

Specification

**Name of Work:- Constg. of Rural Road Under MMGSY - 2022-23 Package No. - 12,
Ta. - Modasa Dist. - Arvalli**

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18	Citizen' s information Board- Providing and fixing of typical MMGSY information board as per instruction. Two MS plates of 1.6 mm thick, of 900 mm x 750mm size fixed at top & bottom duly welded with MS angles of 25 x 25 x 5 mm thick M.S plate shall be welded by two vertical M.S flats & four horizontal M.S flats 5 mm thick to 75 mm x 75 mm of 12 SWG square tubes posts duly embedded in cement concrete M-15 grade blocks of 600mm x 600mm x 75mm, below ground level. Painting New letters & figure of any shade with ready mixed synthetic enample paint of superior quality in required shade and colour, All sections of framed posts and steel tube will be painted with primer and two coats of epoxy paints as per drawing Clause 1701 and Annexure 1700.1 (10.16)	18	

19	<p>MMGSY "LOGO" Board : Providing and fixing of MMGSY LOGO inforamatory 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.</p>	19	
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20	<p>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 embedded in cement concrete M15 grade block of 450x450x600mm below ground level. The height of the bottom of the lower plate will be 1200mm from normal ground level and the bottom of the middle plate will be 100mm above the top level of the lower most plate. the diamond shaped plate mounted over flat angle iron frame will be connected to middle plate by square steel section of 47mmx47mm, thickness 12SWG having a spacing of 100mm between the diamond shaped plate and middle plate and this square section will be riveted to the bottom point of the diamond shaped plate. 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.</p>	20	
21	Excavation for foundatioun upto 1.5 m depth incl. Sorting out & stacking of useful material & disposing of the excavated stuff upto 50m. Lead. (B) Dense or hard soil.	21	
22	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.	22	
23	Supplying and fixing reinforced concrete heavy duty non pressure pipes with collars for culverts incl. Setting and joining the pipes in C.M. 1:2 watering & laying (two level or slope) of 900mm dia. NP3 pipe internal diametre of IS 458 / 1971.	23	
24	Providing and filling in foundation with ordinary cement concrete M- 150 mix and providing necessary vertical pin headers including formwork, vibrating, ramming and curing complete.	24	
25	Providing TMT Bar FE 500/500D reinforcement for R.C.C. work including bending, binding and placing in position complete upto floor two level.	25	
26	Provinding and filling sand below R.C.C. raft in layers including ramming and watering complete.	26	
27	Providing and laying Weep hole in abutment and return by using PVC. pipe of 100 mm dia including laying in proper grade and joining complete etc as per details specification.	27	

28	White washing with lime on wall surface (two coats) to give an even shade including thoroughly booming the surface to remove all dirt, dust; mortar drops and other foreign matter.	28	
29	Dismantling the existing structure including removing & stacking the dismantled materials as and where directed.	29	
30	Providing & casting in situ Controlled cement concrete M - 250 for Cement Concrete Road laid as directed including tamping, vibrating, finishing, curing, and filling in joints with bitumen complete.	30	
31	Compaction and finishing of cement concrete road by trimix process providing extra labour charges for the trimix vacuum dewatering service process on cement concrete road surface by using vacuum dewatering pump floater surface vibrator including making rough finish to surface as per in including levelling the complete.	31	
32	Demolition & disposal of unserviceable materials with all lead & lift. (ii) Un- reinforced cement concrete.	32	
33	Excavation for foundation in sand, Gravel, Clay, Soft soil and Murrum etc., including shorting, strutting and dewatering as necessary and disposing of the excavated stuff as directed.	33	
34	Providing and casting in-situ controlled cement concrete M-250 for RCC raft and cut off walls including shuttering, laying, vibrating, ramming, and curing complete.	34	
35	Providing and casting in situ controlled cement concrete M - 300 for R.C.C. solid slab including centering, scaffolding, curing & finishing comp..(including Epoxy Painting of Exterior Surface)	35	
36	Providing and casting in-situ controlled cement concrete M-300 for average 75mm thick wearing cost laid as directed including tamping, vibrating finishing curing and complete.	36	
37	Providing and casting in-situ controlled cement concrete M-250 for kerb/kerb blocks including formwork, curing and finishing complete.	37	
38	Providing and casting in-situ controlled cement concrete M-300 for approach slab including formwork curing and finishing complete.	38	
39	Providing and placing in position FE 500/500D bar reinforcement for following items including cutting bending hooking and tying complete as per detailed drawing.	39	
40	Providing and fixing post and pipe railing as per detailed drawing including 3 coats of painting to steel works complete.	40	
41	Providing P.V.C. 100 mm diameter water spouts including necessary iron gratings as per drawings.	41	
42	Providing and fixing in position 12 mm thick permoulded joint filler in expansion joint for fixed ends of simply supported span, covered with sealant complete as per drawing and technical specifications.	42	
43	Providing and laying rubble for apron (each stone weighing not less than 40 Kg.) including packing & filling in the interestices with quarry spall.	43	
44	Providing and laying filter media 600 mm thick as directed at the back of abutments, returns and wing walls as per detailed specification.	44	
45	Providing Diversion may be necessary for traffic and maintaining the same for the period as may be necessary as directed by engineer in charge.	45	

46	Dismantling the existing structure including removing and stacking the dismantled materials as and where directed. (A) R.C.C. work.	46	
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Deputy Executive Engineer
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Modasa

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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.

1.1. Scope

Clearing and grubbing shall be performed less than one month in advance of earthwork operations and shall consist of cutting, trimming, removing and disposing of all materials such as trees, tree branches, bushes, shrubs, stumps roots, grass, weeds, anthills, jungle top organic soil not exceeding 150 mm in thickness, rubbish, loose stones, boulders, etc. which are undesirable and unsuitable for use in the works, from the designated area of road land, embankment slopes, drains, cross-drainage structures and such other areas as specified on the drawings or from areas as directed by the Engineer. It shall include grubbing, necessary excavation, backfilling of pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, removal and disposal of cleared materials in accordance with the requirements of these Specifications.

Reclearing of the site of any vegetation, grass shrubs before commencement of work shall be carried out as directed by the Engineer and shall be incidental to the work of clearing and grubbing.

1.2. 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 road which are not to be disturbed shall be protected from injury or damage by providing and installing suitable safeguards as shown in the drawing or as approved by the Engineer.

During clearing and grubbing the Contractor shall take all adequate precautions for preservation of all vegetation adjacent to road land against soil erosion, water pollution, etc. and where required, shall undertake additional works to that effect. 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 schedule for carrying out additional work where required.

1.3. Conservation of Top-soil

The top-soil removed during clearing and grubbing of site, if suitable for re-use shall be transported, conserved and stacked as directed by the Engineer. This shall be incidental to the work.

1.4. Methods, Tools and Equipments

Only such methods, tools and equipment as are approved by the Engineer shall be adopted for the work. If the area has thick vegetation/roots/trees, a crawler or dozer shall be used for clearance purposes. All trees, stumps, etc. falling within excavation and fill line shall be cut to such depth below ground level that in no case these fall within 500 mm of the sub grade. Also, all vegetation such as roots, under-growth, grass and other deleterious matter unsuitable for re-use in the embankment/sub grade shall be removed between fill lines to the satisfaction of the Engineer. On areas beyond these clearing limits trees and stumps required to be removed shall be cut down to 500 mm below ground level so that these do not present an unsightly appearance.

All branches of trees extending above the roadway shall be cut or trimmed so as to provide a clear height of 5 m above the road surface and shoulders.

All excavations below the general ground level arising out of the removal of trees, stumps etc. shall be filled with material conforming to prescribed requirements and compacted to specified density, given by the Engineer.

1.5. Removal of Ant-hills

Ant-hills both above and below the ground, as are liable to collapse and obstruct free subsoil water flow shall be removed by excavating to a suitable depth as directed by the Engineer. The excavated ant-hills material shall be carted away from the site. Cavities in the ground due to removal of ant-hills shall be filled with approved material and compacted to specified densities, as directed by the Engineer.

1.6 Disposal of Materials

All materials including trees, stumps, etc. arising from clearing and grubbing operations shall be the property of Government and shall be disposed off by the Contractor as here-in-after provided or as directed by the Engineer.

Trunks, branches and stumps of trees shall be cleaned of limbs and roots and stacked. Also boulders, stones and other materials usable in road construction shall be neatly stacked as directed by the Engineer. Stacking of stumps, boulders, stones etc. shall be done at specified spots with all lifts and upto a lead of 1000 m.

All products of clearing and grubbing which 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 off in such a manner that there is no likelihood of these getting mixed up with the materials meant for embankment, sub grade and road construction or cause undesirable environmental conditions.

1.7. Measurements for Payment

Clearing and grubbing for road embankment, drains and cross-drainage structures shall be measured on length basis in terms of Hect. Clearing and grubbing of borrow areas shall be incidental to embankment construction and the rates quoted for the embankment construction shall be inclusive of it.

Cutting of trees upto 300 mm in girth including removal of stumps and roots, and cutting/trimming of branches of trees extending above the roadway shall be considered incidental to the clearing and grubbing operations. Removal of stumps of trees upto 300 mm girth left over after trees have been cut by any other agency of the Contractor or Government 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 and removal of stems and roots of trees of girth above 300 mm diameter left over after trees have been cut by any other agency or the government 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 to 2700 mm

- (v) Above 2700 mm to 4500 mm
- (vi) Above 4500 mm

For this purpose, the girth shall be measured at a height of 1 m above ground or at the top of the stump, if the height of the stump is less than 1 m from the ground.

Where the proposed work site passes through dense forest area, clearing and grubbing including cutting of trees of all girths and removal of their roots and stumps, etc. for construction of road embankment, drains and cross-drainage structures shall be measured on area basis.

1.8 Acceptance

Acceptance of clearing and grubbing shall be based on visual inspection of the work for compliance with the above specifications to the satisfaction of the Engineer.

1.9 Rate

1.9.1. The Contract unit rates for the various items of clearing and grubbing shall be paid/payable 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 and roots of trees less than 300 mm in girth as well as stumps left over after cutting of trees carried out by another agency of the Contractor or Government, excavation and backfilling to required density, where necessary, and handling, salvaging, piling and disposing of the cleared materials with all lifts and upto a lead of 1000 m.

1.9.2. The Contract unit rate for cutting (including removal of stumps and roots) of trees of girth above 300 mm and removal of stems and roots of trees of girth above 300 mm left over after trees have been cut by any other agency or the government 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 as directed by the Engineer.

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

The payment shall be made on **Hect.** basis.

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

1. The land width on which the earth work is to be done shall be cleared of all trees having a girth 30 cm. and less, loose stones; vegetation, bushes, stumps and all other objectionable materials. All the materials cleared will be the property of Government. Useful material shall be arranged in convenient stacks along the road boundary or as directed at places within 50 metres lead, and handed over to the department in convenient section. 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 works property or people in the neighborhood. 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 line, curves, slopes, grades and sections as shown on the plan or directed by the Engineer-in-charge. The contractor shall provide all labours and materials such as lime, strings, pegs, nails, bamboos, stone, mortar, concrete, etc. required for setting out, establishing. Bench Marks and giving profiles: The contractor shall be responsible for maintaining the B. Ms. profiles alignment and other marks as long as they are required for the Work on the opinion of the Engineer-in-charge. If the contractor defaults in this respect they may be restored by the department at the cost of the contractor.

3. When an existing, embankment is to be widened, continuous, horizontal benches, each at least 0.3 metre wide shall be cut into the existing slope for ensuring adequate bond with the fresh embankment materials to be added. The material obtained from the cutting of benches can be utilized in the widening of the embankment. The 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 type of hauling equipment.

4. The soil to be used for embankment shall be free from trees stumps, roots, rubbish or any other objectionable materials. Only material considered suitable by the Engineer-in-charge shall be used for the construction and that considered unsuitable other disposed off as directed by him. The selection of the materials to be used in the construction of embankment shall be made after soil surveys and investigations carried out by the Department. The embankment shall consist of earth available from road-side borrow pits on either side with all lead and all lifts and within land width in the manner specified in Para 11 below. The road, if any required for the purpose of haulage of earth by men, animals or vehicles will be constructed. (If not existing) and maintained by the contractor at his own cost.

5. Location, shape and size of borrow pits shall be as indicated by the Engineer - in - charge. Pits shall not be dug continuously. Ridges of not less than 8 metres width should be left at interval not exceeding 300 metres. Small drain shall be cut through the ridges to facilitate drainage. The outer edge of borrow pits shall be so regulated that the bottom does not cut an imaginary line having a slope of 1 vertical to 4 horizontal projected from the edge of final section of the bank, the maximum depth in any case being limited to 1.5 metres. Also on pits shall be dug within 5 metres of the toe of the final section of the road embankment.

5.1 No borrow pits shall be allowed at the following sites along the road.

(1) up to 30 metres on either side of C.D. Works.

(2) up to 15 metres on either side of cart track crossing for which approaches are to be constructed.

5.2 If there is top layer of black cotton or other objectionable soils, the same shall be removed and disposed of elsewhere and usable material found at lower level will only be used in the embankment.

6. The embankment shall be constructed in uniform layers not exceeding 250 mm in loose thickness. The soil shall be spread uniformly over the entire width of the embankment, unless otherwise

directed by the Engineer-in-charge. All clods of hard lumps of earth shall be broken to have maximum size of 15 cm: when being placed in the embankment and a maximum of size 5 cm when being placed in the top 45 cm of the embankment, the work of next layer shall be allowed only after the first layer below it has been thoroughly compacted.

7. Where an embankment is to be placed on sloping ground, the surface of the ground shall be benched in the steps of trenches or broken up in such a manner that the new material shall have perfect bond with the existing surface. Where the embankment is to be placed over an existing road surface, the surface shall be scarified to minimum depth of a 5 cm. so as to provide ample bond between the old and new material. However when the embankment is to be placed over an old concrete pavement and lies within 1 metre of new sub grade level, the pavement shall be broken up in pieces not to exceed 0.1 m and may be left under the new embankment. If the existing road surface is of granular or bituminous type and lies within 1 mt of the new sub grade level, the same shall be scarified to a depth of minimum 50 mm. so as to provide ample bond between the old and the new material.

