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**1. DESCRIPTION**

This work shall consist of the application of one coat of surface dressing, consisting of a layer of bituminous binder sprayed on a base prepared previously followed by a cover of stone chipping properly rolled to form a wearing course to the requirements of these specifications.

**2. MATERIALS**

**2.1 Stone chipping :** The machine crushed B.T. stone chipping shall consist of fairly cubical fragments of clean, hard, tough and durable rock of uniform quality throughout. These shall be obtained by crushing B.T. stone. The chipping shall be free of elongated or flaky pieces, soft or disintegrated stone, salt, alkali, vegetable matter, dust and adherent coatings.

**2.2 Binder :** The binder shall be straight run bitumen of 80/100 or 60/70 penetration and satisfying the requirement of I.S. 73 or other type of bitumen as may be approved by the Department.

Necessary storage arrangements i.e. provision of tanks etc. for bulk asphalt shall be done by the contractor without any extra charges.

In the case of bitumen is to be supplied by Department in bulk at the rate and place shown in Schedule "A" for bulk asphalt, contractor shall have to make adequate arrangement for stacking bulk asphalt at plant site, according to requirement. If the asphalt is supplied as bulk on plant site, the rate of conveyance for lead difference from store to plant site shall be recovered at S.O.R. for Qty of asphalt supplied.

**2.3 Keeping Records :** The Department shall keep a day account of the supply and use of the asphalt in separate bound register having numbered pages in the proforma prescribed by the Department. Day to day signature of the responsible contractor or his representative as may be directed by Engineer-in-charge shall be obtained in this register. The register shall be maintained by the Department and shall be produced with each bill.

**TABLE . Physical requirements of aggregates**

Sr. No.	Test	Test Method	Requirement
1	Los Angeles Abrasion Value*	IS : 2386 (Part IV)	40% Maximum
2	Aggregate Impact Value*	- do -	30% Maximum
3	Flakiness Index	IS : 2386 (Part I)	30% Maximum
4	Stripping Value	IS : 6241	25% Maximum
5	Soundness		
	(i) Loss with Sodium Sulphate 5 cycles		12%
	(ii) Loss with Magnesium		18%
6	Water Absorption	IS : 2386 (Part III)	1% Maximum

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

Note : If crushed slag is used, Clause 404.2.3 shall apply.

Requirements of stone chipping and binder content for surface dressing for 10 sq. mt.

Sr. No.	Type of Construction	Nominal Size of stone chipping	Specifications percent passing through Sieve and retained on Sieve	Quantity of materials	Binder content
1.	Single coat surface dressing of first coating of two coat surface coating	12 mm	Passing 20 mm Sieve & Retained on 10 mm Sieve	0.15 CM	18 kg
2.	Second Coat of two coat surface dressing	10 mm	Passing 12 mm Sieve & retained on 4.5 mm sieve	0.10 CM	11 kg

**3. CONSTRUCTION OPERATION**

**3.1 Weather & seasonal limitations :** The surface dressing work shall be carried on only when the atmospheric temperature in shade is above 15° C. No bituminous materials shall normally be applied when the surface of cover material is damp when the weather is foggy or rainy or during dust storms.

**3.2 Preparation of base :** The base on which surface dressing is to be laid shall be prepared, shaped and conditional to the specified lines, grade and cross section as directed by the Engineer-in-charge.

The surface shall be thoroughly swept and scraped cleans of dust and any other extraneous matter before the spraying of binder. As necessary the cleaning shall be done first with hard brushed, then with softer brushes and finally by blowing with sacks or gunny bags.

**3.3 Application of binder :** Binders shall be heated to 163° C to 177° C. and sprayed on the dry surface in uniform manner with the help of self-propelled mechanical sprayers having, self-heating arrangement and bitumen pressure pump and spray nozzle bar capable of spraying bitumen uniformly at specified rate as given in above table. Excessive deposits of binder caused by stopping or starting of the sprayer or Through leakage or any other reasons shall be suitably corrected before the stone chipping are spread.

**3.4 Application of stone chippings :** The cover material i.e. machine crushed B. T. chips of 11.2 mm. nominal size shall be stacked on road side by filling standard boxes of 2.0 m x 1.50 m x 0.50 m the measurement shall be recorded in the measurement book after

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collection in two kilometre length is complete. The material shall be cross checked by another D.E.E. as per rules. There after, the spreading shall be allowed. The permission of Engineer-in-charge shall be obtained before spreading.

Immediately after the application of binder, stone chippings in a dry and clean, state shall be spread uniformly on the surface, preferably by means of mechanical gritter, otherwise, manually so as to cover the surface completely. If necessary, the surface shall be broomed to ensure uniform spread of chippings.

**3.5 Rolling :** Immediately after the application of the cover material, the entire surface shall be rolled with a 8-10 tones three wheeled roller. Rolling shall commence at the edges and progress towards the centre except in supper elevated portions, where it shall proceed from the inner edge to the other. Each pass of the roller shall uniformly be not less than one third of the track made in the preceding pass. While rolling is in progress additional chippings shall be spread by hand in whatever quantities required to make up irregularities. Rolling shall continue until aggregate particles are firmly bedded in the binder and present a uniform closed surface.

**3.6 Application of second coat of surface dressing :** Where surface dressing in two coats is specified the second coat shall be applied immediately after laying the first coat. The operation shall be the same as describe in para 8.3.3 to 8.3.5.

#### 4. OPENING TO TRAFFIC

Traffic shall not be permitted to run on any newly surface dressed area until the following day. In circumstances, however, the Engineer-in-charge may open the road to traffic immediately after rolling, but in such cases its speed shall be limited to 16 k.m.per hour till the following day.

#### 5. SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to requirements of M.O.S.T. No. 902 Specification.

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

#### 6. ARRANGEMENTS FOR TRAFFIC

During the period of construction flow of traffic shall be maintained as per clause-112.

