

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.

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 and stacking of serviceable materials to be used of auctioned up to a lead of 1000 meters including removal and disposal of top organic soil not exceeding 150 mm in thickness.

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 foil 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 Earthwork in cutting in all sorts of soil and soft murrum including conveying and putting the stuff in spoil bank maintaining minimum distance of five meter between top edge and cutting and toe of spoil bank with all lead and lift.

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 .0.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 utilised) 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 Tape 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. 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 30.0KM. lead

1.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.

2.After clearing the site, the alignment of the road shall be properly set out true to line, curves, slopes grades and sections as shown on the plan or directed by the Engineer-in-charge. The contractor shall provide all labours and materials such as lime, strings, pegs, nails, bamboos, stone, mortar, concrete etc. required for setting out, establishing. Bench Marks and giving profiles. The contractor shall be responsible for maintaining the B.Ms, profiles 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.

3. 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 is 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.

4. 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, the material satisfying the density requirements given in the table below shall be employed for embankment construction.

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.
-Subgrade and earthen shoulders/ verges/ backfill.	Not less than 17.5 kN/cum.

Density requirement of embankment and subgrade materials

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.

5. 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.

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

7. Where an embankment is to be placed on sloping ground, the surface of the ground shall be benched in the steps of trenches or broken up in such a manner that the new material shall have perfect bond with the existing surface. Where the embankment is to be placed over an existing road surface, the surface shall be scarified to minimum depth of a 5 cm so as to provide ample bond between the old and new material. However when the embankment is to be placed over an old concrete pavement and lies within 1 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.

8. 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. Unless directed otherwise, the filling ground culverts, bridges and other structures up to a distance of twice the height of the embankment from the back of the embankment shall be earned out independent of the work on the main embankment. The fill material shall not be placed against any abutment or wing wall unless permission has been given by the Engineer-in-charge but in any case not until the

concrete or masonry has been in position for 14 days, (he 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 tempers 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.

9. 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.

10. 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.
- (v) 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 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 subgrade.

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) Subgrade and 500 mm portion just below the subgrade	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 leveling 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 & Spreading Hard Murrum below sub base of work as per specification ,(including spreading,watering and consolidation) With Vibratory roller exceeding 80KN and not exceeding 120KN etc.complete.

1. The hard murrum shall be supplied from the quarry as approved by the Executive Engineer prior to collection.
2. The hard murrum shall be free from all rubbish, and any organic materials as well as clods of black cotton soil and uniform in size as possible. The hard murrum shall be hard, and of close texture free from decay.
3. Wherever any doubt as to whether above requirement are satisfied in whole or part of the collection, it shall be got screened by the contractor if so ordered by the Executive Engineer and for which no extra payment shall be claimed by the contractor.
4. Any collection which does not fully satisfy the above requirements is liable to be rejected all together.
5. Stacking shall be made by the contractor by filling in the standard steel boxes of 2m x 1.5m x 0.5m and no deduction of voids shall be made from the gross measurements.
6. Regular stacks shall be made by the contractor on a fairly level ground. All the stack shall be marked by white wash immediately on being measured and recorded by the Engineer in charge.
7. Stacks shall be as per actual requirement and any materials in excess shall have to be transported by the contractor at the places directed by the Executive Engineer at the risk and cost of the contractor.

