

# Assessing the Adequacy of Glass Fibres in Dense Bituminous Macadam Grade 2

Rajesh Prajapati<sup>1</sup> Prof. C. B. Mishra<sup>2</sup>

<sup>1</sup>M.E. Student <sup>2</sup>Associate Professor

<sup>2</sup>Department of Civil Engineering

<sup>1,2</sup>BVM Engineering College, V.V.Nagar, Anand, India

**Abstract**— Highways are a principal foundation in the national economy and social welfare, since they give mobility and accessibility to drivers and loads. India is having the second biggest highway organize in the world. A bituminous blend is a blend of coarse aggregate, fine aggregate, rock filler and Binder. The present review expects to create bituminous mix for the Dense Bituminous Macadam Grade-2 utilizing the glass filaments. In this paper, at first VG 30 review binder content has been taken as 4, 4.2, 4.4, 4.6, 4.8 and 5.0 % of the aggregate blend and finds the Optimum Binder Content for typical blend utilizing distinctive volumetric properties of Marshall Mix outline. In order to modify the properties, glass fibres in extent of 0.3%, 0.4% and 0.5% of the total mix are added in mix at OBC. In fibre reinforced bituminous mix the test result show that the Marshall Stability and flows values increased for 0.4% of fibre content in respect to 4.62% optimum binder content. The change of the properties of bituminous mixture shows the constructive outcome of glass fibers.

**Key words:** Marshall Stability, Voids in Mineral Aggregates, Glass fibre, Percentage air voids

## I. INTRODUCTION

Because of the fast development of urbanization and industrialization of the world in the course of the most recent century, the development and support of transportation roadways is a consistent request in urban and rustic ranges. Around 60% of the roadway extend cost is related with the asphalt development. Because of quick, high activity action, significant load, channelized movement development and regularly evolving atmosphere, bituminous black-tops roads are subjected to various sorts of distresses. Along these lines proper blend plan for the diverse layers of the asphalt can enhance the execution, cost and supportability of the bituminous surfaces. Dense bituminous macadam is utilized as folio course and it has great blend with fluctuating the degree to enhance the toughness of asphalt. For the most part Marshall Mix outline strategy is embraced for blend plan of Dense Graded Bituminous Macadam. The present research work tries to recognize a portion of the issues required in this craft of bituminous blend outlined the course of bituminous mix and flow investigate.

## II. EXPERIMENTAL MATERIALS

The materials used in this research include crushed Quartzite aggregate of sizes 25 mm, 10 mm and stone dust were used and tested as per IS Standards for sufficient strength, hardness, toughness were chosen. The results of aggregates tests for the study are shown in Table 1 as per codal provision and limits as per the specifications of Ministry of Road Transport and Highways Table: 500-10 for DBM grade -2.

Bitumen is a thermoplastic material which is a by product of petroleum refining process. It is highly viscous at temperature above 1000°C and is solid state at room temperature. In this study viscosity grade bitumen VG 30 used as a binder in this research for preparation of mix and tested as per Indian Standards which is shown in Table 2. Glass fibre of 10 mm length and varying proportion 0.3, 0.4, 0.5 percent are use in this aggregate grading has been done as per the MoRTH specifications for preparing mix design for DBM grade-2 which is shown in Fig-1.

Sr. No	Property	Test	Specification	Test Result
1	Cleanlines (dust)	Grain size analysis	Max 5 % passing 0.075 IS-Sieve	28mm-22mm 0.55%
				22mm-14mm 0.70%
				14mm-8mm 0.92%
2	Particle shape	Flakiness & Elongation Indices (Combined)	35% Max	27.79 %
3	Strength	Aggregate Impact Value(AIV)	27 % Max	12.08 %
4	Durability	Soundness		
		Magnesium Sulphate	Max 18 %	10.5%
		Sodium sulphate	Max 12 %	8.0 %
5	Water absorption value	Water absorption value	2 % Max	1.40%

