DESIGN PROCEDURE FOR RECYCLED HOT MIX ASPHALT

1. SCOPE

This document outlines the mix design procedures for Superpave hot mix asphalt containing. Reclaimed Asphalt Pavement (RAP) or Roof Shingle Tabs (RST) or both. The method essentially follows MTO LS-309, Practice for Superpave Mix Design, which modifies AASHTO R 35, Standard Practice for Superpave Volumetric Design for Hot-Mix Asphalt (HMA).

2. RELEVANT DOCUMENTS

2.1	MTO LS-282	Quantitative Extraction of Asphalt Cement and Analysis of Extracted Aggregate from Bituminous Paving Mixtures
	MTO LS-309	Practice for Superpave Mix Design
	MTO LS-312	Method for the Fractionation of Unextracted Reclaimed Asphalt Pavement (RAP) for Testing and for Incorporating in Other Test Samples
	MTO LS-313	Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
	MTO LS-604	Relative Density and Absorption of Coarse Aggregate
	MTO LS-605	Relative Density and Absorption of Fine Aggregate
2.2	AASHTO M 320-10	Performance-Graded Asphalt Binder
	AASHTO M 323-12	Superpave Volumetric Mix Design
	AASHTO R 35-12	Superpave Volumetric Design for Hot-Mix Asphalt (HMA)
	AASHTO T 312-12	Preparing and Determining the Density of Hot-Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
2.3	NCHRP Report 452	Recommended Use of Reclaimed Asphalt Pavement in the Superpave Mix Design Method: Technician's Manual

3. TERMINOLOGY

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.

Reclaimed Asphalt Pavement (RAP): The processed hot mix asphalt material that is recovered by partial or full depth removal.

RAP Content: The amount of RAP expressed as a percentage by mass of the mix.

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 LS-309, which modifies AASHTO R 35-12. Additional requirements specific to incorporating RAP or RST are as follows:

5. ADDITIONAL REQUIREMENTS

5.1 Materials Selection: Note 3 of AASHTO R 35, which covers the estimated bulk specific gravity of RAP aggregates using the theoretical maximum specific gravity of RAP and assumed asphalt absorption does not apply.

5.2 Preparation of RAP: RAP shall be prepared for testing and for incorporating in the mix design test samples in accordance with LS-312.

5.3 RAP properties:

5.3.1 The asphalt content and gradation of RAP shall be determined using LS-282.

5.3.2 The bulk specific gravity of the RAP coarse and fine aggregates shall be determined using LS-604 and LS-605, respectively.

5.4 Estimation of RAP content and Selection of New PGAC:

5.4.1 If the RAP content in the mix is known/fixed, use Table 1 as a guideline for selection of new PGAC grade and, if required, determine the RAP asphalt cement properties.

5.4.2 If the RAP content in the mix is to be determined based on the properties of the aggregates, new PGAC, and available RAP, then follow the procedure in NCHRP Report 452, Chapter 3, page 11, for determining the RAP content of the mix.

5.4.3 If RAP content is 40% or more, then use a blending chart, following the procedures in Appendix A, Procedures for Developing a Blending Chart of AASHTO M 323-12.

5.5 Preparation of Mixtures and Specimens

5.5.1 In preparing aggregate batches, or when calculating the total asphalt content of mixtures containing RAP or RST, allowance shall be made for the quantity of asphalt cement in these materials.

Note 1: Refer to NCHRP Report 452 for sample calculations.

5.5.2 For RAP content of 20% or lower, the mixing and compaction temperature to be used in the design of mixtures shall be based on the kinematic viscosity of 170 ± 20 mm^2/s of the unaged binder, as per AASHTO T 312. For RAP content between 20 and 30%, these temperatures shall be increased by 3°C. For RAP content between 30 and 40%, these temperatures shall be increased by 6°C.

Note 2: The mixing and compaction temperatures for modified asphalts may not correspond to the kinematic viscosity specified. For modified asphalts, the manufacturer's recommended temperatures for mixes containing no RAP shall be increased by 3ºC for RAP content between 20 and 30% and by 6ºC for RAP content between 30 and 40%.

5.6 Reporting Requirements: The report shall include:

5.6.1 The source and properties of RAP material(s), which include its asphalt cement content and the extracted RAP gradation;

5.6.2 The results of any characterization testing carried out on the recovered asphalt cement;

5.6.3 Any blending charts, if applicable, generated for determining the appropriate grade of new PGAC;

5.6.4 The percentage of new AC; and

5.6.5 The job-mix formula, which shall include the total AC content.

Table 1 - PGAC Selection Guidelines for Hot Mix Asphalt Incorporating RAP

Level	RAP Content	Recommended New PGAC Grade
I	Equal to or Below 20%	Use the same PGAC grade as for a new mix; based on location (zone) and traffic level.
II	21 to 40%	Reduce both the low and high temperature grades by one grade (e.g. if a PG 58-28 would normally be used, select a PG 52-34).
III	Above 40%	Use blending charts, following the recommendations provided in Appendix A, Procedures for Developing a Blending Chart of AASHTO M 323-12.