8. While stacking materials the depositing should commence at one end of the Km and carried continuously towards the other end unless the Executive Engineer shall direct otherwise
- 9 The hard murum shall only be allowed to be spread after the written permission of the Executive Engineer is obtained.
10. The permission for spreading the hard murrum shall be given by the Executive Engineer if
 - (i) The full quantity of a particular kilometer is completely collected.
 - (ii) The collection of material is also completed in the adjoining two Kilometers
 - (iii) The measurements are recorded in the Measurement book.
11. The hard murum be filled in basket & conveyed where required and spread evenly on the prepared surface be giving twisting motion to the basket at the time of spreading. The surface shall then (15 m) be leveled by means of templates and strings as well as with camber boards and spirit level
12. Between the straight length and curves and at the meeting points of the convex and concave portions of the reverse curves, the change in camber of the road, due to super elevations shall be made as well as with camber boards and spirit level.
13. At the time of spreading hard murum a small quantity (about 4 to 5 percent) as directed shall be retained at the first instance. It shall be spread later on after partial consolidation as required to rectify the camber and to fill up the hollows if any. No extra amount shall be paid for this.
14. The surface shall be brought to the required camber which shall be checked at every 50 ft. (15 M.) by means off templates while the length in between shall tested by strings and corrected as required.
15. The centre line shall first be marked in the sub grade which is properly consolidated and has uniform camber and grade as required.
16. The hard murum shall be laid for a small length on 25 ft. (8 M.) and then the edge stones shall be laid.
17. Pegs shall be driven on either side of the road and joined with strings true and parallel with a distance between them equal to the width to be laid.
18. Immediately following the spreading of the hard murrum, rolling shall be started with vibratory roller. The capacity of the vibrating roller shall depend upon the type of the aggregate and shall be indicated by Engineer-in-charge.
19. Except on super elevated portions where the rolling shall proceed from inner edge to outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inwards parallel to center line of the road in successive passes uniformly lapping preceding tracks by at least one half the width.
20. Rolling shall continue until the aggregate is thoroughly keyed and the creeping of the aggregate ahead of the roller is no longer visible. During

rolling slight sprinkling of water may be done, if necessary. Rolling shall not be done when the sub-grade is soft or yielding or when it causes wave like motion in the sub-grade or sub-base course.

21. The rolled surface shall be checked transversely and longitudinal with templates and any irregularities corrected by loosening the surface, adding or removing necessary amounts of aggregate and rerolling until, the entire surface conforms to desired camber and grade. In no case shall the use of screening be permitted to make up depression.
22. Payment will be made on Cum. basis of the finished work and shall include collection, royalties, duties, conveyance to the site with all lead and lift, cost of watering, rent of machinery cost fuel, wages of drivers and cleaners including all labour, tools, equipment and other incidental expenses etc required to complete the work.

Item No6 Construction of granular sub-base 150 mm thick layer by providing machine crushed B.T. material satisfying MORT&H specification (Fifth revision) of Grading I 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 etc. complete.

401 GRANULAR SUB-BASE

401.1 Scope

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

401.2 Materials

401.2.1 The material to be used for the work shall be of grading required. The grading to be adopted for a project shall be as specified in the Contract. Where the sub-base is laid in two layers as upper sub-base and lower sub-base, the thickness of each layer shall not be less than 150 mm.

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

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

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

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

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

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

401.3.2 Spreading and Compacting

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

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

Immediately after spreading the mix, rolling shall be done by an approved roller. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer upto 200 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall or on superelevation. For carriageway having crossfall on both sides, rolling shall commence at the edges and progress towards the crown.

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

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

401.4 Surface Finish and Quality Control of Work

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

401.5 Arrangements for Traffic

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

401.6 Measurements for Payment

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

401.7 Rate

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

- i) making arrangements for traffic to Clause 112 except for initial treatment to verges, shoulders and construction of diversions;

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

Item No.7 Providing, laying, Spreading and Compacting stone aggregate 45 mm to 90 mm size to WBM Grade I Single layer 100 mm thick in required layer including spreading in uniform thickness hand packing rolling with vibratory roller 8 to 10 tonnes to proper grade and camber applying and brooming rerusite type of screening binding filler materials to fill up the interstices of course aggregate wearing and compacting

405. WATER BOUND MACADAM SUB-BASE/BASE/SURFACING

405.1. Scope

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

405.2. Materials

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

TABLE 400.7: PHYSICAL REQUIREMENTS OF COURSE AGGREGATES FOR WATER BOUND MACADAM FOR SUB-BASE/BASE/SURFACING COURSES

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

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

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

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

405.2.5. Crushed slag: Crushed slag shall be made from air-cooled blast furnace slag. It shall be angular shape, reasonably uniform in quality and density and generally free from thin, elongated and soft pieces, dirt or other deleterious materials.

405.2.6 Overburnt (Jhama) brick aggregates: Jhama brick aggregates shall be made from over burnt bricks or brick ballast and be free from dust and other objectionable and deleterious materials.

