

Develop Mix Design and Analysis Procedures for Asphalt Mixtures Containing High-RAP Contents – TPF 5(294)

Louay N. Mohammad, Ph.D.

Department of Civil and Environmental
Engineering

Louisiana Transportation Research Center

Louisiana State University



FHWA Asphalt Binder Expert Task Group
Oklahoma City, Oklahoma
September 17, 2015



Transportation Pool Fund Program

<http://www.pooledfund.org/Details/Study/536>



TRANSPORTATION POOLED FUND PROGRAM

[Home](#) | [About TPF](#) | [How to Participate](#) | [Open Solicitations](#) | [Search](#) | [Forms](#) | [Success Stories](#) | [Related Links](#) | [Email Alerts](#)

[Home](#) > [Home](#) > [Search Solicitations and Studies](#) > [Study Detail View](#) [Study Detail View](#)

Study Detail View

Design and Analysis Procedures for Asphalt Mixtures Containing High-RAP Contents and/or RAS

General Information

Study Number: TPF-5(294)

Status: Cleared by FHWA

Contract/Other Number:

Lead Agency: Louisiana Department of Transportation and Development

Last Updated: Oct 30, 2013

Contract Start Date:

Est. Completion Date:

Contract End Date:

Partners: CO , FL , LA

Contact Information:

Lead Agency Contact(s):

Harold Paul
harold.paul@la.gov
Phone: ☎ 225-787-9101

FHWA Technical Liaison(s):

Jack Youtcheff
Jack.Youtcheff@fhwa.dot.gov
Phone: ☎ 202-493-3000

Financial Summary:

Contract Amount:

Total Commitments Received: \$196,000.00

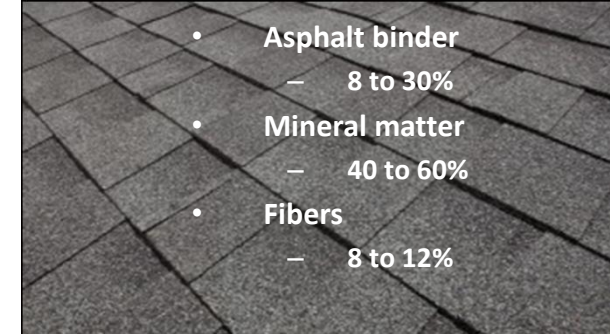
100% SP&R Approval: Approved

Commitments by Organization:

Agency	Year	Commitments
Colorado Department of Transportation	2013	\$28,000.00
Florida Department of Transportation	2012	\$28,000.00
Florida Department of Transportation	2013	\$28,000.00
Florida Department of Transportation	2014	\$28,000.00
Louisiana Department of Transportation and Development	2012	\$28,000.00
Louisiana Department of Transportation and Development	2013	\$28,000.00
Louisiana Department of Transportation and Development	2014	\$28,000.00

Background

- Practice of including **RAP** and/or Recycled Asphalt Shingles (**RAS**) in new asphalt mixtures has increased in recent years
 - economic and environmental benefits
- **RAP** has been widely used
 - Wearing Course: 15%
 - Binder Course: 20%
 - Base Course: 30%
- **RAS** has emerged as a material of interest to the paving community
- **RAP** and/or **RAS** are valuable components in asphalt mixtures
 - With increased demand and limited supply of aggregate and binder
- **Concerns**
 - Hardened and oxidized asphalt binders
 - Causing premature cracking in pavements

