

# **VOLUME II - A**

## **Technical specification**

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## **Technical specifications for construction of roads**

## Section – C24

### Technical specifications for construction of roads, footpath, cycle track & pipe culverts

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## Section – C24: Technical specifications for construction of roads, footpath, cycle track & pipe culverts

### 1 Scope

This specification covers the general requirements for the materials and construction of embankment, preparation of sub grade, stocking & laying of granular sub base, wet mix macadam, dense bituminous macadam and bituminous concrete and walkways and drains and culverts.

### 2 Applicable codes & specifications

The following specifications, standards and codes are made a part of this specification. All standards, tentative specifications, specifications, codes of practices referred to herein shall be the latest edition including all applicable official amendments and revision. In case of discrepancy between this specification and those referred to herein, this specification shall govern.

IS:73	:	Paving bitumen
IS:215	:	Road tar
IS:217	:	Cutback bitumen
IS:383	:	Specification for coarse and fine aggregate from natural sources for concrete.
IS:458	:	Concrete pipes (with and without reinforcement)
IS:460	:	Test sieves
IS:1077	:	Fly ash bricks/Burnt clay bricks
IS:1124	:	Method of test for water absorption of natural building stones.
IS:1195	:	Specification for Bitumen Mastic for flooring.
IS:1196	:	Code of Practice for laying Bitumen Mastic flooring.
IS:2116	:	Sand for masonry mortars.
IS:2386	:	Methods of test for aggregate for concrete.
(Parts I) through VIII)	:	
IS:3102	:	Classification of Fly ash bricks/Burnt clay bricks
IS:3495	:	Method of sampling and testing of clay building bricks.
IS:1834	:	Sealing compounds, hot applied, for joints in concrete.
IRC:SP:53	:	Modified bitumen
IRC 10	:	Practice for borrow pits for road embankment
IRC 15	:	Spec. and code of practice for construction of CC roads
IRC 16	:	Spec. and code of practice for prime and tack coat
IRC 29	:	Specification for bituminous concrete
IRC 35	:	Code of practice for road marking
IRC 36	:	Construction of earthen embankments and sub grade
IRC 51	:	Guidelines for use of soil-lime mixes in road construction

IRC 89	:	Practice for lime fly ash stabilized soil base/ sub-base in pavement
IRC 94	:	Specification for dense bituminous macadam
IRC 109	:	Guidelines for wet mix macadam
IRC:SP:58	:	Use fly ash in road embankments
IRC:SP:63	:	Guidelines for use of interlocking concrete block pavement
IRC:SP:69	:	Guidelines & specification for expansion joints
IRC:SP:97	:	Guidelines on compaction equipment for road works
Ministry of road transport & highways- Fifth revision	:	Specification for Road & Bridge works

Where the requirements of the above codes differ from this specification or other specifications forming a part of the bid document, the latter shall govern

All earthwork and concrete work shall be according to component specifications “Earthwork in Grading, Excavation & Backfilling” and “Cast-in-Situ Concrete and Allied Works” bearing serial no. C1 & C3 respectively.

### 3 Construction sequence

It is intent of this specification that the wet mix macadam road be constructed first and surfaced with bituminous surfacing as specified hereunder. This shall be opened to traffic, as directed by the Employer/EIC. After such period of time as decided by the Employer/EIC, when the major construction and/or erection activities within project areas are over, Contractor shall rectify all defects, wear and tear, etc. and surface the road with bituminous treatment (Dense bituminous macadam, Bituminous concrete etc) as specified hereunder.

### 4 Materials for road & allied structure

#### 4.1. General notes

All materials shall be obtained from local sources and approval of EIC shall be obtained prior to starting of work.

### 5 Embankment construction

#### 5.1. General

These specifications shall apply to the construction of embankments including sub-grades, earthen shoulders and miscellaneous backfills with approved material obtained from approved source, including material from roadway and drain excavation, borrow pits or other sources. All embankments sub-grades, earthen shoulders and miscellaneous backfills shall be constructed in accordance with the

requirements of these specifications and in conformity with the lines, grades, and cross-sections shown on the drawings or as directed by the engineer.

## 5.2. Physical requirements for embankment materials

The materials used in embankments, sub-grades, earthen shoulders and miscellaneous backfills shall be soil, moorum, gravel, reclaimed material from pavement, fly ash, pond ash, a mixture of these or any other material as approved by the engineer. Such materials shall be free of logs, stumps, roots, rubbish or any other ingredient likely to deteriorate or affect the stability of the embankment.

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

- a) Materials from swamps, marches and bogs;
- b) Peat, log, stump and perishable material; any soil that classifies as OL, OI, OH or Pt in accordance with IS:1498;
- c) Materials susceptible to spontaneous combustion;
- d) Materials in a frozen condition;
- e) Clay having liquid limit exceeding 50 and plasticity index exceeding 25; and
- f) Materials with salts resulting in leaching in the embankment.

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

Any fill material with a soluble sulphate content exceeding 1.9 grams of sulphate (expressed as SO<sub>3</sub>) per litre when tested in accordance with BS: 1377, Part 3, but using a 2:1 water-soil ratio shall not be deposited within 500 mm distance (or any other distance described in the Contract), of permanent works constructed out of concrete, cement bound materials or other cementitious material.

Materials with a total sulphate content (expressed as SO<sub>3</sub>) exceeding 0.5 percent by mass, when tested in accordance with BS: 1377, Part 3 shall not be deposited within 500 mm, or other distances described in the Contract, of metallic items forming part of the Permanent works.

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

Ordinarily, only the materials satisfying the density requirements given in Table 300-1 shall be employed for the construction of the embankment and the sub-grade.

**As per table 300 – 1:  
Density requirements of embankment and sub-grade materials**

Sl. No	Type of work	Maximum laboratory dry unit weight when tested as per IS:2720 (Part8)
1.	Embankment up to 3 m height, not subjected to extensive flooding	Not less than 15.2 kN/cum
2.	Embankments exceeding 3m height or embankments of any height subject to long periods of inundation	Not less than 16 kN/cum
3.	Sub grade and earthen shoulders/verges/backfill	Not less than 17.5 kN/cum

**Notes:**

- 1) This table is not applicable for lightweight fill material, e.g., cinder, fly ash, etc
- 2) The material to be used in sub-grade shall be non-expansive and shall satisfy design CBR at the specified dry density and moisture content. In case the available materials fail to meet the requirement of CBR use of stabilization methods in accordance with MORTH-5<sup>TH</sup> REVISION clauses 403 and 404 or by any stabilization method approved by the engineer shall be followed.

The material to be used in sub-grade shall conform to the design CBR value at the specified dry density and moisture content of the test specimen. In case the available materials fails to meet the requirement of CBR, use of stabilization methods in accordance with MORTH-5<sup>TH</sup> REVISION clauses 403 and 404 or by any stabilization method approved by the Engineer or by the IRC Accreditation committee shall be followed.

The material to be used in high embankment construction shall satisfy the specified requirements of strength parameters.

### 5.3. General requirements for embankment materials

The materials for embankment shall be obtained from approved sources with preference given to acceptable materials becoming available from nearby roadway excavation under the same contract.

The work shall be so planned and executed that the best available materials are saved for the sub-grade and the embankment portion just below the sub-grade.

### 5.4. Borrow materials

The arrangement for the source of supply of the material for embankment and sub-grade and compliance with guidelines, and environmental requirements, in respect of excavation and borrow areas as stipulated, from time to time by the Ministry of

Environment and Forests, government of India and the local bodies, as applicable shall be the sole responsibility of the contractor.

Borrow pits along the road shall be discouraged. If permitted by the Engineer, these shall not be dug continuously. Ridges of not less than 8 m width should be left at intervals not exceeding 300 m. small drains shall be cut through the ridges to facilitate drainage. The depth of the pits shall be so regulated that their bottom does not cut an imaginary line having a slope of 1 vertical to 4 horizontal projected from the edge of the final section of the bank, the maximum depth in any case being limited to 1.5 m. Also, no pit shall be dug within the offset width of a minimum of 10m.

Haulage of material to embankments or other areas of fill shall proceed only when sufficient spreading and compaction plant in operating at the place of deposition.

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

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

#### 5.5. Fly-Ash

Use of fly-ash shall conform to the Ministry of Environment and Forest guidelines. Where fly-ash is used the embankment construction shall conform to the physical and chemical properties and requirements of IRC: SP: 38-2001, "Guidelines for Use of Fly-ash in Road Construction." The term fly-ash shall cover all types of coal ash such as pond ash, bottom ash or mound ash.

