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EVALUATION OF MODIFIED BITUMINOUS CONCRETE MIX DEVELOPED USING PARAFFIN WAX

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Abstract: *Bituminous materials are extensively used for pavement construction, primarily because of their excellent binding characteristics, water proofing properties and relatively low cost But In bitumen concrete mix the strength of bitumen concrete depends on all the constituent materials that are used in the mix design i.e. bitumen, coarse aggregate, fine aggregate and filler. Above all the bitumen concrete are prepared by bitumen and mineral aggregate. In this study based on Marshall mix design of bituminous concrete with additives Paraffin wax with different contents like 0.5%, 1.5%, 2%. The Marshall test performing in two ways without additive and with additives like paraffin wax. The result shows that paraffin wax increases the Marshall stability of bitumen mixture.*

Keywords: *Paraffin wax, Marshall stability, BC mix design, Bitumen test*

I. INTRODUCTION

Indian Highways are of covered surface by bitumen. A Bituminous concrete is commonly used as asphalt courses. Mix designs for BC are based on guideline given by MoRTH. In mix design method improvements should finally aim to achieve long lasting perpetual pavements. In a flexible pavement bituminous mixes serve the following three important functions: Provide structural strength, Facilitate subsurface drainage and Provide surface friction especially when pavement in wet condition. The bituminous mix design aims to determine the proportion of bitumen, Filler, fine aggregates, and coarse aggregates to produce a mix which is workable, strong, durable and economical. The requirements of the mix design and the two major stages of the mix design, i.e. dry mix design and wet mix design. Mix design objectives are to provide sufficient workability to permit easy placement without segregation, sufficient flexibility to avoid premature cracking due to repeated bending by traffic, sufficient air voids in the compacted bitumen to allow for additional compaction by traffic, sufficient strength to resist shear deformation under traffic at higher temperature, sufficient bitumen to ensure a durable pavement and sufficient flexibility at low temperature to prevent shrinkage cracks.

II. MATERIALS

A. Bitumen:

Asphalt is also known as bitumen. It is a sticky, black, highly viscous semi-solid or liquid form of petroleum. Bitumen is petroleum product obtaining by the refining of the crude petroleum in the refinery. It is a black or brown in colour and also has waterproofing and other adhesive properties. Bitumen is also found as natural deposit or as component of naturally occurring asphalt, in which it is associated with mineral matter.

B. Aggregate:

Aggregate plays an important role in the performance of bituminous mix. In bituminous mix, aggregates constitute about 90 to 95 percent by weight and comprise 75to 85 percent by volume. Aggregate mainly consisting of both coarse and fine aggregates (coarse aggregate of 14.2 mm to 2.36 mm and fine aggregates of 2.36 mm to 75µ) are used. Coarse aggregates offer compressive and shear strength and shows good interlocking properties and the fine aggregates fills the voids present between the coarse aggregates.

C. Paraffin Wax:

Paraffin Wax is produced only from refineries, which have wax production units. There are three types of Paraffin Wax namely Type-1, Type-2 and Type-3. These categories are based on the oil content.

III. MARSHALL METHOD OF MIX DESIGNMARSHALL STABILITY TEST

Marshall test is carried out to determine the stability of bituminous concrete mix without additives and with additives (paraffin wax). In this tacking binder content 5%, 5.5% and 6%.and paraffin wax content for all binder content is 0.5%, 1.5% and 2%. With this content finding the Marshall stability and flow.

Marshall properties of bituminous concrete mix:

Marshall properties of bituminous concrete mix (Grading-2) are determined. The results obtained at 5%, 5.5%, and 6% bitumen content are presented in below table,

The bitumen content for the mix design is found by taking the average value of the following three bitumen contents found from the graphs of the test results.

i. Bitumen content corresponding to stability
ii. Bitumen content corresponding to Flow
iii. Bitumen content corresponding to Unit weight
iv. Bitumen content corresponding to Bitumen content corresponding to stability
v. Bitumen content corresponding to VFB

