A

Seminar report

On

STONE MASTIC ASPHALT

Submitted in partial fulfillment of the requirement for the award of degree
Of Civil

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Preface

I have made this report file on the topic **STONE MASTIC ASPHALT;** I have tried my best to elucidate all the relevant detail to the topic to be included in the report. While in the beginning I have tried to give a general view about this topic.

My efforts and wholehearted co-corporation of each and everyone has ended on a successful note. I express my sincere gratitude to ……..who assisting me throughout the preparation of this topic. I thank him for providing me the reinforcement, confidence and most importantly the track for the topic whenever I needed it.

CONTENTS

INTRODUCTION

Stone Mastic asphalt (SMA), otherwise known as Stone Matrix Asphalt / Split Mastic Asphalt, was developed in Germany in the mid of 1960's and it has spread throughout Europe and across the world in 1980's and 1990's respectively. The excellent performances include resistant to mechanical and temperature deformation, cracking, and particularly rutting, resistant to weathering actions such as aging and low temperature cracking. Durability is excellent even under slow moving heavy traffic. The textured surface increases skid resistance and provides environmental and driving comfort by reduced noise level, and improved visibility in rainy days.

SMA provides a deformation resistant, durable, surfacing material, suitable for heavily trafficked roads. SMA has found use in Europe, Australia and the United States as a durable asphalt surfacing option for residential streets and highways. SMA has a high coarse aggregate content that interlocks to form a stone skeleton that resist permanent deformation. The stone skeleton is filled with mastic of bitumen and filler to which fibres are added to provide adequate stability of bitumen and to prevent drainage of binder during transport and placement. Typical SMA composition consists of 70−80% coarse aggregate, 8−12% filler, 6.0−7.0% binder, and 0.3 per cent fibre. The deformation resistant capacity of SMA stems from a coarse stone skeleton providing more stone-on-stone contact than with conventional dense graded asphalt (DGA) mixes. Improved binder durability is a result of higher bitumen content, a thicker bitumen film and, lower air voids content. This high bitumen content also improves of flexibility. Addition of a small quantity of cellulose or mineral fibre prevents drainage of bitumen during transport and placement. The essential features, which are the coarse aggregate skeleton and mastic composition, and the consequent surface texture and mixture stability, are largely determined by the selection of aggregate grading and the type and proportion of filler and binder.

SMA is characterized by a stone-on-stone structure. SMA uses a high proportion of larger stones or aggregate that contacts each other. This skeleton of larger stones resists heavy loads by transmitting them to the pavement below. If the under laying pavement is sufficiently strong then the SMA will resist the heavier loads effectively. (A surfacing cannot compensate for a weak pavement).

The bituminous mastic is intended to hold the aggregate in place and to inhibit the ingress of moisture into the pavement and to provide durability. The mastic consists of bitumen and fine aggregate particles; it may also include a polymer modified bitumen and filler material to increase the mastic's strength. Fibres may also be added to stabilize the bitumen and to prevent the binder segregating from the aggregate during transport and placement.

It is important that the aggregate material consist of only the larger stones (in the structure) and fines to provide effective mastic. The intermediate size aggregates are not included, as these keep the larger aggregate apart and reduce the strength of the SMA.

HISTORY OF SMA

Stone Mastic Asphalt (SMA), an asphalt paving mixture, was originated in Germany in the 1970s to provide maximum resistance to rutting caused by the studded tyres on European roads. Strabag, a large German construction company, led to the development of SMA. After the use of studded tyres was no longer allowed, it was found that SMA provided durable pavements which exhibited such high resistance to rutting by heavy truck traffic and proved to be extremely effective in combating wear. In recognition of its excellent performance a national standard was set in Germany in 1984. Since then SMA has spread throughout Europe, North America and Asia Pacific. Several individual Countries in Europe now have a national standard for Stone Mastic Asphalt (SMA), and CEN, the European standards body, is in the process of developing a European product standard. In the United States, Australia, New Zealand and in Asia, the use of SMA is increasing in popularity amongst road authorities and the asphalt industry.

