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No. NHVI-50 (3)/83 *Dated the 22nd February, 1983*

To

Chief Engineers of all State P.W.D.s and Union Territory Administrations dealing with National Highways and other Centrally Financed Roads

Sub: Provision of wearing coat on bridges being constructed on National Highways and other Centrally Financed Roads

Asphaltic wearing coat is provided for some of the bridges at present. Asphaltic wearing coat has the following difficulties :

(i) Unless the required machines are available it becomes difficult to carry out the work of asphaltic wearing coat on bridges in a satisfactory way.

(ii) Further, asphaltic wearing coat does not have a good grip with the concrete of the superstructure as on a Water Bound Macadam road with the result the wearing coat comes out very easily.

(iii) Whenever renewals are done for the approaches the Engineer-in-charge lays the renewal coat on the bridge also resulting in increase in the thickness of wearing coat and consequent dead load on the structure. This is very dangerous in simply supported prestressed concrete bridges as the bottom fibres are designed for zero tension. In some bridges it has been seen that with the renewals, the total wearing coat has come upto the level of the kerb.

(iv) As a camber of 1 in 62.5 is required for asphaltic wearing coat compared to about 1 in 75 for cement concrete wearing coat, the initial dead load on the structure with asphaltic wearing coat is also higher which increases further due to renewals mentioned above.

(v) With cement concrete wearing coat, there is a distant possibility of the wearing coat acting together with the deck slab thereby increasing the strength of the structure. Such a possibility is not there with asphaltic wearing coat.

2. In view of the above factors, it is considered desirable to provide cement concrete wearing coat on all bridges. Specifications to be followed regarding cement concrete wearing coat are enclosed as Appendix I.

3. In case asphaltic concrete wearing coat is considered desirable in view of road paving work in the adjacent stretches being done simultaneously with machinery etc., then the specification to be followed for the same are enclosed as Appendix II.

Enclosures to letter No. NHVI-50 (3)/83 dt. 22.2.83

Appendix I

SPECIFICATIONS FOR CEMENT CONCRETE WEARING COAT FOR BRIDGES

1. GRADE OF CONCRETE

The concrete for the wearing coat should be of minimum M 300 (with mix not leaner than 1 : 1½ : 3).

2. QUALITY OF CONCRETE

2.1. The concrete shall be dense with water cement ratio not greater than 0.4.

2.2. The concrete shall be properly vibrated and compacted using flat footed vibrators.

2.3. The wearing coat after concreting should be kept covered and cured at least for 28 days.

2.4. As early opening of the bridge to traffic before the wearing coat has properly cured for the specified period, will damage the wearing coat, no traffic should be allowed unless curing has been done for 28 days.

3. THICKNESS OF WEARING COAT

The thickness of wearing coat shall be an average of 75 mm, with a thickness of 100 mm at the crust and 50 mm at the edge.

4. REINFORCEMENT

4.1. For simply supported spans, the reinforcement for wearing coat should be 6 mm dia at 200 mm c/c in both directions where the slab is in compression and it should be 6 mm dia at 100 mm c/c in both directions where the slab is in tension.

4.2. In zones where hogging moments occur such as in hammer-heads, cantilever and balanced cantilever bridges where tension will develop, 6 mm dia at 100 mm c/c in both directions should be provided.

4.3. The reinforcement shall be placed at the middle of the wearing coat.

4.4. The free ends of the reinforcement at panel joints should be bent down to protect the ends of the joints.

5. JOINTS AND PANELS

5.1. The cement concrete wearing coat shall be laid in two longitudinal strips with casting of alternate panels in each strip.

5.2. The joints of the panels in the two strips shall be staggered.

5.3. The left out panels have to be subsequently concreted by placing bituminous papers at the joints with the previously laid panels.

5.4. Shuttering will have to be provided at free ends for getting vertical face as well as for ensuring good compacted concrete.

5.5. As smaller panel lengths near expansion joints are susceptible to crack formation, the length of all the panels between expansion joints shall be made equal.