8. To avoid interference with the construction of abutment, wing walls of culverts/bridge structures, the contractor shall, at point to be determined by the Engineer-in-charge, suspend work on embankments 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 interference or damage to the bridge work. Unless directed otherwise, the filling ground culverts, bridge and other structures up to a distance of twice the height of the embankment from the back of the embankment 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-in-charge but in any case not until the concrete or masonry has been in position for 14 days, the embankment 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-in-charge. Where the provision of any filter medium is specified behind the abutment, the same shall be laid in layers with the laying of fill material. The material used for the filter shall conform to the requirements for filler medium and will be paid extra in the relevant item.

9. The embankment shall be finished in conformity with the alignment, levels, and cross sections and dimension shown on the plans or as directed by Engineer-in-charge. Where the alignment of the road is in a curve, the top of the embankment shall be formed with the super elevation and the increased width shown on the drawings or as the Engineer in-charge may direct. Finishing operations shall include the work of shaping and dressing the shoulders, road bed and the side slopes to conform the cross section.

10. The earthwork measurements shall be paid on cross sectional measurements and computing the volumes of earthwork in cubic metres by average area method. The contractor shall sign day to day levelling work and also original cross sections, longitudinal section etc, in token of his acceptance. The working sections both longitudinal and cross of the ground shall be taken by the Engineer-in-charge before the actual work has started. The contractor or his authorised representative shall attend day to day levelling work and sign with date the field book daily, in token of his acceptance. If there is any disagreement, the contractor shall inform of it in writing to the officer concerned with specific reference to the sections before starting further work. Once the work is started, no cognizance of any complaint will be taken merely not signing of level book shall not be deemed as disagreement. The Executive Engineer shall also verify levelling work to the extent of 5% before commencement of earth work and on finalization. The contractor shall maintain the embankment by filling in ruts, rain cuts depression due to shrinkage etc to proper formation and grade till this item is finally measured and accepted by the Department. The measurements shall be taken on compacted earth work. However the contractor shall have to bear loss of deformations etc. if any due to all settlements as well as other type of deformations etc. if any that might have taken place at the time of taking final measurement of item.

11. If usable approved material is available within the land width of road, the same shall be permitted for use in the road embankment subject to the following conditions:

- (i) The borrow pits will be so excavated as to from a road side longitudinal gutter to drain the water, interrupted by such gutter.

- (ii) The width of the drain shall be restricted to 1.5 Mts. only. The depth will be restricted to such grade so as to drain the water efficiently. All balance quantity of earth shall be brought from distant borrow areas only.
- (iii) If there is top layer of black cotton or other objectionable soils; the same shall be removed and disposed off elsewhere and usable material found at the lower level will only be used in the earthen embankment, if the contractor choose to utilize this material.
- (iv) The drain should be aligned along the boundary of the land width of the road. Not pit, other than this drain, shall be dug within 5 metres of toe to the final section of the road embankment.
- (v) No borrow pits shall be allowed in the length in which earth obtained from cutting is specified to be used in embankment.

12. 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 hereunder:

Moisture content of the materials shall be checked at the source of supply and if found less than the 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 hose line 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 down to acceptable level 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-11) 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 IS: (Part-VII). Highly expansive clays shall however be compacted at 2 to 4 percent above the optimum moisture content.

After nodding 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 to 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 metre portion of the embankment below the sub grade.

Hauling equipment shall be moved 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 truck or other hauling equipment, the lower part of the fill should be constructed by dumping successive loads in a uniformly distributed layers of a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers.

13. 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 intends 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 percentage of maximum laboratory dry density as per IS:
1.	Top 0.5 metre portion of embankment below sub grade 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 in spite of that the specific 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.

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

14. The rate of earthwork includes, clearing jungles, dog belling, fixing profiles, erecting necessary pillars for stones for bench marks for levelling purpose, excavating-earth from borrow areas, breaking clods, conveying and spreading earth in layers with all lead and lift, and watering and consolidation of the same as specified above and finishing the entire embankment and incidentals necessary to complete the work to the specifications. The cutting stuff of cutting in ordinary soil, soft Murrum, soft rock, hard Murrum and hard rock shall be utilized in embankment construction under this item within the lead specified in the particular, item. No payment shall be made under this item for the cutting stuff used in embankment but labour for cutting will be paid as per specifications in the particular item, and only balance quantity of earthwork brought from borrow areas will be paid in this item.

15 The payment will be made on **cubic meter** basis of finished work.

ITEM NO. 3 : Providing, laying, and compacting Hard Murrum for Road side shoulders including spreading in uniform thickness, including rolling with vibratory roller 80-100 kN static wt. to proper grade and camber including watering etc. complete.

1. Hard murrum should be of approved quality. Any material which is found inferior shall be rejected and contractor shall remove such rejected material from the site at his own cost. The material of Hard murrum shall be collected from quarries approved by the Executive Engineer.
2. The materials shall be got approved by the Executive Engineer prior to collection on site and shall be free from all, rubbish, dust and any organic materials as well as clods of black cotton soil. Material shall not be allowed to be collected from within the road boundary. The materials to be used shall be got tested prior to its use in road construction.
3. For road work complete stacking of materials as per requirement shall be carried out in 2 K.M. length before spreading. The materials stacks shall be got cross checked by other Deputy Executive Engineer as per rules before spreading. The collection shall always commence at one end of K.M and be carried continuously towards the other end.
The materials shall be stacked by filling standard boxes of size 2m x 1.5m x 0.5m on a fairly level ground. It shall be stacked on road land beyond the top of the bank and on a level ground. The rate includes supplying the hard murrum with all lead and lift on road site and stacking the same in regular pharas of the required dimensions.
4. Wherever any doubt as to whether above requirement are satisfied in whole or part of the collection it shall be got screened by the Contractor if so ordered by the Executive Engineer, and for which no extra payment shall be claimed by the contractor.
5. Any collection which does not fully satisfy the above requirement is liable to be rejected all together.

6. White stacking materials the depositing should commence at one end of the K.M. and carried continuously towards the other and unless the Executive Engineer shall direct otherwise and as a rule measurements shall be taken after every half kilometer of Km. has been fully collected. Any fraction of these distance shall be measured up.

7. **Spreading coarse aggregates:** The Hard murrum shall be spread uniformly and evenly upon the prepared sub grade/ sub-base/ base to proper profile by using templates placed across the road about 6m apart, in such quantities that the thickness of each compacted layer is not more than 150mm. Wherever possible, approved spread the Hard murrum uniformly so as to minimize the need for manual rectification afterwards. Hard murrum 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 Hard murrum shall be allowed.

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

The surface shall be brought to the required camber which shall be checked at every 50 ft. (15 M.) by means of templates and while the necessary of the in between shall be tested by strings and corrected as required.

The centre line shall first be marked in the sub grade which is properly consolidated and has uniform camber and grade as required.

The Hard murrum shall be laid for a small length on 25 ft. (8 M.) and then the edge stones shall be laid.

Pegs shall be driven in either side of the road and joined with strings true and parallel with a distance between them equal to the width to be laid oversize similarly.

The Hard murrum shall be laid as close as possible so as to leave minimum possible interstices and voids.

Before rolling is allowed on soling the side berms shall be filled up to the top of the soling and at least 3'-0" (1 m) on either side so as to prevent metal layer getting disturbed at times during rolling. The rate is inclusive of all the operations as stated above.

- 8 **Rolling:** Immediately following the spreading of the coarse aggregate, rolling shall be started with rollers of 80 to 100 KN capacity tandem or vibratory rollers of 80 to 100 KN static weight. The type of roller to be used shall be approved by the Engineer based on trial run.

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

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 aggregate 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 sub grade is soft or yielding or when it cause a wave-like motion in the sub grade or sub-base course.

The rolled surface shall be checked transversely and longitudinally, with templates and any irregularities corrected by loosening the surface, adding or removing necessary amount of aggregates and re-rolling until the entire surface son forms to desired cross fall (camber) and grade. In no case shall the use of screening 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 course as per Clause 407.4.1.

9. Moisture content of the loose shall be checked in accordance with IS :2720 (Part 2) and suitably adjusted by sparkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniforms and at controlled quantities to variable for applying water uniforms and at controlled quantities to variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from 1 percent above to 2 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 processes b mechanical or other approved means like disc harrows, rotators until the layer is uniformly wet.

Immediately thereafter rolling shall start. For a compacted each layer the compaction shall be done with the help of a vibratory roller of minimum 80 of 100 KN static weight with plain drum of pad foot drum of heavy pneumatic tyred roller of minimum 200 to 300 KN weight having a minimum tyre pressure of 0.7 MN/m² or equivalent capacity roller capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the 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 sports or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 Km hour.

10. 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.
11. Arrangements for Traffic.
During the period of construe on, arrangement of traffic shall be maintained in accordance with Clause 112.
12. Measurements for Payment
Hard Murrum shall be measured as finished work in position in cubic metres.

The Protection of edges of Hard Murrum extended over the full formation as shown in the drawing shall be considered incidental to the work of providing Hard Murrum and as such no extra payment shall be made for the same.

- 13 **Rate**
- (i) Making arrangements for traffic Clause 112 except for initial treatment to verges, shoulders and construction of diversions :
 - (ii) Furnishing all material 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 part widths of road where directed; and
 - (v) Carrying out the required tests for quality control.
14. The rate includes supplying the hard murrum with all lead and lift on road site and stacking the same in regular phases of the required dimensions.

The payment shall be made on **Cubic meter** basic.

ITEM NO. 4 : Construction of Granular Sub Base (GSB) by providing M.C. coarse graded material of grading-I, spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC, and compacting with vibratory roller to achieve the desired density, complete as per MORTH specification.

401 GRANULAR SUB-BASE

401.1 Scope

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

402 Materials

401.2.1

The material to be used for the work shall be natural sand, crushed gravel, crushed stone, crushed slag, or combination thereof depending upon the grading required. Use of materials like brick metal, Kankar and crushed concrete shall be permitted in the lower sub-base. The material shall be free from organic or other deleterious constituents and shall conform to the gradings given in Table 400-1 and physical requirements given in Table 400-2. Gradings III and IV shall preferably be used in lower sub-base. Gradings V and VI shall be used as a sub-base-cum-drainage layer. The grading to be adopted for a project shall be as specified in the Contract. Where the sub-base is laid in two layers as upper sub-base and lower sub-base, the thickness of each layer shall not be less than 150 mm.

401.2.2 If the water absorption of the aggregates determined as per IS:2386 (Part 3) is greater than 2 percent, the aggregates shall be tested for Wet Aggregate Impact Value (AIV) (IS:5640). Soft aggregates like Kankar, brick ballast and laterite shall also be tested for Wet AIV (IS:5640).

Table 400-1: Grading for Granular Sub-Base Materials

IS Sieve	Percent by Weight Passing the IS Sieve					
Designation	Grading I	Grading II	Grading III	Grading IV	Grading V	Grading VI
75.0 mm	100	-	-	-	1100	-
53.0 mm	80-100	100	100	100	80-100	100
26.5 mm	55-90	70-100	55-75	50-80	55-90	75-100
9.50 mm	35-65	50-80	-	-	35-65	55-75
4.75 mm	25-55	40-65	10-30	15-35	25-50	30-55
2.36 mm	20-40	30-50	-	-	10-20	10-25
0.85 mm	-	-	-	-	2-10	-
0.425 mm	10-15	10-15	-	-	0-5	0-8
0.075 mm	<5	<5	<5	<5	-	0-3

Table 400-2: Physical Requirements for Materials for Granular Sub-base

Aggregate Impact Value (AIV)	IS:2386 (Part 4) or IS:5640	40 maximum
Liquid Limit	IS:2720 (Part 5)	Maximum 25
Plasticity Index	IS:2720 (Part 5)	Maximum 6
CBR at 98% dry density (at IS:2720-Part 8)	IS:2720 (Part 5)	Minimum 30 unless otherwise specified in the Contract

401.2 Construction Operations

401.2.1 Preparation of Sub-grade

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

401.3.2 Spreading and Compacting

The sub-base material of the grading specified in the Contract and water shall be mixed mechanically by a suitable mixer equipped with provision for controlled addition of water and mechanical mixing. So as to ensure homogenous and uniform mix. The required water content shall be determined in accordance with IS:2720 (Part 8). The mix shall be spread on the prepared subgrade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation, or other means as approved by the Engineer.

Moisture content of the mix shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted so that, at the time of compaction, it is from 1 to 2 percent below the optimum moisture content.

Immediately after spreading the mix, rolling shall be done by an approved roller. 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 200 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight 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 or on super-elevation. For carriageway having cross fall on both sides, rolling shall commence at the edges and progress towards the crown.

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

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

401.4 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.

401.5 Arrangements for Traffic

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

401.6 Measurements for Payment

Granular sub-base shall be measured as finished work in position in **cubic metres**.

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

401.7 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. supplying all materials to be incorporated in the work including all royalties, fees, rents where applicable with all leads and lifts;
- iii. all labour, tools, equipment, and incidentals to complete the work to the Specifications;
- iv. carrying out the work in part widths of road where directed; and
- v. carrying out the required tests for quality control.

ITEM NO. 5 : Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam (Grade-I) (B.T. Metal of size 45 to 90 mm) specification including spreading in uniform thickness, hand packing , rolling with vibratory roller 80-100 kN static wt. to proper grade and camber, applying and brooming, stone screening / binding materials to fill-up the interstices of coarse aggregate, watering and compacting etc. complete as per Specification.

1 Scope: 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 sub grade/sub base /base or existing pavement, as the case may be and finished in accordance with the requirements of these specifications and it close conformity with the lines, grades, cross sections and thickness as per approved plans or as directed by the Engineer.

1.2 It is, however, not desirable to lay water bound macadam on an existing thin black topped surface without providing adequate drainage facility for water that would get accumulated at the interface of existing bituminous surface and water bound macadam.

2 Materials:-

2.1 Coarse aggregates: Coarse aggregates shall be either crushed or broken stone of BT type only. The aggregates shall conform to the physical requirements set forth in Table 400-6. 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).

2.2 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 materials.