Table 1: Physical Requirements for Coarse Aggregate For Dense Bituminous Macadam (As Per Morth Table : 500-10)

Serial No.	Test	Test Readings	VG 30 (IS: 73-2013)	Test Method
1	Ductility test	58 cm	min 40	IS: 1208 - 1978
2	Penetration Test	52 mm	min 45	IS: 1203-1978
3	Softening Point	52.55 °C	min 47 °C	IS: 1205-1978

4	Specific Gravity	1.05	0.97-1.20	IS: 1202-1978
5	Stripping Value	96%	min 95%	IS:6241-1971
6	Absolute Viscosity at 60 (C°)	2483	2 400-3 600	IS: 1206 (part 2)

Table 2: Physical Requirements for VG 30 grade bitumen for DBM Grade-2

Type of aggregate	28-22 mm	22-14 mm	14-8 mm	8 mm down	rock filler
Aggregate (%)	17	18	22	40	3

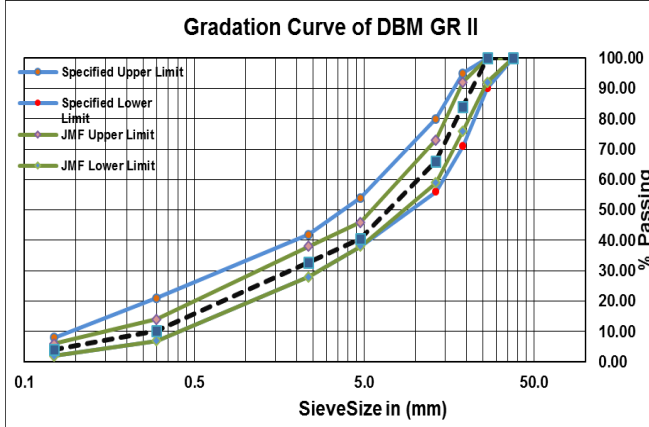


Fig. 1: Aggregate gradation of DBM grade-2

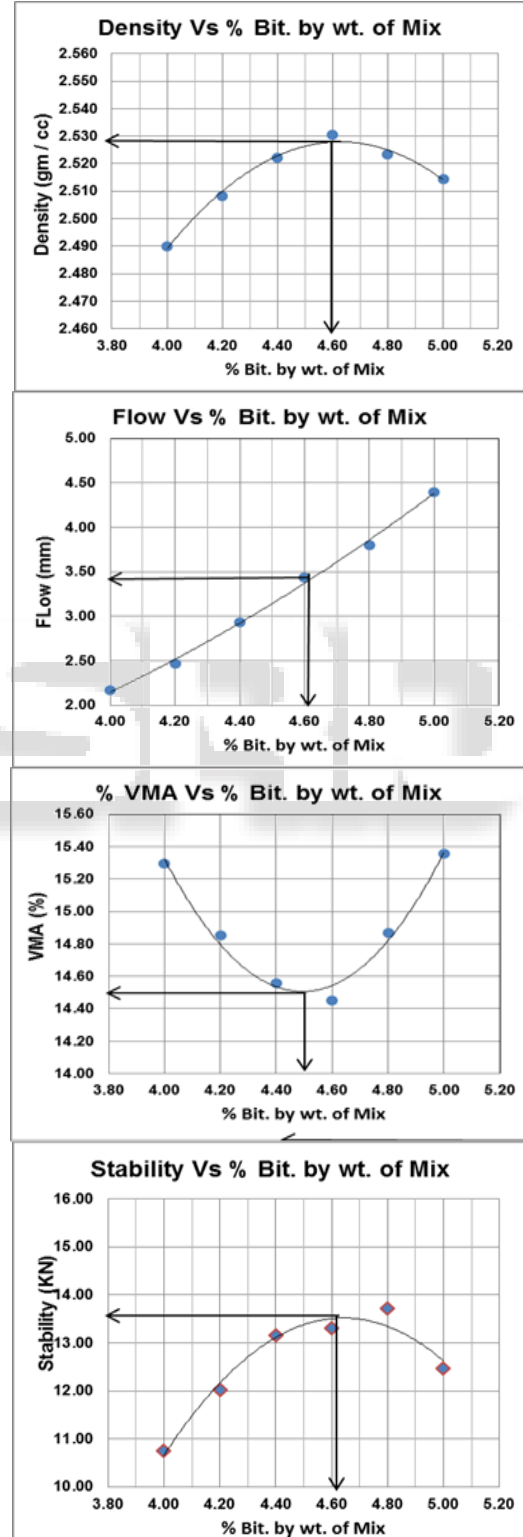
### III. MARSHALL MIX DESIGN FOR DBM (GRADE-2) WITHOUT FIBRES

Properties of aggregate and VG 30 bitumen is carried out scientifically in the laboratory, also gradation is worked out as per codal provision. Marshall