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

TABLE 400.8 : GRADING REQUIREMENTS OF COARSE AGGREGATES

Grading No.	Size Range	IS Sieve Designation	Per cent by weight passing
(1)	90 mm to 45 mm	125 mm 90 mm 63 mm 45 mm 22.4 mm	100 90-100 25-60 0-15 0-5
(2)	63 mm to 45 mm	90 mm	100

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

Note: The compacted thickness for a layer with Grading 1 shall be 100 mm while for layer with other Gradings, i.e., 2 & 3, it shall be 75 mm.

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

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

TABLE : 400.9 : GRADING FOR SCREENING

Grading Classification	Size of Screenings	IS Sieve Designation	Percent by Weight Passing the IS Sieve
A	13.2 mm	13.2 mm	100
		11.2 mm	95-100
		5.6 mm	15-35
		180 micron	0-10
B	11.2 mm	11.2 mm	100
		5.6 mm	90-100
		180 micron	15-35

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

405.2.9 Binding material: Binding material to be used for water bound macadam as a filler material meant for preventing raveling, shall comprise of a suitable material approved by

the Engineer having a Plasticity Index (PI) value of less than 6 for sub-base/base course and 4 to 10 for surfacing course as determined in accordance with IS:2720 (Part 5).

The quantity of binding material where it is to be used, will depend on the type of screenings. Generally, the quantity required for 75 mm compacted thickness of water bound macadam will be 0.06-0.09 m³/10m² and 0.08-0.10 m³/10 m² for 100 mm compacted thickness.

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

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

TABLE 400.10: APPROXIMATE QUANTITIES OF COARSE AGGREGATES AND SCREENINGS REQUIRED FOR 100/75 mm COMPACTED THICKNESS OF WATER BOUND MACADAM (WBM) SUB-BASE/ BASE/ SURFACING COURSE FOR 10 M² AREA.

Classification	Size Range	Compacted thickness	Loose Quantity	Stone Screenings		Crushable Screenings such as moorum or	
				Grading Classification & Size	For WBM Sub-base/ Base Course (Loose Quantity) m ³	Properties	Loose Quantity
Grading 1	90 to 45	100	1.21 to 1.43	Type A 13.2	0.27 to 0.30	LL<20, PI<6 percent passing 0.075 mm 10	0.30 to 0.32
Grading 2	63 to 45	75	0.91 to 1.07	Type A 13.2	0.12 to 0.15	-do-	0.22 to 0.24
Grading 2	63 to 45	75	0.91 to 1.07	Type B 11.2	0.20 to 0.22	-do-	-do-
Grading 3	53 to	75	0.91 to	Type	0.18 to 0.21	-do-	-do-

	22.4		1.07	B 11.2			
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405.3. Construction Operations

405.3.1. Preparation of base: The surface of the subgrade/sub-base/base to receive the water bound macadam course shall be prepared to the specified lines and crossfall (camber) and made free of dust and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm surface is obtained if necessary by sprinkling water. Any sub-base/base/surface irregularities, where predominant, shall be made good by providing appropriate type of profile corrective course (leveling course).

Laying water bound macadam course over an existing bituminous layer shall be avoided since it will cause problems of internal drainage of the pavement at the interface of two courses. It is desirable to completely pick out the existing thin bituminous wearing course where water bound macadam is proposed to be laid over it.

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

405.3.3. Provision of lateral confinement of aggregates: While constructing water bound macadam, arrangement shall be made for the lateral confinement of the aggregate. This shall be done by laying materials in adjoining shoulders along with that of water bound macadam layer and following the sequence of operations described in Clause 407.4.1.

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

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

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

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

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

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

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

The rolled surface shall be checked transversely and longitudinally, with templates and any irregularities corrected by loosening the surface, adding or removing necessary amount of aggregates and re-rolling until the entire surface conforms to desired crossfall (camber) and grade. In no case shall the use of screenings be permitted to make up depressions.

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

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

405.3.6. Application of screenings: After the coarse aggregate has been rolled to Clause 405.3.4, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregate. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motions of hand shovels or by mechanical spreaders, or directly from tipper with suitable grit spreading arrangement. Tipper operating for spreading the screenings shall be so driven as not to disturb the coarse aggregate.

The screenings shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms, hand brooms or both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would

prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregate.

