Module 3-9

Hot Central Plant Recycling

Objectives

Types of hot central plant recycling

Types of equipment and operational sequences

Structural layer coefficients

Economics

Specifications

Quality control

Introduction

RAP use

- **Tens of millions of tons used**
- **Everyday occurrence**
- **45 million tons generated / year**
- **1/3 of all HMA removed is recycled into HMA**
- **Severe limitations in some areas**

Recycling Methods and Equipment

Construction sequence

- **Pavement removal**
- **Crushing and stockpiling**
- **Mixing in central plant**
- **Laydown and compactions**

Generating RAP

Milled RAP

Little additional processing required

Uniform properties in layer

- **Gradation**
- **Asphalt content**
- **Asphalt properties**

Usually stored in separate stockpile

RAP from Full-Depth Removal

Pavement broken into slabs

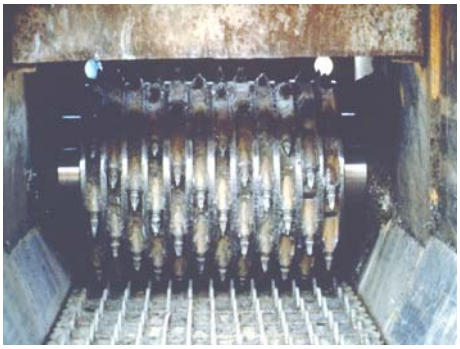
Material must be processed

Often stored for later processing

Material from different sources

Blending / crushing mixed RAP can produce consistent material

RAP Sizing



Stockpiling

Stockpiling RAP

Large, conical stockpiles preferred

RAP does not re-compact

Forms “crust” (200-250 mm) 8-10 inches

Crust sheds water and easily broken

RAP under crust easy to manage

How to Recycle

Equipment

Methods

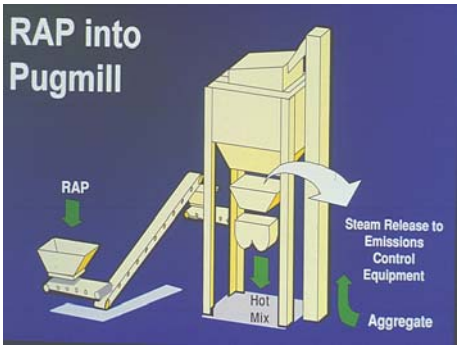
RAP in Plant Facility

Plant type

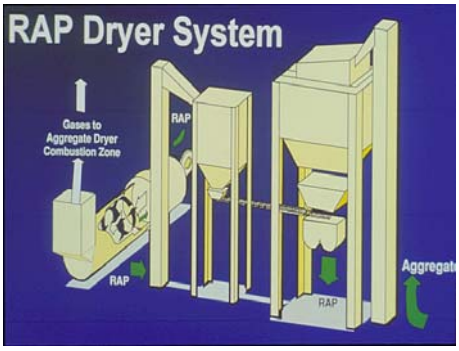
- Batch
- Drum

Adding RAP into Weigh Bucket

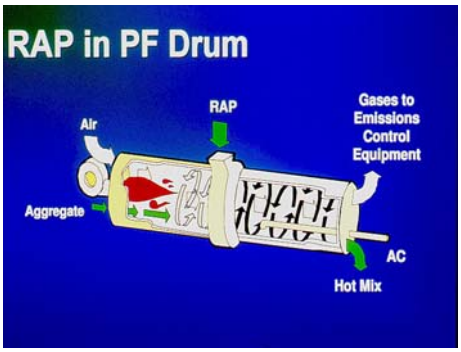
Adding RAP at Pugmill



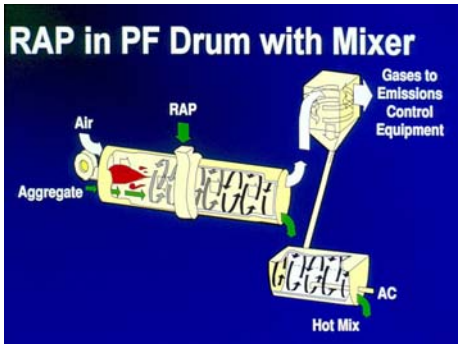
RAP Dryer