#### 7. MEASUREMENTS FOR PAYMENT

Surface dressing shall be measured as finished work in square metres.

#### 8. RATE

The contract unit rate for surface dressing shall be payment in full for carrying out the required operations including full compensation for all components listed in item No. 1 para 2.8

**ITEM-30** Providing and laying 20/25mm thick bituminous open graded carpet with B.T. aggregates 0.66 cm/M.T. using bituminous for tack coat at the rate of @ rate of 10 Kg./10 Smt. on W.B.M. surface and 5 Kg./10 Smt. for B.T. surface and for mixing at the rate of 32.8 kg/M.T. of total mix i.e.3.28 per M.T. of total mix and heating asphalt & aggregate by continuous batching hot mix plant and spreading the same by paver finisher including consolidation with power road roller including providing equipment T & P oil, fire wood, kerosene labour charges etc. compt. using contractor's own machineries hot mix plant and paver finisher including flushing of sand 0.30 cmt/100 sq.mt.

1. The work shall consist of construction in a single course of 20/25 mm. thick premixed carpet as course, on a previously prepared base Single course shall also include additional thickness if any to remove unevenness of the existing surface.
2. The coarse aggregates shall consist of crushed stone only. These shall be clean, strong durable of fairly cubical shape, free of disintegrated pieces, organic or other deleterious matter and adherent coatings. The aggregates shall preferably be hydrophobic and of low porosity and shall satisfy the physical requirements set forth as under.

#### Physical Requirements of Aggregates for Bituminous Macadam.

Sr. No.	Test	Test Method	Requirement
1.	Los Angeles Abrasion Value	IS : 2386 (part IV) *	35% Maximum
2.	Aggregate Impact Value	- do - *	30% Maximum
3.	Flakiness Index	IS : 2386 (Part I)	30% Maximum
4.	Stripping Value	IS : 6241	25% Maximum
5.	Water Absorption	IS : 2386 (Part III)	2% Maximum

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

3. The fine aggregates shall consist of crusher run screening, natural sand or mixture of both. These shall be clean, hard durable, uncoated, dry and free from injurious, soft or flaky pieces and organic or deleterious substance.
4. The filler, where required, shall be an inert material, the whole of which passes 600 micron sieve at least 90 percent passing 150 micron sieve and not less than 70 percent passing 75 micron sieve. The filler shall be cement, stone dust, hydrated lime or fly ash approved by the Engineer-in-charge.
5. The mineral aggregates, including mineral filler, shall be so graded or combined as to conform to the grading as under.

Table Aggregate gradation for Asphalt carpet.

Sieve Size	% by weight passing the Sieve for 20/25 mm thickness
20 mm	100



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12.5 mm	70-100
10.0 mm	20-40
4.75 mm	0-5
2.36 mm	

6. The samples of aggregate of requires gradings for the work shall be got approved from the Engineer-in-charge prior to transportation and collection on plant site. Unapproved materials shall have to be removed from the plant site by the contractor at his own cost. If contractor fails to remove the inferior type of materials from the plant site, the same will be removed by the Department at the cost of the Contractor. Collection of aggregate shall be in different stacks according to various sizes of aggregates.

7. For the purpose of collection of materials, plant site shall be established at suitable place, where hot mix plant shall be installed. Department will extend all necessary co-operation in helping Contractor to get nearby Government land of establishing plant site. However, department is not responsible if no such land is made available to the Contractor and in that case, the Contractor will have to make his own arrangement for the same. Incoming material shall be recorded in a register for the purpose of record.

8. The binder shall be straight run bitumen of a suitable grade satisfying the requirements of IS:73. Bitumen shall be 60/80/100 grade and shall be supplied by the department at the rate and place as mentioned in Schedule "A" of the tender and it shall have to be carted, by the Contractor to the site of work at his own cost. Empty asphalt drums shall have to be returned free of cost to P.W.D. Store from where they are issued or as directed, if so provided in Schedule 'A' Any damage caused to the asphalt drums or loss of asphalt after issue from store shall be the responsibility of the Contractor. Drums of asphalt shall be so stored so as to allow easy inspection and in such place as will not damage the drums and cause the leakage of allow water and other foreign matter to enter. For the purpose of calculating consumption, wastage will not be allowed beyond 2.5 percent. Excess consumption over 2.5 percent will be charged at a panel rate.

9. In case bitumen is to be issued by department in bulk, the same shall be issued to the Contractor at plant site by tankers at the same rate as shown in Schedule 'A'. Contractor shall have to make adequate arrangement for stacking bulk asphalt at plant site according to the requirement. No deduction in rate will be made for supplying heated bulk asphalt.

10. The asphalt should not be used as a fuel. If however, Contractor is found to be using asphalt as fuel, the quantity of asphalt utilised shall be assessed, by the Executive Engineer whose decision will be final and binding to the Contractor who will be charged at double the rate provided in Schedule 'A' of the agreement even though the total consumption of asphalt may be within the theoretical consumption.

11. Department shall keep a day to day account of the supply and consumption of bitumen in a separate bound register having numbered pages and the proforma prescribed by the Department. Day to day signature of the Contractor's representative shall be obtained in this register. Issue rate of bitumen includes (i) Obtaining asphalt from Department's store, (ii) Transporting to site, (iii) Storing and stacking, (iv) Keeping records of supply and consumption and (v) returning the empty drums in good condition to the Department.

12. Semi dense carpet shall not be laid during rainy weather or when the base course is damp or wet.

13. The base on which semidense carpet is to be laid shall be thoroughly swept and scraped clean and free of dust and foreign matter.

14. The work shall consist of application of a single coat of bituminous to an existing road surface preparatory to another bituminous construction. The temperature of bitumen at the time of application shall be in the range of 160 degree centigrade to 175 degree centigrade.

15. Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer-in-charge and sprayed on the base at the rate specified hereafter. The rate of spread of straight run bitumen for tack coat shall be 5 kg per 10 square meter area for an existing bitumen treated surface. The binder shall be applied uniformly. The tack coat shall be applied just ahead of the on coming bituminous construction. In case carpet is to be laid on W.B.M. surface, rate of spread of Bitumen for tack cost will be 10 kg./10smt.

16. The binder content for premixing shall be 3.28 percent by weight of the total mix unless otherwise specified. The quantities of aggregates shall be sufficient to yield the specified thickness after compaction.

17. The contractor shall get the job-mix formula for the mix approved by the Engineer-in-charge before starting the work. In order to obtain the required type of mix, the department may change the proportion of bitumen and gradings of aggregate and contractor shall have to collect the materials accordingly. In case of increase in proportion of bitumen the increased or decreased quantity will be adjusted at the rate provided in Schedule 'A'. The contractor shall have the responsibility of ensuring proper proportioning of materials in accordance with the approved job-mix formula and producing a uniform mix.

18. Hot mix plant of adequate capacity and capable of producing a proper and uniform quality shall be used for preparing the mix. The plant may be either a batch type or a continuous one, having coordinated set of essential unit such as dryer for heating the aggregates, a binder heating and control unit for metering out the correct quantity of heated binder together with a paddle mixer for intimate mixing of the binder and aggregate.

19. The temperature of binder at the time of mixing shall be the range of 150° - 177° degree centigrade and of aggregates in the range of 155° - 163° degree centigrade. Provided also that at no time shall the difference in temperature between the aggregates and the binder exceed 14° degree centigrade.

20. Mixing shall be thorough to ensure that a homogeneous mixture is obtained in which all the particles to the mineral aggregates are coated uniformly.

21. The mix shall be transported from the mixing plant to the point of use in suitable vehicles. The vehicles employed for transport



shall be clean and be covered over during transit if so directed by the Engineer-in-charge.

22. The mix, transported from the hot mix plant to the site, shall be spread by means of a self propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix, to specified grade, lines and cross sections. The temperature of mix at the time of laying shall be in range 121°-163° degree centigrade.

23. Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. Longitudinal joints shall be offset by at least 150 mm. from those in the binder course. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

24. Immediately after the spreading of mix, it shall be thoroughly compacted by 8-10 tonnes 3 Wheel roller moving at a speed not exceeding 5 km per hour.

25. The roller wheels shall be kept damp to prevent the mix from adhering to them but in no case shall fuel lubricating oil be used for this purpose. Rolling shall commence longitudinally from the edge and progress towards the centre except on super elevated portions. When it shall progress from the lower to upper edge parallel to the centre line of the pavement. The roller should proceed on the fresh material with rear or mixed wheel leading or as to minimise the pushing of the mix and each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. Rolling shall continue until the entire surface has been rolled to compaction and all the roller marks eliminated.

26. Sand or stone dust flushing at the rate of 0.03 cm. / 10 smt. shall be done on asphalt surface for which no separate payment will be made.

27. Traffic may be allowed immediately after completion of the final rolling when the mix has cooled down to the surrounding temperature.

28. Surface finish and quality control of work : Control on the quality of materials and works shall be exercised by the Engineer-in-charge by carrying out the following test at the frequencies shown against each :-

Sr. No.	Type of Construction	Test	Frequency
1.	Tack Coat	(i) Binder temperature for application	At regular close intervals.
2.	Semi-Dense Carpet	(ii) Rate of spread of binder	Two test per day
		(i) Aggregate Impact Value	One test per 100 cu. m. of agg.
		(ii) Flakiness Index of Aggre.	- Do -
		(iii) Stripping Value	- Do -
		(iv) Mix Grading	One set of test on individual constituents and mixed aggregates from the dryer for each 100 tonnes of mix subject to a minimum of two test per day
		(v) Temperature of binder in the boiler, aggregate in the dryer and mix at the time of laying and rolling	At regular close intervals.
		(vi) Control of binder content and gradation in the mix (Binder Content test vide ASTM D-2172)	One test for each 100 tonnes of mix subject to max. of two test per day per plant
		(vii) rate of spread mix material	Regular control through checks on layer thickness

29. The contractor shall at all times carry out work on the highway in a manner creating least interference to the flow of traffic while consistent with the satisfactory execution of the same. For all work involving improvements to the existing highway, the contractor shall in accordance with the directives if the Engineer-in-charge provide and maintain, during the execution of the work, a passage for traffic either along a part of the existing carriage way under improvement or on diversion.

30. In case of the improvement works, namely widening strengthening of the existing payment or reconstruction repairs to cross-drainage works. Where such works could be carried out on part widths at a time and the traffic could simultaneously be passed without undue delay and difficulty on the other part; the road shoulder shall be dressed and brought in-line with the payment and maintained throughout out the duration of the work to the satisfaction of the Engineer-in-charge. Where work is continued on long stretches, passing places, at least 20 metre long and 6 metre wide inclusive of the width of the existing carriage way shall be provided at half or one kilometer intervals as directed by the Engineer-in-charge. Extra treatment to shoulders where necessary, shall be given as ordered by the Engineer-in-charge.

31. The contractor shall take the all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades including signs, marking lights and flagmen as may be required, by the Engineer-in-charge for the information and protection of traffic approaching or passing through the section, of the highway under improvement. Before taking up any construction an agreed phased programme for the control of traffic on the highway shall be drawn up in consultation with the Engineer-in-charge.

32. The barricades erected on either side of the carriage way/portion of the carriage way closed to traffic shall be strong to resist violation, and painted with alternate black and white stripes. Red lanterns or warning lights of similar type shall be mounted on the barricades at night and kept lit throughout from sunset to sunrise. At the points where traffic is to deviate from its normal path the channel for traffic shall be clearly marked with the aid of payment marking, painted drums or a similar device to the direction of the

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Engineer-in-charge. At night the passages shall be delineated with lanterns or other suitable light source.

