

TECHNICAL SPECIFICATIONS

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1.0 PREAMBLE:-

1.1 The Technical Specifications contained herein shall be read in conjunction with the other Bidding Documents as specified in this Volume.

1.2 Site Information:-

1.2.1 The information given here under provided elsewhere is given in good faith by the Employer but the Contractor shall satisfy himself regarding all aspects of site conditions and no claim will be entertained on the plea that the information supplied by the Employer is erroneous or insufficient.

2.0 GENERAL REQUIREMENTS:-

The technical specifications in accordance with which the entire work described herein after shall be constructed and completed by the Contractor shall comprise of the "SPECIFICATION"

2.1 Though "SPECIFICATION" for each item are attached with tender they are based on following.

(1) "SPECIFICATION FOR ROAD AND BRIDGE WORKS" (Fourth REVISION printed in year 2001) issued by the Ministry of Road Transport & Highways (MORT & H), Government of India and Published by the Indian Roads Congress, hereinafter to as MORT & H Specifications.

(2) The General Technical Specifications for Road works.

(3) The General Technical Specifications for Bridge works.

Note:- (2) To (3) are Conventional Specifications Booklets usually attached for (R&B) Works.

2.2 If, a particular clause (which is incorporated in "SPECIFICATION") of specification booklets (1) to (3) above is Amended / Modified/ Added upon then the Amendment/ Modification/Addition shall supersede the relevant clause incorporated in " SPECIFICATION"

2.3 In, so far as Amended / Modified / Added Clause may come in conflict or be inconsistent with any of the provisions of the MORT & H Specifications under reference, the Amended/Modified/ Added Clause and the additional specifications shall always prevail.

2.4 In the absence of any definite provisions on any particular issue in the aforesaid Specifications, reference may be made to the latest codes and specification, of IRC and BIS in that order. Where even these are silent, the construction and completion of the works shall conform to sound engineering practice as approved by the ' Engineer' and , in case of any dispute arising out of the interpretation of the above, the decision of the 'Engineer' shall be final and binding on the Contractor.

**Name of Work :- MMGSY 2025-26 (96-5054-04-796-02 Sr.No.12)
Construction Of Varoli Talat Bhavanpada Kishan Vajvadiya Maholla Main Road To
Bhavanpada School Towards Road (NP) km 0/0 To 1/000 Tal. Kaprada. Dist. Valsad**

ITEM WISE SPECIFICATION

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

201.1. Scope

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

201.2. Preservation of Property/Amenities

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

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

201-3. Methods, Tools and Equipments

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

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

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

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

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

201.4. Disposal of Materials

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

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

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

201.5. Measurements for Payment

Clearing and grubbing for road embankment, drains and cross-drainage structures shall be measured on area basis in terms of hectares. Clearing and grubbing of borrow areas shall be deemed to be a part of works preparatory to embankment construction and shall be deemed to have been included in the rates quoted for the embankment construction item and no separate payment shall be made for the same. Cutting of trees upto 900 mm in girth including removal of stumps and roots, and trimming of branches of trees extending above the roadway shall be considered incidental to the cleaning and grubbing operations. Removal of stumps left over after trees have been cut by any other agency shall also be considered incidental to the clearing and grubbing operations.

201.6. Rates

201.6.1. The Contract unit rates for the various items of clearing and grubbing shall be payment in full-for carrying out, the required operations including full compensation for all labour, materials, tools, equipment and incidentals necessary to complete the work. These will also include removal of stumps of trees less than 900 mm in girth as well as stumps left over after cutting of trees carried out by another agency, excavation and back-filling to required density, where necessary, and handling, salvaging, piling and disposing of the cleared materials with all lead and lifts.

Item No.2 Earth work in cutting in all coats of soil and soft murrum including conveying and putting the stuff in spoil bank maintaining minimum distance of five meter between top edge of cutting and top of spoil bank.

This work shall consist of Earth work in cutting in all sorts of soil and soft murrum etc. which may be necessary for road side gutter or road formation in accordance with requirements of these specifications and the lines, grades and cross sections shown in the drawings or as indicated by the Engineer.

1. The land width required for the roadway, gutter side slopes and catch water gutters shall be cleared of all trees having a girth of 30 cms. and less, loose, stones, vegetation, bushes, stumps and all other objectionable materials. The roots of trees and stumps shall be removed to a depth of 30 cms below the grade formation and slopes and excavation filled up with excavated materials and compacted. All the materials cleared will be the property of Government. Useful materials shall be arranged in convenient stacks along the road boundary or as directed at places within 50 mts. lead, and handed over to the department in convenient sections. Unsuitable material shall be burnt or otherwise disposed off by the contractor at his own cost without causing any nuisance, inconvenience or damage to the work, property or people in the neighborhood. If the materials are to be disposed off outside the road land, necessary permission from the private land owners shall be taken by the contractor and royalty etc. if any paid by him without claiming compensations. In all cases, the materials shall be disposed off in a neat manner.
2. After clearing the site, the land width required for the roadway, gutter side slopes and catch water gutters shall be cleared of all trees having a girth of 30 cms. and less, loose, stones, vegetation, bushes, stumps and all other objectionable materials. The roots of trees and stumps shall be removed to a depth of 30 cms below the grade formation and slopes and excavation filled up with excavated materials and compacted. All the materials cleared shall be properly set out true to lines, curves slopes, grades and sections as shown on the plans or directed by the Engineer-in-charge. The contractor shall provide all labour and materials such as lime, strings, pegs, nails, bamboos, stones mortar, concrete etc. required for setting out alignment establishing bench marks and giving profiles. The contractor shall be responsible for maintaining the B. Ms, profiles alignments and other stakes and marks as long as they are required for the work in the opinion of the Engineer. If the contractor defaults in this respect even after the direction by the Engineer within the specified time, they may be restored by the Engineer at the levels etc. If there is any disagreement the contractor shall inform of it in writing to the officer concerned with the specific reference to the sections before starting further work. Once the work has started, no cognizance of any complaint shall be taken. Merely not signing of the book shall not be deemed as disagreement.
3. Profiles of the section including the road side gutters to be excavated shall be laid at suitable intervals of 10m. to 50 m. or other intervals as directed by Engineer to conform to the curved or straight alignment, sections, grades and side slopes. The line out shall be clearly marked and profiles of embankments where excavated materials are to be used shall be set up with the toe line marked on each side. The road way section shall first be excavated with vertical side for each lift and the sides slopes for that lift shall be excavated in steps. These steps shall be smoothened to the required slope when the

excavation reaches the road formation. The contractor shall on no account excavate beyond the slopes or below the specified grade unless so directed by the Engineer in writing. If excavation is done below the specified level or outside the section, it shall not be paid for and the contractor shall be required to fill up at his own cost such extra excavation in the road portion, with approved materials of the embankment grade in layers, watered and fully compacted to attain maximum density laid down for the embankment in its relevant item. The Engineer may require measurement ridges and dead man to be left at specified intervals or places and kept intact till ordered to be removed for the purpose of check measurements. The excavation shall be finished neatly, smoothly, and evenly to the correct lines, curves, grades, if loose shall be scarified, watered and compacted to the same density as the embankment. The section, side slopes and catch water gutter shall be maintained by the contractor at his own cost in such a way that the formation and gutters will be drained by providing for necessary diversions etc, and not damaged due to obstruction of any drainage. Necessary passages shall be provided for leading away seepage, springs, surface flow or rainwater safely without damaging the work. If any damage occurs due to default of the contractor in this respect, he shall make good the damage at his own cost. If it is necessary in the execution of the work to interrupt existing surface drainage, irrigation channels, sewers or under drainage, temporary arrangements shall be provided till such time as is necessary. The contractor at his own cost shall make the existing works or work in hand caused as a result of his operations or negligence shall be made good by the contractor at his own cost. Road side gutters shall be excavated to the specified sections and shall be measured along with the main cutting in cubic meters.

4. If slides occur in the cutting they shall be removed as ordered by the Engineer. If finished slopes slide into the roadways before the final acceptance of the work, such slides shall be removed by the contractor and shall be paid for at the contract rate for the class of excavation involved provided the slides are not due to any negligence of the contractor. The classification of the material in slides shall conform to its conditions at the time of removal and payment made accordingly regardless of its prior condition. Care shall be taken to see that excavation is arranged in a safe way so that there will be no risk to the workmen by slides, falling materials, boulders and collapsing sides etc.
5. If there is traffic nearby or if there are towns and villages in the neighborhood, barricades and or traffic signals shall be provided day and night for the duration of the work in such a way as to prevent accidents. Warning signals shall be displayed at 7mt. from the danger point on both sides giving sufficient warning. If necessary, signalers shall be stationed at each end to regulate traffic where it is heavy. Measures shall be taken to see that the excavation does not affect or damage adjoining structures or property. If there is damage to property, injury to workers, the members of the public, animals etc., due to the negligence of the contractor, he will be responsible and liable to all the consequences including compensation.
6. All the excavated materials shall be property of Government. The useful excavated material shall be used in embankment with all lead and lift and it shall be directly deposited at the required location in specified layers. No handling or conveyance charges shall be paid if the material is temporarily deposited elsewhere and subsequently conveyed to site of deposition. The sequence of operations at convenient places shall be, without interfering with the drainage in any way. If no Government land

is available but the excavated useful stuff is to be stacked temporarily before use under the same agreement, the contractor shall make his own arrangements for the stacking of this material not required for use on embankment or unsuitable materials may be used on his own to uniformly widen embankment to flatten slopes and to fill low places in the road land, if so permitted by the Engineer. Material not required for any use whatsoever may be disposed off by the contractor at his own cost in a manner approved by the Engineer. The excavated material shall not be deposited within 3 m. from the top edge of slope or toe of the bank.

7. If the contractor does not wish to utilize the quantity of cutting within the specified lead for any reason, then he may do the embankment work with the earth from other sources (except borrow pits in the length of the road where cutting stuff is to be utilized) but in that case the full or part quantity on acceptable quality stuff for which payment is made or to be made will be deducted from the net quantity of the earth work in the embankment arrived at as above.
8. The Contract rate shall be a unit of one cubic meter for the strata mentioned in the item of excavation acceptably completed, limited to the dimensions shown on the plans or as directed by the Engineer. The measurements shall be paid on cross sectional measurements and computing the volumes of earth work in cubic meters by average area method. When the classification of the strata changes, the contractor shall bring this to the notice of the Engineer, who will then verify and if necessary take levels for the changed strata for purpose of measurement.

Item No.3 Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts carrying heavy traffic as per IS 458-1991 specifications including setting the pipes in C.M. 1:2 watering and laying (to level or slopes) of class NP3 of following internal diameters.(iii) 600mm dia.

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 NP-3 type conforming to the requirements of IS: 458 and shall be of 300, 600, 900, 1200 mm internal dia. as specified in the item. Each consignment of cement concrete pipes shall be inspected, if necessary and approved by the Engineer-in-charge, either at the place of manufacture or at the site before their incorporation in the works.

NP3, NP2, NP1 pipes are used for R.C.C. 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 contractor from his responsibility of supplying pipes of required standard and will have to bear the loss or damage caused to the work on account of defects found subsequently during 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 carryout 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 works they form a culvert with a smooth uniform invert. Any pipe found defective or damaged during laying shall be removed at there cost of Contractor.
4. The pipes shall be jointed either by collar joint or by flush joint. In the former case, the collars shall be of R.C.C., 150 to 200 mm wide and having the same strength as the pipes to be jointed. Caulking space shall be between 13 and 20 mm according to the diameter of the pipes. Caulking material shall be slightly wet mix of cement and sand in the ratio of 1:2 rammed with Caulking irons. Before caulking the collar shall be so placed that its centre coincides with that of pipe and an even annular space is left between the collar and the pipes. Flush joint may be shaped to form a self centering joint with a joining space 13 cm wide. The joining space shall be filled with cement mortar. 1 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 joint shall be kept covered and damp for at least four days.
5. R.C.C. pipe shall be measured along their centre between their inlet and outlet ends in linear meters.
6. The rate for the pipes shall include the cost of pipe including loading, unloading, handling storing laying in position and joining complete.

Item No.4 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 within 3.0KM. lead

The land width on which the earth work is to be done shall be cleared of all trees having a girth of 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 meters lead, and handed over to the department in convenient section. Unsuitable material 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.

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 alignments and other marks as long as they are required for the work in 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.

When an existing embankment is to be widened, continuous, horizontal benches, each at least 0.3 meter 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. Where the width of the widened portions if insufficient to permit the use of usual rollers, compaction shall be carried out with the help of tandem/sheeps foot rollers, hand rollers, mechanical tempers or other approved plant. 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.

The soil to be used for embankment for sub grade shall be having CBR not less than 5 % and 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 are carried out by the Department. The embankment shall consist of earth available from road-side borrow pits on either side with lead and all lifts, and within land-width in the manner specified in Para 10 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, he material satisfying the density requirements given in the table below shall be employed for embankment construction.

Density requirement of embankment and subgrade materials

Type of Work	Maximum laboratory dry unit weight when tested as per IS:2720 (Part-8)
-Embankment up to 3 meter height, not subjected to extensive flooding.	Not less than 15.2 kN/cum.
-Embankment exceeding 3 meter height or embankments of any height subject to long periods of inundation.	Not less than 16.0 kN/cum.
-Sub grade and earthen shoulders/ verges/ backfill.	Not less than 17.5 kN/cum.

Note:(1) This table is not applicable for lightweight fill material e.g. cinder, fly ash etc.

(2) The Engineer may relax these requirements at his discretion taking into account the availability of materials for construction and other relevant factors.

Field density shall be percentage of laboratory density as recommended by Gujarat Engineering Research Institute.

When permitted, the contractor shall use the soil for embankment work available from box cutting the road. The soil shall be used after approval from Engineer-in-charge. For this purpose the contractor shall make his own arrangement for loading, transporting & unloading the cutting stuff available from box cutting to required site with all lead and lift.

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. The operation of laying the successive layer of earth shall have to be suitably synchronized with the consolidation work. If the soil as delivered to the road bed is too wet, it shall be dried by exposure to the sun till the moisture content is acceptable for compaction. 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 to the density specified.

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 meter 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.

To avoid interference with the construction of abutment, wing walls or return 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. 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 simultaneously 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. Where it may be impracticable to use power rollers or other heavy equipment, the compaction shall be carried out by mechanical tampers or other methods approved by the Engineer-in-charge. Care shall be taken to see that the compaction plant does not hit or come too close to any structural member so as to cause any damage to them.

The embankment shall be finished in conformity with the alignment, levels, 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. The work of laying of earth work in layers shall be synchronized with the work of compaction and consolidation of the earth work and the operations shall also be synchronized with the field and laboratory testing.

If usable approved materials 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 form 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 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 chooses to utilize this material.
- (iv) The drain should be aligned along the boundary of the land width of the road. No pit, other than this drain, shall be dug within 5 meters of the toe to the final section of the road embankment.

No borrow pits shall be allowed in the length in which earth obtained from cutting is specified to be used in embankments.

11 Rolling and Watering

- 11.1 The embankment materials shall be spread uniformly over the entire width of the embankment in layers not exceeding 250 mm 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 that specified for compaction, the same, shall be made good either at the source or after spreading the soil in loose thickness for compaction. In the latter case, water shall be sprinkled directly from a 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 done to acceptable standard for compaction. Should circumstances arise, where owing to wet weather, the moisture content cannot be reduced to the required level by the above procedure, work of compaction shall be suspended.

