Influence of Glass Fiber in Flexible Pavement Concerning Marshal Stability

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Abstract— In recent times; for the purpose of better transportation, better quality and higher ultimate strength of pavement is necessary. In the case of flexible pavement, maintenance cost is considered a greater factor in comparison to the construction cost due to deterioration of pavement. This study stresses on the influence of glass fibre in regards to achieve the desirable properties of bituminous mixes. We also studied the impact of flexible pavement considering the marshal stability using glass fiber.. For the flexible pavement, optimum glass fibre content of 3%, 5% and 7% are considered. Glass Fibre is easily available, environmental friendly, economical and easy to use. To obtain the required strength and increase of life span of the pavement, marshal stability is adopted. The outcome of analysis of different parameters like flow value and stability value is considered.

Key words: Glass Fiber, Bituminous Mix, Marshall Stability

I. INTRODUCTION

The pavement structure should be able to provide a surface of desirable riding quality, sufficient skid resistance, favourable light reacting characteristics, and less noise pollution. A pavement structure can be designed either as a flexible pavement or rigid pavement. Importance of flexible pavement in a developing country like India is still intact. The glass fibres are made of various types of glass depending upon the fiberglass use. These glasses all contain silica or silicate, with varying amounts of oxides of calcium, magnesium, and sometimes boron. Glass fibre also called fibreglass. It is material made from extremely fine fibres of glass Fibreglass is a lightweight, extremely strong, and robust material.

II. PROBLEM IN FLEXIBLE PAVEMENT

Out of many disadvantages out there, the foremost one is the life cycle cost which includes maintenance and pavement strengthening cost incurred during the design life of pavement. Flexible pavements have low or negligible flexural strength and are fairly flexible in their structural action under higher volume of traffic and load.

Flexible pavements often have problems of cracking and rutting due to repeated traffic loads, steps should be taken to increase the life of the bituminous pavements. These usually cause rutting, fatigue and also low temperature cracking, service life of the road pavement is going to be decreased. At present, addition of fibre is one of the effective method applied for binder modification. It is believed that the addition of fibre would enhance materials strength and fatigue characteristics.

III. EXPERIMENTAL INVESTIGATION

A. Materials

1) Coarse Aggregate Crushed aggregate confirming to IS: 383-1987 was used. Aggregates of size 20mm, 16mm and 12.5 mm of specific gravity 2.74 and fineness modulus 7.20 were used.
2) Bitumen of grade 80/100 were used. As per IRC: code 37; Penetration value were found out to be in range of 75-80 and Ductility value were in range of 75-82
3) Glass fibre consisting of silica based thin stranded glass extruded in fibres of grid form.

B. Advantages of Glass Fiber

- It can be molded into any shape
- It has mechanical strength that is so strong and stiff for its weight that it can out-perform most of other materials.
- It last a long time, can be colored, shiny or dull.
- Low maintenance, anti-magnetic
- It is fire resistant, good electrical insulator and weatherproof.

IV. SPECIMEN PREPARATION

Approximately 1200gm of aggregates and filler is heated to a temperature of 175−190oC. Bitumen is heated to a temperature of 121 − 125oC with the first trial percentage of bitumen (say 3.5 or 4% by weight of the mineral aggregates). The heated aggregates and bitumen are thoroughly mixed at a temperature of 154 − 160oC. The mix is placed in a preheated mould and compacted by a rammer with 50 blows on either side at temperature of 138oC to 149oC. The weight of mixed aggregates taken for the preparation of the specimen may be suitably altered to obtain a compacted thickness of 63.5+/-3 mm. Vary the bitumen content in the next trial by +0.5% and repeat the above procedure. Number of trials are predetermined.

V. DETERMINE MARSHALL STABILITY AND FLOW

Marshall stability of a test specimen is the maximum load required to produce failure when the specimen is preheated to a prescribed temperature placed in a special test head and the load is applied at a constant strain (5 cm per minute). While the stability test is in progress dial gauge is used to measure the vertical deformation of the specimen. The deformation at the failure point expressed in units of 0.25 mm is called the Marshall flow value of the specimen.

VI. MARSHAL STABILITY TEST

	Weight	Weight in water	stability	Flow
FOR 1% Binder modifier (glass fibre)	1236	722	1993	3.80
FOR 3% Binder modifier (glass fibre)	1260	723	2011	4.16
FOR 5% Binder modifier (glass fibre)	1284	725	2003	3.96

Table 1:

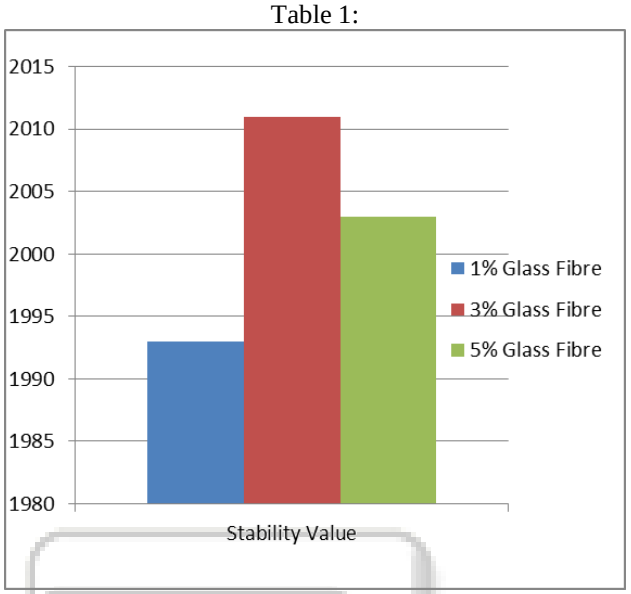

Fig. 1: Stability Value

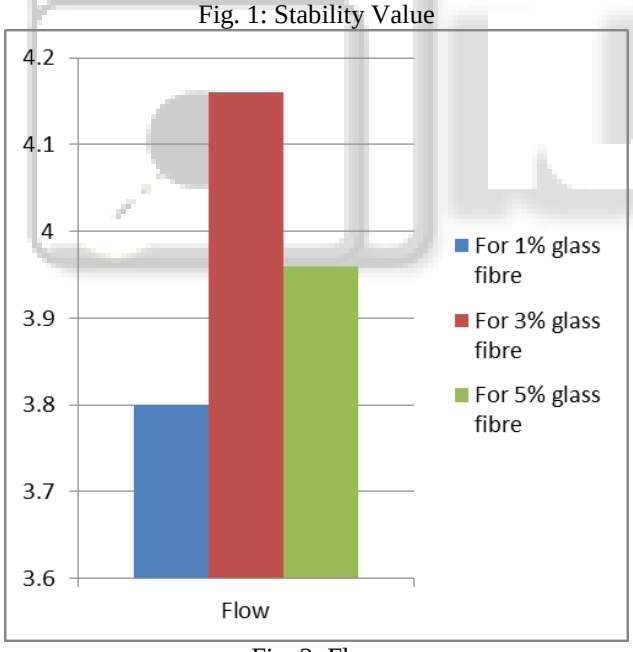

Fig. 2: Flow

VII. CONCLUSIONS

The stability and flow values were obtained which indicate the actual vertical deformation when maximum load is reached.

The stability value was found out to be highest at 3% addition of glass fibre at 2011 while it was lowest at 1% at 1993.

As bituminous pavement is subjected to severe traffic loads from time to time, it is necessary to adopt bituminous material with good stability and flow. Also best result were obtained when the fibre addition was at 3%.

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REFERENCES

[1] Bradley J. Putman, "Effects of Fiber Finish on the Performance of Asphalt Binders and Mastics," Advances in Civil Engineering, vol. 2011, Article ID 172634, 11 pages, 2011. doi:10.1155/2011/172634
[2] MAHREZ Abdelaziz, Mohamed Rehan KARIM, and Herda Yati Katman. 'Fatigue And Deformation Properties Of Glass Fiber Reinforced Bituminous Mixes'. Journal of the Eastern Asia Society for Transportation Studies Vol.6 (2005): pp. 997 – 1007
[3] Supriya, C. B., B. H. Manjunath, and S. V. Dinesh. "Influence Of The Fiber On Improving Mechanical Properties Of Bituminous Mixes.
[4] Moghaddam, Taher Baghaee, Mohamed Rehan Karim, and Mahrez Abdelaziz. "A review on fatigue and rutting performance of asphalt mixes." Scientific Research and Essays 6.4 (2011): 670-682.
[5] Bradley J. Putman (2011). "Effects of Fiber Finish on the Performance of Asphalt Binders and Mastics". Hindawi Publishing Corporation Advances in Civil Engineering, Volume 2011, Article ID 172634
[6] SadyAbdTaih (2011). "The Effect of Additives in Hot Asphalt Mixtures", Journal of Engineering andDevelopment, Vol.15:131-150
[7] Kaloush, Zeiada, Biligiri, Rodezno and Reed (2009). "Evaluation of Fiber-Reinforced Asphalt Mixturesusing Advanced Material Characterization Tests"
[8] Qunshan Ye and Shaopeng Wu (2009). "Rheological Properties of Fiber Reinforced Asphalt Binders", Indian Journal of Engineering and Materials Sciences, Vol.16:93-99
[9] Saeed Ghaffarpour Jahromi and Ali Khodaii (2008). "Carbon Fiber Reinforced Asphalt Concrete", The Arabian Journal for Science and Engineering, Vol.33:357-364
[10] Wu Shaopeng, YE Qunshan, Li Ning and YUE Hongbo (2007). "Effects of Fibers on Dynamic Propertiesof Asphalt Mixtures", Journal of Wuhan University of Technology-Mater, Vol.22:733-736
[11] Abdelaziz Mahrez, Herda Yati Bt Katman and Mohamed Rehan Karim (2005). "Fatigue and Deformation Properties of Glass Fiber Reinforced Bituminous Mixes", Journal of the Estern Asia Society for Transportation Studies, Vol.6:997-1007
[12] Hugo M.R.D Silva, "Study on the Use of Bituminous Mixtures Modified with Acrylic Fibers in Road Pavement Overlays", Case Study.

