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USE OF GLASS FIBRE IN BITUMINOUS MIXES

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ABSTRACT: Mixture of coarse aggregate, fine aggregate, binder and filler forms a bituminous mixture. A bituminous mixture where all ingredients are mixed, placed and compacted at high temperature is Hot Mix Asphalt. Hot mix Asphalt can be in the form of Dense Graded mixes (DGM) known as Bituminous Concrete (BC) or in the form of gap graded mixes known as Stone Matrix Asphalt (SMA). For the stabilization of Stone Matrix Asphalt additives composed of mineral fibres, cellulose fibers or polymers are required to prevent drain down of the mix. The present study aims to study the effects of use of a naturally and locally available fibre called Glass fibre. Glass fibre is used as stabilizer in Stone Matrix Asphalt as an additive in Bituminous Concrete. Mixes were prepared by grading the aggregates as per Ministry of Road Transport And Highways (MORTH) specification, varying binder content regularly from 4% to 6% and varying fibre content from 0%, 0.3% and 0.6% of total mix. Using Marshall Method tests were conducted and based on results Marshall Graphs were plotted. It was observed that Optimum binder content for both the mixes (Bituminous Concrete and Stone Matrix Asphalt) was 5.5%. Also it was concluded that Optimum fibre content for both the mixes was 0.3%. Then the Bituminous Concrete and Stone Matrix Asphalt mixes prepared at Optimum binder content and Optimum Fibre Content are subjected to different performance tests like Drain Down test, to evaluate the effects of fibre addition on mix performance. It was observed that by the addition of the Glass Fibre the drain down characteristics of mixtures decreases, Drain Down value of Stone Matrix Asphalt is reduced to 0.025% and there is negligible drain down of binder of Bituminous Concrete. It is observed that Stone Matrix Asphalt is better than Bituminous Concrete in respect of creep characteristics.

KEYWORDS: Glass fibre, Stone Matrix Asphalt, Bituminous Concrete, Marshall Test, Stability, Air voids, Voids in mineral aggregates.

I. INTRODUCTION

For the construction of highway a huge outlay of Investment is involved. A good amount of investment can be saved by precise designing. Precise designing not only helps is saving of investment but also improves the performance of pavement. Engineering–pavement design and the mix design are two things of major considerations in flexible pavement. Mineral fillers on adding to asphalt mixtures serve dual purpose. Asphalt cement binder mixes with mineral filler (finer than thickness of asphalt film) forms mortar that leads to improved stiffening of the mix. A Mix design consideration is the main emphasis of the present study. A good design of bituminous mix is expected to result in a mix which is adequately (i) durable (ii) strong (iii) environment friendly (iv) resistive to fatigue and permanent deformation (v) economical and so on. Numbers of tests are conducted to achieve these requirements. After conducting number of tests the best one is selected.

II. INGREDIENTS

A bituminous mixture is generally composed of aggregate and bitumen. According to the size of the particles, the aggregates are generally divided into coarse aggregates, fine aggregates and filler fractions. The following sections covers the description of the coarse aggregate, fine aggregate, bitumen, mineral fillers and fibres used in the study.

III. MIXING OF MATERIALS

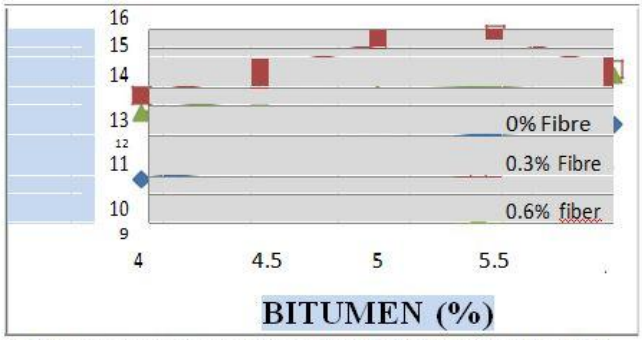
For both Bituminous Concrete and Stone Matrix Asphalt the coarse aggregates, fine aggregates and filler were mixed according to the gradation as given in Table 1 and 2 respectively. For both Bituminous Concrete and Stone Matrix Asphalt Optimum Binder Content (OBC) and Optimum fibre Content (OFC) was found by Marshall Method where binder content is varied from 4% to 6% and fibre content is 0.3% and 0.6%. The glass fibres were cut in to Stone Matrix Asphalt pieces and were then added directly to the aggregate sample in different proportions. To the prescribed mixing temperature the mineral aggregates with fibres and binders were heated separately. For mineral aggregates temperature was maintained at a temperature 10°C higher than the temperature of the binder. To the pre heated aggregate-fibre mixture required quantity of binder was added and thorough mixing was done manually till the colour and consistency of the blend appeared to be uniform. The mixing time was within 2-5 minutes. After that the mixture was poured in to pre-heat Marshall Moulds and using a compactive effort of 75 blows on each side the samples were prepared. For cooling the specimens were kept overnight to room temperature. At 60°C the samples were extracted and tested according to the standard testing procedure.

