MOTT MACDONALD

I-77 Corridor Pavement Management Case Study

Neil Mastin
Mott MacDonald
Infrastructure Advisory Services

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

Covered in this Presentation

- Project Background
- Project Activities
- Data Collection Concepts and Activities
- Next Steps

I-77 HOT Lanes Background

In July of 2014, the NCDOT entered into a comprehensive agreement with I-77 Mobility Partners LLC (Led by Cintra) as a public-private partnership (P3) to expand and widen I-77 near Charlotte, NC

- Project Expanded the roadway from one (1) HOV/HOT lane to (2) HOT lanes
- Extension of the HOT lanes south to I-277 and north to exit 36
- 2-3 general lanes run concurrently with the HOT lanes in each direction
- *I-77 agreement requires a 3rd party to act as an independent Pavement Management expert*
- https://www.i77express.com/

High-level Overview of the Project

- Collect Pavement Data On All HOT and General Purpose Lanes
  - Partnership with ARRB Systems
  - Surface distress and structural data
  - Leverage NCDOT provided data for comparison purposes
- Provide Pavement Data Analysis for HOT and GP Lanes
- Set-up a corridor specific Pavement Management System (PMS)
- Analyze Proposed Work Programs
- Produce Annual Report with Recommendations
- Review and Inspect Retained Work

Unique Elements of the Project for NCDOT

Use of Traffic Speed Deflectometer for structural data collection

ASTM E3303 crack density implementation and comparison with traditional NCDOT Pavement Condition metrics

Corridor management is a mix of PPP and state-maintained roadway

Cracking data collection by two vendors on the same roadway allowing a unique opportunity for comparison

All data and analysis provided to the highway developer and NCDOT for full transparency

Data Collection and Analysis

Collect Automated Pavement Data each year, including use of a Traffic Speed Deflectometer (TSD) in the 1st and 5th year

Store data and conduct Pavement Data Analysis in a SaaS hosted Pavement Management System

Compare Developer and NCDOT Work Programs

- Developer 1 and 5 Year Work Plans for HOT Lanes
- NCDOT Interstate Maintenance plan for the General-Purpose lanes.

Project future PCR and recommended treatments by segment based on the PMS modeling and analysis.

- Multiple short- and long-term analysis periods will be utilized

Produce Annual Report with Recommendations for consideration by NCDOT (General Purpose Lanes), and by the Developer (Toll Lanes)

PMS Analysis

The PMS will be configured specifically for the I-77 corridor to house lane-specific pavement inventory and condition data and to perform analysis.

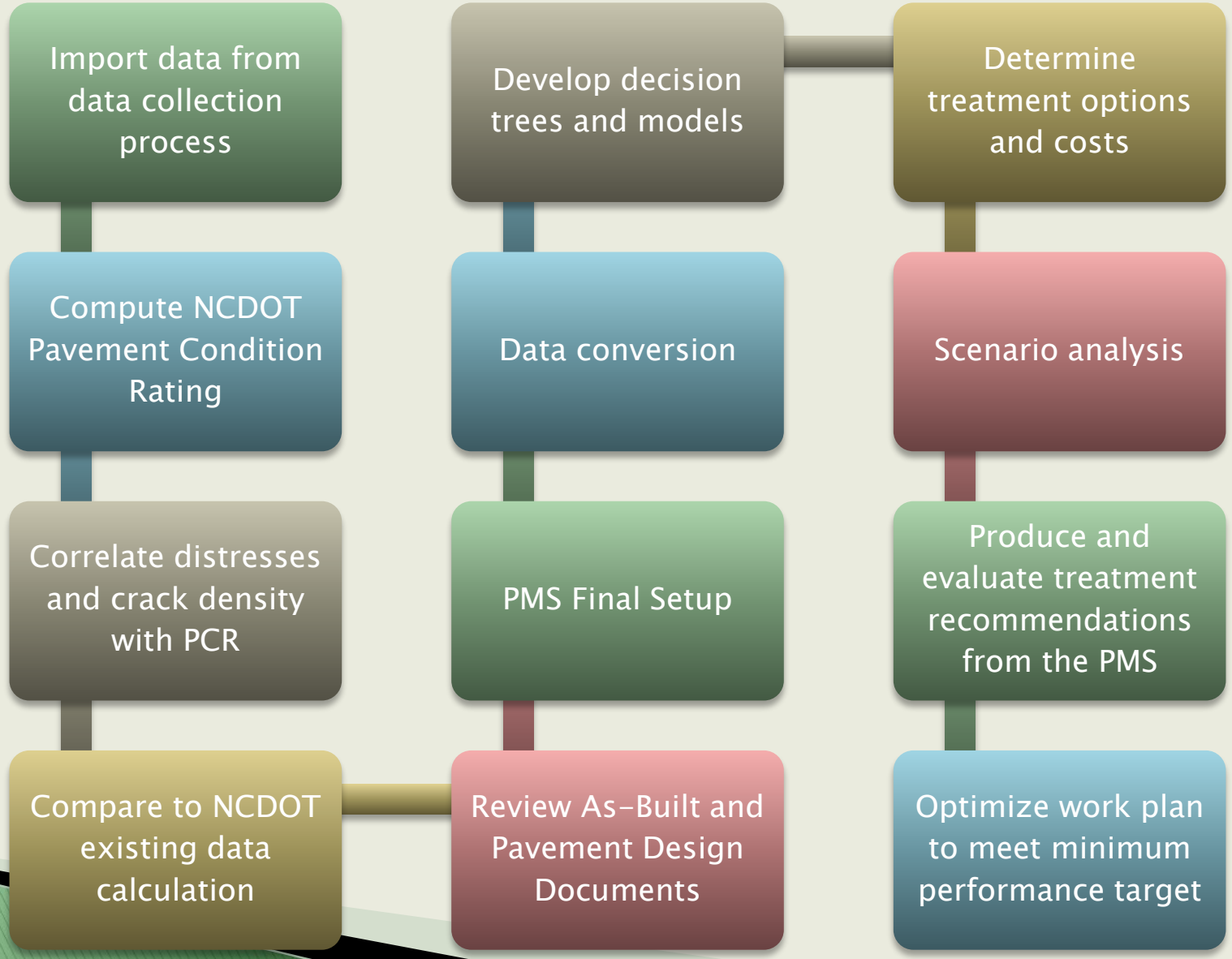
- Crack density data collection method will provide additional granularity needed for the analysis.
- We will correlate distresses and crack density with NCDOT Pavement Condition Rating (PCR)
- Values will be compared with any existing data calculation performed by others, e.g. NCDOT's current data collection vendor, to determine if any significant variability exists.