Embankment constructed out of fly-ash shall be properly designed to ensure stability and protection against erosion in accordance with IRC guidelines. A suitable thick cover may preferably be provided at intervening layers of pond ash for this purpose. A thick soil cover shall bind the edge of the embankment to protect it against erosion. Minimum thickness of such soil cover shall be 500mm.

#### 5.6. Compaction requirements

The contractor shall obtain representative samples from each of the identified borrow areas and have these tested at the site laboratory following a testing program approved by the engineer. It shall be ensured that the sub-grade material when compacted to the density requirements as the table 300-2 shall yield the specified design CBR value of the sub-grade.

**As per table 300 - 2: Compaction requirements for embankment and sub-grade**

Sl. No	Type of work /material	Relative compaction as percentage of max. 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)	<b>Expansive clays</b>	
	a. Sub-grade and 500mm portion just below the sub-grade	Not allowed
	b. Remaining portion of embankment	90-95%

The contractor shall at least 7 working days before commencement of compaction submit the following to the Engineer for approval:

- i) The values of maximum dry density and optimum moisture content obtained in accordance with IS:2720 (Part 8), appropriate for each of the fill materials he intends to use.
- ii) A graph of dry density plotted against moisture content from which each of the values in (i) above of maximum dry density and optimum moisture content were determined.

The maximum dry density and optimum moisture content approved by the Engineer shall form the basis for compaction.

## 5.7. Construction operation

### 5.7.1. Setting out

After the site has been cleared to MORTH-5<sup>TH</sup> REVISION clause 201, the work shall be set out to MORTH-5<sup>TH</sup> REVISION clause 301.2.1 the limits of embankment/sub-grade shall be marked by fixing batter pegs on both sides at regular intervals as guides before commencing the earthwork. The embankment/sub-grade shall be built sufficiently wider than the design dimension so that surplus material may be trimmed, ensuring that the remaining material is to the desired density and in position specified and conforms to the specified side slopes.

## 5.8. Dewatering

If the foundation of the embankment is in an area with stagnant water, and in the opinion of the Engineer it is feasible to remove it, the same shall be removed by bailing out or pumping, as directed by the Engineer, and the area of the embankment foundation shall be kept dry. Care shall be taken to discharge the drained water so as not to cause damage to the works, crops or any other property. Due to any negligence on the part of the Contractor, if any such damage is caused, it shall be the sole

responsibility of the Contractor to repair/restore it to original condition or compensate for the damage at his own cost.

If the embankment is to be constructed under water, MORTH-5TH REVISION clause 305.4.6 shall apply.

#### 5.9. Stripping and storing topsoil

When so directed by the engineer, the topsoil from all areas of cutting and from all areas to be covered by embankment foundation shall be stripped to specified depths not exceeding 150 mm and stored in stockpiles of height not exceeding 2 m for covering embankment slopes, cut slopes and other disturbed areas where re-vegetation is desired. Topsoil shall not be unnecessarily subjected to traffic either before stripping or when in a stockpile. Stockpiles shall not be surcharged or otherwise loaded and multiple handling shall be kept to a minimum.

#### 5.10. Compacting ground supporting embankment/sub-grade

Where necessary, the original ground shall be leveled to facilitate placement of first layer of embankment, scarified, mixed with water and then compacted by rolling in accordance with MORTH-5TH REVISION clauses 305.3.5 and 305.3.6 so as to achieve minimum dry density as given in MORTH-5TH REVISION - table 300-2.

In case where the difference between the sub-grade level (top of the sub-grade on which pavement rests) and ground level is less than 0.5 m and the ground does not have 97 percent relative compaction with respect to the dry density (as give in MORTH-5TH REVISION table 300-2), the ground shall be loosened up to a level 0.5 m below the sub-grade level, watered and compacted in layers in accordance with MORTH-5TH REVISION clause 305.3.5 and 305.3.6 to achieve dry density not less than 97 percent relative compaction as given in MORTH-5TH REVISION table 300-2.

Where so directed by the engineer, any unsuitable material occurring in the embankment foundation (500 mm portion just below the sub-grade) shall be removed, suitably disposed and replaced by approved materials laid in layers to the required degree of compaction.

Any foundation treatment specified for embankments especially high embankments, resting on suspects foundations as revealed by borehole logs shall be carried out in a manner and to the depth as desired by the engineer. Where the ground on which an embankment is to be built has any of such material types (a) to (f) in MORTH-5TH REVISION clause 305.2.1.1 at least 500 mm of such material must be removed and replaced by acceptable fill material before embankment construction commences.

#### 5.11. Spreading material in layers and bringing to appropriate moisture content

The embankment and sub-grade material shall be spread in layers of uniform thickness in the entire width with a motor grader. The compacted thickness of each layer shall not be more than 250mm when vibratory roller/vibratory soil compactor is used and not more than 200 mm when 80-100 kN static roller is used. The motor grader blade shall have hydraulic control suitable for initial adjustment and maintain the same so as to achieve the specific slope and grade. Successive layers shall not be placed until the layer under construction has been thoroughly compacted to the specified requirements as in MORTH-5TH REVISION table 300-2 and got approved by the Engineer, Each compacted layer shall be finished parallel to the final cross-section of the embankment.

Moisture content of the material shall be checked at the site of placement prior to commencement of compaction; if found to be out of agreed limits, the same shall be made good. Where water is required to be added in such construction. Water shall be sprinkled from a water tanker fitted with sprinkler capable of applying water uniformly with a controllable rate of flow to variable widths of surface but without any flooding. The water shall be added uniformly and thoroughly mixed in soil by balding, using disc harrow until uniform moisture content is obtained throughout the depth of the layer.

If the material delivered to the roadbed is too wet, it shall be dried, by aeration and exposure to the sun, till the moisture content is acceptable for compaction, should circumstances arise, where owing to wet weather, the moisture content cannot be reduced to the required amount by the above procedure, compaction work shall be suspended.

Moisture content of each layer of soil shall be checked in accordance with IS: 2720 (Part 2), and unless otherwise mentioned, shall be so adjusted, making due allowance for evaporation losses, that at the time of compaction it is in the range of 1 percent above to 2 percent below the optimum moisture content determined in accordance with IS: 2720 Part 8) as the case may be. Expansive clays shall, however, be compacted at moisture content corresponding to the specified dry density, but on the wet side of the optimum moisture content obtained from the laboratory compaction curve.

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

Clods or hard lumps of earth shall be broken to have a maximum size of 75 mm when being placed in the embankment and a maximum size of 50 mm when being placed in the sub-grade.

Embankment and other areas of fill shall, unless otherwise required in the Contract or permitted by the Engineer, be constructed evenly over their full width and their fullest possible extent and the Contractor shall control and direct construction plant and other construction vehicles. Damage by construction plant and other vehicular traffic shall

be made good by the Contractor with material having the same characteristics and strength of the material before it was damaged.

Embankments and unsupported fills shall not be constructed with steeper side slopes or to greater widths than those shown in the drawings, except to permit adequate compaction at the edges before trimming back, or to obtain the final profile following any settlement of the fill and the underlying material,

Whenever fill is to be deposited against the face of the natural slope, or sloping earthworks face including embankments, cuttings, other fills and excavations steeper than 1 vertical to 4 horizontal, such faces shall be benched as per MORTH-5TH REVISION clause 305.4.1 immediately before placing the subsequent fill.

All permanent faces of side slopes of embankments and other areas of fill shall, subsequent to any trimming operations, be reworked and sealed to the satisfaction of the Engineer by tracking a tracked vehicle, considered suitable by the Engineer, on the slope or any other method approved by the Engineer.

#### 5.12. Compaction

Only the compaction equipment approved by the Engineer shall be employed to compact the different material types encountered during construction. Static three-wheeled roller, self-propelled single drum vibratory roller, tandem vibratory roller, pneumatic tyre roller, pad foot roller, etc., of suitable size and capacity as approved by the engineer shall be used for the different types and grades of materials required to be compacted either individually or in suitable combinations.

The compaction shall be done with the help of self-propelled single drum vibratory roller or pad foot vibratory roller of 80 to 100 kN static weight or heavy pneumatic tyre roller of adequate capacity capable of achieving the required compaction. The contractor shall demonstrate the efficacy of the equipment he intends to use by carrying out compaction trials. The procedure to be adopted for the site trials shall be submitted to the Engineer for approval.

Earthmoving plant shall not be accepted as compaction equipment nor shall the use of a lighter category of plant to provide any preliminary compaction to assist the use of heavier plant be taken into account.

