# Effect of Asphalt Mixture Design and Construction on Density and Durability of Asphalt Pavements

Louay N. Mohammad, Ph.D., P.E. Irma Louise Rush Stewart Distinguished Professor Department of Civil and Environmental Engineering Louisiana Transportation Research Center Louisiana State University

#### FHWA Asphalt Mixture Expert Task Group Meeting



Fall River, MA May 8 – 9, 2018



# Acknowledgement

- Asphalt Lab Staff
- EMCRF Staff
  - –Minkyum Kim
  - -Yucheng Shi

# Coastal Bridge



# **Approaches to Achieve Durable Pavement**

# Mixture Design

- BMD concept
- Additives
- Engineered Materials

# Construction

- Increased Density
  - WMA
  - I.C.

. . .

- Tack Coat
- Long. Joints
- Thermal Segregation

# **Durable Pavement -- Louisiana BMD**

- Volumetric and Performance Mixture Testing
  - Rutting (AASHTO T 324): LWT test (50°C, Wet)
  - Cracking (ASTM 8044): SCB test (25°C)



# **Durable Pavement -- Construction**

## In-place density

- Influence pavement performance

Pavement are constructed to a specified In-place density

- achieved by means of roller compaction

- -% of mixture maximum specific gravity (%Gmm)
- Typical target
- 92% 93% of Gmm, 8% 7% VTM

## Significant advancement

- Improve pavement density





https://www.forconstructionpros.com

# **Durable Pavement -- Construction**



Aschenbrener, T., ETG Presentation, September 13, 2017

#### Effect of Increased Asphalt Pavement Density on Its Durability Objective

- Evaluate effects of increasing initial in-place density of asphalt pavements on their potential field performance
  - Identify methodology for achieving increased in-place density of asphalt pavements with minimal additional costs and without damaging the aggregate structure,
  - Construct a demonstration pavement section that includes a control section (meeting the current minimum density requirement) and a test section (having an average of 1.5% increased in-place density),
  - Evaluate volumetric properties of laboratory and field asphalt samples, and
  - Evaluate laboratory performance characteristics of laboratory and field asphalt samples



# Effect of Increased Asphalt Pavement Density on Its Durability

#### Scope

- Overlay rehabilitation project
- US Route 190 in Livingston Parish, Louisiana



#### Effect of Increased Asphalt Pavement Density on Its Durability Scope

#### Three test sections

- Each is ~ 4000 ft
- Control section

## Two sections for increased in-place density

- WMA chemical additive (Evotherm)
- Increase asphalt binder content
  - » 0.2%

### Each test section

- Wearing and Binder course layers

#### Effect of Increased Asphalt Pavement Density on Its Durability Night Paving

• December 2017 – January 2018



#### Effect of Increased Asphalt Pavement Density on Its Durability Scope

- Density
- High temperature Performance
  - Loaded Wheel Tracking Test
    - AASHTO T-324
  - Rutting
- Intermediate temperature Performance
  - Semi Circular Bend Test
  - Cracking
  - ASTM D8044
- Dynamic Modulus Test
  - IDT mode







# Sample Sample Miller Both



# Field Density – Cores



#### Semi-Circular Bend Test Results, 25°C

#### ASTM D8044 – Field Cores





BC: 23.8% RAP WC: 19.1% RAP

## Semi-Circular Bend Test Results, 25°C ASTM D8044 – Field Cores





BC: 23.8% RAP WC: 19.1% RAP

## LWT Test Results, 50°C AASHTO T 324





BC: 23.8% RAP WC: 19.1% RAP

## Semi-Circular Bend Test Results, 25°C ASTM D8044 – PL





BC: 23.8% RAP STA: Plant produced mixture WC: 19.1% RAP

## Semi-Circular Bend Test Results, 25°C ASTM D8044 - PL





BC: 23.8% RAP STA: Plant produced mixture WC: 19.1% RAP

## Semi-Circular Bend Test Results, 25°C ASTM D8044 - PL





WC: 19.1% RAP LTA: 5 days, 85°C

## Interface Bond Strength Test Results, 25°C AASHTO TP 114



**Selected Field Cores** 

## Summary

- Test sections were successfully constructed
  - Ascertain effect of increased density on pavement performance

#### Preliminary results

- Binder Course
  - » Control
    - □%Gmm = 92.2
  - » Evotherm and Plus Ac
    %Gmm = 95.2 and 94.5
- Wearing Course
  - » Similar Density
    - □%Gmm = 95.6, 96.5, 95.9

## Summary

-Intermediate temperature performance

- » Cracking resistance increased
  - Plus AC section
  - SCB Jc was sensitive to increased binder content and %RAP
- High temperature performance
  - » Similar for test sections

