Comparison between Stability and Flow Value Using Aggregates With Require Gradation and Aggregates Failed In Flakiness and Elongation (40 % Flaky Particles)

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Abstract: ***This study has been undertaken to investigate the determination of Comparison between stability and flow value using Marshall Mix design method with required gradation and the aggregates which are failed in specify gradation range. This study has been carried out in DBM layer. Dense Bituminous Macadam (DBM) is a binder course / base course and profile corrective course of pavement subjected to moderate traffic loads. That will gives long lasting performance as part of pavement structure. The work shall consist of construction in single or multilayers of DBM on a previously prepared base or sub-base. The thickness of the single layer shall be 50mm to 100mm. looking to the past records there is not much work carried out on use of Flaky and Elongated aggregates in the Hot Mix. This report will enhance the research in saving of natural resources by using the discarded aggregates which are not confirming to the shape requirement. The grading of aggregates used to prepare the DBM mix should fall within the limits specified in MORTH. The present study is taken to evaluate the marshal properties of DBM mix prepared using the aggregate having different grading within the grading limits specified by MORTH. and comparison between gradations performing with range of MORTH and aggregates not confirming to the shape criteria of the MORTH. The report also covers the realistic view in respect to Stability, flow value, Voids in Mix (VIM) and Voids filled with bitumen (VFB).***

Index Terms – Bituminous Mix, Marshall mix Design Method, Comparison, Flaky Particles, MORTH

I. INTRODUCTION

Now a day's road transportation plays important role in development of any country. Road transport provides greater utility in transport over short and long distance. Road as one of land transportation infrastructure is very important in supporting the economic for both regional and national development due to this finding the best design of surfacing layer had been a positive competition among manufactures and designers. India has a road network of over 4.69 million kilometers, second large roadways in the world. Highway can be divided into two groups functionally and structurally. Functional classification further classified into five more categories as National Highways, State Highways, Major District Road, Other district roads, Village Road. Based on Structural performance, pavements can be classified into two types – Rigid and Flexible. Flexible pavements are those which are surface with bituminous materials. On the other hand Rigid pavements are composed of pre-stress cement concrete (P.C.C.). Most of the Indian roads are flexible pavements. The particle size distribution, or gradation, of aggregates is most important factor that affects the whole performs of the pavement material. Gradation is one of most influence factors for Marshall Properties of DBM mix, Bituminous concrete as one of road surface material is mainly influenced by the quality of aggregates since aggregate occupies 95% by weight in total mixture.

Flakiness index of an aggregate can be define as a percentage by weight of particle whose least Dimension(Thickness) is less than 0.6 of their Mean dimension. Physical shape of aggregate is a very important property in performance of the bituminous mix in highway pavements.

II. HISTORY

As early as 5000 years ago, bitumen was used by man as a waterproofing and bonding agent, the ancient civilisation in Mesopotamia was familiar with bitumen, which was used for mummification, cementing, building blocks and waterproofing irrigation channels. In Mohenjo-Daro in Indus Valley, a ritual pool waterproofed with a layer of bitumen on the walls has been found. The use of bitumen on roads in recent times picked up in nineteenth century. Natural rock asphalt was initially used, but as petroleum distillation began to grow as an industry to fuel the road vehicles, the residue found equally increasing use in constructing better roads.

III. DIFFERENT FORMS OF BITUMEN

3.1 Cutback bitumen

Normal practice is to heat bitumen to reduce its viscosity. In some situations preference is given to use liquid binders such as cutback bitumen. In cutback bitumen suitable solvent is used to lower the viscosity of the bitumen. From the environmental point of view also cutback bitumen is preferred. The solvent from the bituminous material will evaporate and the bitumen will bind the aggregate. Cutback bitumen is used for cold weather bituminous road construction and maintenance. The distillates used for preparation of cutback bitumen are naphtha, kerosene, diesel oil, and furnace oil. There are different types of cutback bitumen like rapid curing (RC), medium curing (MC), and slow curing (SC). RC is recommended for surface dressing and patchwork. MC is recommended for premix with less quantity of fine aggregates. SC is used for premix with appreciable quantity of fine aggregates.