TABLE-400-6. PHYSICAL REQUIREMENTS OF COARSE AGGREGATES FOR WATER BOUND MACADAM FOR SUB-BASE/BASE COURSES

	Test	Test Method	Requirements
1.	*Los Angeles Abrasion value or *Aggregate impact value.	IS: 2386 (PART-4) IS: 2386 (PART-4) or IS: 5640**	40 percent (Max) 30 percent (Max)
2.	Combined Flakiness and Elongation indices (Total) ***		IS: 2386 (PART-I) 35 percent (Max)

- * Aggregate may satisfy requirements of either of the two tests.
- ** Aggregates like brick metal, kankar, literate etc. which get softened in presence of water shall be tested for impact value under wet conditions in accordance with IS:5640;
- *** The requirement of flakiness index and elongation index shall be enforced only in the case of crushed broken stone and crushed slag.

2.3. 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 M3 and the percentage of glossy material shall not be more than 20. It should also comply with the following requirements:

- (i) Chemical stability To comply with requirements of appendix of BS : 1047
- (ii) Sulphur content Maximum 2 per cent
- (iii) Water absorption Maximum 10 per cent

2.4. Over burnt (Jhama) brick aggregates: Jhama brick aggregates shall be made from over burnt bricks or brick bats and be free from dust and other objectionable and deleterious materials.

2.5 Grading requirement of coarse aggregates: The coarse aggregates shall conform to one of the Grading given in Table 400-7 as specified, provided; however, the use of Grading No.1 shall be restricted to sub-base course only.

TABLE 400-7.GRADING REQUIREMENTS OF COARSE AGGREGATES

Grading No.	Size Range	IS sieve Designation	Percent by Weight Passing.
I	90mm to 45 mm	125 mm	100
		90 mm	90-100
		63 mm	25-60
		45 mm	0-15
		22.4 mm	0-5
II	63mm To 45mm	90 mm	100
		60 mm	90-100
		53 mm	25-75
		45 mm	0-15
		22.4 mm	0-5
III	53mm To 22.4mm	63 mm	100
		53 mm	95-100
		45 mm	65-90
		22.4 mm	0-10
		11.2 mm	0-5

Note: The compacted thickness for a layer with Grading I shall be 100 mm while for layer with other Gradings i.e. 2 & 3, it shall be 75 mm.

2.6 Screenings: Screenings to fill voids in the coarse aggregate shall generally consist of the same material as the coarse aggregate. However, where permitted, predominantly non-plastic material such as Murrum or gravel (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 per cent.

Screenings shall conform to the grading set forth in Table 400-8. The consolidated details of quantity of screenings required for various grades of stone aggregates are given in Table 400-9. The table also gives the quantities of materials (loose) required for 10 m2 for sub-base/base compacted thickness of 100/75 mm.

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

TABLE 400-8 GRADING FOR SCREENINGS

Grading Classification	Size of Screenings	Is Sieve Designation	Per cent by weight passing the IS Sieve
A	13.2 mm	13.2 mm	100
		11.2 mm	95 – 100
		5.6 mm	15 – 35
		180 Micron	0 – 15
B	11.2 mm	11.2 mm	100
		5.6 mm	90 – 100
		180 Micron	15 - 35

TABLE 400-9 APPROXIMATE QUANTITIES OF COARSE AGGREGATES AND SCREENINGS REQUIRED FOR 100/75 MM COMPACTED THICKNESS OF WATER BOUND MACADAM (WBM) SUB-BASE/BASE COURSE FOR 10M² AREA

Classification	Size Range	Compacted thickness	Loose Qty.	Screenings			
				Stone Screening		Crushable Type such as Moorum or Gravel	
				Grading Classification & Size	For. WBM Sub-base / base course (Loose quantity)	Grading Classification & Size	Loose Qty.
Grading 1	90 mm to 45 mm	100 mm	1.21 to 1.43 m ³	Type A 13.2 mm	0.27 to 0.30 m ³	Not uniform	0.30 to 0.32 m ³
Grading 2	63 mm to 45 mm	75 mm	0.91 to 1.07 m ³	Type A 13.2 mm	0.12 to 0.15 m ³	Not uniform	0.22 to 0.24 m ³
Grading 2	63 mm to 45 mm	75 mm	0.91 to 1.07 m ³	Type B 11.2 mm	0.20 to 0.22 m ³	Not uniform	0.22 to 0.24 m ³
Grading 3	53 mm to 22.4 mm	75 mm	0.91 to 1.07 m ³	Type B 11.2 mm	0.18 to 0.21 m ³	Not uniform	0.22 to 0.24 m ³

2.7. 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 or less than 6 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. Generally, the quantity required for 75 mm compacted thickness of water bound macadam will be 0.06-0.09 m³/10 m² and 0.08-0.10 m³/10 m² for 100 mm compacted thickness.

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 such as Moorum or gravel.

3. Construction Operations:

3.1 Preparation of base: The surface of the sub grade/sub-base/base to receive the water bound macadam 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 swatter. Any sub-base/base/surface irregularities, where predominant, shall be made good by providing appropriate type of profile corrective course (leveling course) to Clause 501 of these Specifications.

As far as possible, laying water bound macadam course over an existing thick bituminous layer may be avoided since it will cause problems of internal drainage of the pavement at the interface of two courses. It is desirable to completely pick out the existing thin bituminous wearing course where water bound macadam is proposed to be laid over it. However, where the intensity of rain is low and the interface drainage facility is efficient, water bound macadam can be laid over the existing thin bituminous surface by cutting 50 mm x 50 mm furrows at an angle of 45 degrees to the center line of the pavement at one metre intervals in the existing road. The directions and depth of furrows shall be such that they provide adequate bondage and also serve to drain water to the existing granular base course beneath the existing thin bituminous surface.

3.1 Inverted choke: If water bound macadam is to be laid directly over the sub-grade, without any other intervening pavement course, a 25 mm course of screenings (Grading B) or coarse sand shall be spread on the prepared sub grade before application of the aggregates is taken up. In case of a fine sand or silty or clayey sub grade, it is advisable to lay 100 mm insulating layer of screening or coarse sand on top of fine grained soil, the gradation of which will depend upon whether it is intended to act as a drainage layer as well. As a preferred alternative to inverted choke, appropriate geosynthetics performing functions of separation and drainage may be used over the prepared sub grade as directed by the Engineer. Section 700 shall be applicable for use of geosynthetics.

3.3 Spreading coarse aggregates: The coarse aggregates shall be spread uniformly and evenly upon the prepared sub grade/ sub-base/ base to proper profile by using templates plated across the road about 6m apart, in such quantities that the thickness of each compacted layer is not more than 150mm. Wherever possible, approved spread the aggregates uniformly so as to minimize the need for manual rectification afterwards. 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.

3.4 Rolling: Immediately following the spreading of the coarse aggregate, rolling shall be started with rollers of 80 to 100 KN capacity tandem or vibratory rollers of 80 to 100 KN static weight. The type of roller to be used shall be approved by the Engineer based on trial run.

Except on super elevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the center. First the edge/ edges shall be compacted with roller running forward and backward. The roller shall then move inward parallel to

the center line of the road, in successive passes uniformly lapping preceding tracks by at least one half widths.

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 aggregate 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 sub grade is soft or yielding or when it cause a wave-like motion in the sub grade or sub-base course.

The rolled surface shall be checked transversely and longitudinally, with templates and any irregularities corrected by loosening the surface, adding or removing necessary amount of aggregates and re-rolling until the entire surface son forms to desired cross fall (camber) and grade. In no case shall the use of screening 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 course as per Clause 407.4.1.

3.5 Application of Screenings: After the coarse aggregate has been rolled, 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 to coarse aggregate.

The screening shall be applied at a slow and uniform rate 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 as manner as would prevent filling of voids or prevent the direct bearing of the roller on 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.

3.6 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 screening s 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-bounded and firmly set in its full depth and a grout has been formed of screening, Care shall be taken to see that the base or sub grade does not get damaged due to the addition of excessive quantities of water during construction.

In case of line treated soil sub-base, construction of water bound macadam on top of it can cause excessive water to flow down to the lime treated sub-base before it has picked up enough strength (is still “Green”) and thus cause damage to the sub-base layer. The layer of water bound macadam layer in such cases shall be done after the sub-base attains adequate strength, as directed by the Engineer.

3.7. Application of binding material: After the application of screenings in accordance with Clauses 404.3.5 and 404.3.6 the binding material where it is required to be used (Clause 404.2.7) 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.

3.8 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.

4 Surface Finish and Quality Control of Work:

4.1 The surface finish of construction shall conform to the requirements of Clause 902.

4.2 Control on the quality of materials and works shall be exercised by the engineer in accordance with Section 900.

4.3 The water bound macadam work shall not be carried out when the atmospheric temperature is less than 0°C in the shade.

4.4 Reconstruction of defective macadam: The finished surface of water bound macadam shall conform to the tolerance of surface regularity as prescribed in Clause 902. However, where the surface irregularity of the course exceeds the tolerances or where the course is otherwise defective due to sub grade 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 recomputed. In no case shall decisions be filled up with screenings or binding materials.

5 Arrangement for Traffic.

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

6 Measurements for payment:

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

7 Rate: The contract unit rate for water bound macadam sub-base/base course. Shall be payable in full for carrying out the required operations including arrangement of water used in the work as approved by the Engineer including full compensation for all 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 part widths of road where directed; and
- (v) Carrying out the required tests for quality control.

Item No 06 : Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam (Grade-II) (M.C. Metal of size 40 to 63 mm) specification including spreading in uniform thickness, hand packing , rolling with vibratory roller 80-100 kN static wt. to proper grade and camber, applying and brooming, stone screening / binding materials to fill-up the interstices of coarse aggregate, watering and compacting etc. complete as per Specification. (45 to 63mm size M.C. Metal).

The work shall be carried out as directed with relevant specifications of this tender Item No. 05
The contract rate shall be for a unit of One Cum. of completed item.

Item No 07 : Providing & laying 37.50mm thick Bituminous grout base course with Emulsion RS1 for tack coat @ 4.0 kg./ 10 Sqmt WBM surface and using B.T. stone aggregate as per required gradation with asphalt of VG-30 grade at the rate of 1.99% i.e. 19.90 Kg/ M.T. including heating & mixing in drum mix plant transporting the mix spreading the same by paver finisher and consolidation by vibratory roller as per MORT&H specification including cost of all materials fuel, labours, tools and plant etc using contractors own drum mix plant etc. comp.

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 each course shall be 37.50 mm.

2. Materials

2.1. Bitumen: As per MORT&H Clause 504.2.1 shall apply. The bitumen shall be paving bitumen of Penetration Grade complying with Indian Standard Specifications for "Paving Bitumen" IS: 73, Where permitted by the Engineer, an appropriate grade of emulsion complying with IS:8887 may be used.

2.2. Aggregates: The coarse aggregate shall conform to Clause 504.2.2.

The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on the 2.36 mm, sieve. They shall be clean, hard, and durable, of cubical shape, free from dust and soft or friable matter, organic or other deleterious matter. Where the Contractor's selected source of aggregates has poor affinity for bitumen, as a condition for the approval of that source, the bitumen shall be treated with approved anti-stripping agents, as per the manufacturer's recommendations, without additional payment. Before approval of the source, the aggregates shall be tested for stripping.

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% by weight of the crushed material retained on the 4.75 mm sieve shall have at least two fractured faces.

2.3. Fine aggregates: Fine aggregates shall consist of crushed or naturally occurring material, or a combination of the two, 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 OF AGGREGATES FOR
BITUMINOUS MACADAM**

Property	Test	Specification
Cleanliness	Grain size analysis ¹	Max. 5 % passing 0.075 mm sieve
Particle shape	Flakiness and Elongation Index (Combined) ²	Max. 30 %
Strength*	Los Angeles Abrasion Value ³ Aggregate Impact Value ³	Max. 40 % Max. 30 %
Durability	Soundness ⁴ Sodium Sulfate Magnesium Sulfate	Max. 12 % Max. 18 %
Water Absorption	Water Absorption ⁵	Max. 2%
Stripping	Coating and Stripping of Bitumen aggregate Mixtures ⁶	Minimum retained coating 95 %
Water Sensitivity ⁷	Retained Tensile Strength	Minimum retained coating 95 %

Notes: 1. IS: 2386 Part 1 4. IS: 2386 Part 5
2. IS: 2386 Part 1 5. IS: 2386 Part 3
(The elongation test to be done only on non-flaky aggregates in the sample)
3. IS: 2386 Part 4* 6. IS: 6241

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

*Aggregate may satisfy requirements of either of these two tests.

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 FOR COARSE AND KEY AGGREGATS
FOR BUILT-UP SPRAY GROUT**

IS Sieve Designation (mm)	Cumulative per cent by weight of total aggregate passing	
	Coarse Aggregate	
53.0	100	
26.5	75-100	
22.4	50-85	
13.2	20-40	
5.6	5-20	
2.8	0-5	

3. Construction Operations

3.1. Weather and seasonal limitations: The provisions of 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.

3.2. Equipment: A mechanical broom, compressor, self-propelled or trailed bitumen heater/distributor and 80 to 100 kN smooth steel-wheeled roller, vibratory roller are required.

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 Clause 501. A prime coat shall be applied in accordance with Clause 502 with approved primer as directed by the Engineer.

3.4. Tack coat: A tack coat of Emulsion RS1 shall be ~~2.50Kg./10Sqmt on B.T. surface & 4.0Kg./10Sqmt on WBM surface~~ applied in accordance with the procedure described in Clause 503, as directed by the Engineer.

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.

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.

3.7. Preparation and transportation of mix: The Mix materials 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 materials 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.

3.8. Spreading: 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.

3.9. Compaction: 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 superelevated 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 a 80 to 100 kN static weight roller.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding mix material. The rolling shall then be continued till 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 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
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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.

3.10 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 mm, before the adjacent width is laid.

3.11 Application of key aggregate: key aggregates shall be spread uniformly and evenly, preferably by mechanical means, at the rate of 0.13 cu.m. per 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 80 to 100 kN smooth wheel steel roller in accordance with Clause 505.3.5. 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.

4. Surface Finish and Quality Control

The surface finish of construction shall conform to the requirements of Clause 902. All materials shall comply with the requirements of the relevant provisions in Section 900 of the MORT&H shall apply.

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 method selected by the Contractor for performing this operation, then it shall be considered incidental to the work and shall not be paid for separately.

