Concrete Pavement Evaluation

Concrete Pavement Preservation II

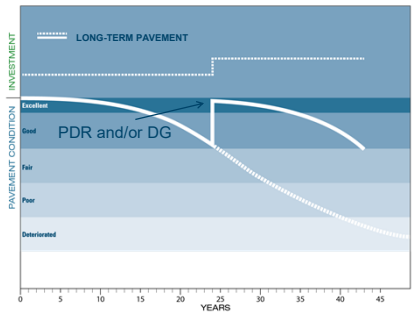
IOWA STATE UNIVERSITY
Institute for Transportation

National Concrete Pavement Technology Center
Tech Center

Purpose of a Pavement Evaluation

- Provides qualitative information to:
  - Determine causes of deterioration
  - Determine if pavement is not a candidate for preservation
  - Develop appropriate alternatives
- Provides quantitative information for:
  - Quantity estimates
  - Assessment of deterioration rates
  - Performing life-cycle cost analyses

Extend the Service Life in Good Condition

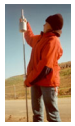


Project Evaluation Approach

- Historical data collection/records review
- Initial site visit and assessment
- Field testing activities
- Laboratory materials characterization
- Data analysis
- Final field evaluation report

Key Pavement Evaluation Components

- Pavement Distress & Drainage Surveys
- Nondestructive Testing
- Surface Characteristics Testing
- Field Sampling and Testing

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Purpose of Distress Survey

- Document pavement condition
- Identify types of distress characterized by severity and extent
- Group areas of similar performance
- Gain insight into causes of deterioration
- Identify additional testing needs
- Identify possible treatment alternatives
- Identify repair areas and quantities

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Distress Identification Manual

- Standardized distress definitions
- Benefits
  - More consistent calls
  - Better communication within and between highway agencies
  - Improvements in any agency activity using pavement performance information

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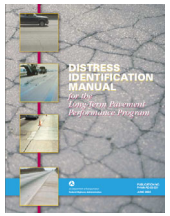
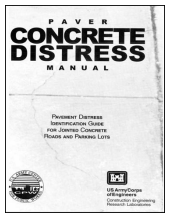
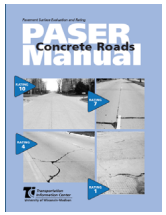
Example Distress Manuals







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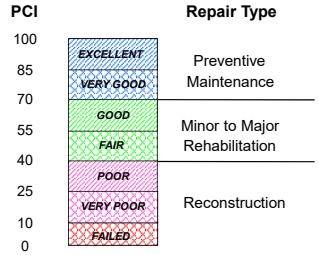
Output of Distress Surveys

- Distress types and quantities
- Overall indicator of condition (PAVER, PASER, State DOT procedures)

Example Index



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Common Concrete Pavement Distresses

- Corner Breaks
- D-Cracking or ASR
- Transverse Cracking
- Spalling
- Patch/Patch Deter.
- Joint Faulting
- Pumping
- Joint Seal Damage
- Blowup
- Map Cracking
- Punchout
- Scaling
- Longitudinal Cracking

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Common Concrete Pavement Distresses

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Longitudinal Cracking

Chapter 6. Longitudinal Cracking
2. Severity

Table 6.1 Severity levels of longitudinal cracking

Distress	Description and Severity Levels	Measurement
Longitudinal Cracking – Jointed Concrete Pavement (JCP)	Cracks that are predominantly parallel to the pavement centerline **Low:** Crack widths less than 0.125 in. (3 mm), no spalling, and no measurable faulting or well-sealed and with a width that cannot be determined **Medium:** Crack widths greater than 0.125 in. (3 mm) but less than 0.50 in. (13 mm); or with spalling less than 3 in. (75 mm); or faulting up to 0.50 in. (13 mm) **High:** Crack widths greater than 0.50 in. (13 mm) or with spalling greater than 3 in. (75 mm) or faulting greater than 0.50 in. (13 mm)	Record the length of longitudinal cracking at each severity level. Also record the length of longitudinal cracking with sealant in good condition at each severity level. Sealant is not considered to be in good condition unless at least 3 ft (1 m) of continuous sealant in good condition is present. In cases where a crack is less than 3 ft (1 m) long, the sealant must be present and in good condition over the entire length of the crack.

