Characterizing Cold Recycled Pavements from Field-Sampled Cores

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NATIONAL PAVEMENT PRESERVATION CONFERENCE
npc23
IMPACTS AND BENEFITS FROM PAVEMENT PRESERVATION

ncpp
National Center for Pavement Preservation
MICHIGAN STATE UNIVERSITY

AASHTO TSP2 PAVEMENT PRESERVATION

ROCKY MOUNTAIN WEST PAVEMENT PRESERVATION PARTNERSHIP
SOUTHEAST PAVEMENT PRESERVATION PARTNERSHIP
MIDWESTERN PAVEMENT PRESERVATION PARTNERSHIP
NORTHEAST PAVEMENT PRESERVATION PARTNERSHIP

Characterizing Cold Recycled Pavements from Field-Sampled Cores

What and Why:

Define Cold Recycled Pavements

Mix Design Ideology and Tests

Comparing Mix Design to As-constructed Pavements

How:

Indiana Case Study- CIR

Illinois Case Study- CCPR

Dynamic Modulus Mastercurves

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Cold In-place Recycling (CIR)	Cold Central Plant Recycling (CCPR)
Typical Depth: 3 – 5 inches **Recycling Agent: Foamed Asphalt or Emulsified Asphalt**	**Typical Depth: 3 - 6 inches** **Recycling Agent: Foamed Asphalt or Emulsified Asphalt**
Agency Usage: - **Alternative to Deep Mill and Fill**	**Agency Usage:** - **Structural Base Layer** - **Alternative to Deep Mill and Fill**

Recycling Agent- Emulsified Asphalt

- **Combination of:**
  - Asphalt
  - Water
  - Surfactants
- **Designed for:**
  - Controlled break times based on recycling application
  - Specified mixture performance requirements- strength, stability

Mix Design Specifications and Guidance Documents

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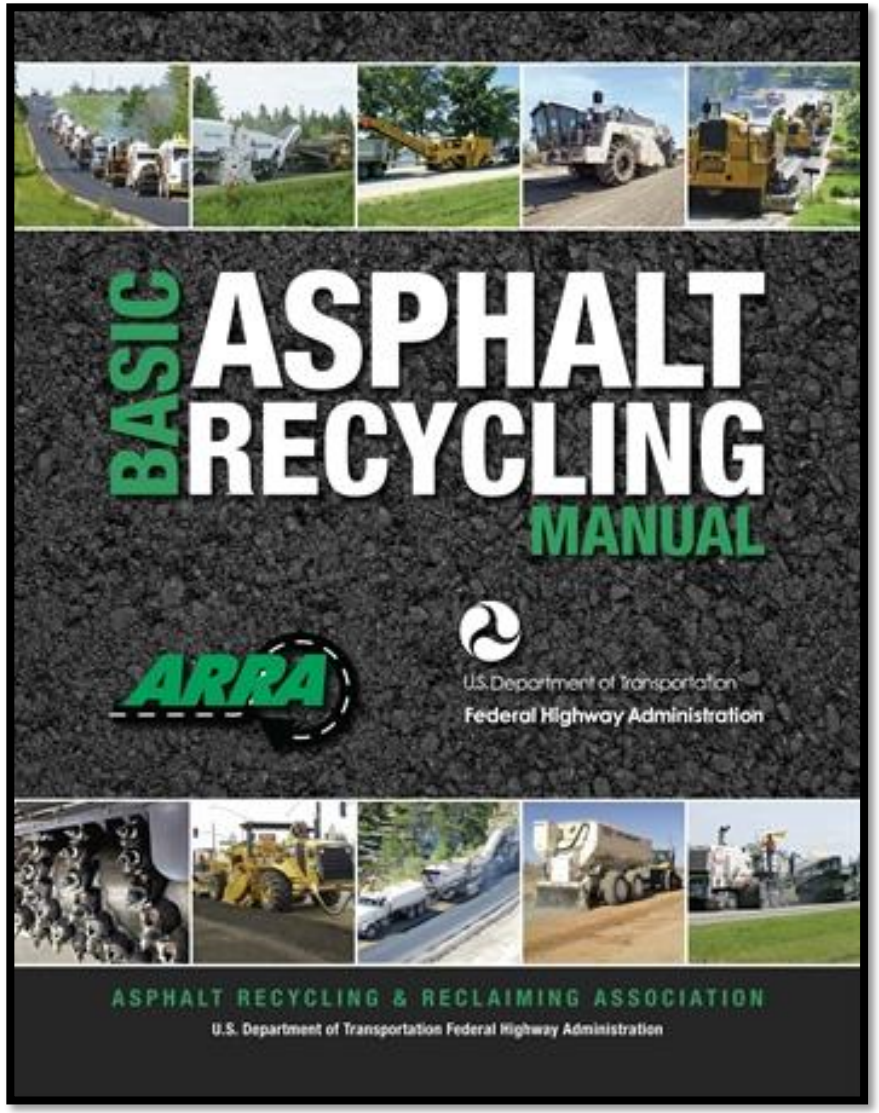
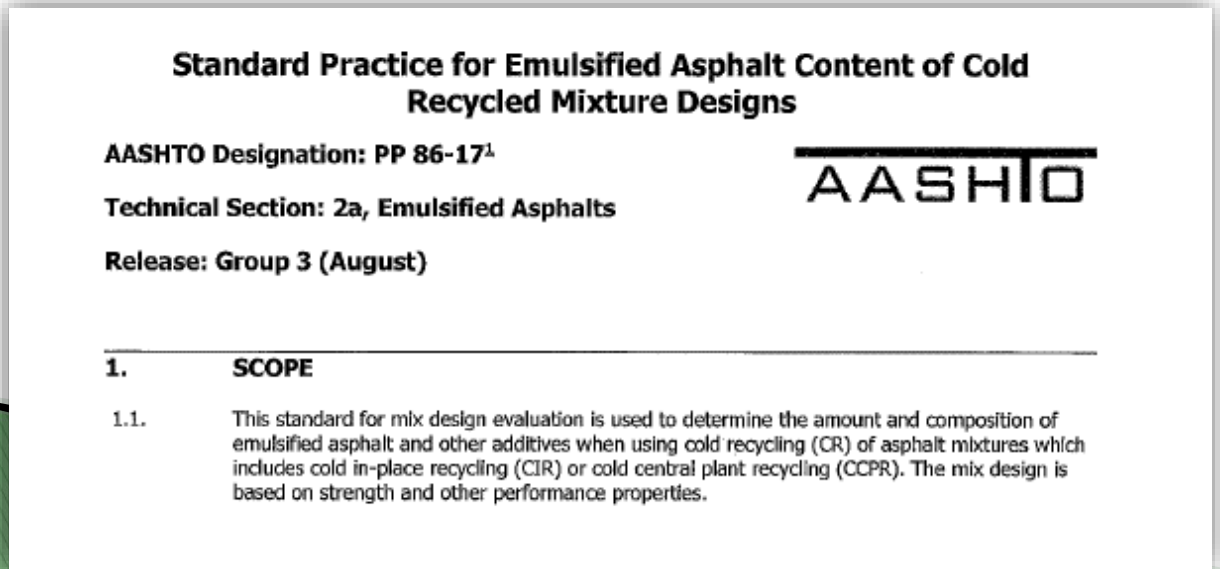
AASHTO Specifications and their contents		
Contents	**Foamed Asphalt**	**Emulsified Asphalt**
Lab Procedure	AASHTO PP 94	AASHTO PP 86
Gradation and performance requirements	AASHTO MP 38	AASHTO MP 31





Standard Practice for Emulsified Asphalt Content of Cold Recycled Mixture Designs

AASHTO Designation: PP 86-17[1]

AASHTO

Technical Section: 2a, Emulsified Asphalts

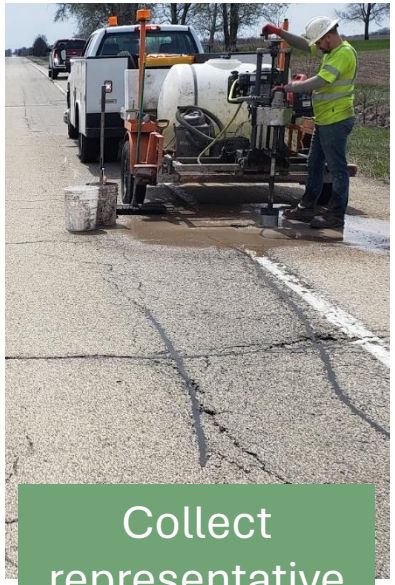
Release: Group 3 (August)

1. SCOPE

1.1. This standard for mix design evaluation is used to determine the amount and composition of emulsified asphalt and other additives when using cold recycling (CR) of asphalt mixtures which includes cold in-place recycling (CIR) or cold central plant recycling (CCPR). The mix design is based on strength and other performance properties.

