IRC:14-2004

RECOMMENDED PRACTICE FOR OPEN GRADED PREMIX CARPET

(Third Revision)

THE INDIAN ROADS CONGRESS
2004

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1. INTRODUCTION

This standard supersedes the following existing documents on the subject:

(i) Recommended Practice for 2 cm Thick Bitumen and Tar Carpets, IRC:14-1977, and

(ii) Tentative Specification for 20 mm Thick Premix Carpet using Cationic Bitumen Emulsion, IRC:97-1987

The IRC:14 was originally printed in 1963. The First Revision was approved by the Council of the Indian Roads Congress in their meeting held at Darjeeling on the 5th and 6th April, 1970. The Council in their 87th meeting held at Madras on the 27th August, 1976 approved the Second Revision.

The IRC:97 was approved by the Council of the Indian Roads Congress in their meeting held on the 22nd May, 1987 and first printed in 1987.

Flexible Pavement Committee (FPC) (personnel given below) in its meeting held on the 10th Feb., 2001 decided to revise the above mentioned documents taking into account the current development in the practice of construction of premix carpet and prepare a consolidated single document on the subject. The Committee assigned the work of preparing the draft document to Dr. P.K. Jain, Scientist and Group Leader, Highway Engineering Materials, Central Road Research Institute. The draft document was discussed by the FPC in its meeting held on the 17th May, 2002 and was approved with certain modifications incorporating the comments of the members of the Committee.

Personnel of Flexible Pavement Committee (H-4) from 2000 to 2002

S.C. Sharma	....	Convenor
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Dr. S.S. Jain	....	Member-Secretary

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(G. Sharan)

Corresponding Members

Sukomal Chakrabarti	Smt. A.P. Joshi
Dr. P.K. Jain	S.K. Nirmal

R.S. Shukla

The newly constituted FPC (personnel given below) considered the modified draft in its meeting held on the 1st August, 2003 and authorized the sub-group comprising Shri S.C. Sharma, Dr. P.K. Jain and Dr. L.R. Kadiyali to finalize the draft for sending to the Highways Specifications and Standards (HSS) Committee. The draft was finalised by the

sub-group in its meeting held on the 17th October, 2003 and sent to HSS Committee.

Personnel of Flexible Pavement Committee (H-4) from 2003 to 2005

S.C. Sharma	....	Convenor
Chief Engineer (Roads), PWD, Guwahati (K. Hazarika)	....	Co-Convenor
Dr. S.S. Jain	....	Member-Secretary

Members

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D.P. Gupta	A Rep. of DGBR (K.K.Y. Mahindrakar)
Dr. L.R. Kadiyali	Area Co-ordinator (FP Dn.), CRRI (Dr. Sunil Bose)
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Secretary, IRC	

Corresponding Members

Dr. P.K. Jain	S.K. Nirmal
Dr. C.E.G. Justo	The Manager (Bitumen), HPC, Mumbai (V.K. Bhatnagar)
J.T. Nashikkar	

HSS Committee discussed the draft in its meeting held on the 20th December, 2003 and approved subject to certain modifications. The Executive Committee approved the document in its meeting held on the 21st December, 2003. The document was considered in the 170th Council Meeting held on the 8th

January, 2004 and it was decided that the Convenor, FPC may review the document, make any modification, if required, and send the same to IRC, taking into account the suggestions of the members. The Council authorized the Convenor, HSS Committee to approve the draft. The modified document was received from Convenor, Flexible Pavement Committee on the 22nd April, 2004 for forwarding to the Convenor, HSS Committee for approval. The document has been approved by Shri Indu Prakash (Convenor, HSS Committee), Director General (Road Development) & Special Secretary to the Govt. of India, Ministry of Road Transport & Highways for printing on 31st May, 2004.

2. SCOPE

This document covers standard specification for laying 20 mm thick open graded premix carpet using paving bitumen/ modified bitumen or bitumen emulsion as binder to serve as a wearing course; the type and grade of binder is left to the discretion of the Engineer-in-Charge, so as to be in conformity with climatic, traffic and terrain conditions. This document also covers specification for seal coat Type A (liquid seal coat) and seal coat Type B (premixed seal coat).

3. OPEN GRADED PREMIX CARPET USING PAVING GRADE BITUMEN/MODIFIED BITUMEN

3.1. Materials

3.1.1. **Binder**: The binder for premix carpet and seal coat shall be one of the following types as directed by the Engineer:

(i) A paving bitumen of suitable penetration grade conforming to IS:73.

