

**Name of Work :- M & R to Various Road Under R & B Sub Division, Radhanpur  
(Santalpur Section part-02) (1) madhutra-datrana-barara-dhokavada road km.0/0 to  
11/980 ( Pro.Asphalt Patch work, Metal Patch Work & Other Misc. Work )**

## **Specifications**

### **Item No.2**

***Providing and laying Spreading and compacting graded stone aggregate to wet mix macadam 100 to 150 mm thick as per MORT&H specification incl. premixing the material with water to O.M.C. in mechanical mix plant. Carriage of mixed material by tipper to site, laying in uniform layers with mechanical grader in sub base, base course on well prepared surface and compacting with vibratory roller to achieves the desired density.***

**406**

### **WET MIX MACADAM SUB-BASE/BASE**

#### **Scope**

This work shall consist of laying and compacting clean, crushed, graded aggregate and granular material, premixed with water, to a dense mass on a prepared 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. 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 upto 200 mm with the approval of the Engineer.

#### **Materials**

#### **Aggregates**

##### **406.2.1.1**

##### **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 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).

**Table 400-12 : Physical Requirements of Coarse  
Aggregates for Wet Mix Macadam for Sub-  
base/Base Courses**

5.No.	Test	Test Method	Requirements
1)	Los Angeles Abrasion value	IS:2386 (Part-4)	40 percent (Max.)
	or Aggregate Impact value	IS:2386 (Part-4) or IS:5640	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.

#### **406.2.1.2 Grading Requirements**

The aggregates shall conform to the grading given in Table 400-13.

**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.

## **Construction Operations**

### **Preparation of Base**

Clause 404.3.1 shall apply.

### **Provision of Lateral Confinement of Aggregates**

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

### **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 pugmill 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.

### **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 levelling 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.

### **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/superelevation, 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 exceed 12 mm when tested with a 3m 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 crossfall. 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 recompacted.

### **Setting and Drying**

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

### **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.

### **Surface Finish and Quality Control of Work**

#### **Surface Evenness**

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

#### **Quality Control**

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

#### **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 recompact in accordance with 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.

#### **Arrangement for Traffic**

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

#### **Measurements for Payment**

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

#### **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 Clause 401.7.

*The Payment shall be made on **CMT** Basis.*

**Item No. 4**

***Constructing of Granular Sub base by providing graded material as per MORT&H table No.400.2 Grade II including spreading in uniform layers with motor graders on preparing surface mixing by mix in place method with rotator at once and compacting with vibratory roller & achieve the desired density complete as per clause 401 for grading.***

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

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

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

IS Sieve 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	<b>100</b>	100	100	80-100	100
26.5 mm	55-90	<b>70-100</b>	55-75	50-80	55-90	75-100
9.50 mm	35-65	<b>50-80</b>	-	-	35-65	55-75
4.75 mm	25-55	<b>40-65</b>	10-30	15-35	25-50	30-55
2.36 mm	20-40	<b>30-50</b>	-	-	10-20	10-25
0.85 mm	-	-	-	-	2-10	-
0.425 mm	10-15	<b>10-15</b>	-	-	0-5	0-8
0.075 mm	<5	<b>&lt;5</b>	<5	<5	-	0-3

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

Aggregate Impact Value (AIV)	IS:2386(Part4) or IS:5640	40 maximum
Liquid Limit	IS:2720 (Part 5)	Maximum 25
Plasticity Index	IS:2720 (Part 5)	Maximum 6
CBR at 98% dry density (at IS:2720-Part 8)	IS:2720 (Part 5)	Minimum 30 unless otherwise specified in the Contract

**401.3 Construction Operations****401.3.1 Preparation of Sub-grade**

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

**401.3.2 Spreading and Compacting**

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

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

Immediately after spreading the mix, rolling shall be done by an approved roller. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer 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.

The Payment shall be made on **CMT** Basis

#### **Item No. 5**

***Engaging earth excavator for maintaing side shoulders, Removing fallen trees,obstracting Ganda Baval, or branches of trees on road, maintaining borrow pit,spreading metal,Rubble,quarry spall, cleaning of open area of building and other misc. works which can be done by earth excavator including diesel, drivers,lubricant etc complete as per direction and instruction of Engineer incharge.***

Work Carried out as per earth excavator for maintaining side shoulders, Removing fallen trees,obstructing Ganda Baval, or branches of trees on road, maintaining borrow pit,spreading metal,Rubble,quarry spall, cleaning of open area of building and other misc. works which can be done by earth excavator including diesel, drivers,lubricant etc complete as per direction and instruction of Engineer incharge.