Cold Recycling Mix Design Methodology

Process:



Collect representative materials of treatment

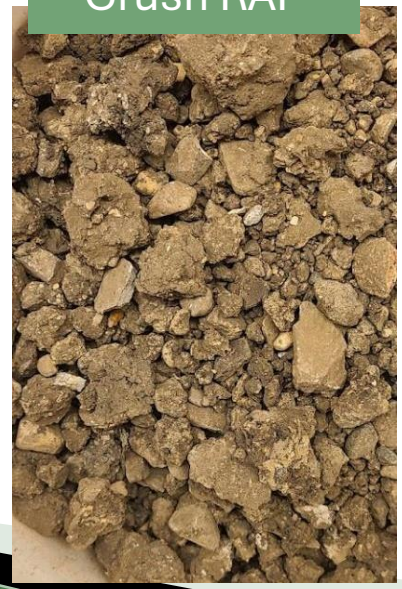
Crush RAP

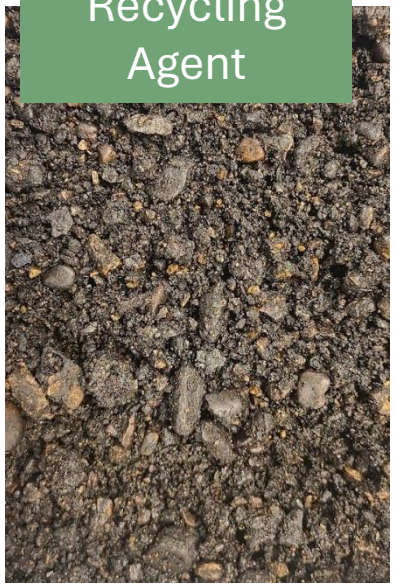
Fractionate

Mix with Recycling Agent

Compact and Cure

Result:

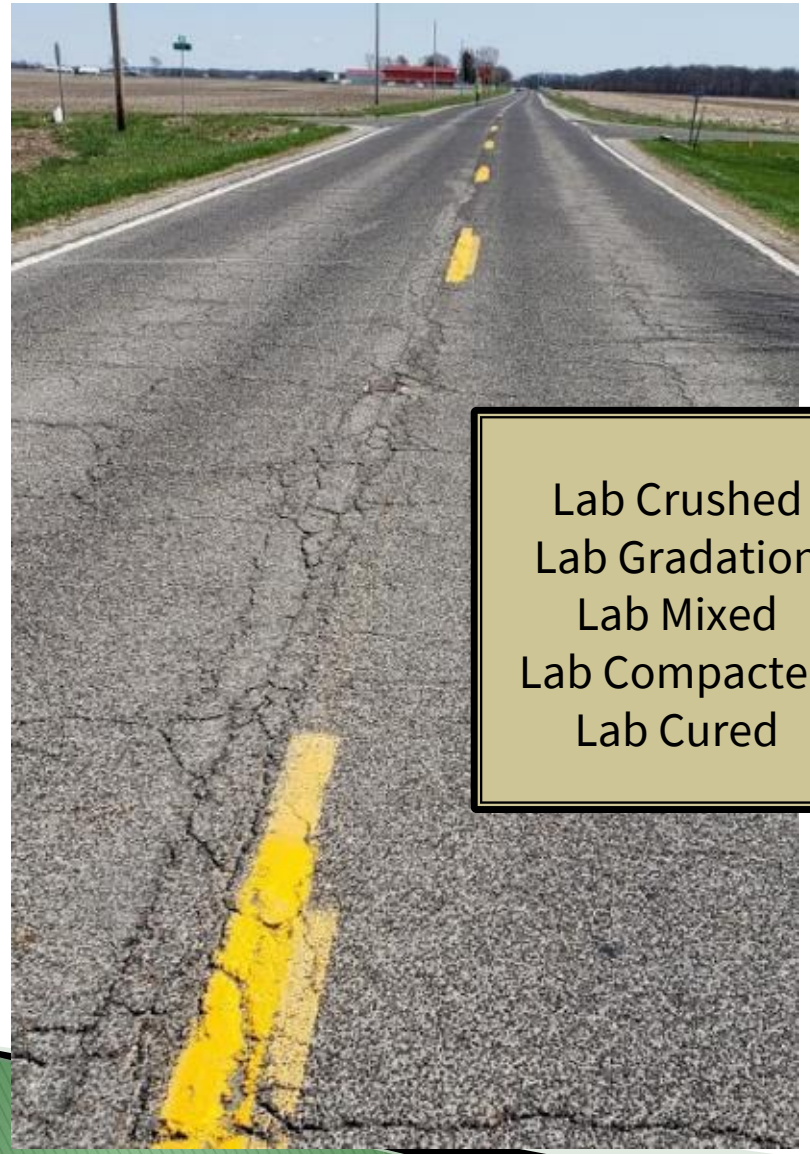




Typical CIR and CCPR Mix Design Requirements

Test Type		Specimen Temperature	Reported Test Result	Typical Minimum Criteria	Properties
Indirect Tensile Strength		25°C	Dry Indirect Tensile Strength	310 kPA (45 psi) for 150mm specimen	Cured Strength
			Retained Indirect Tensile Strength- *of Wet Conditioned Specimen*	70% of Dry Result	Resistance to Moisture induced Damage
Marshall Stability		40°C	Dry Stability	5,560 N (1,250 lbs) for 100mm specimen	Cured Stability
			Retained Stability- *of Wet Conditioned Specimen*	70% of Dry Result	Resistance to Moisture Induced Damage

Mix Design



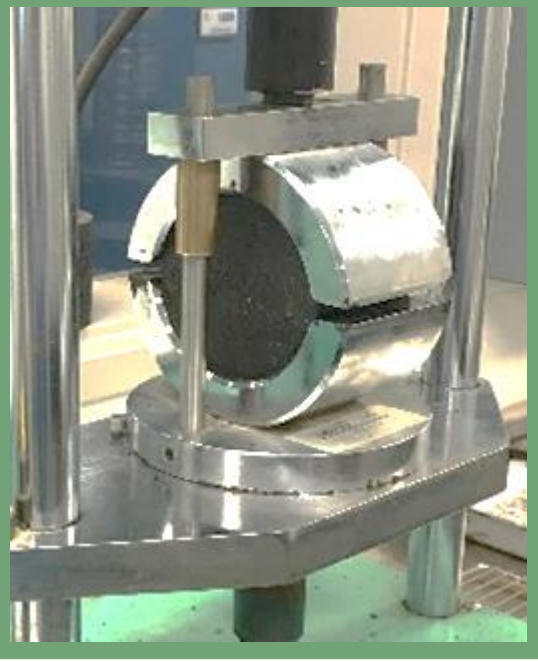
Lab Crushed
Lab Gradation
Lab Mixed
Lab Compacted
Lab Cured

Constructed Pavement

Field Crushed
Field Gradation
Field Mixed
Field Compacted
Field Cured

Pavement Coring

Test Plan

Test Type / Sample Type	100mm Marshall Stability	150mm Indirect Tensile Strength	Asphalt Mixture Performance Tester (AMPT)– Dynamic Modulus
			