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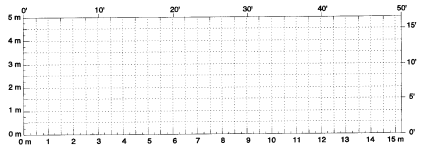
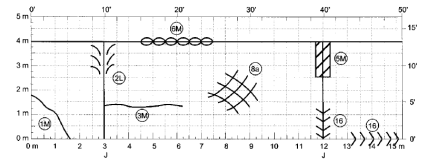
Example Distress Form

Blank



Filled Out



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Drainage Survey

- Purposes:
  - Identify moisture-related distress
  - Document drainage conditions
  - Assess overall pavement drainability
- Things to look for:
  - Topography and cut/fill
  - Pavement/shoulder slopes
  - Condition and geometrics of ditches
  - Condition of drainage outlets or inlets

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Nondestructive Testing

- Not needed on all pavement preservation projects
- Information can be confirmed such as thicknesses, pavement properties, load transfer capabilities, voids, and embedded steel alignment
- Can have significant testing and analysis costs

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Deflection Testing

- For pavement preservation work, valuable tool for assessing:
  - Joint load transfer
  - Presence of voids
  - Structural adequacy
- Fast and produces repeatable results
- Commonly used in project-level analysis

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Use and Interpretation of Deflection Data

- Deflection uniformity along project
- Backcalculation of pavement properties
- Evaluation of joint/crack load transfer
- Void detection

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Ground Penetrating Radar (GPR)

- Determine layer thickness
- Embedded steel location
- Presence of underlying voids

Layer Type	Accuracy (vs. Cores)
New Asphalt	3 – 5%
Existing Asphalt	5 – 10%
Concrete	5 – 10%
Granular Base	8 – 15%

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Magnetic Imaging Tomography (MIT)

- MIT Scan-2
  - Evaluate dowel bar location and orientation
- MIT Scan T2
  - Determine concrete slab thickness

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Ultrasonic Tomography (MIRA)

- Layer thickness
- Relative concrete strength
- Cracking in the concrete layer
- Debonding between concrete layers
- Location of embedded steel
- Areas of joint deterioration and poor consolidation

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Roughness Surveys

- Measures actual pavement profile
- Widespread use in network-level pavement management
- Relatively accurate and repeatable measurements

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Testing Equipment

Non-Contact Lightweight

Portable Laser

High-Speed Profiler

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Roughness Indicators

- International Roughness Index (IRI), current measurement standard
- Pavement Serviceability Rating (PSR)
- General correlations:

Ride Quality	IRI (in/mi)	PSR
Good	< 95	≥ 3.5
Acceptable	≤ 170	≥ 2.5
Not Acceptable	> 170	< 2.5

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Friction Surveys

- Assess overall adequacy of pavement friction as it contributes to safety
- Identify localized areas with poor friction
  - Curves
  - Intersections
  - Ramps

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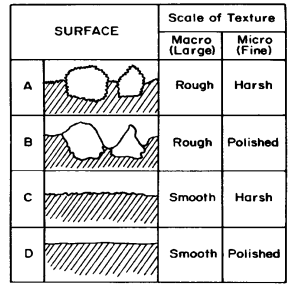
Assessing Surface Friction

- Measure surface friction directly with various devices (e.g., skid trailer)
- Must also consider surface texture
  - Microtexture
  - Macrotexture



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Measuring Surface Texture

- Volumetric (“Sand Patch”) method
- Outflow Meter
- Circular track meter (CTMeter)
- High-speed laser-based devices

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Tire/Pavement Noise Survey

- Emerging as a critical issue, especially in high-volume urban areas
- Problematic to adjacent property and business owners and the traveling public
- On-Board Sound Intensity (OBSI) method

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Purpose of Field Sampling and Testing

- Purposes:
  - Determine layer thicknesses
  - Characterize material properties
  - Diagnose causes (mechanisms) of distress
- Can consist of:
  - Field sampling
  - Field testing
  - Laboratory testing

