

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 specified.

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.

505.2.2 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.

505.2.3 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).

505.2.4 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.

505.2.5 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 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

Property	Test	Specification	Method of Test
Cleanliness (dust)	Grain size analysis	Max5%passing 0.0075mmsieve	IS:2386PartI
Particle shape	Combined Flakiness and Elongation Indices*	Max35%	IS:2386PartI
Strength	Los Angeles Abrasion Value or Aggregate Impact Value	Max35% Max27%	IS:2386Part IV
Durability	Soundness either :Sodium Sulphate or Magnesium Sulphate	Max12% Max18%	IS:2386Part V
Water Absorption	WaterAbsorption	Max2%	IS:2386Part III
Stripping	Coating and Stripping of Bitumen Aggregate Mix	Minimum retained coating 95 %	IS:6241
Water Sensitivity	Retained Tensile Strength**	Min.80%	AASHTO283

* 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
Nominal aggregate size*	37.5mm	26.5mm
Layer thickness	75-100 mm	50-75 mm
IS Sieve ¹ (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 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

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

temperature is 30°C or lower and lowest daily air temperature is -10°C or lower, the bitumen content may be increased by 0.5percent.

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.

505.3.1 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	75blowsoneachfaceofthespecimen			
Minimum stability(kNat600C)	9.0	12.0	10.0	AASHTOT245
Marshall flow (mm)	2-4	2.5-4	3.5-5	AASHTOT245
Marshall Quotient(<u>Stability</u> Flow)	2-5	2.5-5		MS-2andASTM 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			AASHTO T283
% Voids in Mineral Aggregate (VMA)	Minimum percent voids in mineral aggregate(VMA)			

505.3.2 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 ¹ (mm)	Minimum VMA Percent Related to Design Percentage Air Voids
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	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.

505.3.3 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 (G_{mm}), 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 drum mixer, the individual weights of each type of aggregate, and binder per drum;
- 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.

505.3.4 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

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

505.3.5 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.

505.4 Construction Operations

505.4.1 Weather and Seasonal Limitations

The provisions of Clause 501.5.1 shall apply.

505.4.2 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.

505.4.3 Geosynthetics

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

505.4.4 Stress Absorbing Layer

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

505.4.5 Prime coat

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

505.4.6 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 Clause 503, or as directed by the Engineer.

505.4.7 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.

505.4.8 Spreading

The provisions of Clauses 501.5.3 and 501.5.4 shall apply.

505.4.9 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.

505.5 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.

505.6 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.

505.7 Arrangements for Traffic

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

505.8 Measurement for Payment

Dense Graded Bituminous Materials shall be measured as finished work in M.T. basis at a specified thickness as indicated in the contract, drawings or documents or as otherwise directed by Engineer in charge.

505.9 Rate

The contract unit rate for Dense Graded Bituminous shall be payment in full for carrying out the all required operations as specified, and shall include, but not necessarily limited to

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

The rate shall include the provision of bitumen at 4.50 percent by weight of the total mixture.

The variance in actual percentage of bitumen used will be assessed and the payment adjusted up or down accordingly.

- Item No 4** Providing and laying 25 mm thick Semi Dense Bituminous Concrete with B.T. aggregate as per M.O.R.T. & H. with mechanical sprayer and Bulk, asphalt Grade: VG-30 for mixing @ 50.00 KG. / M.T. i.e.
5.0 % by weight of total mix including heating and mixing the aggregate and asphalt by continuous of drum mix plant and hot laid process laying with paver finisher and consolidation with Vibratory roller as per M.O.R.T. & H specification to achieve desire density, including cost all materials equipments, tools and plants, oil, kerosene, firewood, labour charges etc. complete using contractor's own machineries drum mix plant and paver finisher etc. complete.

501. SEMI-DENSE BITUMINOUS CONCRETE

501.1 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 25 mm in thickness.

501.2 Materials

- 501.2.1 Bitumen: The bitumen shall be paving bitumen of viscosity grade VG-30 complying with Indian Standard Specifications 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.