Mix Design	☑	☑	☑
Cores	☑	☑	☑

Mix Design Properties vs. Constructed Properties

Indiana SR 234 CIR

Project Specs

Existing Pavement: Full Depth Asphalt Pavement

Treatment: CIR with Emulsion and Cement

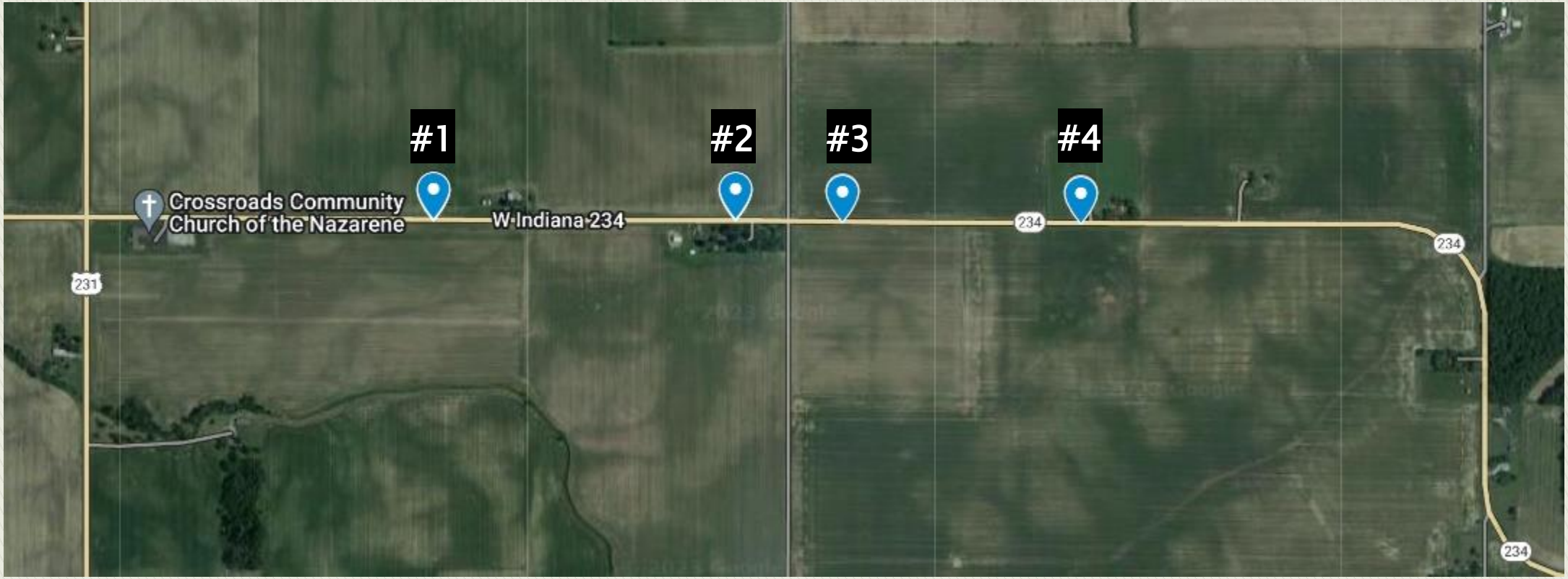
Project Size: 126,505 square yards, 10.37 miles

Procedure:

1. 2.0 inch Pre-mill
2. 4.0 inch CIR
3. Scarify Mill, Tack Coat
4. 2.0 inch HMA Surface

SR 234 Sampling Locations

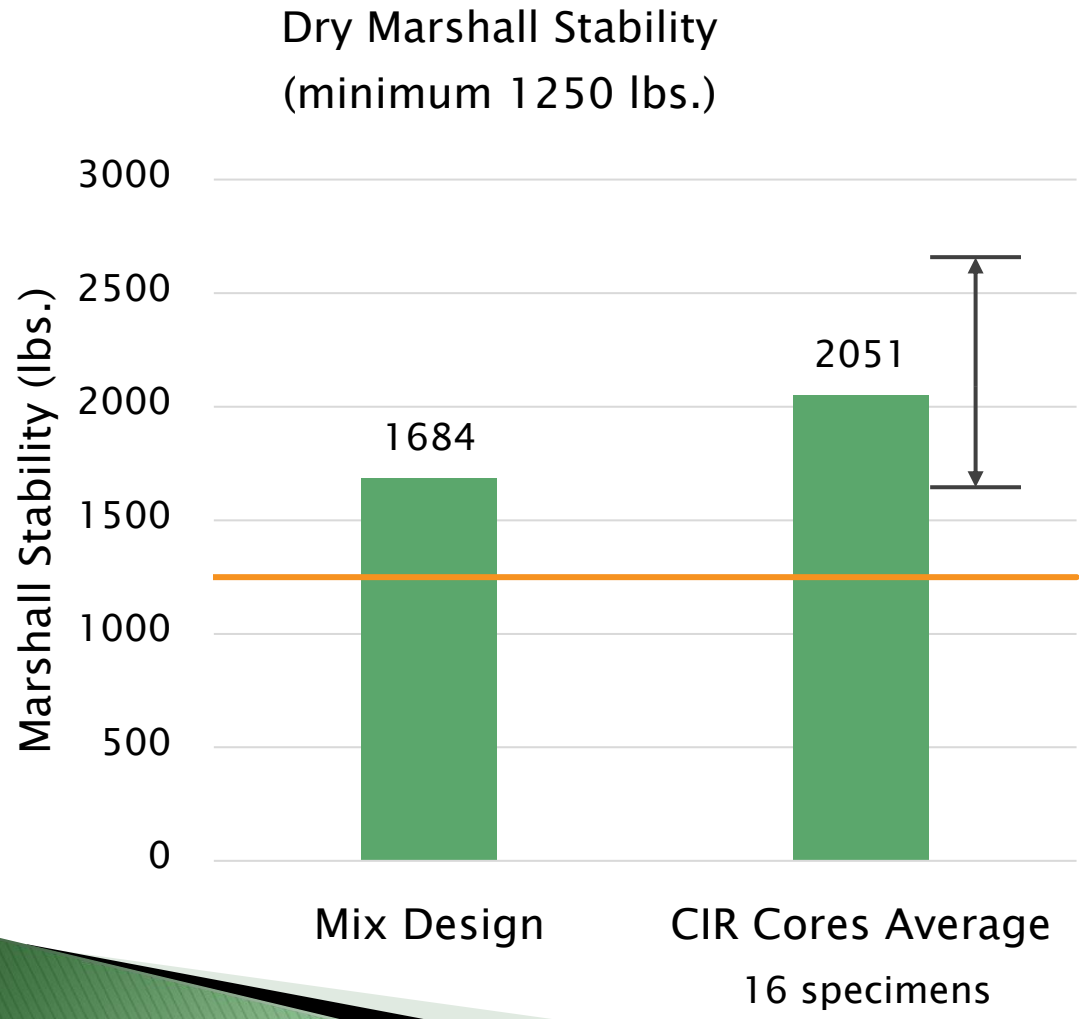
4 stations, EB and WB lanes (8 locations)