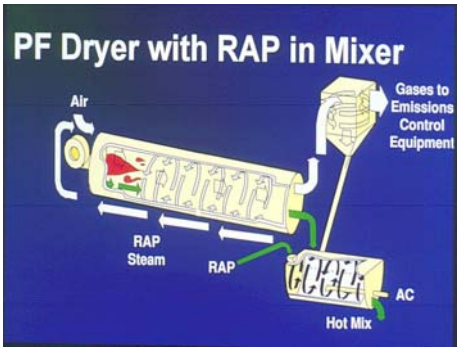
RAP Feed to Parallel Flow Drum Mixer



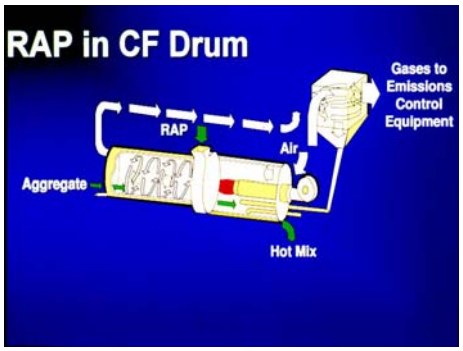
RAP Feed to Drum Drier



RAP Added to Continuous Mixer



RAP Feed to Counter Flow Drum Mixer



Laydown and Compaction

Design Methods

AASHTO

The Asphalt Institute

National Crushed Stone Association

State DOTs

AASHTO Structural Coefficients

Layer	Range	Average	Typical
Surface	0.37- 0.59	0.48	0.44
Base	0.37- 0.49	0.42	0.35

RAP Performance

FHWA survey of 17 states

RAP mixes comparable to virgin mixes
- Proper design
- Process control

Louisiana study
- No significant differences in RAP mix and control

Quality Control

Similar tests as for virgin asphalt cement

Additional tests required

More frequent testing

Greater variation in test results

Quality Control Tests

Composition and properties of RAP

Tests on RAP / RAM / aggregate stockpiles

Tests during construction

- **Gradations of aggregate / RAM**
- **Extraction / recovery tests on RAP and recycled mix**
- **Density of compacted mix**

Summary

Improved processing equipment enhances use

Emission considerations addressed

Processing and handling techniques established

Use of RAP is cost-effective

Quality control

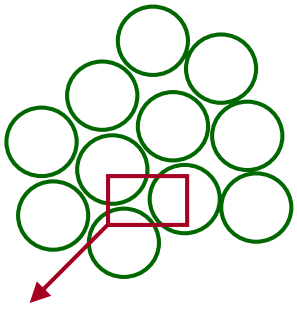
Recycled Mixture Design

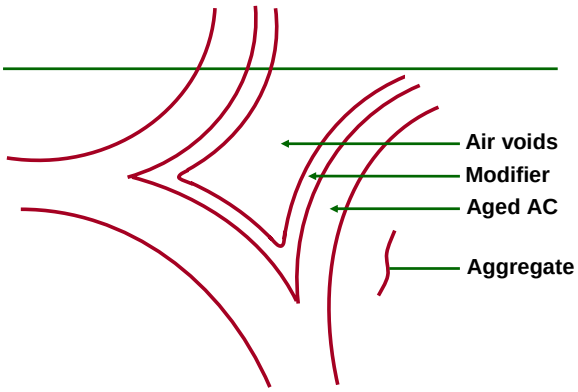
Project considerations

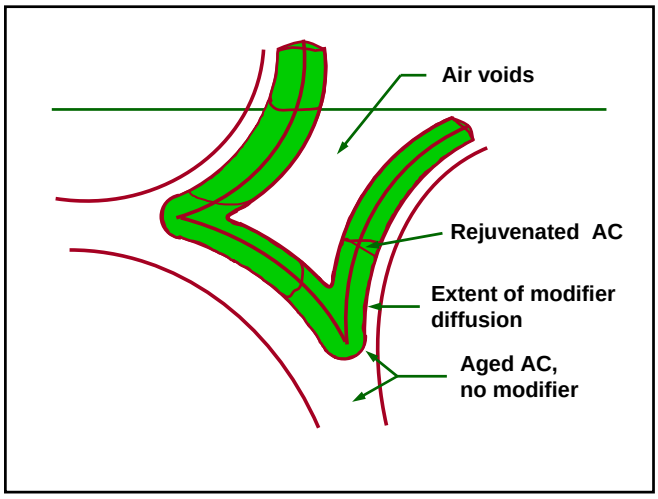
- **Uniformity**
- **Depth of HMA**
- **Presence of chip seals**
- **Asphalt content (bleeding)**
- **Aggregate gradation**
- **Asphalt properties**
- **Traffic**
- **Types of pavement distress**