The Payment shall be made on **Hrs** Basis

**Item No.12**

***Hire charges Hitachi machine incl. fuel, driver on site for all lead etc complete as directed.***

*The work shall consist of all lead and lift the specify places directed by engineer in-charge or govt officer including all type fuel charge and other type of expensive.*

*The rates are including labour charges.*

*The Payment shall be made on **Hrs** basis.*

**Item No.13**

***Hire charges Dumper with hydalice system including loading and unloading transporting and spreding the materials with necessary labours, drivers, incl. cost of fuel etc complete.***

*The work shall consist of all type of material for loading and unloading to the specify places by Hydraulic dumper as directed by engineer in-charge or govt. officer including all type fuel charge and other type of expensive.*

*The rates are including labour charges for loading and unloading materials.*

*The Payment shall be made on **Km** basis.*

**Item No.14**

***Providing and supplying of Labour for maintaining road and building campus as per requirement.***

The work shall be supplying of Labour for maintaining road and building campus as per requirement. Work shall be carried out as per direction and instruction of engineer incharge.

The Payment shall be made on **No** basis.

**Item No.16**

**Engaging tractor with trolley or front loader as regd. Including loading and unloading transporting & spreading the materials up to 15 km lead with necessary labourers/drivers, including cost of fuel etc complete as directed.**

The work shall consist of Engaging tractor with trolley or front loader as regd. Including loading and unloading transporting & spreading the materials up to 15 km lead with necessary labourers/drivers, including cost of fuel etc complete as directed.

The Payment shall be made on **Hrs** basis.

**Item No.19**

**Providing & laying 25 mm. thick compacted SDBC with B.T. Stone chips as per MORT&H gradation & specification with bulk asphalt VG-30 for mixing at the rate of 50.00 Kg./MT by wt. of total mix i.e.(5.00% by weight of total mix) incl. heating the asphalt & aggregates by continuous batching drum mix plant & spreading the same by paver finisher incl. rolling & Consolidation with 10-12 tonnes vibratory & paver roller & pro. all materials, equipments, tools and plants, fire wood, oil, kerosene, labour charges etc and using contractor's own machineries drum mix plant & paver finisher etc complete.**

**508.1. Scope**

This clause specifies the construction of Semi Dense Bituminous Concrete, for use in wearing/binder and profile corrective courses. This work shall consist of construction in a single or multiple layers of semi dense bituminous concrete on a previously prepared bituminous bound surface. A single layer shall be 25mm to 100mm in thickness.

**508.2. Materials**

**508.2.1. Bitumen:** The bitumen shall be paving bitumen of Penetration grade complying with Indian Standard Specification for Paving Bitumen, IS: 73 and of the penetration indicated in Table 500-15, for semi dense bituminous concrete, or this bitumen as modified by one of the methods specified in Clause 521, or as otherwise specified in the

Contract. Guidance on the selection of an appropriate grade of bitumen is given in The Manual for Construction and Supervision of Bituminous Works.

**508.2.2. Coarse aggregates:** The coarse aggregates shall be generally as specified in Clause 507.2.2, except that the aggregates shall satisfy the physical requirements of Table 500-14.

**508.2.3. Fine aggregates:** The fine aggregates shall be all as specified in Clause 507.2.3.

**508.2.4. Filler:** Filler shall be generally as specified in Clause 507.2.4. Where the aggregates fail to meet the requirements of the water sensitivity test in Table 500-14 then 2 per cent by total weight of aggregate, of hydrated lime shall be added without additional cost.

**508.2.5. Aggregate grading and binder content:** When tested in accordance with IS:2386 Part 1 (Wet sieving method), the combined grading of the coarse and fine aggregates and added filler shall fall, within the limits shown in table 500-15 for gradings 1 or 2 as specified in the Contract.

### 508.3. Mixture Design

**508.3.1. Requirements for the mixture:** Apart from conformity with the grading and quality requirements for individual ingredients the mixture shall meet the requirements set out in Table 500-16.

**TABLE 500-14. PHYSICAL REQUIREMENTS FOR COARSE AGGREGATE FOR SEMI DENSE BITUMINOUS CONCRETE PAVEMENT LAYERS**

Property	Test	Specification
Cleanliness (dust)	Grain size analysis <sup>1</sup>	Max 5% passing 0.075mm sieve
Particle shape	Flakiness and Elongation Index (Combined) <sup>2</sup>	Max 30%
Strength*	Los Angeles Abrasion Value <sup>3</sup>	Max 35%
	Aggregate Impact Value <sup>4</sup>	Max 27%
Polishing	Polished Stone Value <sup>5</sup>	Min 55
Durability	Soundness: <sup>6</sup>	
	Sodium Sulphate	Max 12%
	Magnesium Sulphate	Max 18%
Water Absorption	Water absorption <sup>7</sup>	Max 2%

Stripping	Coating and Stripping of Bitumen Aggregate Mixtures <sup>9</sup>	Minimum Retained Coating 95%
Water Sensitivity**	Retained Tensile Strength <sup>8</sup>	Min80%

Notes: 1. IS: 2386 Part 1 6. IS: 2386 Part 5

2. IS: 2386 Part 1 7. IS: 2386 Part 3

(the elongation test may be done only on non-flaky aggregates in the sample)

3. IS: 2386 Part 4\* 8. AASHTOT283\*\*

4. IS: 2386 Part 4\* 9. IS: 6241

5. BS: 812 Part 114

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

\*\* The water sensitivity test is only required if the minimum retained coating in the stripping test is less than 95%.

