100 minimum
65	150-165	150-170	165 maximum	130 minimum	100 minimum
90	140-160	140-165	155 maximum	130 minimum	100 minimum

Roller(s) shall not stand on newly laid material while there is a risk that surface will be deformed thereby. The edges along and transverse of the bituminous macadam laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against it, as per clause 504.3.7.

Where modified bitumen is used, the manufacturing and rolling temperatures shall be as per clause 512.4.2.

504.3.7. Joints: For single-lane road construction, only transverse joints are made, while for double-lane road construction, longitudinal joints have also to be made in addition to transverse joints. While forming joints it is necessary that the premixed material shall be fully compacted and the joint made flush by cutting back the exposed joint for a distance equal to the specified layer thickness, to a vertical face, discarding all loosened material. The vertical face shall be coated completely with 80/100 penetration grade hot bitumen, or cold-applied bitumen, or polymer modified adhesive bitumen tape with a minimum thickness of 2.

506.3.10. Application of key aggregate: Key aggregates shall be spread uniformly and evenly, preferably by mechanical means, at the rate of 0.13 Cu.m. /10 sq.m so as to cover the surface completely. The key aggregate shall be clean, dry and free from dust and deleterious matter. If necessary, the surface shall be swept to ensure uniform application of the key aggregates. The entire surface shall then be rolled with an 8-10 tonnes smooth wheel steel roller in accordance with Clause 506.3.5. While rolling is in progress, additional key aggregates, where required, shall be spread by hand. Rolling shall continue until the entire course is thoroughly compacted and the key aggregates are firmly in position

506.4. Surface Finish and Quality Control

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

506.5. Final Surfacing

The built-up-spray-grout shall be provided with final surfacing within a maximum of forty-eight hours. If there is to be any delay, the course shall be covered by a seal coat to the requirement of Clause 513 before it is open to traffic. Where the seal coat is required as a result of the selected method of performing this operation, then it shall be considered incidental to the work and shall not be paid for separately.

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

506.7. Measurement for Payment:

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

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

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

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

Built-up spray grout shall be measured as finished work in M.T.

506.8. Rate:

The contract unit rate for built-up spray grout shall be payment in full for carrying out the required operations as specified. The rate shall include for, but not necessarily be limited to the components listed under in **Clause 504.8. (i) to (xii)**

504.8. Rate : -

The contract unit rate for premixed bituminous material shall be payment in full for carrying out the required operations including full compensation for, but not necessarily limited to :

(1)Making arrangements for traffic to clause 112 except for initial treatment to verge, shoulders and construction of diversions.

(2)Preparation of the surface to revive the material, Scarifying the exiting surface as directed by Engineer – in – charge.

(3) Providing all materials to be incorporated in the work including arrangement for stock yards. All royalties, fees rents where necessary and all leads and lifts.

(4) Mixing transporting, laying and compacting the mix as specified.

(5) All labour, tools equipment, plant including installation of hot mix plant, power supply units and all machinery incidental to complete the work to these specification.

(6) Carrying out the work in part widths of the road where directed.

(7) Carrying out all tests for control of quality.

(8)The rate shall cover the provision of bitumen at the rate specified in the contract, with the provision that the variation in actual percentage of bitumen used will be assessed and the payment

(9)The rate are to include for all wastage in cutting of joints etc.

(10) The rates are to include for all necessary testing mix design transporting and testing of Samples and cores. If there-is not a project- specific :laboratory, the contractor must arrange to carry out all necessary testing at an outside laboratory approved by the Engineer and all costs incurred are deemed to be included in the rate quoted for the material.

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

(12)The rate includes scarifying of the exiting surface as directed by Engineer in charge.

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

Item No. 12 :- **Providing and laying 37.50 mm. thick Bitumenous Macadam with using asphalt grade VG 30 for tackcoat at the rate of 2.50 Kg./10 sqm. using crushed stone aggregate as per MORT & H gradation and VG-30 grade Bitumen at the rate of 3.40% by weight of total mix (ie 34 kg. / MTon of mix) for binding including heating & mixing the asphalt and aggregates by contineous Drum mix plant and transporting the mix and spreading the same by paver finisher and consolidation with vibratory road roller of 80 to 100 KN Static WT including providing and laying uniformly tack coat and using contractor's own machinaries including cost of all materials, fuel, labours, tools and plant etc using contractor's own machinaries etc. complete.**

: SCOPE:

The work shall consist of construction in a single course of compacted crushed aggregates premixed with a bituminous binder to serve as base /binder course laid immediately after mixing on a base prepared previously in accordance with the, requirement of these specifications and in conformity with the lines and cross sections shown on the drawing or as directed by the Engineer.

: MATERIALS: : BITUMEN \ BINDER: The bitumen shall be paving bitumen of suitable penetration grade (30/40 to 80/100) as per IS : 73. The actual grade of bitumen to be used shall be decided by the Engineer appropriate to the region, traffic, rainfall and other environmental conditions. Guidelines on selection of the grade of bitumen are given in Appendix-4.

: AGGREGATES:

The aggregates shall consist of crushed stone, crushed gravel/shingle or other stones. They shall be clean, strong, durable, of fairly cubical shape and free from disintegrated pieces, organic or other deleterious matter and adherent coating. If crushed shingle/gravel is used, not less than 90 per cent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall preferably be hydrophobic and of low porosity. If hydrophilic aggregates are to be used, the bitumen shall preferably be treated with anti-stripping agents of approved quality in suitable dose as Appendix-5. The aggregates shall satisfy the physical requirements set forth in Table 500-3.

TABLE 500-3. PHYSICAL REQUIREMENTS OF AGGREGATES FOR BITUMINOUS MACADAM

SR.NO	TEST	TEST METHOD	REQUIREMENT
1	Los Angles Abrasion Value*	IS – 2386 (Part – 4)	40 Percent Maximum
2	Aggregate Impact Value*	IS – 2386 (Part – 4)	30 Percent Maximum
3	Flakiness and Elongation Index**	IS – 2386 (Part – 1)	30 Percent Maximum
4	Coating and stripping of bitumen aggregates mixtures	AAShtot-182	Minimum retained Coating 95 Percent
5	Soundness:		
	(I) Loss with sodium Sulphate	IS-2386 (Part-V) 5	12 Percent Maximum
	(II) Loss with magnesium Sulphate		18 Percent Maximum

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

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

Note : If crushed slag is used, Clause 404.2.3. shall apply. : The aggregate for bituminous macadam shall conform to one of the two gradings in Table 500-4, depending on the compacted thickness; the actual grading shall be as specified in the Contract.