Appendix II

SPECIFICATIONS FOR ASPHALTIC CONCRETE WEARING COURSE OVER BRIDGE DECKS

1. MATERIALS:

1.1. **Binder:** The binder shall be straight run bitumen of Grade 80-100 satisfying the requirements of IS : 73.

1.2. **Coarse Aggregate:** The coarse aggregate shall consist of crushed stone, crushed gravel (shingle) or other stones. 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 in Table 1.

Table 1 : PHYSICAL REQUIREMENTS OF AGGREGATES FOR BITUMINOUS MACADAM :

Sl. No.	Test	Test Method	Requirements
1.	Los Angles Abrasion Value*	IS : 2386 (Part IV)	35% Maximum
2.	Aggregate Impact Value*	—do—	30% Maximum
3.	Flakiness Index	IS : 2386 (Part I)	35% 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.

1.3. **Fine Aggregate:** The fine aggregates shall be the fraction passing 2.36 mm sieve and retained on 75 micron sieve, consisting of crusher run screenings, natural 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 deleterious substances.

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

1.5. **Aggregate Gradation:** The mineral aggregates, including mineral filler shall be so graded or combined as to conform to the gradings set forth in Table 2.

Table 2. AGGREGATE GRADATION FOR ASPHALTIC CONCRETE

Sieve Designation	Per cent by weight passing the sieve
20 mm	100
12.5 mm	80-100
10 mm	70-90
4.75 mm	50-70
2.36 mm	35-50
600 micron	18-29
300 micron	13-23
150 micron	8-16
75 micron	4-10

1.6. MIX DESIGN

1.6.1. **Requirement of Mix :** Apart from conformity with the grading and quality requirements of individual ingredients, the mix shall meet the requirement set forth in Table 3.

TABLE 3. REQUIREMENTS OF ASPHALTIC CONCRETE MIX:

Sl. No.	Description	Requirement
1.	Marshall stability (ASTM Designation : D 1559) determined on Marshall specimens compacted by 50 compaction blows on each end.	750 lb Minimum
2.	Marshall flow—(0.01 inch)	8-16
3.	Per cent voids in mix	3-5
4.	Per cent voids in mineral aggregate filled with bitumen	75-85
5.	Binder content per cent by weight of mix.	5-7.5

1.6.2. **Binder Content :** The binder content shall be so fixed as to achieve the requirements of the mix set forth in Table 3 and shall be in the range of 5 to 7.5 per cent by weight of total mix.

1.6.3. **Job mix formula :** The contractor shall intimate to the Engineer-in-charge in writing, at least 20 days before the start of the work, the job mix formula proposed to be used by him for the work and shall give the following details:

i) the source and location of all materials
ii) proportions of all materials expressed as follows where each is applicable :

Binder Coarse Aggregate (I) Coarse Aggregate (II)	as percentage by weight of total mix
Fine Aggregate (I) Fine Aggregate (II) 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 results of test enumerated in Table 3 as obtained by the contractor.

While working out 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 the specification.

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

1.6.4. **Permissible variations from the job-mix formula :** It shall be the responsibility of contractor to produce a uniform mix conforming to the approved job-mix formula subject to the permissible variations indicated in Table 4. These variations are intended to apply to individual specimens taken for quality control tests.

Table 4 : PERMISSIBLE VARIATIONS FROM THE MIX FORMULA

Sl. No.	Description of ingredient	Permissible variation by weight of total mix
1.	Aggregate passing 4.75 mm sieve	± 5.0 per cent
2.	Aggregate passing 2.36 mm sieve	± 4.0 per cent
3.	Aggregate passing 600 micron sieve	± 3.0 per cent
4.	Aggregate passing 75 micron sieve	± 1.0 per cent
5.	Binder	± 0.3 per cent

1.7. Construction Operations

1.7.1. **Weather and seasonal limitations :** Asphaltic concrete shall not be laid during rainy weather or when the base course is damp or wet.

1.7.2. **Preparation of base :** The slab surface should be cleaned of all foreign matter, laitance and loose or scaled concrete with wire brushes and then thoroughly swept.