IV. TEST RESULT & ANALYSIS

Table: 1 Gradation for BC grade-II mix design

Sieve Size	Actual % passing			% Passing proposed mix design			Total Passing %	Limit as per MOST Table - 500/18
	10mm	6mm	Stone Dust	10mm	6mm	Stone Dust		
mm				30.0%	30.0%	40.0%	100.0%	Grading 2
19	85.018	100	100	25.51	30.00	40.00	95.51	100
13.2	6.778	100	100	2.03	30.00	40.00	72.03	79-100
9.5	3.778	100	100	1.13	30.00	40.00	71.13	70-88
4.75	0.478	91.852	100	0.14	27.56	40.00	67.70	53-71
2.36	0.378	50.14	99.65	0.11	15.04	39.86	55.02	42-58
1.18	0.338	12.592	69.665	0.10	3.78	27.87	31.75	34-48
0.6	0.338	5.53	46.915	0.10	1.66	18.77	20.53	26-38
0.3	0.338	2.716	24.79	0.10	0.81	9.92	10.83	18-28
0.15	0.338	1.82	14.745	0.10	0.55	5.90	6.55	12-20
0.075	0.338	1.356	10.165	0.10	0.41	4.07	4.57	4-10

Table: 2 Proportion of aggregate for BC Grade-II

Aggregate Size	10mm	6mm	Stone Dust
Proportions	30%	30%	40%

Table: 3 Bitumen Test Result

Property	Test Results	Specified Limits as per IS
Penetration at 25ºC/100 gm /5 sec, mm	66	60-70
Ductility, cm	80.16	75 cm minimum
Softening Point	50 ºc	40 ºc to 55 ºc
Viscosity at 60ºC, Poise	1057	1000±200

Table: 4 BC Marshall stability and flow result for (5%,5.5%, 6%) binder content without additive

Sr. No	Marshall Property	Test Result			Morth Specification
		5%	5.5%	6%	
1	Marshall Stability,kg	1393	1466	1605	Min 900
2	Flow, mm	4	3	2.6	2.0 – 4.0
3	Air Voids (VV), %	2.74	5.06	5.36	4.0 – 5.0
4	Gm	2.489	2.409	2.384	2.0-3.0
5	VFB, %	14.153	17.244	18.45	65-75