Each layer of the material shall be thoroughly compacted to the densities specified in MORTH-5TH REVISION table 300-2. Subsequent layers shall be placed only after the finished layer has been tested according to MORTH-5TH REVISION clause 903.2.2 and accepted by the Engineer. The Engineer may permit measurement of field dry density by a nuclear moisture/density gauge used in accordance with agreed procedure and provided and gauge is calibrated to give results identical to that obtained from tests in accordance with IS:2720 (Part 28). A record of the same shall be maintained by the Contractor.

When density measurements reveal any soft areas in the embankment/sub-grade/earthen shoulders, further compaction shall be carried out as directed by the Engineer. If in spite of that the specified compaction is not achieved, the material in the soft areas shall be removed and replaced by approved material, compacted using appropriate mechanical means such as light weight vibratory roller, double drum walk behind roller, vibratory plate compactor, trench compactor or vibratory tamper to the density requirements and satisfaction of the Engineer.

## **6 Lime treated soil for improved sub-grade/sub-base**

### **6.1. General**

This work shall consist of laying and compacting an improved sub-grade / lower sub-base of soil treated with lime on prepared sub-grade in accordance with the requirements of these Specifications and in conformity with the lines, grades and cross-sections shown on the drawings or as directed by the Engineer, Lime treatment is generally effective for soils which contain a relatively high percentage of clay and silty clay.

### **6.2. Soil**

Except when otherwise specified, the soil used for stabilization shall be the local clayey soil having a plasticity index greater than 8.

### **6.3. Lime**

Lime for lime-soil stabilization work shall be commercial dry lime slaked at site or pre-slaked lime delivered to the site in suitable packing, Unless otherwise permitted by the Engineer, the lime shall have purity of not less than 70 percent by weight of Quick-lime (CaO) when tested in accordance with IS:1514. Lime shall be properly stored to avoid prolonged exposure to the atmosphere and consequent carbonation which would reduce its binding properties.

### **6.4. Quantity of lime in stabilized mix**

Quantity of lime to be added as percentage by weight of the dry soil shall be as specified in the Contract. The quantity of lime used shall be related to its calcium oxide content which shall be specified. Where the lime of different calcium oxide content is to be used, its quantity shall be suitably adjusted with the approval of the Engineer so that equivalent calcium oxide is incorporated in the work. The mix design shall be done to arrive at the appropriate quantity of lime to be added, having due regard to the purity of lime, the type of soil, the moisture-density relationship, and the design CBR/Unconfined Compressive Strength (UCS) value specified in the Contract. The laboratory CBR/UCS value shall be at least 1.5 times the minimum field value of CBR/UCS stipulated in the Contract.

## 6.5. Water

The water to be used for lime stabilization shall be clean and free from injurious substances. Potable water shall be used.

## 6.6. Weather limitations

Lime-soil stabilization shall not be done when the air temperature in the shade is less than 10°C.

## 6.7. Degree of pulverization

For lime-soil stabilization, the soil before addition of stabilizer, shall be pulverized using agricultural implements like disc harrows (only for low volume roads) and rotavators to the extent that it passes the requirements set out in MORTH-5TH REVISION table 400-3 when tested in accordance with the method described in MORTH-5TH REVISION appendix-3

**As per MORTH-5TH REVISION table 400 – 3: Soil pulverization requirements for Lime stabilization**

IS Sieve designation	Minimum percent by weight passing the IS sieve
26.5 mm	100
5.6 mm	80

## 6.8. Equipment for construction

Stabilized soil sub-bases shall be constructed by mix-in-place method of construction or as otherwise approved by the Engineer. Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small-sized jobs.

The equipment used for mix-in-place construction shall be a rotavator or similar approved equipment capable of pulverizing and mixing the soil with additive and water to specified degree to the full thickness of the layer being processed, and of achieving the desired degree of mixing and uniformity of the stabilized material. If so desired by the Engineer, trial runs with the equipment shall be carried out to establish its suitability for work.

The thickness of any layer to be stabilized shall be not less than 100 mm when compacted. The maximum thickness can be 200 mm, provided the plant used in accepted by the Engineer.

## 6.9. Mix-in-place method of construction

Before deploying the equipment, the soil after it is made free of undesirable vegetation or other deleterious matter shall be spread uniformly on the prepared sub-grade in a

quantity sufficient to achieve the desired compacted thickness of the stabilized layer. Where single-pass equipment is to be employed, the soil shall be lightly rolled as directed by the Engineer.

The equipment used shall either be of single-pass or multiple pass type. The mixers shall be equipped with an appropriate device for controlling the depth of processing and the mixing blades shall be maintained or reset periodically so that the correct depth of mixing is obtained at all times.

With single-pass equipment the forward speed of the machine shall be so selected in relation to the rotor speed that the required degree of mixing, pulverization and depth of processing is obtained. In multiple-pass processing, the prepared sub-grade shall be pulverized to the required depth with successive passes of the equipment and the moisture content adjusted to be within prescribed limits mentioned hereinafter. The lime shall then be spread uniformly and mixing continued with successive passes until the required depth and uniformity of processing have been obtained.

The mixing equipment shall be so set that it cuts slightly into the edge of the adjoining lane processed previously so as to ensure that all the material forming a layer has been properly processed for the full width.

#### 6.10. Construction with manual means

Where manual mixing is permitted, the soil from borrow areas shall first be freed of all vegetation and other deleterious mater and placed on the prepared sub-grade. The soil shall then be pulverized by means of crow-bars, pick axes or other means approved by the Engineer.

Water in requisite quantities may be sprinkled on the soil for aiding pulverization. On the pulverized soil, the lime in requisite quantities shall be spread uniformly and mixed thoroughly by working with spades or other similar implements till the whole mass are uniform. After adjusting the moisture content to be within the limits mentioned later, the mixed material shall be leveled up to the required thickness so that it is ready to be rolled

#### 6.11. Addition of lime

Lime may be mixed with the prepared material either in slurry form or dry state at the option of the Contractor with the approval of the Engineer.

Dry lime shall be prevented from blowing by adding water to the lime or other suitable means selected by the contractor, with the approval of the Engineer.

The tops of windrowed material may be flattened or slightly trenched to receive the lime.

The distance to which lime may be spread upon the prepared material ahead of the mixing operation shall be determined by the Engineer.

No traffic other than the mixing equipment shall be allowed to pass over the spread lime until after completion of mixing.

Mixing or remixing operations, regardless of equipment used, shall continue until the material is free of any white streaks or pockets of lime and the mixture is uniform.

Non-uniformity of colour reaction, when the treated material is tested with the standard phenolphthalein alcohol indicator, will be considered evidence of inadequate mixing.

#### 6.12. Moisture content for compaction

The moisture content at compaction checked vide IS: 2720 (Part 2) shall neither be less than the optimum moisture content corresponding to IS: 2720 (Part 8) nor more than 2 percent above it.

#### 6.13. Rolling

Immediately after spreading, grading and leveling of the mixed material, compaction shall be carried out with approved equipment preceded by a few passes of lighter rollers if necessary. Rolling shall commence at edges and progress towards the centre, except at super elevated portions or for carriageway with unidirectional cross-fall where it shall commence at the inner edge and progress towards the outer edge.

During rolling, the surface shall be frequently checked for grade and crossfall (camber) and any irregularities corrected by loosening the material and removing / adding fresh material. Compaction shall continue until the density achieved is at least 98 percent of the maximum dry density for the material determined in accordance with IS: 2720 (Part 8).

Care shall be taken to see that the compaction of lime stabilized material is completed within three hours of its mixing or such shorter period as may be found necessary in dry weather.

During rolling it shall be ensured that roller does not bear directly on hardened or partially hardened treated material previously laid other than what may be necessary for achieving the specified compaction at the joint. The final surface shall be well closed, free from movement under compaction planes, ridges, cracks or loose material. All loose or segregated or otherwise defective areas shall be made good to the full thickness of the layer and re-compacted.

#### 6.14. Curing

The sub-base course shall be suitably cured for the minimum period of 7 days after which subsequent pavement courses shall be laid to prevent the surface from drying out and becoming friable. No traffic of any kind shall ply over the completed sub-base unless permitted by the Engineer.

#### 6.15. Surface finish and quality control of work

The surface finish of construction shall conform to the requirements of MORTH-5TH REVISION clauses 902.

Control on the Quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

#### 6.16. Strength

When lime is used for improving the sub-grade, the soil-lime mix shall be tested for its CBR value, when lime stabilized soil is used in the sub-base, it shall be tested for unconfined compressive strength (UCS) at 7 days. In case of variation from the design CBR/UCS, in situ value being lower, the pavement design shall be reviewed based on the actual CBR/UCS values. The extra pavement thickness needed on account of lower CBR/UCS value shall be constructed by the Contractor at his own cost.