6. Arrangements for Traffic

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

7. Measurements 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 & measure authority.

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

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

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

8. Rate

The contract unit rate for built-up spray grout shall be payment in full for carrying out the required operations as specified, and shall include, but not necessarily limited to all components listed in clause

8.2 (i) to (xi). The rate shall include the provision of bitumen, at 1.99 percent by weight of the total mixture. The variance in actual percentage of bitumen used will be assessed and the payment adjusted.

The Contract rate shall be for a unit of one M.T. for completed item. Built-up-spray grout shall be measured as finished work in M.T.

Item No 08 : Providing and laying 25 mm thick premix asphalt carpet using 0.66 cmt per 1 MT.mix with M.C. stone agg. & Emulsion RS1 for tack coat @ rate of 2.50 kg / 10 smt. & using asphalt VG-30 of 33.60 kg .ie. 3.36 % by Drum Mix Plant & spreading the same by paver finisher with vibratory roller 80 to 100 KN. static wt. incl. providing all equipments tools and plants, fire wood, oil, kerosene, labour charges etc. complete with contractor's own machineries, etc. complete.

1. SCOPE

The work shall consist of laying and compacting bituminous carpet of 25 mm thick in a single course composed of suitable small size aggregate premixed with a bituminous blinder on a previously prepared base, in accordance with the requirement of these specifications to serve as a wearing course.

2. MATERIALS

2.1 BITUMEN

The bitumen shall be paving bitumen of suitable penetration grade VG-30 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

2.2 AGGREGATES

2.2.1 The coarse aggregates shall consist of crushed stone, stones. The shall be clean, strong durable of fairly physical shape and free from disintegrated pieces, organic or other deleterious matter and adherent coating.

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 doses as Appendix-5. The aggregates shall satisfy the physical requirement set forth in Table – 1

TABLE –1 PHYSICAL REQUIREMENTS OF AGGREGATES

Sr. No.	TEST	TEST METHOD	REQUIREMENT
1	Los Angeles Abrasion value	IS-2386 (part-4)	35 percent(Max)
2	Aggregate Impact value	-- do --	30 percent(Max)
3	Flakiness and elongation index	IS-2386 (part-1)	30 percent(Max)
4	Stripping value	IS - 6241	25 percent(Max)
5	Water absorption	IS-2386 (Part-3)	2 percent (Max)
6	Coating & stripping of bitumen aggregate mixtures	AASHTOT – 182	Minimum retain coating 95 %
7	Soundness (i) Loss with sodium sulphate (ii) Loss with magnesium sulphate	IS- 2386 (Part-5) Cycles	12 percent(Max) 18 percent (Max)

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

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

2.2.4 Filler : The filler, where required, shall be an inert material the whole passes 600 micron sieve at least 90 percent passing 150 micron sieve and not less than 70 percent passing 75 micron sieve. The filler shall be cement , stone dust, hydrated lime, fly ash and other non- plastic mineral matter approved by the Engineer-in-charge.

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

TABLE-2 AGGREGATE GRADING FOR BITUMINOUS CARPET

IS SIEVE DESIGNATION	Percent by weight passing the sieve
	for 25 mm thickness
20.0 mm	100
12.5 mm	70-100
10.0 mm	20 - 40
4.75 mm	0 - 5
2.36 mm	

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

2.3 PROPORTIONING OF MATERIALS

The bitumen content of premixing shall be 3.36 percent by weight of the total mix except when otherwise directed by the Engineer.

2.4 VARIATION IN PROPORTIONING OF MATERIAL

The contractor shall have the responsibility for ensuring proper proportioning of materials and producing a uniform mix. A variation in binder content ± 0.3 percent by weight of total mix shall however be permissible for individual specimens taken for quality control tests vide section 900.

3. CONSTRUCTION OPERATIONS

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

3.2 PREPARATION OF THE BASE

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

3.3 TACK COAT

3.3.1 PREPARATION OF BASE

The surface on which the tack coat is to be applied shall be cleaned of dust and any extraneous material before the application of the binder by using a mechanical broom or any other approved equipment/ method as specified by the Engineer in charge

3.2 APPLICATION OF BINDER

The binder shall be of Emulsion RS1 and satisfying the requirement of IS-73 and shall be supplied by the contractor to the site of work at his own cost. It shall be the responsibility of the contractor to carefully handle the inflammable bituminous cut back material so as to safeguard against any fire mishap. The binder shall be applied uniformly with the aid of either self propelled or towed bitumen pressure sprayer with self heating arrangement and spraying bar with nozzles having constant volume or pressure system. Capable of spraying bitumen at specified rates and temperature so as to provide a uniformly unbroken spread of bitumen. Work should be planned so that more than the necessary tack coat for the day's operation is placed on the surface. After application and prior to succession construction allow the tack coat to cure, without being disturbed until the water/ cutter has completely evaporated as determined by the Engineer.

RATE OF APPLICATIONS OF TACK COAT

Apply tack coat of Emulsion RS1 at the rate of ~~4 kg per 10 sq meter area on W.B.M. surface~~ and 2.5 kg per 10 sq. mt. area on bituminous surface.

3.3 PREPARATION AND TRANSPORT OF MIX

Bituminous carpet mix shall be prepared in a hot mix plant of adequate capacity and capable of producing a mix of proper and uniform quality with thoroughly coated aggregates.

Hot mix plant shall be of suitable capacity preferably of batch mix type. Total system for crushing of stone aggregate and feeding of aggregate fractions in required proportions to achieve the desired mix, deployed 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 arrangement for initial proportioning of aggregates from each bin in the required quantities in order to have free flow of fines from the bin it is advisable to have vibrator fitted on bin to intermittently shake it.
- (c) Belt conveyers below each bin should have variable speed drive motors. There should be electronic load sensor on the main conveyor for measuring the flow of aggregates.
- (d) Dryer unit with burner capable of heating the aggregate to the required temperature without any visible unburnt fuel or carbon residue on the aggregates and reducing the moisture content of the aggregate specified minimum.
- (e) The plant shall be fitted with suitable type of thermometric instruments at appropriate places so as to indicate of record/ register the temperature of heated aggregate, 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 aggregate 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.
- (i) The plant should have centralized control panel/ cabin capable of presetting. Controlling/ synchronizing all operations starting from feeding of cold aggregate 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 screen for accurate sizing of hot aggregate 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 aggregate 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 aggregate with binder.

C. FOR CONTINUOUS TYPE PLANT

Graduation control unit having vibratory screen for accurate sizing of hot aggregate and storing them in separate bins. This unit should be fully covered to reduce the maintenance cost and for better environmental condition.

There should be appropriate arrangement for regulating and volumetric control of the flow of hot aggregate from each bin to achieve the required proportioning.

- (iv) Paddle mixer unit shall be capable of producing, homogeneous mix with uniform coating of all particles of the mineral aggregate with binder.

D. FOR DRUM MIX PLANT

(i) It is a prerequisite that only properly screened and graded material are fed to the bins. If required a vibratory screening unit shall be installed at the plant side to ensure the same. A primary 4 – deck vibratory screening unit shall be installed before the multiple bin cold Feed system for screening the aggregates and grading the same.

(ii) Belt conveyers 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.

(iii) There should be arrangement to measure moisture content of the aggregate that moisture correction may be applied for working out requirements of binder and filler.

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

Mixture shall be used to ensure that a homogeneous mixture is obtained in which all particles of the aggregate are coated uniformly and the discharge temperature of mix shall be between 130° c to 160° 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.

3.4 SPREADING

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

- (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 requirement.

- (d) The screed shall have tamping and vibrating arrangement 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 the finished surface is free from surface blemishes.

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

- (g) The 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 be operated in the opinion of the Engineer, he may permit manual laying of the mix.

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

Longitudinal joints and edges shall be constructed true to the longitudinal line parallel to the center line of the road. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material. Longitudinal and transverse joints shall be offset by at least 150 mm from 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 the previously laid mix with asphalt cutter/pavement breaker and surface painted with hot bitumen before placing fresh material. Longitudinal joints shall be preferably hot joints. Cold longitudinal joints shall be properly heated with joint heater to attain a suitable temperature of about 80C before laying of adjacent material.

3.5 COMPACTION :

After the spreading of mix rolling shall be done by 80 to 100 KN vibrating road 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 moves at a speed not more than 5 km/h. Rolling shall be done with care to avoid unduly roughening of the pavement surface.

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

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

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding mix material. The rolling shall then be continued till the entire surface has been rolled to 95 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 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 lubrication oil be used for this 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° c.

Roller(s) shall not stand on newly laid material while there is a risk that surface will be deformed thereby. The edges along and transverse of the bituminous 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.

4. 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 minerals and works shall be exercised by the Engineer in accordance with section 900.

5. The bituminous carpet shall be covered with either the next pavement course or wearing course as the case may be without any delay.

6. ARRANGEMENTS OF TRAFFIC

During the period of construction, arrangement of traffic shall be done to clause- 112.

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 & measure authority.

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

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

The work shall be measured as finished work by weight in metric tones.

8. RATE

- (i) The contract unit rate for work shall be payment in the full for carrying out the required operations including full compensation for.
- (ii) Making arrangements for traffic to clause 112 except for initial treatment to verge shoulders and construction of diversions.
- (iii) Preparation of base except for laying of profile corrective course but including filling of potholes.
- (iv) Providing all material to be incorporated in the work including arrangement for stock yards all royalties, fees, rents where necessary and all leads and lifts.
- (v) All labour, tools, equipments, plant, including installation of hot mix plant, power supply units and all machineries, incidental to complete the work to the specifications.
- (vi) Currying out the work in part width of the road where directed.
- (vii) Currying out all tests for control of quality and.
- (viii) The rate shall cover the provision of bitumen at 3.36 per cent of weight of total mix. With the provision that the variation of quantity of bitumen will be assessed and the payment adjusting as per the rate of bitumen quote & rate also including providing tack coat at the rate of 2.5 kg per 10 sq mt area on normal bituminous surface.

Item No 09 : Providing and laying bitumenous Seal coat 0.18 cmt / 10 smt. with machine crushed aggregate using 45.00 kg. VG-30 of bitumen per M.T. of total weight of mix agg. (4.50 % of total weight of mix) by drum mix plant and spreading the same by paver finisher and consolidation with vibratory roller 80 to 100 KN static wt. incl. providing all materials equipments, tools and plants, fire wood, oil, kerosene, labour charges etc. comp & flushing sand @ rate of 0.30.

1. DESCRIPTION

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

2. MATERIALS

2.1 Binder : The shall be straight run bitumen of 60/70 or 80/100 grade satisfying the requirement of IS:73. The actual grade of the binder to be used shall be decided by the Engineer-in-charge.

2.2 Coarse aggregates : The coarse aggregates shall consist of crushed stone or crushed gravel. These shall be clean, durable of cubical shape, free disintegrated pieces, organic or other deleterious matter and adherent coatings. The aggregates shall preferably be hydrophobic and of low porosity and shall satisfy the physical requirements set forth in Table 1.

Physical requirement of aggregates for seal coat			
Sr.No.	Test	Test Mathod	Requirement
1.	Los Angles abrasion Value OR Aggregate Impact Value	IS : 2386 (Part – IV) ---do---	40 % maximum 30 % maximum
2.	Flakiness and Elongation Indices (Total)	IG : 2386	30 % maximum
3.	Coating and stripping of Bitumen aggregates mixtures	AASTC – 7	Minimum retained Coating 95 %
Soundness :			
i.	Loss with sodium sulphate	IS – 2386 (Part – V) 5 Cycles	12 % Maximum
ii.	Loss with magnesium sulphat	5 Cycles	18 % Maximum
5.	Water Absorption	IS – 2386 (Part – III) Note	1 % Maximum

:-Aggregate may satisfy requirement of either of two tests

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

2.4 Filler : The filler, where required, shall be an inert material the whole passes 600 micron sieve at least 90 percent passing 150 micron sieve and not less than 70 percent passing 75 micron sieve. The filler shall be cement , stone dust, hydrated lime, fly ash and othe non- plastic mineral matter approved by the Engineer-in-charge.

2.5 Aggregate gradation : The mineral aggregates, including mineral filler, shall be so graded of combined as to conform to gradings set for this tables below:

Table : Aggregate gradation Pre-Mix Seal Coat

Sieve Designation	Percentage by wt passing through sieve
12.5mm	—
10.0mm	100
4.75mm	40 - 85
2.35mm	5 - 20
75 micron	0 - 4

2.6 Proportioning of materials : The content for premixing shall be 4.50 kg per M.T. (4.50% by weight) for mixing aggregate.

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

The contractor shall get the job-mix formula for the mix approved by the Engineer-in-charge before starting the work.

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

3. CONSTRUCTION OPERATIONS

3.1 Weather and seasonal limitation : The work of laying shall not be taken up during rainy weather or when the base course is damp or wet or during dust storm or when the atmospheric temperature in shade is 10⁰ c or less.

3.2 **Preparation of base** : The base on which the mix materials is to be laid shall be prepared shaped and conditioned to the specified , lines, grade and cross section in accordance with MORT&H Specification Clause 601 as directed by the Engineer-in-charge. The surface shall be thoroughly swept and scraped clean and free of dust and foreign matter.

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

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

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

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

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

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

3.5 Rolling : Immediately after the spreading of mix, it shall be thoroughly compacted by rolling with a set of vibratory rollers moving at a speed not exceed 5 km per hour. The initial or break-down rolling shall be with 80 to 100 KN vibrating road rollers and the surface finished by final rolling with 8-10 tonne tandem rollers or suitable pneumatic rollers.

The roller wheels shall be kept damp to prevent the mix adhering to them but in no case shall fuel lubricating oil be used for this purpose. Rolling shall commence longitudinally from the edge and progress towards the centre except that at super elevated portions, it shall progress from the lower to upper edges parallel to the centre line of the pavement. The roller should proceed on the fresh material with rear or fixed wheel leading so as to minimize the pushing of the mix shall continue until the entire surface has been rolled to compaction and all the roller marks eliminated.

OPENING TO TRAFFIC

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

SURFACE FINISH AND QUALITY CONTROL OF WORK

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

ARRANGEMENT FOR TRAFFIC

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

MEASUREMENT FOR PAYMENT

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

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

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

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

8. RATE

The Contract unit rate for seal coat shall be for payment for carrying out the required operations including full compensation for all components listed in MOST Specification Clause 503.8

Item No 10 : Providing & fixing ordinary Kilometre stone of pre cast C.C. 1:2:4 including necessary reinforcement per I.R.C type design fixing in C.C. 1:2:4 including painting, lettering etc. complete.