3.2 Bitumen Emulsion

Bitumen emulsion is a liquid product in which bitumen is suspended in a finely divided condition in an aqueous medium and stabilized by suitable material. Normally cationic type emulsions are used in India. The bitumen content in the emulsion is around 60% and the remaining is water. When the emulsion is applied on the road it breaks down resulting in release of water and the mix starts to set. The time of setting

depends upon the grade of bitumen. The viscosity of bituminous emulsions can be measured as per IS: 8887-1995. Three types of bituminous emulsions are available, which are Rapid setting (RS), Medium setting (MS), and Slow setting (SC). Bitumen emulsions are ideal binders for hill road construction. Where heating of bitumen or aggregates are difficult. Rapid setting emulsions are used for surface dressing work. Medium setting emulsions are preferred for premix jobs and patch repairs work. Slow setting emulsions are preferred in rainy season.

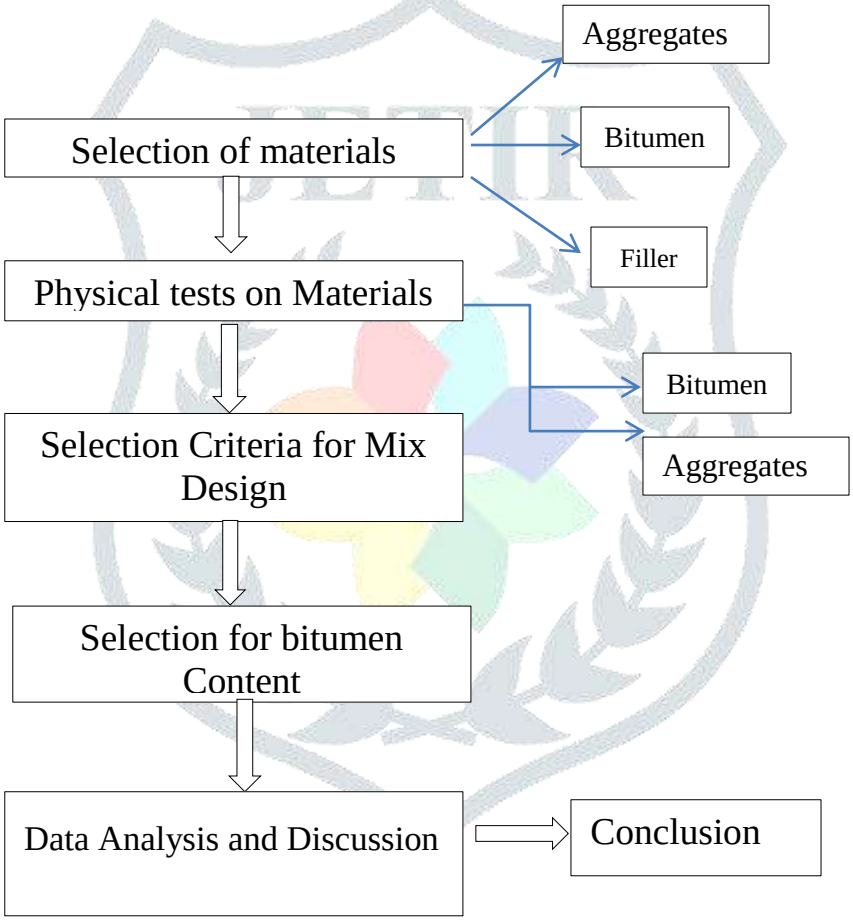
3.3 Bituminous primers

In bituminous primer the distillate is absorbed by the road surface on which it is spread. The absorption therefore depends on the porosity of the surface. Bitumen primers are useful on the stabilized surfaces and water bound macadam base courses. Bituminous primers are generally prepared on road sites by mixing penetration bitumen with petroleum distillate**.**

IV. OBJECTIVES

- To find out physical properties of aggregates.
- To find out physical properties of bitumen.
- To find comparison between gradations performing with range of MoRTH and aggregates not confirming to the shape criteria of the MoRTH & to finalize percentage.
- To use flaky and elongated aggregates by weight of mix.
- Performing mix design of DBM with both aggregates.
- To find out optimum bitumen content.