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Common Field Sampling and Testing Methods

- Coring
- Material sampling
- Dynamic cone penetrometer (DCP)
- Standard penetration testing (SPT)

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Common Laboratory Tests

- Subgrade and granular base/subbase
  - Characterization (soil classification, moisture content)
  - California Bearing Ratio (CBR)
  - Resilient Modulus (Mr)
- Stabilized layers and PCC slab
  - Indirect Tension
  - Unconfined Compression
  - Special Materials Evaluation Tests

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Then and Now Distress Identification

Then

- Discrete Test Locations (Sampling)
- Manual Data Collection & Analysis
- Limited Computing Capacity
- Field Reviews Only
- Guestimates of Climate Data
- Little to No Ability to Evaluate Products or Test Sections
- Linear MP Location Data
- 2D Profile Measurements
- Limited to No Maintenance Data
- Questionable Traffic Data

Now

- 100% Roadway Coverage
- Automated Data Collection & Analysis
- Almost Unlimited Computing Capacity
- In-Office Visual Review of Roadways
- Accurate Environmental Data
- Ability for PMS to Test Sections and Products
- GPS Coordinates
- 3D Profile Measurements
- Exact Maintenance Locations and Costs
- Better Traffic Data?

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Additional Information

- Introduction
- Preventive Maintenance and Pavement Preservation Concepts
- **Concrete Pavement Evaluation p. 17-57**
- Slab Stabilization and Slab Jacking
- Partial-Depth Repairs
- Full-Depth Repairs
- Retrofitted Edgedrains
- Dowel Bar Retrofit, Cross Stitching, and Slot Stitching
- Diamond Grinding and Grooving
- Joint Resealing and Crack Sealing
- Concrete Overlays
- Strategy Selection

Will be updated 4th quarter 2020

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Thanks for your time

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Concrete Pavement Evaluation for Restoration

CP Tech Center Preservation Webinar

June 9, 2020

John Donahue, P.E.
Construction and Materials Liaison Engineer

PCC Restoration History in Missouri

- Missouri had traditionally addressed pavement distresses in new and existing PCC pavements with full depth repairs or asphalt overlays.
- Often, the magnitude of the solutions were disproportionate to the severity of the distresses.
- A move to employ alternate, less intrusive preservation, repair, and rehabilitation treatments began in the early 2000's.
- PCC restoration techniques have yielded short-to-long term performance benefits.

I-35 JRCP in Clinton County with Asphalt Overlay Milled

Only do what's necessary!

PCC Pavement Evaluation Considerations

- Distress severity
- Location of distresses
- Age of PCC pavement
- Depth of reinforcement
- Load transfer
- Aesthetics
- Estimating quantities

Distress Severity

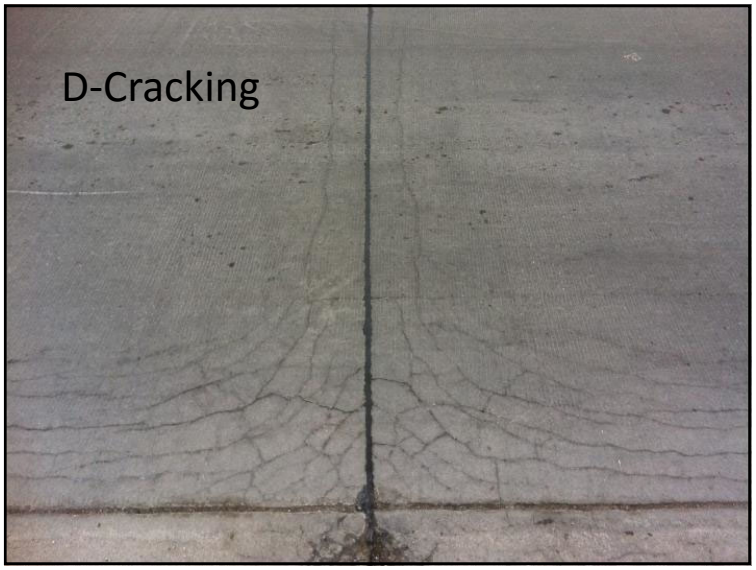
Full depth repairs should be a last resort!