: PROPORTIONING OF MATERIALS: The bitumen content for premixing shall be **3.40** per cent by weight of the total mix except when otherwise directed by the Engineer.

The maximum compacted thickness of a layer shall be 100mm. The quantities of aggregates to be used shall be sufficient to yield the specified thickness after compaction.

TABLE 500-4. AGGREGATE GRADING FOR BITUMINOUS MACADAM

Mix Designation Nominal aggregates size Layer thickness	Grading 1 40mm 80-100 mm	Grading 2 19mm 50 -75 mm
IS SIEVE DESIGNATION	% by weight passing the Sieve	
	Grading 1	Grading 2
45.00 mm	100	-
26.50 mm	75-100	100
22.40 mm	60-95	75-100
11.20 mm	30-55	50-85
5.60 mm	15-35	20-40
2.80 mm	,5-20	,5-20
90 micron	0-5	0-5

VARIATION IN PROPORTIONING OF MATERIAL:

The contractor shall have the responsibility for ensuring proper proportioning of materials and producing a uniform mix. A variation in

binder content $\pm$ 0.3 percent by weight of total mix shall, however, be permissible in individual specimen taken for quality control test vide MOST Specification Section 900.

: CONSTRUCTION OPERATIONS:

: WEATHER AND SEASONAL LIMITATION:

The work of laying shall not be laid during rainy weather or when the base course is damp or wet or during dust storm or when the atmospheric temperature in shades is 10^{0} C or less.

: PREPARATION OF THE BASE:

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

: TACK COAT:

Tack coat as per Clause 503 of MOST Specification shall be applied over the base .

RATE OF APPLICATION OF TACK COAT:

Apply tack coat at the rate of **2.5 Kg / 10 Sq. meter** area on bituminous surface as per directed by Engineer in charge.

: PREPARATION AND TRANSPORT OF MIX:

Bituminous macadam mix shall be prepared in a hot mix plant of adequate capacity and capable of

yielding a mix of proper and uniform quality with thoroughly coated aggregates.

The hot mix plant shall be a batch mix plant of suitable capacity. Total system for crushing of stone aggregates and feeding of aggregate fractions in required proportions to achieve the desired mix, deployed by the Contractor must be capable of meeting the overall Specification requirements under stringent quality control. The plant shall have the following essential features:

A GENERAL:

(a) The Plant shall have coordinated set of essential units capable of producing uniform mix as per the job mix formula.

(b) Cold aggregate feed system with minimum 4 bins having belt conveyor arrangements for initial proportioning of aggregates from each bin in the required quantities in order to have free flow of fines. The bin it is advisable to have vibrator fitted on bin to intermittently shake it.

(c) Belt conveyer below each bin should have variable speed drive motors. There should be electronic load sensor on the main conveyer for measuring the flow of aggregates.

(d) Dryer unit with burner capable of heating the aggregates to the required temperature without any visible un burnt fuel or carbon residue on the aggregates and reducing the moisture content of the aggregates specified minimum.

(e) The plant shall be fitted with suitable type of thermometric instruments at the appropriate places so as to indicate of record / register the temperature of heated aggregates, bitumen and mix.

(f) Bitumen supply unit capable of heating measuring / metering and spraying of bitumen at specified temperature with automatic synchronization of bitumen and aggregates feed in the required proportion.

(g) A filler system suitable to receive bagged or bulk supply of filler material and its incorporation to the mix in the correct quantity wherever required.

(h) A suitable built in dust control system for the dryer to contain recycle permissible fines in to the mix. It should be capable of preventing the exhaust of fine dust in to atmosphere for environmental control wherever so specified by the Engineer in charge.

(I) The plant should have centralized control panel / cabin capable of presetting, controlling / Synchronizing all operation stating from feeding of cold aggregates to the discharge of the hot mix to ensure proper quality of mix. It should have indicators for any malfunctioning in the operation.

(j) Every hot mix plant should be equipped with siren or horn so that the operator may use the same before starting the plant every time in the interest of safety of staff.

B FOR BATCH TYPE PLANT:

(I) Gradation control unit having minimum four back vibratory screens for accurate sizing of hot aggregates and storing them in separate bins. This unit should be fully covered to reduce the maintenance cost and for better environmental condition.

(II) Proper arrangement for accurate weighting of each size of hot aggregates from the control panel before mixing.

(III) Paddle mixer unit shall be capable of producing homogeneous mix with uniform coating of all particles of the mineral aggregates with binder.

The temperature of Binder at the time of mixing shall be in the range of 150^{0} c to 163^{0} C and aggregates in the range of 155^{0} C to 163^{0} C provided that this difference in temperature between aggregates and binder at no time exceeds 14^{0} C. Mixing shall be thorough to ensure that a homogeneous mixture is obtained in which all particles of the aggregates are coated uniformly, and the discharge temperature of mix shall be between 130^{o} C to160^{0} C.

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

SPREADING:

The mix transported from tipper at the site to Paver shall be spread immediately by means of self propelled mechanical Paver with suitable screens capable of spreading, tamping and finishing the mixture to the specified grades and cross sections. The Paver finisher shall have the following essential features as below.

(a) Loading hoppers and suitable distributing mechanism.

(b) All drivers having hydrostatic drive/control.

(c) The machine shall have a hydraulically extendable screed for appropriate width requirements.

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

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

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

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

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

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

However in restricted locations and in narrow widths where the available plant cannot operate in the opinion of the Engineer in Charge, he may permit manually laying of the mix.

The temperature of the mix at the time of laying shall be in the range of 120 ^{0}C to 160 ^{0}C. In multi-layer construction, the longitudinal joint in one layer shall offset that in the layer below by about 150 mm. However, the joint in the top-most layer shall be at the lane line of the pavement.

Longitudinal joints and edges shall be constructed true to the longitudinal line parallel to the centerline of the road. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material. Longitudinal and transverse joints shall be offset by at least 150 mm form those in the lower course and the joint on the top most layer shall not be allowed to fall within the wheel path. All transverse joints shall be cut vertically to the full thickness of previously laid mix with asphalt cutter/pavement breaker and surface painted with hot bitumen before placing fresh material. Longitudinal joints shall be preferably hot joints. Cold longitudinal joints shall be properly heated with joint heater to attain a suitable temperature of about 80 ^{0}C before laying of adjacent material.