V. RESEARCH METHODOLOGY



5.1 Selection of Materials

- There are three types of materials that I have to select, and the materials are Aggregates, Bitumen and Filler.
- Aggregates are collect from quarry (RK Quarry, at savali road)
- I will use bitumen of grade VG-30 or VG-40.
- Any filler can use.

5.2 Physical tests of Materials

- To carry out all the physical properties of the materials, (Aggregates, Bitumen, Filler)

5.3 Selection criteria for mix design

- Criteria's are select as MoRTH-5th Revision.

5.4 Selection of Bitumen Content.

- Bitumen Contents are Select between 4.5% to 6% in variation of 0.25, so there are 6 variation I will use for preparation of mould for stability and flow purpose.

5.5 Data analysis and discussion.

5.6 Conclusion

VI. RESULTS AND DISCUSSION

6.1 Results of Physical test of aggregates

Table 6.1: Results of physical tests of Aggregates

Sir no	Tests	Methods	Test Results	Specifications
1	Impact test	IS-2386 (Part-IV)	3.63 %	24 % Max
2	Crushing Test	IS-2386 (Part-4)	8.77 %	30 % Max
3	Flakiness Index	IS-2386 (Part-I-1963)	26 %	35 % Max
4	Elongation Index	IS-2386 (Part-I-1963)	12 %	
5	Abrasion Test	IS-2386 (Part-IV)	18.9 %	30 % Max
6	Specific Gravity	IS-2386 (Part-IV)	2.6	2.5 – 3.0

6.2 Results of Physical test of Bitumen

Table 6.2: Results of physical tests of Bitumen

SR NO	Test	Code	Result	Requirement as per MORTH
1	Penetration	IS- 1203-1978	35.66 mm	35 Min
2	Specific Gravity	IS- 1202-1978	1.028	-
3	Softening Point	IS- 1205-1978	54 degree C	50 Min
4	Ductility	IS- 1208-1978	100 cm	-
5	Flash Point	IS- 1209-1978	274 degree C	220 Min
6	Absolute Viscosity	IS- 1206 Part 2-1978	3274.6	3200-4800
7	Kinematic Viscosity	IS- 1206 Part 3 - 1978	424.84	400 Min

6.3 Result of Marshall Test on bituminous Concrete Using VG-40 Bitumen

Table 6.3: Results of Marshall (Regular)

% Bitumen	Avg Stability (kg)	AVG Flow (mm)	CDM	SGMA	SGM	CDMA	VIM%	VMA%	VFB%
4.25	834	5.60	2.34	2.62	2.46	2.23	4.09%	14.50%	65.10%
4.5	1944	7.10	2.39	2.63	2.47	2.29	3.04%	12.93%	76.46%
4.75	508	8.70	2.35	2.62	2.44	2.24	3.68%	14.50%	74.56%

6.4 Result of Marshall Test on bituminous Concrete Using VG-40 Bitumen (40 % Flaky)

Table 6.4: Results of Marshall (40 % Flaky)

% Bitumen	Avg Stability (kg)	AVG Flow (mm)	CDM	SGMA	SGM	CDMA	VIM%	VMA%	VFB%
4.25 (40%)	1715	5.40	2.37	2.63	2.47	2.27	4.18	13.53	69.16
4.5 (40%)	860	9.60	2.38	2.63	2.46	2.28	3.42	13.42	73.93
4.75 (40%)	716	4.90	2.37	2.63	2.45	2.26	3.30	13.75	76.00