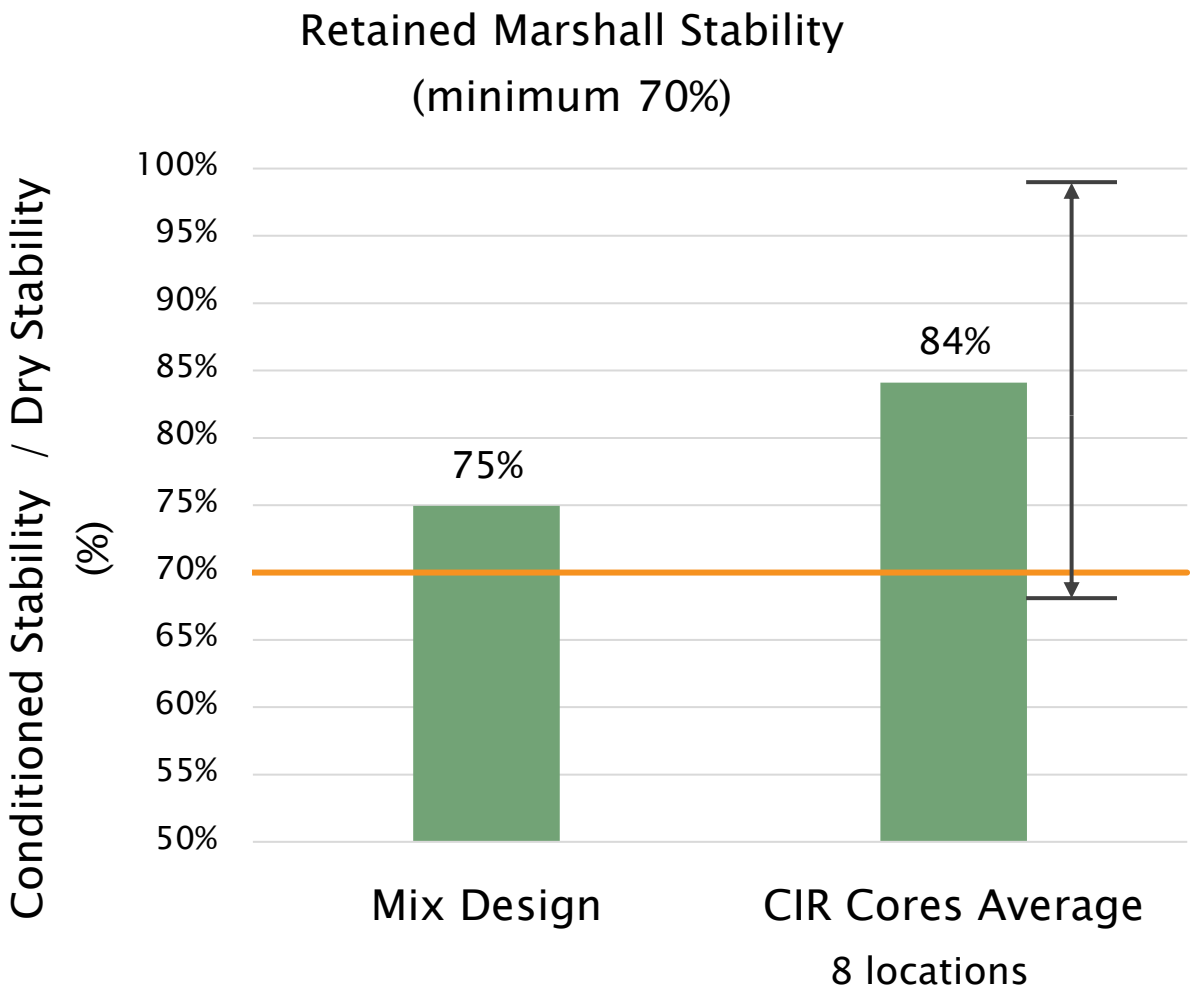


CIR Age at time of coring: 2.5 months
3 of 11 production days represented

Mix Design Properties vs. Constructed Properties

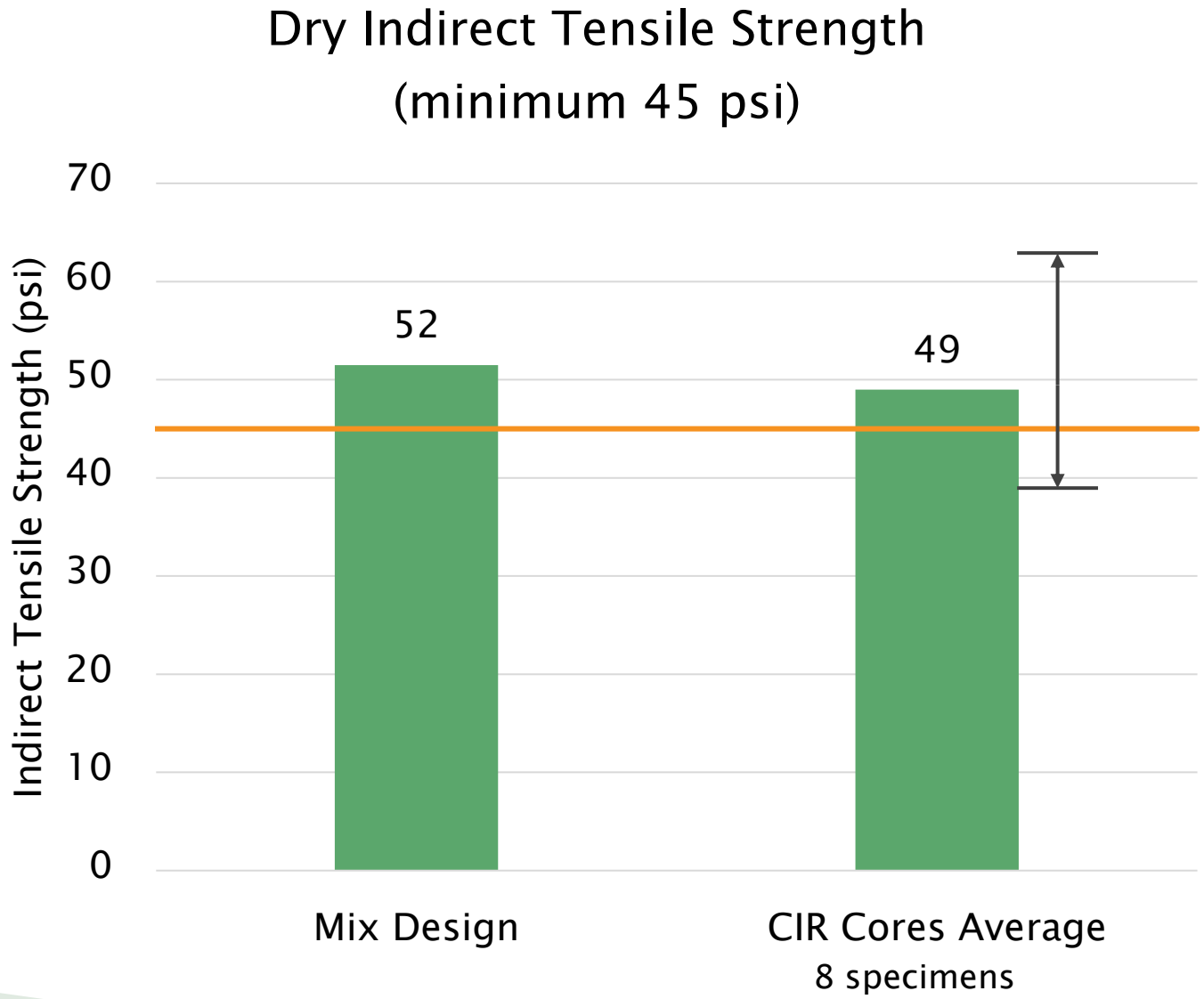
SR 234 CIR





Mix Design Properties vs. Constructed Properties

SR 234 CIR



Illinois Catlin-Indianola Road CCPR

Project Specs

Existing Pavement: 8” Concrete Pavement

Treatment: CCPR with asphalt emulsion

Project Size: 40,661 square yards, 2.8 miles

Procedure:

1. RAP Stockpile
2. Concrete pavement joint repair
3. Tack Coat
4. 3.0 inch CCPR
5. Tack Coat
6. 1.5 inch HMA Surface

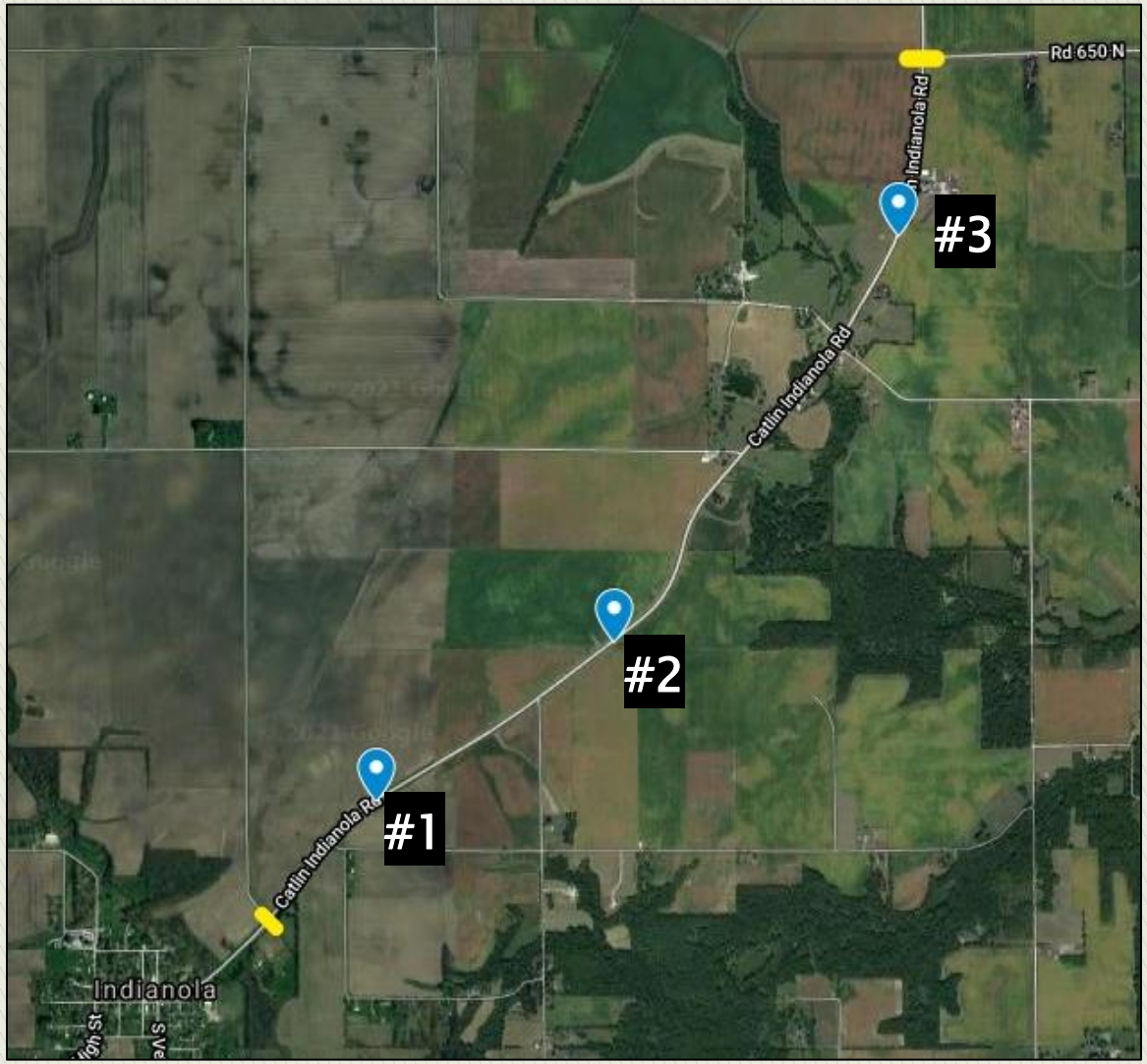
CCPR Laydown

Catlin-Indianola Road Sampling Locations

3 locations- 1 Southbound, 2 Northbound

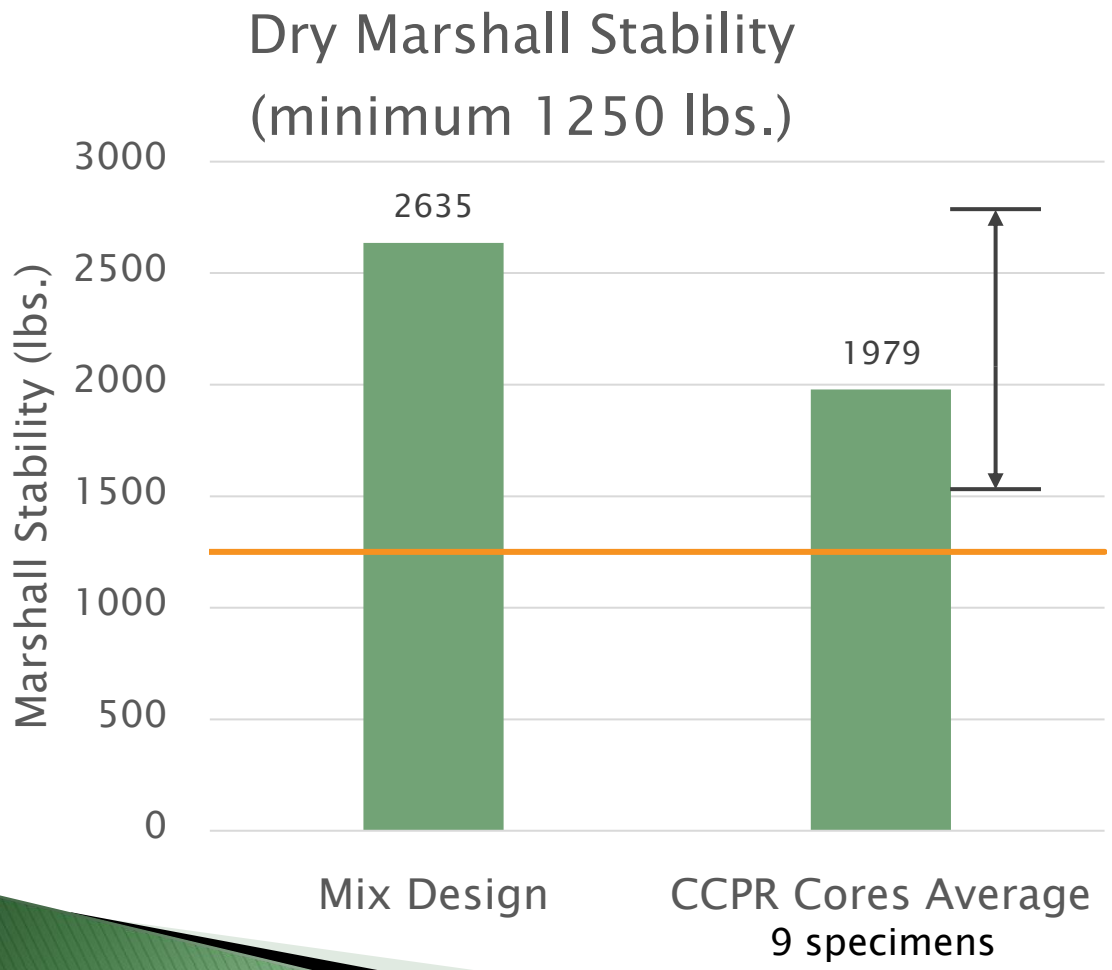
3 of 3 production days represented

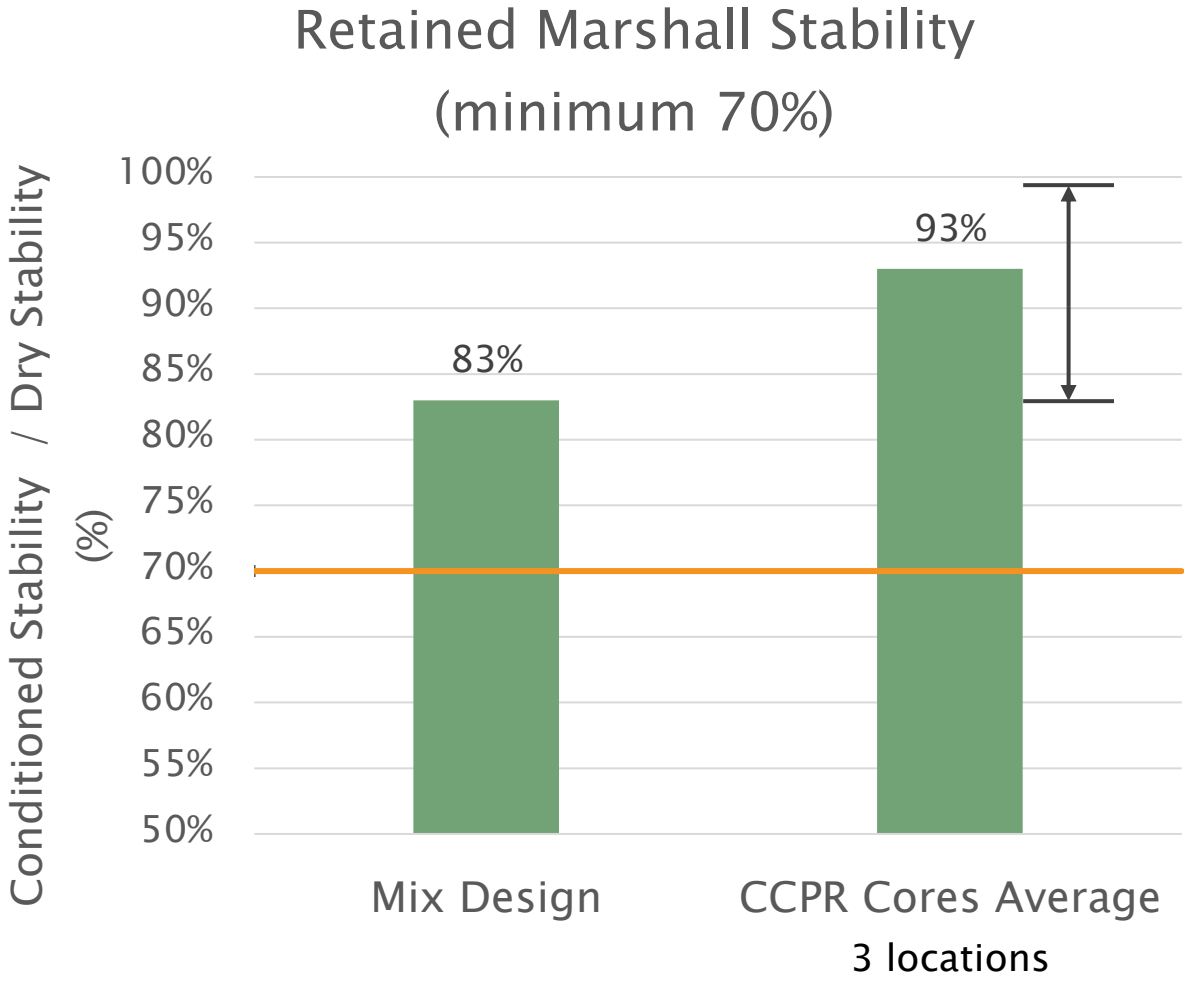
CCPR Age at time of coring: 7 months



Mix Design Properties vs. Constructed Properties

