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Evaluation Of Bituminous Mixes Using Natural Fibre

Natarajan. K (P6815PTN07)

PG Student, Prist University, Thanjavur

Abstract

Generally a bituminous mixture is a mixture of coarse aggregate, fine aggregate, filler and binder. A Hot Mix Asphalt is a bituminous mixture where all constituents are mixed, placed and compacted at high temperature. HMA can be Dense Graded mixes (DGM) known as Bituminous Concrete (BC) or gap graded known as Stone Matrix Asphalt (SMA). SMA requires stabilizing additives composed of cellulose fibbers, mineral fibres or polymers to prevent drain down of the mix.

In the present study, an attempt has been made to study the effects of use of a naturally and locally available fibre called SISAL fibre is used as stabilizer in SMA and as an additive in BC. For preparation of the mixes aggregate gradation has been taken as per MORTH specification, binder content has been varied regularly from 4% to 7% and fibre content varied from 0% to maximum 0.5% of total mix. As a part of preliminary study, fly ash has been found to result satisfactory Marshall Properties and hence has been used for mixes in subsequent works.

Using Marshall Procedure Optimum Fibre Content (OFC) for both BC and SMA mixes was found to be 0.3%. Similarly Optimum Binder Content (OBC) for BC and SMA were found to be 5% and 5.2% respectively. Then the BC and SMA mixes prepared at OBC and OFC are subjected to different performance tests like Drain down test, Static Indirect Tensile Strength Test and Static Creep Test to evaluate the effects of fibre addition on mix performance. It is concluded that addition of sisal fibre improve the mix properties like Marshall Stability, Drain down characteristics and indirect tensile strength in case of both BC and SMA mixes. Ii is observed that SMA is better than BC in respect of indirect tensile strength and creep characteristics.

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

Preparation of Mixes

The mixes were prepared according to the Marshall procedure specified in ASTM D1559. For BC and SMA the coarse aggregates, fine aggregates and filler were mixed according to the adopted gradation as given in Table 3.1. and Table 3.2 respectively. First a comparative study is done on BC by taking three different type of filler i.e. cement, fly ash, stone dust. Here Optimum Binder Content (OBC) was found by Marshall Test where binder content is very from 0% to 7%. Then Optimum Binder Content (OBC) and Optimum fibre Content (OFC) of both BC and SMA was found by Marshall Method where binder content is very from 0% to 7% and fibre content is vary from 0.3% to 0.5%. The sisal fibres after being cut in to small pieces (15-20 mm) were added directly to the aggregate sample in different proportions. The mineral aggregates with fibres and binders were heated separately to the prescribed mixing temperature. The temperature of the mineral aggregates was maintained at a temperature 10°C higher than the temperature of the binder. Required quantity of binder was added to the pre heated aggregate-fibre mixture and thorough mixing was done manually till the colour and consistency of the mixture appeared to be uniform. The mixing time was maintained within 2-5 minutes. The mixture was then poured in to pre-heated Marshall Moulds and the samples were prepared using a compactive effort of 75 blows on each side.

The specimens were kept overnight for cooling to room temperature. Then the samples were extracted and tested at 60°C according to the standard testing procedure.

Results

Result and Observation of test carried out in previous chapter is presented, analyzed and discuss. This chapter is divided into five sections. First section is deals with parameter used for analysis. Second section deals with calculation of Optimum binder Content (OBC) of BC where cement, fly ash, stone dust is used as filler. Third section deals with calculation of Optimum binder Content (OBC) and Optimum Fibre content (OFC), Marshall Properties of BC with or without using fibre. Fourth section deals with calculation of Optimum binder Content (OBC) and Optimum Fibre content (OFC), Marshall Properties of SMA with or without using fibre. Fifth section deals with result of Drain down test and Static Indirect Tensile Stress and static Creep test.

Conclusions

As per MORTH Specification mix design requirements of bituminous mix is given in table 5.1. As BC made of from all the three type filler satisfy above requirements we can

use them as filler. Although BC with cement as filler gives maximum stability, as it is costly we can also use fly ash and stone dust as filler material. Use of fly ash is helpful in minimise industrial waste.

Property	Value
Marshall stability (KN at 60°C)	>9KN
Flow Value (mm)	2-4
Air Void (%)	3-6
VFB (%)	65-75
OBC (%)	5-6

Different test like Drain down test, Indirect Tensile Strength (ITS), Static creep test is done on MIX at their OBC, OFC and its conclusion is given below.

1. Drain down of SMA is more than BC without fibre. At their OFC drain down of binder is decreases.

2. From Indirect Tensile Strength it is concluded that Tensile Strength of SMA is more than BC.

3. From Static Creep Test it is concluded that by addition of fibre to BC and SMA mixes deformation reduced. MORTH recommended that permanent deformation should not be more than 0.5 mm. SMA sample with fibre shows deformation about 0.45mm which is good.

Remarks

Here two type of mix i.e. SMA and BC is prepared where 60/70 penetration grade bitumen is used as binder. Also a naturally available fibre called sisal fibre is used with varying concentration (0 to 0.5%). 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, Indirect Tensile Strength and static creep test it is concluded that SMA with using sisal fibre gives very good result and can be used in flexible pavement.

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