(ii) A modified bitumen conforming to IRC:SP:53.

The binder for tack coat shall be rapid setting cationic bitumen emulsion conforming to IS:8887.

In snow bound areas, where use of emulsion or paving bitumen is not feasible, cut back bitumen conforming to IS:217 or IS:454 may be used with the approval of Engineer-in-Charge.

3.1.2. **Coarse aggregates**: The coarse aggregates shall consist of angular fragments and be clean, hard, tough, durable and of uniform quality throughout. They shall be crushed rock, gravel, river shingle or slag and should be free of elongated or flaky pieces, soft and disintegrated material, vegetable or other deleterious matter. The aggregates shall satisfy the properties given in Table 1.

Table 1. Properties of Coarse Aggregates

Sl. No.	Property	Specification	Method of test
1.	Abrasion value, using Los Angeles machine or Aggregate Impact Value	Max. 40% Max. 30%	IS:2386 (Part IV) -do-
2.	Flakiness index	Max. 25%	IS:2386 (Part I)
3.	Stripping value*	Max. 10%	IS:6241
4.	Water absorption (except in case of slags) **	Max. 2%	IS:2386 (Part III)
5.	Soundness: Loss with sodium sulphate - 5 cycles (in case of slag only)	Max. 12%	IS:2386 (Part V)
6.	Bulk density (in case of slag only)	Min. 1120 kg/m^3	IS:2386 (Part III)
7.	Polish stone value***	Min. 55	BS:812 (Part-114)

* If the stripping value of the aggregates exceeds the specified value of 10 per cent, stripping agents may be used.

** Maximum 1 per cent for seal coat.

*** Test of polish stone value is not necessary for Major District Roads and Rural Roads.

3.1.3. **Fine aggregates**: The fine aggregates for premixed seal coat shall be crushed stone dust, sand, or grit and shall consist of clean, hard, durable, uncoated, coarse dry particles, and shall be free from dust, soft or flaky particles, organic matter or other deleterious substances. The sand equivalent value of fine aggregate shall be 60 (min) as tested by test method given in IS:2720(Part 37).

3.2. Quantities of Materials Required

3.2.1. **Aggregates**: The quantity of aggregates required for premix carpet and seal coat is given in Tables 2 and 3 respectively.

Table 2. Quantity of Aggregates for Premix Carpet

Aggregates size	Quantity per 10m² of road surface
Coarse aggregates - Nominal size 13.2 mm (passing IS:22.4 mm square mesh sieve and retained on IS:11.2 mm square mesh sieve)	0.18 m³
Coarse Aggregates - Nominal size 11.2 mm size (passing IS:13.2 mm square mesh IS sieve, retained on 5.6 mm square mesh IS sieve)	0.09 m³
Total Quantity of Aggregates	0.27 m³

Table 3. Quantity of Aggregates for Seal Coat

Type of seal coat	Aggregates size	Quantity per 10m² area of road surface
A	Coarse aggregates - 6.7 mm size (passing IS 11.2 mm square mesh sieve, retained on IS 2.8 mm square mesh sieve)	0.09 m³
B	Fine aggregates - Medium coarse sand (fineness modulus of more than 2.5) or fine grit (passing IS Sieve No. 2.36 mm and retained on IS Sieve No. 180 microns)	0.06 m³

3.2.2. **Binder**: The quantity of binder required for tack coat, premix carpet, and seal coat is given in Tables 4, 5 and 6 respectively.

Table 4. Quantity of Binders for Tack Coat

Item	Quantity per 10m² area of road surface
On a granular surface (Primed)	2.5 to 3.5 kg
On an existing black top surface*	2.0 to 3.0 kg

* In case the existing black top surface is extremely rich in binder, or fatty, the tack coat may be eliminated in hot climate regions at the discretion of the Engineer-in-Charge, if a good bond between the existing surface and the superimposed layer can be ensured.

Table 5. Quantity of Binder for Premix Carpet

Item	Quantity per 10m² area of road surface
For 13.2 mm size coarse aggregates	9.5 kg @ 52 kg per m^3
For 11.2 mm size coarse aggregates	5.1 kg @ 56 kg per m^3
Total	14.6 kg

Table 6. Quantity of Binder for Seal Coat

Type of seal coat	Quantity per 10m² area of road surface
Type "A" (liquid seal coat)	9.8 kg
Type "B" (premixed seal coat)	6.8 kg

3.3. Construction Procedure

3.3.1. **Weather and seasonal limitation**: Laying of bituminous mix shall not be carried out during rain, fog, dust

storm or when the air temperature at the surface is below 10°C or wind speed exceeds 40 km/h.

