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TO STUDY THE BEHAVIOUR OF ASPHALT CONCRETE PAVEMENT USING STEEL WOOL FIBER

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ABSTRACT: *One of the innovative technique improvement in bitumen concrete pavement is addition of steel fiber (wool). Asphalt concrete is a self-healing concrete. In asphalt concrete, the steel fiber is assembled to make it electrically conductive and applicable for induction heating. The purpose of steel wool fiber added in asphalt concrete for improve its strength and fatigue characteristics during ductility. Cracking is one of the major problem occur on the pavement and it is directly affected to* serviceability, strength, life span, quality of flexible pavement. When small amount of cracks occurs in the asphalt concrete *pavement that time induction generator is used to heat the material to recover the cracks through the high temperature. During the summer season if the temperature is high, then there will be cracks start closing by themselves. It may be also promoted artificially through induction heating or by microwave heating. Performance of asphalt pavement must constantly be repaired to meet the demand of today's transportation. This research use of steel wool fiber add in asphalt concrete to prevent the asphalt damage by the weather and load traffic. This study attempts to know value of characteristics. Three different amounts of fiber were used: 0%, 0.3% & 0.5% by total volume of mixture with 9.5mm length and 8.89 to 12.7mm diameter was studied by conducting marshal stability test. The results show that the use of steel wool fiber will affect characteristics of mixture asphalt concrete. As addition of 0.3% steel wool fiber the stability value increase and further addition of fiber 0.5% stability decrease and flow value increase.*

KEYWORDS: Asphalt concrete, steel wool fiber, Infiltration, induction heating.

1. INTRODUCTION

According to recent researchers, designer and manufacturer are always looking for recent improved and developed way to protect the atmosphere in the most effective ways possible. Due to high population the continuously rapid growth in traffic demand with high strength allowable in the pavement. Three main factors affecting to durability of asphalt concrete mixtures are, (1) water damage (2) Thermal cracking (3) Ageing. The department of Transportation and Highway authorities is to provide economical, durable free from cracks, safe, smooth pavement to the public. Due to the heavy load, cracking occurs on pavement. If the water infiltrate through the cracks may subsequently cause weakening and deterioration of the base and subgrade. Cracking appears at the pavement there is resettlement of pavement damage caused by cracking failure is generally expensive. Therefore, there is need to implement emerging technologies which may enhance the cracking obstruction of asphalt concrete. The steel wool fibers added in asphalt concrete to increasing its strength, particle loss resistance, and fatigue resistance (stress). A mixture of asphalt concrete consisting coarse aggregate, fine aggregate, filler and binder commonly used to surface roads, parking lots, core of embankment dams, airports etc. Healing of asphaltic material is an intrinsic property that has been reported in the late 1960s and was notice to occur at high temperature and with long rest periods between loads. Application of steel wool fiber is improve the strength of the pavement, life period as well as reduce the overall cost of the road construction. Environmental conditions combined with traffic loads contribute to precious deterioration of asphalt concrete pavements, durability of pavement and reducing its strength. Asphalt concrete can restore its stiffness and strength subjected to rest period.

2. OBJECTIVES

- To study introduction and advantages of asphalt concrete using steel wool fiber.

- To study the design mix procedure.
- To study the relevant IS codes related to asphalt concrete mix design.
- To study the behavior of asphalt concrete with the steel wool fiber.
- To design the flexible pavement with sufficient workability.

3. METHODOLOGY

1. Study of IS codes and literature review
2. Selection of Material Selection
3. Identify the characteristics of steel wool suitable which is used in asphalt concrete.
4. Tests on materials

Coarse Aggregates

Coarse aggregates is the portion of concrete which is made up of the concrete will collected from a local source, up to 4.75 mm IS sieve size. Its specific gravity was found as 2.75.

Fine Aggregates

Fine aggregates were collected from a local crusher with passing 4.75 mm and retained on 0.075 mm IS sieve. Its specific gravity was found as 2.6.

Sr. No	Property	Test Method	Test Result
1	Aggregate Impact Value (%)	IS: 2386 (P IV)	14.3
2	Aggregate Crushing Value (%)	IS: 2386 (P IV)	13.02
3	Los Angles Abrasion Value (%)	IS: 2386 (P IV)	18

Table 1: Physical properties of coarse aggregate

Filler

Aggregate which are passing through 0.075 mm IS sieve is called as filler. Here cement is used as filler whose specific gravity is 3.0.

Binder

Here 60/70 penetration grade binder (bitumen) is used as binder for preparation of Mix, whose specific gravity was 1.01. Its important property is given in table.

Sr. No	Property	Test Method	Value
1	Penetration at 25degree C (mm)	IS: 1203-1978	67.7
2	Softening Point (degree C)	IS: 1203-1978	48.5
3	Specific gravity	IS: 1203-1978	1.03

Table 2: Properties of binder

5. Prepare proportion of mix.

- The mix will be prepared according to the Marshall procedure specified in ASTM D1559.