Primarily for –

- Shattered slabs
- Severe spalling
- Internal degradation (D-cracking, ASR, etc.)

I-35 Shattered Slab

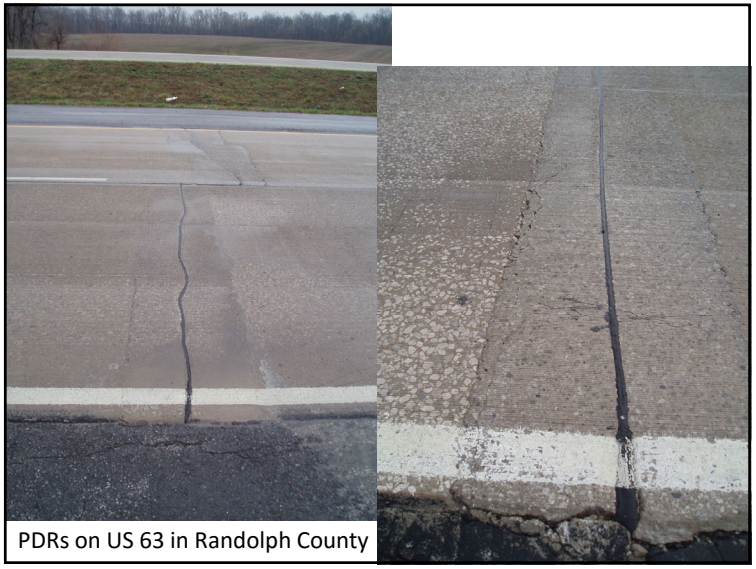

I-64 Joint Spalling


D-Cracking


Low Air Content

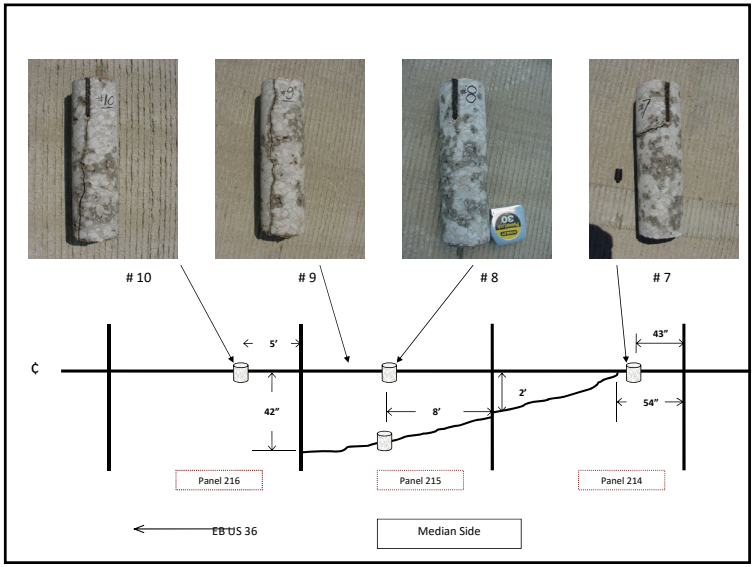

Short-Term
Solution

Do nothing?



PDRs on US 63 in Randolph County

Location of Distresses



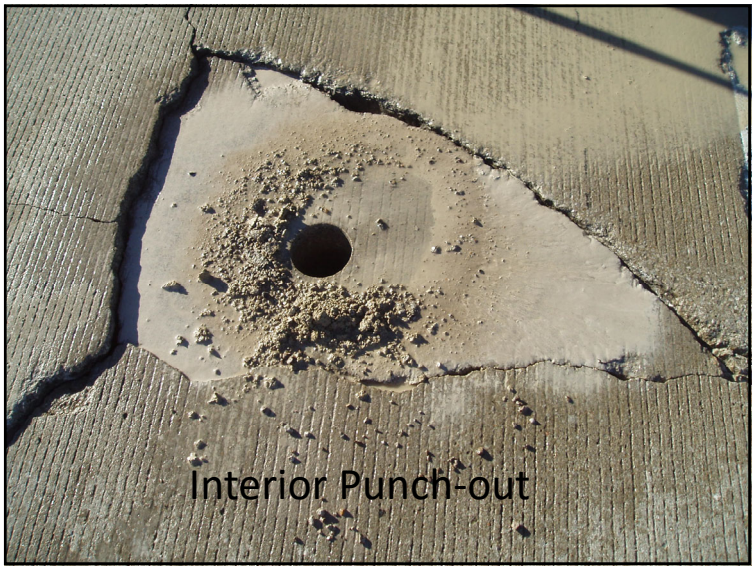

Age of PCC Pavement
Rte 105 in Charleston at 47 Years


65-Year Old
Pavement!!