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

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

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

405.3.8. Application of binding material: After the application of screenings in accordance with Clauses 405.3.5 and 405.3.6 the binding material where it is required to be used (Clause 405.2.7) shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water, the resulting slurry swept in with hand brooms, or mechanical brooms to fill the voids properly, and rolled during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling of voids, forms a wave ahead of the wheels of the moving roller.

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

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

405.4. Surface Finish and Quality Control of Work

405.4.1. The surface finish of construction shall conform to the requirements of Clause 1802.

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

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

405.4.4. Reconstruction of defective macadam: The finished surface of water bound macadam shall conform to the tolerance of surface regularity as prescribed in Clause 1802. However, where the surface irregularity of the course exceeds the tolerances or where the course is otherwise defective due to subgrade soil mixing with the aggregates, the course to its full thickness shall be scarified over the affected area, reshaped with added material or removed and replaced with fresh material as applicable and recompacted. In no case shall depressions be filled up with screenings or binding material.

405.5. Arrangement for Traffic

During the period of construction, the arrangement of traffic shall be done as per Clause 111.

405.6. Measurements for Payment

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

405.7. Rate

The Contract unit rate for water bound macadam sub-base/base course shall be payable in full for carrying out the required operations including full compensation for all components listed in Clause 401.9 (i) to (v) including arrangements of water used in the work as approved by the Engineer

Item No.8 Providing & laying spreading and compacting stone aggregate 45 mm to 63 mm size to W.B.M. 75 mm thick in Two layers including spreading in uniform thickness, hand packing, rolling with vibratory roller 8 to 10 tonnes to proper grade and camber, applying and brooming requisite type of screening/ binding/ filler materials to fill up the interstices of coarse aggregate, watering and compacting to the required density. Grading II using screening type A (13.2 mm stone aggregate)

This work shall consist of laying and compacting well graded material on prepared sub grade in accordance with detailed specification of item No. 6 of this contract except that the materials to be used for the work shall be crushed stone, free from organic or other deleterious constituents and confirm to the **grading II**.

Item No. 9 Providing and applying primer coat with Bitumen emulsion (SS-I) on prepared surface of granular base including cleaning of road surface and spraying primer at the rate of 7.50 kg/ 10sqmt using mechanical means as per Technical Specification Clause 502. (Hincol made only) (ii) Medium porosity.

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 three 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 60° 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 10° 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 referred to in Clause 502.4.3. of MORT&H specification stated above.

Item No. 10 Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts carrying heavy traffic as per IS 458-1991 specification including setting the pipes in C.M. 1:2 watering and laying (to level or slopes) of Class NP3 of following internal diameter. (iii) 600 mm 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 **600 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.11 Providing and laying bituminous base course 37.5 mm thick compacted with tack coat of Emulsion RS-1 at the rate of 2.5 Kg./10Sqmt. and using B.T. stone aggregates of required gradation and asphalt (VG-30) grade for mixing @ 1.99 % by weight of total mix 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

Scope

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 viscosity grade 60/70 (VG-30) 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 Course**

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%

Property	Test	Specification
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.

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	25 mm	
layer thickness	37.5 mm	
IS : Sieve [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	60 /80 (VG-30)	

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 10° 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 RS-1 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 60/70 grade (VG-30) 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 than 10° 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 **2.50 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 14° 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 filter 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 the 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 by hand tools by experienced staff and compacted to the satisfactions 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 145° 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
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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 echelon, where this is practicable, and in sufficient proximity for adjacent widths to be 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 whichever 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 no 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. 12 Providing laying and rolling of 25mm thick open graded premix bituminous carpet with B.T. aggregate as specified and using bitumen for tack coat at the rate of 2.5kg/10sqm and using VG30 bitumen for mixing with aggregate at the rate of 3.36 % i.e. 33.60 kg/M.Ton of total mix including heating and mixing in drum mix plant, transporting, spreading the same with paver finisher and consolidation with vibratory roller including necessary firewood, oil, lubricants, Labour charges etc. using contractor's own drum mix plant and equipment, tool etc completed 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 viscosity grade (VG-30) 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	(VG-30)

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 10° 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 (VG-30) 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 150°C to 163°C and that of the aggregate in the range of 155°C to 163°C provided that the difference in temperature between the binder and aggregate at no time exceeds 14°C. Mixing shall be thorough to ensure that a homogeneous mixture is obtained in which all particles of the aggregates are coated uniformly and the discharge temperature of mix shall be between 130°C and 160°C.