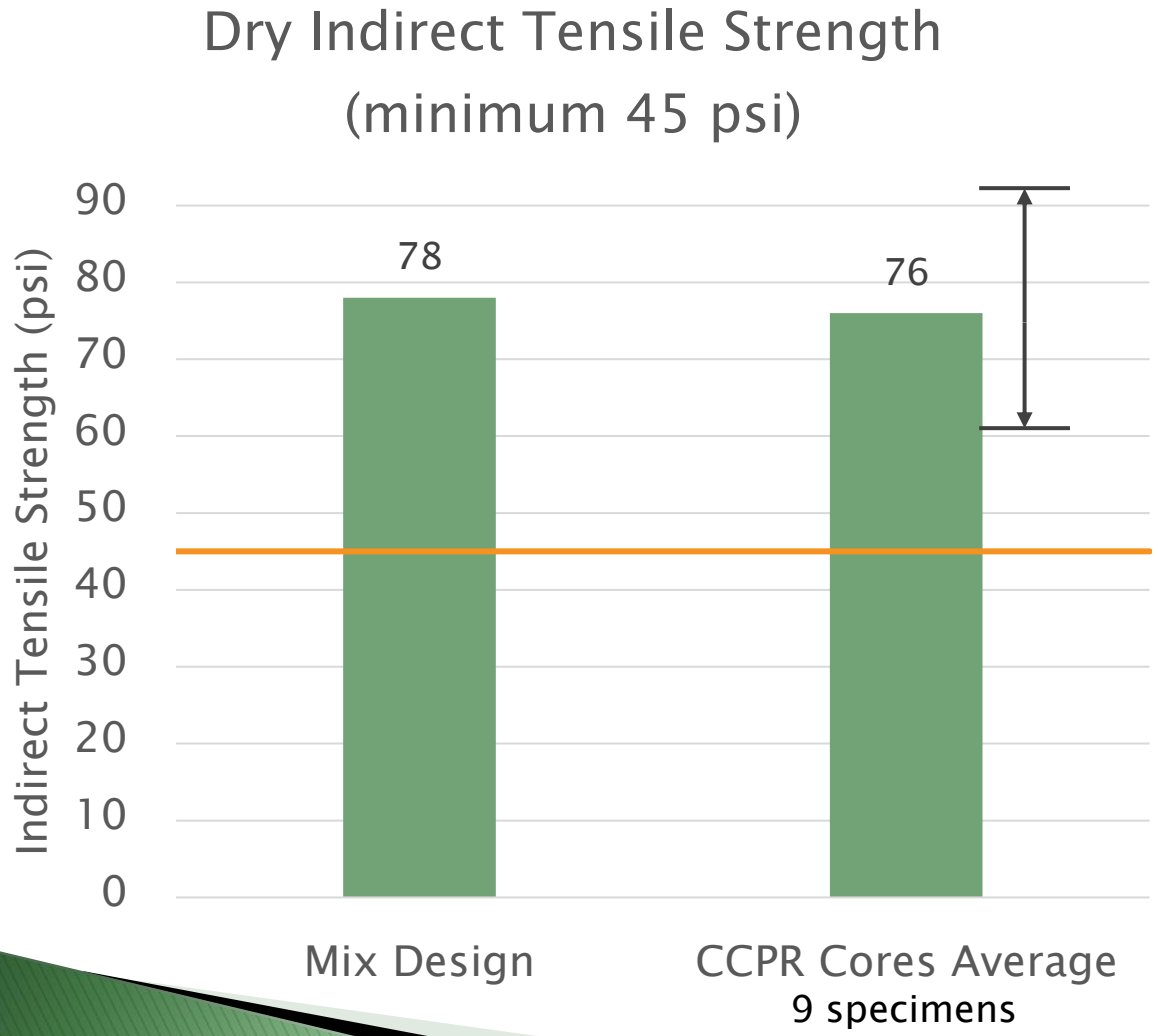
Catlin-Indianola Road CCPR

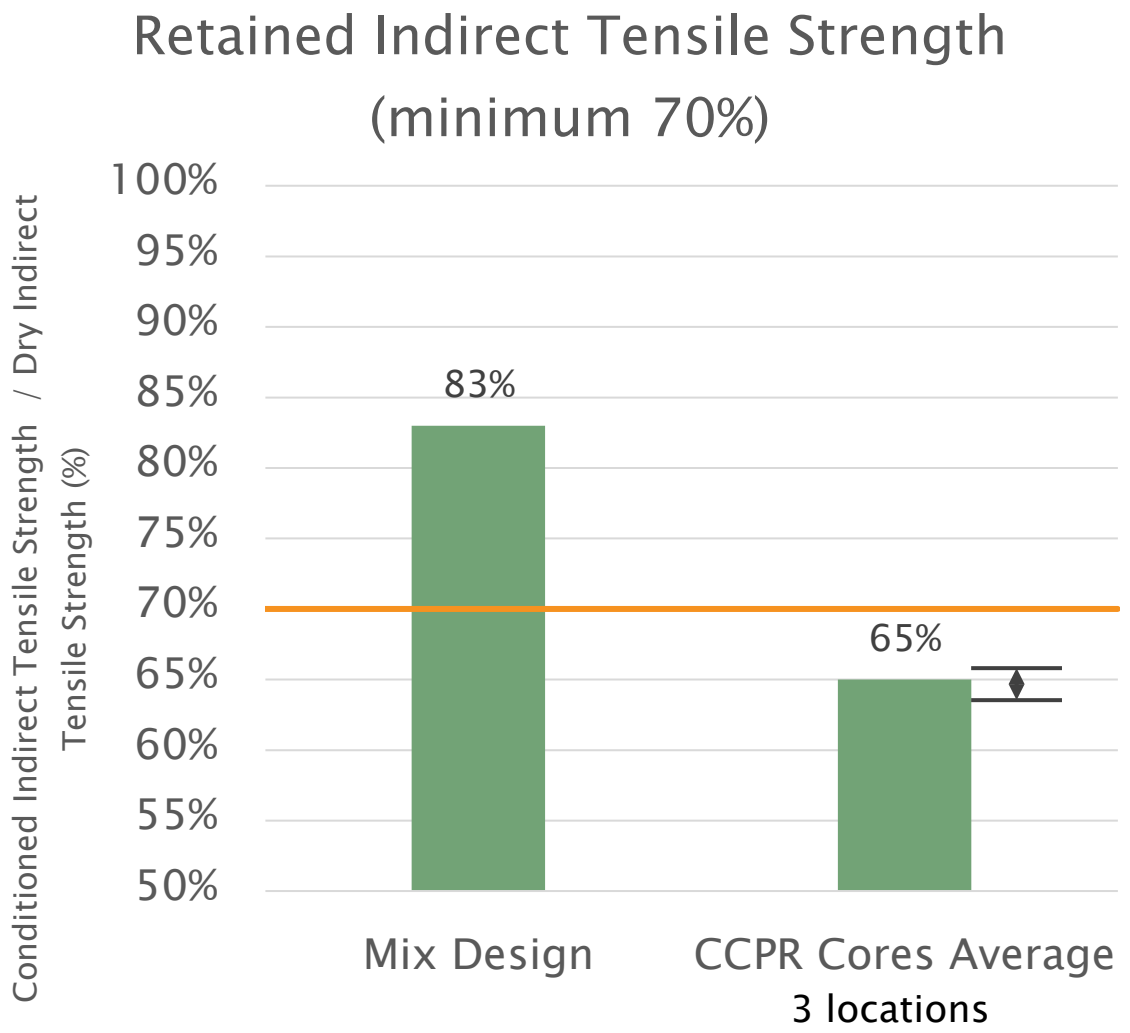




Mix Design Properties vs. Constructed Properties

Catlin-Indianola Road CCPR





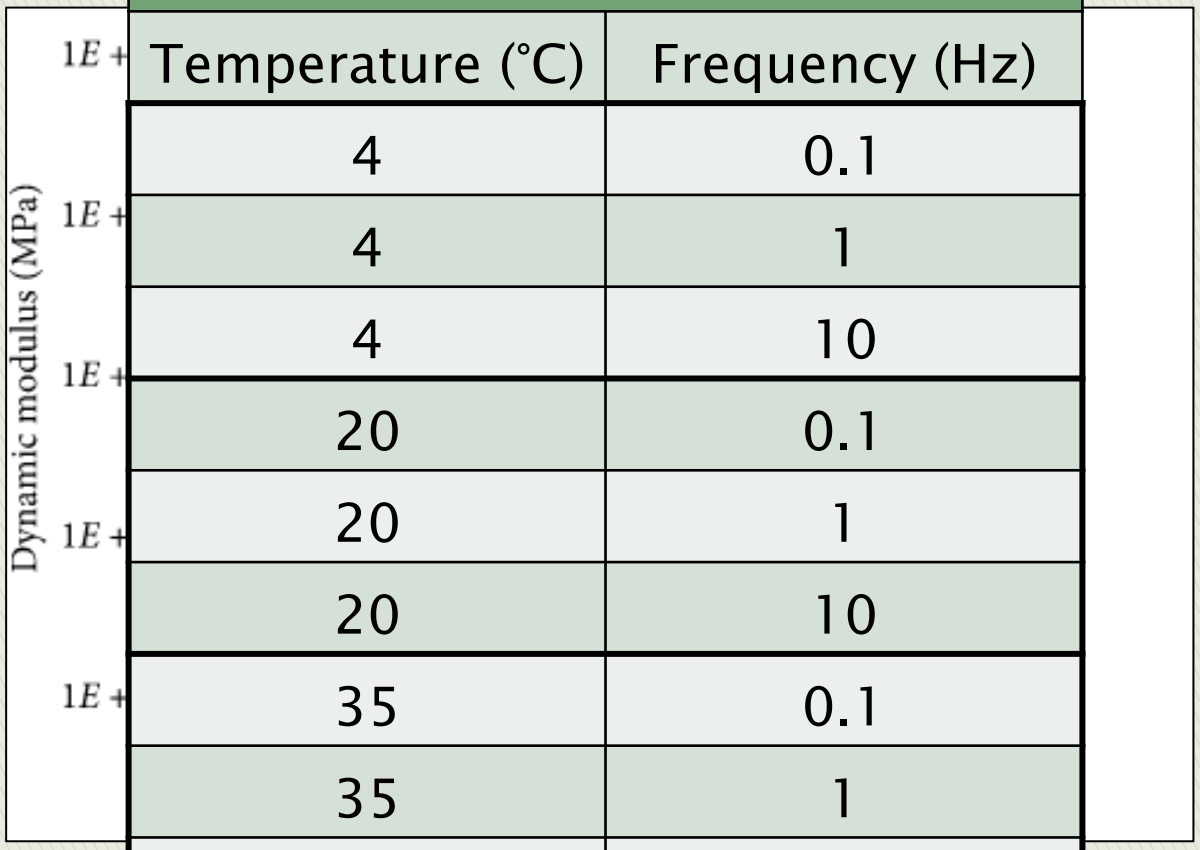
AMPT- Dynamic Modulus, E*

- **Equipment:** Temperature chamber, strain gauges, loading platens, small scale geometry specimens
- Small Scale specimen preparation for field cores and lab specimens per *AASHTO PP 99*