45-Year Old JRCP


No Mid-Panel Cracks


7-Year Old Unbonded JPCP Overlay


Interior Punch-out


No Interlayer !!


Epoxy Repairs
on US 36

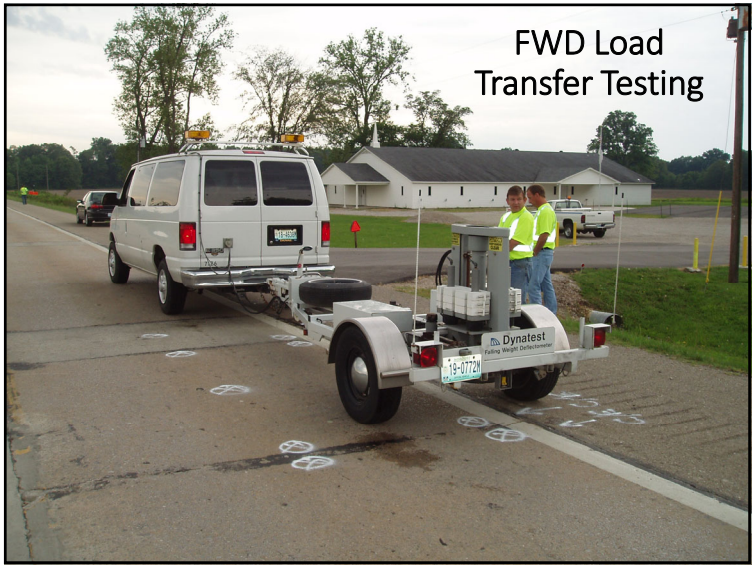

Depth of
Reinforcement

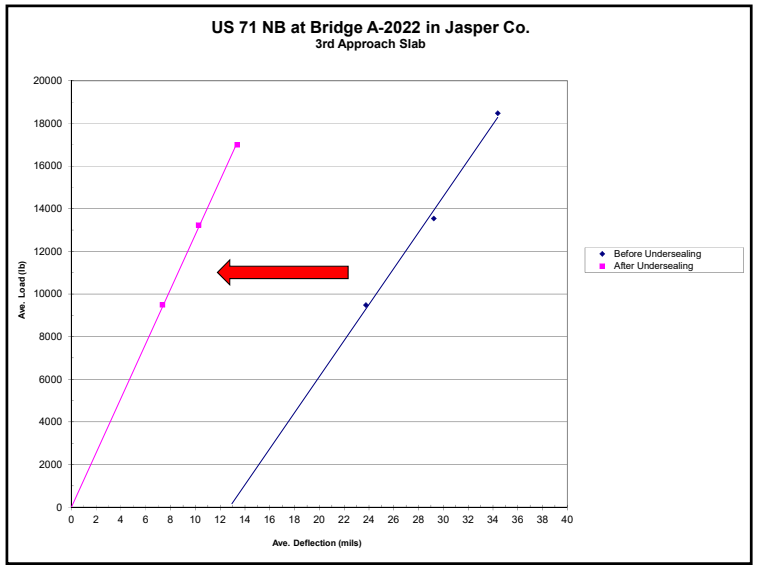

JRCP Wire Mesh Placement


‘Manual’ Depth
