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Assesement of Interaction Between Bituminous Asphalt Layers

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Abstract*- The interlayer holding of present day multi-layered asphalt framework assumes a significant job to accomplish long haul execution of an adaptable asphalt. It has been seen that helpless holding between bituminous asphalt layers adds to significant asphalt overlay troubles, for example, untimely exhaustion, top down breaking, potholes, and surface layer delamination. One of the most widely recognized upsets because of helpless holding between bituminous layers is a slippage disappointment, which for the most part happens where overwhelming vehicles are regularly quickening, decelerating, or turning. To upgrade the holding between layers, a tack coat is showered in the middle of the bituminous asphalt layers. A tack coat is an utilization of a bituminous emulsion or bituminous folio between a current bituminous/solid surface and a recently developed bituminous overlay. Regularly, hot bituminous folios, reduction bitumens or bituminous emulsions are utilized as tack coat materials. This investigation is expected to assess the bond quality at the interface between asphalt layers by performing research facility tests. To do this goal, three unique connections are manufactured for use in Marshall Loading Frame for finding the presentation of tack coat laid at the interface between Bituminous Concrete (BC) and Dense Bituminous Macadam (DBM) layers in the research facility. In this examination, the aftereffects of the examples arranged with 100 mm and 150 mm measurement examples utilizing two sorts of regularly utilized emulsions, in particular CMS-2 and CRS-1 as tack coat at application rates fluctuating at 0.20 kg/m2, 0.25 kg/m2 and 0.30 kg/m2 made at 250C temperature are introduced. It is seen that CRS-1 as tack coat gives higher interface bond quality worth contrasted with CMS-2. Also, independent of the kinds of emulsions utilized as tack coat, the ideal pace of use is seen as 0.25 kg/m2 as suggested in MORT&H's particulars.

***Keywords*- asphalt layers, Bituminous Concrete (BC) ,Dense Bituminous Macadam (DBM), CMS-2 and CRS-1**

I. INTRODUCTION

The cutting edge adaptable asphalt is commonly structured and developed in a few layers for powerful pressure circulation across asphalt layers under the overwhelming traffic loads. The interlayer holding of the multi-layered asphalt framework assumes a significant job to accomplish long haul execution of asphalt. Sufficient bond between the layers must be guaranteed with the goal that numerous layers proceed as a solid structure. To accomplish great bond quality, a tack coat is typically splashed in the middle of the bituminous asphalt layers. Thus, the applied burdens are equitably appropriated in the asphalt framework and in this way, diminish auxiliary harm to the asphalts.

It has been seen that helpless holding between asphalt layers adds to significant asphalt overlay troubles. One of the most widely recognized bothers because of helpless holding between asphalt layers is a slippage disappointment, which as a rule happens where substantial vehicles are frequently quickening, decelerating, or turning. The vehicle load makes dynamic ordinary and distracting worries in the asphalt interfaces from even and vertical burdens. With the vehicle load being moved to each fundamental bituminous layer, the interface between the layers is indispensable to the asphalts trustworthiness. Slippage disappointment creates when the asphalt layers start to slide on each other for the most part with the top layer isolating from the lower layer. This is brought about by an absence of security and a sufficiently high level power to make the two layers start to isolate. Other asphalt issues that have been connected to helpless bond quality between asphalt layers incorporate untimely weakness, top down splitting, potholes, and surface layer delamination. One such outcome is the arrangement of splits looking like a bow as appeared in figure 1.1.

Figure 1. Slippage Crack.

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1. Materials Used

1.1. Aggregates

For preparation of cylindrical samples composed of Dense Bituminous Macadam (DBM) and Bituminous Concrete (BC), aggregates were as per grading of Manual for Construction and Supervisions of Bituminous Works of Ministry of Road Transport and Highways (MORT&H, 2001) as given in Table 3.1 and 3.2 respectively.

1.2. Coarse Aggregates

Coarse aggregates consisted of stone chips collected from a local source, up to 4.75 mm
IS sieve size. Standard tests were conducted to determine their physical properties as summarized in Table 3.3.

1.3. Fine Aggregates

Fine aggregates, consisting of stone crusher dusts were collected from a local crusher with fractions passing 4.75 mm and retained on 0.075 mm IS sieve. Its specific gravity was found to be 2.62.