- Here Optimum Binder Content (OBC) is found by Marshall Test, where binder content is very from 0% to 15%.
- The steel wool after being cut in to small pieces is added directly to the aggregate sample in fix proportion.
- The mineral aggregates with wool and binders are heated separately to the prescribed mixing temperature.
- The temperature of the mineral aggregates is maintained at a temperature 10°C higher than the temperature of the binder.
- Required quantity of binder is added to the pre heated aggregate-wool mixture and thorough mixing was done manually till the color and consistency of the mixture appeared to be uniform.
- The mixing time is maintained within 2-5 minutes.
- The mixture is then poured in to pre-heat Marshall Molds and the samples must prepared using a comp active effort of 75 blows on each side.
- The specimens will keep overnight for cooling to room temperature.
- Then the samples be extracted and tested at 60°C according to the standard testing procedure

4. RESULT AND DISCUSSION

Effect of binder on bituminous concrete

1. Marshall Stability

It is observed that stability value increase with increasing binder content up to certain binder Content, then stability value decreases.

Variation of Marshall Stability values with different Binder content.

Table 3: % Bitumen vs. Stability

Sr. no.	% Bitumen replacement	Stability KN
1	4.0	12.96
2	4.5	13.37
3	5.0	14.74
4	5.5	13.01
5	6.0	12.23
6	6.5	11.00
7	7.0	10.56

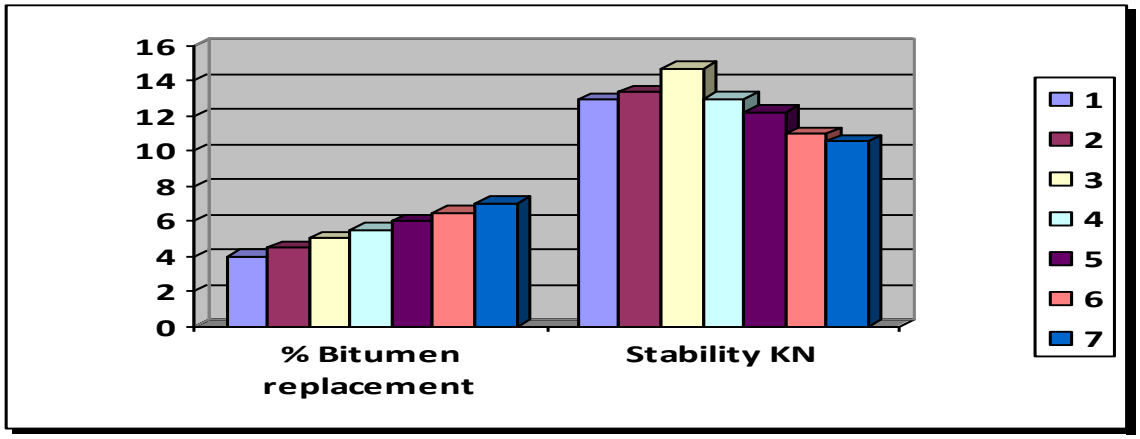

Fig. 1: Graphically fig arrangement of Marshall Stability for % Bitumen replacement

2. Marshall Flow Value

It is observed that binder content increase with increase in flow value. For Bitumen Concrete flow value should be 2 to 4 mm.

Variation of flow value with different binder content of Bitumen Concrete with filler

Sr. no.	% Bitumen replacement	Flow MM
1	4.0	2.0
2	4.5	2.2
3	5.0	2.4
4	5.5	3.6
5	6.0	3.0
6	6.5	3.2
7	7.0	3.7

Table 4: % Bitumen vs. flow mm

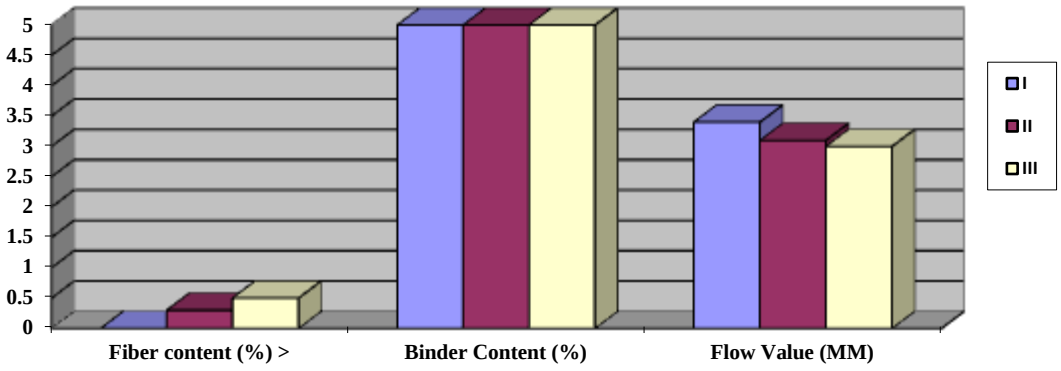

Fig. 2: -graphically arrangement of Maximum Marshall Flow Value and binder content

Effect of fiber on BC

For preparation of mix binder content varies from 4 to 7% and fiber content varies from 0.3% to 0.5%. Here OBC and OFC i.e. Marshall Properties is calculated by Marshall Method.