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

After adding the required amount of water, the soil shall be processed by means of harrows, rotary mixers or as otherwise approved until the layer is uniformly wet.

Clods or hard lumps of earth shall be broken to have maximum size of 150 mm when being placed in the lower layers of the embankment and a maximum size of 60 mm when being placed in the top 0.5 meter portion of the embankment below the sub-grade.

Hauling equipment shall be dispersed uniformly over entire surface of the previously constructed layer to minimize cutting of uneven compaction.

Where the embankment is to be constructed on low area ground that will not support the weight of trucks 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.

- 11.2** Compaction of the earthwork shall be carried out using vibratory roller of required capacity or any other 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 following table

Compaction requirements for embankment and sub grade.

Sr. No.	Type of Work/ materials	Relative compaction as percentage of maximum laboratory dry density as per IS:2720 (Part-8)
1.	Sub grade and earthen shoulders	Not less than 97.
2.	Embankment	Not less than 95.
3.	Expansive Clays	
	A)Sub grade and 500 mm portion just below the sub grade	Not allowed.
	B)Remaining portion of embankment	Not less than 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 specified compaction is not achieved, the materials in the soft areas shall be removed and replaced by approved materials and compacted to the density requirement, to the satisfaction of the Engineer-in-charge.

- 12. Measurements for Payment:** The earthwork measurements shall be paid on cross sectional measurements and computing the volumes of earth work in cubic meters by average area method. The contractor shall sign day to day leveling work and also original cross section, 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 is started. The contractor or his authorized representative shall attend day to day leveling 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 sectioned 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 leveling 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. The quantity of cutting stuff available from cutting/box cutting will be deducted from the net quantity of the earth work in the embankment arrived at. No deduction for shrinkage shall be made from gross measured quantity of compacted earth work. However the contractor shall have to bear loss of quantity due to all settlements as well as other types of deformations etc. if any that might have taken place at the time of taking the final measurements of this item.

13. 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, 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 that particular item. No payment shall be made under this item for the cutting stuff used in the 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. The contract unit rate also includes cost of mechanical roller and water tanker required for consolidation including all labour, equipments fuel, hire charges, tolls, and incidentals necessary.

Item No.5 Supplying, Stacking and Spreading the Hard Murrum including rolling and watering etc. Complete.

1. The materials for the purpose shall be of approved quality. Any materials which are found inferior shall be rejected and the contractor shall remove such rejected materials from the site at his own cost. The material shall be approved by the Executive Engineer or his authorized agent.
2. River or nala or sea sand required for the work shall be clear, sound, properly, graded, free from organic materials silt clay etc. and shall be got approved by the Engineer-in-charge. The sand shall be obtained and brought from the source approved by the Engineer-in-charge. The sand shall be well graded. The payment shall be made on Cubic Metre basis.
3. Stacking shall be done by filling in the standard steel boxes, of 2 m x 1.5 m x 0.5 m size which shall be supplied by the Department if available on rent. Otherwise contractor shall make his own arrangement. No deduction for voids shall be made from (lie grade measurements. Where any doubt exists as to whether the quantity of stacks of murrum in an hectometer is not confirming with the cubic content of the standard pharas (2 x 1,5 x 0,5 M) the same shall be got corrected by the contractor if so ordered by the Engineer-in-charge for which no extra payment shall be claimed by the contractor. If the quantity of murrum in any stack in a particular hectometre is found to be less than the standard measurements viz., 1.5 cmt. The entire collection in the hectometer shall be paid on the basis of His quantity so found. Regular slacks shall be done by the Contractor on a fairly

level ground Stacking of the mut-rum sati be done in a manner as erected by the Engineer-in-charge.

4. For road work completed stacking of murrum as per requirement shall be earned out in 2 K.M. length before spreading. The collection shall always, be commenced at one end of the K.M. and be carried continuously toward the other end unless the Engineer-in-charge shall direct otherwise.
5. The payment shall be made on cubic metre basis without deduction for voids. The contractor shall maintain all stacks in regular and proper size till the whole materials are collected, measured and finally accepted by the Department. The spreading of materials shall not be allowed till the materials are fully stacked and completed kilometer wise.
6. The rate includes cost of collection, conveyance to the site with all lead and lift and filling the boxes including all labour, tools, equipment and other incidental expenses.
7. The rate quoted are inclusive of all shall such tools.-duties, fees. royalties, taxes etc.
The Murrum used as crust shall be as per C.B.R. Report.
The measurements shall be taken on cubic meter basis.

Item No.6 Construction of granular sub-base by providing coarse graded material grading-II, 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 clause 401.B

401.1 Scope :

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

The materials to be used for the work shall be a machine crushed crushed stone aggregate. The material shall be free from organic or other deleterious constituents and confirm to the Table 400.2 grading II.

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

IS sieve Designation	Percent by weight passing the IS sieve. Grading II
75.0 mm	-
53.0 mm	100
26.5 mm	50-80
9.5 mm	-
4.75 mm	15-35
2.365 mm	-
0.425 mm	-
0.075 mm	<10
CBR Value (Minimum)	25

1. MATERIALS.
2. Material passing 425 micron (0.425 mm) sieve for all the three grading when tested according to IS : 2720 (Part 5) shall have liquid limit and plasticity index not more than 25 and 6 percent respectively.
3. **401.2.2 Physical requirements:**
4. The materials shall have a 10 percent fines value of 50 KN or more (for sample in soaked condition) when tested in compliance with B.S.: 812 (Part 111). The water absorption value of the coarse aggregate shall be determined as per IS : 2386 (Part 3) : if this value is greater than 2 percent,
5. the soundness test shall be carried out on the material delivered to site as per IS : 383. For grading II and III materials, the CBR shall be determined at the density and moisture content likely to be developed in equilibrium conditions which shall be taken as being the density relating to a uniform air voids content of 5 percent.
6. **401.3 Strength of sub-base.**
7. It shall be ensured prior to actual execution that the material to be used in the sub base satisfies the requirements of CBR and other physical requirements when compacted and finished.
8. When directed by the Engineer, this shall be verified by performing CBR tests in the laboratory as required on specimens remolded at field dry density and moisture content and any other tests for the "Quality" of materials, as may be necessary.
9. **401.4 Construction Operations:**
10. **401.4.1 Preparation of Sub grade:**
11. Immediately prior to the laying of sub-base, the sub grade already finished to Clause 301 or 305 as applicable shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water, if necessary and rolled with two passes of 80-100 KN smooth wheeled roller.
12. **401.4.2 Spreading and compacting:**
13. The sub-base material of grading specified in the Contract shall be spread on the prepared sub grade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation or other means as approved by the Engineer.
14. When the sub-base material consists of combination of materials mentioned in Clause 401.2.1, of this item mixing shall be done mechanically by the mix in place method.
15. Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small-sized jobs. The equipment used for mix-in-place construction shall be a rotavator or similar approved equipment capable of mixing the material to the desired degree. If so desired by the Engineer, trial runs with the equipment shall be carried out to establish its suitability for the work.
16. Moisture content of the loose material shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface of other means approved by the Engineer so that, at the time of compaction, it is from 1 percent above to 2 percent below the optimum moisture content corresponding to IS:2720 (Part 8). While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed

by mechanical or other approved means like disc barrows, rotavators until the layer is uniformly wet.

17. Immediately thereafter, rolling shall start. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 KN weight may be used. For a compacted single layer upto 225 mm the compaction shall be done with help of a vibratory roller of minimum 80 to 100 KN static weight with plain drum or pad foot drum or heavy pneumatic tyred roller of minimum 200 to 300 KN weight having a minimum tyre pressure of 0.7 MN/ M² or equivalent capacity roller capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional cross fall and super elevation and shall commence at the edges and progress towards the centre for portions having cross fall on both sides each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling, the grade and cross fall (camber) shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 Km per hour. Rolling shall be continued till the density achieved is at least 98 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,
18. 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.
19. **401.5. Surface Finish and Quality Control of work:**
20. The surface finish of construction shall conform to the requirements of Clause 902 of MORT & H specifications. Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900 of MORT & H specifications.
21. **401.6 Arrangements for Traffic:**
22. During the period of construction, arrangement of traffic shall be maintained in accordance with Clause 112 of MORT & H specifications.
23. **401.7 Measurements for Payment:**
24. Granular sub base shall be paid as finished work in position on cross sectional measurements and computing the volume of GSB work in cubic meters by average area method.
25. 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.
26. **401.8 Rate:**
27. The Contract unit rate for granular sub base shall be payment in full for carrying out the required operations including full compensation for:
28. [i] Making arrangements for traffic to Clause 112 as above except for initial treatment to verges, shoulders and construction of diversions.
29. [ii] Furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lift.
30. [iii] All labour, tools, equipment and incidentals to complete the work to the specifications.
31. [iv] Carrying out the work in part widths of road where directed, and
32. [v] Carrying out the required tests for quality control.

Item No.7 Construction of Granular Sub Base by providing coarse graded machine crushed B. T. material satisfying MOST Specification of Grading - I using 53 mm to 26.5 mm @ 30% (M.C. Metal), 26.5 mm to 4.75 mm @ 60% (M.C.Metal), 2.36 mm below @ 10% (Stone Dust) including spreading in uniform layer 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 with C.B.R. > 30% etc. complete.

401.1 Scope :

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

The materials to be used for the work shall be a machine crushed crushed stone aggregate. The material shall be free from organic or other deleterious constituents and conform to the Table 400.2 grading I.

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

IS sieve Designation	Percent by weight passing the IS sieve. Grading I
75.0 mm	100
83.0 mm	-
26.5 mm	55 – 75
9.5 mm	-
4.75 mm	10 – 30
2.365 mm	
0.425 mm	
0.075 mm	< 10
CBR Value (Minimum)	30

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

401.2.2 Physical requirements:

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

401.3 Strength of sub-base.

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

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

401.4 Construction Operations:

401.4.1 Preparation of Sub grade:

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

401.4.2 Spreading and compacting:

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

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

Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small-sized jobs. The equipment used for mix-in-place construction shall be a rotavator or similar approved equipment capable of mixing the material to the desired degree. If so desired by the Engineer, trial runs with the equipment shall be carried out to establish its suitability for the work.

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

Immediately thereafter, rolling shall start. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 KN weight may be used. For a compacted single layer upto 225 mm the compaction shall be done with help of a vibratory roller of minimum 80 to 100 KN static weight with plain drum or pad foot drum or heavy pneumatic tyred roller of minimum 200 to 300 KN weight having a minimum tyre pressure of 0.7 MN/ M² or equivalent capacity roller capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional cross fall and super elevation and shall commence at the edges and progress towards the centre for portions having cross fall on both sides each pass of the roller shall uniformly

overlap not less than one third of the track made in the preceding pass. During rolling, the grade and cross fall (camber) shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 Km per hour. Rolling shall be continued till the density achieved is at least 98 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.

401.5. Surface Finish and Quality Control of work:

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

401.6 Arrangements for Traffic:

During the period of construction, arrangement of traffic shall be maintained in accordance with Clause 112 of MORT & H specifications.

401.7 Measurements for Payment:

Granular sub base shall be paid as finished work in position on cross sectional measurements and computing the volume of GSB work in cubic meters by average area method.

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

401.8 Rate:

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

- [i] Making arrangements for traffic to Clause 112 as above except for initial treatment to verges, shoulders and construction of diversions.
- [ii] Furnishing all materials to be incorporate in the work including all royalties, fees, rents where necessary and all leads and lift.
- [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.8 Providing, laying, spreading and compacting graded stone aggregate to wet mix macadam specification including premixing the Material with water at OMC in mechanical mix plant carriage of mixed Material by tipper to site, laying in uniform layers with paver in sub- base / base course on well prepared surface and compacting with vibratory roller to achieve the desired density.

406.1 SCOPE

This work shall consist of laying and compacting clean, crushed, graded aggregate and granular material, premixed with water, to a dense mass on a prepared subgrade sub base/ base or existing pavement as the case may be in accordance with the requirements

of these specifications. The material shall be laid in one or more layers as necessary to lines, grades and cross-sections shown on the approved drawings or as directed by the Engineer.

The thickness of a single compacted Wet Mix Macadam layer shall not be less than 75mm. When vibrating or other approved types of compacting equipment are used, the compacted depth of a single layer of the sub-base course may be increased to 20cm upon approval of the Engineer.

406.2 MATERIALS

406.2.1 AGGREGATES

406.2.1.1 PHYSICAL REQUIREMENTS :

Course aggregates shall be crushed stone. If crushed gravel / shingle is used, not less than 90 percent by weight of the gravel / shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table 400-10 below.

TABLE 40-10 PHYSICAL REQUIREMENT OF COARSE AGGREGATES FOR WET MIX MACADAM FOR SUBBASE / BASE COURSES

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

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

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

If the water absorption value of the coarse aggregate greater than 2 percent, the soundness test shall carried out on the material delivered to site as per 2386 (Part – 5).

406.2.1.2 Grading requirements :

The aggregates shall conform to the grading given in Table 400-11

TABLE 400-11. GRADING REQUIREMENTS OF AGGREGATES FOR WET MIX MACADAM.

IS sieve Designation	Percent by weight passing the IS sieve.
53.0 mm	100
45.0 mm	95 – 100
26.5 mm	--
22.4 mm	60 – 80
11.20 mm	40 – 60
4.75 mm	25 – 40
2.36 mm	15 – 30
600 micron	8 – 12
700 micron	0 – 8

Materials finer than 425 micron shall have plasticity index (P.I.) not exceeding 6. The final gradation approved within these limits shall be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice-versa.

406.3 Construction Operation :

406.3.1 Preparation of base : Clause 404.3.1 as below shall apply.

404.3.1 Preparation of base: The surface of the subgrade/sub-base/base to receive the water bound macadam course shall be prepared to the specification 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 unit firm surface is obtained if necessary by sprinkling water. Any sub-base/base/surface irregularities, where predominant, shall be made good by providing appropriate type of profile corrective course (levelling 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 centre 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.

406.3.2 Provision of lateral confinement of aggregates :

While constructing wet mix macadam arrangement shall be made for the lateral confinement of wet mix. This shall be done by laying materials in adjoining shoulders along with that of wet mix macadam layer and following the sequence of operations described in Clause 407.4.1 as below.

407.4 Construction Operations:

407.4.1 Shoulder: The sequence of operations shall be such that the construction of paved shoulder is done in layers each matching the thickness of adjoining pavement layer. Only after a layer of pavement and corresponding layers in paved and earth shoulder portion have been laid and compacted, the construction of next layer of pavement and shoulder shall be taken up.

Where the materials in adjacent layers are different, these shall be laid together and the pavement layer shall be compacted first. The corresponding layer in paved shoulder portion shall be compacted thereafter, which shall be followed by compaction of earth shoulder layer.

The adjacent layers having same material shall be laid and compacted together.

In all cases where paved shoulders have to be provided along side of existing carriageway, the existing shoulders shall be excavated in full width and to the required depth as per clause 301.3.7 under no circumstances, box cutting shall be done for construction of shoulders.

Compaction requirement of earthen shoulder shall be as per table 300-2 in the case of bituminous courses, work on shoulder (earthen/hard/paved), shall start only after the pavement course has been laid and compacted.

During all stages of shoulder (earth/hard/paved) construction, the required cross fall shall be maintained to drain off surface water

Regardless of the method of laying, all shoulder construction material shall be placed directly on the shoulder. Any spilled material dragged on to the pavement surface shall be immediately removed, without damage to the pavement, and the area so affected thoroughly cleaned.