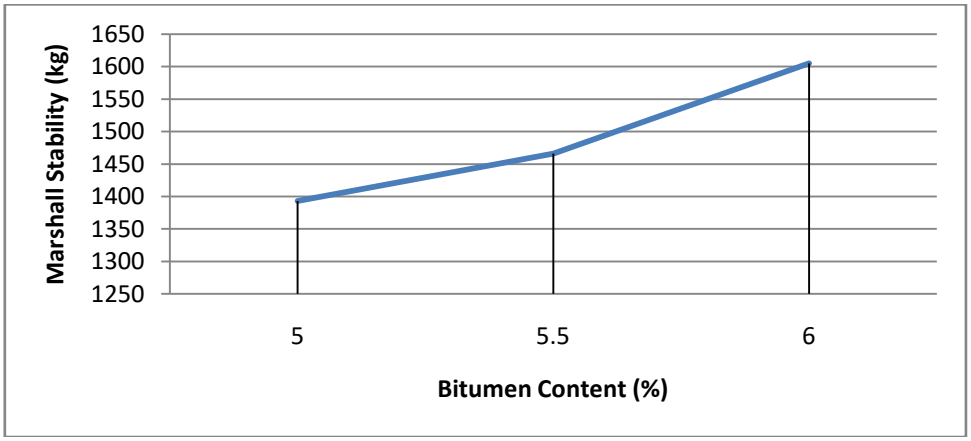

Figure: 1 Binder content v/s Marshall Stability

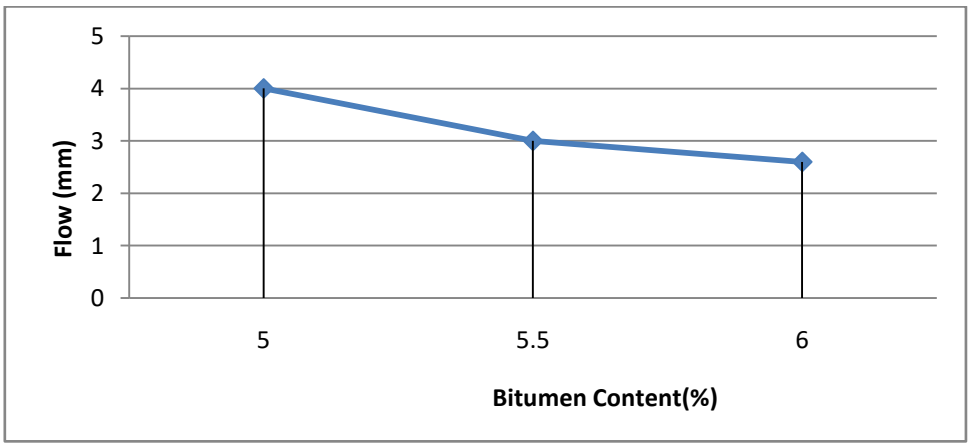

Figure: 2 Binder Content v/s Marshall Flow

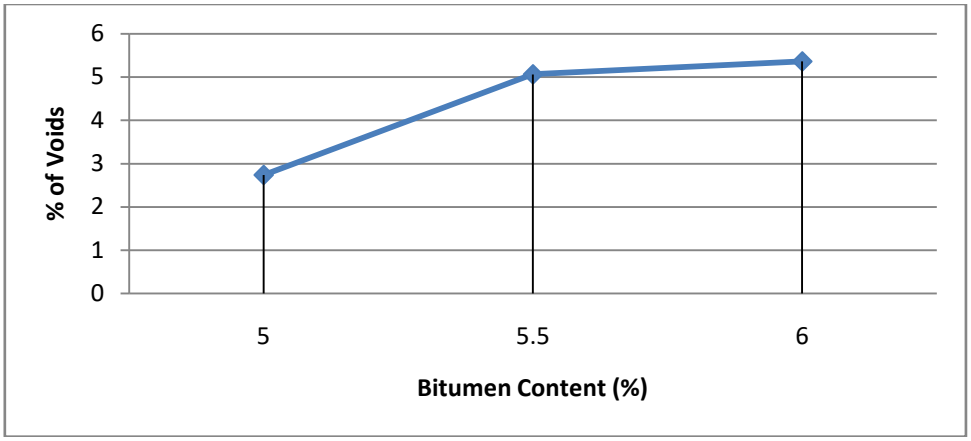

Figure: 3 Binder Content v/s %of voids

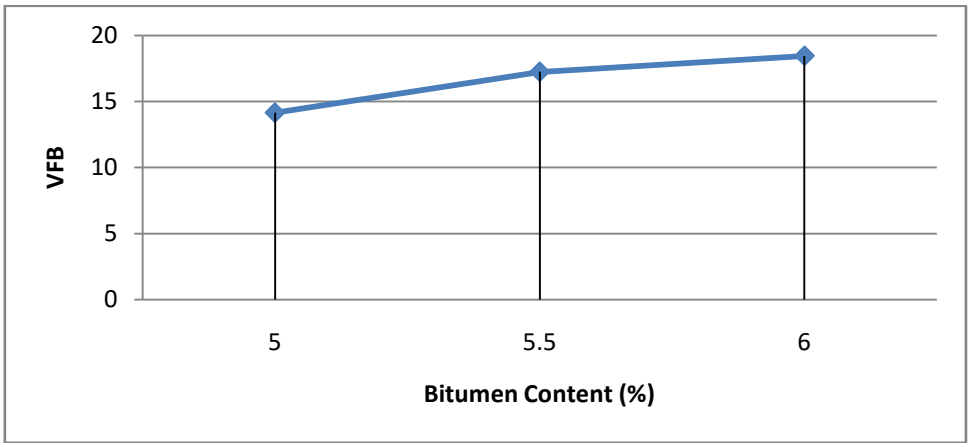

Figure: 4 Binder Content v/s VFB

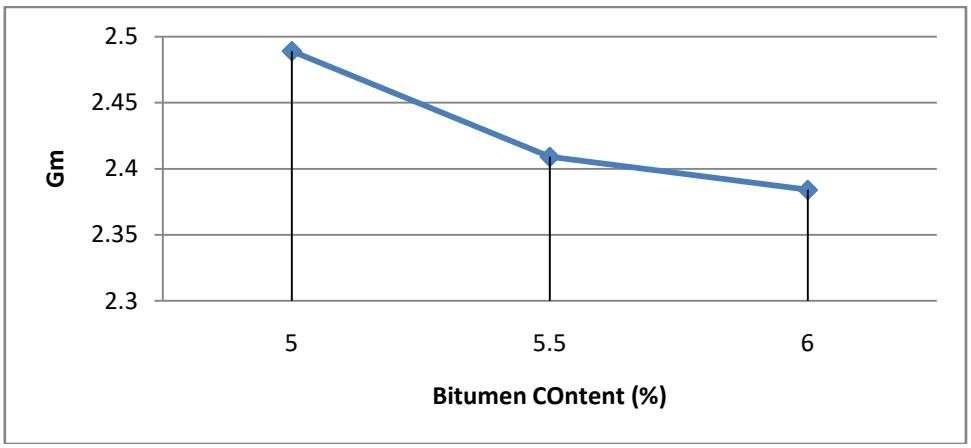

Figure: 5 Binder Content v/s GM

Table: 5 BC Marshall stability and flow result for Paraffin Wax with Bitumen Content 5%

Sr. No.	Marshall Property	Paraffin wax content (5%)			Morth specification
		1%	1.5%	2%	
1.	Marshall Stability(kg)	1413	1500	1431.27	Min 900
2.	Flow (mm)	3	3	2.7	2.0 – 4.0

Table: 6 Marshall Various Parameters results with paraffin wax and Bitumen Content 5%

Sr. no	Paraffin wax content (%)	Air voids (%)	Gm	VFB%	Morth specification
1	1	8.53	2.403	53.56	4.0-5.0
2	1.5	9.25	2.324	48.67	Min. 14
3	2	10.54	2.320	42.09	65-75

Table: 7 BC Marshall stability and flow result for Paraffin Wax with Bitumen Content 5.5%