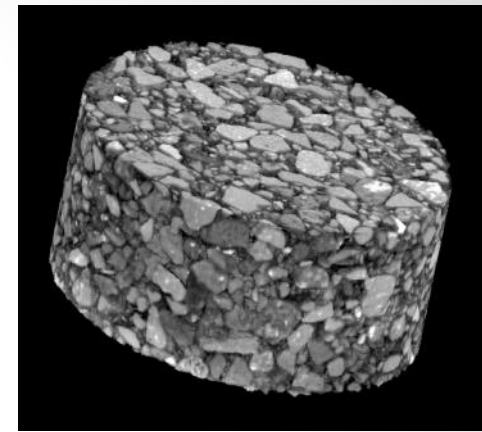


<http://www.solidwasteagency.org/#/business/drop-off/shingle/>



Asphalt Mixture Design: Concern

- Optimum asphalt cement content
 - Quantity
 - NOT QUALITY
 - RAP and/or RAS



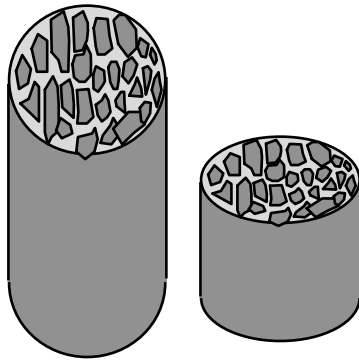
VOLUME

MASS



*Total
Volume*

*Total
Mass*





Objective

- Evaluate fatigue/fracture tests that can be conducted on plant mixtures (lab or field compacted) from participating states
 - ranking the quality of RAP and or RAP/RAS mixtures as compared to virgin mixtures.



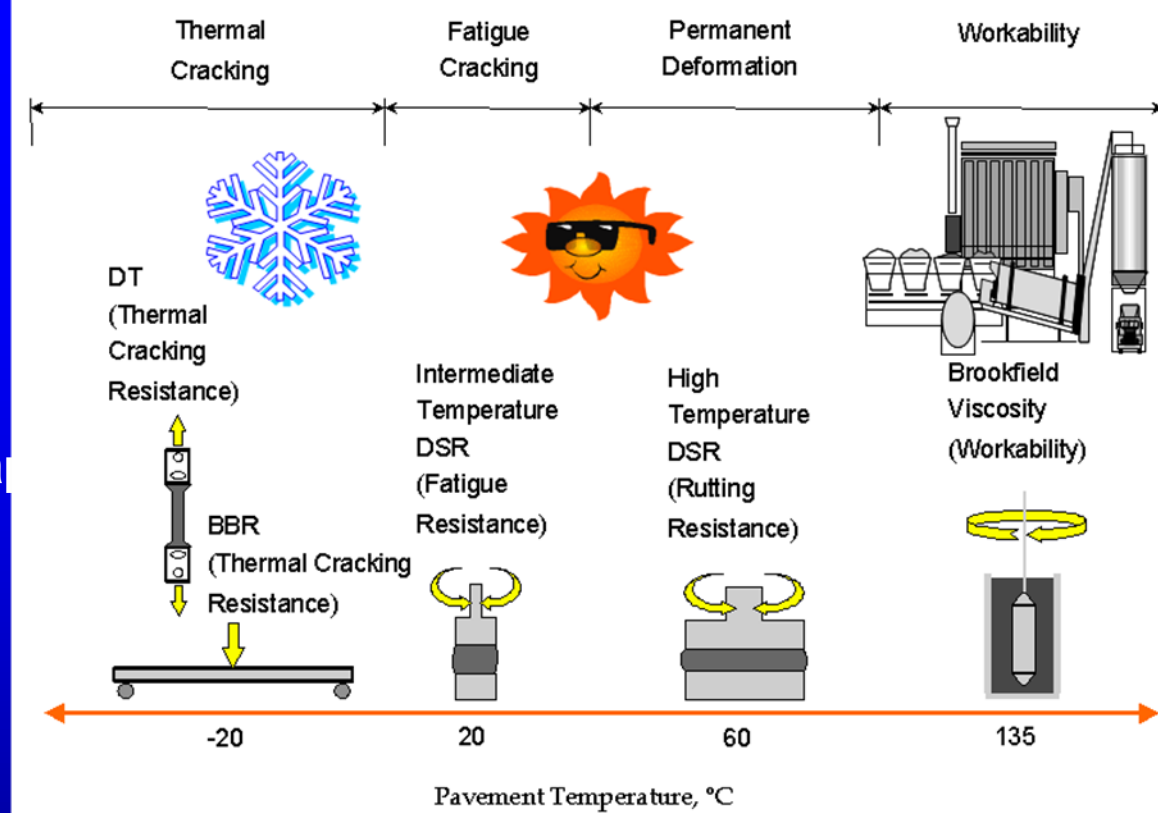
Scope

- **Two field projects**
 - Each field project
 - » Two mixtures: Conventional, RAP and/or RAS
 - Conventional may include 15% RAP
 - Four mixtures
- **Collect Mix Design / Pavement Design Record**
 - JMF
 - Loose mixtures
 - Cores
 - » Challenging
- **Standard Materials Characterization**
 - Binder
 - » Solvent Extraction
 - Aggregate properties
 - Mixture