33. One way traffic operation shall be established whenever the traffic is to be passed over part of the carriage way inadequate for two lane traffic. This shall be done with the help of flagmen kept positioned on opposite side during all hours. For regulation of traffic, the flagmen shall be equipped with red and green flags and lanterns lights. On both sides, suitable regulatory/warning signs shall be installed for the guidance of carriage way begins and the other 120 metres away. The signs shall be of approved design and the refractory type if so directed.

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

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

35. Weight of mix materials will be done in presence of responsible person, not less than the rank of supervisor of Department and the measurements shall be recorded by the Deputy Engineer, Junior Engineer or Supervisor, if so authorised. Record of each dumper will be maintained separately in bound and numbered register which will be maintained by the department representatives and signed by the contractor. Proper gate pass system shall be established, for the vehicles coming to the plants, site and out going from the plant site. The location of hectometre in which individual dumpers are unloaded shall be recorded carefully.

36. The contract unit rate for semidense carpet shall be in full for carrying out the required operation including full compensation for:-

1. Making arrangements of control and safety of traffic.
2. Preparation of base.
3. Providing all materials to be incorporated in the works with all lead and lifts.
4. All labour, tools, equipment and incidentals to complete the work to the specification.

**ITEM-31** Providing and laying seal coat with 0.18 cum stone chips i.e. 0.2727 M. T. per 10 sq. mt. using 42.50 kgs of bitumen per M.T. (4.25% by weight) for mixing the aggregates, heating the asphalt including mixing by continuous batching of hot mix plant and spreading the same by paver finisher and consolidation with power roller including providing all equipments by the contractor and flushing sand at the rate of 0.30 cu. m / 100 sq. mt.

#### 1 DESCRIPTION

The work shall consist of construction of premix seal coat as wearing course, on a previously prepared base, to the requirement of these specification.

#### 2. MATERIALS

2.1 **Binder:** The binder shall be straight run bitumen of 60/70 or 80/100 grade satisfying the requirement of IS:73. The actual grade of the binder to be used shall be decided by the Engineer-in-charge and it shall have to be brought by contractor to the site at his own cost unless otherwise specified in schedule 'A'.

2.2 **Coarse aggregates:** The coarse aggregate shall consist of crushed stone or crushed gravel. These shall be clean, durable, of cubical shape, free disintegrated pieces, organic or other deleterious matter and adherent coatings. The aggregates shall preferably be hydrophobic and of low porosity and shall satisfy the physical requirements set forth in Table given in Item No. 30 Para 2. Except that the upper limit for water absorption value shall be one percent.

2.3 **Fine aggregates:** The fine aggregates shall consist of crusher run screenings, natural sand or a mixture of both. These shall be clean, hard, durable, uncoated, dry and free from injurious, soft or flaky pieces and organic or deleterious substances.

2.4 **Filter:** The filler, where required, shall be an inert material the whole of which passes 600 micron sieve at least 90 percent passing 150 micron sieve and not less than 70 percent passing 75 micron sieve. The filler shall be cement, stone dust, hydrated lime, fly ash and other non-plastic mineral matter approved by the Engineer-in-charge.

2.5 **Aggregate gradation:** The mineral aggregates, including mineral filler, shall be so graded or combined as to conform to gradings set forth in tables below:

Table : Aggregate gradation Pre-Mix Seal Coat

Sieve Designation	Percentage by wt passing through Sieve	
	For type 'A'	For Type 'B'
12.5 mm	-	100
10 mm	100	70-100
4.75 mm	40-85	20-40
2.35 mm	5-20	5-20
75 micron	0-4	0-4

2.6 **Proportioning of materials:** The binder content for premixing shall be 42.50 kg per M.T. (4.25% by weight) for mixing aggregate. The quantities of aggregates shall be sufficient to yield the specified thickness after compaction.

The contractor shall get the job-mix formula for the mix approved by the Engineer-in-charge before starting the work.

2.7 Variation in Proportioning of material: The Contractor shall have the responsibility of ensuring proper proportioning of materials



in accordance with the approved job mix formula and producing a uniform mix. A variation in binder content of  $\pm 0.3$  percent by weight of total mix shall, however, be permissible in individual specimen taken for quality control tests vide MOST Specification Section 900.

### 3. CONSTRUCTION OPERATIONS

**3.1 Weather and seasonal limitation :** Premix seal coat shall not be laid during rainy weather or when the base course is damp or wet.

**3.2 Preparation of base :** The base on which premix seal coat is to be laid shall be prepared shaped and conditioned to the specified, lines, grade and cross section in accordance with MOST Specification Clause 601 as directed by the Engineer-in-charge. The surface shall be thoroughly swept and scraped clean and free of dust and foreign matter.

**3.3 Tack coat : Application of binder :** Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer-in-charge and sprayed on the base at the rate specified hereafter. The rate of spread in terms of straight run bitumen shall be 5 kg per 10 square metre area for an existing bitumen treated surface and 10 kg per 10 square metre area for an untreated water bound macadam surface. The binder shall be applied uniformly with the aid of sprayers. The tack coat shall be applied just ahead of the oncoming bituminous construction.

**3.4 Preparation of the mix :** Hot mix plant of adequate capacity and capable of producing a proper and uniform quality shall be used for preparing the mix. The plant should be continuous type having a co-ordinated set of essential units such as dryer for heating the aggregates, device for feeding by weight or volume the required quantities of aggregates, a binder heating and control unit for metering out the correct quantity of heated binder together with a paddle mixer for intimately mixing of the binder and aggregates. For details regarding Hot mix plant the Annexure 'A' may be referred.

The temperature of binder at the time of mixing shall be in the range of  $150^{\circ}\text{C} - 177^{\circ}\text{C}$  and aggregates in the range of  $150^{\circ}\text{C} - 163^{\circ}\text{C}$  provided also that at no time shall the difference in temperature of the aggregates and the binder exceed  $14^{\circ}\text{C}$ .