: COMPACTION:

After the spreading of mix rolling shall be done by 80 to 100 KN vibratory rollers. Rolling shall start as soon as possible after the material has been spread deploying a set of rollers as the rolling is to be compacted in limited time frame.

The roller shall move at a speed not more than 5km/hour. Rolling shall be done with care to avoid unduly roughening of the pavement surface. Rolling of the longitudinal joints shall be done immediately behind the paving operation. After this the rolling shall commence at the edges and progress towards the center longitudinally except that on super elevated and uni-directional cambered portions. It shall progress from the lower to the upper edge parallel to the centerline of the pavement.

The initial or break down rolling shall be done with 80 – 100KN static weight smooth wheel roller (3 wheels or tandem) as soon as it is possible to roll the mix without cracking the surface or having the mix pick up on the roller wheels. The second or intermediate rolling shall follow the break down rolling with vibratory/vibratory rollers of 80 to 100KN static weight or pneumatic tyres roller of 150 to 250 KN weight, with minimum 7 wheels, and minimum tyres pressure of 0.7 MPA as closely as possible to the Paver and

be done while the paving mix is still at a temperature that will result in maximum density. The final rolling shall be done while material is still workable enough for removal of roller marks, with 650 to 80 KN tandem rollers. During the final rolling, vibrator system shall be switched off. The joints and edges shall be rolled with 80 to 100KN static roller.

When roller has passed over the whole area once, any high spots or depressions, which become apparent shall be compacted by removing or adding mix material. The rolling shall then be continued till the entire surface has been rolled to 95 percent of the average laboratory density (obtained from Marshall specimens compacted as defined in table 500-10). There is no crushing of aggregates and all roller makes have been eliminated. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. The roller wheel shall be overlap not less than one third of the track made in the preceding pass. The roller wheel shall be up. In no case fuel, lubricating oil to be used for this neither purpose nor excessive water poured on the wheels.

Rolling operations shall be completed in every respect before the temperature of the mix falls below 100^{0} C.

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

: SURFACE FINISH AND QUALITY CONTROLL OF WORK:

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

: The bituminous macadam shall be covered with either the next pavement course or wearing course, as the case may be, without any delay. If there is to be any delay, the course shall be covered by a seal coat to the requirement of Clause 513 before allowing any traffic over it. The seal coat in such cases shall be considered incidental to the work and shall not be paid for separately.

: ARRANGEMENTS OF TRAFFIC:

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

: MEASURMENTS OF PAYMENTS:

The work shall be measured as finished work in cubic metres or by weight in metric tonnes as provided in the Contract.

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

Department will be free to get some loaded dumpers test checked at other weight bridge. Weight Bridge will be periodically got calibrated and verified form weight and measure authorities.

FOR THE PURPOSE OF APPLICATION OF TACK COAT:

If the theoretical area as per sanctioned estimate for basis of tones differs with actual area of work done in the field, the reduction in or addition to payment shall have to be exceeding respectively.

Weight of mix materials will be done in presence or responsible person, not less than the rank of supervisor of department and the measurement shall be recorded by the Deputy Executive or Assistant

Engineer or Additional Assistant Engineer If so authorized. Record of each dumper will be maintained separately in bound and numbered register, which will be maintained by the departmental representative and signed by the contractor. Proper gate pass system shall be established for the vehicles coming to the plant site and outgoing from the plant site. The location of the kilometer, hectometer and meter in which individual dumper are unloaded be recorded carefully.

: RATE:

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

(a) Making arrangements for traffic to Clause 112 except for initial treatment to verge, shoulders and construction of diversion.
(b) Preparation of base except for laying of profile corrective course but including filling of potholes.
(c) Providing all materials to be incorporated in the work including arrangement for stockyards, all royalties, fees, rents where necessary and all lead and lift.
(d) All Labour, tools, equipment, plant including installation of hot mix plant, vibratory supply units and all machineries, incidental to complete the work to the specifications.
(e) The rate includes scarifying of the exiting surface as directed by Engineer in charge.
(f) Carrying out the work in part widths of the road where directed.
(g) Carrying out all tests for control of quality, and
(h) The rate shall cover the provision of bitumen at the rate specified in the contract, with the provision that the variation in actual percentage of bitumen used will be assessed and the payment adjusted accordingly.

Item No. 13 :- **Providing and laying Mix Seal Surfacing 20.00 mm thick using stone chipping as per MORT & H specification and asphalt grade VG-30 for mixing @ 50.90 Kg/M.T. i.e. 5.09 % of total weight of mix including heating the asphalt and aggregate mixing by continuous Drum mix plant transporting mixed material and spreading the same by pavers finisher and consolidation by vibratory roller of 80 Kn to 100 Kn static weight and flushing sand or stone dust @ 0.03 cmt / 10 smt including cost of labour, oil, lubricant etc using contractor's own Machineries and plant firewood, oil, kerosene, labour charges etc. complete**

512.1. Scope

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

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

512.2. Materials

512.2.1. **Binder :** The binder shall be bitumen of a suitable viscosity grade **VG-30** as specified in the Contract, or as directed by the Engineer, and satisfying the requirements of IS: 73.

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

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

512.2.2. **Coarse aggregates : 504.2.2.1.** The aggregates shall consist of crushed stone, crushed gravel/shingle or other stones. They shall be clean, strong, durable, of fairly cubical shape and free from disintegrated pieces, organic or other deleterious matter and adherent coating. If crushed shingle/gravel is used, not less than 90 per cent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall preferably be hydrophobic and of low porosity. If hydrophilic aggregates are to be used, the bitumen shall preferably be treated with anti-stripping agents of approved quality in suitable dose as per *Appendix-5.* The aggregates shall satisfy the physical requirements set forth in Table 500-3.

TABLE 500-3. PHYSICAL REQUIREMENTS OF AGGREGATES FOR BITUMINOUS MACADAM

S. No.	Test	Test Method	Requirement
1	Los Angeles Abrasion Value	IS:2386 (Part - 4)	40 percent Maximum
2	Aggregate Impact Value*	-do-	30 percent Maximum
3	Flakiness and Elongation Indices (Total)	IS: 2386 (Part - 1)	30 percent Maximum
4	Coating and Stripping of Bitumen Aggregate	AASHTO T 182 Mixtures coating	Minimum retained 95 per cent
5	Soundness:	IS: 2386 (Part - *5)*	
(i)	Loss with Sodium Sulphate 5 cycles		12 percent Maximum
(ii)	Loss with Magnesium Sulphate 5 cycles		18 per cent Maximum
6	Water absorption	IS: 2386(Part - 3)	1 per cent Maximum

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

Note : If crushed slag is used, Clause 404.2.3 shall apply.