- Testing per *AASHTO TP 132*

AMPT- Dynamic Modulus, E*

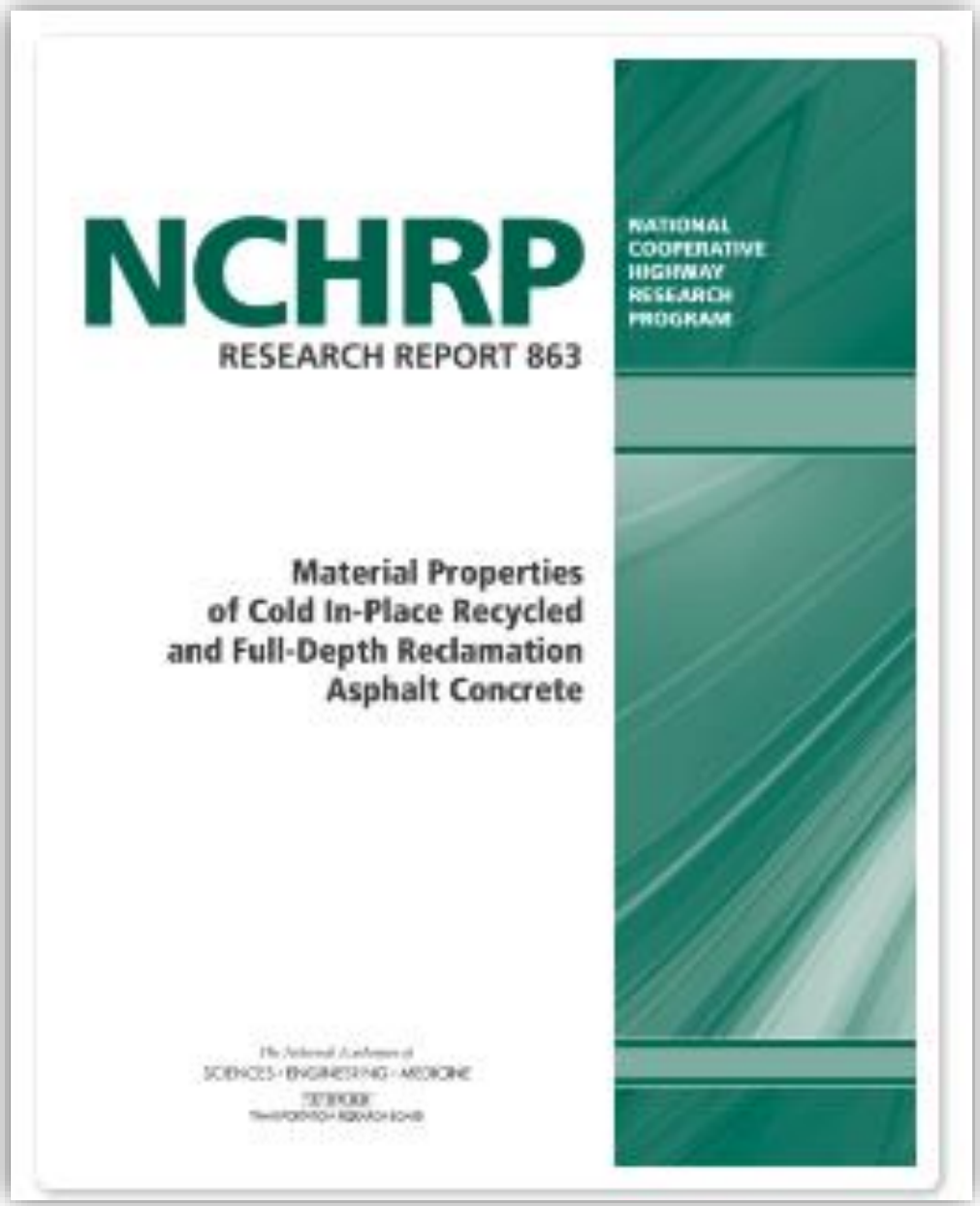
- **Measures:** Material response (strain) from sinusoidal loading (stress)
- **Outputs:** Data used to create a mastercurve, which predicts material response at ANY temperature or loading rate
  - -Used for pavement design (MEPDG)

Test Conditions	
Temperature (°C)	Frequency (Hz)
4	0.1
4	1
4	10
20	0.1
20	1
20	10
35	0.1
35	1
35	10