Mixing shall be throughout to ensure that a homogeneous mixture is obtained in which all the particles of the mineral aggregates are coated uniformly.

The mix shall be transported from the mixing plant to the point of use in suitable vehicles. The vehicles employed for transport shall be clean and be covered over in the transit if so directed by the Engineer-in-charge.

**3.5 Spreading :** The mix, transported from the hot mix plant to the site, shall be spread by means of self propelled mechanical paver with suitable screens capable of spreading, tamping and finishing the mix, true to specified grade, line and cross sections. The temperature of mix at the time of laying shall be in the range of  $121^{\circ}\text{C} - 163^{\circ}\text{C}$ .

Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. Longitudinal joints shall be offset by at least 150 mm from those in the binder course. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

**3.6 Rolling :** Immediately after the spreading of mix, it shall be thoroughly compacted by rolling with a set of rollers moving at a speed not exceeding 5 km per hour. The initial or break-down rolling shall be with 8-12 tonne three wheeled rollers and the surface finished by final rolling with 8-10 tonne tandem rollers, or suitable pneumatic rollers. Rolling temperature shall not be less than  $100^{\circ}\text{C}$  in any case the rolling shall be completed the temperature of mix falls about  $80^{\circ}\text{C}$ .

The roller wheels shall be kept damp to prevent the mix adhering to them but in no case shall fuel lubricating oil be used for this purpose. Rolling shall commence longitudinally from the edge and progress towards the centre except that at super elevated portions, it shall progress from the lower to upper edges parallel to the centre line of the pavement. The roller should proceed on the fresh material with rear or fixed wheel leading so as to minimise the pushing of the mix and each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. Rolling shall continue until the entire surface has been rolled to compaction and all the roller marks eliminated.

### 4. OPENING TO TRAFFIC

Traffic may be allowed immediately after completion of the final rolling when the mix has cooled down to the surrounding temperature.

### 5. SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to the requirements of most specification Clause 901 Control on the quality of material and works shall be exercised by the Engineer-in-charge in accordance with MOST Specification Clause 902.

### 6. ARRANGEMENT FOR TRAFFIC

The provision of MOST Specification Clause 105 shall apply as regards the flow to traffic during construction.

### 7. MEASUREMENT FOR PAYMENT

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

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

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

Weigh of mix materials will be done in presence of responsible person, not less than the rank of supervisor of Department, Deputy Executive Engineer or Assistant Engineer or Addl. Assistant Engineer if so authorised. Record of each dumper will be maintained

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separately in bound and numbered register which will be maintained by the departmental representatives and signed by the contractor. Proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site. The location of the kilometer, hectometer in which individual dumper are unloaded will be recorded carefully.

### 8. RATE

The Contract unit rate for seal coat shall be for payment for carrying out the required operations including full compensation for all components listed in MOST Specification Clause 503.7

**Item No. 32 :-** Providing and laying 25mm thick Semidense Bituminous concrete with drum mix plant using crushed stone aggregate of specified grading and stone dust as filler, premixed with asphalt / bitumen by weight of total mix at 5.00% (i.e. 50 kg/MT) and tack coat by emulsion asphalt \_\_\_\_\_ Sq.mt. transporting the hot mix to work site, laying with a paver finisher to the required grade / level and alignment, rolling with power roller / vibratory roller to achieve the desired compaction as per MoRTH specification clause No. 508 complete in all respects. Complete using contractors own machineries drum mix plant & paver finisher etc. complete or as specified.

### 508. SEMIDENSE BITUMINOUS CONCRETE

#### 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 25 mm to 100mm in thickness.

#### 508.2. Materials

**508.2.1. Bitumen:** The bitumen shall be paving bitumen of Penetration grade 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. 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.

**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 specified in the Contract.

#### 508.3. Mixture Design

**508.3.1. 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 BITUMINOUS CONCRETE PAVEMENT LAYERS**

Property	Test	Specification
Cleanliness (dust)	Grain size analysis <sup>1</sup>	Max 5% passing 0.075 mm 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>8</sup>	Minimum retained coating 95%
Water sensitivity**	Retained tensile strength <sup>9</sup>	Min 80%

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



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

The requirement 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 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 - 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>2</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, 80/100 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
Percent air voids	3 - 5
Percent voids in mineral aggregate (VMA)	See Table 500-12
Percent voids filled with bitumen (VFB)	65 - 78

**508.3.3. 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

#### **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 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.



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**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 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. Arrangement 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 as specified in clause 507.8

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

**Item No. 33 :-** Providing and laying Dense bituminous macadam of \_\_\_\_\_ thickness with B.T. Aggregates as per M.O.R.T.&H. gradation and emulsion asphalt for tack coat @ 2.50 Kg. / 10 Sq.Mt. with mechanical sprayer & bitumen grade 60/70 for mixing @ 40.00 Kg./M.T. i.e. 4% by weight of total mix including heating and mixing the aggregates and asphalt by continuous batching of drum mix plant and spreading the same by paver finisher and consolidation with vibratory roller including providing all materials, equipments, tools and plant, oil, kerosene, firewood, labour charges etc. comp. using contractor's own machineries, drum mix plant and paver finisher etc. complete.

**507. DENSE GRADED BITUMINOUS MACADAM**

**507.1. Scope**

This clause specifies the construction of Dense Graded Bituminous Macadam, (DBM) for use mainly, but not exclusively, in base/binder and profile corrective course, DBM is also intended for use a road base material. This 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 50mm to 100mm.

**507.2. Materials**

**507.2.1. Bitumen:** The specifications of requirements of bitumen shall be as per Clause No. 508.2.1

**507.2.2. Coarse aggregates:** The aggregates shall satisfy the physical requirements specified in Table 500-8, for dense bituminous macadam. The requirement shall be similar to that of Clause 504 except that aggregates shall satisfy physical requirements specified in Table 500-8.