406.3.4 Preparation of mix :

Wet Mix Macadam shall be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced / positive mixing arrangement like pug-mil or pan type mixer of concrete batching plant.

Optimum moisture for mixing shall be determined in accordance with IS : 2720 (Part – 8) after replacing the aggregate fraction retained on 22.4 mm sieve with material of 4.75 micron to 22.4 mm size. While adding water, due allowance should be made for evaporation losses. However, at the time of compaction, water in the wet mix should not vary from the optimum value by more than agreed limits. The mixed material should be uniformly wet and so segregation should be permitted.

406.3.4 Spreading of mix :

Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared sub grade / sub-base / base in required quantities. In no case should these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed stretch be permitted.

The mix may be spread either by a paver finisher or motor grader. For portions where mechanical means cannot be used, manual means as approved by the Engineer shall be used. The motor grader shall be capable of spreading the material uniformly all over the surface. Its blade shall have hydraulic control suitable for initial adjustments and maintaining the same so as to achieve the specified slope and grade.

The paver finisher shall be self – propelled, having the following features :

- (i) Loading hoppers and suitable distribution mechanism
- (ii) The screed shall have tamping and vibrating arrangement for initial compaction to the layer as it is spread without rutting or otherwise marring the surface profile.
- (iii) The paver shall be equipped with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes. The surface of the aggregate shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate as may be tested by depth blocks during construction.

No segregation of larger and fine particles should be allowed. The aggregates as spread should be allowed. The aggregates as spread should be of uniform gradation with pockets of fine materials.

406.3.5 Compaction :-

After the mix has been laid to the required thickness, grade and care full / camber the same shall be uniformly compacted, to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 100mm, a smooth wheel roller of 80 to 100 KN weight may be used. For a compacted single layer up to 200mm, the compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 KN or equivalent capacity roller. The speed of the roller shall not exceed 5 km/h. In portions having unidirectional cross fall / super elevation rolling shall

commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the center line of the road. Uniformly overlapping each preceding track by at least one fourth width until the entire surface has been rolled. Alternate trips of the roller shall be terminated in stops at least 1 m away from any preceding stop. In portions in camber, rolling should be at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall progress gradually towards the center parallel to the center line of the road uniformly overlapping each of the preceding track by at least one – Fourth width until the entire surface has been rolled.

Any displacement occurring as a result of reversing of the direction of a roller or from any other caused shall be corrected at once as specified and / or removed and made good.

Along forms, Kerbs, walls or other places not accessible to the roller, the mixture shall be thoroughly compacted with mechanical tampers or a plate compactor. Skin patching of an area without scarifying the surface to permit proper bonding of the added material shall not be permitted.

Rolling should not be done when the sub grade is soft or yielding or when it caused a wave-like motion in the sub – base/ base course or sub grade. If irregularities develop during rolling which exceed 12mm when tested with a 3 meter straight edge, the surface should be loosened and premixed material added or removed as required before rolling again so as to achieve a conforming to the desired grade and cross fall. In no case should the use of unmixed material be permitted to make up the depressions.

Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry the material as determined by the method outlined in IS : 2720 (Part-8) After completion, the surface of any finished layer shall be wellclose, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of the layer and recompact.

406.3.6 Setting and drying :

After final compaction of wet mix macadam course, the road shall be allowed to dry for 24 hours.

406.4 Opening to Traffic :

Preferably no vehicular traffic of any kind should be allowed on the finished wet mix macadam surface till it has dried and the wearing course laid.

406.5 Surface Finish and Quality control of work

406.5.1 Surface evenness :

The surface finish of construction shall conform to the requirements of Clause 902 of MORT & H specifications.

406.5.2 Quality Control :

Control on the quality of materials and works shall be exercised by the Engineer in accordance with section 901 of MORT & H specifications

406.6 Rectification of Surface Irregularity :

Where the surface irregularity of the wet mix macadam course exceeds the permissible tolerances or where the course is otherwise defective due to subgrade soil getting mixed with the aggregates, the full thickness of the layer shall scarified over the affected area. Reshaped with added premixed material or removed and replaced with fresh premixed

material as applicable and recomputed in accordance with Clause 406.3 of this item . The area treated in the aforesaid manner shall not be less than 5m long and 2m wide. In no case shall depressions be filled up with unmixed and ungraded material or fines.

406.6.7 Arrangement for Traffic :

During the period of construction, arrangement of traffic shall be done as per Clause 112 of MORT & H specifications

406.8 Measurements for Payment :

Wet mix macadam shall be paid as finished work in position on cross sectional measurements and computing the volume of WMM work in cubic meters by average area method.

406.9 Rate : The Contract unit rate for wet mix macadam shall be payment in full for carrying out the required operations including full compensation for all components listed below.

- i) Making arrangement for traffic to Clause 112 as above Except for initial treatment to verges, shoulders and Construction of diversions
- ii) Furnishing wet 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.9 Providing and applying evenly Priming coat with emulsion asphalt at the rate of 7.50 Kg/ 10 Sq.m on road surface using emulsion SS-1 (Himcol Made) pressure sprayer etc. complete including the cost of asphalt

502.1 Scope

This work shall consist of the application of a single coat of low viscosity liquid bituminous material to a porous granular surface preparatory to the superimposition of bituminous treatment or mix.

502.2 Materials

502.2.1 Primer : Primer shall be bitumen emulsion of SS-1 grade complying with IS 8887

Primer viscosity :

The type and viscosity of the primer shall comply with the requirements of IS 8887, as sampled and tested for bituminous primer in accordance with these standards. Guidance on viscosity and rate of spray is given in Table 500-1.

TABLE 500-1. VISCOSITY REQUIREMENT AND QUANTITY OF LIQUID BITUMINOUS PRIMER

Type of Surface	Kinematic Viscosity of Primer at 60o C (Centistokes)	Quantity of Liquid Bituminous Material per 10 Sq.M. (kg)
Low porosity	30 – 60	6 to 9
Medium porosity	70 – 140	9 to 12
High porosity	250 – 500	12 to 15

502.2 Weather and Seasonal Limitations

Bituminous primer shall not be applied to a wet surface (see 502.4.2) or during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the

shade is less than 10o C. Surfaces which are to receive emulsion primer should be damp. But no free or standing water shall be present.

502.3 Construction

502.4.1.1 Equipment :

The Primer distributor shall be a self-propelled or towed bitumen pressure sprayer equipped for spraying the material uniformly at specified rates and temperatures. Hand spraying of small areas. Inaccessible to the distributor, or as directed by the Engineer.

502.4.2 Preparation of road surface : The surface to be primed shall be prepared in accordance with Clauses **501.8** .

501.8 This work shall consist of preparing an existing granular surface and shall be performed on such widths and lengths as shown on the drawing or as directed by the Engineer

Immediately prior to applying the primer the surface shall be carefully swept clean of dust and loose particles, care being taken not to disturb the inter locked aggregate. This is best achieved when the surface layer is slightly moist (lightly sprayed with water and the surface allowed to dry) and the surface should be kept moist until the primer is applied.

502.4.3 Application of emulsion bituminous primer : The rate of application of the primer shall be at rate of 7.5 Kg / 10 Sq.m. or as directed.

The bituminous primer shall be sprayed uniformly in accordance with Clause 501. The method for application of the primer will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar and speed of forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

502.4.4 Curing of primer and opening to traffic : A primed surface shall be allowed to cure for at least 24 hours or such other period as is found to be necessary to allow all the volatiles to evaporate before any subsequent surface treatment or mix is laid. Any unabsorbed primer shall first be blotted with an application of sand, using the minimum quantity possible. A primed surface shall not be opened to traffic other than that necessary to lay the next course. A very thin layer of clean sand may be applied to the surface of the primer, to prevent the primer picking up under the wheels of the paver and the trucks delivering bituminous material to the paver.

502.5 Quality Control of Work :

For control of the quality of materials supplied and the works carried out, the relevant provisions of Section 901 of MORT & H specifications shall apply.

502.6 Arrangements for Traffic

During construction operations, arrangements for traffic shall be made in accordance with the provisions of Clause 112 of MORT & H specifications.

502.7 Measurement for Payment

Prime coat shall be measured in terms of surface area of application in square meters.

502.8 Rate :-

The contract unit rate for prime coat with adjustments as described in Clause 502.7 of MORT&H specification shall be payment in full for carrying out the required operations including full compensation for all components listed below

- [i] Making arrangements for traffic to Clause 112 as above 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 lift.
- [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.

Payment shall be made on the basis of the provision of prime coat at an application rate of 7.5 kg per 10 square meter, with adjustment, plus or minus, for the variation between this amount and the actual amount approved by the Engineer after the preliminary trials

Item No.10 Providing and laying bituminous base course 37.5mm thick compacted in one layer with tack coat of asphalt Emulsion RS-1 at the rate of 2.5 Kg / 10 Sqmt. and using B.T. stone aggregate or required gradation and asphalt (VG-30) grade for mixing @ 1.99 % by weight of total mix for mixing including heating the aggregate and asphalt by drum mix plant and spreading the same by paver finisher and consolidation with vibratory roller including providing all materials, equipments, tools and plants, oil, kerosene, fire wood, labour charges etc. complete.

This work shall consist of bituminous construction in single layer having 37.5 mm compacted thickness of crushed aggregates premixed with a bituminous binder on a previously prepared base to the requirements of these specification.

504.2 Materials :-

504.2.1 Bitumen :-

The bitumen shall be paving bitumen of penetration grade 80/100 (VG-10) complying with Indian Standard specification for "Paving Bitumen" IS:73.

504.2.2 Coarse aggregates :-

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, 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 have 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 aggregate shall be tested for stripping.

The aggregates shall satisfy the physical requirements set forth in Table 500-3 as under.

**Table 500.3 Physical, Requirements for Coarse aggregates
for bituminous Macadam**

Property	Test	Specification
Cleanliness	Grain Size analysis	Max. 5% passing 0.075 mm sieve.
Particle shape	Flakiness and Elongation Index (Combined)	Max. 30%
Strength	Los Angeles Abrasion Value	Max. 40%
	Aggregate Impact Value	Max. 30%
Durability	Soundness Sodium Sulphate	Max. 12%

Property	Test	Specification
	Magnesium Sulphate	Max. 18%
Water Absorption	Water Absorption	Max. 2%
Stripping	Coating and stripping of Bitumen aggregate Mixtures.	Minimum retained coating 95%
Water Sensitivity	Retained Tensile Strength	Minimum 80%

Notes :-

[1] IS : 2386 Part – 1 [2] IS : 2386 Part – 1 [the elongation test to be done only on non-flaky aggregate in the sample]

[3] IS : 2386 Part – 4 [4] IS : 2386 Part – 5 [5] IS : 2386 Part – 3

[6] IS : 6241 [7] 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.

504.2.3 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.

504.2.4 Aggregate grading and binder content :-

The combined aggregate grading for the mixture shall fall within the limits of grading requirement and content of bitumen shall be at the rate of 19.90 Kg./M.T. i.e. 1.99 % by weight of total mix.

504.2.5 Proportioning of material :-

The aggregates shall be proportioned and blended to produce a uniform mixture complying with the requirements of following Table. The binder content shall be within a tolerance of ± 0.3 % by weight of total mixture when individual specimens are taken for quality control tests in accordance with the provisions of Section 900.

Table - Composition of Bituminous course

Nominal aggregate size layer thickness IS : Sieve [MM]	25 mm 37.50 mm	
	Cumulative % by weight of total aggregate passing.	
	Coarse aggregate	Key aggregate
40 mm	100	-
26.50 mm	40-75	-
22.4 mm	-	100
13.20 mm	0-20	40-75
5.60 mm	-	0-20
2.80 mm	0-5	0-5
Bitumen content % by weight of total mixture	1.99	
Bitumen Grade	80 /100 (VG-10)	

Note :- Appropriate bitumen contents for conditions in cooler areas of India may be upto 0.5% higher subject to the approval of the Engineer.

504.3 Construction Operations :-

504.3.1 Weather and seasonal limitations :-

Laying shall be suspended while free standing water is present on the surface to be covered or during rain, fog and dust storms. After rain the bituminous surface, prime or tack coat, shall be blow off with a high pressure air jet to remove excess moisture or the surface left to dry before laying shall start, laying of bituminous mixtures shall not be carried out when the air temperature at the surface on which it is to be laid is below 10⁰ C or when the wind speed at any temperature exceeds 40 K.M./H at 2 Mt. height unless specifically approved by the Engineer.

504.3.2 Preparation of the base :-

The base on which bituminous course is to be laid shall be prepared shaped and compacted to the required profile in accordance with Clauses-501.8 and 902.3 as appropriate and a prime coat, shall be applied in accordance with Clause-502 where specified or as directed by the Engineer.

501.8 Preparation of Surface :-**504.8.1 Scope :-**

This work shall consist of preparing an existing granular or black topped surface bituminous course. The work shall be performed on such widths and lengths as shown on the drawings or as instructed by the Engineer. The existing surface shall be firm and clean and treated with prime or tack coat as shown on the drawings as otherwise stated in the contract.

504.3.3 Tack coat :-

A tack coat in accordance with Clause-503 shall be applied as required by the contract documents or as directed by the Engineer.

503 Tack Coat :-**503.1 Scope :-**

This work shall consist of the application of a single coat of bitumen 80/100 grade (VG-10) to an existing bituminous road surface preparatory to the superimposition of a bituminous mix, when specified in the contrast or instructed by the engineer.

503.2 Materials :-**503.2.1 Binder :-**

The binder used for tack coat shall be bitumen 80/100 grade (VG-10) complying with IS: 73 or as directed by the Engineer.

503.3 Weather and Seasonal Limitations :-

Bituminous material shall not be applied to a wet surface or during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less then 10⁰ C.

503.4 Construction :-**503.4.1 Equipment :-**

The tack coat distributor shall be a self propelled or towed bitumen pressure sprayer equipped for spraying the material uniformly at a specified rate, hand spraying of small areas, inaccessible to the distributor it narrow strips, shall be sprayed with a pressure hand sprayer of as directed by the Engineer.

503.4.2 Preparation of base :-

The surface on which the tack coat is to be applied shall be clean and free from dust, dirt and any extraneous material and other wise prepared in accordance with the requirements

of Clauses-501.8 & 513 as appropriate. Immediately before the application of the tack coat the surface shall be swept clean with a mechanical broom and high-pressure air jet or by other means as directed by the Engineer.

503.4.3 Application of tack coat :-

The application of tack coat shall be at 2.5 Kg/ 10 Sq.mt. as specified in the contract and shall be applied uniformly

The method of application of the tack coat will depend on the type of equipment to be used size of nozzles, pressure at the spray bar, and speed of forward movement. The contractor shall demonstrate at a spraying trial that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

504.3.4 Preparation and transportation of the mixture :-

501.3 Mixing :-

Premixed bituminous materials, shall be prepared in a hot mix plant of adequate capacity and bituminous concrete, shall be prepared in a hot mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coating aggregates. Appropriate mixing temperatures can be found in 500.5 of these specifications, the difference in temperature between the binder and aggregate should at no time exceed 14⁰ C. In order to ensure uniform quality of the mix and belief writing of aggregates, the hot mix plant shall be calibrated from time to time.