Sr. No.	Marshall Property	Paraffin wax content (5.5%)			Morth specification
		1%	1.5%	2%	
1.	Marshall Stability(kg)	1521.61	1425.72	1458	Min 900
2.	Flow (mm)	3.3	3.4	3.6	2.0 – 4.0

Table: 8 Marshall Various Parameters results with paraffin wax and Bitumen Content 5.5%

Sr.no	Paraffin wax content (%)	Air voids (%)	Gm	VFB%	Morth specification
1	1	8.26	2.383	57.25	4.0-5.0
2	1.5	9.33	2.487	50.59	Min. 14
3	2	10.26	2.383	44.95	65-75

Table: 9 Marshall stability and flow result for Paraffin Wax with Bitumen Content 6%

Sr. No.	Marshall Property	Paraffin wax content (6%)			Morth specification
		1%	1.5%	2%	
1.	Marshall Stability(kg)	1527.55	1405.82	1450.57	Min 900
2.	Flow (mm)	3.5	3.7	3.9	2.0 – 4.0

Table: 10 Marshall Various Parameters results with paraffin wax and Bitumen Content 6%

Sr.no	Paraffin wax content (%)	Air voids (%)	Gm	VFB%	Morth specification
1	1	5.24	2.364	69.54	4.0-5.0
2	1.5	6.68	2.331	61.39	Min. 14
3	2	8.68	2.377	51.53	65-75