3.3.2. **Preparation of surface**: The underlying surface on which the bituminous surface is to be laid must be free from dust, caked mud or any loose and extraneous matter and shall be prepared and shaped to the specified profile. Where the existing surface is potholed or rutted, these irregularities must be corrected with premixed chippings or coated macadam, depending upon the depth of the depressions or pothole, laid after applying a tack coat of binder and well rammed, thereafter. The surface should be swept clean by removing caked earth and other foreign matter with wire brushes sweeping with brooms (mechanical broom) and finally dusting with air jet, washing or other means approved by the Engineer-in-Charge. On granular surface prime coat shall be applied as per IRC:15.

3.3.3. **Application of tack coat**: Before spreading of premixed material, a tack coat should be applied on the prepared/ primed surface using a self propelled or towed pressure sprayer at the specified rate. Hand spraying for small areas inaccessible to the distributor can be done with the approval of the Engineer-in-Charge. The range of spraying temperature for bituminous emulsion shall be 20°C to 70°C. The tack coat shall be left to cure until all the volatiles have evaporated.

3.3.4. **Preparation of premix**: The bitumen shall be heated in boilers of suitable design approved by the Engineer-in-Charge, to the temperature appropriate to the grade of bitumen. Aggregates shall be heated to the required temperature. A mixer of appropriate capacity and type approved by the Engineer-in-Charge, preferably, a hot-mix plant shall be used for mixing aggregates and binder. It shall be ensured that bitumen does not come in direct contact with flame. Mixing

shall be thorough to ensure that a homogeneous mixture is obtained in which the aggregates are coated uniformly. It shall be ensured that the difference in temperature between the binder and aggregate at no time exceeds 15^0C. The mix shall be transported from hot mix plant or mixer to the point of use in a suitable vehicle or wheelbarrows. The vehicle employed for transport of mix shall be clean and the mix being transported shall be covered in transit, if so felt essential and directed by the Engineer-in-Charge. The temperatures for binder, aggregates, and mixed material at discharge from plant with different grades of bitumen/modified bitumen are given in Table 7.

Table 7. Manufacturing and Rolling Temperature with Different Grades of Bitumen/Modified Bitumen

Bitumen penetration	Range of temperature °C				
	Bitumen mixing	Aggregate mixing	Mixed material at		Rolling
			Discharge	Laying site	
30-40	160-170	160-175	170 Maximum	130 Minimum	100 Minimum
60-70	150-165	150-170	165 Maximum	125 Minimum	90 Minimum
80-100	140-160	140-165	155 Maximum	115 Minimum	80 Minimum
Modified bitumen*	165-185	155-175	160 Maximum	130 Minimum	115 Minimum

* The above Table gives broad range of temperatures, exact temperatures depends upon the type and amount of modifier used and shall be adopted as per advice of supplier or test data of modified bitumen at different temperatures.

3.3.5. **Spreading of premix**: After curing of tack coat, the premixed material shall be spread by suitable means, preferably by a paver, to the desired thickness, grade and

camber and/making due allowance for any extra quantity required to fill depressions, if any. Camber shall be checked by means of a camber board and irregularities shall be levelled out. Excessive use of blades or rakes should be avoided. The temperature of mix at laying site shall be within the range given in Table 7.

3.3.6. **Rolling**: As soon as sufficient length (say 20-25 m) of the premix has been laid, rolling should commence with 8-10 tonne smooth wheeled tandem type rollers or other approved roller. Rolling should commence at the edges and progress towards the center longitudinally except in the case of super-elevated sections, where this should commence at the inner edge and proceed towards the outer edge of the curve. When the roller has passed once over the whole area, any high spot or depression which become apparent should be corrected by removing or adding the same premixed material. Rolling shall then be continued until the entire surface has been rolled and the roller marks eliminated. In each pass of the roller, the preceding track shall be covered uniformly by at least 1/3 width. Excessive rolling shall be avoided. Moisten the roller wheels with minimum possible amount of water to prevent the premix from adhering to the wheels and being picked up. In no case shall fuel/lubricating oils will be used for this purpose. Excess use of water for this purpose shall be avoided. The rolling operation should be completed before temperature of mix reaches the values given in Table 7.