If a continuous mixing plant is to be used for mixing the bituminous macadam, the Contractor Must demonstrate by laboratory analysis that the cold feed combined grading is within the grading limits specified for the bituminous bound material. In the case of a designed job mix, the bitumen and filler content shall be derived using this combined grading. Further details shall be available in the Manual for Construction and Supervision of bituminous works.

501.4 Transporting :-

Bituminous 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 an Engineer, a thin coating of diesel or lubricating oil may be applied to the interior of the vehicle to prevent sticking and to facilitate discharge of the material.

504.3.5 Spreading :-

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

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

The minimum thickness of material laid in each paver pass shall be in accordance with the minimum values given in the relevant parts of these specifications. When laying binder course or wearing course approaching an expansion joint of a structure, machine

laying shall stop 300 mm short of the joint. The remainder of the pavement upto the joint and the corresponding area beyond it, shall be laid by hand, and the joint or joint cavity shall be kept clear of surfacing material.

Bituminous material with temperature greater than 145⁰ C shall not be laid or deposited on bridge deck water proofing systems, unless precautions against heat damage have been approved by the Engineer.

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

- [i] For laying regulating course of irregular shape and varying thickness.
- [ii] In confined spaces where it is impracticable for a paver to operate.
- [iii] For foot Ways.
- [iv] At the approaches to expansion joints at bridge viaducts or other structures.
- [v] For laying mastic asphalt in accordance with clause 515 as below.
- [vi] For filling of path holes.
- [vii] Where directed by the Engineer.

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

- [1] At the edge of the layers of material and at gullies and manholes.
- [2] At the approaches to expansion joints at bridges, viaducts or other structures.
- [3] As directed by the Engineer.

Table 500.5 Manufacturing and Rolling Temperatures.

Penetration	Bitumen Mixing [C]	Aggregate Mixing [C]	Mixed Material [C]	Rolling [C]	Laving [C]
35	106-170	160-175	170 Maximum	100 Maximum	130 Maximum
65	150-165	150-170	165 Maximum	90 Maximum	125 Maximum
90	140-160	140-165	155 Maximum	80 Maximum	115 Maximum

504.3.6 Rolling :-

Compaction shall be carried out in accordance with the provisions of Clauses 501.6 and 501.7 as below.

501.6 Compaction :-

Bituminous materials shall be laid and compacted in layers which enable the specified thickness, surface level, regularity requirements and compaction to be achieved.

Compaction of bituminous materials shall commence as soon as possible after laying. Compaction shall be substantially completed before the temperature falls below the minimum rolling temperatures stated in the relevant part of these specifications. 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 compared portion, it shall progress from the lower to the upper edge parallel to the center line of the pavement. Rolling shall continue until all roller marks have been removed from the surface. All

deficiencies in the surface after laying shall be made good by the attendants behind the paver before initial rolling is commenced. The initial or breakdown rolling shall be done with 8-10 tonnes dead weight smooth wheeled roller. The immediate rolling shall be done with 8-10 tonnes dead weight or vibratory roller or with a pneumatic tired roller of 12 to 15 tonnes weight having nine wheels, with tire pressure of at least 5.6 K.G./Sq.Mt. The finish rolling shall be done with 6 to 8 tonnes smooth wheeled tandem rollers.

Where compaction is to be determined by density of the requirements to prove the performance of rollers shall apply in order to demonstrate that the specified density can be achieved. In such cases the contractor shall nominate the plant and the method by which he intends to achieve the specified level of compaction and finish at temperatures above the minimum specified rolling temperature. Laying trials shall then demonstrate the acceptability of the plant and method used.

Bituminous materials shall be rolled in a longitudinal direction with the driven rolls nearest the paver. The rollers shall first compact material adjacent to joints and then work from the lower to the upper side of the layer, overlapping on successive passes by at least one-third of the width of the rear roller in the case of a pneumatic-tyred roller, at least the nominal width of 300 mm.

In portions with super elevated and un-directional camber, after the edge has been roller, the roller shall progress from the lower to the upper edge.

Roller should move at a speed of not more than 5 K.M./ H. The roller shall not be permitted to stand on pavement which has not been fully compacted and necessary precautions shall be taken to prevent dropping of oil, grease, petrol or other foreign matter on the pavement either when the rollers are operating or standing. The wheels of rollers shall be kept moist with water and the spray system provided with the machine shall be in good working order, to prevent the mixture from adhering to the wheels. Only sufficient moisture to prevent adhesion between the wheels of rollers and the mixture should be used. Surplus water shall not be allowed to stand on the partially compacted pavement.

501.7 Joints :-

Where longitudinal joints are made in pre-mixed bituminous materials, the materials shall be fully compacted and the joint made flush in one of the following ways, only method [iii] shall be used for transverse joints.

- [1] By beating the joints with an approved joint heater when the adjacent width is being laid but without cutting back or coating with binder. The heater shall raise the temperature of the full depth of material to within the specified range of minimum rolling temperature and maximum temperature at any stage for the material for a width not less than 75 mm. The contractor shall have equipment available for use in the event of a heater break down to form joints by method[iii].
- [2] By using two or more pavers operating in echeion, where this is practicable, and in sufficient proximity for adjacent widths tube fully compacted by continuous rolling.
- [3] By cutting back the exposed joint for a distance equal to the specified layer thickness, to a vertical face discarding all loosened material and coating the vertical face 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.

All joints shall be offset at least 300 mm from parallel joints in the layer beneath or as directed and in a layout approved by the Engineer. Joints in the wearing course shall coincide with either the lane edge or the lane marking which ever is appropriate. Longitudinal joints shall not be situated in wheel track zones.

Rolling shall be continued until the specified density is achieved or where no density is specified, until there is not further movement under the roller. The required frequency of testing is defined in Clause-903.

Surface Finish and Quality Control

The surface finish of the completed construction shall conform to the requirements of Clause 902 of MORT & H Specification. All materials and workmanship shall comply with the provisions set out in Section 900 of MORT & H Specification.

Arrangements for Traffic

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

Measurement for Payment :-

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

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

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

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

Rate for premixed bituminous materials : - The unit rate for premixed bituminous material shall be payment in full for carrying out the required operation including full compensation for, but not limited to:

1. Making arrangements for traffic to clause 112 except for initial treatment to verge, shoulders and construction of diversions.
2. Preparation of the surface to revive the materials.
3. Providing all materials to be incorporated in the work including arrangement for stock yards. All royalties, fees rents where necessary and all leads and lifts.
4. Mixing transporting, laying and compacting the mix as specified.

5. All labour, tools equipment, plant including installation of hot mix plant, power supply units and all machinery incidental to complete the work to these specification.
6. Carrying out the work in part widths of the road where directed.
7. Carrying out all tests for control of quality, and
8. The rate shall cover the provision of bitumen at the rate specified in the contract, with the provision that the variation in actual percentage of bitumen used will be assessed and the payment adjusted accordingly.
9. The rate for premixed material are to include for all wastage in cutting of joints etc.
10. The rates are to include for all necessary testing mix design transporting and testing of samples, and cores. If there is not a project specific laboratory, the contractor must arrange to carry out all necessary testing at an outside laboratory approved by the Engineer, and all costs incurred are deemed to be included in the rate quoted for the material.
11. The cost of all plant and laying trials as specified to prove the mixing and laying methods is deemed, to be included in the contractor's rates for the materials.

Item No.11 Providing laying & rolling of 25 mm thick Open graded Premix bituminous carpet with B.T. aggregate as specified and using RS1 Emulsion for tack coat at the rate of 2.5 kg/10 sq.mt. and using bitumen grade VG-30 for Mixing with aggregate at the rate of 3.36 % i.e. 33.60 kg / M.T. of total mix including heating and mixing in drum mix plant transporting and spreading the same with paver finisher and consolidation with vibratory roller including necessary fire wood , oil , lubricant , labour charges etc. using contractor's own drum mix plant and equipment ,tool etc .complete in accordance with the requirement of specification.

Scope :-

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

Materials :-

Bitumen :-

The bitumen shall be paving bitumen of penetration grade 80/100 (VG-10) complying with Indian Standard specification for "Paving Bitumen" IS:73.

Coarse aggregates :-

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, 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 have 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 aggregate shall be tested for stripping.

The aggregates shall satisfy the physical requirements set forth in Table 500-3 as under.

**Table 500.3 Physical, Requirements for Coarse aggregates
for bituminous Macadam**

Property	Test	Specification
Cleanliness	Grain Size analysis	Max. 5% passing 0.075 mm sieve.
Particle shape	Flakiness and Elongation Index (Combined)	Max. 30%
Strength	Los Angeles Abrasion Value	Max. 40%
	Aggregate Impact Value	Max. 30%
Durability	Soundness	
	Sodium Sulphate	Max. 12%
	Magnesium Sulphate	Max. 18%
Water Absorption	Water Absorption	Max. 2%
Stripping	Coating and stripping of Bitumen aggregate Mixtures.	Minimum retained coating 95%
Water Sensitivity	Retained Tensile Strength	Minimum 80%

Notes :-

[1] IS : 2386 Part – 1

[2] IS : 2386 Part – 1 [the elongation test to be done only on non-flaky aggregate in the sample]

[3] IS : 2386 Part – 4 [4] IS : 2386 Part – 5

[5] IS : 2386 Part – 3 [6] IS : 6241

[7] 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.

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

Proportioning of material :-

The aggregates shall be proportioned and blended to produce a uniform mixture complying with the requirement mentioned below.. The binder content shall be within a tolerance of ± 0.3 % by weight of total mixture when individual specimens are taken for quality control tests in accordance with the provisions of Section 900.

Table 500.4 Composition of Bituminous Macadam

IS : Sieve [MM]	Cumulative % by weight of total aggregate passing.
22.40 mm	100
13.20 mm	70 – 100
11.20 mm	20 – 40
3.60 mm	0
Bitumen content % by weight of total mixture	3.36
Bitumen Grade	80/100 (VG-10)

Construction Operations :-

Weather and seasonal limitations :-

Laying shall be suspended while free standing water is present on the surface to be covered or during rain, fog and dust storms. After rain the bituminous surface, prime or tack coat, shall be blow off with a high pressure air jet to remove excess moisture or the surface left to dry before laying shall start, laying of bituminous mixtures shall not be carried out when the air temperature at the surface on which it is to be laid is below 10⁰ C or when the wind speed at any temperature exceeds 40 K.M./H at 2 Mt. height unless specifically approved by the Engineer.

Preparation of the base :-

The base on which bituminous macadam is to be laid shall be prepared shaped and compacted to the required profile in accordance with Clauses-501.8 and 902.3 as appropriate and a prime coat, shall be applied in accordance with Clause-502 where specified or as directed by the Engineer.

Tack coat :-

This work shall consist of the application of a single coat of 80/100 (VG-10) bitumen on prepared surface preparatory to the superimposition of a bituminous mix, when specified in the contract or instructed by the engineer.

Equipment :-

The tack coat distributor shall be a self propelled or towed bitumen pressure sprayer equipped for spraying the material uniformly at a specified rate, hand spraying of small areas, inaccessible to the distributor in narrow strips, shall be sprayed with a pressure hand sprayer or as directed by the Engineer.

Application of tack coat :- (as per IRC - 16 - 2008)

The application on tack coat shall be at 2.5 Kg/ 10 Sq.mt. as specified in the contract and shall be applied uniformly.

The method of application of the tack coat will depend on the type of equipment to be used size of nozzles, pressure at the spray bar, and speed of forward movement. The contractor shall demonstrate at a spraying trial that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

Preparation of premix

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

The temperature of the binder at the time of mixing shall be in the range of 150⁰C to 163⁰C and that of the aggregate in the range of 155⁰C to 163⁰C provided that the difference in temperature between the binder and aggregate at no time exceeds 14⁰C. Mixing shall be thorough to ensure that a homogeneous mixture is obtained in which all particles of the aggregates are coated uniformly and the discharge temperature of mix shall be between 130⁰C and 160⁰C.

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

Spreading and rolling :

The pre mixed material shall be spread by suitable means to the desired thickness, grades and cross-fall (camber) making due allowance for any extra quantity required to fill up depressions, if any. The cross-fall should be checked by means of camber boards and

irregularities levelled out. Excessive use of blades or rakes should be avoided. As soon as sufficient length of bituminous material has been laid, rolling shall commence with 8 – 10 tonne rollers, - smooth wheel tandem type, or other approved equipment. Rolling shall begin at the edge and progress toward the center longitudinally, except that on super elevated and uni-directional cambered portions, it shall progress from the lower to upper edge parallel to the centre line of the pavement.

When the roller has passed over the whole area once, any high spots or depressions, which become apparent, shall be corrected by removing or adding premixed materials. Rolling shall then be continued until the entire surface has been rolled and all the roller marks eliminated. In each pass of the roller the preceding track shall be overlapped uniformly by at least 1/3 width. The roller wheels shall be kept damp to prevent the premix from adhering to the wheels. In no case shall fuel/lubricating oil be used for this purpose. Excess use of water for this purpose shall also be avoided.

Rollers shall not stand on newly laid material. Rolling operations shall be completed in every respect before the temperature of the mix falls below 100° C. Joints along and transverse to the surfacing laid and compacted earlier shall be cut vertically to their full depth so as to expose fresh surface which shall be painted with a thin coat of appropriate.¹ hinder before the new mix is placed against it.

Opening to traffic :

No traffic shall be allowed on the road until the seal coat has been laid. After the seal coat is laid, the road may be opened to traffic according to Clause 513.4. of MORT&H specifications

Surface finish and quality control of work :

The surface finish of construction shall conform to the requirements of Clause 902 of MORT&H specifications. For control of the quality of materials supplied and the works carried out, the relevant provisions of Section 900 of MORT&H specifications shall apply.

Arrangements for traffic :

During the period of construction, arrangement of traffic shall be made in accordance with the provisions of Clause 112 of MORT&H specifications.

Measurement for Payment :-

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

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

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

Weight of mix materials will be done in presence of responsible person, not less than the rank of Supervisor of Department and the measurements shall be recorded by the Deputy Executive Engineer or Assistant Engineer or Additional Assistant Engineer, if so

authorized. Record of each dumper will be mentioned separately in bond and numbered register which will be maintained by the Department representatives and signed by the contractor. Proper gate pass system shall be established for the vehicle coming to the plant site and going from the site. The location of the K.M. hectometer and meter in which individual dumpers are unloaded shall be recorded carefully.

Rate :- The contract unit rate for Open graded premix carpet shall be payment in full for carrying out the required operations as specified. The rate shall include for all components listed below.

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

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

Item No.12 Providing and laying seal coat with B.T. aggregate as specified using aggregate at the rate of 0.18 Cu.mt./10 Sq. mt. and bitumen grade VG-30 for mixing with aggregate at the rate of 4.5 % i.e. 45.00 Kg. / M.T. of total mix including heating and mixing in drum mix plant and transporting and spreading the same by paver finisher and consolidation with vibratory roller including necessary fire wood , oil , lubricant , labour charges using contractor's own drum mix plant, machineries and equipment tools etc. complete in accordance with the requirement of specification

513.1. Scope

513.1.1. This work shall consist of the application of a seal coat for sealing the voids in a bituminous surface laid to the specified levels^ grade and cross fall (camber).

513.1.2. Seal coat shall be of Premixed seal coat comprising of a thin application of fine aggregate premixed with bituminous binder.

513.2. Materials

Bitumen :-

The bitumen shall be paving bitumen of penetration grade 80/100 (VG-10) complying with Indian Standard specification for “Paving Bitumen” IS:73

Coarse aggregates :-

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, 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 have 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 aggregate shall be tested for stripping.