6.7 Graphical Representation of Marshall (Regular)

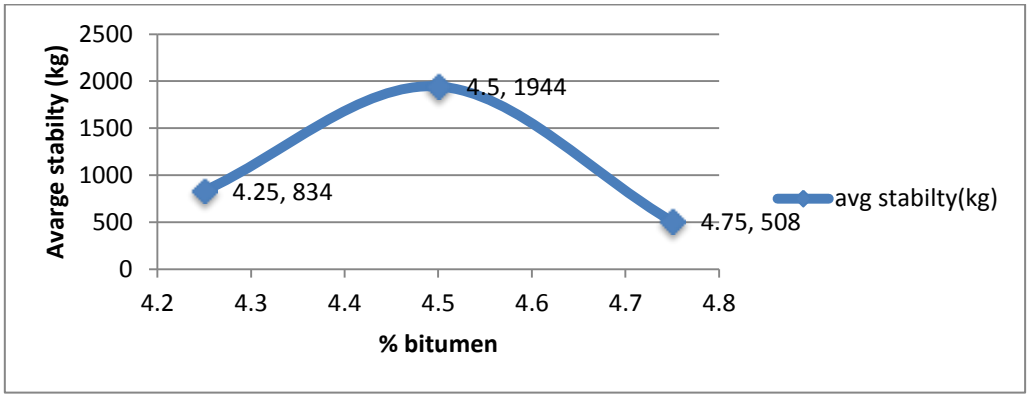


Fig 6.1 % Bitumen V/S Stability

- As shown in a graph Stability increase at 4.5 bitumen content and decrees at 4.25 and 4.75 bitumen content.
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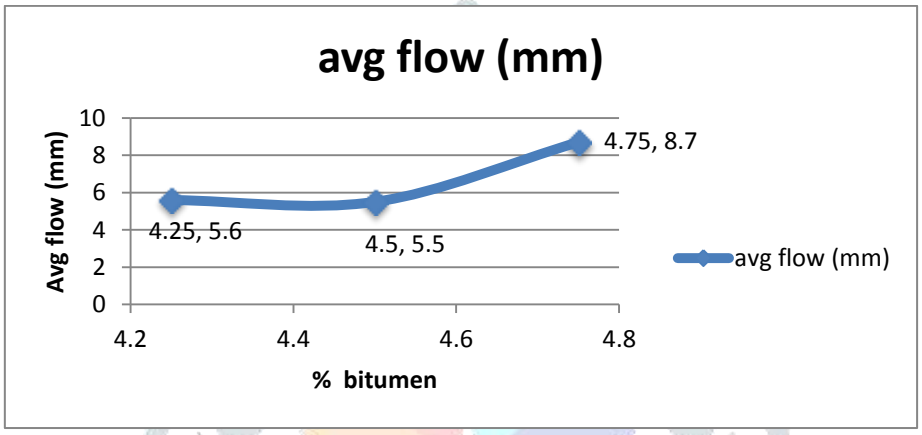

Fig 6.2 % Bitumen V/S Flow

- Here % of Bitumen Content & Flow Value is shown in figure , as per the graph flow value increase with increase in Bitumen %

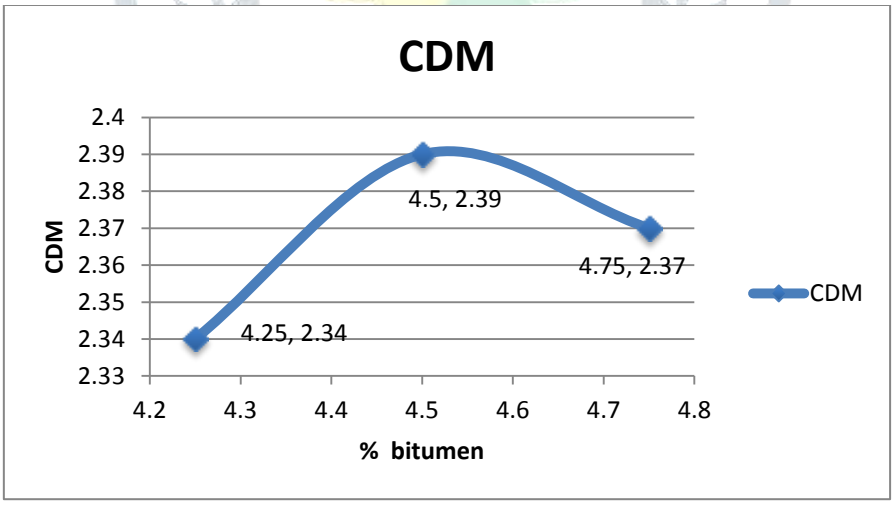

Fig 6.3 % Bitumen V/S CDM

- Here As per the Graph we get maximum CDM for 4.5 % Bitumen Content.