3.3.7. **Application of seal coat**: The seal coat shall be applied immediately after laying the premix carpet and rolled. Liquid seal coat shall be preferred.

3.3.7.1. **Type A seal coat (liquid seal coat)**: The binder shall be heated to the temperature appropriate to the grade of

bitumen given in Table 7 and sprayed on the dry surface in a uniform manner preferably with a self-propelled mechanical sprayer. Immediately after the application of binder, stone chips, which shall be clean and dry, shall be spread uniformly at the specified rate, on the surface preferably by means of a self-propelled or towed mechanical grit spreader or by any other suitable means as directed by the Engineer-in-Charge so as to cover the surface completely. If necessary, the surface shall be brushed to ensure uniform spread of chips. Immediately after the application of the cover material, the entire surface shall be rolled with a 8-10 tonne smooth wheeled steel roller or 8-10 tonne static weight vibratory roller, as provided in Clause 3.3.6. While rolling is in progress, additional chips shall be spread by hand in necessary quantities required to make-up irregularities. Rolling shall continue until all aggregate particles are firmly embedded in the binder and present a uniform closed surface.

3.3.7.2. **Type B seal coat (premixed seal coat)**: A mixer of appropriate capacity and type approved by the Engineer-in-Charge shall be used for preparation of the mixed material. Preparation of the premix shall be done in accordance with Clause 3.3.4. The binder shall be heated to the temperature appropriate for the grade of bitumen. The aggregates shall be dry and suitably heated to a temperature shown in Table 7 before these constituents are placed in mixer. Mixing of binder with aggregates of the specified proportions shall be continued until the latter are thoroughly coated with the former. The mix shall be immediately transported from the mixer to the point of use and spread uniformly on the bituminous surface to be sealed.

As soon as a sufficient length has been covered with the

premixed material, the surface shall be rolled with an 8-10 tonne smooth-wheeled roller. Rolling shall be continued until the premixed material completely seals the voids in the bituminous course and smooth uniform surface is obtained.

3.3.8. **Surface finish and quality control**: The finished surface should be uniform and conform to the lines, grades and typical cross-sections as specified. When tested with a 3 meter straight edge, the longitudinal profile of the finished surface shall have no undulation greater than 8 mm for machine laid premix carpet and 10 mm in case of manually laid premix carpet. In any 300 m length, the number of maximum size undulations shall not exceed the value specified in IRC:SP:16 for various category of roads. The cross profile, when checked with a camber template, shall not show a variation of more than 6 mm for machine laid premix and 8 mm for manually laid premix carpet from the specified profile. The quality control shall be carried out in accordance with the methods and procedures described in IRC:SP:11 "Handbook of Quality Control for Construction of Roads and Runways".

3.4. Opening to Traffic

No traffic shall be allowed on the road until the seal coat has been laid. After the seal coat has been laid the road may be opened to traffic in accordance with the following provisions.

In the case of Type B seal coat, traffic may be allowed soon after final rolling when the premixed material has cooled down to the surrounding temperature. In the case of Type A seal coat, traffic shall not be permitted to run on any newly sealed area until the following day. In special circumstances, however, the Engineer may open the road to traffic early, with speed restriction of 16 km/h.

4. OPEN GRADED PREMIX CARPET WITH CATIONIC BITUMEN EMULSION

4.1. Materials

4.1.1. **Binder**: The binder shall be cationic bitumen emulsion conforming to IS:8887. For premix carpet, the binder shall be of Medium Setting (MS) grade. For seal coat Type A (liquid seal coat), Rapid Setting (RS) grade shall be used or as directed by the Engineer-in-Charge. For seal coat Type B (premixed seal coat), Slow Setting (SS) grade shall be used. The binder for tack coat shall be Rapid Setting (RS) type.

4.1.2. **Coarse aggregates**: The requirement of Clause 3.1.2. shall apply.

4.1.3. **Fine aggregates**: The requirement of Clause 3.1.3. shall apply.

4.2. Quantities of Materials Required

4.2.1. **Aggregates**: The quantity of aggregates for premix carpet and seal coat shall be as per Clause 3.2.1.

4.2.2. **Binder**: The quantity of emulsion for tack coat shall be as per Clause 3.2.2. The quantity of binder for premix carpet and seal coat shall be as in Tables 8 and 9 respectively.