#### 6.17. Arrangements for traffic

During the period of construction, arrangements for traffic shall be provided and maintained in accordance with MORTH-5TH REVISION clause 112.

#### 6.18. Measurement for payment

Stabilized soil sub-graded sub-base shall be measured as finished work in position in cubic metres.

#### 6.19. Rate

The Contract unit rate for lime stabilized soil sub-graded / sub-base shall be payment in full for carrying out the required operations including full compensation for all components listed in MORTH-5TH REVISION clause 401.7 (i) to (v).

## 7 Granular sub-base

### 7.1. General

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

## 7.2. Materials

The material to be used for the work shall be natural sand, crushed gravel, crushed stone, crushed slag, or combination thereof depending upon the grading required. Use of materials like brick metal, Kankar and crushed concrete shall be permitted in the lower sub-base. The material shall be free from organic or other deleterious constituents and shall conform to the grading given in MORTH-5TH REVISION table 400-1 and physical requirements given in MORTH-5TH REVISION table 400-2. Grading III and IV shall preferably be used in lower sub-base. Grading V and VI shall be used as a sub-base-cum-drainage layer. The grading to be adopted for a project shall be as specified in the Contract. Where the sub-base is laid in two layers as upper sub-base and lower sub-base, the thickness of each layer shall not be less than 150 mm.

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 late rite shall also be tested for Wet AIV (IS: 5640).

### As per MORTH-5TH REVISION 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

### As per MORTH-5TH REVISION table 400 – 2: Physical requirements for materials for granular sub-base

Aggregate Impact Value (AIV)	IS:2386 (Part 4) or S: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

## 7.3. Preparation of sub-grade

Immediately prior to the laying of sub-base, the sub-grade already finished to MORTH-5TH REVISION 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.

#### 7.4. 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 sub-grade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation, or other means as approved by the Engineer.

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

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

#### 7.5. Surface finish and quality control of work

The surface finish of construction shall conform to the requirements of MORTH-5TH REVISION clause 902. Control on the quality of materials and works shall be exercised by the Engineer in accordance with MORTH-5TH REVISION Section 900.

#### 7.6. Arrangements for traffic

During the period of construction, arrangements for the traffic shall be provided and maintained in accordance with MORTH-5TH REVISION clause 112.

#### 7.7. 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.

#### 7.8. Rate

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

- i) Making arrangements for traffic to MORTRH-5<sup>TH</sup> REVISION 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 carrying out the required tests for quality control.

### **8 Wet mix macadam sub-base/base**

#### 8.1. General

This work shall consist of laying and compacting clean, crushed, graded aggregate and granular material, premixed with water, to a dense mass on a prepared sub-grade/sub- base/ base or existing pavement as the case may be in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as necessary to lines, grades and cross-sections shown on the approved drawings or as directed by the Engineer.

The thickness of a single compacted Wet Mix Macadam layer shall not be less than 75 mm (as per MORTH-5<sup>TH</sup> REVISION). When vibrating or other approved types of compacting equipment are used, the compacted depth of a single layer of the sub-base course may be up to 200 mm with the approval of the Engineer.

#### 8.2. Physical requirements

Coarse aggregates shall be crushed stone. If crushed gravel/shingle is used, not less than 90 percent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in MORTH-5TH REVISION table 400 – 12.

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

**As per MORT table 400 – 12: Physical requirements of coarse aggregates for wet mix macadam for sub-base / base courses**

S. No.	Test	Test Method	Requirements
1)	Los Angeles Abrasion value Or Aggregate impact value	IS:2386 (Part-4)  IS: 2386 (Part-4) or IS:5640	40 percent (Max.)  30 percent (Max.)
2)	Combined Flakiness and Elongation indices (Total)	IS: 2386 (Part-1)	35 percent (Max.)*

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

### 8.3. Grading requirements

The aggregates shall conform to the grading given in MORTH-5TH REVISION table 400-13.

**As per MORTH-5TH REVISION table 400–13: Grading requirements of aggregates for wet mix macadam**

IS Sieve designation	Percent by weight passing the IS Sieve
53.00 mm	100
45.00 mm	95 – 100
26.50 mm	–
22.40 mm	60 – 80
11.20 mm	40 – 60
4.75 mm	25 – 40
2.36 mm	15 – 30
600.00 micron	8 – 22
75.00 micron	0 – 5

Material finer than 425 micron shall have plasticity Index (PI) not exceeding 6

The final gradation approved within these limits shall be graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa.

#### 8.4. Preparation of base

The surface of the sub-grade/sub-base/base to receive the wet mix macadam course shall be prepared to the specified graded and camber and cleaned of dust, dirt and other extraneous material. Any rust or soft yielding places shall be corrected in an approved manner and rolled unit firm surface is obtained.

Where the WMM is to be laid on an existing metallic road, damage area including depressions and potholes shall be repaired and made good with the suitable material. The existing surface shall be scarified and re-shaped to the required grade and camber before spreading the coarse aggregate for WMM.

As far as possible, laying wet mix macadam course over existing bituminous layer may be avoided since it will cause problems of internal drainage of the pavement at the interface of two courses. It is desirable to completely pick out the existing thin bituminous wearing course where wet mix macadam is proposed to be laid over it.

#### 8.5. Provision of lateral confinement of aggregates

While constructing wet mix macadam, arrangement shall be made for the lateral confinement of wet mix. This shall be done by laying materials in adjoining shoulders along with that of wet mix macadam layer and following the sequence of operations described in MORTH-5TH REVISION clause 404.3.3.

#### 8.6. Preparation of mix

Wet mix macadam shall be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced/ positive mixing arrangement like pug mill or pan type mixer of concrete batching plant. The plant shall have following features:

- i) For feeding aggregates- three/ four bin feeders with variable speed motor
- ii) Vibrating screen for removal of oversize aggregates
- iii) Conveyor Belt
- iv) Controlled system for addition of water
- v) Forced/positive mixing arrangement like pug-mill or pan type mixer
- vi) Centralized control panel for sequential operation of various devices and precise process control
- vii) Safety devices

Optimum moisture for mixing shall be determined in accordance with IS: 2720 (Part-8) after replacing the aggregate fraction retained on 22.4 mm sieve with material of

4.75 mm to 22.4 mm size. While adding water, due allowance should be made for evaporation losses. However, at the time of compaction, water in the wet mix should not vary from the optimum value by more than agreed limits. The mixed material should be uniformly wet and no segregation should be permitted.

#### 8.7. Spreading of mix

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

The mix may be spread by a paver finisher. The paver finisher shall be self-propelled of adequate capacity with following features:

- i) Loading hoppers and suitable distribution system, so as to provide a smooth uninterrupted material flow for different layer thicknesses from the tipper to the screed.
- ii) Hydraulically operated telescopic screed for paving width upto to 8.5 m and fixed screed beyond this. The screed shall have tamping and vibrating arrangement for initial compaction of the layer.
- iii) Automatic leveling control system with electronic sensing device to maintain mat thickness and cross slope of mat during laying procedure.

In exceptional cases where it is not possible for the paver to be utilized, mechanical means like motor grader may be used with the prior approval of the Engineer. The motor grader shall be capable of spreading the material uniformly all over the surface.

The surface of the aggregate shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate as may be required. The layer may be tested by depth blocks during construction. No segregation of larger and fine particles should be allowed. The aggregates as spread should be of uniform gradation with no pockets of fine materials.

The Engineer may permit manual mixing and /or laying of wet mix macadam where small quantity of wet mix macadam is to be executed. Manual mixing/laying in inaccessible/ remote locations and in situations where use of machinery is not feasible can also be permitted. Where manual mixing/laying is intended to be used, the same shall be done with the approval of the Engineer.

#### 8.8. Compaction

After the mix has been laid to the required thickness, grade and crossfall/camber the same shall be uniformly compacted to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 100 mm, a smooth wheel roller of 80 to 100kN weight may be used. For a compacted single layer upto 200 mm, the

compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 kN with an arrangement for adjusting the frequency and amplitude. An appropriate frequency and amplitude may be selected. The speed of the roller shall not exceed 5 km/h.

In portions having unidirectional cross fall/super elevation, rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the center line of the road, uniformly over-lapping each preceding track by at least one-third width until the entire surface has been rolled. Alternate trips of the roller shall be terminated in stops at least 1 m away from any preceding stop.

In portions in camber, rolling should begin at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall then progress gradually towards the center parallel to the center line of the road uniformly overlapping each of the preceding track by at least one-third width until the entire surface has been rolled.

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

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

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

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material as determined by the method outlined in IS: 2720 (Part – 8).

After completion, the surface of any finished layer shall be well-closed, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of the layer and re-compacted.