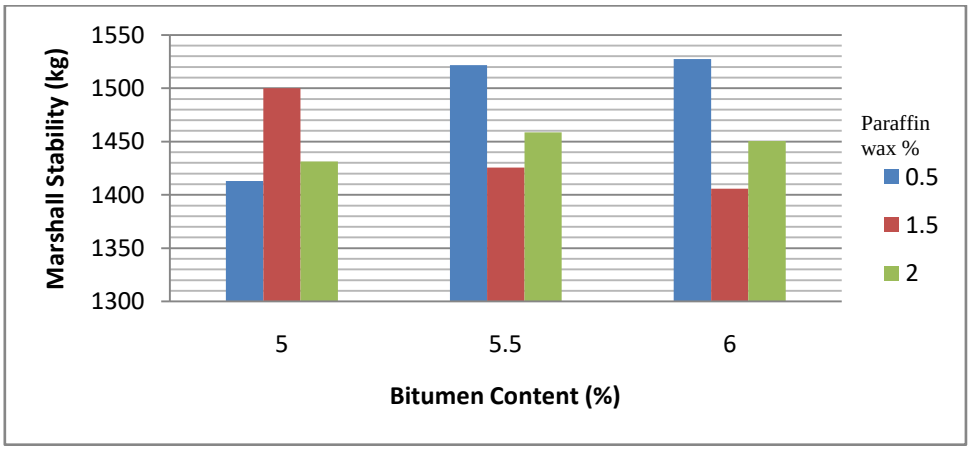

Figure: 6 Binder content v/s Marshall Stability

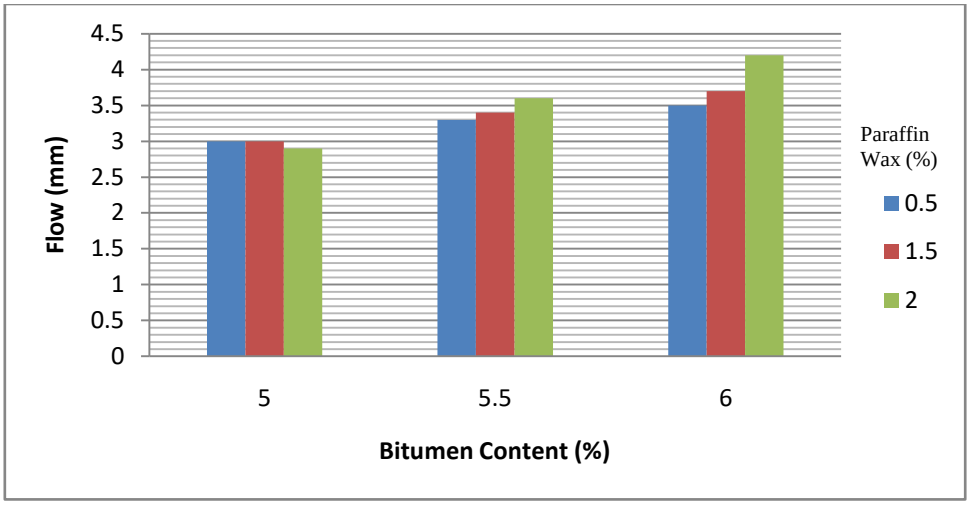

Figure: 7 Binder Content v/s Marshall Flow

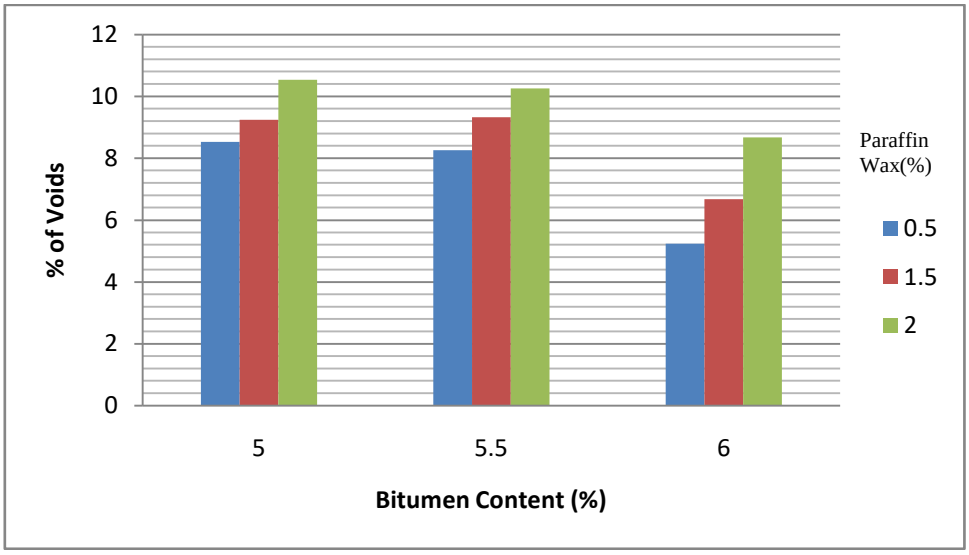

Figure: 8 Binder Content v/s %of voids

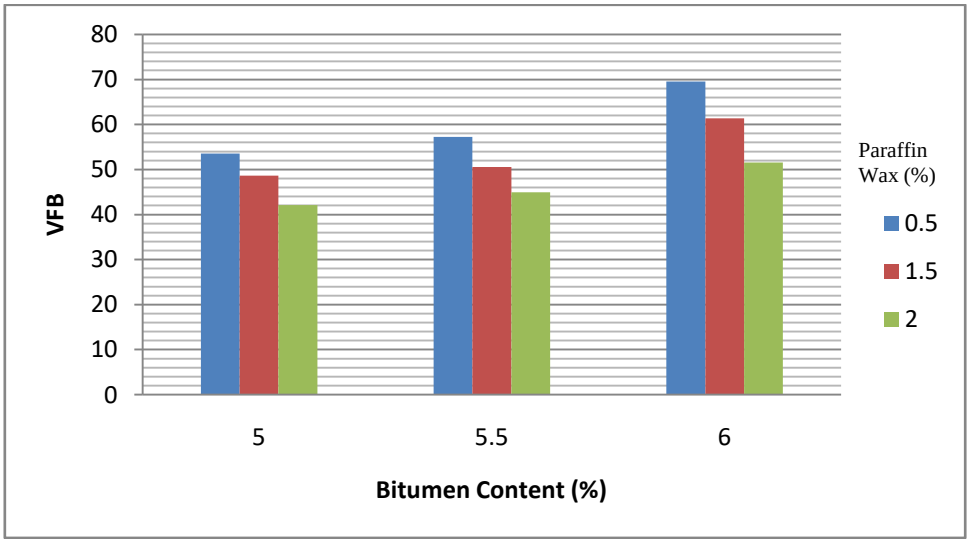

Figure: 9 Binder Content v/s VFB

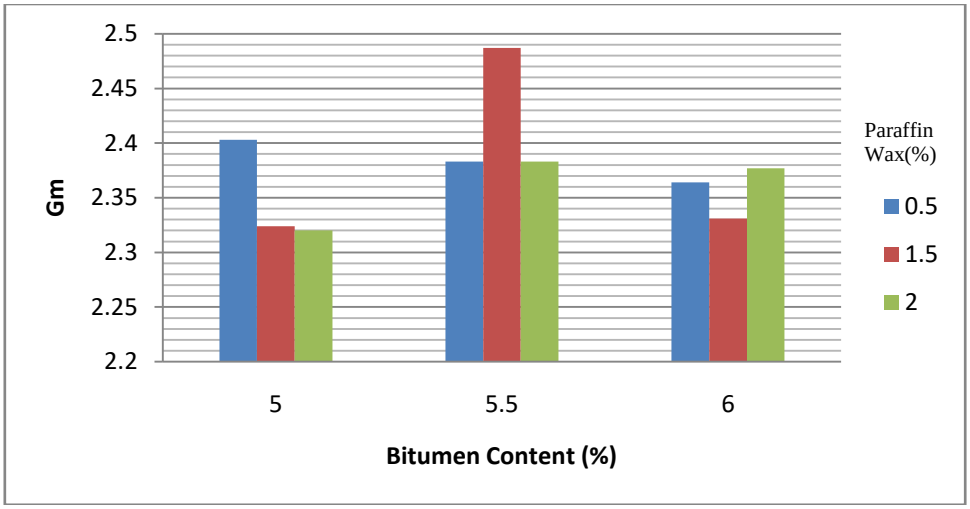

Figure: 10 Binder Content v/s GM

V. CONCLUSION

In the present study, the importance was to add the Paraffin wax to use bituminous concrete (BC) mix and to evaluate the various mix properties like Marshall Stability, flow, bulk density, voids in the mix and voids field with bitumen (VFB).

- It is observed that bitumen mix content increase the Marshall stability also increases.
- It is observed that bitumen mix content with Paraffin wax have all most same Marshall Property.

It is also observed that when 0.5% adding paraffin wax the strength of Marshall is comparatively increases but all the result of Marshall test are satisfy the Morth specification.

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