1.7.3. **Tack coat :** The surface should then be applied with a tack coat of 80/100 bitumen at the rate of 7.5 kg to 10 kg per sq. m. immediately before laying the asphaltic concrete wearing coarse.

1.7.4. **Preparation of 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 may either be of batch type or conunuous one, having coordinated set of essential units such as dryer for heat-

ing the aggregates, device for grading and batching 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 intimate mixing of the binder and aggregates. A fines feeder for incorporation of the correct quantity of filler is also a necessary auxiliary.

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

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

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

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

Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. 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. While laying two or more layers, the longitudinal joints should be offset by at least 150 mm. The longitudinal joint in the top layer should be preferably at the centre line of the pavement.

1.7.6. **Rolling :** After the spreading of mix by paver, it should be thoroughly compacted by rolling with a set of rollers moving at a speed not exceeding 5 kms/hr. The initial or breakdown rolling shall be with 8 to 12 tonne three—wheeled roller and surface finished by final rolling with 8 to 10 tonne tandem rollers or suitable pneumatic rollers.

Rolling should begin at the edge and proceed longitudinally parallel to the road central line—each trip overlapping 1/2 the roller width and gradually progressing to the crown of the road. On superelevated portions the rolling shall begin at the low side and progress to the high side by overlapping of longitudinal trips parallel to the central line.

The rolling operation should always progress with the drive wheel forward in the direction of paving. During rolling the wheels of roller shall be kept moist to prevent the mix from adhering to them but in no case shall oil/lubricating oil be used for this purpose.

Rolling shall be continued till the density achieved is 95% of that of the laboratory. Marshall specimen prepared from mix sampled from the plant and all roller marks are eliminated. Rolling operations should be completed in every respect before the temperature of the mix falls below 100°C.

1.8. **Surface Finish**

1.8.1. **Longitudinal Profile :** The maximum permissible undulation on A.C. surface should not be more than 8 mm when measured with a 3—metre straight edge. Also in any 300 metres length, the maximum number of undulations exceeding 6 mm should not exceed 10.

1.8.1. **Cross Profile :** The maximum permissible variation from specified profile under camber template should not be more than 4 mm.

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

2.0. **Quality Control :** The following tests should be carried out according to frequencies indicated in Table 5.

TABLE 5. CONTROL TESTS AND FREQUENCIES FOR ASPHALTIC CONCRETE

Sl. No.	Type of construction	Test	Frequency
1.	Tack Coat	i) Quality of binder	As required
		ii) Binder temperature for application	At regular close intervals
		iii) Rate of spread of binder	Two tests per day
2.	Asphaltic Concrete	i) Quality of binder	As required
		ii) Aggregate Impact value, Flakiness Index and stripping value of aggregate	One test per 50-100 m^3 of aggrtegate.
		iii) Mix-grading	One set of tests on individual constituents and mixed aggregates from the dryer for each 100 tonnes of mix subject to a minimum of two sets per plant per day.
		iv) Control of temperature of binder in boiler, aggregate in the dryer and mix at the time of laying and rolling.	At regular close intervals.
		v) Stability of mix (vide ASTM : D-1559)	For each 100 tonnes of mix produced, a set of three marshall specimens to be prepared and tested for stability, flow value density, and void content, subject to a minimum of two sets being tested per plant per day.
		vi) Binder content and gradation in the mix (binder content test vide ASTM : D—2172)	One test for each 100 tonnes of mix subject to a minimum of two tests per day per plant.
		vii) Rate of spread of mixed material	Regular control through checks on the weight of mixed material and layer thickness.
		viii) Density of compacted layer	One test per 500 m^2.

3. Construction Details

3.1. As the adjustment of camber required in deck slab, bed blocks etc. has proved to be difficult in some cases, the camber required may be achieved in wearing coat itself as shown in Standard Drawing No. BD/1—69A.

3.2. Wherever, gaps are required to be left in asphaltic wearing coat for expansion gap purposes, it is suggested that initially the wearing coat for the full length including the gap width required may be laid and then vertical cuts made to achieve the gap at the required locations to be marked on the RCC kerb on either side before laying the asphaltic wearing coat.