Adjustments

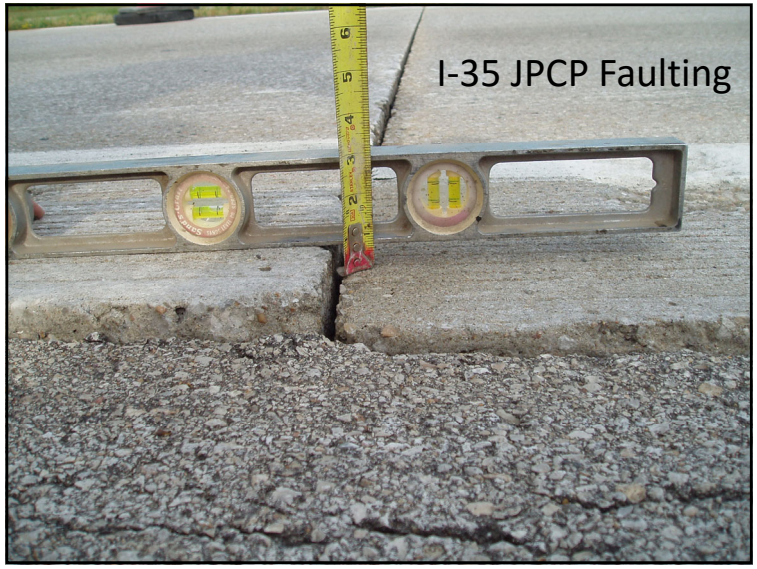

Checking Depth
of Steel
Reinforcement

Load Transfer



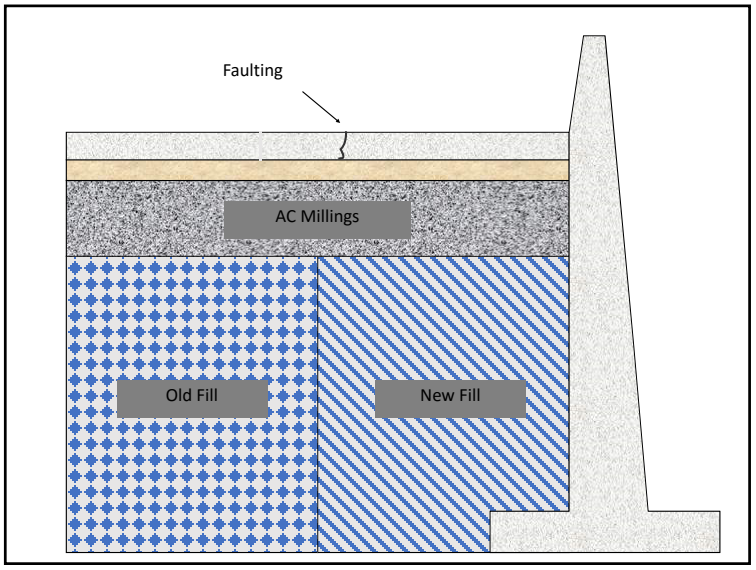

US 71 NB at Bridge A-2022 in Jasper Co.
3rd Approach Slab
Ave. Load (lb)
Ave. Deflection (mils)
Before Undersealing
After Undersealing