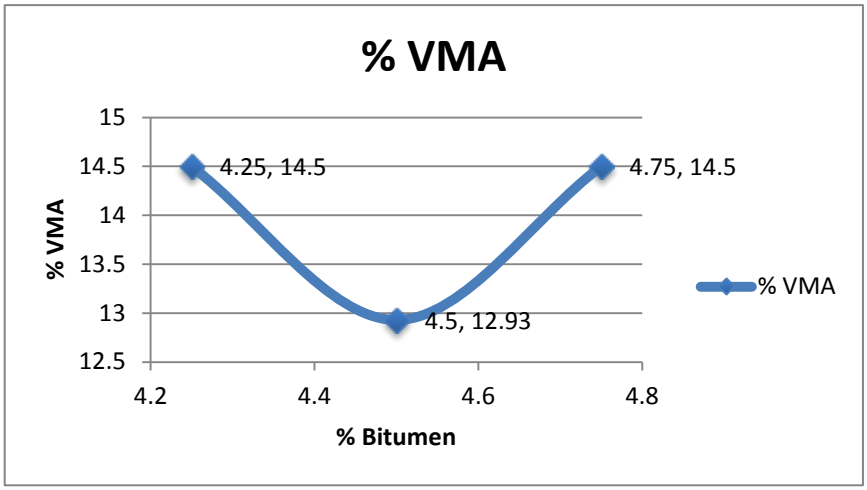

Fig 6.4 % Bitumen V/S %VIM

- Voids in bituminous mix decrees at 4.5 % Bitumen Content

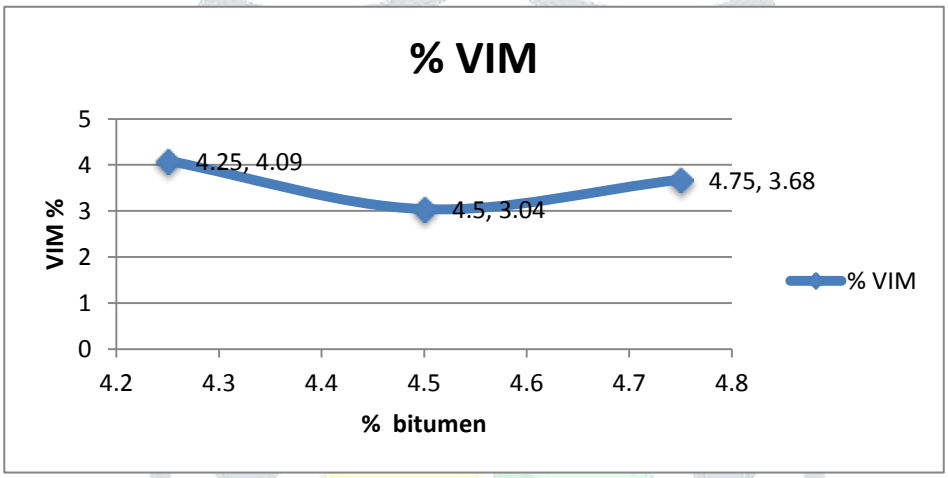

Fig 6.5 % Bitumen V/S %VMA

- VMA is decrees at 4.5 % otherwise its increased
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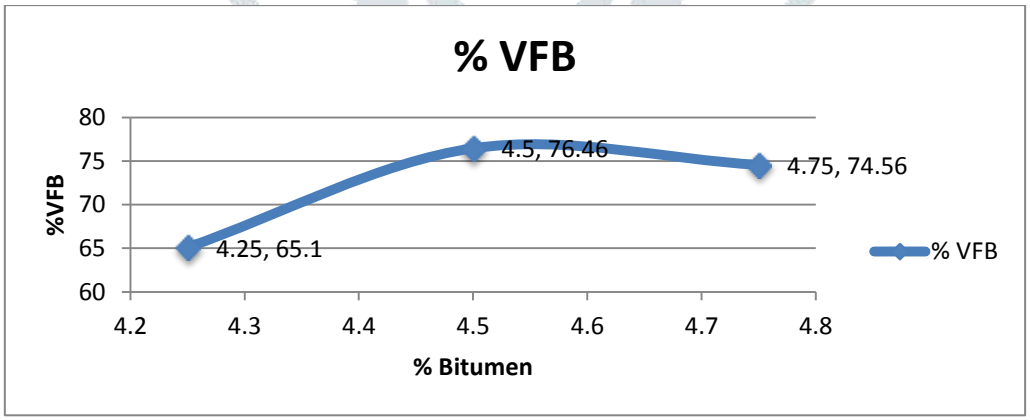