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

1. Kilometre stone shall be of approved quality and precast 1:2:4 R.C.C. as specified in the item.
2. The size, manner of fixing, painting and lettering of K.M. stone shall conform specification as per I.R.C. 8 (Type design for Highway kilometer stones) The fixing of K.M. stone shall be carried out in ordinary concrete of grade specified in the item using hand broken metal field metal or gravel. The measurement for payment shall be made per NO. of K.M. stone fixed in position.
3. Unite rate for kilometer stone includes the cost of all materials, labour tools, fixing, finishing curing lettering and painting as directed by the Engineer-in-charge.

ITEM NO. 11 : 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 shall be carried out as per the specification item of ordinary kilometer stone (item No. 12 except that the size of kilometer stone shall be smaller than that of ordinary kilometer stone as per I.R.C. 26 (Type design for 200 metre stones) and fixing shall be in ordinary concrete specified in the item. The measurement for payment as well as the operation in the unit rate shall be as per ordinary kilometers stones.

Fixing shall be in C.C.1:5:10 which will consist of one part of cement, five part of good sand and ten parts of good brick bats. The measurement for payment as well as the operations included in the unit rate shall be as per ordinary kilometers stone. Rate includes all labour and curing etc. necessary for concrete.

The Payment shall be made on No. basis for complete item.

ITEM NO. 12 : Providing and fixing indicator stone of approved stone as per I.R.C. type design in C.C. 1:4:8 including white washing etc. complete.(ii) Fixing in C.C. 1:5:10

1. Indicator shall be of approved quality and of the size 20 cm x20 cm its length shall not be less than 80 cms. The top 38 cm shall be chisel dressed on all sides. The size, shape and dimension of the indicator stone shall be exact and stones shall be neatly dressed and finished before fixing. The indicator stones shall be fixed firmly in position in embankment or cutting as the case may be. The exposed part of the indicator stones shall be given three coats of white wash. Any excavation necessary for fixing of the indicator stone shall be done by the contractor at his own cost. The measurement the payment shall be the number of indicator stone fixed in position.
2. Unit rate of indicator stone includes the cost of all materials, labours, tools, fixing & white washing as directed by the Engineer-in-charge.

The Payment shall be made on **No.** basis for complete item.

ITEM NO. 13 : 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

1. Guard stone shall be of approved quality and precast/ Cast in situ in 1:2:4 R.C.C. as specified in the item.
2. The size, manner of fixing, painting and lettering of Guard stone shall conform as per drawing and as directed by the Engineer-in-charge. The fixing of Guard stone shall be carried out in ordinary concrete of grade specified in the item using metal or gravel. The measurement for payment shall be made per No. of Guard stone fixed in position.
3. Unite rate for Guard stone includes the cost of all materials, labour tools, fixing, finishing curring lettering and painting as directed by the Engineer-in-charge.

ITEM NO. 14 : Cautionary Warning Sign :-Providing and fixing sing boards made out of 2mm aluminum 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 ;reflectorized with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm, 75 x 75 x 6mm 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 60 Cms. for each leg. including excavation, curing etc. complete under the supervision of engineer in charge.(B) High Intensity Grade.

Placement and Operation of Road Signs

Placement of road signs will be within road users' view. To aid in conveying proper meaning, road signs will be positioned with respect to the location or situation to which it applies. The location and legibility of the road sign will be such as to provide adequate response time to road users to read and take action at the operating speed.

Orientation of Signs

The signs will be placed at right angles to the line of travel of the approaching traffic. Where light reflection from the sign face is encountered to such an extent as to reduce legibility, the sign should be turned slightly away from the road. On horizontal curves, the sign should not be fixed normal to the carriageway but the angle of placement will be determined with regard to the course of the approaching traffic.

Sign faces will be normally vertical, but on gradients it may be desirable to tilt a sign forward or backward from the vertical to make it normal to the line of sight and improve the viewing angle.

1. Material for Signs

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

I. Reinforcing Steel

Reinforcing steel shall conform to the requirements of IS 1786 unless otherwise specified.

II. Bolts, Nuts and Washers

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

III. Plates and Supports

Plates and support sections for the signposts shall conform to IS 226 and IS 2062 or any other stated IS specification.

IV. Substrate

The substrate shall be either Aluminum sheeting or Aluminum Composite Material(ACM) conforming to following subsections.

a) Aluminum Sheet

Aluminum sheets used for sign boards shall be of smooth, hard and corrosion resistant aluminum alloy conforming to IS 736 - Material Designation 24345 or 1900.

b) Aluminum Composite Material (ACM)

ACM sheets used for sign boards is a sandwiched construction with a thermoplastic core of „Low Density Polyethylene“ (LDPE) between two thick skins/sheets of Aluminum with overall thickness of 4 mm and 3 mm, and Aluminum skin thickness of 0.4 - 0.5 mm and 0.25 - 0.3 mm respectively on both sides. The retro reflective sheeting must be applied on the top surface with aluminum surface with recommended surface preparation from sheeting manufacturer. A fluorocarbon coating may be applied over the exposed surface of aluminum to ensure corrosion resistant and weather ability and shall conform to relevant ASTM. The mechanical properties of 4mm and 3mm ACM and that of its Aluminum skin shall conform to the requirement given in Table 6.1, when tested in accordance with the test methods mentioned against each of them

b) Plate Thickness

Shoulder mounted ground signs with a maximum side dimension not exceeding 600 mm shall not be less than 1.5 mm thick with Aluminum and 3 mm thick with Aluminum Composite Material. All other signs shall be at least 2 mm thick with Aluminum and 4 mm thick with Aluminum Composite Material. The thickness of the sheet shall be related to the size of the sign and its support and shall be such that it does not bend or deform under prevailing wind and other loads. All overhead signs made with Aluminum Composite Material shall be minimum 4 mm thick to withstand wind and other loads without deformation.

Table: 6.1 Specifications for Aluminum Composite Material (ACM)

S.N	Description	Specification for 4mm		Specification for 3mm
		Standard test	Acceptable value	Acceptable value
A	Mechanical Properties of ACM			
1	Peel off strength with retro reflective sheeting. (Drum Peel Test)	ASTM D903	Min. 4 N/mm	Min. 4 N/mm
2	Tensile strength	ASTM E638	Min. 40 N/mm ²	Min. 30 N/mm ²
3	0.2% Proof Stress	ASTM E638	Min. 34 N/mm ²	Min. 34 N/mm ²
4	Elongation	ASTM E638	Min. 6 %	Min. 5 %
5	Flexural strength	ASTM C393	Min. 130 N/mm ²	Min. 120 N/mm ²
6	Shear strength with Punch shear test	ASTM D732	Min. 18 N/mm ²	Min. 18 N/mm ²
B	Properties of Aluminum Skin			
1	Tensile strength (Rm)	ASTM E8	Min. 150 N/mm ²	Min. 130 N/mm ²
2	Modulus of elasticity	ASTM E8	Min. 70,000 N/mm ²	Min. 70,000 N/mm ²
3	Elongation	ASTM E8	A ₅₀ Min. 2%	A ₅₀ Min. 2%
4	0.2 % Proof Stress	ASTM E8	Min. 110 N/mm ²	Min. 110 N/mm ²

V. Retro Reflective Sheeting

The retro reflective sheeting used on the signs shall consist of white or coloured sheeting having a smooth outer surface, which has the property of retro reflection over its entire surface. It shall be weather resistant and exhibit color fastness. It shall be new and unused and show no evidence of cracking, scaling, and pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate of having the sheeting tested for coefficient of retro reflection, daytime colour and luminance, shrinkage, flexibility, liner removal, adhesion, impact resistance, specular gloss and fungus resistance, 3 years outdoor weathering and its having passed these tests shall be obtained from International/Government laboratory/Institute by the manufacturer of the sheeting and in case the certificate is obtained from international agency, it should also be obtained from Indian agency within 3 years of launching of product by the manufacture in abroad. Alternatively, a certificate conforming to ASTM Specification (D 4956-09) on artificial accelerated weathering requirements from a reputed laboratory in India will be accepted. The supplier will have to

submit performance guarantee of meeting the requirement of three years outdoor weathering of the sheeting.

All micro prismatic grade sheets will be as per ASTM D 4956-09 Type IV. The reflective sheeting shall be made of micro prismatic retro-reflective material. The retro-reflective surface, after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro reflection (determined in accordance with ASTM D 4956-09), When totally wet, the sheeting shall show not less than 90 percent of the values, of retro-reflection indicated in Table 6.4. at the end of the 7 years, the sheeting shall retain at least 80 percent of its original retro-reflectance.

Table 6.4: Acceptable Minimum Coefficient of Retro-reflection for Type-IV Prismatic Grade Sheeting (Candelas per Lux per Square Metre)

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

Messages/borders: The message (legends, letters, numerals etc.) letter, numerals, symbols/legend/arrow etc. in Gujarati, Hindi and /or English, should be either be screen-printed or to be cut out from durable transparent Overlay Electrocutable film as per drawing and Technical Specifications for Road and Bridge works (Fifth Revision). The borders shall be either Screen printed or Cut out from durable transparent Overlay Electrocutable film and screen printing shall be processed and finished with materials and in a manner specified by the sheeting manufacturer. Cutouts shall be of materials as specified by the sheeting manufacturer and shall be bonded with the sheeting in the manner specified by the manufacturer. For screen-printed transparent coloured areas on white sheeting, the coefficient of retro-reflection shall not be less than 50 per cent of the values of corresponding colour in the above table. Whenever transparent overlay film is used for making any type of sign, the coloured portion of sign shall have coefficient of reflectivity not less than the reflectivity of type and colour of sheeting normally used, as given in the above table 6.4.

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

2. Fabrication:

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

with grease, oil or other contaminants prior to the application of retro-reflective sheeting. Complete sheets of the material shall be used on the signs except where it is unavoidable. At splices, sheeting with pressure-sensitive adhesives shall be overlapped not less than 5 mm. Where screen printing with transparent colours is proposed, only butt joint shall be used. The material shall cover the sign surface evenly and shall be free from twists, cracks and folds. Cut-outs to produce legends and borders shall be bonded with the sheeting in the manner specified by the manufacturer.

3. Warranty and durability: The Contractor shall obtain from the manufacture a seven-year warranty for satisfactory field performance including stipulated retroreflectance of the retro-reflectance sheeting. And submit the same to the Engineer. The Contractor/supplier shall also furnish a certification that the signs and materials supplied against the assigned work meets all the stipulated requirements and carry the stipulated warranty. Processed and applied in accordance with recommended procedures, the reflective material shall be weather resistant and, following cleaning, shall show no appreciable discolouration, cracking, blistering or dimensional change and shall not have less than 50 per cent of the specified minimum reflective intensity values (Table 800-1 and 800-2) when subjected to accelerated weathering for 1000 hours, using type E or EH weatherometer (AASHTO Designation M 268).

4. Installation

4.1. Sign posts, their foundations and sign mountings shall be so constructed as to hold these in a proper and permanent position against the normal storm wind loads or displacement by vandalism. Normally, signs with an area 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 galvanized iron (G.I.). Post(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.

4.2. All components of sign and supports, other than the reflective portion and MS / 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.

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

4.4. Fixing:

1.1. Materials

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

1.1.1. Concrete: Concrete shall be of the M20 grade or as shown on the Contract drawings otherwise as directed by the Engineer.

1.1.2. Water: Water shall conform to IS: 456-1978. Storage & handling of water shall be clean.

1.1.3. Cement: Cement shall conform to IS: 269-1976 or I.S: 455-1976.

1.1.4. Sand, aggregates: Sand, aggregate & its gradation shall conform to M6, M12 & M13 of General Technical Specifications for Building Works..

1.2. Installation

1.2.1. The supporting structure and signs shall be fabricated and erected as per details given in the plans.

1.2.2. The work of construction of foundation for sign supports including excavation and backfill, forms, steel reinforcement, concrete and its placement shall conform to the relevant Specifications given in these Specifications.

1.2.3. Signs posts, their foundations and sign mountings shall be so constructed as to hold signs in a proper and permanent position to adequately resist swaying in the wind or displacement by vandalism.

1.2.4 After installation of sign is complete, the sign shall be inspected by the Engineer. If specular reflection is apparent on any sign, its positioning shall be adjusted by the Contractor to eliminate or minimize this condition.

5. Measurements for Payment

The measurement of standard cautionary, mandatory and information signs supplied and fixed, while for direction and place identification signs, these shall be measured in No. basis.

6. Rate

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

Item No 15 : 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 quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand postand frame fabricated from suitable sizeiron angle of 35 x 35 x 3mm 75x 75x 6mm 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.(B) High Intensity Grade.

The work shall be carried out as directed with relevant specifications of this tender Item No. 14
The contract rate shall be for a unit of One No. of completed item.

Item No 16 : Regulatory/Mandatory signs :Providing and fixing sing boards made out of 2mm aluminum 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; reflectorized with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm 75x75x6mm as required; painted with best quality epoxy coatings in black and white bends. the details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(B)High Intensity Grade

The work shall be carried out as directed with relevant specifications of this tender Item No. 14
The contract rate shall be for a unit of One No. of completed item.

Item No 17 : Direction sign (Junction board):-Providing and fixing sing boards made out of 2mm aluminum sheet; size 244 x 122cms. rectangle as as per the design of IRC-67- 1977 pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; Letters and numerals should be as per IRC-30-1968, 3.1m long (2 nos) stand post and frame fabricated from suitable size iron angle of 50 x 50 x 5mm 75x75x6mm as required; painted with best quality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(B)High Intensity Grade

The work shall be carried out as directed with relevant specifications of this tender Item No. 14
The contract rate shall be for a unit of One No. of completed item.

Item No 18 : Citizen' s information Board- Providing and fixing of typical MMGSY information board as per instruction. Two MS plates of 1.6 mm thick, of 900 mm x 750mm size fixed at top & bottom duly welded with MS angles of 25 x 25 x 5 mm thick M.S plate shall be welded by two vertical M.S flats & four horizontal M.S flats 5 mm thick to 75 mm x 75 mm of 12 SWG square tubes posts duly embedded in cement concrete M-15 grade blocks of 600mm x 600mm x 75mm, below ground level. Painting New letters & figure of any shade with ready mixed synthetic enample paint of superior quality in required shade and colour, All sections of framed posts and steel tube will be painted with primer and two coats of epoxy paints as per drawing Clause 1701 and Annexure 1700.1 (10.16).