Adopted aggregate gradation for DBM

Property	Grading
Nominal Aggregate Size (mm)	25
IS Sieve (mm)	Percent Passing
37.5	100
26.5	95
19.0	83
13.2	68
4.75	46
2.36	35
0.300	14
0.075	5

Adopted aggregate gradation for BC

Property	Grading
Nominal Aggregate Size (mm)	13
IS Sieve (mm)	Percent Passing
19.0	100
13.2	89.5
9.5	79
4.75	62
2.36	50
1.18	41
0.600	32
0.300	23
0.150	16
0.075	7

2. Binder

One conventional commonly used bituminous binder, namely VG 30 bitumen collected from local source was used in this investigation to prepare the samples. Conventional tests were performed to determine the important physical properties of these binders. The physical properties thus obtained are summarized in Table

3. Tack Coat Materials

The tack coat materials selected for this study include two emulsions CMS-2 and CRS-1. Standard tests were conducted to determine their physical properties as summarized in Table.

Physical properties of VG 30 bitumen binder

Property	Test Method	Test Result
Penetration at 25°C	IS : 1203-1978	67.7
Softening Point (R&B), °C	IS : 1205-1978	48.5
Viscosity (Brookfield) at 160°C, cP	ASTM D 4402	200

Physical properties of Tack Coats

Property	Test Method	Emulsion Type	Test Results
Viscosity by Saybolt Furol viscometer, seconds: At 50^0 C	ASTM D 6934	CRS-1	37
		CMS-2	114
Density in g/cm^3	As per Chehab et al. (2008)	CRS-1	0.986
		CMS-2	0.986
Residue by evaporation, percent	ASTM D 244	CRS-1	61.33
		CMS-2	67.59
Residue Penetration 25^0 C/100 g/5 sec	IS : 1203-1978	CRS-1	86.7
		CMS-2	106.7
Residue Ductility 27^0 C cm	IS : 1208-1978	CRS-1	100+
		CMS-2	79

Rate of application of Tack Coat as per MORT&H Specification

Type of Surface	Quantity in kg per m^2 area
Normal bituminous surface	0.20 to 0.25
Dry and hungry bituminous surface	0.25 to 0.30
Granular surface treated with primer	0.25 to 0.30
Non bituminous surface	
Granular base (not primed)	0.35 to 0.40
Cement Concrete pavement	0.30 to 0.35

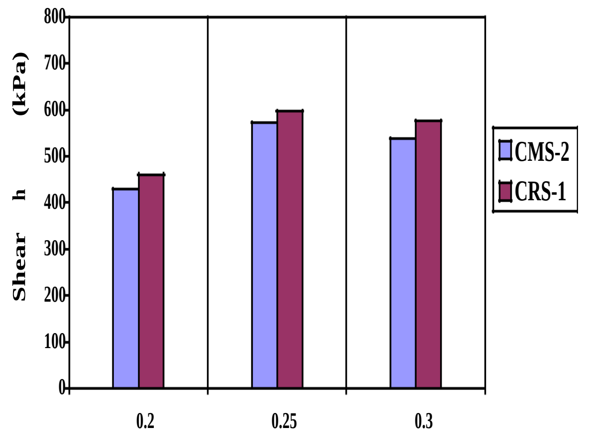

Figure 2. Plot of Shear Strength v/s Tack Coat application rates for 100 mm diameter specimens using Shear testing model no. 1.

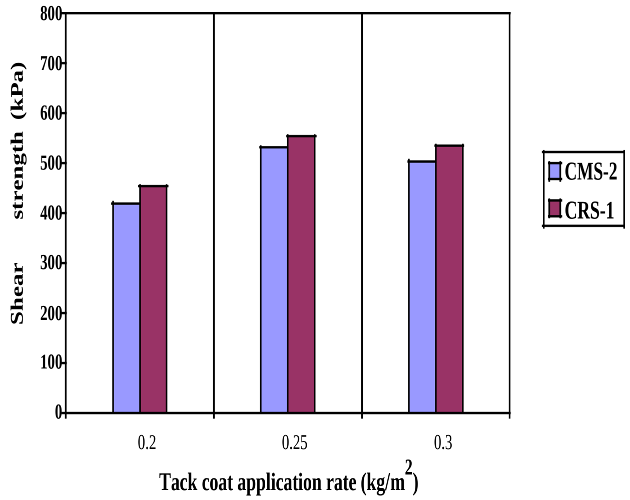

Figure 3. Plot of Shear Strength v/s Tack Coat application rates for 150 mm diameter specimens using Shear testing model no. 2.