Fig 6.6% Bitumen V/S %VF

- Voids filled with bitumen is Maximum at 4.5 Bitumen %.

6.7 Graphical Representation of Marshall (Flaky 40 %)

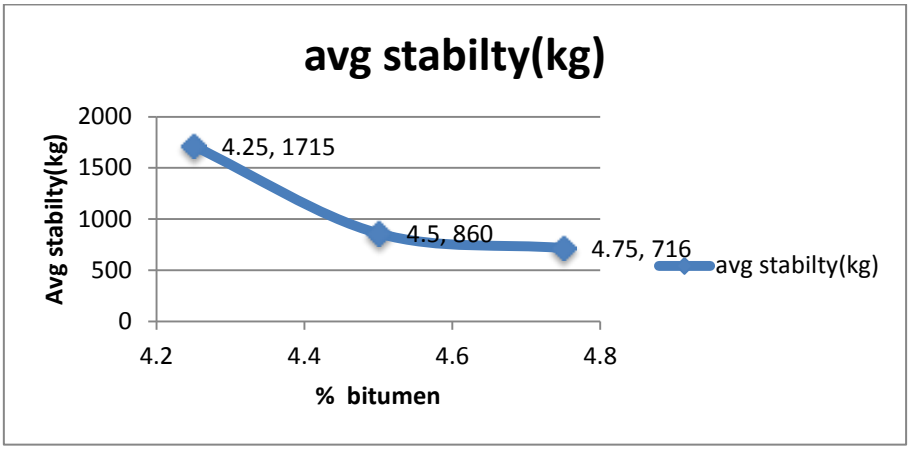

Fig 6.7 % Bitumen V/S Stability

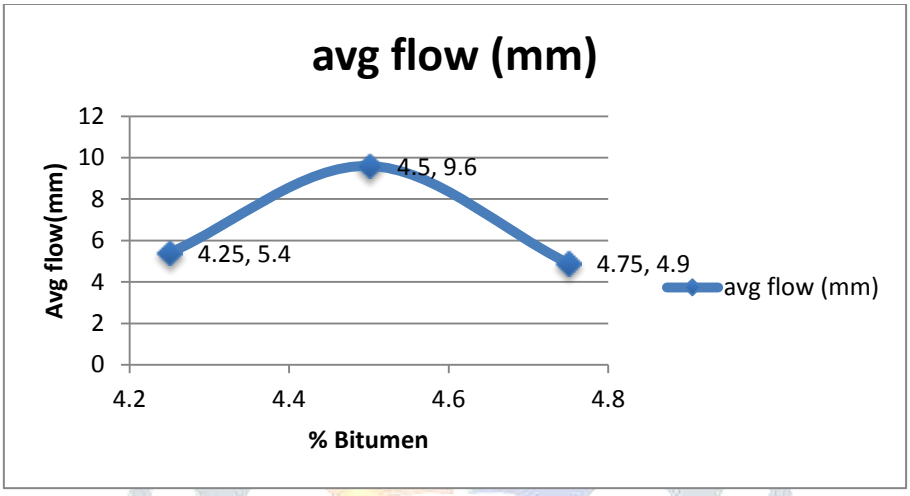

Fig 6.8% Bitumen V/S Flow (mm)

