PRACTICE FOR SMA MIX DESIGN

1. SCOPE

1.1 This document outlines the mix design procedures for Stone Mastic Asphalt.

1.2 This procedure may be used for mix designed with a content of Roof Shingle Tabs.

2. REFERENCES

2.1 MTO Test Methods

- LS-287 Percent Compaction of compacted Bituminous Paving Mixture (MRD Method)
- LS-307 Recycled Hot Mix Asphalt
- LS-310 Draindown Characteristics in Uncompacted Asphalt Mixtures
- LS-313 Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
- LS-604 Relative Density and Absorption of Coarse Aggregate
- LS-605 Relative Density and Absorption of Fine Aggregate

2.2 AASHTO Standards

- M 320-10 Performance-Graded Asphalt Binder
- M325-08 Standard Specification for Designing Stone Matrix Asphalt (SMA)
- R46-08 Standard Practice for Designing Stone Matrix Asphalt (SMA)
- T 84-10 Specific Gravity and Absorption of Fine Aggregate
- T 85-10 Specific Gravity and Absorption of Coarse Aggregate
- T 209-12 Theoretical Maximum Specific Gravity and Density of Hot-Mix Paving Mixtures
- T 283-07 Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage
- T 305-09 Determination of Draindown Characteristics in Uncompacted Asphalt Mixtures
- T 312-12 Preparing and Determining the Density of Hot-Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor

2.3 NAPA IS-127 Evaluation of Baghouse Fines for HMA

3. TERMINOLOGY

Filler: Material passing the 75 µm sieve.

SMA: Stone mastic asphalt.

SMA Mortar: A mixture of asphalt cement, filler, and stabilizing additive.

Stabilizing Additive: Either cellulose or mineral fibre.

Job Mix Formula (JMF): The percentage passing on each designated sieve of the total mass of aggregate and the amount of asphalt cement as a percentage by mass of the mixture that are based on specified mix design procedures.

Performance Graded Asphalt Cement (PGAC): An asphalt binder that is produced from petroleum residue, either with or without the addition of non-particulate modifiers, according to AASHTO M 320.

Roof Shingle Tabs (RST): Ground roof shingle scrap generated when new shingles are trimmed during production.

4. PROCEDURE

Mix design procedures and tests shall be in accordance with AASHTO R46 except as noted below under Exceptions and Additional Requirements.

5. EXCEPTIONS

5.1 References to AASHTO T 312 are deleted and replaced with LS-313.

5.2 References to AASHTO T 305 are deleted and replaced with LS-310.

5.3 References to AASHTO T 209 are deleted and replaced with LS-287.

5.4 References to AASHTO M325 are deleted and replaced by “the owner’s specifications”.

5.4 References to AASHTO T 84 and AASHTO T 85 are deleted and replaced with LS-605 and LS-604, respectively.

5.5 SMA designed with a content of RST shall be designed in conjunction with LS-307.

6.0 ADDITIONAL REQUIREMENTS

6.1 Determine bulk specific gravity of the blended coarse aggregate and the blended fine aggregate using LS-604 and LS-605, respectively. When SMA is designed with RST, the coarse and fine aggregates extracted from the RST shall be included in the blended coarse aggregate and the blended fine aggregate.

6.2 The owner’s SMA mortar testing requirements shall be carried out and shall meet the requirements of Table 1.

6.3 The mix design shall incorporate as a minimum, the greater of the amount of hydrated lime determined as required through testing or the amount specified by the owner.

6.4 Draindown sensitivity shall also be determined for 15^{o}C above the anticipated plant production temperature.

7. REPORTING

7.1 Information shall be provided in a legible manner. The documentation required with the mix design submission is covered by AASHTO R46. The documents shall include, but are not limited to, the following information:

7.1.1 Mix design and JMF documents that are signed, dated, and certified correct by the person accountable for the engineering and management responsibility for the laboratory that conducted the work shall be provided.

7.1.2 Contract number, item number, and mix type for which the mix design and JMF were completed and a description of the usage of the mix on the contract shall be provided.

7.1.3 All material proportions and sources for aggregates, including the owner's Mineral Aggregate Inventory for the aggregate sources, asphalt cement, mineral fillers, fibres, and any other additives used, the name of each product, its manufacturer and the manufacturer's data sheet shall be included. Information provided for fibres shall include test results for all the owner's fibre requirements. The amount of RST in per cent by mass and volumetric data shall also be included.

7.1.4 PGAC and source and per cent by mass of the required new asphalt cement. Information on asphalt cement modifiers, hydrated lime, and any other additive including name, source, type, manufacturer, its manufacturer's data sheet, and per cent by mass of asphalt cement shall be provided.

A graph of the temperature-viscosity relationship for the PGAC that is to be used in the mix. The graph will show the viscosity over a temperature range of at least 135-165^{o}C, and will indicate the recommended mixing and compaction temperatures. Mixing and compaction temperature used in the mix design and the compaction temperature of the reheated mixture to be employed in the testing of the production mix shall also be included.

7.1.5 AASHTO T 283 test results and AASHTO T 283's completed Moisture Damage Laboratory Data Sheet. All visual observations made during the design process with particular attention and comments regarding stripping and coating for both the coarse and fine aggregates shall be provided.

7.1.6 Information regarding fines that are returned to the mix, aggregate breakdown during production, and the resultant change in the aggregate gradations shall be included.

7.1.7 Complete gradations for all coarse and fine aggregates, aggregate absorptions, bulk specific gravity and saturated surface dry density for each aggregate, the blended coarse aggregate, the blended fine aggregate and the combined aggregate density along with information on the test method used shall be included.

7.1.8 Target values for per cent passing each designated sieve for the design aggregate structure shall be shown against the SMA control points.

7.1.9 The volumetric properties for the mixture selected. The per cent air voids, voids in mineral aggregate, voids in coarse aggregate of the selected mix design compared with the requirements for air voids, voids in mineral aggregate and voids in coarse aggregate in the dry rodded condition shall

be included. Graphs shall be provided for the air voids, voids in mineral aggregate, bulk relative density (G_{mb}), maximum relative density (G_{mm}) and the gyratory curves of the mixture plotted against asphalt cement content.

Mix bulk specific gravity and percentage by volume and the method used to determine it shall be clearly identified. Theoretical maximum specific gravity shall be provided.

7.1.10 Extracted bulk relative density, percentage asphalt cement, and gradation for the RST if included in the mix shall be provided.

7.1.11 Typical mix weight to produce a gyratory specimen with a height of 115 ± 5 mm shall be included.

7.1.12 Results of the SMA mortar testing are to be reported in comparison with the values stated in Table 1.

7.1.13 Draindown sensitivity test results shall be included.

Table 1
Properties of SMA Mortar

Test	Requirement
Unaged Dynamic Shear Rheometer, $G^*/\sin\delta$	5 (kPa) minimum
RTFO Aged Dynamic Shear Rheometer, $G^*/\sin\delta$	11 (kPa) minimum
PAV Aged Bending Beam Rheometer, Stiffness	1500 (MPa) maximum