#### 8.9. Setting and drying

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

#### 8.10. Opening to traffic

No vehicular traffic shall be allowed on the finished wet mix macadam surface. Construction equipment may be allowed with the approval of the Engineer.

#### 8.11. Surface finish and quality control of work

##### 8.11.1. Surface evenness

The surface finish of construction shall conform to the requirements of MORTH-5TH REVISION clause 902.

##### 8.11.2. Quality control

Control on the quality of materials and works shall be exercised by the Engineer in accordance with MORTH-5TH REVISION section 900.

#### 8.12. Rectification of surface irregularity

Where the surface irregularity of the wet mix macadam course exceeds the permissible tolerances or where the course is otherwise defective due to sub-grade soil getting mixed with the aggregates, the full thickness of the layer shall be scarified over the affected area, re-shaped with added premixed material or removed and replaced with fresh premixed material as applicable and re-compacted in accordance with MORTH-5TH REVISION clause 406.3. The area treated in the aforesaid manner shall not be less than 5 m long and 2 m wide. In no case shall depressions be filled up with unmixed and ungraded material or fines.

#### 8.13. Arrangement for traffic

During the period of construction, arrangements for traffic shall be done as per MORTH-5TH REVISION Clause 112.

#### 8.14. Measurements for payment

Wet mix macadam shall be measured as finished work in position in cubic metres.

#### 8.15. Rate

The Contract unit rate for wet mix macadam shall be payment in full for carrying out the required operations including full compensation for all components listed in MORTH-5TH REVISION clause 401.7.

## 9 Prime coat over granular base

### 9.1. General

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. The work shall be carried out on a previously prepared granular/ stabilized surface to MORTH-5TH REVISION clause 501.8.

### 9.2. Materials

The primer shall be cationic bitumen emulsion SS1 grade conforming to IS::8887 or medium curing cutback bitumen conforming to IS: 217 or as specified in the Contract.

Quantity of SS1 grade bitumen emulsion for various types of granular surface shall be as given in MORTH-5TH REVISION table 500-3.

#### As per MORTH-5TH REVISION table 500 – 3: Quantity of bitumen emulsion for various types of granular surfaces

Type of surface	Rate of Spray (Kg/Sqm)
WMM/WBM	0.7-1.0
Stabilized soil bases/Crusher run macadam	0.9-1.2

Cutback for primer shall not be prepared at the site. Type and quantity of cutback bitumen for various types of granular surface shall be as given in MORTH-5TH REVISION table 500-4.

#### As per MORTH-5TH REVISION table 500 – 4: Type and quantity of cutback bitumen for various types of granular surface

Type of surface	Type of cutback	Rate of spray (Kg/Sqm)
WMM/WBM	MC 30	0.6-0.9
Stabilized soil bases/ Crusher run macadam	MC 70	0.9-1.2

The correct quantity of primer shall be decided by the Engineer and shall be such that it can be absorbed by the surface without causing run-off of excessive primer and to achieve desired penetration of about 8-10 mm.

### 9.3. Weather and seasonal limitations

Primer shall not be applied during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 10OC. Cutback bitumen as primer shall not be applied to a wet surface. Surfaces which are to receive emulsion primer should be damp, but no free or standing water shall be present. Surface can be just wet by very light sprinkling of water.

#### 9.4. Equipment

The primer shall be applied by a self-propelled or towed bitumen pressure sprayer equipped for spraying the material uniformly at specified rates and temperatures. Hand spraying shall not be allowed except in small areas, inaccessible to the distributor, or in narrow strips where primer shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

#### 9.5. Preparation of road surface

The granular surface to be primed shall be swept clean by power brooms or mechanical sweepers and made free from dust. All loose materials and other foreign materials shall be removed completely. If soil/ moorum binder has been used in the WBM surface, part of this should be brushed and removed to a depth of about 2 mm so as to achieve good penetration.

#### 9.6. Application of bituminous primer

After preparation of the road surface as per MORTH-5TH REVISION clause 502.4.2, the primer shall be sprayed uniformly at the specified rate. 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.

No heating or dilution of SS1 bitumen emulsion and shall be permitted at site. Temperature of cutback bitumen shall be high enough to permit the primer to be sprayed effectively through the jets of the spray and to cover the surface uniformly.

#### 9.7. Curing of primer and opening to traffic

A primed surface shall be allowed to cure for at least 24 hours or such other higher period as is found to be necessary to allow all the moisture/volatiles to evaporate before any subsequent surface treatment or mix is laid. Any unabsorbed primer shall first be blotted with a light 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.

#### 9.8. Quality control of work

For control of the quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

#### 9.9. Arrangements for traffic

During construction operations, arrangements for traffic shall be made in accordance with the provisions of MORTH-5TH REVISION clause 112.

#### 9.10. Measurement for payment

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

#### 9.11. Rate

The contract unit rate for prime coat shall be payment in full for carrying out the required operations including full compensation for all components listed in MORTH-5TH REVISION clause 401.7 (i) to (v) and as applicable to the work specified in these Specifications. Payment shall be made on the basis of the provision of prime coat at an application rate of quantity at 0.6 kg per square metre or at the rate specified in the Contract, with adjustment, plus or minus, for the variation between this quantity and the actual quantity approved by the Engineer after the preliminary trials referred to in MORTH-5TH REVISION clause 502.4.3.

### **10 Tack coat**

#### 10.1. General

The work shall consist of the application of a single coat of low viscosity liquid bituminous material to existing bituminous, cement concrete or primed granular surface preparatory to the superimposition of a bituminous mix, when specified in the Contract or as instructed by the Engineer. The work shall be carried out on a previously prepared surface in accordance with MORTH-5TH REVISION clause 501.8.

#### 10.2. Materials

The binder used for tack coat shall be either Cationic bitumen emulsion (RS 1) complying with IS: 8887 or suitable low viscosity paving bitumen of VG 10 grade conforming to IS:73. The use of cutback bitumen RC: 70 as per IS: 217 shall be restricted only for sites at sub-zero temperatures or for emergency applications as directed by the Engineer. The type and grade of binder for tack coat shall be as specified in the Contract or as directed by the Engineer.

#### 10.3. Weather and seasonal limitations

Bituminous material shall not be applied 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. Where the tack coat consists of emulsion, the surface shall be slightly damp, but not wet. Where the tack coat is of cutback bitumen, the surface shall be dry.

#### 10.4. Equipment

The tack coat shall be applied by a self-propelled or towed bitumen pressure sprayer, equipped for spraying the material uniformly at a specified rate. Hand spraying shall not be permitted except in small areas, inaccessible to the distributor, or narrow strips, shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

#### 10.5. 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 be otherwise prepared in accordance with the requirements of MORTH-5TH REVISION clauses 501.8. The granular or stabilized surfaces shall be primed as per MORTH-5TH REVISION clause 502. 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.

#### 10.6. Application of tack coat

The application of tack coat shall be at the rate specified in MORTH-5TH REVISION table 500-5, and it shall be applied uniformly. If rate of application of Tack Coat is not specified in the contract, then it shall be the rate specified in MORTH-5TH REVISION table 500-5. No dilution or heating at site of RS1 bitumen emulsion shall be permitted. Paving bitumen if used for tack coat shall be heated to appropriate temperature in bitumen boilers to achieve viscosity less than 2poise. The normal range of spraying temperature for a bituminous emulsion shall be 20°C to 70°C and for cutback, 50°C to 80°C. The method of application of tack coat will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar, and speed or 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.

#### As per MORTH-5TH REVISION table 500 – 5: Rate of application of tack coat

Type of surface	Rate of spray of binder in Kg per Sqm
Bituminous surfaces	0.20 – 0.30
Granular surfaces treated with primer	0.25 – 0.30
Cement concrete pavement	0.30 – 0.35

#### 10.7. Curing of tack coat

The tack coat shall be left to cure until all the volatiles have evaporated before any subsequent construction is started. No plant or vehicles shall be allowed on the tack coat other than those essential for the construction.

#### 10.8. Quality control of work

For control of the quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

#### 10.9. Arrangements for traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of MORTH-5TH REVISION clause 112.

#### 10.10. Measurement for payment

Tack coat shall be measured in terms of surface area of application in square metres.

#### 10.11. Rate

The contract unit rate for tack coat shall be payment in full for carrying out the required operations including for all components listed in MORTH-5TH REVISION Clause 401.8 (i) to (v) and as applicable to the work specified in these Specifications. The rate shall cover the provision of tack coat, at 0.2 kg per square metre or at the rate specified in the Contract, with the provision that the variation between this quantity and actual quantity of bitumen used will be assessed and the payment adjusted accordingly.