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

**507.2.3. Fine aggregates :** Fine aggregates shall consists of crushed or naturally occurring mineral material, or a combination of the two, passing the 2.36mm sieve and retained on the 75 micron sieve. 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 3) 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)

**TABLE 500-8. PHYSICAL REQUIREMENTS FOR COARSE AGGREGATE FOR DENSE GRADED BITUMINOUS MACADAM**

Property	Test	Specification
Cleanliness (dust)	Grain size analysis <sup>1</sup>	Max 5% passing 0.075 mm sieve
Particle shape	Flakiness and elongation Index (combined) <sup>2</sup>	Max 30%
Strength	Los Angeles Abrasion Value <sup>3</sup>	Max 30%
	Aggregate Impact value <sup>4</sup>	Max 24%
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>8</sup>	Minimum retained coating 95%
Water sensitivity**	Retained tensile strength <sup>9</sup>	Min 80%

Notes:

1. IS:2386 Part 1

6. IS: 2386 Part 5

2. IS:2386 Part 1

7. IS: 2386 Part 3

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(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%.

**507.2.3. Fine aggregates:** Fine aggregates shall be the fraction passing 2.36 mm sieve and retained on 75 micron sieve, consisting of crusher-run screening, gravel, sand or a mixture of both. These shall be clean, hard, durable, uncoated, dry and free from any injurious, soft or flaky pieces and organic or other deleterious substances.

#### 507.2.4. Filler

Filler shall consist of finely divided mineral matter such as rock dust, hydrated lime or cement as approved by the Engineer

The filler shall be graded within the following limits:

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

Mineral filler shall consist of rock dust, hydrated lime or portland cement, or after inert mineral matter approved by the Engineer. It shall be dry and free from lumps.

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. When the coarse aggregate is gravel, 2 per cent by mass of total aggregate of portland cement or hydrated lime shall be added and the percentage of fine aggregate reduced accordingly. Cement or hydrated lime is not required when the gravel is limestone.

**507.2.5. 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 500-10 for dense bituminous macadam gradings 1 or 2 as specified in the Contract. The type and quantity of bitumen, and appropriate thickness are also indicated for each mixture type.

TABLE 500-10. COMPOSITION OF DENSE GRADED BITUMINOUS MACADAM PAVEMENT LAYERS

Grading	1	2
Nominal aggregate size	40mm	25mm
Layer Thickness	80-100 mm	50-75 mm
IS Sieve <sup>1</sup> (mm)	Cumulative % by weight of total aggregate passing	
45	100	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 <sup>2</sup>	Min. 4.0	Min. 4.5
Bitumen grade (pcn)	65 to 90	65 to 90

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.

#### 507.3. Mixture Design

**507.3.1. 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 500-11.

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



TABLE 500-11. REQUIREMENTS FOR DENSE GRADED BITUMINOUS MACADAM

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

**507.3.2. Binder content:** The binder content shall be optimised to achieve the requirements of the mixture set out in Table 500-11 and the traffic volume as specified in the Contract. Where 40 mm dense bituminous macadam mixture is specified, the modified Marshall method described in MS-2 shall be used. This method requires modified equipment and procedures; particularly the minimum stability values in Table 500-11 shall be multiplied by 2.25, and the minimum flow shall be 3 mm.

**507.3.3. Job mix formula:** The contractor shall inform the Engineer in writing at least 20 days before the start of the work. 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 to the Engineer for approval before the placing of the material.

**507.3.4. Permissible variation from job mix formula:** It shall be the responsibility of the Contractor to produce a uniform mix conforming to the approved job mix formula subject to the permissible variations of the individual percentages of the various ingredients in the actual mix from the job mix formula to be used within the limits as specified in Table 500-11. These variations are intended to apply to individual specimens taken for quality control tests vide Section 900.

TABLE 500-13 PERMISSIBLE VARIATIONS FROM THE JOB MIX FORMULA

S. No.	Description of Ingredients	Permissible variation	
		Base/binder course	Wearing course
1.	Aggregate passing 19 mm sieve or larger	± 8%	± 7%
2.	Aggregate passing 13.2 mm, 9.5 mm	± 7%	± 6%
3.	Aggregate passing 4.75 mm	± 6%	± 5%
4.	Aggregate passing 2.36 mm, 1.18mm, 0.6mm,	± 5%	± 4%
5.	Aggregate passing 0.3mm, 0.15mm	± 4%	± 3%
6.	Aggregate passing 0.075 mm	± 2%	± 1.5%
7.	Binder content	± 0.3%	± 0.3%
8.	Mixing temperature	± 10°C	± 10%

**507.3.5. 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 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.

#### 507.4. Construction Operations

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

**507.4.2. Preparation of base:** The base on which Dense Graded Bituminous Macadam is to be laid shall be prepared in accordance with Clause 501 or as directed by the Engineer. The surface shall be thoroughly swept clean free from dust and foreign matter using mechanical broom and dust removed or blown off by compressed air. In portions where mechanical broom cannot reach, other approved method shall be used as directed by the Engineer.

**5.7.4.3 Geosynthetics :** Where Geosynthetics are specified in the Contract this shall be in accordance with the requirements stated in Clause 70.3

**507.4.4. 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.

**507.4.5 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 Clause 502 or as directed by the Engineer.

**507.4.6 Tack Coat :** Where the material on which the dense bituminous macadam is to be placed is bitumen bound surface, a tack coat shall be applied as specified, in accordance with the provisions of Clause 503 or as directed by the Engineer.

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

**507.4.8 Spreading :** The provisions of Clause 501.5.3 and 501.5.4 shall apply.

**507.4.9 Rolling :** The general provisions of Clause 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.



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

**507.6. 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 work shall be exercised by the Engineer in accordance with Section 900.