Binder Experiment

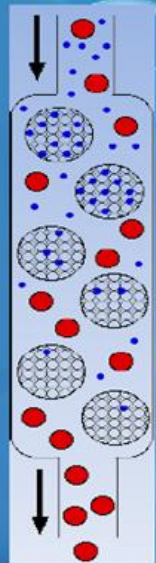
● Binder Rheology

- PG grading
- MSCR
- GPC (Gel permeation chromatography)
- SARA
- Others



GPC

- GPC separates molecules on the basis of size (like sieving!).
- When a mixture of molecules dissolved in a solvent is applied to the top of the column, the smaller molecules are distributed through a larger volume of gel than is available to the large molecules. Consequently, the large molecules move more rapidly through the column, and in this way the mixture can be separated (fractionated) into its components.



AGILENT 1100 GPC SYSTEM



Mixture Experiment

- **Specimen Types**

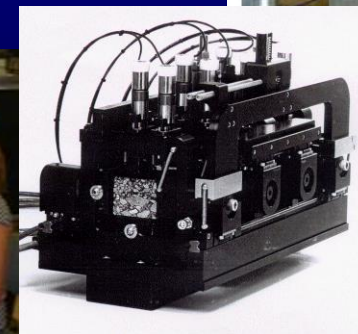
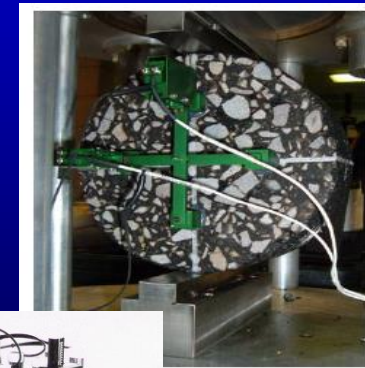
- Plant produced laboratory compacted (PL)
- Plant Produced Field Compacted (PF, Cores)
 - » Challenging
- Triplicates

- **Fracture/fatigue testing**

- Semi-circular bend test, SCB
- Overlay tester test, OT
- Energy Ratio Test
- Beam Fatigue Test
- Direct Tension Cyclic Fatigue
 - » SVECD

- **Per mixture and Specimen type**

- 5 tests x 3 = 15 mixes



Field Project

● FLDOT

- SR 80 Palm Beach County
- Ranger Construction
- West Palm Beach area
- Mix 1: Mix with 50% RAP
- Mix 2: Mix with ~20% RAP



● FHWA

- *Advance Use of Recycled Asphalt in Flexible Pavement Infrastructure: Develop and Deploy Framework for Proper Use and Evaluation of Recycled Asphalt in Asphalt Mixtures*
- *11 Lanes*



U.S. Department of Transportation
Federal Highway Administration

Data Analysis

- Each test will be ranked
- Develop a score card



Data Analysis

- Each test will be ranked
 - Specimen preparation
 - Instrumentation
 - Standard test method
 - Testing
 - Training
 - Interpretation
 - Sensitivity to mix composition parameters
 - Routine Application
 - Correlation to field performance
 - Data Analysis
 - Repeatability
 - Cost

3. Testing			
1: Testing is very involved and requires substantial oversight.	2: Testing requires heavy oversight.	3: Testing requires moderate oversight.	4: Testing is very straightforward and requires little oversight.



**T
H
A
N
K

Y
O
U**

 **LSU**
LOUISIANA STATE UNIVERSITY
Photo: Jim Zietz, Office of Public Affairs