### **11 Dense Bituminous Macadam**

#### 11.1. General

The specification describes the design and construction procedure for Dense Bituminous Macadam, (DBM), for use mainly, but not exclusively, in base/binder and profile corrective courses. The work shall consist of construction in a single or multiple layers of DBM on a previously prepared base or sub-base. The thickness of a single layer shall be 50 mm to 100 mm.

#### 11.2. Bitumen/ Crumb rubber modified bitumen (CRMB)

The bitumen shall be viscosity grade paving bitumen complying with the Indian Standard Specification IS: 73, modified bitumen complying with MORTH-5TH REVISION clause 501.2.1 and IRC: SP: 53/ IS: 15462 or as otherwise specified in the contract.

#### 11.3. Coarse aggregates

The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on 2.36 mm sieve. They shall be clean, hard and durable of cubical shape, free from dust and soft or friable matter, organic or other deleterious substances. Where the Contractor's selected source of aggregates has poor affinity for bitumen, the Contractor shall produce test results that with the use of anti-stripping agents, the stripping value is improved to satisfy the specification requirements. The

Engineer may approve such a source and as a condition for the approval of that source, the bitumen shall be treated with an approved anti-stripping agent, as per the manufacturer's recommendations, at the cost of the Contractor. The aggregates shall satisfy the requirements specified in MORTH-5TH REVISION table 500-8.

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

#### 11.4. Fine aggregates

Fine aggregates shall consist of crushed or naturally occurring mineral material, or a combination of the two, passing the 2.36 mm sieve and retained on the 75 micron sieve. These shall be clean, hard, durable, dry and free from dust, and soft or friable matter, organic or other deleterious matter. Natural sand shall not be allowed in binder courses. However, natural sand up to 50 percent of the fine aggregate may be allowed in base courses. The fine aggregate shall have a sand equivalent value of not less than 50 when tested in accordance with the requirement of IS: 2720 (Part 37). The plasticity index of the fraction passing the 0.425 mm sieve shall not exceed 4, when tested in accordance with IS: 2720 (Part 5).

#### 11.5. Filler

Filter shall consist of finely divided mineral matter such as rock dust, hydrated lime or cement approved by the Engineer. The filler shall be graded within the limits indicated in MORTH-5TH REVISION table 500-9.

The filler shall be free from organic impurities and have a plasticity Index not greater than 4. The Plasticity Index requirement shall not apply if filler is cement or lime. Where the aggregates fail to meet the requirements of the water sensitivity test in MORTH-5TH REVISION table 500-8, then 2 percent by total weight of aggregate, of hydrated lime shall be used and percentage of fine aggregate reduced accordingly.

#### 11.6. Aggregate grading and binder content

When tested in accordance with IS: 2386 Part I (wet sieving method), the combined grading of the coarse and fine aggregates and filler for the particular mixture shall fall within the limits given in MORTH-5TH REVISION table 500 -10 for grading 1 or 2 as specified in the Contract. To avoid gap grading, the combined aggregate gradation shall not vary from the lower limit on one sieve to higher limit on the adjacent sieve.

**As per MORTH-5TH REVISION table 500 – 8: Physical requirements for coarse aggregate for Dense Bituminous Macadam**

Property	Test	Specification	Method of test
Cleanliness (dust)	Grain size analysis	Max 5% passing 0.075 mm sieve	IS: 2386 Part I
Particle shape	Combined flakiness and elongation indices*	Max 35%	IS: 2386 Part I
Strength	Los Angeles abrasion value or aggregate impact value	Max 35% Max 27%	IS: 2386 Part IV
Durability	Soundness either : Sodium sulphate or magnesium sulphate	Max 12% Max 18%	IS:2386 Part V
Water absorption	Water Absorption	Max 2%	IS: 2386 Part III
Stripping	Coating and stripping of bitumen aggregate Mix	Minimum retained coating 95%	IS: 6241
Water sensitivity	Retained tensile strength**	Min. 80%	AASHTO 283

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

*\*\*If the minimum retained tensile test strength falls below 80 percent, use of anti stripping agent is recommended to meet the requirement.*

**As per MORTH-5TH REVISION table 500 – 9: Grading requirements for mineral filler**

15 Sieve (mm)	Cumulative percent passing by weight of total aggregate
0.6	100
0.3	95 – 100
0.075	85 – 100

**As per MORTH-5TH REVISION table 500 – 10: Composition of Dense Graded Bituminous Macadam**

Grading	1	2
Nominal aggregate size*	37.5 mm	26.5 mm
Layer thickness	75 - 100 mm	50 – 75 mm
IS Sieve1 (mm)	Cumulative % by weight of total aggregate passing	
45	100	
37.5	95- 100	100
26.5	63- 93	90- 100
19	-	71- 95
13.2	55- 75	56- 80
9.5	-	-
4.75	38- 54	38- 54

Grading	1	2
2.36	28- 42	28- 42
1.18	-	-
0.6	-	-
0.3	7- 21	7- 21
0.15	-	-
0.075	2- 8	2- 8
Crumb rubber modified bitumen (CRMB) content % by mass of total mix	Min 4.3**	Min 4.7**

\* The nominal maximum particle size is the largest specified sieve size upon which any of the aggregate is retained.

\*\* Corresponds to specific gravity of aggregates being 2.7. In case aggregate have specific gravity more than 2.7, the minimum CRMB content can be reduced proportionately. Further the region where highest daily mean air temperature is 30°C or lower and lowest daily air temperature is - 10°C or lower, the CRMB content may be increased by 0.5 percent.

CRMB content indicated in MORTH-5TH REVISION table 500 - 10 is the minimum quantity. The quantity shall be determined in accordance with MORTH-5TH REVISION clause 505.3.

#### 11.7. Modified bitumen

- Studies have revealed that properties of bitumen and bituminous mixes can be improved /modified with the incorporation of certain additives or blend of additives. These additives are called "Modifiers" and the bitumen premixed with these modifiers is known as "Modified Bitumen".
- Use of modified bitumen in the top layers of the pavement is expected to significantly enhance the life of the surfacing and extend the time of the next renewal.
- The use of Modified Bitumen in construction/maintenance of bituminous roads significantly improves the pavement performance and is cost effective, when life-cycle cost is taken into consideration.
- Since a bituminous mix prepared with modified bitumen has a higher stiffness modulus, enhanced fatigue life, better resistance to creep and higher indirect tensile strength, it is suitable as a wearing course, a binder course and overlay material on surfaces which are cracked and subjected to heavy traffic.
- Modified bitumen performs better than conventional bitumen in situations, where the aggregates are prone to stripping. Due to their better creep resistance properties, they can also be used at busy intersections, bridge decks and roundabouts for increased life of the surfacing.
- There are four types of modified bitumen and CRMB (Crumb rubber modified bitumen) is one of the four types of modified bitumen.
- These four types are further divided into three grades based on the penetration value/softening point value.

- The specification requirements of modified bitumen for various climatic conditions are given in table 2 of IRC: SP:53-2010.

11.8. Crumb rubber modified bitumen (CRMB)

- Crumb Rubber Modified Bitumen (CRMB) is hydrocarbon binder obtained through physical and chemical interaction of crumb rubber (produced by recycling of used tyres) with bitumen and some specific additives. Readily available in the market from reputed suppliers.
- The three grades of CRMB are CRMB-50, CRMB-55 and CRMB-60.
- As per IRC: SP: 53-2010, CRMB-60 grade shall be used as binder for the flexible pavement works based on the climatic condition of the project area

11.9. Mix design

The CRMB content required shall be determined following the Marshall mix design procedure contained in Asphalt Institute Manual MS - 2.

The Fines to Bitumen (F/B) ratio by weight of total mix shall range from 0.6 to 1.2.

11.10. Requirements for the mix

Apart from conformity with the grading and quality requirements for individual ingredients, the mixture shall meet the requirements set out in MORTH-5TH REVISION table 500 -11.

**As per MORTH-5TH REVISION table 500 – 11: Requirements for Dense Graded Bituminous Macadam**

Properties	Viscosity grade paving bitumen	Modified bitumen		Test method
		Hot climate	Cold climate	
Compaction level	75 blows on each face of the specimen			
Minimum stability (kN at 600C)	9.0	12.0	10.0	AASHTO T245
Marshall flow (mm)	2 - 4	2.5 - 4	3.5 - 5	AASHTO T245
Marshall Quotient <div style="border: 1px solid black; padding: 2px; display: inline-block;"> <math>\frac{\text{Stability}}{\text{Flow}}</math> </div>	2 - 5	2.5 - 5		MS - 2 and ASTM D2041
% air voids	3 - 5			
% Voids Filled with Bitumen (VFB)	65 - 75			
Coating of aggregate particle	95% minimum			IS: 6241
Tensile Strength <b>ratio</b>	80% Minimum			AASHTO T 283
% Voids in Mineral Aggregate (VMA)	Minimum percent voids in mineral aggregate (VMA) are set out in Table 500-13			

## 11.11. Binder content

The binder content shall be optimized to achieve the requirements of the mix set out in MORTH-5TH REVISION table 500 -11. The binder content shall be selected to obtain 4 percent air voids in the mix design. The Marshall method for determining the optimum binder content shall be adopted as described in the Asphalt Institute Manual MS - 2.

