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Performance Study of Stone Matrix Asphalt Using PMB 40 And PMB 70

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Abstract- ***Stone Matrix Asphalt (SMA) is a gap-graded asphalt mixture used for high durability and rut resistance in flexible pavements. Polymer Modified Bitumen (PMB) improves the performance characteristics of SMA mixtures. This study evaluates the performance of SMA prepared using PMB 40 and PMB 70. The comparison is based on Marshall Stability, flow values, moisture susceptibility, rutting resistance, and durability characteristics. The study concludes that PMB 70 provides better resistance to deformation and improved pavement life under heavy traffic conditions.***

Index Terms- ***Stone Matrix Asphalt, PMB 40, PMB 70, Marshall Stability, Rutting Resistance***

I. INTRODUCTION

Stone Matrix Asphalt (SMA) is a premium asphalt mixture designed for heavily trafficked roads. SMA provides better rutting resistance, durability, and skid resistance due to stone-on-stone aggregate contact. Polymer Modified Bitumen enhances flexibility, adhesion, and resistance to cracking. PMB 40 and PMB 70 are widely used in SMA pavement construction.

Polymer Modified Bitumen (PMB) is widely used in SMA to improve pavement performance under heavy traffic and varying climatic conditions. PMB 40 and PMB 70 are commonly used modified binders in highway construction. PMB improves elasticity, fatigue resistance, moisture resistance, and rutting performance of asphalt mixtures. Studies show that SMA mixtures prepared with PMB exhibit better stability and durability compared to conventional mixes.

This performance study focuses on comparing SMA mixes prepared using PMB 40 and PMB 70 to determine their engineering properties and suitability for pavement construction.

II. OBJECTIVES

1. To study the properties of Stone Matrix Asphalt.
2. To evaluate the performance of SMA using PMB 40 and PMB 70.
3. To determine Marshall Stability and flow values.
4. To study rutting resistance and moisture susceptibility.
5. To compare the durability characteristics of PMB 40 and PMB 70 mixes.
6. To identify the suitable binder grade for heavy traffic conditions.

III. MATERIALS USED

1. Coarse Aggregates
   - Crushed stone aggregates
   - Provides stone-on-stone contact
   - Improves load carrying capacity
2. Fine Aggregates
   - Stone dust or quarry dust
   - Fills voids in the mix
3. Mineral Filler
   - Lime or cement
   - Improves adhesion and stiffness
4. Polymer Modified Bitumen
   - PMB 40
   - PMB 70
5. Stabilizing Fibers
   - Cellulose fiber or coconut fiber
   - Prevents drain-down of binder

IV. METHODOLOGY

Step 1: Material Testing
- Aggregate impact test
- Abrasion test
- Specific gravity test
- Water absorption test
- Bitumen penetration and softening point test

Step 2: Preparation of SMA Mix

- Aggregates heated to mixing temperature
- PMB heated separately
- Fibers added to aggregates
- Binder mixed thoroughly

Step 3: Marshall Mix Design

- Specimens prepared with varying binder content
- Compaction using Marshall hammer
- Determination of Optimum Binder Content (OBC)

Step 4: Performance Testing

- Marshall Stability Test
- Flow Test
- Indirect Tensile Strength Test
- Rutting Test
- Drain-down Test
- Moisture Susceptibility Test

V. RESULTS AND DISCUSSION

The SMA mix with PMB 70 showed higher Marshall Stability and better rut resistance compared to PMB 40. PMB 70 also exhibited improved moisture resistance and durability under heavy traffic conditions.

VI. OBSERVATIONS

Parameter	SMA with PMB 40	SMA with PMB 70
Marshall Stability	High	Very High
Flow Value	Moderate	Optimum
Rutting Resistance	Good	Excellent
Fatigue Life	Good	Better
Moisture Resistance	Good	Excellent
Durability	High	Very High

VII. ADVANTAGES OF SMA USING PMB

- High rut resistance
- Better skid resistance
- Increased pavement life
- Reduced maintenance
- Better fatigue performance
- Improved resistance to cracking
- Suitable for highways and heavy traffic roads

VIII. APPLICATIONS

- National highways
- Expressways
- Airport pavements
- Urban roads with heavy traffic
- Bridge decks and flyovers

IX. CONCLUSION

Stone Matrix Asphalt is an advanced pavement technology that provides superior performance compared to conventional asphalt mixtures. The use of Polymer Modified Bitumen significantly improves the engineering properties of SMA mixtures.

Among the two binders studied, PMB 70 shows better performance in terms of Marshall Stability, rutting resistance, fatigue life, and moisture resistance. PMB 40 also performs effectively but is comparatively less resistant under heavy traffic and high temperatures.

Therefore, SMA using PMB 70 is more suitable for heavily trafficked roads and high-temperature regions, while PMB 40 can be effectively used for medium traffic conditions. Overall, the use of PMB in SMA enhances pavement durability, reduces maintenance costs, and increases service life.

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