The aggregates shall satisfy the physical requirements set forth in Table 500-3 as under.

**Table 500.3 Physical, Requirements for Coarse aggregates
for bituminous Macadam**

Property	Test	Specification
Cleanliness	Grain Size analysis	Max. 5% passing 0.075 mm sieve.
Particle shape	Flakiness and Elongation Index (Combined)	Max. 30%
Strength	Los Angeles Abrasion Value	Max. 40%
	Aggregate Impact Value	Max. 30%
Durability	Soundness	
	Sodium Sulphate	Max. 12%
	Magnesium Sulphate	Max. 18%
Water Absorption	Water Absorption	Max. 2%
Stripping	Coating and stripping of Bitumen aggregate Mixtures.	Minimum retained coating 95%
Water Sensitivity	Retained Tensile Strength	Minimum 80%

Notes :-

[1] IS : 2386 Part – 1

[2] IS : 2386 Part – 1 [the elongation test to be done only on non-flaky aggregate in the sample]

[3] IS : 2386 Part – 4 [4] IS : 2386 Part – 5

[5] IS : 2386 Part – 3 [6] IS : 6241

[7] 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.

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

513.2.3. Aggregate for Type B seal coat : The aggregate shall be sand or grit and shall consist of clean, hard, durable, uncoated dry particles and shall be free from dust, soft or flaky / elongated material, organic matter or other deleterious substances. The aggregate shall

pass 2.36mm sieve and be retained on 180 micron sieve. The quantity used for premixing shall be 0.18 cubic metres per 10 square metres area.

AGGREGATE GRADATION

IS Sieve Designation (mm)	Cumulative per total weight of total aggregate passing	
	Type A	Type B
13.2mm	--	100
11.2mm	100	88-100
5.6mm	52-88	31-52
2.8mm	14-38	5-25
0.090 mm	0-5	0-5

The quantity of binder used for premixing in terms of straight run bitumen 80/100 (VG-10) grade shall be 4.50 % by weight of mix.

513.3. Construction Operations

513.3.1. Weather and seasonal limitations:

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

513.3.2. Preparation of surface : The seal coat shall be applied immediately after laying the bituminous course which is required to be sealed. Before application of seal coat materials, the surface shall be cleaned free of any dust or other extraneous matter.

513.3.4. Construction of Type B seal coat: A mixer of appropriate capacity and type approved by the Engineer shall be used for preparation of the mixed material. The plant shall have separate dryer arrangements for heating aggregate.

The binder shall be heated in boilers of suitable design, approved by the Engineer to the temperature appropriate to the grade of bitumen or as directed by the Engineer. The aggregates shall be dry and suitably heated to a temperature between 150°C and 165°C or as directed by the Engineer before these components are placed in the mixer. Mixing of binder with aggregates to the specified proportions shall be continued until the latter are thoroughly coated with the former.

The mix shall be immediately transported from the mixing plant to the point of use and spread uniformly on the bituminous surface to be sealed.

As soon as a sufficient length has been covered with the premixed material, the surface shall be rolled with an 8-10 tonne smooth-wheeled roller. Rolling shall be continued until the premixed material completely seals the voids in the bituminous course and a smooth uniform surface is obtained.

513.4. Opening to Traffic

In the case of Type B seal coat, traffic may be allowed soon after final rolling when the premixed material has cooled down to the surrounding temperature.

513.5. Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements of Clause 902 of MORT&H specifications.

For control on the quality of materials supplied and the works carried out, the relevant provisions of Section 900 of MORT&H specifications shall apply.

513.6. Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112 of MORT&H specifications

513.7. Measurement for Payment

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

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

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

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

513.8. Rate

The contract unit rate for seal coat shall be payment in full for carrying out the required operations as specified. The rate shall include for all components listed below.

- (i) Making arrangements for traffic to clause 112 except for initial treatment to verge, shoulders and construction of diversions.
- (ii) Preparation of the surface to revive the materials.
- (iii) Providing all materials to be incorporated in the work including arrangement for stock yards. All royalties, fees rents where necessary and all leads and lifts.
- (iv) Mixing transporting, laying and compacting the mix as specified.
- (v) All labour, tools equipment, plant including installation of hot mix plant, power supply units and all machinery incidental to complete the work to these specification.
- (vi) Carrying out the work in part widths of the road where directed.
- (vii) Carrying out all tests for control of quality, and

- (viii) The rate shall cover the provision of bitumen at the rate specified in the contract, with the provision that the variation in actual percentage of bitumen used will be assessed and the payment adjusted accordingly.
- (ix) The rate for premixed material are to include for all wastage in cutting of joints etc.
- (x) The rates are to include for all necessary testing mix design transporting and testing of samples, and cores. If there is not a project specific : laboratory, the contractor must arrange to carry out all necessary testing at an outside laboratory approved by the Engineer, and all costs incurred are deemed to be included in the rate quoted for the material.
- (xi) The cost of all plant and laying trials as specified to prove the mixing and laying methods is deemed, to be included in the contractor's rates for the materials.

Item No.13 Providing and laying asphalt painting on B.T. surface with bitumen VG-30 at rate 5.00Kg / 10Sq.mt. including spreading stone dust for painting surface at rate of 0.03 cu.mt. / 10 sq.mt.

1 Scope :-

This work shall consist of the application of a single coat of bitumen (VG-30)grade to an existing bituminous road surface in accordance with the following specifications.

2 Materials :-

2.1 Bitumen :-The bitumen used for asphalt painting shall be (VG-30) grade complying with IS: 73

2.2 Stone Dust :-

2.2.1. This shall be obtained from crushing hard black trap or equivalent. It shall not contain more than 8% of silt as determined by field test will measuring cylinder. The method of determining silt contents by fields test is given as under :

2.2.2. A sample of stone dust to be tested shall be placed without drying in 200 mm. measuring cylinder. The quantity of the sample shall be such that it fills the cylinder up to 100 mm. mark. The clean water shall be added up to 150 mm. mark. The mixture shall be stirred vigorously and the content allowed to settle for 3 hours.

2.2.3. The height of silt, visible as settled layer above the stone dust shall be expressed as percentage of the height of the stone dust below The stone dust containing more than 8% silt shall be washed so as to bring the content within the allowable limit.

2.2.4. The fineness modules of stone dust shall not be less than 1.80

3 Weather and Seasonal Limitations :-

Bituminous material shall not be applied to a wet surface or during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less then 10⁰ C.

4 Construction :-

4.1 Equipment :-

The asphalt painting shall be applied through a distributor and it shall be a self propelled or towed bitumen pressure sprayer equipped for spraying the material uniformly at a

specified rate, hand spraying of small areas, inaccessible to the distributor in narrow strips, shall be sprayed with a pressure hand sprayer or as directed by the Engineer.

4.2 Preparation of base :-

The surface on which the asphalt painting is to be applied shall be clean and free from dust, dirt and any extraneous material and other wise prepared in accordance with the requirements of Clauses-501.8 & 513 of MORT & H as appropriate. Immediately before the application of the asphalt painting the surface shall be swept clean with a mechanical broom and high-pressure air jet or by other means as directed by the Engineer.

4.3 Application of asphalt painting :-

The application of asphalt for painting shall be at 5.0 Kg/ 10 Sq.mt. as specified in the contract and shall be applied uniformly. The asphalt shall be heated in the tanker and the temperature of the asphalt at the time of spraying shall be in the range of 150⁰C -177⁰C.

The method of application of the tack coat will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar, and speed of forward movement. The contractor shall demonstrate a spraying trial that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

5.0 Spreading of Stone Dust

Soon after the spraying of asphalt, the stone dust shall be spread evenly with a twisting motion of baskets at the rate of 0.03Cum/10 Sqm. The entire surface shall be broomed to ensure uniform application of the stone dust. While the traffic is allowed on the painted surface and at later stage if additional stone dust is required, it shall be carried out by the contractor without any extra payment.

6.0 Opening to Traffic :-

Traffic may be allowed immediately after completion of flushing of stone dust on asphalt painted surface.

7.0 Arrangement of Traffic :-

The provision of MOST Specification Clause 112 shall apply as regards the flow of traffic during construction.

8.0 Mode of Measurement & Payment :

The Item shall be measured and paid as finished work in Square meters. The rates shall include the cost of all materials, labour, equipments etc. involved in all the operations described above. The rate shall be for a unit of one sq. meter.

Item No.14 Providing and fixing ordinary kilometer stone of precast C.C. 1:2:4 including necessary reinforcement as per I.R.C. type design in C.C. 1:4:8 including lettering and painting etc. complete. (For OD.R. & V.R.)

1. Kilometer stone shall be of approved quality and shall be of 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 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.
3. The measurement for payment shall be made per No. of K.M. stone fixed in position.

4. Unit 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.15 Providing and fixing Hectometer stone as per I.R.C. type design including lettering and painting etc. complete. (ii) Fixing in C.C. 1:5:10

1. Hectometer stone shall be of approved quality and as per I.R.C. 26 (Type design for 200 meter stones) and shall be fixed in C.C. 1:5:10 which will consist of one part of cement, five part of good sand and ten parts of machine crushed metal 40 mm nominal size. Rate includes all labour and curing etc. necessary for concrete.
2. The measurement for payment shall be made per No. of Hectometer stone fixed in position.
3. Unit rate for hectometer stone includes the cost of all materials, labour, tools, fixing, finishing curing, lettering and painting as directed by the Engineer-in-charge

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

801.1 GENERAL

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

801.1.2 The signs shall be reflectorised type and made of encapsulated lens type reflective sheeting vide Clause 801.3, fixed over aluminium sheeting as per these Specifications.

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

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

- 801.2.1 Concrete :** Concrete shall be of the grade shown on the contract drawings or otherwise as directed by the Engineer.
- 801.2.2 Reinforcing Steel :** Reinforcing steel shall conform to the requirement of IS : 1786 unless otherwise shown on the drawing.
- 801.2.3 Bolts, nuts, washers:** High strength bolts shall conform to IS: 1367 whereas precision bolts, nuts, etc. shall conform to IS: 1364.
- 801.2.4 Plates and supports:** Plates and support sections for the sign posts. shall conform to IS:226 and IS:2062 or any other relevant IS Specifications.
- 801.2.5 Aluminium:** Aluminium sheets used for sign boards shall be of smooth, hard and corrosion resistant aluminium alloy conforming to IS:736 Material designation 24345 or 1900.
- 801.2.6 Signs with a maximum side dimension not exceeding 600 mm shall not be less than 1.5 mm thick. All others shall be at least 2 mm thick. The thickness of the sheet shall be related to the size of the sign and its support and shall be such that it does not bend or deform under the prevailing wind and other loads.
- 801.2.7 In respect of sign sizes not covered by IRC:67, the structural details (thickness, etc.) shall be as per the approved drawings.

801.3 TRAFFIC SIGNS HAVING RETRO-REFLECTIVE SHEETING

- 801.3.1 General Requirements: The retro-reflective sheeting used on the sign shall consist of the white or coloured sheeting having a smooth outer surface which has the property of retro-reflection over its entire surface. It shall be weather-resistant and show colour fastness. It shall be new and unused and shall show no evidence of cracking, scaling, pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate of having tested the sheeting for these properties in an unprotected outdoor exposure facing the sun for two years and its having passed these tests shall be obtained from a reputed laboratory, by the manufacturer of the sheeting. The reflective sheeting shall be either of Engineering Grade material with enclosed lens or of High Intensity Grade with encapsulated lens. The type of the sheeting to be used would depend upon the type, functional hierarchy and importance of the road.
- 801.3.3 Engineering Grade sheeting :** This sheeting shall be of enclosed lens type consisting of microscopic lens elements embedded beneath the surface of a smooth, flexible, transparent, water-proof plastic, resulting in a non-exposed lens optical reflecting system. The retro reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro-reflection (determined In accordance with ASTM Standard :E-81 0) as indicated in Table 800-2.

Table 800 – 2

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

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

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

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

801.3.5 For screen-printed transparent coloured areas on white sheeting, the co-efficient of retro-reflection shall not be less than 50 per cent of the values of corresponding colour in Tables 800-1 and 800-2, as applicable.

801.3.6 Cut-out messages and borders, wherever used, shall be made out of retro-reflective sheeting (as per Clause 801.3.2 or 801.3.3 as applicable), except those in black which shall be of non-reflective sheeting.

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

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

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

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

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

801.3.10 FABRICATION :

801.3.10.1 Surface to be reflectorised shall be effectively prepared to receive the retro reflective sheeting. The aluminium sheeting shall be degreased either by acid or hot alkaline etching and all scale/dust removed to obtain a smooth plain surface before the application of retro-reflective sheeting. If the surface is rough, approved surface primer may be used. After cleaning, metal shall not be handled, except by suitable device or

clean canvas gloves, between all cleaning and preparation operation and application of reflective sheeting/primer. There shall be no opportunity for metal to come in contact with grease, oil or other contaminants prior to the application of retro-reflective sheeting.

801.3.10.2 Complete sheets of the material shall be used on the signs except where it is unavoidable; at splices, sheeting with pressure sensitive 1 adhesives shall be overlapped not less than 5 mm. Sheeting with heat activated adhesives may be spliced with an overlap not less than 5 mm or butted with a gap not exceeding 0.75 mm. Where screen printing with transparent colours is proposed, only butt jointing shall be used. The material shall cover the sign surface evenly and shall be free from twists, cracks and folds. Cut-outs to produce legends and borders shall be bonded with the sheeting in the manner specified by the manufacturer.

801.3.11 Warranty and durability: The contractor shall obtain from the manufacturer a seven year warranty for satisfactory field performance including stipulated retro-reflectance of the retro-reflective sheeting of high intensity grade and a five year warranty for the adhesive sheeting of engineering grade and submit the same to the Engineer. In addition, a seven year and a five year warranty for satisfactory in field performance of the finished sign with retro-reflective sheeting of high intensity grade and engineering grade respectively, inclusive of the screen printed or cut out letters/legends and their bonding to the retro-reflective sheeting shall be obtained from the Contractor/supplier and passed on to the Engineer. The Contractor/supplier shall also furnish a certification to 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 (Tables 800-1 and 800-2) when subjected to accelerated weathering for 1000 hours, using type E or EH weatherometer (AASHTO Designation M 268).

801.4 INSTALLATION

801.4.1 Sign posts, their foundations and sign mountings shall be so constructed as to hold these in a proper and permanent position against the normal storm wind loads or displacement by vandalism. Normally, signs with an area 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 end(s) shall be firmly fixed to the ground by means of properly designed foundation. The work of foundation shall conform to relevant specifications as specified.

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

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

801.5 MEASUREMENTS FOR PAYMENT

The measurement of information signs shall be in numbers sign board supplied and fixed.

801.6RATE

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.17 MMGSY Logo Board:- Providing and fixing MMGSY Logo Board made out of 2mm aluminium sheet, as per the drawing & design. Pre treated with phosphating process and acid etching coated with one coat of epoxy primer and two coat of best quality epoxy paint, reflectorized with retro reflective sheeting as per the latest M.O.S.T. specification, 3.1 Mt. long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3 mm, 75 x 75 x 6 mm 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 (A)Engineering grade.**

The work of providing and fixing MMGSY board shall be executed as per relevant specifications of **Item No. 16** of this contract. The measurement shall be in numbers of board supplied and fixed in position

- Item No.18 Village name/ Bump Ahead sign :-Providing and fixing sign boards made out of 2mm aluminium sheet; size 90 x 60cms. rectangle as as per the design of IRC-67-1977 pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; Letters and numerals should be as per IRC-30-1968, 3.1m long (2 nos) stand post and frame fabricated from suitable size iron angle of 50 x 50 x 5mm painted with best quality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)...**

The work of providing and fixing Village Name board shall be executed as per relevant specifications of **Item No. 16** of this contract. The measurement shall be in numbers of board supplied and fixed in position.