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

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

TABLE 500-26. AGGREGATE GRADATION

IS Sieve Designation (mm)	Cumulative per cent by weight of Total aggregate passing	
	Type A	Type B
13.2 mm	-	100
11.2 mm	100	88- 100
5.6 mm	52 - 88	31 -52
2.8 mm	14 - 38	5 - 27
0.090 mm	0 - 5	0- 5

512.2.5. Proportioning of materials: The total quantity of aggregates used for Type A or B close-graded premix surfacing shall be 0.27 cubic metre per 10 square metre area. The quantity of binder used for premixing in terms of straight-run bitumen shall be 22.0 kg and 19.40 kg per 10 Square metre area for Type A and Type B surfacing respectively.

512.3. Construction Operations

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

501.5.2. Cleaning of surface: The surface on which the bituminous work is to be laid shall be cleaned of all loose and extraneous matter by means of a mechanical broom or any other approved equipment / method as specified in the contract. The use of a high pressure air jet from a compressor to remove dust or loose matter shall be available fall time on the site, unless otherwise specified in the Contract.

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

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

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

Bituminous material with a temperature greater than 145^0C shall not be laid or deposited on bridge deck waterproofing systems, unless precautions against heat damage have been approved by the Engineer.

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

(i) For laying regulating courses of irregular shape and varying thickness.
(ii) In confined spaces where it is impracticable for a paver to operate.
(iii) For footways.
(iv) At the approaches to expansion joints at bridges, viaducts or other structures.
(v) For laying mastic asphalt in accordance with Clause 515.
(vi) For filling of potholes.
(vii) Where directed by the Engineer.

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

(i) At the edges of the layers of material and at gullies and manholes.

(ii) At the approaches to expansion joints at bridges, viaducts or other structures.

(iii) As directed by the Engineer.

501.5.4. Cleanliness and overlaying: Bituminous material shall be kept clean and uncontaminated. The only traffic permitted to run on bituminous material to be overlaid shall be that engaged in laying and compacting the next course or, where a binder course is to be sealed or surface dressed, that engaged on such surface treatment. Should any bituminous material become contaminated the Contractor shall make it good to the satisfaction of the Engineer, in compliance with Clause 501.8.

Binder course material shall not remain uncovered by either the wearing course or surface treatment, whichever is specified in the Contract, for more than three consecutive days after being laid. The Engineer may extend this period, by the minimum amount of time necessary, because of weather conditions or for any other reason. If the surface of the base course is subjected to traffic, or not covered within three days, a tack coat shall be applied, as directed by the Engineer.

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

512.7. Measurements for Payment

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

The measurement shall be all measures for finished work on weight base in **Metric Tonne.**

512.8. Rate

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

501.8.8.2. Rate for premixed bituminous material: The contract unit rate for premixed bituminous material shall be payment in full for carrying out the required operations including full compensation for, but not necessarily limited to:

(i) Making arrangements for traffic to Clause 112 except for initial ant to verge. shoulders and construction of diversions;

(ii) Preparation of the surface to receive the material.

(iii) Providing all materials to be incorporated in the work including arrangement for stock yards, all royalties, fees, rents where necessary and all leads and lift.

(iv) Mixing, transporting, laying and compacting the mix, as specified.

(v) All labour, tools, equipment, plant including installation of drum mix plant power supply units and all machinery, incidental to complete the work to these Specifications;

(vi) Carrying out the work in part widths of the road where directed;

(vii) Carrying out all tests for control of quality; and

(viii) The rate shall cover the provision of bitumen at the rate specified in the contract, with the provision that the variation in actual percentage of bitumen used will be assessed and payment will be adjusted accordingly.

(ix) The rates for premixed material are to include for all wastage in cutting of joints etc.

(x) The rates are to include for all necessary testing, mix design, transporting and testing of samples, and cores. If there is not a project specific laboratory, the Contractor must arrange to carry out all necessary testing at an outside Laboratory, approved by the Engineer, and all costs incurred are deemed to be included in the rate quoted for the material.

(xi) The cost of all plant and laying trials as specified to prove the mixing and laying methods is deemed to be included in the Contractor's rates for the material.

Item No. 14 : 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. 15:- Providing and fixing guard stone as per I.R.C. type design including white washing etc. complete.(ii) Fixing in C.C. 1:5:10

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

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

RATE

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

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

Item No. 16:- 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.17 : 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 refiectivesheeting 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.

1.2 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 materialof 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 printer 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 contactwith 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. Atsplices, 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 aproper 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 or 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. 18 : Village name/ Bump Ahed sign :-Providing and fixing sing boards made out of 2mm aluminium sheet; size 90 x 60cms. rectangle as as per the design of IRC-67-1977 pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro refiective sheeting as per latest M.O.S.T. Specifications; Letters and numerals should be as per IRC-30-1968, 3.1m long (2 nos) stand post and frame fabricated from suitable size iron angle of 50 x 50 x 5mm painted with best quality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)...

The relevant specification of Item No. 17 shall be followed for the execution for the work is **Providing and fixing sing boards made out of 2mm aluminium sheet; size 90 x 60cms. rectangle as as per the design of IRC-67-1977 pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro refiective sheeting as per latest M.O.S.T. Specifications; Letters and numerals should be as per IRC-30-1968, 3.1m long (2 nos) stand post and frame fabricated from suitable size iron angle of 50 x 50 x 5mm painted with best quality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)...**

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

Item No. 19: **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 refiective 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. 17 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 refiective 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

Item No. 20 : **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 shalll 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 I nert 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 *I* supplier *I* 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 is 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 heads 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 shar8 edges.

1.3.4.2 The materials upon heating to application temperatures shall not exude fume~, 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 molton 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 houses.

