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EFFECT OF FLAKINESS AND ELONGATION INDEX OF AGGREGATES ON BITUMINOUS MIX IN DBM GRADE II

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Abstract : It is well established that aggregate shape characteristics affect bitumen pavement performance. The strength and frictional characteristics of the aggregate structure are controlled by angularity and texture. While aggregate form affects the anisotropic response of Bitumen mixtures, aggregate texture has a significant impact on the adhesive bond between the aggregate and the binder. One important shape criterion that influences how well aggregate performs and behaves in bituminous mixes is the flakiness index. The physical characteristics of aggregates have a significant impact on the strength and serviceability requirements of bituminous mixtures, such as Stability, Flow, and voids in total mix and Voids Filled with Bitumen (VFB). It was discovered that the internal resistance of a bituminous mix correlates well with the change in rotation angle of coarse aggregate. The internal resistance of a mix was also influenced by the particle shape, which also impacted how densely aggregate was packed. For boosting aggregate internal friction and enhancing rutting resistance, cubical particles were preferred. The physical characteristics of bitumen and aggregates were identified in the current investigation. For DBM Grade-II with varying percentages of combined flakiness and elongation, the Marshall characteristics were obtained using the Rothfutch's approach. The study's findings revealed that as the combined Flakiness and Elongation index increases, the strength and stability of bituminous mixes steadily decline. For greater strength, bituminous mixes should not exceed 30% on the Flakiness and Elongation index.

***Index Terms* – VFB, VMA, DBM, Marshall, Rothfutch.**

I. INTRODUCTION

The shape of aggregate particle has a significant influence on the performance of the bituminous pavement. Particle shape can be described as cubical, flat, elongated and round. The presence of flaky aggregates is considered as undesirable in bituminous mixtures because of their tendency to break down during construction and subsequent traffic operations [1]. The voids present in a compacted mix depend on the shape of aggregates. Blade shape aggregates have more voids and reduce the workability. Hence it was felt that the study on the effect of the blade shape aggregates on bituminous mixtures is relevant and essential [3]. This study is carried out on bituminous concrete (B.C) of grade of 20 mm nominal size of aggregate. Flaky aggregates have been added gradually to the test samples from 0 to 10, 20, 30 and 40 %.

II. METHODOLOGY

1) Collection of Material
The required amount of flakey and elongated aggregates are collected so that the dosage of such aggregates are 10, 20, 30 and 40 % of the total mix. The neat bitumen is used for the test.

2) Tests on Aggregates and Bitumen The tests on aggregate, neat bitumen are conducted to determine the physical properties.

3) Proportioning Of Aggregates The proportioning of aggregates are done by using Rothfutch's method to arrive different percentage of aggregates to be added to the mix.

4) Determination of properties of the Mix
Marshall method of mix design is followed in the study. Marshall graphs are plotted to obtain binder content. The OBC obtained is 5.5%

5) Determination of Marshall Stability and Flow
The Marshall moulds prepared with neat bitumen of 5.5% and by using 10, 20, 30 and 40 % of flakey and elongated aggregates. The Marshall graphs are plotted to obtain its properties.

6) Prepare Graphical Plots

Binder content versus corrected Marshall stability , Binder content versus Marshall flow ,Binder content versus percentage of void (Vv) in the total mix , Binder content versus voids filled with bitumen (VFB), Binder content versus unit weight or bulk specific gravity (Gm)

7) Comparison of Marshall Properties The Marshall stability values are compared with 10, 20, 30 and 40 % of flakey and elongated aggregates.

III. RESULTS AND CONCLUSION

1) Test results of Aggregates

Table 1 Test results of Aggregate

Type of Test	Test Result
Specific gravity, 20mm	2.78
12.5mm	2.69
4.75mm	2.4
Impact Test	27 %

2) Test result of Bitumen

Table 2 Test results of Bitumen

Type of Test	Test Result
Specific gravity	1.04
Viscosity test	4.56 mm
Flash and Fire point test	200 ºC
Softening point test	59 ºC

Table 3 Marshall properties of OBC

Bitumen %	4.5	5.0	5.5	6.0
Theoretical Sp. Gravity (Gt)	2.38	2.37	2.36	2.34
Bulk Specific gravity (Gm)	2.26	2.28	2.29	2.26
Air voids (Vv)	4.9	3.79	3.42	3.41
% Volume of Bitumen (Vb)	9.06	10.16	11.07	12.76
VMA	13.96	19.95	14.49	16.17
VFB	64.89	72.83	76.4	79.05