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 superelevated 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 binder 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. 13 Providing and laying premix seal coat with B.T. aggregate as specified using aggregate at the rate of 0.24 cum/10 sqm. and bitumen (V.G.30) for mixing with aggregate at the rate of 4.50% i.e.45.00 Kg / M.ton of total mixing including heating and mixing in drum mix plant and transporting spreading the same by paver finisher and consolidation with vibratory roller including necessary firewood, oil, lubricants, 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 Viscosity grade 60/70 (VG-30) 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
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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 60/70 (VG-30) 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 bond 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. 14 Providing and laying Asphalt Painting on B.T. surface with bitumen VG 30 at the rate of 5.00 kg/ 10sqm, and spreading stone dust for painting surface at the rate of 0.03 cum/ 10sqm.

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 or as directed by Engineer.

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 with measuring cylinder. The method of determining silt contents by field test is given as under.

2.2.2 A sample of stone dust to be tested shall be placed without drying in 200mm measuring cylinder. The quantity of the sample shall be such that it fills the cylinder upto 120mm mark. The water shall be added upto 150mm mark. The mixture shall be silted vigorously and the content allowed to settle for 3 hours.

2.2.3. The height of silt visible as settled 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 modulus of stone dust silt not be less than 1.80.

3. Weather and Seasonable Limitations

Bituminous material shall not be applied to a wet surface or during a dust storm or when the weather is so rainy or windy or when the temperature in the shade is less than 10°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. The 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 in charge.

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 otherwise prepared in accordance with the requirement of Clause 501.8 & 513 of MORTH & if 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 in charge.

4.3 Application of Asphalt painting

The application of asphalt for painting shall be at 5.00 Kg/10 Sq.mt. as specified in the contract and shall be applied uniformly. The asphalt shall be added in the tanker and the temperature of the asphalt at the time of spraying shall be in the range of 150°C - 177°C.

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 asphalt the stone dust shall be sprayed evenly with a twisting motion of baskets at the rate of 0.03 Cum/10 Sq.m. The entire surface shall be boomed to ensure uniform application of the stone dust. While the traffic is allowed on the painting 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 painting surface.

7.0 Arrangement of Traffic

The provision of MORTH 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. 15 Providing and fixing ordinary Kilometer stone of precast C.C. 1:2:4 including necessary reinforcement as per I.R.C. type design in C.C. 1:4:8 including painting, lettering etc. complete (For O.D.R road V.R.)

Kilometer stone shall be of approved quality and shall be of Hard Stone as specified in the item.

1. 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.
2. The measurement for payment shall be made per No. of K.M. stone fixed in position.
3. 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. 16 Providing & Fixing Hectometer stone as per I.R.C. type design including painting, lettering etc. complete (i) Fixing in C.C.1:5:10

1. The work shall be carried out as per the item of ordinary kilometre stone except that the size of Hectometre stone shall be smaller than that of ordinary kilometre stone as per I.R C. 19 (Type design for 200 metre stones) and fixing shall be in earth. The measurement for payment as well as the operations included in the unit rate shall be as per ordinary kilometres stone.

Item No. 17 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 phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; Letters and numerals should be as per IRC-30-1968, 3.1m long (2 nos) stand post and frame fabricated from suitable size iron angle of 50 x 50 x 5mm painted with best quality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x

45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR).

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 either reflectorised or non-reflectorised as shown on the drawing or as directed by the Engineer. When they are of reflectorised type, they shall be of retro-reflectorised type and made of encapsulated lens type reflective sheeting vide Clause 801.3, fixed over aluminium sheeting as per these Specifications.

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.

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

Table 800-1

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

(CANDELAS PER LUX PER SQUARE METRE)

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

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

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

Table 800 – 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

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 aluniinium 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. Sheetting 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 standard cautionary, mandatory and information signs shall be in numbers of different types or signs supplied and fixed.