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 be note be slippery when wet.
The marking shall not lift from the payment in freezing weather.
After application and proper drying the stripe shall show no appreciable deformation of discoloration under traffic and under road temperatures up to 60 C.
The marking shall be deteriorate by contact with sodium chloride calcium chloride or oil drippings from traffic.
The stripe of marking shall maintain its original dimension3 and position.
Cold ductility of the material shall be such as to permit normal movement with the road surface without chopping or cracking.
The colour of yellow marking shall conform to IS colour no. 356 as given in IS : 164.

Reflectorised Paint: Reflectorised paint, if used, shall conform to the specification by the manufacturers and approved by the engineer. Refleciorising 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 n~:lti1ods 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 ruggedness on sides and ends and be parallel to the general alignment of the carriageway. The: upper surface of the lines shall be level, uniform and free steaks.

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 **Sq.mt** 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 confirming to these specification complete as per the approved drawing(s) or as directed by the engineer and other incidental cost necessary' to complete the work to these specifications.

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. 21 : Supplying and fixing cat eye (Stimsonite) made out from Acrilo beautile 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. If 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 of 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 places 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 side 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. 22: **Hazard Marker Sign :-Providing and fixing sing boards made out of 2mm aluminium sheet; size 90 x 30cms. rectangle as as per the design/drawing attached (IRC) pretreated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro refiective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm & 50 x 50 x 5mm painted with best quality epoxy coatings The fixing at site shall be in 1:2:4 CC block of size 45x45x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)...**

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

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

Item No. 23: 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 nineth 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 printer 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 or 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.24 :- **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 embeded in cement concrete M15 grade block of 450x450x600mm below ground level. The height of the bottom of the lower plate will be 1200mm from normal ground level. The spacing between the diamond shaped plate and Lower Plate is kept 150mm. MMGSY logo, letters and numerals on the ACM should be made up of Retro Reflective sheeting of Type-1 AEGP Class-A grade as per the latest MORD section 1700 and IRC 67-2012 specifications. Al 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.25:- **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 specificaitons 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. Al 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. 26 :- Chevron sign :-Providing and fixing sign boards made out of 1.5mm aluminium sheet / 3mm ACP (Aluminum composite Panel); size 60x50 cm as per design of IRC-67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ;reflectorised with Micro Prismatic Grade retro refiectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.3 mtr long stand post of 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 50 x 50 x 5mm; painted with bestquality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge.The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg.including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from originaa manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (A) Class-B Type-4 Retro Reflective sheeting

The relevant specification of Item No. 17 shall be followed for the execution for the work is Chevron sign :-Providing and fixing sign boards made out of 1.5mm aluminium sheet / 3mm ACP (Aluminum composite Panel); size 60x50 cm as per design of IRC-67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ;reflectorised with Micro Prismatic Grade retro refiectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.3 mtr long stand post of 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 50 x 50 x 5mm; painted with bestquality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge.The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg.including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from originaa manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (A) Class-B Type-4 Retro Reflective sheeting

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

Item No. 27 :- STOP SIGN:-Providing and fixing sing boards made out of 2mm aluminium sheet; size 90 x 90cms. rectangle as per the design of IRC-67-1977 pre treated with phospheting process & acid teching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro refiective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm 75x75x6mm as required; painted with best quality epoxy coatings in black and white bends. the details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing tec. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)...

The relevant specification of Item No. 17 shall be followed for the execution for the work is STOP SIGN:-Providing and fixing sing boards made out of 2mm aluminium sheet; size 90 x 90cms. rectangle as per the design of IRC-67-1977 pre treated with phospheting process & acid teching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro refiective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm 75x75x6mm as required; painted with best quality epoxy coatings in black and white bends. the details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing tec. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)...

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

Item No. 28 :- Regulatory/Mandatory signs :Providing and fixing sing boards made out of 2mm aluminium sheet; size 60cms. diameter circle as per the design of IRC-67-1977 pre treated with phospheting process & acid eteching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro refiective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm 75x75x6mm as required; painted with best quality epoxy coatings in black and white bends. the details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)...

The relevant specification of Item No. 17 shall be followed for the execution for the work is

Providing and fixing sing boards made out of 2mm aluminium sheet; size 60cms. diameter circle as per the design of IRC-67-1977 pre treated with phospheting process & acid eteching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro refiective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm 75x75x6mm as required; painted with best quality epoxy coatings in black and white bends. the details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)...

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

Item No. 29 : 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 refiective 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. 17 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 refiective 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.30 :- Excavation for foundation upto 1.5 m depth including sorting out and stacking of useful materials and disposing off the excavated stuff upto 50 Meter lead. (B) Dense or Hard soil

- **All sorts of Soil**

Any soil which generally require close application of picks or jumpers or scarifies to loosen it stiff clay, gravel and stone etc. fall under this category.

1. Excavation for structures shall consist of the removal of materials for the construction of foundations for bridges, culverts, retaining walls, head walls, cut off walls, pipe culverts and other similar structures, in accordance with the requirements, of these specifications and the lines and dimensions shown on the drawings or as indicated by the Engineer-in-charge. The work shall be include all necessary sheeting, shorting, bracing, draining and pumping and the removal of all logs, stumps, scrubs and other deleterious matter and obstruction necessary for the foundations, trimming bottoms of excavations back filling and clearing up the site and the disposal of all surplus materials.

2 After the site has been cleared the limits of excavations shall be set out true to lines, curves, slopes and sections as shown on the drawings or as directed by the Engineer-in-charge. The contractor shall provide all labour, survey instruments and materials such as strings, pegs, nails, bamboos, stones, lime, mortar-concrete etc. required in connection with the setting out of works and the establishment of bench mark, centre line stones and other marks and stakes as long as the opinion of the Engineer-in-charge, they are required for the work.

3. Excavation shall be taken to the width of the step of the footing. The contractor at his own expense shall put up necessary shoring , strutting and planking or cut slopes to a safer angle or both with due regard to the safety of personal and works and to the satisfaction of the Engineer- in - charge.

4. The depth to which the excavation is to be carried out shall be is shown on the drawings, unless the type of materials encountered is such as to require changes, in which case the depth shall be as ordered by the Engineer-in-charge.

5 Where water is met with in excavation due to stream flow, seepage, rain or other reasons, the contractor shall take adequate measure such as bailing pumping, to keep the foundation trenches dry when so required and to protect the green concrete // masonry against damage by erosion or sudden rising of water level. The method to be adopted in this regard and, other details thereof shall be left to the choice of the contractor but subject to approval of the Engineer-in-charge. Approval of the Engineer-in-charge shall however not relieve the contractor of the responsibility for the

adequacy of dewatering, and production arrangements and for the quality and safety of the works.