- Item No.19 Road marking with hot applied thermoplastic paints with reflectorising glass beads on bitumin surface providing and laying a hot applied thermoplastic compound 2.5 mm thick including reflectorising glass beads @ 250gms per sqm area, thickness of 2.5mm is excluding of surface applied glass beds as per IRC:35-2015. The finished surface to be level, uniform and free from streaks and holes. zebra patta /bump patta lane/center line/ edge line/cut patta. The white color marking should provide liminance coefficinet on cemend road shall be min 130 mcd/m2/lux and Asphalt road shall be min 100 mcd/m2/lux during the service lifeduring the day time. The marking should meet the performance criteria for night time reflectivity, wet reflectivity and skid resistance as mentioned in the section-15 of IRC 35-2015. Warranty for the Retro reflectivity should be two years.**

General :-

Hot Applied Thermoplastic Road Marking.

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

THERMOPLASTIC MATERIALS GENERAL :

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

REQUIREMENT :

Composition: the pigment, beads and aggregate shall be uniformly dispersed in the resin. The material shall be free from all skins, dirt and foreign objects and shall comply with requirements indicated in Table 800 – 3.

**Table 800 – 3 PROPORTIONS OF CONSTITUENTS OF MARKING MATERIAL
(percentage by weight)**

Component	White	Yellow
Binder	18.00 min.	18.00 min.
Glass Beads	30 – 40	30 – 40

Titanium Dioxide	10.00 min.	- - -
Calcium Carbonate and Inert Fillers	42.00 max	See Note
Yellow Pigments	- - -	- do -

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

II Properties : The properties of thermoplastic material, when tested in accordance with ASTM D36/ BX-3262- (Pa. T1) shall be as below :

A) Luminance :

White : Daylight luminance at 45 degree 65 per cent min. as per AASHTO M 249.

B) Drying time : When applied at a temperature specification by the manufactures and to the required thickness, the material shall set to bear traffic in not more than 15 minutes.

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

D) Cracking resistance at low temperature : The material shall show no cracks on application to concrete blocks.

E) Softening point : $102.5 \div 9.5$ as per ASTM D 36.

F) Flow resistance : Note more than 25 per cent as per AASHTO M 249.

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

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

IV Reflectorisation : Shall be achieved by incorporation of beads, the grading and other properties of the beads shall be as specified in Clause 803.4.3 of MORT & H Specification.

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

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

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

REFLECTORIZING GLASS BEADS

GENERAL : This Specification covers two types of glass beads to be used for to production of reflectorised pavement markings. Type 1 beads are those which are a constituent of the basic thermoplastic compound vide Table 800 – 3 and type – 2 beads are those which are to be sprayed on the surface vide Clause 803.6.3.

The glass beads shall be transparent, colourless and free from milliness, dark particles and excessive air inclusions.

These shall conform to the requirements spelt out in clause 5.4.3.3.

SPECIFIC REQUIREMENTS. A GRADATION :

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

TABLE 800-4 GRADATION REQUIREMENT FOR GLASSBEADS

Sieve Size	Per Cent Retained	
	Table – 1	Table – 2
1.18 mm	0 to 3	--
850 micron	5 to 20	0 to 5
600 micron	--	5 to 20
425 micron	65 to 95	--
300 micron	--	30 to 75
180 micron	0 to 10	10 to 30
Below 180 micron		0 to 15

B. ROUNDNESS :

The glass beads shall have a minimum of 70 per cent true spheres.

C. REFRACTIVE INDEX :

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

D. FREE FLOWING PROPERTIES :

The glass beads shall be free of hard lumps and clusters and shall dispense readily under any condition suitable for paints striping. They shall pass the free flow-test.

TEST METHODS :

The specific requirement shall be tested with the following methods.

- I Free-flow test : Spread 100grams of beads evenly in a 100 mm diameter glass dish. Place the dish in a 250 mm inside diameter desiccators which is filled within 25 mm of the top of a desiccators plate with sulphur acid water solution (specific gravity 1.10) Cover the desiccators and let it stand for 4 hours at 20 to 29 degree C. Remove Sample from desiccators, transfer beads to a pan and inspect for lumps or clusters. Then pour beads into a clean dry glass funnel having a 100 mm stem and 6 mm orifice. If necessary, initiate flow by lightly tapping the funnel. The glass spheres shall be essentially free of lumps and clusters and shall flow freely through the funnel.
- II The requirements of gradation, roundness and refractive index of glass beads and the amount of glass beads in the compound shall be tested as per BS 6088 and BS 3262 (Part 1).
- III The Contractor shall furnish to the Employer a copy of certified test report from the manufacturer of glass beads obtained from a reputed laboratory showing results of all tests specified therein and shall certify that material meets all requirements of this Specification. However, if so required, these tests may be carried out as directed by the Engineer in charge.

APPLICATION PROPERTIES OF THERMOPLASTIC MATERIAL

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

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

PREPARATION :

- i) The material shall be melted in accordance with the manufacturer's instructions in a heater fitted with a mechanical stirrer to give a smooth consistency to the thermoplastic materials to avoid local overheating. The temperature of the mass shall be within the range specified by the manufacturer, and shall on no account be allowed to exceed the maximum temperature stated by the manufacturer. The molten material should be used as expeditiously as possible and for thermoplastic materials. Which has natural binders or is otherwise sensitive to prolonged heating the materials shall be maintained in a molten condition for more than 4 hours.
- ii) After transfer to the laying equipment, the material shall be maintained within the temperature range specified by the manufacturer for achieving the desired consistency for laying.

PROPERTIES OF FINISHED ROAD MARKING :

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

REFLECTORISED PAINT :

Reflectorised paint, if used shall conform to the specification by the manufacturers and approved by the engineer. Reflectorising glass beads for reflectorising paints where used shall conform to the requirements of Clause 5.3.

APPLICATION

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

The thermoplastic materials shall be applied hot either by screening or extrusion process. After transfer to the laying apparatus, the material shall be laid at a temperature within the range specified by the manufacturer for the particular method of laying being used. The paint shall be applied using a screed or extrusion machine.

The pavement temperature shall not be less than 10 C. during application. All surface to be marked shall be thoroughly cleaned of all dust, dirt, grease, oil and all other foreign matter before application of the paint.

The material, when formed into traffic stripes, must be readily renewable by placing an overlay of new material directly over an old line of compatible material. Such new material shall so bend itself to the old line that no splitting or separation takes place.

Thermoplastic paint shall be applied in intermittent or continuous lines of uniform thickness of at least 2.5 mm unless specified otherwise. Where arrows or letters are to be provided, thermoplastic compound may be hand-sprayed. In addition to the beads included in the material, a further quantity of glass beads of Type 2, conforming to the above noted specification shall be sprayed uniformly into a mono layer on to the hot paint line quick succession of the paint spraying operation. The glass beads shall be applied at the rate of 250 grams per square meter area.

The minimum thickness specified in exclusive of surface applied glass beads. The method of thickness measurement shall be in accordance with Appendices B and C of BS- 3262 (Part 3).

The finished lines shall be free from ruggedness on sides and ends and be parallel to the general alignment of the carriageway. The upper surface of the lines shall be level, uniform and free from streaks.

MEASUREMENT FOR PAYMENT.

The painted marking shall be measured in sq. meters of actual area marked (excluding the gaps. If any).

In respect of markings line directional arrows and lettering. Etc., the measurement shall be in Square meter basis.

Rate

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

Item No.23 Cautionary Warning sign :- Providing and fixing Cautionary Sign Board made out of 2mm aluminium sheet, size 90 x 90 x 90 cms equilateral triangle, as per the design of IRC-67-1977. Pre treated with phosphating process and acid etching coated with one coat of epoxy primer and two coats of best quality epoxy paint, reflectorized with retro reflective sheeting as per the latest M.O.S.T. specification, 3.1 Mt. long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3 mm, 75 x 75 x 6 mm; painted with best quality epoxy coating in black and white bands. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 cms for each leg, including excavation curing etc. complete under the supervision of Engineer-In-Charge (A) Engineering grade.

The work of providing and fixing **Cautionary Warning sign** shall be executed as per relevant specifications of **Item No. 16** of this contract. The measurement shall be in numbers of board supplied and fixed in position.

Item No.24 Chevron sign :-Providing and fixing sign boards made out of 1.5mm aluminium sheet / 3mm ACP (Aluminum composite Panel); size 60x50cm rectangular as per design of IRC-67-2012. Pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflective sheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.3 mtr long stand post of Iron Angle 75 x75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35x35x3mm; painted with best quality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 Cms. for each leg including excavation, curing etc. complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be

The work of providing and fixing **Chevron sign** shall be executed as per relevant specifications of **Item No. 16** of this contract. The measurement shall be in numbers of board supplied and fixed in position.

Item No.25 Regulatory/Mandatory signs :Providing and fixing sign boards made out of 2mm aluminium sheet; size 60cms. diameter circle as per the design of IRC-67-1977 pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm 75x75x6mm as required; painted with best quality epoxy coatings in black and white bends. the details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineering grade.

The work of providing and fixing **Regulatory/Mandatory signs** shall be executed as per relevant specifications of **Item No. 16** of this contract. The measurement shall be in numbers of board supplied and fixed in position.

Item No.25 Hazard Marker Sign :-Providing and fixing sign boards made out of 2.0 mm aluminium sheet / 4 mm ACP (Aluminum composite Panel); size 90x30 cms. rectangular as per design of IRC-67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 1.8mtr long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective

The work of providing and fixing **Hazard Marker Sign** shall be executed as per relevant specifications of **Item No. 16** of this contract. The measurement shall be in numbers of board supplied and fixed in position.

Item No.25 STOP SIGN:-Providing and fixing sing boards made out of 2mm aluminium sheet; size 90 x 90cms. rectangle as per the design of IRC-67-1977 pre treated with phospheting process & acid teching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm 75x75x6mm as required; painted with best quality epoxy coatings in black and white bends. the details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing tec. complete under the supervision of engineer in charge.(A) Engineering grade.

The work of providing and fixing **STOP SIGN** shall be executed as per relevant specifications of **Item No. 16** of this contract. The measurement shall be in numbers of board supplied and fixed in position.

Item No.27 Excavation for foundation up to 1.5m depth including sorting out and stacking of useful material and disposing off the excavated stuff as directed by Engineer in charge with all lead and lift in (2) 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 obstruction 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 string 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 put up necessary shoring, strutting and planking or cut slopes to a safer angle or both with due regard to the safety of personal and works and to the satisfaction of the Engineer-in-charge.
4. The depth to which the excavation is to be carried out shall be 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 leveled both longitudinally and transversely or stepped as directed by the Engineer-in-charge. Before footing is laid, the surface shall be slightly watered and rammed. In the event of excavation having been made deeper than that shown on the drawings or as otherwise ordered by the Engineer-in-charge, the extra depth shall be made up with concrete or masonry of the foundation grade at the cost of the contractor. Ordinary filling shall not be used for the purpose to bring the foundation to level. If there are any slips or blows in the excavation, these shall be removed by the contractor at his own cost.
8. Near towns, villages and all frequented places, trenches and foundation pits shall be securely fenced, provided with proper caution signs and marked with red lights at night to avoid accidents. The contractor shall take adequate protective measures to see that the excavation operations do not affect or damage adjoining structures.
9. 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 are to be used in the construction of embankment, it shall be directly deposited at the required location, with all lead as directed.
11. All useful materials not intended for use in the bank, shall be stacked neatly on Government land as directed by the Engineer-in-charge with all lead. Unsuitable and surplus materials not intended for use shall be disposed off as directed by the Engineer-in-charge.
12. Excavation for structures shall be measured in cubic meters for each class of materials encountered, limited to the dimensions shown on the drawing or as directed by the Engineer-in-charge. Excavation over increased width cutting of slopes, shoring, shuttering and planking shall be deemed as convenience for the contractor in executing the work and shall 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;
 6. All labour, materials, tools equipment, safeguards and incidentals necessary to complete the work to the specification.
14. Excavation shall be for dense or hard soil such as vegetation or organic soil, turf, sand, silt, loam, clay, mud, black cotton soil, soft shale or soft murrum, 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 75 mm. occurring in such strata shall be deemed to be covered under this category. The classification of excavation shall be decided by the Engineer-in-charge and his decision shall be final and binding on the contractor.

Item No.28 Providing & filling in foundation with ordinary cement concrete M 100 mix and providing necessary vertical pin headers including formwork vibrating ramming & curing complete.

Ordinary cement concrete of specified Grade i.e. cement concrete M-100 shall be carried out in accordance with the following relevant specification.

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 volume as

given in table below for different grades of concrete 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 the specified 28 days works cube compressive strength of that mix on 150 mm. cubes expressed in kg/cm².
3. The ordinary concrete mix shall generally be specified by volume. For cement which normally comes in bags and is used by weight, volume shall be worked out taking 50 kg. of cement as 0.035 cubic meter in volume. While measuring aggregate by volume, shaking, ramming or hammering shall not be done. Proportioning of sand shall be as per its dry volume. In case it is dump, 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 of different proportions of mix shall be as given in Table below.

TABLE

Grade of Concrete	Mix By Volume	Total Quantity of dry aggregates by volume per 50 Kg. of cement, to be taken as sum of the individual volumes of fine and coarse aggregates max	Proportion of fine aggregate to coarse aggregate	Quantity of water per 50 kg. of cement max.
1	2	3	4	5
(1 Cubic meter = 1000 liters)				
Ordinary	Liters			Liters
M.100	1:3:6	300	General 1:2 for fine aggregate to coarse aggregate by volume but subject to a upper limit of 1:1. ½ & a lower limit of 1:3	34
M.150	1:2:4	220		32
M.200	1:1.1/2:3	160		30
M.250	1:1:2	100		27

NOTE- The proportions of the aggregates shall be adjusted from upper limit to lower limit progressively as the grading of the fine aggregates becomes finer & 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 aggregates 10 mm, 20 mm. and 40 mm. respectively (after carrying out sieve analysis).