The requirements for minimum per cent voids in mineral aggregate (VMA) are set out in Table 500-12.

**508.3.2. Binder content:** The binder content shall be optimised to achieve the requirements of the mixture set put in Table 500-16 and the traffic volume as specified in the Contract. The Marshall method for determining the optimum binder content shall be adopted as described in the Asphalt Institute Manual MS-2, replacing the aggregates retained on the 26.5mm sieve and retained on the 22.4mm sieve, where approved by the Engineer.

**TABLE 500-45. COMPOSITION OF SEMI DENSE BITUMINOUS CONCRETE PAVEMENT LAYERS**

Grading	1	2
Nominal aggregate size	13mm	10mm
Layer Thickness	35-40 mm	25-30 mm
IS Sieve <sup>1</sup> (mm)	Cumulative % by weight of total aggregate passing	
45		
37.5		
26.5		
19	100	
13.2	90-100	100
9.5	70-90	90-100
4.75	35-51	35-51
2.36	24-39	24-39
1.18	15-30	15-30
0.6	--	--
0.3	9-19	9-19
0.15	--	--
0.075	3-8	3-8
Bitumen content % by mass of total mix <sup>3</sup>	Min 4.5	Min 5.0
Bitumen grade (pen)	65*	65*

**Notes:** 1. The combined aggregate grading shall not vary from the low limit on one

sieve to the high limit on the adjacent sieve.

2. Determined by the Marshall method.

- \* Only in exceptional circumstances, 60/70 penetration grade may be used, as approved by the Engineer.

**TABLE 500-16. REQUIREMENTS FOR SEMI DENSE BITUMINOUS PAVEMENT LAYERS**

Minimum stability (kN at 60°C)	8.2
Minimum flow (mm)	2
Maximum flow (mm)	4
Compaction level (Number of blows)	75 blows on each of the two faces of the specimen
Per cent air voids	3-5
Per cent voids in mineral aggregate (VMA)	See Table 500-12
Per cent voids filled with bitumen (VFB)	65-78

**508.3.3. Job mix formula:** The procedure for formulating the job mix formula shall be generally as specified in Clause 507.3.3 and the results of tests enumerated in Table 500-16 as obtained by the Contractors.

**508.3.4. Plant trials - permissible variation in job mix formula:**

The requirements for plant trials shall be all as specified in Clause 507.3.4. and permissible limits for variation as shown in Table 500-13.

**508.3.5. Laying trials:** The requirements for laying trials shall be all as specified in Clause 507.3.5.

**508.4. Construction Operations**

**508.4.1. Weather and seasonal limitations:** The provisions of Clause 501.5.1 shall apply.

**508.4.2. Preparation of base:** The surface on which the Semi Dense Bituminous material is to be laid shall be prepared in accordance with 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 access, other approved methods shall be used as directed by the Engineer.

**508.4.3. Geosynthetics:** Where Geosynthetics are specified in the Contract this shall be in accordance with the requirements stated in Clause 703.

**508.4.4. Stress absorbing layer:** Where a stress absorbing layer is specified in the Contract, this shall be applied in accordance with the requirements of Clause 522.

**508.4.5. Tack coat:** Where specified in the Contract, or otherwise required by the Engineer, a tack coat shall be applied in accordance with the requirements of Clause 503.

**508.4.6. Mixing and transportation of the mixture:** The provisions as specified in Clauses 501.3. and 501.4 shall apply.

**508.4.7. Spreading:** The general provisions of Clauses 501.5.3 and 501.5.4 shall apply.

**508.4.8. Rolling:** The general provisions of 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.

#### **508.5. Opening to Traffic**

The newly laid surface shall not be open to traffic for at least 24 hours after laying and the completion of compaction, without the express approval of the Engineer in writing.

#### **508.6. Surface Finish and Quality Control**

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

#### **508.7. Arrangements for Traffic**

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

#### **508.8. Measurement for Payment**

The measurement shall be all as specified in Clause 507.8.

#### **508.9. Rate**

The contract unit rate shall be all as specified in Clause 507.9. except that the rate shall include the provision of bitumen at 4.75 per cent, by weight of total mixture. The variance in actual percentage of bitumen used will be assessed and the payment adjusted up or down, accordingly.