6. Pumping from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of movement of water through any fresh concrete. No pumping shallbe permitted during the placing of concrete or for any period of at least 24 hours thereafter, unless lot is done from a suitable sump separated from the concrete work by a water tight wall or other similar means.

7. The bottom of the foundation shall be leveled both longitudinally and transversely or stepped as directed by the Engineer-in-charge. Before footing is laid, the surface shall be slightly watered and rammed. In the event of excavation having been made deeper than that shown on the drawings or as otherwise ordered by the Engineer-in-charge, the extra depth shall be made up with concrete or masonry of the foundation grade at the cost of the contractor. Ordinary filling shall not be used for the purpose to bring the foundation to level. If there are any slips or blows in the excavation, these shall be removed by the contractor at his own cost.

8. Near towns, villages and all frequented places, trenches and foundation pits shall be securely fenced, provided with proper caution signs and marked with red lights at night to avoid accidents. The contractor shall take adequate protective measures to see that the excavation operations do not affect or damage adjoining structures.

9. Back filling shall be done with approved materials after concrete or masonry is fully set and carried out in such a way as not to cause undue thrust on any part of the structure. All space between foundation masonry or concrete and the sides of excavation shall be refilled to the original surface, making due allowance for settlement in 250 mm. loose layers, which shall be watered and compacted.

10. All the excavated materials shall be the property of the Government. Where the excavated materials is to be used in the construction of embankment, it shall be directly deposited atthe required location with in all lead and lift.

11. All useful materials not intended for use in the bank, shall be stacked neatly on Government land as directed by the Engineer-in-charge with in all lead. Unsuitable and surplus materials not intended for use shall be disposed off as directed by the Engineer - in - charge.

12. Excavation for structures shall be measured in **Cubic Meter** for each class of materials encountered, limited to the dimensions shown on the drawing or as directed by the Engineer-in-charge. Excavation over increased width cutting of slopes, shoring, shuttering and planking shall be deemed as convenience for the contractor in executing the work and shall be measured and paid for separately. Payment shall be made carried

out on **Cubic Meter** basis.

13. The contract unit rate for the items of excavation for structures shall be paid in full for carrying out the required operations including . . .

(1) Settings out and fixing bench marks and center lines stones.

(2) Construction of necessary shoring and bracing and their subsequent removal.

(3) Removal of all logs, stumps, grubs and other deleterious matter and obstructions for placing the foundations including trimming of bottoms of excavations.

(4) Foundation sealing, dewatering including pumping.

(5) Foundation sealing, including necessary dewatering including pumping and makingnecessary cofferdam to facilitated construction work.

(6) Back filling, clearing up the site and disposal of all surplus materials with in all liftsand lead up to 100 meters.

(7) Back filling, clearing up the site and disposal of all surplus materials with in all liftsand lead up to 100 meters.

(8) All labour, materials, tools, equipment, safe guards and incidentals, necessary tocomplete the work to the specification.

14. Excavation shall be for ordinary soil such as vegetable or organic soil, turf slit, and loam, clay, mud, plat, black cotton soil, soft shale or soft murrum a mixture of these and similar material which yields to the ordinary application of pick and shovel, rake or other ordinary digging equipment. Removal of gravel or any other nodular material having diametre in any one direction not exceeding 75 mm occurring in such strata shall be deemed to be covered under this category. The classification of excavation shall be decided by the Engineer-in- charge and his decision shall be final and binding on the Contractor.

15. The Contract Rate shall be for a unit of One Cubic meter basis for completed item work.

Item No. 31:- 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. tine 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 volume but subject to a upper limit of 1:1.1/2 & a lower limit of 1:3.	34
M-150	1:2:4	220		32
M-200	1:1.1/2:3	160		30
M-250	1:1:2	100		27

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

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

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

5. Following shall be the maximum nominal size of coarse aggregate for the different items 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 and wing walls and their per caps	40 mm
iii	R.C.C. works in cross girders, deck slab, wearing coat, kerb, light post, blast walls, approach slab etc. and hollow type piers, abutments, wing walls andtheir pier caps	20mm
iv	R.C.C. bearings	20 mm
v	For any other item of construction not covered by items (i) to (v)	As specified on the drawing or as desired by the Engineer in charge in case it is 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 andshall 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 typeof cement to another.

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

14. If concreting is not started with 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-charge. Concreting then shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried in properly designed agitators, operating continuously, when this time shall be within 2 hours of the addition of cement to the mix andwithin 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 0.30metre in all other cases.

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

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

17. Immediately after compaction concrete shall be protected against harmful effects of weather including rain, running water shocks, vibrations due to traffic, rapid temperature changes. Fast drying put process, it shall be covered with wet sacking Hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set. It shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonry work over the foundation concrete may be started after 48 hours of it'slaying 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 shallhowever be delivered into following two district categories :-

(1) Shuttering i.e. from work required for forming the concrete
(2) Scaffolding i.e. formwork required for supporting shuttering.
Forms for shuttering shall be constructed only, in metal suitably lined. Forms for scaffolding shall be constructed of metal or timber. Both shuttering and scaffolding shall be or substantial rigid construction and shuttering shall be true to shape and dimensions show onthe drawings. All bolts and reverts shall be counter-suck 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 eitherbefore 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 from work or where otherwise agreed to by the engineer-in-charge be coated with an approved material to prevent adhesion of concrete to the from work. Release agents shall be applied strictly in accordance with the manufacture's instruction and shall not be allowed to come into contact with any reinforcement of prestressing tendons a and anchorage shall be applied strictly in accordance with the manufacturers instruction and shall not be allowed to come into contact with any reinforcement of prestressing tendons and anchorage. Different release agents shall not be used in from work of concrete which will be visible in the finished works.

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

22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any for work. While fixing the time for removal of formworks. Due consideration shall be given to local condition, Character of the structure, the weather and other condition that influence the setting of concrete the removal of The load supporting of soffit forms any commence when concrete has attained strength and of the materials used in the mix. Where field operations are controlled by the strength test of concrete, the removal of the load supporting of soffit forms may commence when concrete has attained strength equal including the effect of any further addition of loads. When field operations are not controlledby strength test of concrete the vertical forms of beams, columns and walls may beremoved after 2 days. The props of slabs and beams may be removed after 14 and 21 days respectively. All from work shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to avoid any stock or vibrations. Supports shall be removed in such a manner as to permit the contract the concrete to take stresses due to its own weight uniformly and gradually. Whereinternal 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 m. 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 thespecified strength.