3) Marshall Graphical plots

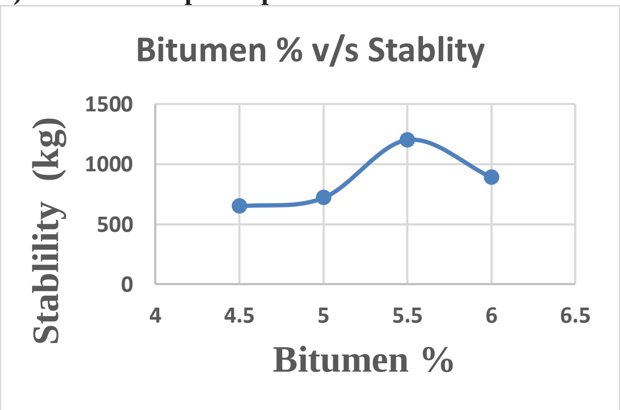

Fig 1 Bitumen Content v/s Stability

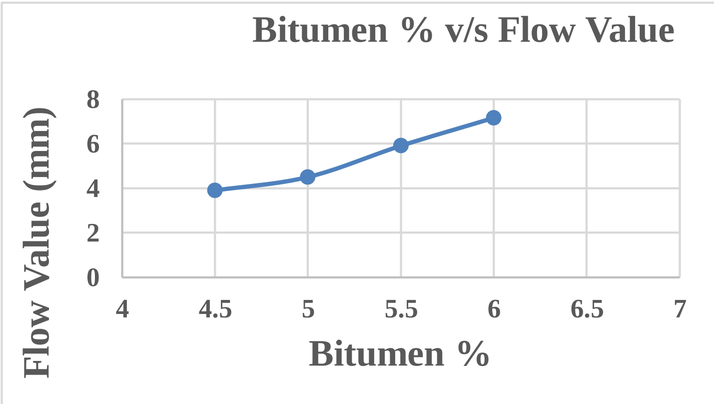

Fig 2 Bitumen Content v/s Flow value

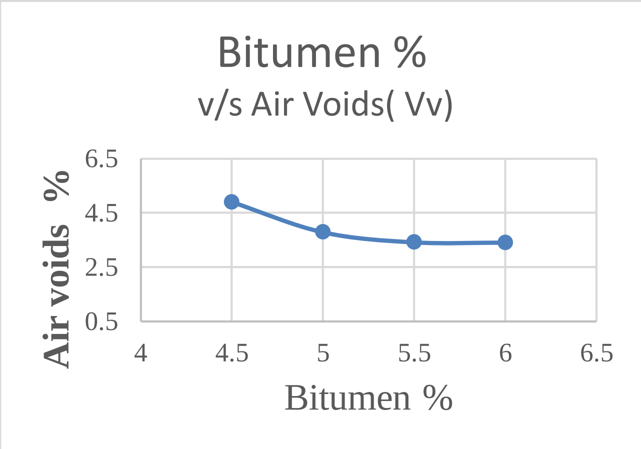

Fig 3 Bitumen Content v/s Air voids

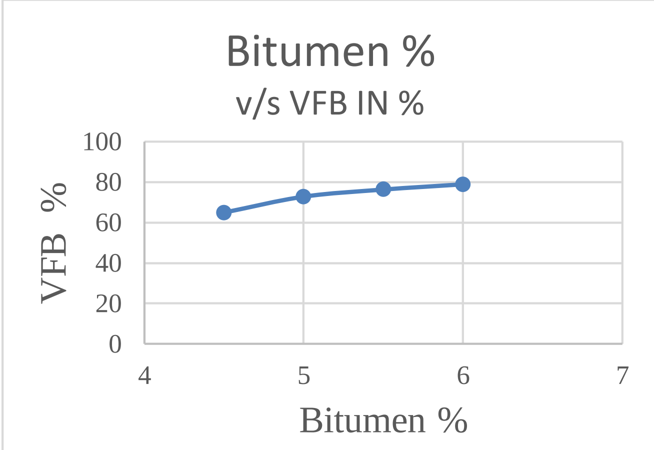

Fig 4 Bitumen Content v/s VFB

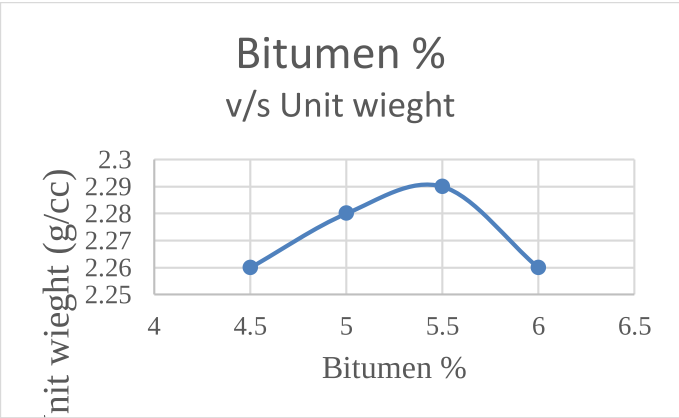

Fig 5 Bitumen Content v/s unit weight

Fig 6 Prepared Marshall moulds

IV CONCLUSION

Based on Laboratory Studies conducted by varying Combined Index of Aggregate on DBM Grade II, the following conclusion may be drawn.

1. From Graphs – 1, 3, & 5 we conclude that upon addition of Bitumen the voids present in the mix decreases.
2. Increase of flakiness and elongation index decreases the stability by 16.10%. From table 14 it yields the result that combine indices of 0, 10 & 20% it satisfies the standard requirement. While 30 and 40 % fails to do so.
3. Flow is gradually decreasing with increase of flakiness and Elongation index in the mix,
From table 14 combined indices of aggregates at 30 and 40% are having the flow value within the standard range, but at 0, 10 and 20% flow value is more than the standard value. This may adversely affect in segregation of Aggregate.
4. Elongated particles caused more instability than that by the flaky particles in terms of Marshall flow.
5. Void filled with bitumen (VFB) is a property that is highly related to VTM. The more void percentage in the Mix decreases the more voids are filled by bitumen. From table 14 the combined indices at 0 and 10% varies with in the range and at 20, 30 and 40% did not fall within the range.
6. Though VMA is an attribute which is related with filler ratio and viscosity of the bitumen but, also it can be influenced by flakiness and Elongation index as well. The values that are obtain from the laboratory test combined indices at 0, 10 and 20% will satisfies the standard values while 30 and 40% is less than the standard values.
7. A flakiness index of higher than 30% is necessary to have a stable bituminous mix.
8. From the results the combined indices of Aggregates at 0, 10, and 20% will satisfies the most of the standard values. Hence it has been concluded that flakiness and Elongation index should be kept below 30 % for a better strength.
9. According to MORTH 4^{th} revision specification section permissible allowance is 30% but in our study we got less than 30%.

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