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.	Item of Construction	Maximum nominal size of
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No.		Coarse aggregate
(i)	R.C.C. well curb. R.C.C. well staining and R.C.C. Piles	40 mm
(ii)	R.C.C. well staining	63 mm
(iii)	Well cap or pile cap; solid type piers, abutment and wing-walls, and their pier caps	40 mm
(iv)	R.C.C. works in cross girders deck slab, wearing coats, 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 items (i) to (v)	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 substances. The sand be got approved by the Engineer-in-charge.
7. All materials shall be stored as to prevent their deterioration or intrusion of their quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-charge shall not be used in the 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 size 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 class working condition and so maintained throughout the construction. Mixing shall be continued till materials are uniformly distributed and uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate show complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.
11. When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons. It shall be done en 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 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 Engineering-in-charge. Concrete shall be so transported and placed that no contamination, segregation or loss 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. Concreting being given, 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 agitators, operating continuously, when this time shall be within 2 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to be the Engineer-in-charge, concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 meter when internal vibrators are used and not exceeding 0.30 meter 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 meters. When trucking or chutes are used they shall be kept clean and used in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept, clean, thoroughly wetted and covered with a 13 mm. thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the well 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, running 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. 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. 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 counter-sunk and well ground to provide a smooth, plane surface.
19. Forms shall be mortar-tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports, They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribe lines occurring during and after placing the concrete. Screw jacks or hard wood 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 counteract the effects of any fixed as to provide for such camber. Forms shall be so constructed as to be removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections. Unless otherwise specified or directed, chamfers or fillets of sizes 25 mm x 25 mm shall be provided at all angles of formwork to avoid sharp corners.
20. The inside surfaces of shuttering shall, except in the case of permanent form work or where otherwise agreed to by the Engineer-in-charge, be coated with an approved material to prevent adhesion of concrete to the form work. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not be allowed to come into contact with any reinforcement or pre-stressing tendons and anchorages. Different release agents 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 work is removed. Where ever applicable arrangements 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 tendon's. The form work should take due account of the calculated amount of positive or negative camber so as to ensure the correct final shape of the structures having regard to the deformation of a false work, scaffolding or propping and the instantaneous or deferred deformation due to various causes affecting pre-stressed structures. Where there are re-entrant angles in the concrete sections the form work should be removed, at those sections as soon as possible after the concrete has set in order

to avoid cracking due to shrinkage of concrete. Formwork shall be tight enough to prevent any appreciable loss of cement during vibrations, suitable tolerances should be provided in the formwork. Immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the Engineer-in-charge due notice before pouring any concrete in the forms to permit him to inspect and accept the formwork 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, character of the structure, the weather and other conditions that influence the setting 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 or soffit forms may commence when concrete has attained strength equal to at least twice the stress to which the concrete will be subjected at the time of striking props including the effect of any further addition 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 lowered in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted, they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to reuse the formwork, it shall be cleaned and made good to the satisfaction, of the Engineer-in-charge.
23. Immediately after the removal of forms, all exposed bars or bolts passing through the cement concrete member and used for shuttering or any other purpose shall be cut inside the cement concrete member to a depth of at least 25 mm. below the surface of the concrete and the resulting holes 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, honey comb spots, broken edges or corners and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry as consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces which have been pointed shall be kept moist for a period of twenty four hours. If 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.

Type of Work	Slumps
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	Where vibrators are used	Where vibrators are not used
1 Mass concrete in RCC foundations, footings and retaining walls	10 mm to 25 mm	80 mm
2 Beams, slabs and columns simply reinforced.	25mm to 40 mm	100 to 120 mm
3 Thin R.C.C. section or section with congested steel	40 mm to 50 mm 50 mm	125 mm to 150 mm 150 mm

25. Works strength tests shall be made in accordance with IS : 516. Each test shall be conducted on ten specimens, five of which shall be tested at seven days and the remaining five at 28 days. The samples of concrete shall be taken on each day of concreting and cubes shall be made at the rate of one for every 5 cubic meter of concrete or a part thereof. However, if concreting done in a day is less than 15 cubic meter, the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer-in-charge. Similar works tests shall be carried out whenever the quality and grading of materials is charged irrespective of the quantity of concrete provided. The number of specimens may be suitably increased as deemed necessary by the Engineer-in-charge when procedure of tests given above reveal 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 for each day may have values less than the specified strength, provided the lowest value is not less than 85 per cent of the specified strength.
27. R.C.C. work shall have exposed concrete surface. Centering design and its erection shall be approved by the Engineer-in-charge. One carpenter with helper will invariably be kept 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 Asstt. Engineer/Addl. Asstt. 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 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 show on the drawings and according to these specifications. The rate shall also include the cost of making/fixing and removing of all centers and forms required for the work.

Item No.29 Providing & filling in foundation with ordinary cement concrete M 150 mix and providing necessary vertical pin headers including formwork vibrating ramming & curing complete.

This work shall consist of providing and filling in foundation with ordinary cement concrete M.150 mix and shall be carried out as per relevant detailed specification of **Item No. 27** of this contract. The payment will be made on Cum basis of the finished work.

Item No.30 Supplying fixing & joining reinforced concret heavy duty non pressure pipe carrying indian railway standard with collars for culverts carrying heavy traffic as per Indian railway standard specification including setting and joining the pipe in cement mortar 1:2 watering or laying (to level and slope)of I.S.class NP-3 900mm dia internal

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 NP-3 type conforming to the requirements of IS: 458 and shall be of 300, 600, 900, 1200 mm internal dia. as specified in the item. Each consignment of cement concrete pipes shall be inspected, if necessary and approved by the Engineer-in-charge, either at the place of manufacture or at the site before their incorporation in the works.

NP3, NP2, NP1 pipes are used for R.C.C. 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 contractor from his responsibility of supplying pipes of required standard and will have to bear the loss or damage caused to the work on account of defects found subsequently during 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 carryout 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 works they form a culvert with a smooth uniform invert. Any pipe found defective or damaged during laying shall be removed at there cost of Contractor.
4. The pipes shall be jointed either by collar joint or by flush joint. In the former case, the collars shall be of R.C.C., 150 to 200 mm wide and having the same strength as the pipes to be jointed. Caulking space shall be between 13 and 20 mm according to the diameter of the pipes. Caulking material shall be slightly wet mix of cement and sand in the ratio of 1:2 rammed with Caulking irons. Before caulking the collar shall be so placed that its centre coincides with that of pipe and an even annular space is left between the collar and the pipes. Flush joint may be shaped to form a self centering joint with a joining space 13 cm wide. The joining space shall be filled with cement mortar. 1 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 joint shall be kept covered and damp for at least four days.
5. R.C.C. pipe shall be measured along their centre between their inlet and outlet ends in linear meters.
6. The rate for the pipes shall include the cost of pipe including loading, unloading, handling storing laying in position and joining complete.

Item No.31 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. The guard stone shall be of approved quality and of 20 cm x 15 cm. size and its length shall not be less than 75 cms. The top portion shall be rounded. The top 38 cm. shall be chisel dressed on all sides. The size, shape and dimensions of the guard stones shall be exact and shall be neatly dressed and finished.
2. The guard stone shall be fixed in position as directed by the Engineer-in-charge in earth. The exposed part of the guard stones shall be given three coats of white wash. Any excavation necessary for fixing of the guard stones shall be done by the contractor at his own cost. The measurement for payment shall be per number of guard stone fixed in position.
3. Unit rate of guard stone includes the cost of all materials, labours, tools, fixing & white washing as directed by the Engineer-in-charge.
4. In case of Deep/Causeway the guard stone shall be fixed in mansony of head wall as directed by Engineer-in-charge.

Item No.32 Providing and fixing 20cm x 15cm x 2.5cm thick year plate of marble stone set in C.M. 1:4 including Finishing and engraving letters, etc. complete

Marble stone for year plate shall be white and of approved quality and shall be 25 mm thick It shall be of 20 cms x 15 cms x 2.5 cms size or standard size as directed by the Engineer-in-charge of the work.

Lettering on year plate shall be done by U-shape engraving and shall be filled with black paint of approved quality. Lettering shall be done as directed by the Engineer-in-charge. The marble plate shall be fixed in neat cement at a place as directed by the Engineer-in-charge. Cement shall conform to relevant I.S. specification.

Measurement shall be per number of marble plate fixed.

Item No.33 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.

1.1. Materials

- 1.1. The clear Cole shall be made from glue and boiling water by mixing 1 Kg. mixture shall be suitably tinted where required for use under coloured distemper it directed. Glue shall conform to I.S. 352-1959 (Specifications for animal glue)
- 1.2. Lime used shall be Freshly burnt class 'C' Lime (fat lime) and white in colour conforming to I S. 712-1973. Water shall conform to M-1. Best quality of gum shall be used in (the preparations of white wash. Ultramarine blue or Indigo : This shall conform to I.S. 55-1970 for points, and shall be used for preparation of white wash, Pigments. Mineral colours, not affected by lime shall be used in preparing colour wash.

2.0. Workmanship

- 2.1. Preparation of white wash solution Surface already white or colour. The fat lime shall be slaked as site and shall be mixed and stirred with about five liters of water for 1 kg. of unslaked lime to make a trim cream This shall be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth, 4 Kg. of gum dissolves in hot water shall be added to each cubic meter of lime cream Small quantity of ultramarine blue (Up to 3 gins, per kg. of lime) shall also be added to the last two coats of white wash solution and the whole solution shall be stirred thoroughly before use.

2.2. Preparation of surface:

- 2.2.1. The surface shall be thoroughly cleaned of all dust, dirt, mortar cropping and other foreign matter before white wash is to be applied.
- 2.2.2. The surface spoiled by smoke soot shall be scrapped with steel wire brushes or steel scrapers 01 shall be rubbed with over-burnt surkhi or brick bats. The surface shall be then broomed to remove all dust dirt and shall be washed with clean water.
- 2.2.3. Oil or grease spots shall be removed by suitable chemical and smooth surface shall be rubbed with wire Brushes.
- 2.2.4. 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. Such

portion shall be wetted and allowed to dry. They shall then be given one coat of white wash

2.2.5. All unnecessary nails shall be removed the holes, cracks, patches etc. shall be made good with material similar in composition to the surface to be prepared

2.3. Scaffolding :

Wherever scaffolding is necessary it shall be erected in such a way that as far as possible on part of scaffolding shall rest against the surface to be white or colour washed A properly secured strong and well tied suspended platform (Zoola) may be used for white washing. Where ladders are used pieces of old gunny bags shall be tied at top and bottom to prevent scratches to the floors and walls. For white washing of ceilings, proper stage scaffolding shall be erected where necessary.

2.4. Application of white wash :

2.4.1. On the surface so prepared the white wash shall be applied with 'Moon' brush. The first stroke of the brush shall be from top downwards, another from bottom upwards over the first stroke and similarly one stroke from the right another from the left, over the first stroke brush before it dries. This will form one coat each coat shall be allowed to dry before and uniform finish free from brush marks and it should not come off easily when rubbed with finger

2.4.2. Splashing and dropping if any on the doors and windows, ventilators etc shall be removed and the surface cleaned.

2.4.3. Priming and Alkali resistant treatments, scraping of surface washing etc. surface spoiled by smoke soot removed of oil and grease spots, treatment for infection with efflorescence moulds moss, fungi, algae and lichen and patch repairs to plaster wherever done shall not be paid extra.

3.0. Mode of measurement & payment

3.1. All the work shall be measured in the decimal system as under:

- (a) Dimensions shall be measured to the nearest 0.01 m.
- (b) Area in individual item shall be worked out to the nearest 0.01 sq.m.

All the work shall be measured in sq. mt. Deductions for jambs, soffits, sills etc. for openings not exceeding 0.5 sq. mt. each in area, for ends of joists, posts, beams, girders, steps etc. not exceeding 0.5 sq mt. each in area and for openings exceeding 0.5 sq. mt. and not exceeding 3.0. sq. mt. each in area, deductions and additions shall be made as under.

3.2. No deductions shall be made for ends of joists, beams, posts, etc. and openings not exceeding 0.5 sq mt. each. No addition shall be made for reveals, jambs, soffits, sills etc. of these openings not for finish around ends of joints, beams, posts etc.

3.3. No deductions for openings exceeding 0.5 sq.mt. but not exceeding 3 sq. mt. each shall be made as follows and no addition will be made for reveals, jambs, soffits etc. of these openings :

- (a) When both the faces of walls are provided with finish, deduction shall be made for one face only.
- (b) When each face of wall is provided with different finish, deduction shall be made for that side of frame for door, windows, etc. on which width of reveals is less than that of the other side. Where width of reveals on both faces of wall are equal, deduction of .50% of area of opening on each face shall be made from total area of finish.

- (c) When only one face of wall is treated and the other face is not treated, full deduction shall be made if the width of reveal on the treated side is less than that on the untreated side, but if the width of the reveal is equal or more than on the untreated side neither deductions nor additions to be made for reveals, jambs, soffits, sills etc.
- 3.4** In case of area of openings exceeding 3 sq. mt. each, deductions shall be made for openings but jambs, soffits, sills shall be measured.
- 3.5.** No deductions shall be made for attachment such as casing, conducts, pipe, electric wiring and the like.
- 3.6.** Corrugated surfaces shall be measured flat as fixed and not girth. The quantities so measured shall be increased by the following percentage and the resultant shall be included with the general areas:
- (a) Corrugated steel sheets..... 14%
- (b) Corrugated A.C. sheets..... 20%
- (c) Semi corrugated A.C. Sheets..... 10%
- (d) Naintial pattern roof (Plain sheeting sheets)..... 10%
- (e) Naintial pattern roof (with corrugated sheets)..... 25%
- 3.7.** Cornices and other wall features, when they are not picked out in a different finish/colour shall be girthed and included in the general area.
- 3.8.** The rate shall include the cost of ail materials, labour, scaffolding, protective measures etc. involved in all the operations described above.
- 3.9.** The rate shall be for a unit of One sq. meter.

Item No.34 Providing and laying - Fitter Media 600mm thick directed at the back of abutments, returns and wing walls as per detailed specifications

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 asunder:-

Sr. No.	No. of Size Range	Sieve designation	Percentage by passing through the sieve
	63 mm to 40 mm	90 mm	100-00
		63 mm	85-100
		50 mm	35-70
		40 mm	00-15
		20 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 up to 15% and below 20 mm. it shall be allowable upto 5%. The filter Material shall be tightly placed to a thickness of not less than 600 mm. and provided over the entire surface behind abutments, wings or return walls to the full height as shown on drawing and as directed.

Materials shall be first stacked in boxes of 2 m. x 1½ m. x 0.5 m. size on fairly level ground and measured for cross checking the adequacy of the quantity required.

The filter media behind abutment and return wall shall consist of three layers, the first layer of rubble of required size, the second layer of stone aggregates of 40 to 63 mm size and the third layer of coarse sand. The total thickness of the filter media shall not be less than 600mm as specified in the item.

The measurement for payment shall be made as finished work on Sqm..basis

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

Item No.35 Providing and fixing in position ISI mark TMT (Fe-500) bar for temperature reinforcement for mass concrete pier/abutment returns including cutting bending and tying as required complete

1601. DESCRIPTION

This work shall consist of furnishing and placing high strength deformed reinforcement (TMT)bars (untensioned) of the shape and dimensions shown on the drawings and conforming to these Specifications or as approved by the Engineer.

1602. GENERAL

Steel for reinforcement shall meet with the requirements of IS 1786:2008.

1603. PROTECTION OF REINFORCEMENT

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

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

1604. BENDING OF REINFORCEMENT

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

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

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

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

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

1605. PLACING OF REINFORCEMENT

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

Reinforcement bar shall be placed accurately in position as shown on the drawings. The bars, crossing one another shall be 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.

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 bar 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.

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

Layers of reinforcements shall be separated by spacer bar at approximately one metre intervals.

The minimum diameter of spacer bar 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.

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

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

Bar 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 point of weakness is not created in hardened concrete. The coated reinforcing Reel

shall be held in place by OK of plastic or plastic coated binding wires especially manufactured for the purpose. Reference shall be made to Section 1000 for other requirements.

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

1606. BAR SPLICES

1606.1.Lapping

All reinforcement shall be furnished in full lengths as indicated on the drawing. No splicing of bars, except where shown on the drawing, 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 course aggregate, whichever is greater. If this is not feasible, overlapping bars shall be bound with annealed steel binding wire, not less than 1 mm diameter and twisted tight in such a manner as to maintain minimum clear cover to the reinforcement from the concrete surface. Lapped splices shall be staggered or located at points, along the span where stresses are low.