1. Marshall Stability

It is observed that Stability value increases with increase binder content up to some binder content; then stability value decreases. Also, stability value increases with increase fiber content and further addition of fiber it decreases. Variation of Marshall Stability value with different binder content with different fiber is given: -

Sr. No.	Fiber content (%) >	Binder Content (%)	Max. Stability (KN)
1	0	5	14.38
2	0.3	5	14.55
3	0.5	5	14.01

Table 5: Maximum Marshall Flow value and binder content

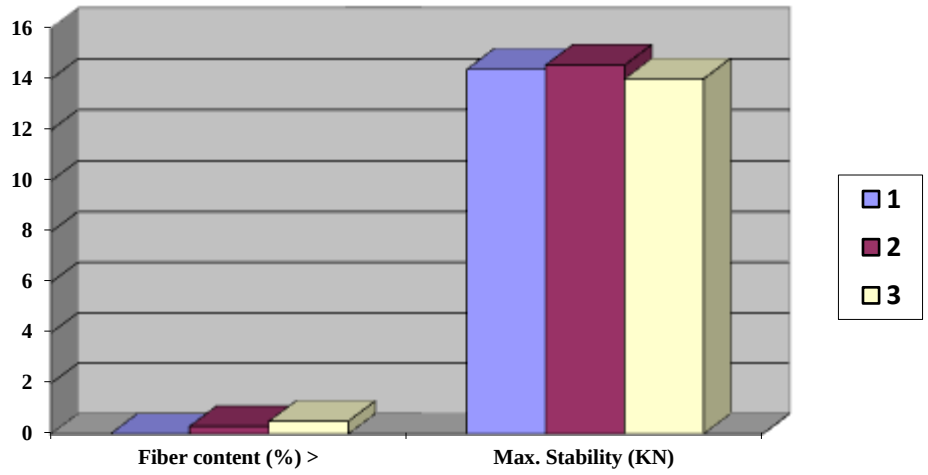

Fig.3: graphically arrangement of Maximum Marshall Stability values and binder content

2. Flow Value

It is observed that binder content increases with increasing flow value. For BC flow value should be 2 to 4 mm. Variation of flow value with different binder content with different fiber content is shown

SR. NO.	Fiber content (%) >	Binder Content (%)	Flow Value (MM)
1	0	5	3.4
2	0.3	5	3.1
3	0.5	5	3.0

Table 1: Maximum Marshall Flow Value and binder content

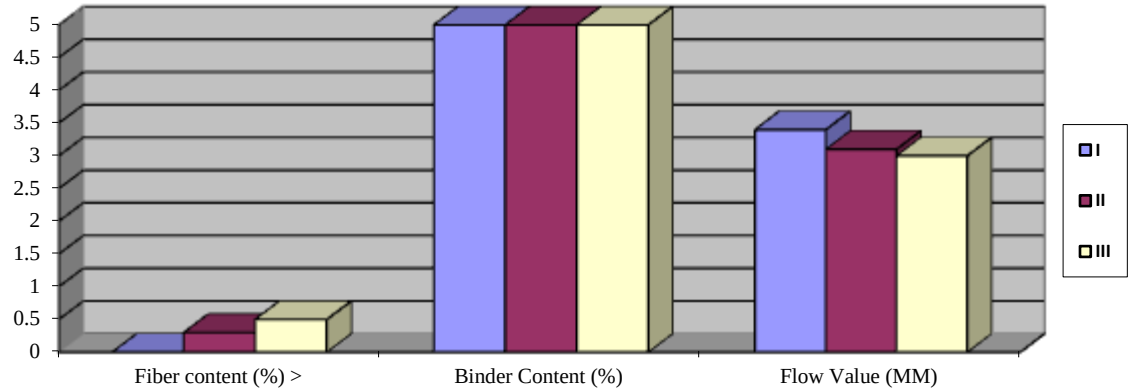

Fig no: - 4.4 graphically arrangement of Maximum Marshall Flow Value and binder content

As addition of 0.3% of fiber the stability value increases and flow value decreases and further addition of fiber 0.5% stability decreases and flow value increases. Hence Here for BC Optimum Binder Content is taken as 5% and Optimum Fiber Content value is taken as 0.3%.

5. CONCLUSIONS

Steel wool fiber effect on the volumetric and mechanical properties of asphalt concrete. Asphalt concrete is answer to many problems faced due to use of self-heating asphalt concrete. During the research it is observed the length of the fiber is change after the compaction of material. Steel wool fiber not improve the abrasion loss tensile strength of asphalt concrete. Added steel wool fiber in asphalt concrete is promote the self -heating concrete.

By the using of steel fibers, the road thickness will be reduce up to 25% to 30% with the increase in the durability of the road pavement, so it can decrease the Overall cost of the pavement construction.

Therefore, in this current study it was found that the long-ridged steel fiber better result in the chosen parameter and an addition of .3% of fiber content will improve the performance of dense Bituminous Macadam.

6. FUTURE SCOPE

1. To design the flexible pavement with Sufficient workability
2. To make bituminous mix economical
3. Enough strength to survive heavy wheel loads and tire pressure
4. Increase durability of pavement

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