27. R.C.C. work shall have exposed concrete surface. Centering design and its erection shallbe approved by the Engineer-in- charge. One carpenter with helper will invariably be kept throughout the period of concreting. Movement of labour and other persons shall be totally prohibited over reinforcement laid in position. For access to different

parts, suitable mobile platforms shall be provided so that steel reinforcement in position as not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber, kapachi or metal pieces shall not be used for this purpose. Concreting of important structural members shall always be done in the presence andunder 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 belowthe 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.32 :- Providing & casting in situ ordinary cement concrete M-150 Mix and providing necessary pin headers including shuttering, scaffolding, laying, vibrating and finishing concrete without V-grooves (A) Height from 0 to 5 mt

The relevant specification of **Item No…31…** shall be followed for the execution for the work is **Providing and casting in situ ordinary cement concrete M-150 mix and providing necessary pin headers including shuttering, scaffolding, laying, vibrating, curing and finishing complete without V-Groves. (A) Height from 0.0 M. to 5.0 M.**

This Item is measured in Cum. Unit. The payment will be made on cum. basis of the finished work

Item No.33 :- Providing TMT Bar FE 500D reinforcement for R.C.C. work including bending, binding and placing in position complete upto floor two level

1.0. GENERAL

This work shall consist of furnishing and placing coated, or uncoated or high strength deformed reinforcement, bars (intentioned) of the shape and dimensions shown on the drawings and conforming to these Specifications or as approved by the Engineer in charge.

2.0. MATERIAL

2.1. TMT Bars

Reinforcements may be either T.M.T. tensile steel, high strength deformed bars. They may be uncoated or coated with epoxy or with approved protective coatings.

2.2. T.M.T. bars reinforcement for R C C work shall conform IS 432 (Part II) 1966 and shall be of tested quality. It shall also comply with relevant part of IS 456-1966.

2.3. All reinforcement shall be clean and free from dirt, paint, grease or oil, all scale or loose or thick rust at the time of placing.

2.4. All steel shall be procured form original producers no re-rolled steel shall be incorporated in the work.

2.5. Only new steel shall be delivered to the site every bar shall be inspected before placing to its position and defective brittle or burnt bar shall be discarded cracked ends of bars shall be discarded.

3.0. Pitch

3.1. Distance between bars shall be as specified in drawings and as directed by the Engineer in Charge all bars shall be placed at an accurate distance from each other and shall be bind tightly to maintain the desired pitch Suitable means shall be provided for holding bars securely in position.

4.0. Binding wire

4.1. Mild steel binding wire shall be of 1.63 mm or 1.22 mm (16 to 18 gauge diameter and shall conform IS 280-1972.

4.2. The use of black wire will be permitted for binding reinforcement bars. It shall be free form free from dirt, paint, grease or oil, oil scale or loose or thick rust and any other undesirable coating which may prevent adhesion of cement mortar at the time of binding

4.3. Only new binding wire shall be delivered to the site all binding wire shall be inspected before binding to its position and defective brittle, rusted, used wire, shall be discarded

5.0. PROTECTION OF REINFORCEMENT

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

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

6.0. Workmanship

6.1. The work shall consist of furnishing and placing reinforcement to the shape and dimensions shown as on the drawings or as directed by The Engineer in charge.

6.2. Reinforcing steel shall conform accurate to the dimensions given in the bar bending schedules shown on relevant drawing

7.0. BENDING OF REINFORCEMENT

7.1. Bar bend g sched ule shall be furnished by the Contractor and got approved by the Engineer before start of work.

7.2. Reinforcing steel shall conform to the dimensions and shapes given in the approved bar bending Schedules.

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

Bars shall not be bent or straightened in a manner that will damage parent material or the coating bars bent during transport or handling shall, be straightened before beinng used on work and shall not be heated to facilitate straightening.

8.0. PLACING OF REINFORCEMENT

8.1. The reinforcement cage should generally be fabricated in the yard at ground level, and then shifted and placed in position. The reinforcement shall be placed strictly, in accordance with the drawings and shall be assembled in position, only when structure is otherwise ready for placing of concrete. Prolonged time gap, between assembling of reinforcements and casting of concrete, which may result in rust formation on the surface, shall not be permitted.

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

8.3. Bars shall be kept in position usually by the following methods:
In case of beam an slab construction, industrially produced polymer cover blocks of thickness equal to the specified cover shall be placed between the bars and formwork subject to Satisfactory evidence that the polymer composition is not harmful to concrete and reinforcement. Cover blocks made of concrete may be permitted by the Engineer, provided they have the same strength and specification as those of the member.

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

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

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

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

8.8. Bars coated with epoxy or any other approved protective coating shall be placed on supports that do not damage the coating. Supports shall be installed in a manner such that planes of weakness are not created in hardened concrete. The coated reinforcing steel shall be held in place by use of plastic or plastic coated binding wires especially manufactured for the purpose.

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

9.0. Lapping

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

10.0. Welding

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

10.2. While welding may be permitted for T.M.T. reinforcing bars conforming to IS:432, welding of deformed bars conforming to IS: 1786 shall in general be prohibited. Welding may be permitted in case of bars of other than S 240 grade including special. Welding grade of S 415 grade bars conforming to IS:1786, for which necessary chemical analysis has been secured and the carbon equivalent (CE) calculated from the chemical composition using the formula:

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

is 0.4 or less.

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

10.4. Bars shall be bent cold to the specified shape and dimensions or as directed by Engineer in charge using the proper bender tool, operated by hand or power to attain proper radius of bends. Bars shall not be bend or straightened in a manner that will injure the material. Bars bent during transport or handling shall be straightened before being used in the work. Bars shall not be heated to facilate bending.

10.5. Unless otherwise specified a 'U' type hook at the end of each bar shall invariably be provided to main reinforcement. The radius of the bane shall not be less then twice the diameter of the round bar and the length of the straight part of the bar beyond the end of the curve shall be at least four times of the diameter of the round bar. In case of bars which are not round and in case of deformed bars, the diameter shall be taken as the diameter of circle having an equivalent effective area. The hooks shall be suitably encased to prevent any spiting of the concrete.