US 67 in Butler County

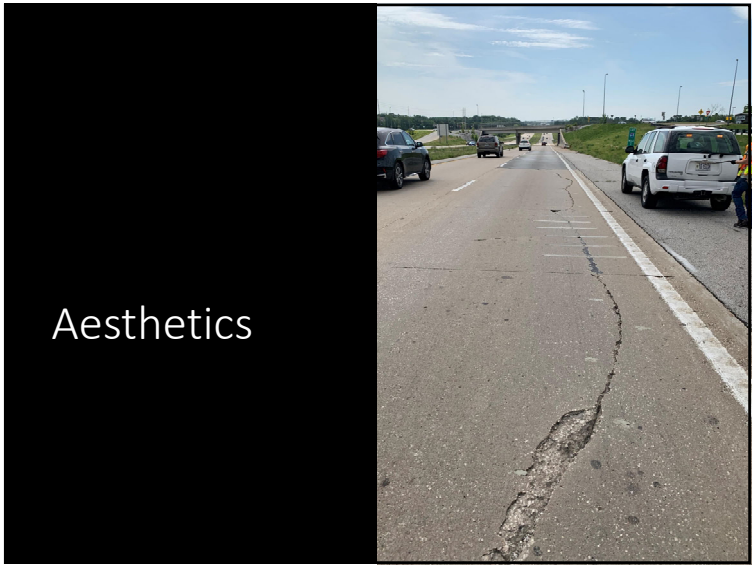

I-35 JPCP Faulting


Inadequate Dowel Bar
Embedment

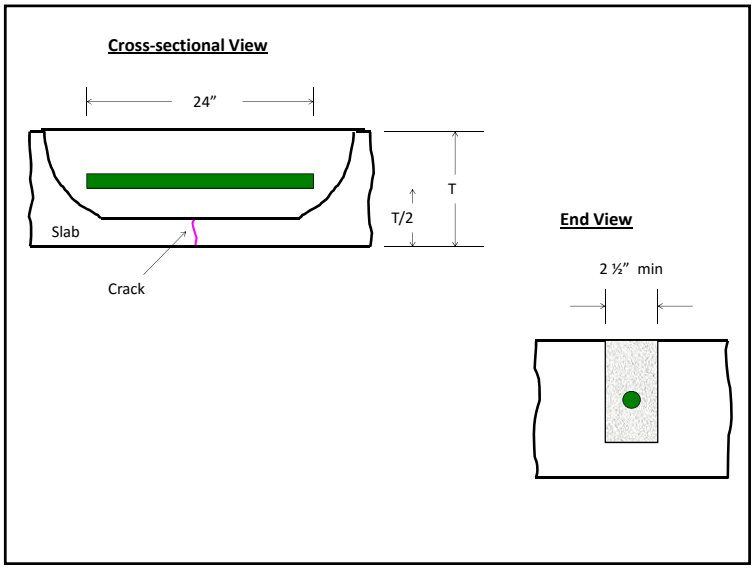

Longitudinal cracking and faulting
Rte 94 in St. Charles County

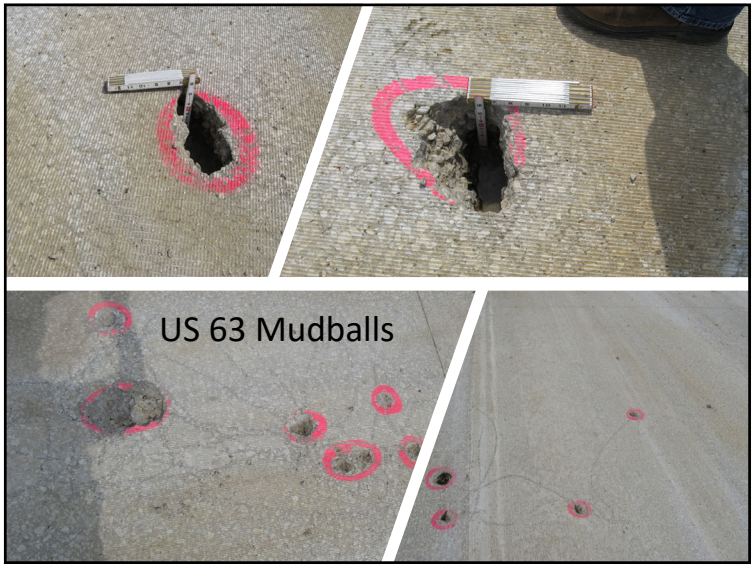

Faulting
AC Millings
Old Fill
New Fill


March 2009
Heavy Duty Cross-Stitching
February 2013


Aesthetics


I-55 Exit Ramp in Scott County


Cross-sectional View
24”
T
T/2
Slab
Crack
End View
2 ½” min


US 63 Mudballs

Cross-stitching appearance

Estimating Quantities

Scoping Repair Quantities

- Generally, repair quantities can be expected to increase ~ 10% from the time of project scoping to the award of contract, so roadway designers should set up plan quantities accordingly.
- Logmile or GPS coordinates for repairs should be included.
- May (or not) add other preservation treatments as contingency.

Field Inspector Reviews

- After a project is let, plan quantities for repair work will probably require modifications based on real time conditions.
- Construction inspectors will increasingly find themselves making repair decisions on the fly and therefore should have a general understanding of concrete restoration treatments and triggers.
- Project construction engineers must make decisions to stay within the contract budget.

Thank you!

Questions?

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