The work shall be carried out as directed with relevant specifications of this tender Item No. 14
The contract rate shall be for a unit of One No. of completed item.

Item No 19 : 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 1700.1.3. The top most plate will be of 3mm ACP in diamond shape of 600x600mm size, riveted with MS angle iron frame of 25mmx25mmx5mm size on back on edges. The Lower plate will be of 4mm ACP of 1100x300mm size riveted with MS angle iron frame of 25mmx25mmx5mm size on back on edges. Riveting of all the sheets over angle and flat iron frame will be done neatly to have plain surface on one side. The angle iron frame of Both the plates will be welded to a 75mm

x75mmx6mm Mild steel post at Centre and this post will be embedded in cement concrete M15 grade block of 450x450x600mm below ground level. The height of the bottom of the lower plate will be 1200mm from normal ground level. The spacing between the diamond shaped plate and Lower Plate is kept 150mm. MMGSY logo, letters and numerals on the ACM should be made up of Retro Reflective sheeting of Type-1 AEGP Class-A grade as per the latest MORD section 1700 and IRC 67-2012 specifications. All the section of the frame and posts shall be painted with primer and two coats of epoxy paint. The design, painting and lettering shall be done as per the MMGSY Logo sign Design and as directed by Engineer in-charge. A warranty for 5 years for the Retro reflective sheeting for Type-1 Class-A from original manufacturer shall be submitted by contractor.

The work shall be carried out as directed with relevant specifications of this tender Item No. 14

The contract rate shall be for a unit of One No. of completed item.

Item No 20 : MMGSY Project Information Board: Providing and fixing of typical PMGSY Project informatory sign board with Logo as per 1700 of MORD specifications and drawing. The board will be a composite unit consisting of Three Plates ACM (Aluminum Composite Material), material specifications as per clause 17001.3. The top most plate will be of 3mm ACM in diamond shape of 600x600mm size, riveted with MS angle iron frame of 25mmx25mmx5mm size on back on edges. The middle 4mm ACM plate will be 1200x150mm size riveted with MS angle iron frame of 25mmx25mmx5mm size on back on edges. The main 4mm ACM lower most plate will be 1500mmx600mm size, riveted with MS angle iron frame of 25mmx25mmx5mm size. Riveting of all the sheets over angle and flat iron frame will be done neatly to have plain surface on one side. The angle iron frame of lower most plate and flat iron frame of the middle plate will be welded to two nos. 75mm x75mm (12 SWG) sheet tubes posts placed at 1125mm apart centre to centre. the top of the middle plate will be flushed with the top of 75mm dia medium steel tube posts and these posts will be embedded in cement concrete M15 grade block of 450x450x600mm below ground level. The height of the bottom of the lower plate will be 1200mm from normal ground level and the bottom of the middle plate will be 100mm above the top level of the lower most plate. the diamond shaped plate mounted over flat angle iron frame will be connected to middle plate by square steel section of 47mmx47mm, thickness 12SWG having a spacing of 100mm between the diamond shaped plate and middle plate and this square section will be riveted to the bottom point of the diamond shaped plate. MMGSY logo, letters and numerals on the ACM should be made up of Retro Reflective sheeting of Type-1 AEGP Class-A grade as per the latest MORD section 1700 and IRC 67-2012 specifications. All the section of the frame and posts shall be painted with primer and two coats of epoxy paint. The design, painting and lettering shall be done as per the MMGSY Signage Guide and as directed by Engineer-In-charge. . A warranty for 5 years for the Retro reflective sheeting for Class-A respectively, from original manufacturer shall be submitted by contractor.

The work shall be carried out as directed with relevant specifications of this tender Item No. 14

The contract rate shall be for a unit of One No. of completed item.

ITEM NO. 21 : Excavation for foundation upto 1.5 m depth incl. Sorting out & stacking of useful material & disposing of the excavated stuff upto 50m. Lead. (B) Dense or hard soil.

1. Excavation for structures shall consist of the removal of material for the construction of foundations for bridges, culverts, retaining walls, headwalls, 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 include all necessary sheeting, shoring, bracing, draining and pumping and the removal of all logs, stumps, shrubs, and other deleterious matter and obstructions necessary for the foundations, trimming bottoms of excavations; back filling and clearing up the site and the disposal of all surplus material.
2. After the site has been cleared the limits of excavation shall be set out true to lines, curves, slopes, grades 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 in the opinion of the engineer-in-charge, they are required for the work.
3. Excavation shall be taken to the width of the lowest step of the footing. The contractor at his own expense shall 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 as shown on the drawings, unless the type of material 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, springs, rain or other reasons, the contractor shall take adequate measures 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 methods 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 shall be permitted during the placing of concrete or for any period of at least 24 hours thereafter, unless it 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 levelled 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 to 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. Backfilling 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 at the required location, within 100 metres lead.

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 within 100 metres 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 metres for each class of material encountered, limited to the dimension 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 not be measured and paid for separately.

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. Setting out and fixing bench marks and centre 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. Backfilling, Clearing up the site and disposal of all surplus material within all lifts and lead upto 100 metres;
6. All labour, materials, tools equipment, safeguards and incidentals necessary to complete the work to the specification.

14. Excavation shall be for ordinary soil such as vegetation or organic soil, turf, sand, silt, loam, clay, mud, 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, or other ordinary digging equipment. Removal of gravel or any other nodular material having diameter in any one direction not exceeding 75mm. 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.

The contract rate shall be for a unit of One Cum. of completed item.

Item No. 22 : Providing and filling in foundation with ordinary cement concrete M- 100 mix including formwork, vibrating, ramming and curing complete. (A) Foundation and plinth.

1. In case of ordinary concrete, mix is not required to be designed by preliminary tests and proportions of cement, fine aggregates and coarse aggregates are specified by value as given in table below for different four grade designated as ordinary M. 100; M. 150; M.200 and M.250.

2. In the designation of a concrete mix, letter 'M' refers to the mix and the number to the specified 28 days works cube compressive strength of that mix on 150 mm cubes, expressed in kg./cm.

3. The ordinary concrete mix shall generally be specified by volume. For cement which normally comes in bags and is used by weight, volume shall be worked out taking 50 kg. of cement as 0.035 cubic

metre in volume. While measuring aggregate by volume, shaking, ramming or hammering shall not be done

proportioning of sand be as per its dry volume. In case it is damp allowance for bulking shall be made as per IS:2386 (Part III)

4 Ingredients required for ordinary concrete containing one 50 kg. bag of cement for different proportions of mix shall be as given in Table below.

Generally 1:2 for fine aggregate to coarse aggregate by volume but to up limit of 1:1:5 and lower limit of 1:3	Grade of Mix by Volume	Total quantity of dry Aggregate by volume per 50 kg cement to be taken assume of individual volume of fine % coarse Aggregate maximum (1 cubic metre = 1000 Litre)	Proportions of fine aggregate to Coarse aggregate	Quantity of water per 50 kg of cement maximum
Ordinary M100	1:3:6	300	Generally 1:2 for fine aggregate to coarse aggregate by volume but to up limit of 1:1:5 and lower limit of 1:3	34
Ordinary M150	1:2:4	220		32
Ordinary M200	1:1:5:3	160		30
Ordinary M250	1:1:2	100		27

Note : The proportions of the aggregates shall be adjusted from upper limit of lower limit progressively as the 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 shall be 1:1 1/2, 1:2 and 1:3 for maximum size of aggregated 10mm. 20mm and 40 mm. respectively.

Note-2 A mix leaner than M. 100 (1 : 3 : 6) may be used for non - structural parts, if provided in the contract. In such case grading of aggregates shall be by volume. Other requirements for mixing, placing & curing shall be the same.

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

Sr. No	Item of construction	Maximum nominal size of coarse aggregate
i	R.C.C. well curb, R.C.C. well steining and R.C.C. piles.	40 mm
ii	P.C.C. well steining	63 mm
iii	Well cap of pile cap; solid type piers, abutments and wing-walls, their pier caps.	40 mm

iv	R.C.C. works in cross girders, deck slab, wearing coarse, kerb, light posts, blast walls approach slab etc., and hollow type piers, abutments, wing-walls and their pier caps.	20 mm.
v	R.C.C. bearings	20 mm
vi	For any other item of construction not covered by item (i) to (v) above	As specified on the drawing or as desired by the Engineer-in-charge in case it is not specified 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 5 mm. less than the minimum cover to the reinforcement whichever is the smaller.

6. Fine aggregate shall be clean, hard, coarse sand. It shall be free from dust and such other and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-charge shall not be used in the works.

8. Cement shall be stored above the ground level in perfectly dry and water tight sheds. Wherever bulk storage containers are used, their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months. The aggregate shall be stored in such a way as to prevent admixture of foreign materials. Different sizes of fine or coarse aggregate shall be stored in separate stock- piles sufficiently away from the each other to prevent intermixing the materials.

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

10. For all work concrete shall be mixed in a mechanical mixer which along with other accessories shall be kept in first call working condition and so maintained throughout the construction. Mixing shall be continued till materials are uniformly distributed and uniform colour of the entire 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 shall then be mixed thoroughly by turning over to get a mixture of uniform colour. Enough water shall then be added gradually through a rose can and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 per cent 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 be the Engineer-in-charge, the first batch of its constituent material takes places. All form work and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer-in-charge has been obtained.

14. If concreting is not started within 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-charge. Concerning being, it shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried in properly design to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to be the Engineer-in-charge, concrete shall be deposited in

horizontal layers to a compacted depth of not more than 0.45 metre when internal vibrators are used and not exceeding 0.30 metre in all other cases.

15. Unless otherwise agreed to by the Engineer-in-charge concrete shall not be dropped into place from a height exceeding 2 metre. When trunking or chutes are used they shall be kept clean and used in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept, clean thoroughly wet, and covered with a 13 mm. thick layer of mortar composed of cement and sand in the ratio as in the concrete mix itself. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before placing of the concrete surface with wire or bristle brushes, care being taken to avoid dislodgement of any particles 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 corners and close spots.

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

17. Immediately after compaction, concrete shall be protected against harmful effects of weather, including rain, raining water, shocks, vibration, traffic, rapid temperature changes, frost and driving out process. It shall be covered with wet sacking, hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set, and shall be kept continuously wet for a period of not less than

14 days from the date of placement. Masonry work over the foundation concrete may be started after 48 hours of its laying but the curing of concrete shall be continued for a minimum period of 14 days.

18. Form work shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Form work shall however be divided into following two distinct categories :-

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

(2) Scaffolding i.e. form-work required for supporting shuttering.

Forms for shuttering shall be constructed only in metal suitably lined. Forms for scaffolding shall be constructed of metal or timber. Both shuttering and scaffolding shall be of substantial rigid construction and shuttering shall be true to shape and dimensions shown on the drawings. All bolts and rivets shall be countersunk 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 as dry as consistency as is possible to use. Considerable pressure shall be supplied in filling and pointing to ensure thorough filling in all voids. Surfaces which have been pointed shall be kept moist for a period of twenty four hours. If rock pockets/honeycombs, in the opinion of the Engineer-in-charge are of such an extent or character as to affect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of the structure affected.

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

Sr. No	Type of work	Slumps	
		vibrator are used	vibrator are not used

i	Mass concrete in R.C.C. foundations, Footing and retaining	10 to 25 mm	80 mm
ii	Beams, slabs and columns simply reinforced	25 to 40 mm	100 to 120 mm
iii	Thin R.C.C. section or section with 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 then 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 metre, the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer-in-charge. Similar works tests shall be carried out whenever the quality and grading of materials is change irrespective of the quantity of concrete proud. The number of specimens may be suitable increased as deemed necessary by the Engineer-in-charge when procedure of 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 strength, provided the lowest value is not less than 85 per cent of the specifies strength.

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

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

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

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

31. The unit rate for concrete shall include the cost of all material, labour, tools and plan 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 show on the drawings and according to these specifications. The rate shall also include the cost of making/fixing and removing of all centres and forms required for the work.

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

Item No 23 : Supplying and fixing reinforced concrete heavy duty non pres-sure pipes with collars for culverts incl. Setting and joining the pipes in C.M. 1:2 watering & laying (two level or slope) of 900mm dia. NP3 pipe internal diametre of IS 458 / 1971.

1. The work 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 NP3 type conforming to the requirements of IS : 458 and shall be of dia as specified in the item. Each consignment of cement concrete pipes shall be inspected. If necessary and approved by the Engineer-in-charge, either at the place of manufacture or at the site before their incorporation in the work.

NP3, NP2, NP1 pipes are used R. C. C. pipes where testing of pipes. Where testing of pipes will not be feasible the contractors will have to produce a certificate from the manufacturers on company's letter head the given hereinafter form.

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

FORM OF CERTIFICATE FOR NP3, NP2, NP1 PIPES

We _____ manufacturer of R. C. C. pipes produce R.C.C. pipes as per the requirement of IS : 458 and also carry out the required test at our place. We have acquired equipments for carrying out test and are prepared to carrying out test 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 pipe shall be placed in position until the foundations have been approved by the Engineer- in-charge. Where two or more pipes are to be laid adjacent to each other, they shall be separated by a distance equal to at least half the diameter of the pipe subject to minimum of 450 mm. The laying of pipes on the prepared foundation shall start from the outlet and proceed towards the inlet and be completed to the specified lines and grades. The pipes shall be fitted and matched so that when laid in work they form a culvert with a smooth uniform invert. Any pipe found defective or damaged during laying be removed at the cost of contractor.

4. The pipes shall be jointed wither by collar joint or by flush joint. In the former case, the collars shall be of R.C.C. 150 to 200 mm wide and having the same strength as the pipes to be jointed. Caulking space shall be between 13 and 20 mm according to the diameter of the pipes. Caulking material shall be slightly wet mix of cement and sand in ratio of 1:2 rammed with causing irons. Before caulking the collar shall be so placed that its centre coincides with that of pipe and even annular space is left between the collar and the pipes. Flush joint may be shaped to form a self centring joint with a joining space 13 cm. wide. The joining space shall be

filled with cement mortar. 1 cement to 2 sand, mixed sufficiently dry to remain in position when forced with a trowel or rammer. Care shall be taken to fill all voids and excess mortar shall be removed. 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 joints shall be kept covered and damp for at least four days.