Viscosity Grade (VG) Bitumen Specification as per IS 73 : 2013

Characteristics	VG-10	VG-20	VG-30	VG-40
Absolute Viscosity ⁶⁰ C, poises, min	800	1600	2400	3200
Kinematic Viscosity ¹³⁵ CCSI, min	250	300	350	400
Flash point, C, min	220	220	220	220
Solubility in trichloroethylene, % min	99.0	99.0	99.0	99.0
Penetration at ²⁵ C	80-100	60-80	50-70	40-60
Softening point, C min	40	45	47	50
Test on residue from thin film oven test/ RTFOT:				
(A) Viscosity ratio at ⁶⁰ , max	4.0	4.0	4.0	4.0
(B) Ductility at ²⁵ C, cm, min after thin film oven test	75	50	40	25

- 504.2.2 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.
- 504.2.3 Fine aggregates: The fine aggregates shall be all as specified in Clause 507.2.3.

- 504.2.4 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.

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 added filler shall fall within the limits shown in Table 500-15 for gradings 1 or 2 specified in the contract.

509.3 Mixture Design

- 509.3.1. Requirement 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 ¹	Max 5% passing 0.75 mm sieve
Particle shape	Flakiness and elongation Index (combined) ²	Max30%
	Los Angeles Abrasion Value ³	Max35%
Strength*	Aggregate Impact value ⁴	Max27%
Polishing	Polished stone Value ⁵	Min55
Durability	Soundness ⁶	Max12%
	Sodium Sulphate	Max18%
	Magnesium Sulphate	
Water absorption	Water absorption ⁷	Max2%
Stripping	Coating and stripping of bitumen aggregate mixtures ⁹	Minimum retained coating 95%
Water sensitivity**	Retained tensile strength ⁸	Min80%

Notes:

1. IS:2386Part1
 2. IS:2386Part1
 3. IS: 2386Part 4*
 4. IS:2386Part4*
 5. BS:812Part114
 - 6.IS:2386Part5
 - 7.IS:2386Part3
 - 8.AASHTOT283**
 - 9.IS:6241
- (the elongation test may be done only on non-flaky aggregates in the samples)

* 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 than95%.

508.3.2 Binder content: The binder content shall be optimised to achieve the requirements of the mixture set out 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 26.5 mm sieve and retained on the 22.4 mm sieve, where approved by the Engineer.

TABLE 500-15. COMPOSITION OF SEMI DENSE BITUMINOUS CONCRETE
PAVEMENT LAYERS

Grading	1	2
Nominal aggregate size	13 mm	10 mm
Layer Thickness	35-40mm	25-30mm
IS Sieve ¹ (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 ²	Min4.5	Min5.0
Bitumen grade (pen)	65*	VG-30

Notes:

- The combined aggregate grading shall not vary from the low limit on one sieve to the high limit on the adjacent sieve.
 - Determined by the Marshall method.
- * Only in exceptional circumstances, VG-10 (80/100) viscosity grade may be used, as approved by the Engineer.

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

Minimum stability(kNat60 ⁰ C)	8.2
Minimum flow (mm)	2
Maximum flow (mm)	4
Compaction level (Number of blows)	75blowsoneachofthetwofacesof the specimen
Percent air voids	3-5
Percent voids in mineral aggregate (VMA)	SeeTable500-12
Percent 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.
- 508.3.4.1.1 Laying Trials : The requirements for laying trials shall be all as specified in Clause 507.3.5
- 509.4 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 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 500.22.
- 508.4.6 Mixing and transportation of the mixture - The provisions as specified in Clauses 500.1.3 and 500.1.4 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 500.1.6 and 500.1.7 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.

509.5 Opening of Traffic

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

509.6 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.