**507.7. Arrangements for Traffic :** During the period of construction, arrangements for the traffic shall be done to Clause 112.

**507.8 Measurement for Payment :** Dense Graded Bituminous Materials shall be measured as finished work either in cubic metres, tons or by the square metre at a specified thickness as detailed on the Contract drawings, or documents, or as directed by the Engineer.

**507.9 Rate :** The Contract unit rate for Dense Graded Bituminous Macadam shall be payment in full for carrying out the all required operations as specified, and shall include, but not necessarily limited to all components listed in Clause 501.8.8.2 (i) to (xi). The rate shall include the provision of bitumen, at 4.25 per cent 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-34 :** Providing and laying bituminous 37.5 mm thick lean bound macadam in one or two layers considering 0.66 cum. per M.T. mix materials with machine crushed stone aggregate and asphalt for tack coat @ the rate of 4 Kg / 10 sq. mt. (on metaled surface) / 2.5 kg per 10 sq. mt. (on existing B. T. surface) using 30 kg. of bitumen per asphalt including mixing the aggregate, heating the asphalt including mixing by continuous batching of hot mix plant and spreading the same by paver finisher and consolidation with power roller including providing all equipments by the contractor and finishing sand at the rate of 0.30 cu.m / 100 sq. mt.

### 1. DESCRIPTION

The work shall consist of construction in one layer each 37.5 mm thick LBM on previously prepared base, to the requirements of these specifications.

### 2. MATERIALS

**2.1 Binder :** The binder shall be straight run bitumen of 60/70 or 80/100 grade satisfying the requirement of IS:73. The actual grade of the binder to be used shall be decided by the Engineer-in-charge and it shall have to be brought by the contractor to the site of work at his own cost.

**2.2 Coarse aggregates :** The coarse aggregate shall consist of crushed stone or crushed gravel. These shall be clean, durable, of cubical shape, free disintegrated pieces, organic or other deleterious matter and adherent coatings. The aggregates shall preferably be hydrophobic and of low porosity and shall satisfy the physical requirements set forth in Table given in Item No. 18 Para 2.

**2.3 Fine aggregates :** The fine aggregates shall consist of crusher run screenings, natural sand or a mixture of both. These shall be clean, hard, durable, uncoated, dry and free from injurious, soft or flaky pieces and organic or deleterious substances.

**2.4 Filler :** The filler, where required, shall be an inert material the whole of which passes 600 micron sieve at least 90 percent passing 150 micron sieve and not less than 70 percent passing 75 micron sieve. The filler shall be cement, stone dust, hydrated lime, fly ash and other non-plastic mineral matter approved by the Engineer-in-charge.

**2.5 Aggregate gradation :** The mineral aggregates, including mineral filler, shall be so graded or combined as to conform to gradings set forth in tables below :

Table : Aggregate gradation For LBM

Sieve Size	%by weight passing the Sieve		Sieve Size	%by weight passing the Sieve	
	37.5	75 m.m.		37.5	75 m.m
40 mm	-	100	-	-	-
25 mm	100	75-100	4.75 mm	15-35	15-35
20.0 mm 70-100	60-95	2.36 mm	5-20	5-20	
10.0 mm 35-60	30-55	0.75 mm	0-5	0-5	

The above gradation is tentative. To achieve Correct quantity the contractor shall get the job mix formula for the mix approved by Engineer-in-charge before starting the work.

**2.6 Proportioning of materials :** The binder content for premixing shall be 3.0 percent by weight of the total mix. The quantities of aggregates shall be sufficient to yield the specified thickness after compaction. The contractor shall get the job-mix formula for the mix approved by the Engineer-in-charge before starting the work.

**2.7 Variation in Proportioning of material :** The Contractor shall have the responsibility of ensuring proper proportioning of materials in accordance with the approved job mix formula and producing a uniform mix. A variation in binder content of  $\pm 0.3$  percent by weight of total mix shall, however, be permissible in Individual specimen taken for quality control tests vide MOST Specification Section 900.

### 3. CONSTRUCTION OPERATIONS

**3.1 Weather and seasonal limitation :** Lean Bound Macadam shall not be laid during rainy weather or when the base course is damp or wet.

**3.2 Preparation of base :** The base on which LBM is to be laid shall be prepared shaped and conditioned to the specified, lines, grade and cross section in accordance with MOST Specification Clause 601 as directed by the Engineer-in-charge. The surface shall be thoroughly swept and scraped clean and free of dust and foreign matter.



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**3.3 Tack coat : Application of binder :** Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer-in-charge and sprayed on the base at the rate specified hereafter. The rate of spread in terms of straight run bitumen shall be 2.5 kg per 10 square metre area for an existing bitumen treated surface and 4 kg per 10 square metre area for an untreated water bound macadam surface. The binder shall be applied uniformly with the aid of sprayers. At specified temperature, so as to provide uniformly rate and unbroken spread bitumen. The tack coat shall be applied just ahead of the oncoming bituminous construction.

**3.4 Preparation of the mix :** Hot mix plant of adequate capacity and capable of producing a proper and uniform quality shall be used for preparing the mix. The plant should be continuous type having a co-ordinated set of essential units such as dryer for heating the aggregates, device for feeding by weight or volume the required quantities of aggregates, a binder heating and control unit for metering out the correct quantity of heated binder together with a paddle mixer for intimately mixing of the binder and aggregates. For details regarding Hot mix plant the Annexure 'A' may be referred.

The temperature of binder at the time of mixing shall be in the range of 150° C - 177° C and aggregates in the range of 150° C - 163° C provided also that at no time shall the difference in temperature of the aggregates and the binder exceed 14° C.

Mixing shall be throughout to ensure that a homogeneous mixture is obtained in which all the particles of the mineral aggregates are coated uniformly.

The mix shall be transported from the mixing plant to the point of use in suitable vehicles. The vehicles employed for transport shall be clean and be covered over in the transit if so directed by the Engineer-in-charge.