Method as per Asphalt Institute Manual (MS 2, 1997) of mix design was done for this study. The Marshall Test specimens were arranged by including 4.0, 4.2, 4.4, 4.6, 4.8, 5.0 every percent of bitumen by weight of mix. Stability-Flow analysis and Volumetric analysis was carried out and test values obtained are plotted graphically. The OBC is found to be 4.62% by weight of mix. The properties of the Marshall design and limits for DBM grade 2 as per MoRTH specifications are given in Table 3.

% Bit. By Weight of Mix	Bulk Sp. Gr. (G <sub>mb</sub> )	Stability (KN)	Voids in Mineral Aggregate (VMA (%))	Voids Filled with Bitumen (VFB (%))	Flow (mm)	Air Voids (V <sub>A</sub> (%))
4.00	2.490	10.75	15.29	48.84	2.17	7.82
4.20	2.508	12.03	14.85	56.77	2.47	6.42
4.40	2.522	13.16	14.56	63.05	2.93	5.38
4.60	2.531	13.30	14.45	68.22	3.43	4.59

4.80	2.523	13.72	14.87	72.15	3.80	4.14
5.00	2.514	12.46	15.36	74.41	4.40	3.93
Limits(MoRTH Table-500 :11)	.....	Min 9 kN	12-15	65-75	2-4	3-5