PERFORMANCE CHARACTERISTICS OF SMA

The development of modern pavement technology is needed to accelerate significant improvement of pavement quality of highways, airport runways and urban roads.

Fig. 3.1 Stability in SMA mix.

SMA meets the following demands upon an asphalt pavement:

- Good stability at high temperatures
- Good flexibility at low temperatures
- High wearing resistance
- High adhesive capacity between the stone granules and the bitumen

- A mix with no tendency to separate
- Good skid resistance
- Reduced water spray
- Lower traffic noise

Good stability at high temperatures

SMA mix has a self-supporting stone skeleton of crushed high quality coarse aggregate, which provides an increase in internal friction and shear resistance and hence its extremely high stability.

Good flexibility at low temperatures

SMA mix has a binder rich mastic mortar which has superior properties over dense graded asphalt in resisting thermal cracking.

High wearing resistance

SMA mix has low air voids, which make the mix practically impermeable, and provide satisfactory ageing resistance, moisture susceptibility and durability.

High adhesive capacity between the stone granules and the bitumen

With the increase of the amount of filler, cellulose fibres are added as stabiliser. The three dimensional structure of cellulose fibre assists the bitumen to maintain a high viscosity, thickens the bituminous film and improves the bitumen/aggregate adhesion.

A mix with no tendency to separate

An efficient stabilisation of the mastic in order to prevent its segregation from the coarse particles.

Good skid resistance

Because of the macro-texture of the road surface and the use of coarse aggregates with a high Polished Stone Value, SMA pavement achieves a better level of skid resistance.

Reduced water spray

Because of its greater texture depth, there is less water spray, and at night there is fewer glares reflected from the road surface and better visibility of road markings.

Lower traffic noise

SMA road surfaces generally offer lower levels of noise due to the texture properties.

COMPOSITION OF SMA

Stone Mastic Asphalt is characterised by its high stone content which forms a gap-graded skeleton-like stone structure. The voids of the structural matrix are filled with high viscosity bituminous mastic. The high stone content of at least 70% ensures stone-on-stone contact after compaction. The required degree of mastic stiffness is achieved through the addition of crushed sand.

SMA mixes have a bitumen content of minimum 6.5%. The bitumen in the gap-graded mix is stabilised during the mixing process, intermediate storage, transportation, surfacing and compaction through the addition of cellulose fibre stabilising additive.

Addition of cellulose fibre does not chemically modify bitumen, but rather enhances physical property of the finished product by allowing the use of higher bitumen contents. It tends to thicken or bulk the bitumen so that it does not run off the aggregate prior to compaction. The content of cellulose fibre is 0.3% by weight of mixture. If the technological requirements of SMA are fully met, good results can be obtained by just using standard bitumen and a cellulose fibre drainage inhibitor.

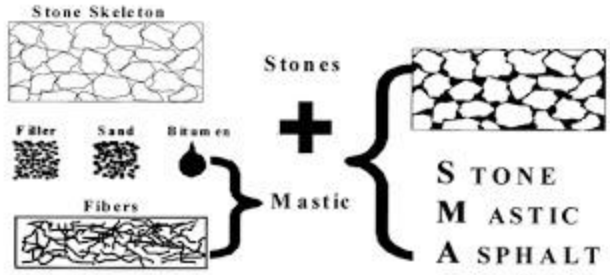

Fig. 4.1 Composition of SMA

Materials Used

1. Coarse and fine aggregate

2. Bitumen

3. Fibre

4. Filler

Coarse and fine aggregate

The aggregates are crushed by using jaw pressure to get different size of aggregates varying from 16 mm to 75 micron. The coarse aggregate must be hard, durable, and roughly cubical in shape when crushed. Qualities of aggregates were check through various tests like Impact Value Test, Crushing Value Test, Los Angel's Abrasion Value Test, Flakiness and Elongation Index Test.

Bitumen

Bitumen act as a binder in SMA mix. Different grade of bitumen are used in different mix like hot-mix or gap-graded mix or dense-graded mix. For preparation of SMA mix we used 60/70 bitumen.