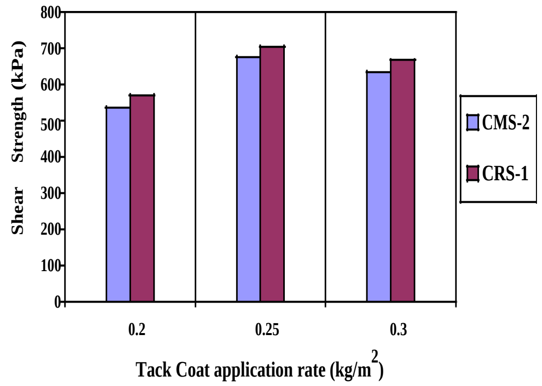

Figure 4.3: Plot of Shear Strength v/s Tack Coat application rates for 150 mm diameter specimens using Shear testing model no. 3.

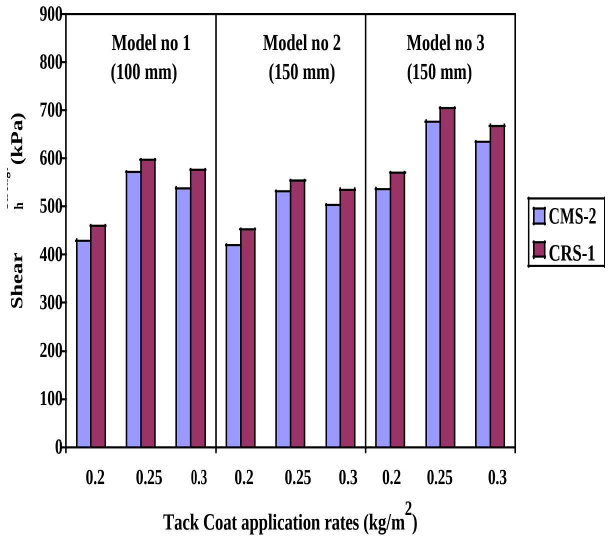

Figure 4.4: Comparison of Shear Strength v/s Application rates for the three models.

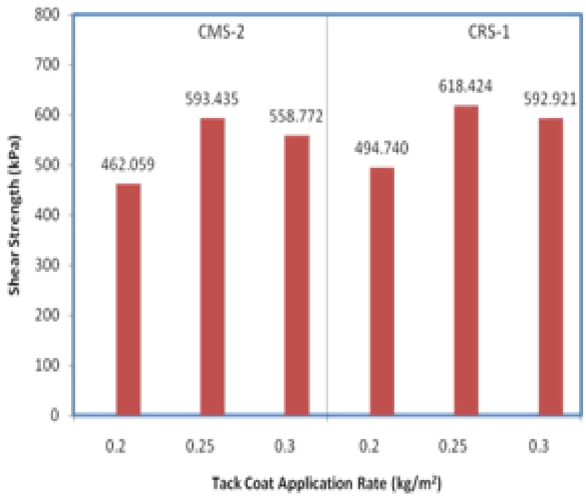

Figure 5. Average Shear Strength v/s Application rates for the three models.

II. CONCLUSIONS

A research center investigation was led to assess the bond quality between the Bituminous Concrete (BC) and Dense Bituminous Macadam (DBM) layers with tack coat showered at the interface. For this reason three straightforward shear testing models were created and tries were led utilizing the equivalent in a Marshall Stability Apparatus. For shear testing model no 1, research facility tests were directed on 100 mm distance across tube shaped examples at a temperature of 250 C by applying a shear power of steady distortion pace of 50.8 mm/min. While the shear testing model no. 2 and 3 were manufactured to assess the bond quality of 150 mm distance across tube shaped examples. The examples were set up in research facility by applying CMS-2 and CRS-1 as tack coat at interface at application rates fluctuating at 0.20 kg/m2, 0.25 kg/m2 and 0.30 kg/m2. Coming up next are explicit perceptions drawn from the test outcomes.

- The test results closed the application pace of 0.25 kg/m2 as the ideal one for all the tack coats
- Generally, CRS-1 as tack coat gave the most noteworthy shear quality at all application rates, 0.20 kg/m2, 0.25 kg/m2 and 0.30 kg/m2 when contrasted with CMS-2.
- The shear quality qualities acquired from shear testing model no. 3 were higher than those acquired from model no.1 and 2 for a wide range of tack coat at all application rates. This may be because of erraticism as the shear load was applied close to the interface along these lines; the shear quality qualities got were lower than those acquired from model no. 3 where a concentric shear load was applied.
- Considering all models together, normal shear quality qualities were seen as 462.059, 593.435 and 558.772 kPa utilizing CMS-2 as tack coat at application paces of 0.20 kg/m2, 0.25 kg/m2 and 0.30 kg/m2 individually while utilizing CRS-1 as tack coat at application paces of 0.20 kg/m2, 0.25 kg/m2 and 0.30 kg/m2 the normal shear quality qualities acquired were 494.740, 618.424 and 592.921 kPa separately.

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