**3.5 Spreading :** The mix, transported from the hot mix plant to the site, shall be spread by means of self propelled mechanical paver with suitable screens capable of spreading, tamping and finishing the mix, true to specified grade, line and cross sections. The temperature of mix at the time of laying shall be in the range of 121° C - 163° C.

Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. Longitudinal joints shall be offset by at least 150 mm from those in the binder course. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

**3.6 Rolling :** Immediately after the spreading of mix, it shall be thoroughly compacted by rolling with a set of rollers moving at a speed not exceeding 5 km per hour. The initial or break-down rolling shall be with 8-12 tonne three wheeled rollers and the surface finished by final rolling with 8-10 tonne tandem rollers, or suitable pneumatic rollers.

The roller wheels shall be kept damp to prevent the mix adhering to them but in no case shall fuel lubricating oil be used for this purpose. Rolling shall commence longitudinally from the edge and progress towards the centre except that at super elevated portions, it shall progress from the lower to upper edges parallel to the centre line of the pavement. The roller should proceed on the fresh material with rear or fixed wheel leading so as to minimise the pushing of the mix and each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. Rolling shall continue until the entire surface has been rolled to compaction and all the roller marks eliminated.

#### 4. OPENING TO TRAFFIC

Traffic may be allowed immediately after completion of the final rolling when the mix has cooled down to the surrounding temperature.

#### 5. SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to the requirements of most specification Clause 901 Control on the quality of material and works shall be exercised by the Engineer-in-charge in accordance with MOST Specification Clause 902.

#### 6. ARRANGEMENT FOR TRAFFIC

The provision of MOST Specification Clause 105 shall apply as regards the flow to traffic during construction.

#### 7. MEASUREMENT FOR PAYMENT

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

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

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

Weight of mix materials will be done in presence of responsible person, not less than the rank of supervisor of Department, Deputy Executive Engineer or Assistant Engineer or Addl. Assistant Engineer if so authorised. Record of each dumper will be maintained separately in bound and numbered register which will be maintained by the departmental representatives and signed by the contractor. Proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site. The location of the kilometer, hectometer in which individual dumper are unloaded will be recorded carefully.

**7.2** In case of LBM, DBM and asphaltic concrete of thickness 50 mm and above, initial levels before commencement of the work and final levels after completion of the work will be taken as indicated below for working out the average thickness of pavement laid, also the actual area of work done will be measured and the quantity of the work actually done shall be computed in Cu.M. basis. The actual tonnage of the mix shall then be worked out based on the designed density, for broad cross check on the actual tonnage of total mix used in the works.

Surface levels before and after laying the pavement course shall be taken as below :



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Cross profiles will be taken at least at every ten meters longitudinally as shown below :

- (a) For single lane : Levels at 15 Cms & 75 cms. from both the edges and centre point. (Levels at 5 points)
- (b) For double Lane : Levels at 15 Cms & 75 cms : 175 Cms. 275 Cms. from both the edges and the centre point. (Levels at 9 Points)
- (c) Widening single to double lane : Levels at 15 Cms. from both the edges and the centre Carriage way (Up to 2 meters widening) point (Levels at 3 Points)]

However, in special cases if necessary, the cross profiles may be taken at closer length upto 3 meters.

8. **RATE** : The contract unit rate for L. B. M. shall be for payment in full for carrying out the required operations including full compensation for all components listed in MOST Specification Clause 503.8.

#### Item No. 35 :- BITUMINOUS CONCRETE

##### 509.1. Scope

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

##### 509.2. Materials

**509.2.1. Bitumen:** The bitumen shall be paving bitumen of Penetration grade 60/70 complying with Indian Standard Specification for Paving Bitumen, IS: 73 and of the penetration indicated in Table 500.18, for bituminous concrete, or this bitumen as modified by one of the method 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.

**509.2.2. 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 500-17.

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

**509.2.4. 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 500-17 then 2 per cent by total weight of aggregate, of hydrated lime shall be added without additional cost.

**509.2.5. 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 gradings 1 or 2 as specified in the Contract.

##### 509.3. Mixture Design

**509.3.1. 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.

**509.3.2. 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 aggregates retained on the 26.5mm sieve and retained on the 22.4mm sieve, where approved by the Engineer.

**509.3.3. 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 <sup>1</sup>	Max 5% passing 0.075 mm sieve
Particle shape	Flakiness and Elongation Index	Max 30% (combined) <sup>2</sup>
Strength*	Los Angeles Abrasion Value <sup>3</sup>	Max 30%
	Aggregate Impact value <sup>4</sup>	Max 24%
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>8</sup>	Minimum retained coating 95%
Water sensitivity**	Retained tensile strength <sup>9</sup>	Min 80%

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



GBS

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 507.3.3 and the results of test enumerated in Table 500-19 as obtained by the Contractor.

**509.4. Plant trials - permissible variation in 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.

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

**509.4. Construction Operations**

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

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

Grading	1	2
Maximum aggregate size	19mm	13mm
Layer Thickness	50-65 mm	30-45 mm
IS Sieve (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 <sup>2</sup>	5.0-6.0	5.0-7.0
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.

**509.4.2 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.

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

**509.4.4 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.

**509.4.5 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.

**509.4.6 Mixing and transportation of the mixture.** The provision as specified in 8 Clauses 501.3 and 501.4 shall apply.

**509.4.7 Spreading:** The general provisions of clauses 501.5.3 and 501.5.4 shall apply.

**509.4.8 Rolling:** The general provisions of clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials.

**509.5 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.

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

**509.8 Measurement for Payment :** The measurement shall be all as specified in Clause No. 503.8.

**509.9 Rate :** The contract unit rate shall be all as specified in Clause No. 507.9, except that the rate shall include the provision of bitumen at 5.5 per cent, by weight of total mixture. The variance in actual percentage of bitumen used will be assessed and the payment adjusted