Fibre

Fibres are used as stabiliser in SMA mix. Fibres help to increase the strength and stability and decrease the drain down in SMA mix. There are different types of fibres are used in SMA mix like cellulose fibre, polymer fibre, natural fibre and mineral fibre.

Filler

Filler is used in SMA mix for better binding of materials. Rock dust, slag dust, hydrated lime, hydraulic cement, fly ash, mineral filler and cement are used as filler in SMA mix, also we can use the fine aggregate below 75 micron as filler.

ADVANTAGES

- 20-30% increase in pavement life over conventional pavements
- Good aggregate interlock
- Low permeability
- Improve in skid resistance due to the high percentage of fractured aggregate to motoring public particularly on wet pavement.
- Surface texture characteristic may reduce sound from the tyre and pavement contact as well as water spray and glare.
- Strength and stiffness derived from binder and aggregate structure
- Relatively high binder contents provide good Durability
- Durability (longer in-service life) of SMA should be equal to, or greater than, DGA and significantly greater than OGA.
- It provides a textured, durable and rut resistant wearing course.
- Surface texture characteristics are similar to OGA, so noise generated is lower than DGA but slightly higher than OGA.
- It can be produced and compacted with the same plant and equipment as for normal hot mix DGA using procedural modifications.
- SMA can be used on heavily trafficked roads where good deformation resistance is required.
- Surfacing may reduce reflective cracking from underlying cracked pavements due to its flexible mastic.
- At the end of its service life it is 100% recyclable.

DISADVANTAGES

- SMA mix requires higher mixing temperature.
- Potential construction problem with SMA mixtures are drainage and bleeding.
- Storage and placement temperatures cannot be lowered to control drainage and bleeding problem due to the difficulty in obtaining the required compacted.
- Increased material cost associated with high bitumen and filler content.
- Increased mixing time and time taken to add extra filler may result in reduced productivity.
- Possible delays in openings (the road) as SMA should be cooled to 40°c to prevent early flushing of the binder to the surface.
- Needs more carefully monitoring the composition at the mixing plant.
- Moisture seeping from the SMA surface for long periods after rain.
- White fines on the surface of the pavements.
- Premature rutting
- Stripping of asphalt layers below the SMA surfacing.
- Potholing

Fig. 6.1 Moisture seeping from surface after rain / white fines

APPLICATIONS

Stone Mastic Asphalt has proved superior on heavily trafficked roads and industrial applications:

- with high lorry frequency
- intense wheel tracking
- at traffic lights
- at intersections
- on highways
- on gradients
- on bridges
- in bus lanes
- at bus-stops
- in car parks
- in harbours
- on airport runways
- on un/loading areas

Gap-graded Stone Mastic Asphalt reduces noise emissions considerably. The macro texture of this road surface absorbs traffic noise. Because of its noise absorptive property, this surface is very suitable for access roads in residential areas and on estates. Fine Stone Mastic

Asphalt grades laid in thin layers are used extensively for preventive maintenance and road repair purposes. The stone skeleton matrix can accommodate unevenness of the underlying pavement to improve driving comfort.

CONCLUSION

Stone Mastic Asphalt has proved superior on heavily trafficked highways all over the world during recent years. The use of SMA is increasing in popularity amongst road authorities and the asphalt industry.

SMA's longer service life gives it a better return on investment than most alternative materials even though the initial costs may be higher. Given that a life span increase of at least 5–10 years can be obtained and that additional advantages covered earlier are gained, it is clear that the choice of SMA can be a good investment.

As a result of different climatic conditions in individual areas, there must be limited differences in mix specification relating to voids, binder content and binder stiffness. In wet and cold regions a lower void content and higher bitumen content is used whilst in drier and warmer regions the void content is generally higher and the binder content lower with a stiffer binder. However, aggregate grading should remain fairly consistent other than in exceptional cases such as wearing course for airport runways.

To gain the maximum benefit from SMA it is important to ensure that the mixture is well designed and a high standard of production and lying is maintained.

REFERENCE

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