1606.2.Welding

1606.2.1.

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

1606.2.2.

While welding may be permitted for mild steel reinforcing bars conforming to IS:432, welding of deformed bars conforming to IS:1786 shall in general be prohibited. Welding may be permitted in case of bars of other than S 240 grade including special welding grade of S 41S grade bars conforming to IS: 1786, for which necessary chemical analysis has been secured and the carbon equivalent (CE) calculated from the chemical composition using the formula :

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mg + V}{5} + \frac{Ni + Cu}{15} \text{ is } 0.4 \text{ or less}$$

1606.2.3.The method of welding shall conform to IS:2751 and 15:9417 and to any supplemental specifications to the satisfaction of the Engineer.

Welding may be carried out by metal arc welding process. Oxy-acetelene welding shall not be permissible. Any other process may be used subject to the approval of the Engineer and necessary additional requirements to ensure satisfactory joint performance. Precautions on over heating, choice of electrode, selection of correct current in arc welding etc., should be strictly observed.

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

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

Generally, shop welding in controlled conditions is to be preferred, where feasible. Site welding where necessary shall, however, be permitted when the facilities, equipment,

process, consumables, operators, welding procedure are adequate to produce and maintain uniform quality at par with that attainable in shop welding to the satisfaction of the Engineer.

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

Suitable means shall be provided for holding the bars securely in position during welding. It must be ensured that no voids are left in welding. When welding is done in 2 or 3 stages, previous surface shall be cleaned properly. Bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before carrying out welding. Oily competent and experienced welders shall be employed on the work with the approval of the Engineer. No welding shall be done on coated bars.

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

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

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

1606.3. Mechanical Coupling of Bars

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

1607. TESTING AND ACCEPTANCE

The material shall be tested in accordance with relevant IS specifications and necessary test certificates shall be furnished. The fabrication, furnishing and placing of reinforcement shall be in accordance with these specifications and shall be checked and accepted, by the Engineer.

1608. MEASUREMENTS FOR PAYMENT

Reinforcement shall be measured in length including hooks, if any, separately for different diameters as actually used in work, excluding overlaps. From the length so measured, the weight of reinforcement shall be calculated in **M.T.** on the basis of 15:1732. Wastage, overlaps, couplings, welded joints, spacer bars, chairs, stays, hangers and annealed steel wire or other methods for binding and placing shall not be measured and cost of these items shall be deemed to be included in. the rates for reinforcement

1609. RATE

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

The unit rate for coated reinforcement shall be deemed to also include cost of all material, labour, tools and plant, royalty, transportation and expertise required to carry

out the work. The rate shall also cover sampling, testing and supervision required for the work.

Payment shall be made on **M.T.** basis

Item No.36 Providing weep holes in abutment, returns using 100 mm. dia A.C. pipe with C.I. grating including cutting, placing the pipe in required slope and position as directed etc. complete. (As per detailed specification

2706 WEEP HOLES

Weep holes shall be provided on all plain concrete, reinforced concrete, brick masonry and stone masonry structures such as, abutment, wing wall and return walls as shown on the drawings or as directed by the Engineer to permit water to flow out without building up pressure in the back fill. Weep holes shall be provided with 100 mm diameter AC/PVC/HDPE pipe for structures in plain/reinforced concrete or brick masonry. In case of stone masonry, weep holes shall be of rectangular shape 80 mm wide, 150 mm high or circular with 150 mm diameter. Weep holes shall extend through the full width of concrete/masonry with slope of about 1 vertical: 20 horizontal towards the draining face. The spacing of weep holes shall be 1 m in either direction or as shown in the drawings with the lowest at 150 mm above the low water level or ground level whichever is higher or as directed by the Engineer.

2707 TESTS AND STANDARDS OF ACCEPTANCE

The material shall be tested in accordance with these Specifications and shall meet the prescribed criteria and requirements.

The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

2708 MEASUREMENTS FOR PAYMENT

The measurement for payment for weep holes shall be made numbers. For structures in stone masonry, weep holes shall be deemed to be included in the item of stone masonry work and shall not be measured separately.

2709 RATE

The contract unit rate for weep holes shall include the cost of all labour, material, tools and plant required for completing the work as per these Specifications.

Item No.37 Earth work for embankment including breaking clods dressing with all lead & lifts and including watering rolling and consolidation of sub grade in layers of O.M.C. to required dry density including filling in depressions which occur during the process using vibratory roller 80 to 100 KN (E) From borrow area within 3.00 Km Lead Having C.B.R. More than 5.00%

The land width on which the earth work is to be done shall be cleared of all trees having a girth of 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 meters lead, and handed over to the department in convenient section. Unsuitable material 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.

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 alignments and other marks as long as they are required for the work in 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.

When an existing embankment is to be widened, continuous, horizontal benches, each at least 0.3 meter 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. Where the width of the widened portions if insufficient to permit the use of usual rollers, compaction shall be carried out with the help of tandem/sheeps foot rollers, hand rollers, mechanical tempers or other approved plant. 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.

The soil to be used for embankment for sub grade shall be having CBR not less than 5 % and 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 are carried out by the Department. The embankment shall consist of earth available from road-side borrow pits on either side with lead and all lifts, and within land-width in the manner specified in Para 10 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, he material satisfying the density requirements given in the table below shall be employed for embankment construction.

Density requirement of embankment and subgrade materials

Type of Work	Maximum laboratory dry unit weight when tested as per IS:2720 (Part-8)
-Embankment up to 3 meter height, not subjected to extensive flooding.	Not less than 15.2 kN/cum.
-Embankment exceeding 3 meter height or embankments of any height subject to long periods of inundation.	Not less than 16.0 kN/cum.
-Sub grade and earthen shoulders/ verges/ backfill.	Not less than 17.5 kN/cum.

Note:(1)This table is not applicable for lightweight fill material e.g. cinder, fly ash etc.

(2)The Engineer may relax these requirements at his discretion taking into account the availability of materials for construction and other relevant factors.

Field density shall be percentage of laboratory density as recommended by Gujarat Engineering Research Institute.

When permitted, the contractor shall use the soil for embankment work available from box cutting the road. The soil shall be used after approval from Engineer-in-charge. For this purpose the contractor shall make his own arrangement for loading, transporting & unloading the cutting stuff available from box cutting to required site with all lead and lift.

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. The operation of laying the successive layer of earth shall have to be suitably synchronized with the consolidation work. If the soil as delivered to the road bed is too wet, it shall be dried by exposure to the sun till the moisture content is acceptable for compaction. 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 to the density specified.

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 meter 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.

To avoid interference with the construction of abutment, wing walls or return 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. 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 simultaneously 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. Where it may be impracticable to use power rollers or other heavy equipment, the compaction shall be carried out by mechanical tampers or other methods approved by the Engineer-in-charge. Care shall be taken to see that the compaction plant does not hit or come too close to any structural member so as to cause any damage to them.

The embankment shall be finished in conformity with the alignment, levels, 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. The work of laying of earth work in layers shall be synchronized with the work of compaction and consolidation of the earth work and the operations shall also be synchronized with the field and laboratory testing.

If usable approved materials 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 form 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 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 chooses to utilize this material.
- (iv) The drain should be aligned along the boundary of the land width of the road. No pit, other than this drain, shall be dug within 5 meters of the toe to the final section of the road embankment.

No borrow pits shall be allowed in the length in which earth obtained from cutting is specified to be used in embankments.

11 Rolling and Watering

- 11.1 The embankment materials shall be spread uniformly over the entire width of the embankment in layers not exceeding 250 mm 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 that specified for compaction, the same, shall be made good either at the source or after spreading the soil in loose thickness for compaction. In the latter case, water shall be sprinkled directly from a 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 standard for compaction. Should circumstances arise, where owing to wet weather, the moisture content cannot be reduced to the required level by the above procedure, work of compaction shall be suspended.

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

After adding the required amount of water, the soil shall be processed by means of harrows, rotary mixers or as otherwise approved until the layer is uniformly wet.

Clods or hard lumps of earth shall be broken to have maximum size of 150 mm when being placed in the lower layers of the embankment and a maximum size of 60 mm when being placed in the top 0.5 meter portion of the embankment below the sub-grade.

Hauling equipment shall be dispersed uniformly over entire surface of the previously constructed layer to minimize cutting of uneven compaction.

Where the embankment is to be constructed on low area ground that will not support the weight of trucks of other hauling equipment, the lower part of the fill should be constructed by 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.

- 11.2** Compaction of the earthwork shall be carried out using vibratory roller of required capacity or any other 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 following table

Compaction requirements for embankment and sub grade.

Sr. No.	Type of Work/ materials	Relative compaction as percentage of maximum laboratory dry density as per IS:2720 (Part-8)
1.	Sub grade and earthen shoulders	Not less than 97.
2.	Embankment	Not less than 95.
3.	Expansive Clays	
	A)Sub grade and 500 mm portion just below the sub grade	Not allowed.
	B)Remaining portion of embankment	Not less than 90.

Subsequent layers shall placed only after finished layer has been tested according 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 specified compaction is not achieved, the materials in the soft areas shall be removed and replaced by approved materials and compacted to the density requirement, to the satisfaction of the Engineer-in-charge.

- 12. Measurements for Payment:** The earthwork measurements shall be paid on cross sectional measurements and computing the volumes of earth work in cubic meters by average area method. The contractor shall sign day to day leveling work and also original cross section, 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 is started. The contractor or his authorized representative shall attend day to day leveling 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 sectioned 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 leveling 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. The quantity of cutting stuff available from cutting/box cutting will be deducted from the net quantity of the earth work in the embankment arrived at. No deduction for shrinkage shall be made from gross measured quantity of compacted earth work. However the contractor shall have to bear loss of quantity due to all settlements as well as other types of deformations etc. if any that might have taken place at the time of taking the final measurements of this item.

13. 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, 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 that particular item. No payment shall be made under this item for the cutting stuff used in the 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. The contract unit rate also includes cost of mechanical roller and water tanker required for consolidation including all labour, equipments fuel, hire charges, tolls, and incidentals necessary.

Signature of the contractor

Executive Engineer,
Panchayat (R&B) Division
Valsad

- : SCHEDULE FOR TESTING OF MATERIALS :-

For ensuring quality control and workmanship Various tests prescribed below for materials shall be taken at periodical intervals as stipulated below. The materials shall be got tested at Government recognized Laboratory (R&B) or field Laboratory of GERI (R&B) for which 1% of the estimated amount put to tender shall be recovered from the contractor from the RA bills and final bills and the testing charges shall be paid to the GERI by the Government . However if the charges increase over 1% no excess recovery shall be made from the contractor as per resolution of B & C department dated 10th May 1985 vide TNC/ 1085/ (4)/ S

It. No. as per schedule "B"	Brief description of materials to be tested	Qty of material	Prescription of test which shall be carried out	Frequency at which test shall be carried out	Total No of test to be taken.
1]	Coarse Aggregate 40 to 63 H.B. 40 to 63 M.C 25 to 40 M.C 12 to 20 M.C. 40 mm 20 mm		- Gradation test - Impact value - Flakiness and elongation	1 to 100 cm 1 test 100 to 500 cm 3 test 500 to 1500 cm 5 test 1500 to 5000 cm 7 test Minimum 1 test/ work	
2]	Grit 6 to 10		- Stripping value	As above	
3]	Granular materials		- Gradation - Atterbeg limits	As above	
4]	Murrum		- P I Value	One test per 50 cum.	
5]	Sand/ quarry spall		- Silt content - Gradation - CBR test	One test per work/ season One test per 200 cmt. One test per work	
6]	Asphalt		1 Penetration test as per IS 1203 2 Ductility test as per IS 1208 3 Specific gravity test as per IS 1202 4 Softening point test as per IS 1204 5 Viscosity test as per IS 1206	1 to 10 tanker 1 test 11 to 20 tanker 2 test 21 to 50 " 3 test 51 to 100 " 4 test Remaining every 50" 1 test	
7]	Cement		- Consistency - Setting time - Compressive strength - Fineness	Up to 50 MT 1 test 100 MT 2 test 200 MT 3 test 300 MT 4 test 500 MT 5 test	

			- Chemical analysis - Soundness	800 MT 1300 MT and 8 test for larger consignment	6 test 7 test	
8]	CC Cubes C.C. 1:3:6 M-150 M-100		- Compressive Strength (I.S. 519 – 1959)	1 to 5 cms 6 to 15 cms 16 to 20 cms 21 to 50 cms 51 and above (For each additional 50 m ³ or part thereof)	1 No 2 No 3 No 4 No 4 + 1	
9]	Water		- Chemical test	Once for approval of source of supply		
10]	Steel		- Tensile Strength - Yield Stress - Elongation - Size	1 test/ 40 tonnes/ per category		
11]	Bricks		- Water absorption - Efflorence - Size - Compressive Strength	1 test per 50,000 bricks		
12]	Prime coat/ Tack coat		- Quality of binder - Binder temperature for application - Rate of spread of binder	Number of samples per lot and test as per IS:73 At regular close intervals Two test per 500 m ² and not less than two test per day		
13]	Carpet and Seal coat mix/ B.M/ M.S.S.		- Quality of binder - Grading - Temperature of binder - Binder content vide 45 IMD 2172 - Rate of spread of mix materials	Number of samples per lot and test as per IS:73 1 test on individual contents and mix aggregate from the dryer for each 100 tonnes of mix subject to minimum of two test per plant per day At regular close intervals One test for each 100 tonnes of mix subject to mini. of Two per day Regular control through checks on layer thickness		

14]	Granular Sub-base		<ul style="list-style-type: none"> - Gradation - Atterberg limits - Moisture content prior to compaction - Density of compacted layer - Deleterious constituents - C.B.R. 	<p>As mentioned under serial number 3</p> <p>As mentioned under serial number 3</p> <p>As mentioned under serial number 3</p> <p>One test per 500 m²</p> <p>As required</p> <p>As required</p>	
15]	Wet Mix Macadam		<ul style="list-style-type: none"> - Aggregate Impact Value - Grading - Flakiness and Elongation Index - Atterberg limits of portion of aggregate passing 425 micron sieve - Density of compacted layer 	<p>As mentioned under serial number 1</p> <p>As mentioned under serial number 1</p> <p>As mentioned under serial number 1</p> <p>As mentioned under serial number 3</p> <p>One test per 500 m²</p>	
16]	Water Bound Macadam		<ul style="list-style-type: none"> - Aggregate Impact Value - Grading - Flakiness Index and Elongation index - Atterberg limits of binding material - Atterberg limits of portion of aggregate passing 425 micron sieve 	<p>As mentioned under serial number 1</p> <p>As mentioned under serial No.1 As mentioned under serial number 1</p> <p>As mentioned under serial number 1</p> <p>As mentioned under serial number 1</p>	

The Number of tests will be as per Manual of quality control or latest Govt. G.R./Circular and it will be considered final

The contractor shall have to pay 1% of the estimated cost put to tender towards all testing of materials and the same shall be deducted from their bills for the works.

Testing charges of GERI shall be borne by Govt. No refund be made nor extra charges over 1% shall be recoverable from the contractor.

If directed by the Engineer in charge, the materials intended to be used for the work but not included in the above schedule shall also be got tested at Government recognized Laboratory or field Laboratory.

Signature of Contractor

Executive Engineer
Panchayat (R&B) Division
Valsad