The Payment shall be made on **MT** Basis

**Item No.20**

***Providing & laying 50 mm thick compacted D.B.M. with B.T. stone aggregates as per MORT&H gradation & specification with mechanical sprayer and bitumen grade (VG-30) for mixing at the rate of 45.0 kg/M.T. by weight of total mix i.e.( 4.5% by weight of total mix ) including heating the asphalt & aggregates by continuous batching drum mix plant & filling potholes, patches manually including rolling & consolidation with 10-12 tones vibratory and power roller & providing all materials, equipments, tools & plants, fire wood, oil, kerosene, labour charges etc. and using contractors own machineries drum mix plant & paver finisher etc. comp. (Without Tack Coat & Laying Manually Without Paver Machine)***

**505                      DENSE BITUMINOUS  
MACADAM**

**Scope**

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.

**Materials**

**505.2.1**

**·Bitumen**

The bitumen shall be viscosity grade paving bitumen complying with the Indian Standard Specification IS:73, modified bitumen complying with Clause 501.2.1 or as otherwise specified in the Contract.

The type and grade of bitumen to be used shall be specified in the Contract.

**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, 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 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.

### **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 upto 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).

### **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 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 Table 500-8, then 2 percent by total weight of aggregate, of hydrated lime shall be used and percentage of fine aggregate reduced accordingly.

### **Aggregate Grading and Binder Content**

When tested in accordance with IS:2386 Part 1 (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 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.

**Table 500-8 : Physical Requirements for Coarse Aggregate for Dense Bituminous Macadam**

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

Particle shape	Combined Flakiness and Elongation Indices*	Max35%	IS:2386 Part I
Strength	Los Angeles Abrasion Value or Aggregate Impact Value	Max35% Max27%	IS:2386 Part IV
Durability	Soundness either :Sodium Sulphate or Magnesium Sulphate	Max 12% Max 18%	IS:2386 Part V
Water Absorption	Water Absorption	Max2%	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.

**Table 500-9 : Grading Requirements for Mineral Filler**

IS sieve (mm)	Cumulative Percent Passing by Weight of Total Aggregate
0.6	100
0.3	95-100
0.075	85- 100

**Table 500-10 : Composition of Dense Graded Bituminous Macadam**

Grading	1	2
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Nominal aggregate size*	37.5mm	26.5 mm
Layer thickness	75-100 mm	50-75 mm
IS Sieve <sup>1</sup> (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
2.36	28-42	28-42
1.18	–	–
0.6	–	–
0.3	7-21	7-21
0.15	–	–
0.075	2-8	2-8
Bitumen content % by mass of total mix	Min 4.0**	Min 4.5**

\* 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 bitumen 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 bitumen content may be increased by 0.5 percent.

Bitumen content indicated in Table 500-10 is the minimum quantity. The quantity shall be determined in accordance with Clause 505.3.

### Mix Design

The bitumen 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.

### 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 Table 500-11.

**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	AASHTOT245
Marshall flow (mm)	2-4	2.5-4	3.5-5	AASHTOT245
Marshall Quotient (Stability) Flow	2-5	2.5-5		MS-2 and ASTM 02041
%air voids	3-5			
% Voids Filled with Bitumen (VFB)	65-75			
Coating of aggregate particle	95% minimum			IS:6241
Tensile Strength ratio	80% Minimum			AASHTOT283
% Voids in Mineral Aggregate (VMA)	Minimum percent voids in mineral aggregate (VMA) are set out in Table 500-13			

### Binder Content

The binder content shall be optimized to achieve the requirements of the mix set out in 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 Table 500-12 shall be multiplied by 2.25, and the minimum flow shall be 3 mm.

**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.

### **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 gradings 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 (Gmm), 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.

### **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 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 Section 900.

**Table 500-13: Permissible Variations in the Actual Mix from the Job Mix Formula**

<b>Description</b>	<b>Base/binder Course</b>
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

## **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 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 sq.m 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.

## **Construction Operations**

### **Weather and Seasonal Limitations**

The provisions of Clause 501.5.1 shall apply.

### **Preparation of Base**

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

### **Geosynthetics**

Where Geosynthetics are specified in the Contract, this shall be in accordance with the requirements stated in Clause 703.

## **Stress Absorbing Layer**

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

## **Mixing and Transportation of the Mix**

The provisions as specified in Clauses 501.3 and 501.4 shall apply. 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.

### **Spreading**

The provisions of Clauses 501.5.3 and 501.5.4 shall apply.

**for tack coat at the** rate of 2.5 kg./ 10 sq.mt. with mechanical sprayer and bitumen grade ( VG - 30)

## **Rolling**

The general provisions of 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.

## **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.

## **Surface Finish and Quality Control of Work**

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



### **Arrangements for Traffic**

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

### **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.

### **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 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.

The Payment shall be made on **MT** Basis

***Signature of Contractor...***

***Dy. Executive Engineer  
R&B Sub Division  
Radhanpur***