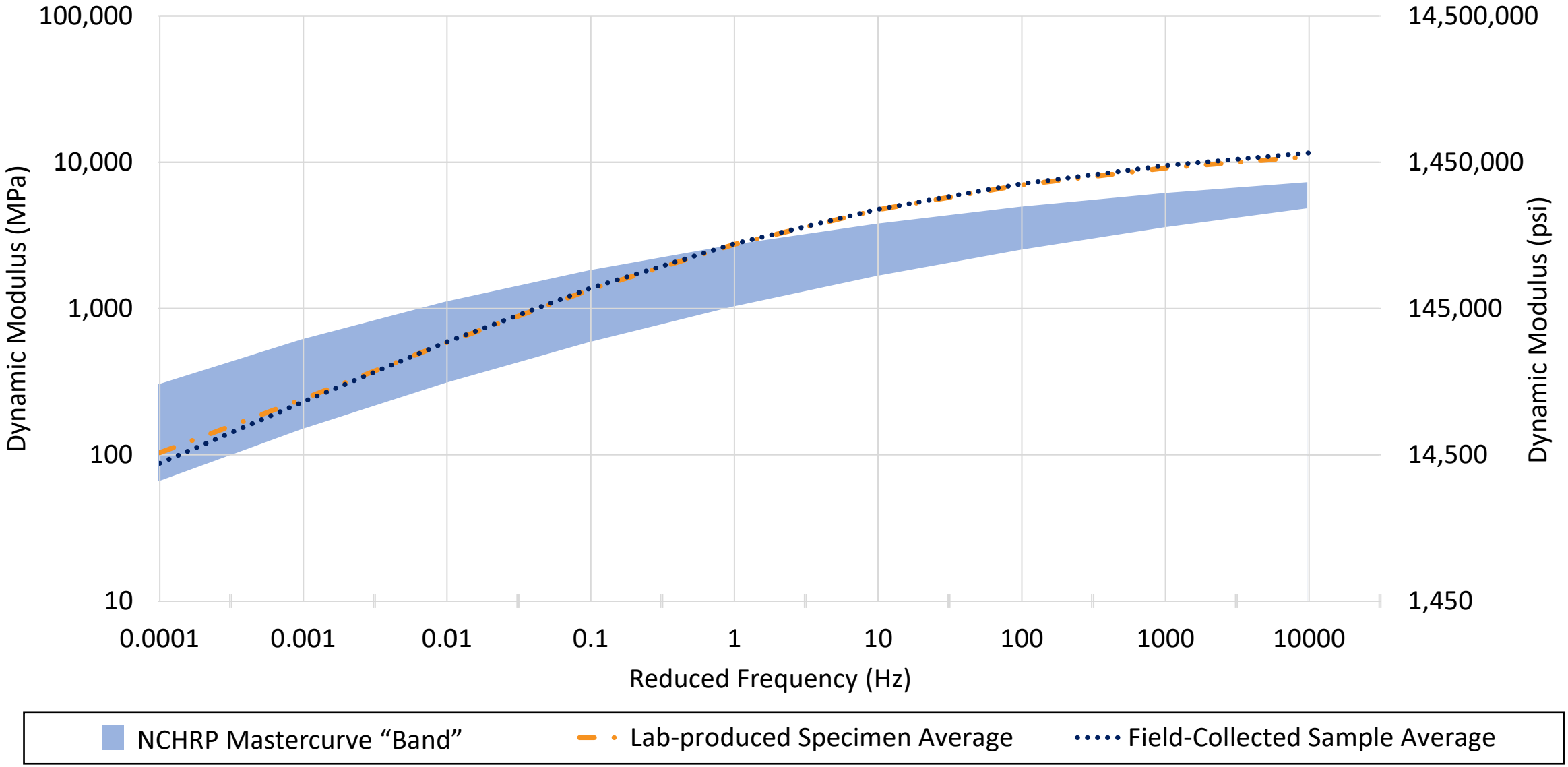
Applications to Industry

- Industry Research to model recycled layers in MEPDG programs with Level 1 inputs (NCHRP Research Report 863)
- Comparison with Industry-available mastercurves



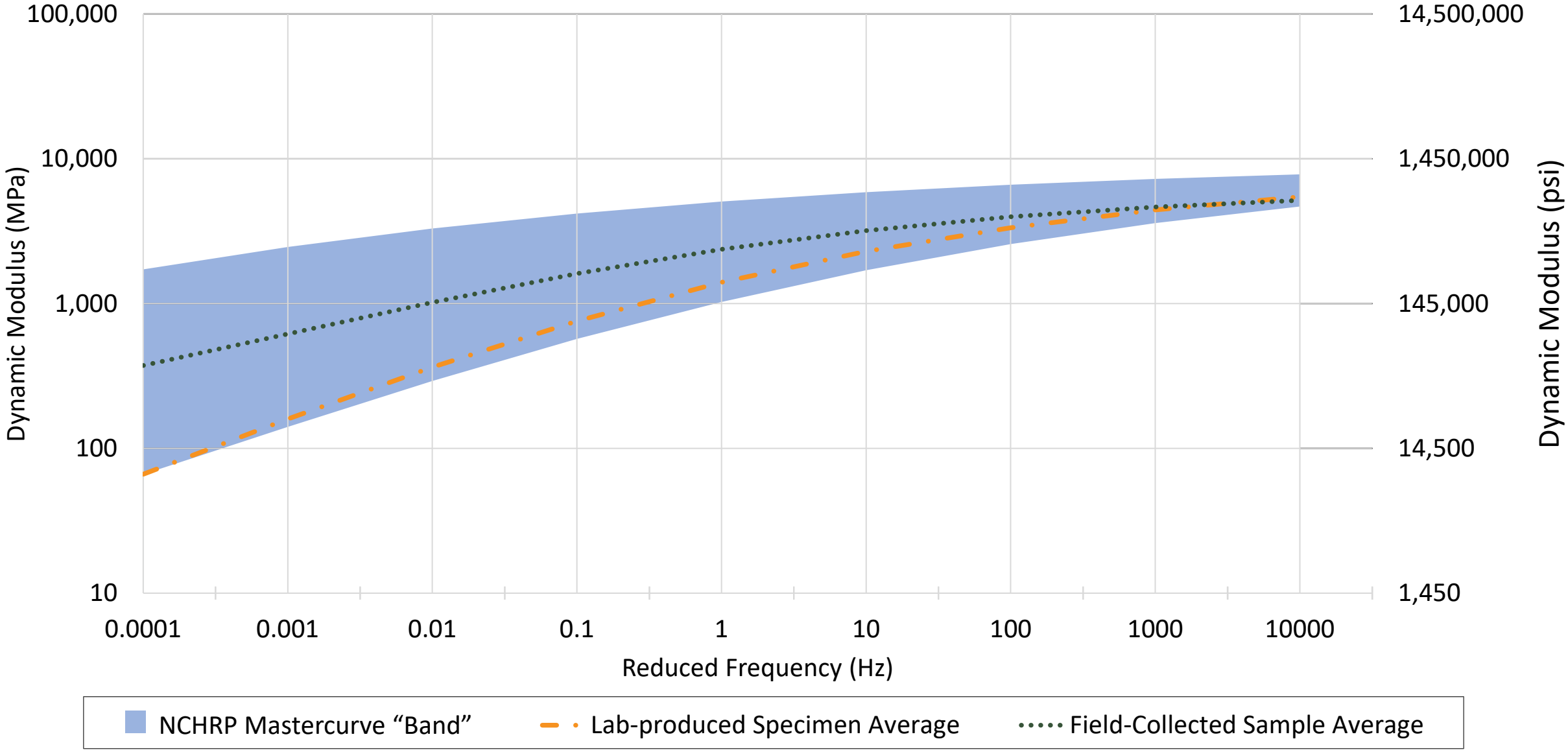
Catlin Indianola CCPR Dynamic Modulus Mastercurve

with reference to NCHRP Research Project 863: CCPR Mastercurves



SR 234 CIR Dynamic Modulus Mastercurve

with reference to NCHRP Research Project 863: Bitumen + Cement Curves



Discussion of Sample & Project Differences

In place of cores, how are CIR & CCPR projects typically verified for quality?

Test Type	Purpose
Depth of Pulverization	Confirming material amounts
Pulverized Material Gradation	
Asphalt Emulsion Content	
Water Content	
Optimum Field Density	Confirming peak density is reached, consistently
Compacted In-place Field Density	
Field Moisture Content for Curing	Confirming material can be overlaid

Takeaways

- Mix Design is a critical piece in beginning to understand constructed properties
- Collection of Cold Recycling cores is a unique opportunity to build knowledge and gather project data
- Industry has developed a platform for agencies to further understand these techniques and materials
  - -Specifications
  - -Research

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Thank you!