801.6 RATE

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

Item No.18 Providing & fixing junction boards made out of 4mm ACP sheet size 120 x 90 cms rectangle with message on both sides of the board, as per the design of IRC. Pre treated with phospheting process and acid etching with one coat of epoxy primer and two coat of coats of best quality epoxy paint front side reflectorised with high intensity micro prisomatic grade type - IV retro reflective sheeting as per IRC 67 and latest M.O.S.T. specification and back side message / lettering shall be painted with ready mix synthetic enamel paint of superior quality in required shade and colour as specified, mounted on two numbers of 3.6m long standard post iren angle of 50 X 50 X 5 mm and frame fabricated from suitable MS angle of 40 x 40 x 3 mm as required, painted with beat quality epoxy coating in black and white bends. The details of letters/symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 C.C. block of size 45 X 45 X 60cms for each leg. including excavation, curing etc. complete under the supervision of engineer in Charge.

The work of providing and fixing **Junction Board** shall be executed as per relevant specifications of **Item No. 17** of this contract. The measurement shall be in numbers of **Junction Board** supplied and fixed in position.

Item No.19 MMGSY Logo Board:- Providing and fixing MMGSY Logo Board made out of 2mm aluminium sheet, as per the drawing & design. Pre treated with phospheting process and acid etching coated with one coat of epoxy primer and two coat of best quality epoxy paint, reflctorized 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)Engineer grade.

The work of providing and fixing **Logo Board** shall be executed as per relevant specifications of **Item No. 17** of this contract. The measurement shall be in numbers of **Logo Board** supplied and fixed in position.

Item No.20 Cautionary Warning Sign for Bump/Curve :-Providing and fixing sing boards made out of 2mm aluminium sheet; size 60 x 60 x 60 cms. equilateral triangle 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 retro refiectivesheeting as per latest M.O.S.T.Specifications; 3.1m long stand postand frame fabricated from suitable sizeiron angle of 35 x 35 x 3mm, 75 x 75 x 6mm as required; painted with bestquality epoxy coatings in black andwhite bends. The details of symbol foreach board shall be as per theinstruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg.including excavation, curing etc.complete under the supervision of engineer in charge.(A) Engineer Grade.

The work of providing and fixing **Cautionary Warning Sign** shall be executed as per relevant specifications of **Item No. 17** of this contract. The measurement shall be in numbers of **Cautionary Warning Sign** supplied and fixed in position.

Item No.21 STOP/SPEED SIGN:-Providing and fixing sing boards made out of 2mm aluminium sheet;shall be octagonal in shape of 75 cm x 75 cm and shall have red background and white border. The word "STOP" written in white (in English or local language) with125 mm height letters, centrally positioned. The height of the octagon and border shall as per the design of IRC: 67-2012 pre treated with phospheting process & acid teching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm 75x75x6mm as required; painted with best quality epoxy coatings in black and white bends. the details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing tec. complete under the supervision of engineer in charge.(A) Engineer Grade.

The work of providing and fixing **STOP/SPEED SIGN** shall be executed as per relevant specifications of **Item No. 17** of this contract. The measurement shall be in numbers of **STOP/SPEED SIGN** supplied and fixed in position.

Item No.22 Regulatory/Mandotary Sign-Providing & Fixing Sign Board made out of 2 mm alluminium sheet,size 60 cms, Diameter Circle as per design of IRC-67-2012 pre treated with phospheting process & Acid teching,coated with one coat of epoxy primerand two coats of best quality epoxy paint,reflectorised with retro feflective sheeting as per latest M.O.S.T. Specification,3.1 m long stand post and frame fabricated from suitable size iron angle of 35X35X3 mm 75X75X6 mm sas reuired painted with best quality epoxy coating in black and white bend,The detailes of symbol for each board shall be as per the instyruction of engineer in charge.The fixing at site shall be in 1:2:4 cc block of size 45X45X60 cms for each leg,including excavation curing etc.complete under the supervision of engineer in charge (A) Engineer Grade

The work of providing and fixing **Regulatory/Mandotary Sign** shall be executed as per relevant specifications of **Item No. 17** of this contract. The measurement shall be in numbers of **Regulatory/Mandotary Sign** supplied and fixed in position.