5. R.C.C. Pipes shall be measured along their centre between their inlet and outlet ends in linear meters

6. The rate for the pipe shall include the cost of pipe including loading, unloading, handling storing laying in position and joining complete.

The contract rate shall be for a unit of One **Rmt.** of completed item.

Item No 24 : Providing and filling in foundation with ordinary cement concrete M- 150 mix and providing necessary vertical pin headers including formwork, vibrating, ramming and curing complete.

The work shall be carried out as directed with relevant specifications of this tender Item No. 22

The contract rate shall be for a unit of One **Cum.** of completed item.

ITEM NO. 25 : Providing TMT Bar FE 500/500D 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 TMT 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 TMT/medium tensile steel or high strength deformed bars. They may be uncoated or coated 'with epoxy or with approved protective coatings.

2.2. TMT bars reinforcement for RCC work shall conform to IS 1786 FE-500/500D 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, oil scale or loose or thick rust at the time of placing

2.4. All steel shall be procured from 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 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 schedule 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 being 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 and slab construction, industrially produced polymer cover blocks of thickness equal to the specified cover shall be placed between the bars and formwork subject to satisfactory evidence that the polymer composition is not harmful to concrete and reinforcement. Cover blocks made of concrete may be permitted by the Engineer, provided they have the same strength and specification as those of the member.

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 $1 \frac{1}{4}$ 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 TMT 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: $CE = C + Mn + Cr + Mg + V + Ni + Cu \times 6.5$ 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 bent 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 facilitate 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 bend shall not be less than 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 spitting 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.

10.7. 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 nor 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.

10.8. 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

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.	40 mm	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 overlaps, separately for different diameters as actually used in the work. Where welding or coupling is resorted to, in place lap joints, such joints shall be measured for payment as equivalent length of overlap as per design requirement. From the length so measured, the weight of reinforcement shall be calculated in tones on the same basis of as per table given above even though steel is supplied to the contractor by the department on actual weight. Length shall include hooks at the ends. Wastage and annealed steel wire for binding shall not be measured and the cost of these items shall be deemed to be included in the rate for reinforcement.

11.3. The rate for reinforcement includes cost of steel binding wires, its carting from Department Store to work site with all leads and lifts (in case of it is supplied by department), cutting, bending, placing in position, binding and fixing in position as shown on the drawings and as directed. It shall also include all devices for keeping reinforcement in approved position, cost of joining as per approved method and all wastage and spacer bars.

11.4. The contract rate shall be for a unit of One **Kg.** of completed item.

ITEM NO. 26 : Providing and filling sand below R.C.C. raft in layers including ramming and watering complete.

- 1 The sand to be used for filling shall be coarse, granular, clean, free from dust and deleterious matters obtained from a source as approved by the Engineer-in-charge. Sand between return shall conform to I.S. : 383.
- 2 After the bottom plug has been laid and tested for leakage the level of its top shall be ascertained and recorded and the well shall be filled with sand under water in suitable layers not exceeding 30 cm. at a time and each layer well compacted by rodding to maximum density upto the level of the underside of the plug as per detailed drawing or as directed by the Engineer-in-charge.
- 3 Sand between returns and below raft foundations shall be filled in suitable layers not exceeding 30 cms. at a time and each layer shall be well compacted.
- 4 Mode of measurement shall be the total cubical content (in **cubic meter**) of the area covered by sand filling.

ITEM NO. 27 : Providing and laying weep holes in abutments and return by using PVC pipes of 100 mm. diameter including laying in proper grade and jointing etc.complete as per detailed drawings.

Weep holes of 100 mm internal diameter may be provided at 1.0 metre centre to centre in horizontal & vertical direction 100 mm diameter. P. V. C. pipe shall be provided for full width of abutment & return. The pipe shall be provided with slope of 1 vertical to 20 horizontal towards draining face. (slope 1 IN 20) Gigrating shall be provided on P. V. C. pipe on inner face of Abutment & Return.

The bottom row of weep holes may be provided just 15 centimetres above the ground level or low water level, whichever is higher.

Measurment for payment shall be per **number** of weep holes provided.

Unit rate includes the cost of materials labour, tools, cutting, fixing to complete the work.

The rate shall be inclusive of royalties & all taxes & tool tax.

ITEM NO. 28 : White washing with lime on wall surface (two coats) to give an even shade including thoroughly booming the surface to remove all dirt, dust; mortar drops and other foreign matter.

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 sides to protect it against rain, moisture, weather and extraneous materials mixing with it. All lime that has been damaged in any ways shall be rejected and all rejected materials shall be removed from site of work.
2. **Workmanship :** The tat lime shall be slaked at site and shall be mixed and stirred with about five liters of water and 1 Kg of unslaked 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 full 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 dries. 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. meters. Deduction for pipe openings shall be made fully both sides of openings. 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**.

The contract rate shall be for a unit of One **Sq. meter**. of completed item.

Item No 29 : Dismantling the existing structure including removing & stacking the dismantled materials as and where directed.

1. The work shall consist of removing as here in after set forth, exiting, culverts, bridges pavement kebrs and other structures like guards rails, fences, utility poles, manholes, catch basins, intels, etc. which are n place but interfere with the new construction or are not suitable to ermain in place and of as eging and disposing of the resulting materials and back filling the resulting trenches and pits.

2. Existing culverts, bridge, pavements and other structures which are within the highway and which are designated to be removed, shall be removed up to limits and extent specification in the drawing or as indicated by the Engineer-in-charges.
3. Dismantling and removal operations shall be carried out with such equipment and in such a manner as to leave undisturbed, adjacent pavement, structures and other work to be left intact.
4. All operations necessary for the removal of any existing structure which might endanger new construction shall be completed prior to the start of new work.
5. The structures shall be dismantled carefully and the resulting materials so removed as not to cause any damage to the serviceable materials to be salvaged the part of the structure to be retained and any other properties of structures nearby.
6. Unless otherwise specified the superstructure portion of culverts/ bridges shall be entirely removed and other parts removed to below the ground level of as necessary depending upon the interference they cause to the new construction. Removal of overlying of adjacent material if required in connection with the dismantling of the structures shall be incidental to this item.
7. Where existing culverts/ bridges are to be extended or otherwise incorporated in the new work only such part or parts of the existing structure shall be removed as are necessary to proper connection to the new work. The connecting edges shall be cut, chipped and trimmed to the required lines and grades without weakening or damaged any part of the structure to be retained. Reinforcing bars which are to be left in place so as to project into new work as dowels or ties shall not be injured during removal of concrete.
8. Pipe culverts shall be carefully removed in such a manner as to avoid damage to the pipes.
9. Steel structure shall unless otherwise provided be carefully dismantled in such a manner as to avoid damage to members thereof. If specified in the drawing or directed by the Engineer-in-charges that structure is to be removed in a condition suitable for re-erection all members shall be match marked by the contractor with white lead painted before dismantling. End pins, nuts, bolts, plates, etc shall be painted with a mixture of white lead tallow and loose parts shall be securely wired to adjacent members or packed in boxes.
10. Timber structures shall be removed in such a manner as to avoid damages to such timber or lumber as is designated by the Engineer-in-charges to be salvaged.
11. In removing pavements, kerbs, gutters and other Structure like guards rails, fences, manholes, catch basins inlets etc. where portions of the existing construction are to be left in the finished work, the same shall be removed to an existing joint or cut and chipped to a true line with a face perpendicular to the surface of the existing structure. Sufficient removed shall be made to provide for proper grades and connections with the new work as directed by the Engineer-in-charges.
12. All concrete pavement base course in carriage way and shoulder etc designated for removed shall be broken to pieces whose volumes shall not exceed 0.02 cubic metre and stockpiled designated locations if the materials is to be used later or otherwise arranged for disposal as directed.
13. Where directed by the Engineer-in-charge holes and depressions caused by dismantling operations shall be backfilled with excavated at designated locations if the material is to be used later or otherwise arranged for disposal as directed.
15. All materials obtained by dismantling shall be the property of Government. Unless otherwise specified, materials having any salvage value shall be placed in neat stacks of like materials within the right-of-way as directed by the Engineer-in-charge for which contractor will remain responsible for its safe custody and preservation for 60 days after recording measurements of the salvaged materials.
16. Structure steel removed from old structure shall unless otherwise specified or directed be stored in a neat and presentable manner on blocking in location suitable for loading,

structures or portions there of which are specified in the contract for re-erections shall be stored in separate piles.

17. Timber or lumber from old structures which is designated by the Engineer-in-charge as materials to be salvaged shall have all nuts and bolts removed from and shall be stored in neat piles in locations suitable for loading.
18. All the products of dismantling operations which in the opening of the Engineer-in-charges cannot be used or auctioned shall be disposed as directed, within 100 metres,
19. The work of dismantling structure shall be paid for in **Nos** (Lump) basis
20. The contract unit rates for the various items for dismantling shall be payment iii full for carrying out the required operations including full compensation for all labor, materials tools equipment safeguard and incidentals necessary to complete the work. These will also include excavation and backfilling where necessary and for handling, salvaging, piling and disposing of the dismantled materials all lifts and up to a lead of 100 metres.

Item No 30 : Providing & casting in situ Controlled cement concrete M - 250 for Cement Concrete Road laid as directed including tamping, vibrating, finishing, curing, and filling in joints with bitumen complete.

1. For controlled concrete, design of the mix shall be approved after preliminary tests and all necessary precautions shall be taken in its production to ensure that the required works cube strength is attained and maintained. The controlled concrete shall be in eight grades designated as M. 100, M. 150, M. 200, M. 250, M. 300, M. 350, M. 400 and M. 450. with the suffix 'Controlled' added to it.
2. In the designation of a concrete mix, letter 'M' refers to the mix and the number to the specified 28 days works cube compressive strength of that mix on 150 mm. cubes, expressed in kg/cm^2 where ordinary Portland cement conforming to IS : 269 or Portland blast furnace cement conforming IS : 455 is used, the compressive strength requirements for various grades of concrete shall be as given below on the next page :-

Grade of Concrete	Compressive works test strength in kg/cm^2 on 150 mm. cubes, conducted in accordance with IS : 516	
	Min at 7 days	Min. at 28 days.
M 100	70	100
M 150	100	150
M 200	135	200
M 250	170	250
M 300	200	300
M 350	235	350
M 400	270	400
M 450	300	450

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

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

3. Concrete mix shall be designed on the basis of preliminary tests so as to attain a strength at least 33 per cent higher than required on work tests. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work in question and can be properly compacted with the means available. Except where it can be shown to the satisfaction of the engineer-in-charge that supply of properly graded aggregate of uniform quality can be maintained till the completion of work, grading of aggregate should be controlled by obtaining the coarse aggregates in different sizes and blending them in the right proportions as required. Aggregates of different sizes shall be stocked in separate stock piles. Required quantity of material shall be stock piled several hours, preferably a day, before use. Grading of coarse and fine aggregate shall be checked as frequently as possible, frequency for a given job being determined by the Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the preliminary tests.

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

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

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

Sr. No	Item of construction	Maximum nominal size of coarse aggregate
i	R.C.C. well curb, R.C.C. well steining and R.C.C. piles.	40 mm
ii	P.C.C. well steining	63 mm
iii	Well cap of pile cap; solid type piers, abutments and wing-walls, their pier caps.	40 mm
iv	R.C.C. works in cross girders, deck slab, wearing course, kerb, light posts, blast walls approach slab etc., and hollow type piers, abutments, wing-walls and their pier caps.	20 mm.
v	R.C.C. bearings	20 mm

vi	For any other item of construction not covered by item (i) to (v) above	As specified on the drawing or as desired by the Engineer-in-charge in case it is not specified on drawing.
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For heavily reinforced concrete members as in the case of ribs of main beams, nominal maximum size of aggregate shall usually be restricted to 5 mm. less than the minimum lateral clear distance between the main bars or 5 mm. less than the minimum cover to the reinforcement, whichever is the smaller.

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

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

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

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

11. 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 constructing. 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 then mixing be done for less than 2 minutes after all ingredients have been put into the mixer.

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 be the Engineer-in-charge, the first batch of concrete from the mixer shall contain only two thirds of normal quantity of coarse aggregate. Mixing plant shall be thoroughly cleaned before changing from one type of cement to another.

13. The method of transporting and placing concrete shall be approved by the Engineer-in-charge. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes place. All form work and reinforcement contained in 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 within 24 hours of the approval being given. It shall have to be obtained again form the Engineer-in-charge. Concerting then shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been is 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 form the mixer unless carried in properly design agitators, operating continuously when this time shall be within 3 hours of the addition of cement to the mix an within 30 minutes of its discharge from the agitator. Except where otherwise agreed to be the Engineer-in-charge.

Concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 metre when internal vibrators are used not exceeding 0.30 metre in all other cases.

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

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

17. Immediately after compaction, concrete shall protected against harmful effects of weather including rain, running water, shocks, vibration, traffic, rapid temperature changes, frost and drying out process. It shall be covered with we sacking, hessian or other similar absorbent material approved by the Engineer-in- charge soon after the initial set, and shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonary work over the foundation concrete may be started after 48 hours of its laying but the curing of concrete shall be continued for a minimum period of 14 days.

18. Form work shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Formwork shall however be divided into following two distinct 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 b constructed of metal of timber. Both shuttering and scaffolding shall be substantial rigid construction of shuttering shall be true to shape and dimensions show on the drawings. All bolts and reverts shall be counter-sunk and well ground to provide a smooth, plane surface.

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

20. The inside surface of shuttering shall, except in the case of permanent form work or where otherwise agreed to be the Engineer-in-charge, be coated with an approved material to prevent adhesion of concrete to the form work. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not be allowed to come into contact with any

reinforcement or prestressing tendons and anchorages. Different release agent shall not be used in form work for concrete which will be visible in the finished works.