IV. LABORATORY TESTS OF INGREDIENTS

- MARSHALL TEST
- DRAIN DOWN TEST
- IN DIRECT TENSILE STRENGTH TEST
- STATIC INDIRECT TENSILE TEST (Marshall Apparatus)

Table shows Marshall Properties of SMA Specimens without Fibers

Bitumen Content (%)	stability (kN)	low Value (mm)	Unit weight (gm/cc)	Air Void VTA (%)	Voids in mineral aggregates VMA (%)	Voids Filled with Bitumen VFB(%)
4.0	0.6	2.4	.44	.5	16.4	2
5.0	1.7	.9	.49	.5	16.1	3
6.0	2.5	.6	.46	.0	17.2	2



(The Graph shows variation of Marshall Stability Value with Glass fibre)

V. LITERATURE REVIEW

Pavement consists of more than one layer of different material supported by a layer called sub grade. Generally pavement is two type flexible pavement and Rigid pavement. Flexible pavements are so named because the total pavement structure deflects, or flexes, under loading. A flexible pavement structure is typically composed of several layers of material. Each layer receives the loads from the above layer, spreads them out then passes on these loads to the next layer below. Typical flexible pavement structure consisting of: Surface course. This is the top layer and the layer that comes in contact with traffic. It may be composed of one or several different HMA sub layers. HMA is a mixture of coarse and fine aggregates and asphalt binder Base course. This is the layer directly below the HMA layer and generally consists of aggregate (either stabilized or un-stabilized). Sub-base course. This is the layer (or layers) under the base layer. A sub-base is not always needed.

VI. CONCLUSIONS

Here two type of mix i.e. SMA(Stone Matrix Asphalt) And BC(Bituminious Concrete) is prepared where 60/70 penetration grade bitumen is used as binder. Also a naturally available fibre called GLASS fibre is used with varying concentration (0, 0.3% and 0.6%). OBC and OFC is found out by Marshall Method of mix design. Generally by adding 0.3% of fibre properties of Mix is improved. From different test like Drain down test, it is concluded that SMA with using GLASS fibre gives very good result and can be used in flexible pavement.

Bituminous concrete and Stone Matrix Asphalt with Different Fibre Content

- Here Optimum Binder Content and optimum fibre content is found 5.5% and 0.3% respectively
- By addition of fibre up to 0.3% Marshall Stability value increases and with further addition of fibre it decreases. But addition of fibre stability value not increased as high as Stone Matrix Asphalt.
- By addition of fibre unit weight increases but as in case of Stone Matrix Asphalt unit weight decreases as compare to mix without fibre, but addition of 0.6% fibre in bituminous concrete unit weight decreases and in case Stone Matrix Asphalt it remains same as 0.3% of fibre value.
- By addition of fibre in bituminous concrete and Stone Matrix Asphalt Air Void increases as compare to mix without fibre, but addition of 0.6% fibre air voids again increases but in case of Stone Matrix Asphalt air voids decreases.
- By addition of fibre Voids in Mineral Asphalt increases in both the mixes as compare to mix without fibre, but addition of 0.6% fibre again Voids in Mineral Asphalt increases but in case of Stone Matrix Asphalt air voids decreases.

VII. FUTURE SCOPE

Many properties of Stone Matrix Asphalt and B.C. mixes like Marshall Properties, drain down characteristics, are studied during this investigation. Solely 60/70 penetration grade bituminous blend and a changed fibre referred to as glass fibre are tried during this investigation. However, a number of the properties like fatigue properties, wet susceptibleness characteristics, resistance to rutting and dynamic creep behavior will additionally be investigated. Artificial and natural fibres and other sort of binder can even be tried in mixes and compared. Glass fibre utilized in this study may be a low price material, thus a analysis will be created to understand its impact on price of construction. Moreover, to confirm the success of this new material, experimental stretches is also created and periodic performances monitored.

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