509.7 Arrangement for Traffic

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

509.8 Measurement of Payment

The measurement shall be all measures for finished work on weight base in M.T

509.9 Rate

The contract unit rate shall be as specified in Clause 507.9, except that the rate shall include the provision of bitumen 5.00 percent, by weight of total mixture. The variance in actual percentage of bitumen used will be assessed and the payment adjusted accordingly, only if the mix design is less than 5.00 percent. If the bitumen content in mix design is more than 5% the difference will be paid only upto 5.00 percent

Item No 5

Providing and laying 30 mm thick Bituminous Concrete with B.T. aggregate as per M.O.R.T. & H. and using emulsion RS-1 as per IS 8887: for tack coat @ 2.50 KG. / 10 Sq.m. with mechanical sprayer and asphalt Grade: VG-30 for mixing @ 55.00 KG. / M.T. i.e. 5.5% by weight of total mix including heating and mixing the aggregate and asphalt by continuous of drum mix plant and hot laid process laying with paver finisher and consolidation with Vibratory roller as per M.O.R.T. & H specification to achieve desire density, including cost all materials equipments, tools and plants, oil, kerosene, firewood, labour charges etc. complete using contractor's own machineries drum mix plant and paver finisher etc. complete.

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 in thickness.

2.0 Materials

2.1 Bitumen: The bitumen shall be paving bitumen of viscosity grade VG-30 complying with Indian Standard Specifications for "Paving Bitumen" IS: 73, and of the Viscosity indicated in Table 500-18, 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.

Viscosity Grade (VG) Bitumen Specification as per IS 73 : 2013

Characteristics	VG-10	VG-20	VG-30	VG-40
Absolute Viscosity at 60°C, poises, min	800	1600	2400	3200
Kinematic Viscosity at 135°C, cSt, min	250	300	350	400
Flash point, C, min	220	220	220	220
Solubility in trichloroethylene, % min	99.0	99.0	99.0	99.0
Viscosity at 2°C	80-100	60-80	50-70	40-60
Softening point, C min	40	45	47	50
Test on residue from thin film oven test / RTFOT :				
(A) Viscosity ratio at 60°C, max	4.0	4.0	4.0	4.0
(B) Ductility at 25°C, cm, min after thin film over test	75	50	40	25

507.2.1.1 Coarse Aggregates

2.2 Coarse aggregates - The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on the 2.36 mm sieve. They shall be clean, hard, durable or cubical shape, free from dust and soft or friable matter, organic or other deleterious substances. Where the Contractor's selected source of aggregates have poor affinity for bitumen, as a condition for the approved anti-stripping agent, as per the manufacture's

recommendations, without additional payment. Before approval of the sources, the aggregates shall be tested for stripping. The aggregates shall satisfy the physical requirements specified in Table 500-17, for bituminous concrete.

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

- 2.3 Fine aggregates - Fine aggregates shall consist of crushed or naturally occurring mineral material or a combination of the two, passing the 2.36 mm sieve and retained on the 75 micron sieve. They shall be clean, hard, durable, dry and free from dust, and soft or friable matter, organic or other deleterious matter.

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).

- 2.4 Filler - Filler shall consist of finely divided mineral matter such as rock dust, hydrated lime or cement approved by the Engineer. Where the aggregates fail to meet the requirements of the water sensitivity test in Table 500-17 then 2 percent by total weight of aggregate, of hydrated lime shall be added without additional cost.

- 2.5 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 added filler shall fall within the limits shown in Table 500-18 for grading 1 or 2 as specified in the Contract.

3. Mixture design

- 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 500-19.

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

TABLE 500-12. MINIMUM PER CENT VOIDS IN MINERAL AGGREGATE (VMA)

Nominal Maximum Particle Size ¹ (mm)	Minimum VMA, Percent Related to Design Air Voids, Percent ²		
	3.0	4.0	5.0
9.5	14.0	15.0	16.0
12.5	13.0	14.0	15.0
19.0	12.0	13.0	14.0
25.0	11.0	12.0	13.0
37.5	10.0	11.0	12.0

Notes:

1. The nominal maximum particle size is 0.1e size larger than the first sieve to retain more than 10 percent.
2. Interpolate minimum voids in the mineral aggregate (VMA) for design air voids values between those listed.
- 3.2 Binder content - The binder content shall be optimised to achieve the requirements of the mixture set out in Table 500-19 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 aggregate retained on the 26.5 mm sieve and retained on the 22.4 mm sieve, where approved by the Engineer.
- 3.3 Job mix formula - The procedure for formulating the job.

