

BITUMINOUS MIXES USING A NATURAL FIBRE TESTING AT LABORATORY

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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 fibers, 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. It is observed that SMA is better than BC in respect of indirect tensile strength and creep characteristics.

Key Words: Bituminous Concrete (BC), Stone Matrix Asphalt (SMA), Sisal Fibre, Marshall Properties, Static Indirect Tensile Strength, Static Creep

INTRODUCTION

Highway construction involves enormous financing costs. An exact engineering design can save substantial funding and the reliable execution of the in-service road can be achieved. Two important things are

analyzed in the adaptable pavement engineering plan and the blend plan. The display consideration is related to the design of the mixture. A large bituminous blend plan is expected to lead to a blend that is (i) solid (ii) strong (iii) resistant to

weariness and lasting distortion (iv) environmentally friendly (v) prudent and so on. A blend creator tries to fulfill these requirements through a number of tests on the blend with different proportions and finishes with the best. The present research work tries to distinguish a few of the issues included in this craftsmanship of bituminous blend design and the heading of current research. In the mid-1900s, the bituminous clearing strategy was to begin with in rural streets in order to deal with the rapid expulsion of fine particles from the Water Bound Macadam, caused by the rapid development of cars. Heavy oils were used as a tidy palliative at the beginning. A pat test called eye estimation handle was used to estimate the imperative amount of the overwhelming oil in the mixture. In this preparation, the mixture was pressed like a pancake and pressed against a brown paper. The suitability of the amount was decreed depending on the degree of color it was produced on the paper. In this examination, a comparative consideration was made between Bituminous Concrete (BC) and Stone Framework Black-top (SMA) mixtures with changing cover substance (4%-7%) and fiber content (0.3%-0.6%). Bitumen is used as a binder in the display study 50/60 infiltration review and sisal fiber is used as a stabilizing additive.

REVIEW OF LITERATURE

The sidewalk made by the more than one layer of many materials is carry by a layer is called sub-class. There are usually two types of sidewalks and hard sidewalks. Flexible berths are set because the overall berth bends under load. Flexible platform structure usually consists many layers of materials. Every layers get the load from the upper layer, then distributes, transfers those loads to next below layer. Flexible paving structures including:

- Surface Coarse - It is the top layer & the traffic exposed layer. It can consist of one or several different HMA sub layers. Mixture of fine, coarse aggregate and asphalt binder is known as HMA.
- Basic course – The layer below HMA layer is known as basic course.
- Sub base-session- Below the base layer the layer is known as sub base session. There is always a need for a sub-base.

TYPES OF BITUMINIOUS DESIGNS

1. DENSE BITUMEN MACADAM (DBM)

A binder course for roads with more heavy commercial vehicles and a close premix material with 5-10 percent void content.

2. BITUMINIOUS CONCRETE (BC)

Bituminous concrete consists of a mixture of totals graded persistently from the most extreme estimate, usually less than 25 mm, by a fine filler of less than 0.075 mm.

Adequate bitumen is included in the mixture so that the compacted mixture is viable and impervious and has valuable dissipative and flexible properties. The bituminous blend plan points to the extent of bitumen, filler, fine totals and ground totals to create a workable, solid, robust and conservative mixture.

3. ADEQUATE BITUMEN DESIGN

- Adequate quality to withstand shear distortion under higher temperature activity.
- Discuss adequately the voids in the compacted bitumen to allow extra compaction by activity.
- Adequate functionality for easy arrangement without segregation.
- Adequate resistance to maintain a strategic distance from untimely splitting due to rehashed twisting by traffic.
- Adequate resistance at moo temperature to anticipate shrinkage cracks

4. REQUIRMENT FOR BITUMINIOUS MIXES

- Stability
- Durability
- Flexibility
- Skid Resistance
- Workability

5. CONSITUENTS OF THE MIX

- Coarse Totals
- Fine Totals
- Filler

- Binder

RESULT OF MATERIAL USED

1. Physical Properties of Sisal Fiber
Density (gm/cm) 1.6 Elongation (%) – 1.9-2.4

Tensile Strength (MPa) 513-630 Young Modulus (MPa) 9.2-9.4

2. Chemical Properties of Sisal Fiber
Cellulose(%) 68-76
Hemi-Cellulose(%) 12-14

Lignin(%) 10-13

Pectin(%) 9

Moisture Content(%) 10-24 pH 5.8-6.3

3. Gradation of Aggregate For Bitumen Concrete (BC)

4. Gradation of Aggregate For Stone Matrix Asphalt (SMA)

5. Physical Properties of Coarse Aggregate

RESULTS OF MARSHALL STABILITY, UNIT WEIGHT AND DEFORMATION

Marshall Stability With Their Different Corresponding Binder Content (Fly Ash, Stone Dust, Cement) With BitumeDifference of Unit Weight of Bitumen With Different Binder (Fly Ash, Stone Dust, Cement) ContentDifference of Air Voids In Bitumen With Different Binder (Fly Ash, Stone Dust, Cement) Content

EFFECT OF TEMPRATURE ON INDIRECT TENSILE STRENGTH

Here the graph is representing the effect of the temperature on indirect tensile strength with bitumen concrete (BC) with and without fiber and also stone matrix asphalt(SMA) with and without fiber

STATIC CREEP TEST

In this graph the deformation of the bitumen concrete (BC) and stone matrix asphalt (SMA) with and without fiber is shown

CONCLUSION

Optimum Binder Content(OBC) is 5.1% and Optimum Fiber Content (OFC) is 0.4%. It is found that for SMA without fiber the binder requirement is 5.6%, this value is reduced to 5.2 % by the expansion of sisal fiber 0.4% to SMA and advanced fiber addition increase to 6 leading to the greatest drain down. Stability decreases by an overall expansion of 0.4% fiber to SMA stability value increase and further additions. By expansion of 0.4% fiber to SMA stream value decreases and encourage expansion of fiber flow value increases. The fundamental benefit of using fiber is that the mix decreases void. There are two types of mix i.e. SMA and BC are prepared for use as a cover for bitumen 50/60. In addition, a sisal fiber that is actually available is used at different concentrations (0 to 0.6 percent). A Marshall blend design method is used to determine OBC and OFC. The fiber properties of Blend 's are generally

improved by 0.4%. Drain down test, indirect tensile strength and static creep test conclude that SMA has exceptionally good sisal fiber results and can be used in flexible paving.

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