Table 3: Summary of VG 30 grade Bituminous Mix Design for DBM Grade 2



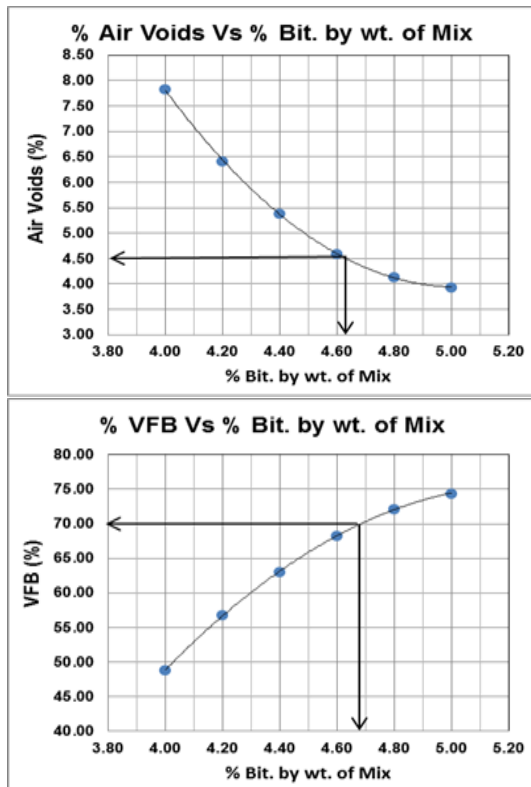


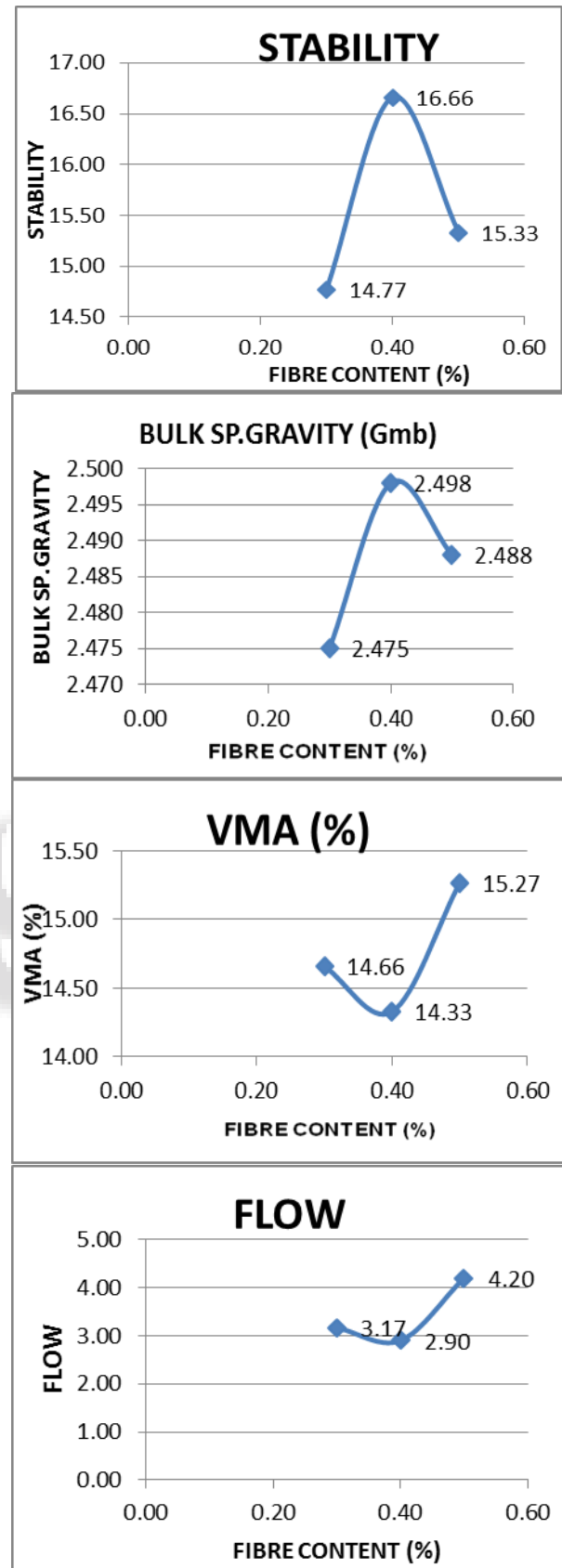
Fig. 2: Marshal graphical plots of Bituminous mix for DBM grade -2 without fibres

#### IV. MARSHALL MIX DESIGN FOR DBM (GRADE-2) WITH GLASS FIBRES:

The volumetric analysis of various parameters in Bituminous mix design at varying bitumen content and doses of fibres were performed to arrive at Glass fibre to binder ratio as the same was adopted for finding out Optimum Binder Content (OBC). Marshall Samples were made using Glass fibres and also calculated for various tests for volumetric analysis.