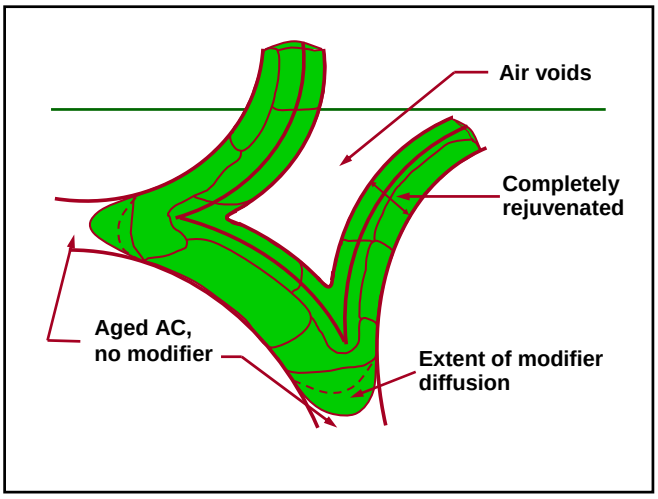
Typical Pavement Core

Looking at the Asphalt Films









Mixture Design

Evaluated salvaged material

- Asphalt properties
- Aggregate properties

Need for additional aggregate

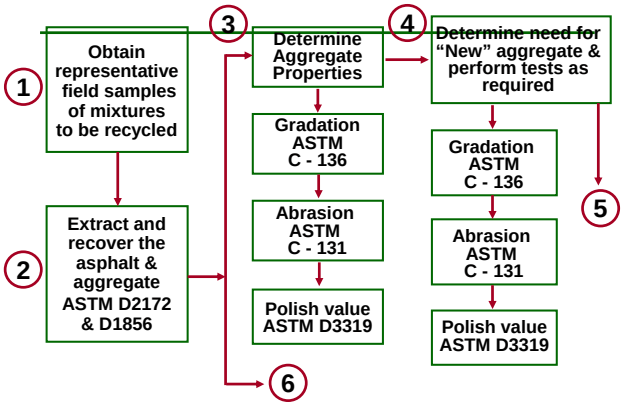
Selection of recycling agent

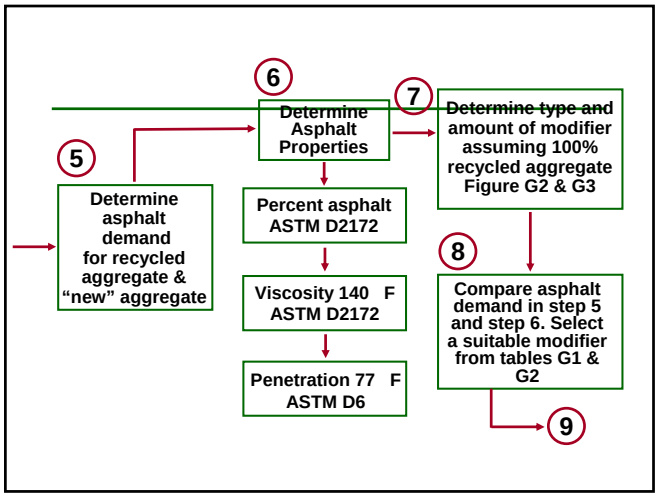
- Type
- Amount

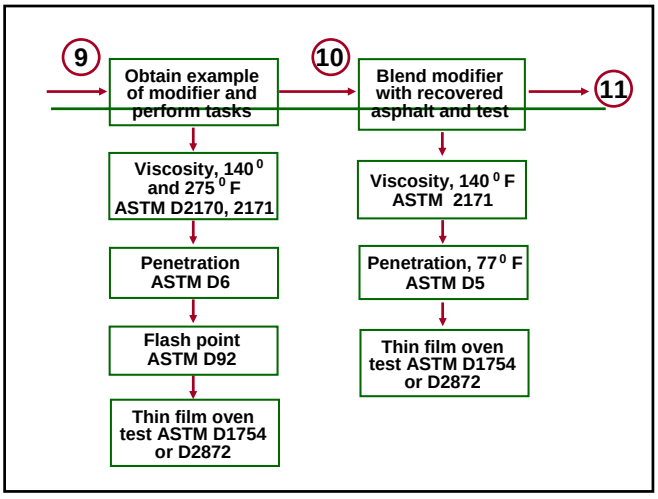
Preparation and testing of mixtures

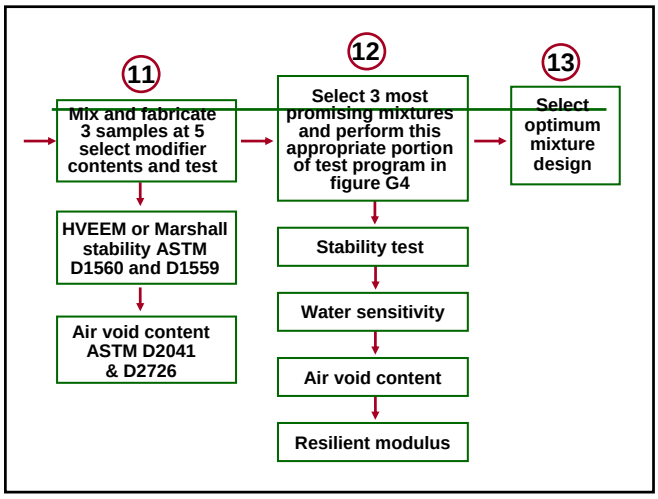
Select optimum for design

Mixture Design Procedure









Other Tests

Resilient modulus

Creep (permanent deformation)

Indirect tensile strength

Water susceptibility

Summary