Where maximum size of the aggregate is more than 26.5 mm, the modified Marshall method using 150 mm diameter specimen described in MS - 2 and ASTM D 5581 shall be used. This method requires modified equipment and procedures. When the modified Marshall test is used, the specified minimum stability values in MORTH-5TH REVISION table 500-12 shall be multiplied by 2.25, and the minimum flow shall be 3 mm.

**As per MORTH-5TH REVISION table 500 – 12: Minimum percent voids in mineral aggregate (VMA)**

Nominal maximum particle Size <sup>1</sup> (mm)	Minimum VMA percent related to design percentage air voids		
	3.0	4.0	5.0
26.5	11.0	12.0	13.0
37.5	10.0	11.0	12.0

**Note:** Interpolate minimum voids in the mineral aggregate (VMA) for designed percentage air voids values between those listed.

## 11.12. Job mix formula

The Contractor shall submit to the Engineer for approval at least 21 days before the start the work, the job mix formula proposed for use in the works, together with the following details:

- i) Source and location of all materials;
- ii) Proportions of all materials expressed as follows:
  - a. Binder type, and percentage by weight of total mix;
  - b. Coarse aggregate/Fine aggregate/Mineral filler as percentage by weight of total aggregate including mineral filler;
- iii) A single definite percentage passing each sieve for the mixed aggregate;
- iv) The individual grading of the individual aggregate fraction, and the proportion of each in the combined grading;
- v) The results of mix design such as maximum specific gravity of loose mix (G<sub>mm</sub>), compacted specimen densities, Marshall stability, flow, air voids, VMA, VFB and related graphs and test results of AASHTO T 283 Moisture susceptibility test;

- vi) Where the mixer is a batch mixer, the individual weights of each type of aggregate, and binder per- batch;
- vii) Test results of physical characteristics of aggregates to be used;
- viii) Mixing temperature and compacting temperature.

While establishing the job mix formula, the Contractor shall ensure that it is based on a correct and truly representative sample of the materials that will actually be used in the work and that the mix and its different ingredients satisfy the physical and strength requirements of these Specifications.

Approval of the job mix formula shall be based on independent testing by the Engineer for which samples of all ingredients of the mix shall be furnished by the Contractor as required by the Engineer.

The approved job mix formula shall remain effective unless and until a revised Job Mix Formula is approved. Should a change in the source of materials be proposed, a new job mix formula shall be forwarded by the Contractor to the Engineer for approval before the placing of the material.

#### 11.13. Plant trials - Permissible variation in job mix formula

Once the laboratory job mix formula is approved, the Contractor shall carry out plant trials to establish that the plant can produce a uniform mix conforming to the approved job mix formula. The permissible variations of the individual percentages of the various ingredients in the actual mix from the job mix formula to be used shall be within the limits as specified in MORTH-5TH REVISION table 500-13 and shall remain within the gradation band. These variations are intended to apply to individual specimens taken for quality control tests in accordance with MORTH-5TH REVISION Section 900.

#### As per MORTH-5TH REVISION table 500 – 13: Permissible variations in the actual mix from the job mix formula

Description	Base / binder course
Aggregate passing 19 mm sieve or larger	± 8%
Aggregate passing 13.2 mm, 9.5 mm	± 7%
Aggregate passing 4.75 mm	± 6%
Aggregate passing 2.36 mm, 1.18 mm, 0.6 mm	± 5%
Aggregate passing 0.3 mm, 0.15 mm	± 4%
Aggregate passing 0.075 mm	± 2%
Binder content	± 0.3%
Mixing temperature	± 10°c

#### 11.14. Laying trials

Once the plant trials have been successfully completed and approved, the Contractor shall carry out laying trials, to demonstrate that the proposed mix can be successfully laid and compacted all in accordance with MORTH-5TH REVISION clause 501. The laying trial shall be carried out on a suitable area which is not to form part of the works. The area of the laying trials shall be a minimum of 100 Sqm of construction similar to that of the project road, and it shall be in all respects, particularly compaction, the same as the project construction, on which the bituminous material is to be laid.

The Contractor shall previously inform the Engineer of the proposed method for laying and compacting the material. The plant trials shall then establish if the proposed laying plant, compaction plant, and methodology is capable of producing satisfactory results. The density of the finished paving layer shall be determined by taking cores, no sooner than 24 hours after laying, or by other approved method. The compacted layers of Dense Graded Bituminous Macadam (DBM) shall have a minimum field density equal to or more than 92% of the density based on theoretical maximum specific gravity (Gmm) obtained on the day of compaction in accordance with ASTM D 2041.

Once the laying trials have been approved, the same plant and methodology shall be applied to the laying of the material on the project, and no variation of either shall be acceptable, unless approved in writing by the Engineer, who may at his discretion require further laying trials.

#### 11.15. Weather and seasonal limitations

The provisions of MORTH-5TH REVISION clause 501.5.1 shall apply.

#### 11.16. Preparation of base

The base on which Dense Graded Bituminous Material is to be laid shall be prepared in accordance with MORTH-5TH REVISION clauses 501 and 902 as appropriate, or as directed by the Engineer.

#### 11.17. Geo synthetics

Where Geo synthetics are specified in the Contract, this shall be in accordance with the requirements stated in MORTH-5TH REVISION clause 703.

#### 11.18. Stress absorbing layer

Where a stress absorbing layer is specified in the Contract, this shall be applied in accordance with the requirements of MORTH-5TH REVISION clause 517.

#### 11.19. Prime coat

Where the material on which the dense bituminous macadam is to be laid is other than a bitumen bound layer, a prime coat shall be applied, as specified, in accordance with the provisions of MORTH-5TH REVISION clause 502, or as directed by the Engineer.

#### 11.20. Tack coat

Where the material on which the dense bituminous macadam is to be laid is either bitumen bound layer or primed granular layer, tack coat shall be applied, as specified, in accordance with the provisions of MORTH-5TH REVISION clause 503, or as directed by the Engineer.

#### 11.21. Mixing and transportation of the mix

The provisions as specified in MORTH-5TH REVISION clauses 501.3 and 501.4 shall apply. MORTH-5TH REVISION table 500-2 gives the mixing, laying and rolling temperature for dense mixes using viscosity grade bitumen. In case of modified bitumen, the temperature of mixing and compaction shall be higher than the mix with viscosity grade bitumen. The exact temperature depends upon the type and amount of modifier used and shall be adopted as per the recommendations of the manufacturer. In order to have uniform quality, the plant shall be calibrated from time to time.

#### 11.22. Spreading

The provisions of MORTH-5TH REVISION clauses 501.5.3 and 501.5.4 shall apply.

#### 11.23. Rolling

The general provisions of MORTH-5TH REVISION clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials. The compaction process shall be carried out by the same plant, and using the same method, as approved in the laying trials, which may be varied only with the express approval of the Engineer in writing.

#### 11.24. Opening to traffic

It shall be ensured that the traffic is not allowed without the approval of the Engineer in writing, on the surface until the dense bituminous layer has cooled to the ambient temperature.

#### 11.25. Surface finish and quality control of work

The surface finish of the completed construction shall conform to the requirements of MORTH-5TH REVISION clause 902. All materials and workmanship shall comply with the provisions set out in Section 900 of these Specifications.

#### 11.26. Arrangements for traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of MORTH-5TH REVISION clause 112.

#### 11.27. Measurement for payment

Dense Graded Bituminous Materials shall be measured as finished work either in cubic metres, tonnes or by the square metre at a specified thickness as indicated in the Contract drawings, or documents, or as otherwise directed by the Engineer.

#### 11.28. Rate

The contract unit rate for Dense Graded Bituminous Macadam shall be payment in full for carrying out all the required operations as specified and shall include, to all components listed in MORTH-5TH REVISION clause 501.8.8.2. The rate shall include the provision of bitumen, at 4 percent and 4.5 percent by weight of the total mixture for grading 1 and grading 2 respectively.

The variation in actual percentage of bitumen used shall be assessed and the payment adjusted plus or minus accordingly.