21. Special measures shall be taken to ensure that the form work does not hinder the shrinkage of concrete because without these cracking could occur before the form works removed. Where applicable arrangement must be made to ensure that the form work does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons. The formwork should take due account of the calculated amount of positive or negative camber so as to ensure the correct final shape of the structure having regard to the deformation of false work, scaffolding or propping and the instantaneous or deferred deformation due to various causes affecting prestressed structures. Where they are re-entrant angles in the concrete sections the form work should be removed at these sections as soon as possible after the concrete has set in order to avoid cracking due to shrinkage of concrete. Form work shall be tight enough to prevent any appreciable loss of cement during vibrations. Suitable tolerance should be provided in the formwork. Immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the Engineer-in-charge due notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength, alignment and general fitness, but such inspection shall not relieve the contractor of his responsibility for safety of men, machinery, materials and for results obtained.

22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any formwork. While fixing the time for removal of formwork, due consideration shall be given to local conditions that influence the setting of concrete and of concrete and of the materials used in the mix. Where field operations are controlled by strength tests of concrete the removal of the load supporting of sffit forms may commence when concrete has attained strengthening props including the effect of any further additional of loads. When field operations are not controlled by strength tests of concrete the vertical forms of beams, columns and walls may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 days respectively. All formwork shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly and gradually. Where internal metal ties are permitted, they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to 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 to a depth of atleast 25 mm. below the surface of the concrete and the resulting holes be filled by cement mortar. All fins caused by form joints, all cavities produced by the removal of form ties and all other holes and depressions, honeycomb spots, broken edges or corners and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregated 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 through filling in all voids. Surfaces which have been pointed shall be kept moist for a period of twenty four hours. If rock pockets/honey-combs, in the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of the structure affected.

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

Sr. No	Type of work	Slumps	
		vibrator are used	vibrator are not used

i	Mass concrete in R.C.C. foundations, Footing and retaining	10 to 25 mm	80 mm
ii	Beams, slabs and columns simply reinforced	25 to 40 mm	100 to 120 mm
iii	Thin R.C.C. section or section with congested steel	40 to 50 mm	125 to 150 mm

25. For controlled concrete preliminary tests shall consist of three sets of separate tests, and in each set, tests shall be conducted on six specimens. Not more than one set of six specimens shall be made on any particular day. Of the six specimen in each set, three shall be tested at seven days and the remaining three at

28 days. The preliminary tests at 27 days are intended only to indicate the strength likely to be attained at 28 days. The preliminary tests at 27 days are intended only to indicate the strength likely to be attained at 28 days. Work strength tests shall be made in accordance with IS : 516. Each test shall be conducted on ten specimens five of which shall be tested at seven days and the remaining five at 28 days. The samples of concrete shall be taken on each day of concreting and cubes shall be made at the rate of one for every 5 cubic metre of concrete of a part thereof. However, if concreting done in a day is less than 15 cubic metre, the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer-in-charge. Similar works tests shall be carried out whenever the quality and grading of materials is changed irrespective of the quantity of concrete poured. The number of specimens may be suitably reduced in case of a poor quality of concrete and in other special cases.

26. The average strength of the group of cubes cast for each day shall not be less than the specified works cube strength. 20 per cent of the cubes cast each day may have values less than the specified strength, provided the lowest value is not less than 85 per cent of the specified strength.

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

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

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

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

31. 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 centres and forms required for the work.

ITEM NO. 31 : Compaction and finishing of cement concrete road by trimix process providing extra labour charges for the trimix vacuum dewatering service process on cement concrete road surface by using vacuum dewatering pump floater surface vibrator including making rough finish to surface as per in including levelling the complete.

Tremix Process :-

Surplus water from the concrete is removed immediately after placing and vibration, reducing the water : cement ratio to an optimum level. This is done using the Vacuum Equipment comprising of Suction Mat Top Cover, Filter pads and Vacuum Pump. The process starts immediately after surface vibration

Filter pads are placed on the fresh concrete leaving about 4 inches of fresh concrete exposed on all sides. The Top Cover is then placed on the filter pads and rolled out till it covers the strips of exposed concrete on all sides. The Top Cover is then connected to the vacuum pump through a suction hose and the pump is started Vacuum is immediately created between the filter pads and the top cover. A tmospheric pressure compresses the concrete and the surplus water is squeezed out. This process lowers the water content in the concrete by 15-25 % The dewatering operation takes approx. 1.5 - 2 minutes per centimeter thickness of the floor. The dewatered concrete is compacted and dried to such an extent that it is possible to walk on it without leaving any foot prints. This is the indication of concrete being properly dewatered and ready for finishing. The finishing operations - Floating & Trowelling take place right after dewatering. Floating operation is done with Floating disc. This ensures after mixing of sand & cement particles, further compaction and closing the pores on the surface. Floating operation generates skid-free finish. Trowelling is done with Trowelling blades in order to further improve the wear resistance, minimize dusting and obtain smoother finish. Repeated passes with disc and blades improve the wear resistance substantially.

The Payment shall be made on **square meters** basis for complete item.

ITEM NO. 32 : Demolation & disposal of unserviceable materials with all lead & lift. (ii) Un- reinforced cement concrete.

The work shall be carried out as directed with relevant specifications of this tender Item No. 29.

The contract rate shall be for a unit of One **No.** of completed item.

ITEM NO. 33 : Excavation for foundation in sand, Gravel, Clay, Soft soil and Murrum etc., including shorting, strutting and dewatering as necessary and disposing of the excavated stuff as directed.

The work shall be carried out as directed with relevant specifications of this tender Item No. 21.

The contract rate shall be for a unit of One **Cum.** of completed item.

ITEM NO. 34 : Providing and casting in-situ controlled cement concrete M-250 for RCC raft and cut off walls including shuttering, laying, vibrating, ramming, and curing complete.

The work shall be carried out as directed with relevant specifications of this tender Item No. 30.

The contract rate shall be for a unit of One **Cum.** of completed item.

ITEM NO. 35 : Providing and casting in situ controlled cement concrete M - 300 for R.C.C. solid slab including centering, scaffolding, curing & finishing comp..(including Apoxy Painting of Exterior Surface)

The work shall be carried out as directed with relevant specifications of this tender Item No. 30.

The contract rate shall be for a unit of One **Cum.** of completed item.

ITEM NO. 36 : Providing and casting in-situ controlled cement concrete M-300 for average 75mm thick wearing cost laid as directed including tamping, vibrating finishing curing and complete.

The work shall be carried out as directed with relevant specifications of this tender Item No. 30.

The contract rate shall be for a unit of One **Cum.** of completed item.

ITEM NO. 37 : Providing and casting in-situ controlled cement concrete M-250 for kerb/kerb blocks including formwork, curing and finishing complete.

The work shall be carried out as directed with relevant specifications of this tender Item No. 30.

The contract rate shall be for a unit of One **Cum.** of completed item.

ITEM NO. 38 : Providing and casting in-situ controlled cement concrete M-300 for approach slab including formwork curing and finishing complete.

The work shall be carried out as directed with relevant specifications of this tender Item No. 30.

The contract rate shall be for a unit of One **Cum.** of completed item.

ITEM NO. 39 : Providing and placing in position FE 500/500D bar reinforcement for following items including cutting bending hooking and tying complete as per detailed drawing.

The work shall be carried out as directed with relevant specifications of this tender Item No. 25.

The contract rate shall be for a unit of One M.T. of completed item.

ITEM NO. 40 : Providing and fixing post and pipe railing as per detailed drawing including 3 coats of painting to steel works complete.

1. G. I. pipes shall be of light duty type. Concrete shall conform to relevant specifications of item of concrete of ordinary grade specified in the item. For structural steel relevant specifications of item of steel cutting edge and for mild steel, relevant specifications of item of M. S. reinforcement shall apply.

2. The pipe railing shall consist of R. C. C. posts of required dimensions as approved by the Engineer-in-charge or structural steel section as shown on the drawings. The structural section shall be anchored to R. C. C. in the manner as directed by the Engineer-in-charge. Three rows of G. I. pipe, of 40 mm. diameter shall be provided. Holes of required size shall be made in the posts and the pipe shall be fixed with necessary couplings and three coats of enamel paint shall be applied to iron work (first coat shall be of red lead). If R. C. C. posts are used, they shall be applied 2 coats of white wash. The posts shall be fixed at 2 m. to 2.5 m. centre to centre depending upon the span-length.

3. Railing shall be measured in **running meters**.

4. Unit rate includes cost of all materials, labour, tools and plant to complete the job.

ITEM NO. 41 : Providing P.V.C. 100 mm diameter water spouts including necessary iron gratings as per drawings.

1. Material for the water spout shall be as mentioned in the item and shall be got approved from the Engineer-in-charge.

2. Water spout shall be 100 mm. internal dia. PVC. pipe shall be provided at the entry and shall be fixed in the recess so as to be flush with the road surface. The quality and size of the grating

shall be got approved from the Engineer-in-charge. The water spouts shall project at-least 10 cm. outside the concrete and shall be rigidly fixed in it. The grating and PVC. pipe shall be painted with two coats of anticorrosive black bitumen paint.

3. Measurement shall be per **number** of water spout fixed.

4. Unit rate includes cost of all materials, labour and tools to complete the work.

ITEM NO 42 : Providing and fixing in position 12 mm thick permoulded joint filler in expansion joint for fixed ends of simply supported span, covered with sealant complete as per drawing and technical specifications.

- 1 Open joints shall be constructed at the locations as directed by the Engineer-in-charge using a wood strip, metal plate, other suitable material which is subsequently removed. When removing the material, care shall be exercised to avoid chipping or breaking the corners of the concrete. The edge of the concrete at the joints shall be edge finished. Reinforcement shall not extend across as open joint.
- 2 When performed filler is to be provided the filler shall be placed in correct position before concrete is placed against the filler. The filler material shall form part of the joining and while concreting the slab, care shall be taken to prevent the former from being displaced. After the work is completed, the exposed face of the joint shall be cleaned of all loose material sticking to it.
- 3 The material used for filling expansion joint shall be bitumen impregnated felt which shall conform to the requirements of IS : 1838, and shall be got approved from the Engineer-in-charge. The joint shall consist of large pieces or an assembly of small pieces to make up the required size shall be avoided.
- 4 The expansion joint shall be measured in **square meters**. Thickness of the expansion joint will be 20 to 25 mm. Width of the expansion joint shall be equal to full depth of the slab.
- 5 The rate shall include the cost of all materials, labour, equipments and other incidental charges for fixing the joints complete in all respect as per these specifications and as shown on the drawings.

ITEM NO. 43 : Providing and laying rubble for apron (each stone weighing not less than 40 Kg.) including packing & filling in the interestices with quarry spall.

- 1.0 The work shall consist of laying boulders directly on the prepared surface for protection against scour.
- 2.0 The stones unused in apron shall be sound, haiti, durable & fairly regularly in shape. Stone subject to marked deterioration by water or weather shall not be used. The thickness and shape of apron shall be as indicated on the drawings or as directed by the Engineer-in-charge. The surface on which the apron is to be laid shall be leveled and prepared for the length and width as shown on the drawings. The size of stone shall be as possible & weight shall be as specified in the item but in no case any fragment shall weight less than 40 kg. The specific gravity of stone shall be as high as possible and it shall not be less than 2.50 To ensure regular and orderly disposition of the full intended quantity of stone in the apron, template cross walls in dry masonry shall be built about a meter wide and to the full height of the specified thickness of the apron at intervals of 30 meters and all along the length and width of the apron. Within these walls, the stone then shall be hand- packed.
- 3.0 Payment shall be made on **CMT** basis of chatta. The materials shall have to be stacked at site before laying. Preparation of base or laying bedding shall be deemed incidental to the work nothing shall deducted for voids. The rate shall include cost of materials, labour & tools to complete the job.

ITEM NO. 44 : Providing & laying filter media 600 mm thick as directed at the back of abutments and returns and wing wall as per detailed specification.

1 Well graded pebbled or metal of 40 mm. to 63 ,mm. size shall be used. The grading and tolerances of metal of pebbles shall be as under :-

Sr. No.	No. of Size Range	Sieve designatio	Percentage by weight passing through the sieve
1	63 mm. to 40 mm.	90 mm.	100-00
		63 mm.	90-100
		53 mm.	25-75
		45 mm.	00-15
		22.4 mm.	00-05

The size shall be 40 mm. to 63 mm. where in tolerance limit for over size shall be upto 15% and that for lower size should be upto 15% and below 20 mm. It shall be allowable upto 50%. The filter material shall be tightly placed to a thickness of not less that 600 mm. and provided over the entire surface behind abutments, wings or return walls to the full height.

2 Materials shall be first stacked in boxed of 2m X 1.1/s m. X 0.5 m. size on fairly level ground and measured.

3 The measurement for payment shall be made on **Sq. meter** basis.

4 The unit rate includes the cost of materials, scaffolding labour and tools to complete the work.

ITEM NO. 45 : Providing Diversion may be necessary for traffic and maintaining the same for the period as may be necessary as directed by engineer in charge.

- 1 The item provides for the diversion of traffic by suitable means such as by constructing earthwork , & M.C. Metal as may be necessary and approved by Engineer-in-charge. The contractor shall take all necessary protective measures against possible erosion due to tide variations if any and maintain the diversion in proper manner during construction. He shall not be entitled for any payment or compensation in the event of washing of the at any time, either due to tidal waters if any or floods, or any other reasons what ever, and the contractor shall reconstruct the same. If required at his risk and cost. The size of the diversion shall be such as allow without obstruction and inconvenience, enough working free space all around the traffic & works.
- 2 The contractor shall construct and maintain satisfactorily necessary diversion works so as to safely pass the traffic and also satisfactory meet with any sudden rise of flow due to tides, flood or any other reason, without damaging the works.
- 3 The diversion shall be completely removed and their materials shall be disposed of in the manner as directed by the Engineer-in-charge when no longer required.
- 4 The measurements for paying will be in running metres is required to be made at site & instruction by Engineer-in-charge
- 5 The unit cost includes all materials labour and equipment to complete the job. Diversion will have to be construed and maintained till all operations to complete the entire works.

The contract rate shall be for a unit of One **No.** of completed item.

ITEM NO. 46 : Dismantling the existing structure including removing and stacking the dismantled materials as and where directed. (A) R.C.C. work.

The work shall be carried out as directed with relevant specifications of this tender Item No. 29.

The contract rate shall be for a unit of One **Cum.** of completed item.

Signature of Contractor

**Deputy Executive Engineer
Panchayat R&B Sub-Division
Modasa**

**Executive Engineer
Panchayat R & B Division
Modasa**