TABLE 8. QUANTITY OF BINDER FOR PREMIX CARPET

Item	Quantity per 10 m^2 area	Type
For 13.2 mm size aggregate	13-15 kg	MS
For 11.2 mm size aggregate	6-7 kg	MS
Total	19-22 kg	

Table 9. Quantity of Binder for Seal Coat

Type of seal coat	Quantity per 10 m^2 area	Type
Type A (liquid seal coat)	12 to 14 kg	RS
Type B (premixed seal coat)	10 to 12 kg	SS

4.3. Construction

4.3.1. **Weather and seasonal limitation**: As per Clause 3.3.1.

4.3.2. **Preparation of surface**: As per Clause 3.3.2.

4.3.3. **Preparation of binder**: Before opening, the cationic bitumen emulsion drums shall be rolled at slow speed, to and fro, at least 5 times, for a distance of about 10 metres, to distribute any storage sedimentation.

4.3.4. **Preparation of premix**: Premixing of cationic bitumen emulsion and aggregates can be carried out in a suitable mixer, such as, cold mixing plant or concrete mixer. Where specified in the Contract for large works continuous mixing operation shall be done either in batch or continuous cold mix plant suitable for preparation of emulsion mixes.

When using concrete mixer for preparing the premix, 0.135 cum (0.09 cum of 13.2 mm size and 0.045 cum of 11.2 mm size) of aggregate per batch shall be used to cover 5 sqm area of road surface with 20 mm average thickness. First the coarse aggregate of 13.2 mm shall be placed into the mixer followed by 4.5 to 5.5 kg of cationic bitumen emulsion and then the 11.2 mm size aggregate shall be added followed by remaining quantity of emulsion. After the materials have been mixed thoroughly, the mix shall be immediately transported to

the laying site in suitable vehicles. Too much mixing (exceeding 2 minutes) shall be avoided.

Where mixing is done manually by shovels, 0.06 cum of aggregates can be conveniently mixed in one heap, with appropriate quantity of emulsion, with the approval of the Engineer-in-Charge. It is preferable to make the aggregates damp before mixing as it reduce the effort required for mixing and also help to get better coating of aggregates. The 13.2 mm size aggregates and half of the emulsion are mixed first followed by 11.2 mm size aggregate and remaining quantity of emulsion.

4.3.5. **Spreading and rolling of premix**: The premixed material shall be spread within 10 minutes of applying the tack coat. The mix should be spread uniformly to the desired thickness, grades and cross fall (camber) making due allowance for any extra quantity required to fill-up depressions, if any. The cross fall should be checked by means of camber boards and irregularities levelled out. Too much raking is to be avoided. The rolling shall start immediately after laying the premix. A smooth wheeled tandem roller of 8–10 tonnes shall be used unless the Engineer-in-Charge, based on the results of laying trials, approves other compaction equipment. Rolling operation shall be carried out in accordance with the Clause 3.3.6.

4.3.6. **Application of seal coat**: Seal coat of Type A or Type B shall be applied 4 to 6 hours after laying cold mixed premix carpet. In case of seal coat Type A (liquid seal coat), immediately after spraying emulsion, clean and washed stone chips shall be spread uniformly at the specified rate, on the surface preferably by means of a self-propelled or towed mechanical grit spreader or by any other suitable means as directed by the Engineer-in-Charge so as to cover the surface

completely. If necessary, the surface shall be brushed to ensure uniform spread of chips. Rolling with 8-10 tonnes roller should start soon after spreading chips. The rolling operation shall be as indicated in Clause 3.3.7.1 as far as practicable. In case of seal coat Type B (premixed seal coat), grit of specified size and quantity shall be made wet with water before mixing with required quantity of SS grade emulsion as specified in Clause 4.2.2. The mixing, spreading and rolling shall be carried out as indicated in Clause 3.3.7.2 as far as practicable.

4.3.7. **Surface finish and quality control**: The surface finish of construction shall conform to the requirements of Clause 3.3.8.

4.4. Opening to Traffic

Traffic may be allowed over the premix carpet after 6 to 8 hours of laying the seal coat. However, in the case of single lane roads, traffic may be allowed after 4 hours or when the mix is properly set and the speed is restricted to not more than 16 km/hour. If vehicle tyres pick-up any premix material, the spot shall be filled-up by new mix. If traffic conditions permit, the road shall not be opened until 24 hours after laying.