## 12 Bituminous concrete

### 12.1. General

This work shall consist of construction of Bituminous Concrete, for use in wearing and profile corrective courses. This work shall consist of construction in a single layer of bituminous concrete on a previously prepared bituminous bound surface. A single layer shall be 30 mm/40 mm/50 mm thick.

### 12.2. Bitumen/ CRMB

The bitumen shall be viscosity grade paving bitumen complying with the Indian Standard Specification IS: 73, modified bitumen complying with MORTH clause 501.2.1 and IRC: SP: 53/ IS: 15462 or as otherwise specified in the Contract.

The type and grade of bitumen to be used shall be as specified in clause 9.2.5 and 9.2.6 of this specification.

### 12.3. Coarse aggregates

The coarse aggregates shall be generally as specified in MORTH clause 504.2.2, except that the aggregates shall satisfy the physical requirements of MORTH table 500-16 and where crushed gravel is proposed for use as aggregate, not less than 95 percent by weight of the crushed material retained on the 4.75 mm sieve shall have at least two fractured faces.

#### As per MORTH-5TH REVISION table 500 – 16: Physical requirements for coarse aggregate for bituminous concrete

Property	Test	Specification	Method of test
Cleanliness (dust)	Grain size analysis	Max 5% passing 0.075 mm sieve	IS:2386 Part I

Property	Test	Specification	Method of test
Particle shape	Combined flakiness and elongation indices	Max 35%	IS:2386 Part I
Strength	Los angeles abrasion value or aggregate impact value	Max 30% Max 24%	IS:2386 Part IV
Durability	Soundness either: Sodium Sulphate or Magnesium Sulphate	Max 12% Max 18%	IS:2386 Part V
Polishing	Polished stone value	Min 55	BS:812-114
Water absorption	Water absorption	Max 2%	IS:2386 Part III
Stripping	Coating and stripping of bitumen aggregate mix	Minimum retained coating 95%	IS:6241
Water sensitivity	Retained tensile strength*	Min 80%	AASHTO 283

\*If the minimum retained tensile test strength falls below 80 percent, use of anti stripping agent is recommended to meet the requirement.

#### 12.4. Fine aggregates

The fine aggregates shall be all as specified in MORTH-5TH REVISION clause 505.2.3.

#### 12.5. Filler

Filler shall be as specified in MORTH-5TH REVISION clause 505.2.4.

#### 12.6. Aggregate grading and binder content

When tested in accordance with IS: 2386 Part 1 (Wet grading method), the combined grading of the coarse and fine aggregates and filler shall fall within the limits shown in MORTH -5TH REVISION table 500-17. The grading shall be as specified in the Contract.

#### As per MORTH-5TH REVISION table 500 – 17: Composition of bituminous concrete pavement layers

Grading	1	2
Nominal aggregate size*	19 mm	13.2 mm
Layer thickness	50 mm	30 – 40 mm
15 Sieve1 (mm)	Cumulative % by weight of total aggregate passing	
45		
37.5		
26.5	100	
19	90 – 100	100
13.2	59 – 79	90 – 100
9.5	52 – 72	70 – 88
4.75	35 – 55	53 – 71

Grading	1	2
2.36	28 – 44	42 – 58
1.18	20 – 34	34 – 48
0.6	15 – 27	26 – 38
0.3	10 – 20	18 – 28
0.15	5 – 13	12 – 20
0.075	2 – 8	4 – 10
CRMB content % by mass of total mix	Min 5.4*	Min 5.6**

**Notes:**

\* The nominal maximum particle size is the largest specified sieve size up on which any of the aggregate is retained.

\*\* Corresponds to specific gravity of aggregate being 2.7. In case aggregate have specific gravity more than 2.7, the minimum CRMB content can be reduced proportionately. Further the region where highest daily mean air temperature is 30°C or lower and lowest daily air temperature is - 10°C or lower, the CRMB content may be increased by 0.5 percent

## 12.7. Mix design

## 12.7.1. Requirements for the mix

MORTH -5TH REVISION Clause 505.3.1 shall apply.

## 12.7.2. Binder content

MORTH -5TH REVISION Clause 505 .3.2 shall apply.

## 12.7.3. Job mix formula

MORTH-5TH REVISION Clause 505.3.3 shall apply.

## 12.7.4. Plant trials – Permissible variation in job mix formula

The requirements for plant trials shall be as specified in MORTH clause 505.3.4 and permissible limits for variation as given in MORTH table 500-18.

**As per MORTH-5TH REVISION table 500 – 18: Permissible variations in plant mix from the job mix formula**

Description	Permissible variation
Aggregate passing 19 mm sieve or larger	± 7%
Aggregate passing 13.2 mm, 9.5 mm	± 6%
Aggregate passing 4.75 mm	± 5%
Aggregate passing 2.36 mm, 1.18 mm, 0.6 mm	± 4%
Aggregate passing 0.3 mm, 0.15 mm	± 3%

Description	Permissible variation
Aggregate passing 0.075 mm	± 1.5%
Binder content	± 0.3%
Mixing temperature	± 10°C

#### 12.8. Laying trials

The requirements for laying trials shall be as specified in MORTH clause 505.3.5. The compacted layers of bituminous concrete (BC) shall have a minimum field density equal to or more than 92 percent of the average theoretical maximum specific gravity (Gmm) obtained on the day of compaction in accordance with ASTM 02041

#### 12.9. Weather and seasonal limitations

The provisions of MORTH-5TH REVISION clause 501.5.1 shall apply.

#### 12.10. Preparation of base

The surface on which the bituminous concrete is to be laid shall be prepared in accordance with MORTH-5TH REVISION clauses 501 and 902 as appropriate, or as directed by the Engineer. The surface shall be thoroughly swept clean by mechanical broom and dust removed by compressed air. In locations where a mechanical broom cannot get access, other approved methods shall be used as directed by the Engineer.

#### 12.11. Geo synthetics

Where Geo synthetics are specified in the Contract, this shall be in accordance with the requirements stated in MORTH-5TH REVISION Clause 703.

#### 12.12. Stress absorbing layer

Where a stress absorbing layer is specified in the Contract, this shall be applied in accordance with the requirements of MORTH-5TH REVISION Clause 517.

#### 12.13. Tack coat

The provisions as specified in MORTH-5TH REVISION Clause 504.4.6 shall apply.

#### 12.14. Mixing and transportation of the mix

The provisions as specified in MORTH-5TH REVISION Clauses 501.3, 501.4 and 504.4.7 shall apply.

#### 12.15. Spreading

The general provisions of MORTH-5TH REVISION clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials.

#### 12.16. Rolling

The general provisions of MORTH-5TH REVISION clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials.

#### 12.17. Opening to traffic

Provisions in MORTH-5TH REVISION Clause 504.5 shall apply.

#### 12.18. Surface finish and quality control

The surface finish of the completed construction shall conform to the requirements of MORTH -5TH REVISION Clause 902. All materials and workmanship shall comply with the provisions set out in MORTH -5TH REVISION Section 900 of these specifications.

#### 12.19. Arrangements for traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of MORTH-5TH REVISION Clause 112.

#### 12.20. Measurement for payment

The measurement shall be as specified in MORTH-5TH REVISION Clause 505.8

#### 12.21. Rate

The contract unit rate shall be all as specified in MORTH-5TH REVISION clause 504.9, except that the rate shall include the provision of bitumen at 5.2 percent & 5.4 percent for grading 1 and grading 2 by weight of total mix respectively. The variation in actual percentage of bitumen used will be assessed and the payment adjusted plus and minus accordingly.

### **13 Road markings**

#### 13.1. General

The work shall consist of providing road markings at site including supply of materials and carrying out the work in accordance with IRC: 35 and these Specifications.

The colour, width and layout of road markings shall be in accordance with the Code of Practice for Road Markings IRC: 35 and as specified in the drawings or as directed by the Engineer. No centre line marking shall be done on single-lane roads.

### 13.2. Materials

Ordinary paints shall be used for road markings, conforming to IS:164. These shall have a wear resistance of at least 4 hours under accelerated laboratory test Yellow colour (conforming to IS colour No. 356) as given in IS:164, white and black colours are the standard colours used for markings.

### 13.3. Application

Painting may be done by machine or by hand (preferably by machine). The Contractor shall maintain traffic control while painting operations are in progress so as to cause minimum inconvenience to traffic compatible with protecting the workmen.

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

### 13.4. Measurements for payment

The painted markings shall be measured in square meter with no deductions for intermediate gaps as shown on the drawings.

In respect of markings, like directional arrows and lettering, etc., the measurement shall be by numbers.

### 13.5. Rate

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