10.6. All reinforcement bars shall be accurately placed in exact position shown on the drawings and shall be securely held in position during placing of concrete by annealed binding wire not less than 1 mm in size and by using say blocks or metal chairs spacers, metal hangers, supporting wires or other

approved devices at sufficiently close intervals, Bars shall not be allowed to sag between supports not displaced during concreting or any other operations of the work. All devices used for positioning shall be of not corrodible material wooden and metal supports shall not extended to the surface of the concrete, except where shown in drawings. Placing bars on layers of freshly laid concrete as the work progresses for adjusting bar spacing shall not be allowed. Pieces of broken stone or brick and wooden blocs shall not be used Layers of bars shall be separated by spacer bars pre-cast mortar blocks or other approved devices. Reinforcement after bending placed in position shall be maintained in a clean condition until completely embedded in concrete, Special care shall be exercised to prevent any displacement of reinforcement in concrete already placed. To prevent reinforcement form corrosion, concrete cover shall be provided as indicated on drawings. All bars protruding from concrete and to which other bars are to be sliced and which are likely to be exposed for a period exceeding 10 days shall be protected by a thick coat of neat cement grout.

10.7. Bars crossing each other where required shall be secured by binding wire (annealed) of size not less than 1 mm in such a manner that they do not slip over at the time of fixing and concreting.
As far possible bars of full length shall be used in case this is not possible, overlapping of bars shall be done as directed by the Engineer in charge When practicable overlapping bars shall not touch each other, but be kept apart by 25 mm Where no feasible overlapping bars shall be bound with annealed wires not less than 1 mm thick twisted tight The overlaps shall be staggered for different bars and located at points along the span where neither sheer not bending moments is maximum.

10.8. Whenever indicated on drawing or desired the Engineer in charge bars shall be jointed by coupling which shall have a cross section sufficient to transmit the full stresses of bars The end of the bars that are jointed by coupling shall be upset for sufficient length so that the effective cross section at the base of threads is not less than the normal cross section of the bar. Threads shall be standards threads Steel for coupling shall conform to IS 226.

10.9. When permitted or specified on the drawings joints of reinforcement bars shall butt-welded so as to transmit their full stresses Welded joints shall preferably be located at points when steel will not be subject to more than 75 percent of the maximum permissible stresses and welds so staggered that at any one section not more than 20 percent of the rods are welded Only electric are welding using a process which excludes air form the molten metal and conforms to any or other special provisions for the work shall be accepted Suitable means shall be provided for holding bars securely in position during welding It shall be ensured that no voids are left in welding and when welding is done in two or three stages previous surface shall be cleaned properly Ends of bars shall be cleaned of all loose scale rust stages paint and other foreign matter before welding Only competent welders shall be employed on the work. The M S electrodes used for welding shall conform IS 814 Welded pieces of reinforcement shall be tested. Specimen shall be taken form the actual site and their number shall frequency to test shall be as directed by the Engineer in charge.

11.0 MODE OF MEASUREMENTS & PAYMENT

11.1. For the purpose of payment the bar shall be measured correct up to 10 mm length and weight payable works out at the rate specified below

Sr. No	Diameter of steel	weight of steel per running meter	Sr. No	Diameter of steel	weight of steel per running meter
1	6 mm	0.22 Kg / Rmt	8	20 mm	2.47 Kg / Rmt
2	8 mm	0.39 Kg / Rmt	9	22 mm	2.98 Kg / Rmt
3	10 mm	0.62 Kg / Rmt	10	25 mm	3.85 Kg / Rmt
4	12 mm	0.89 Kg / Rmt	11	28 mm	4.83 Kg / Rmt
5	14 mm	1.21 Kg / Rmt	12	32 mm	6.31 Kg / Rmt
6	16 mm	1.58 Kg / Rmt	13	36 mm	7.99 Kg / Rmt
7	18 mm	2.00 Kg / Rmt	14	40mm	9.86 Kg / Rmt

11.1. Excess consumption over 5% will be charged at penal rate.

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

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

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

11.4. The rate shall be for a unit of **one Kg.**

Item No.34 :- 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. (iv) 900 mm dia.

The relevant specification of **Item No…10…** shall be followed for the execution for the work is 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. (iv) 900 mm dia.

This Item is measured in Running Meter Unit. The payment will be made on cum. basis of the finished work

Item No. 35 :- White washing with lime on wall surface (two coats) to give an even shade including thoroughly booming the surface to remove all dirt, dust; mortar drops.

White washing with lime on wall surface two coat to give an even shade including thoroughly brooming the surface to remove all dirt, and mortar drops and other foreign matter.

1. **General :** Lime shall be hydraulic lime of approved quality.

The slaked lime, if stored, shall be kept in a weather proof and damp roof shed with impervious floor and The slaked lime, is stored, shall be kept in a weather proof and damp roof shed with impervious floor and sides to protect it against rain, moisture, weather and extraneous materials mixing with it. All time that has been damated in any ways shall be rejected and all rejected materials shall be removed from site of work.

2. **Workmanship :** The fat lime shall be slaked at site and shall be mixed and stirred with about five liters of water and 1 kg. of un slaked lime to make a thin cream. This shall be allowed to stand for a period of 24 hours and then shall be added to each cubic meter of lime cream small Quantity of ultra Marine blue shall also be added to the last two coat of white wash solution and the whole solution shall be stirred thoroughly before use.

3. **Preparation of surface :** The surface shall be thoroughly cleaned of all dust mortar dropping and other foreign matter before white wash is to be applied. Oil or grease spots shall be removed by suitable chemicals and smooth, surface shall be rubbed with wire brush.

All unsound portion of the surface plaster shall be removed to fuil depth of plaster in rectangular patches and plastered again after raking the masonry joints properly.

4. **Application of white wash :** On the surface so prepared the white wash shall be applied with brush. The first stroke of the brush shall be from top to downwards and another from bottom to upwards over the first stoke and similarly one stroke from the right and another from the left over the first stroke before it drieds.

Each coat shall be allowed to dry before next coat is applied number of coats as specified in item shall be
applied.

5. **Mode of Measurement & Payment :** All work shall be measured in the decimal system i.e. in **sq.m..** Deduction for pipe openings shall be made fully both sideds of penings the rates shall includes the cost of all materials, labour, scaffolding protective etc. involved in all the operations described. The rate shall be for a unit of one sq. meter.