TABLE 500-17. PHYSICAL REQUIREMENTS FOR COARSE AGGREGATE FOR BITUMINOUS CONCRETE PAVEMENT LAYERS

Property	Test	Specification
Cleanliness (dust)	Grain size analysis ¹	Max 5% passing 0.75mm sieve
Particle shape	Flakiness and elongation Index(combined) ²	Max 30% (combined) ²
Strength*	Los Angeles Abrasion Value ³ Aggregate Impact value ⁴	Max30% Max24%
Polishing	PolishedStoneValue ⁵	Min 55
Durability	Soundness ⁶ Sodium Sulphate Magnesium Sulphate	Max 12% Max 18%
Water absorption	Water absorption ⁷	Max 2%
Stripping	Coating and Stripping of Bitumen Aggregate Mixtures ⁹	Minimum retained coating 95%
Water Sensitivity**	Retained Tensile Strength ⁸	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 samples)

3. IS: 2386 Part 4*

8. AASHTO T 283**

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% mix formula shall be generally as specified in clause

500.7.3.3 and the results of tests enumerated in Table 500-19 as obtained by the Contractors.

- 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.
- 3.5 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, unless specifically approved in writing, by the Engineer. 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.

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.

4. Construction Operation

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

TABLE 500-18**COMPOSITION OF BITUMINOUS CONCRETE PAVEMENT LAYERS**

Grading	1	2
Nominal aggregate size	19 mm	13 mm
Layer Thickness	50–65 mm	30–45 mm
IS Sieve ¹ (mm)	Cumulative % by weight of total aggregate passing	
45		
37.5		
26.5	100	
19	79-100	100
13.2	59-79	79-100
9.5	52-72	70-88
4.75	35-55	53-71
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
Bitumen content % by mass of total mix ²	5.0–6.0	5.50 %
Bitumen grade (pen)	65	VG-30

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.

TABLE 500-19. REQUIREMENTS FOR BITUMINOUS PAVEMENT LAYERS

Minimum stability (kN at 60°C)	9.0
Minimum flow (mm)	2
Maximum flow (mm)	4
Compaction level (Number of blows)	75 blows on each of the two faces of the specimen
Percent air voids	3-6
Percent voids in mineral aggregate (VMA)	See Table 500-12
Percent voids filled with bitumen (VFB)	65-75
Loss of stability on immersion in water at 60°C (ASTM D 1075)	Min. 75 percent retained strength

- 4.2 Preparation of base :- The surface on which the bituminous concrete 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.
- 4.3 Geosynthetics - Where Geosynthetics are specified in the Contract this shall be in accordance with the requirements stated in Clause 703.
- 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 500.22.
- > Quality Control Work :
For control of the quality of materials supplied and the works carried out the relevant provisions of Section 900 shall apply.
- > Specifications : The rate shall cover the provision of tack coat at 0.25 kg per square meter with the provision that the variation in actual quantity of bitumen used will be assessed and the payment adjusted accordingly.
- 4.6 Mixing and transportation of the mixture - The provisions as specified in Clauses 500.1.3 and 500.1.4 shall apply.
- 4.7 Spreading - The general provisions of Clauses 501.5.3 and 501.5.4 shall apply.
- 4.8 Rolling - The general provisions of Clauses 500.1.6 and 500.1.7 shall apply, as modified by the approved laying trials.
- 4.9. Opening to Traffic
The newly laid surface shall not be open to traffic for at least 24 hours after laying and completion of compaction, without the express approval of the Engineer in writing.
- 5.0 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.
- 6.0 Arrangement for Traffic
During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.
- 7.0 Measurement for Payment
The measurement shall be on M.T. basis.