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An Experimental Study of Bituminous Mixes using a Natural Fibre

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ABSTRACT

A bituminous mixture typically consists of filler, binder, coarse and fine aggregates. When creating a hot mix asphalt, all of the ingredients are combined, spread out, and compacted at a high temperature. HMA can be either gap graded or dense graded mixes (DGM), also known as bituminous concrete (BC) or stone matrix asphalt (SMA). To stop the mix from draining down, SMA requires stabilising additives made of cellulose fibres, mineral fibres, or polymers. In the current study, an effort has been made to examine the impacts of using SISAL fibre, a locally and naturally occurring fibre that is employed as an additive in BC and as a stabiliser in SMA. In order to prepare the mixes, aggregate gradation was taken in accordance with MORTH specifications, binder concentration was routinely varied between 4% and 7%, and fibre content was varied between 0% and a maximum of 0.5% of the overall mix. Fly ash was employed for mixes in later operations after preliminary research revealed that it had satisfactory Marshall Properties.

KEYWORDS: *bituminous, mixture, aggregate, gradation, employed, fibres*

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INTRODUCTION

Construction of highway involves huge outlay of investment. A precise engineering design may save considerable investment as well a reliable performance of the in-service highway can be achieved. Two things are of major considerations in flexible pavement engineering–pavement design and the mix design. The present study is related to the mix design considerations.

A good design of bituminous mix is expected to result in a mix which is adequately

(i) strong (ii) durable (iii) resistive to fatigue and permanent deformation (iv) environment friendly (v) economical and so on. A mix designer tries to achieve these requirements through a number of tests on the mix with varied proportions and finalizes with the best one. The present research work tries to identify some of the issues involved in this *art* of bituminous mix design and the direction of current research.

LITERATURE SURVEY

Bitumen acts as a binding agent to the aggregates, fines and stabilizers in bituminous mixtures. Binder provides durability to the mix. The characteristics of bitumen which affects the bituminous mixture behaviour are temperature susceptibility, visco-elasticity and aging. The behaviour of bitumen depends on temperature as well as on the time of loading. It is stiffer at lower temperature and under shorter loading period. Bitumen must be treated as a visco-elastic material as it exhibits both viscous as well as elastic properties at the normal pavement temperature. Though at low temperature it behaves like an elastic material and at high temperatures its behaviour is like a viscous fluid. Bitumen along with different additives (fifers, polymers etc.) are act as a stabilizer for bituminous Mix. Polymer modified bitumen can also be used as a stabilizer with or without additives in the mixture. Different types of bitumen have been used by various researchers to the mixture properties. Penetration grade bitumen such as 60/70, modified bitumen such as CRMB, PMB and Superpave performance grade bitumen are used to evaluate SMA mixtures.

Brown and Mallick (1994) used viscosity grade binder AC-20 for their research on SMA properties related to mixture design. Mogawer and Stuart (1996)

also used AC-20 binder. Putman et al. (2004) used a performance grade binder PG 76-22 to study the SMA properties.

They observed that polymer modified bitumen gives better performance (in terms of deformation) than unmodified bitumen.

Sharma et al. (2004) used natural rubber powder to modify 80/100 penetration grade bitumen. They termed it as Natural Rubber Modified Bitumen (NRMB). Kamaraj et al.(2006) used 60/70 grade bitumen and SBS modified bitumen (PMB-40) in SMA for their investigation. Chiu and Lu (2007) investigated the feasibility of using Asphalt Rubber (AR) as a binder for SMA. They produced this AR by blending ground tire rubber (GTR) with AC-20 asphalt. They termed it as AR-SMA. The performance of AR-SMA was evaluated in terms of moisturesusceptibility. It was found that the AR-SMA mixtures were not significantly different from the conventional SMA mixtures in terms of moisture susceptibility. It was also observed that no fibre was needed to prevent drain down when this AR is used in the mix.

It has been reported by Reddy et al. (2006) that the fatigue life, temperature susceptibilityand resistance to moisture damage characteristics of the bituminous mixes can be improved by the use of CRMB as compared to other unmodified bitumen.

METHODOLOGY

MATERIAL & SPECIFICATIONS

Aggregates

For preparation of Bituminous mixes (BC, SMA) aggregates as per MORTH grading as given in Table 3.1 and Table 3.2 respectively, a particular type of binder and fibre in required quantities were mixes as per Marshall Procedure.

Table 1 Adopted aggregate Gradation for BC (MORTH)

Sieve size (mm)	Percentage passing
26.5	100
19	95
9.5	70
4.75	50
2.36	35
0.30	12
0.075	5

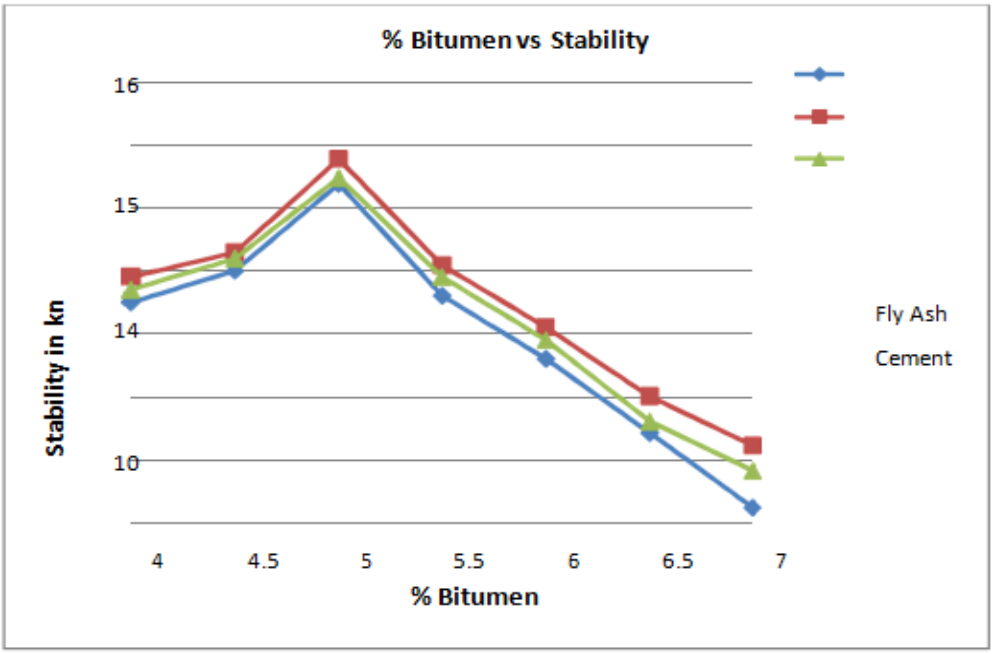

Fig 1 Variation of Marshall Stability of BC with different binder

Table 2. Maximum Marshall Stability values and their corresponding binder content

BC with filler type	Max. Stability (KN)	Corresponding Binder Content (%)
Cement	14.78	5
Stone dust	14.48	5
Fly ash	14.38	5

CONCLUSION

1. Here OBC is 5%, OFC is found as 0.3%
2. By addition of fibre up to 0.3% Marshall Stability value increases and further addition of fibre it decreases. But addition of fibre stability value not increased as high as SMA.
3. By addition of fibre flow value also decreases as compare to mix without fibre, but addition of 0.5% fibre again flow value increases.

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