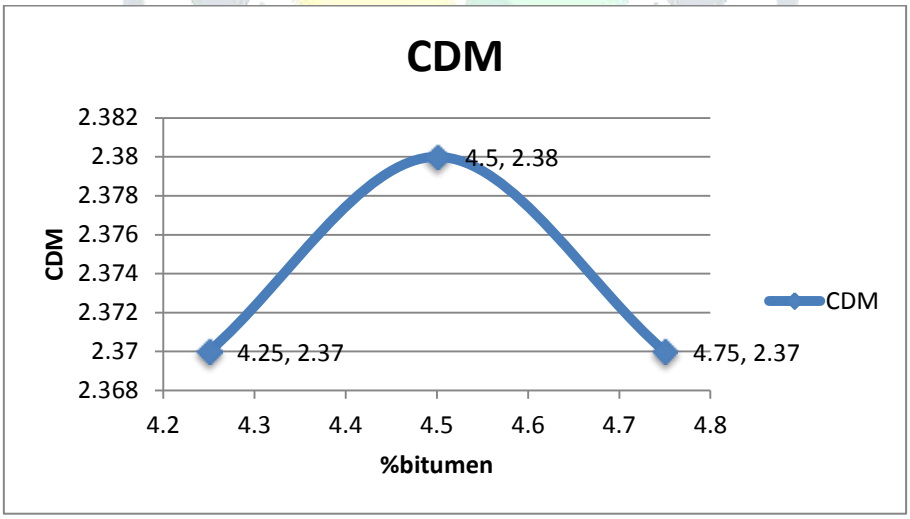

Fig 6.9 % Bitumen V/S CDM

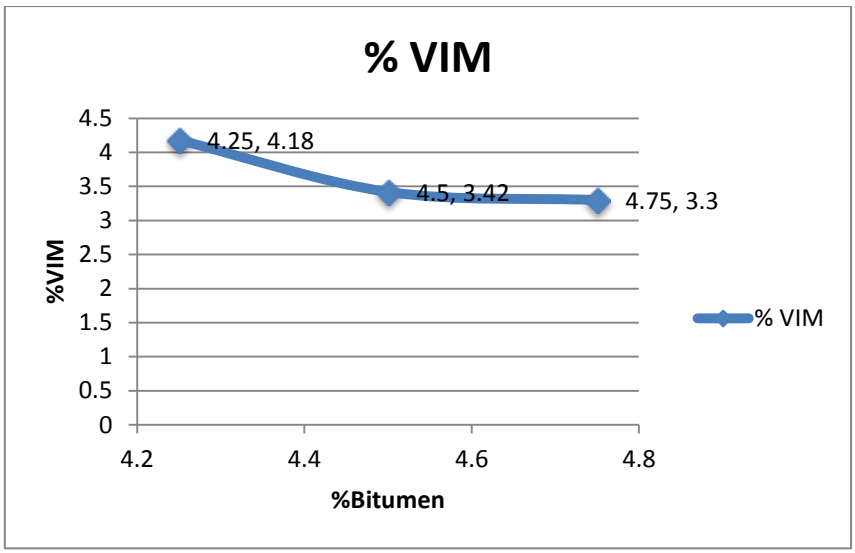

Fig 6.10 % Bitumen V/S %VIM

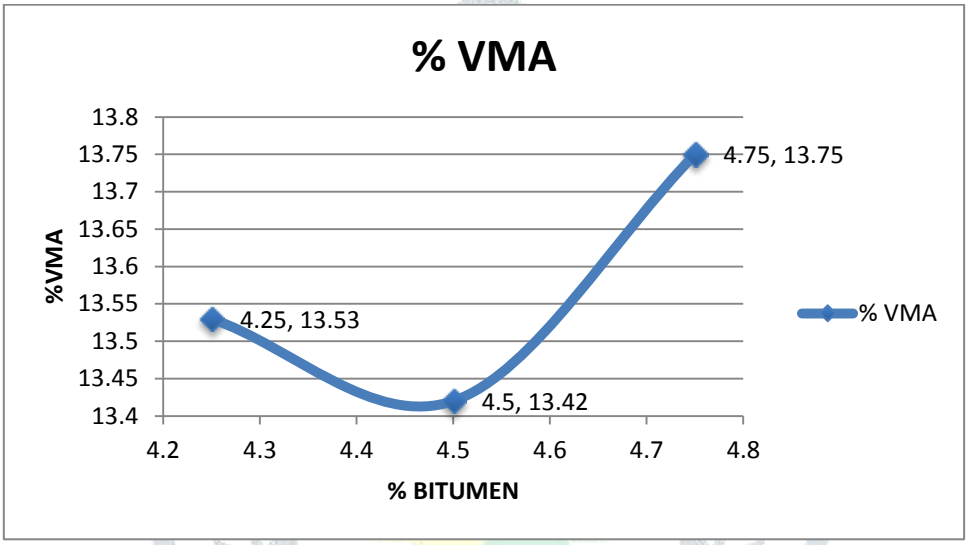

Fig 6.11 % Bitumen V/S %VMA

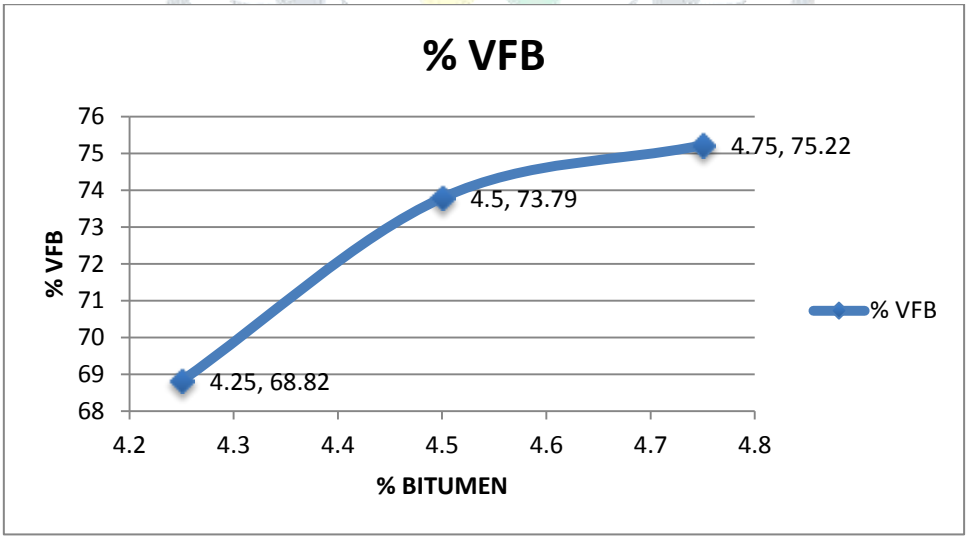

Fig 6.12 % Bitumen V/S % VFB

- According to the above graphs the % VIM Values for bitumen content like 4.25, 4.5 and 4.75 is 4.18, 3.42 and 3.3 respectively, In MORTH the limit varies between 3 to 5 %, so the %VIM Values are satisfactory.
- As the Flaky % VMA values for different bitumen content is 13.53, 13.45 and 13.75 where the limit for the same according to MORTH is 13-14%, so the results are acceptable.
- And the %VFB graphs reading for different bitumen content like 4.25,4.5 and 4.75 is 68.82, 73.79 and 75.22 respectively and the limits for %VFB in MORTH is 65 % to 75%

VI. Conclusion

- The flaky particles are desirable to use; because the (values of mix design) results are desirable and satisfied the criteria's which are given by MORTH.
- As Flaky particles have low impact and crushing values it is recommend to use in Rural Roads and Other PWD Roads except National Highway and State Highway for better Durability.
- By utilising Flaky Particles we can Save Natural Recourses.
- More Economical Compare to regular one.

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