Bitumen/ Fibre content(% ) by wt. of total mix	Bul k Sp. Gr. (Gm b)	Stabili ty (KN)	Void s in Mine ral Agg. VM A (%)	Voids Filled with Bitu men VFB( %)	Flow (m m)	Air Voi ds VA (%)
4.62	2.52 9	12.88	14.52	67.62	3.4 7	4.7
0.30	2.47 5	14.77	14.66	66.58	3.1 7	4.9 0
0.40	2.49 8	16.66	14.33	68.41	2.9 0	4.5 3
0.50	2.48 8	15.33	15.27	63.49	4.8 0	5.5 7
Limits (MoRTH Table-500 :11)	----	Min 9 kN	12 to 15	65-75	2 to 4	3 to 5

Table 3: Summary of VG 30 grade Bituminous Mix Design with Glass fibres for DBM Grade 2



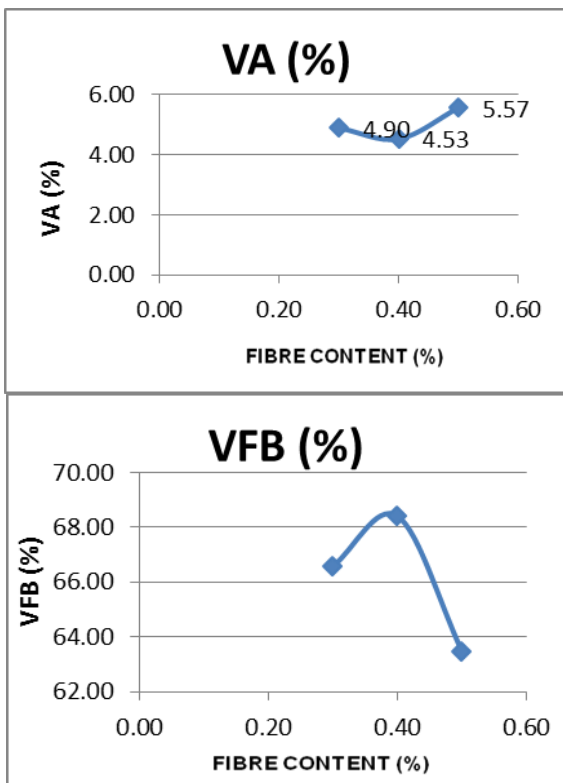


Fig. 3: Marshal graphical plots of Bituminous mix for DBM grade -2 using Glass fibres

#### V. CONCLUSION

It is watched that stability esteem increments with increment binder content up to certain binder content; then stability esteem diminishes. Likewise stability esteem increments with increment fibre content and further expansion of fibre it diminishes. Variety of Marshall Stability esteem with OBC binder content with different dosages fibre is noted. The research facility examinations uncovered that all volumetric properties with 0.4 % of glass fibre adjusted bituminous blend gives most the best values satisfying the criteria's set down in codal arrangement.

#### REFERENCES

- [1] Abdelaziz Mahrez, "Prospect of using glass fiber reinforced bituminous mixes " Journal of the Eastern Asia Society for Transportation Studies, Vol.5, October, 2003
- [2] IS: 1202- 1978, "Methods for testing tar and bituminous materials: determination of specific gravity"
- [3] IS: 1203- 1978, "Methods for testing tar and bituminous materials: determination of penetration "
- [4] IS: 1205- 1978, "Methods for testing tar and bituminous materials: determination softening point".
- [5] IS: 1206- 1978, "Methods for testing tar and bituminous materials: determination of viscosity".
- [6] IS: 2386 (Part 1) - 1963, "Methods of test for Aggregates for concrete: Particle size and shape"
- [7] IS: 2386 (Part 3) - 1963, Methods of test for Aggregates for concrete: specific gravity, density, voids, absorption and bulking.
- [8] IS: 2386 (Part 4) - 1963, Methods of test for Aggregates for concrete: Impact value and Abrasion value.

- [9] IS: 6241- 1974, "Method of test for determination of stripping value of road aggregate".
- [10] Manoj shukla, Dr.Devesh Tiwari and K. Sitaramanjaneyulu, "Performance characteristics of asphalt concrete mix modified with glass fibres" IJPC-International Journal of Pavements Conference, São Paulo, Brazil, 2013
- [11] Ministry of Road Transport and Highways (MoRTH-fifth revision, 2013)