PMS Analysis

MM team will run various optimization analysis scenarios plans that meet the minimum performance targets established in the P3 Technical Requirements.

- The proposed PMS will be use to analyze the data collected for the purposes of calculating required PCRs for each roadway segment
- The PMS will assist in providing a recommended (optimized) work plan, and projections of future roadway conditions with respect to performance criteria established between NCDOT and the Developer.
- NCDOT and Developer planned projects will be incorporated into the analysis.

Pavement Optimization Process

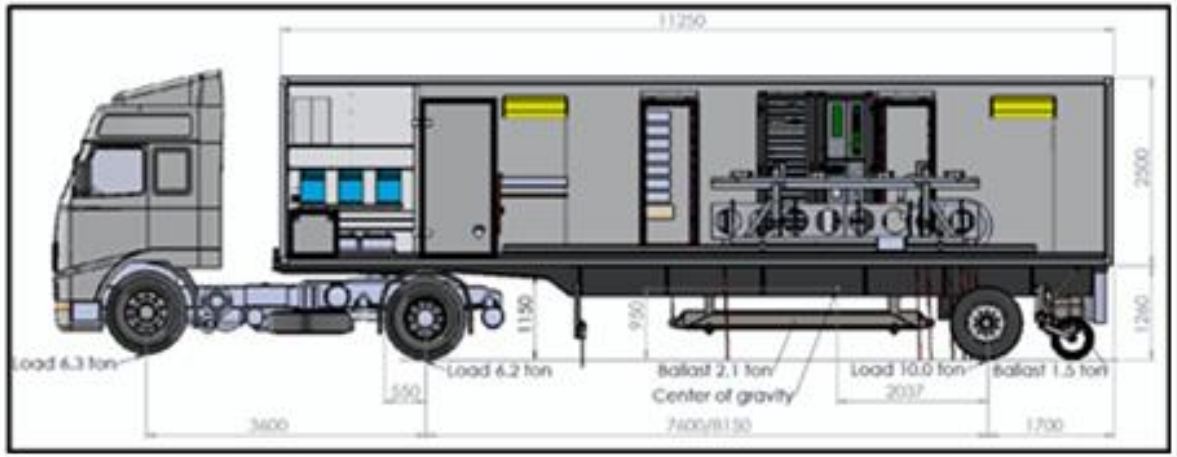


Data Collection

Why did we choose to use the Traffic Speed Deflectometer (TSD)?

- Assess the Structural Condition of Pavement at high speed
- Continuous Data Measurement
- Identifying weak sections of road surfaces
- Determine sections suitable for preservation vs sections that will require heavier treatments
  - *Right Treatment, Right Place, Right Time*
- This project encompasses both Network and Project-level Pavement Management

Courtesy ARRB Systems

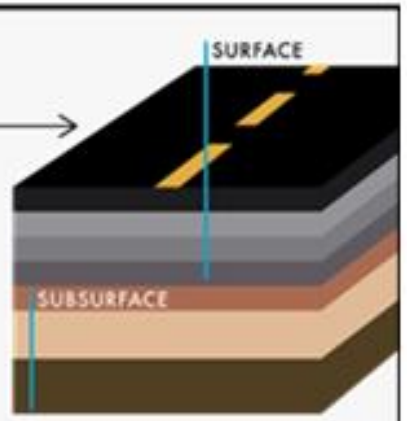


RATING

- Evaluates the pavement surface
- Does not account for service life

HEALTH

- Measures subsurface conditions
- Accounts for service life



Courtesy ARRB Systems

Road Surface Characteristics
Automated Rutting & Crack Detection

+

Pavement Structural Response
Velocity of deflecting road surface

Single Pass Collection

- Crack detection
- Multiple high frequency lasers for deflection
- Roughness Detection
- Right-of-way cameras
- 3D GPR Capability →

Pavement with a smooth surface but…

Courtesy ARRB Systems

…cores show problems with pavement health

Courtesy ARRB Systems

Surface Characteristics

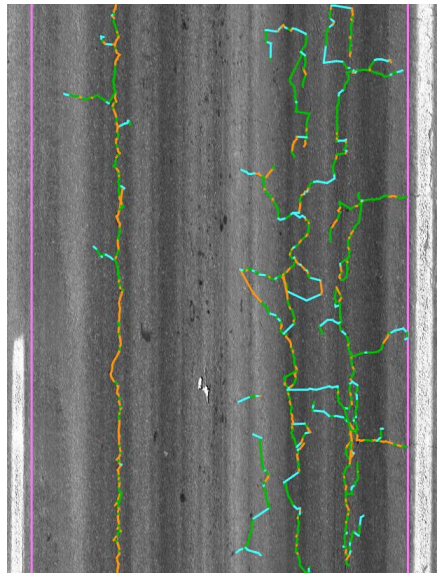
AUTOMATED CRACK DETECTION

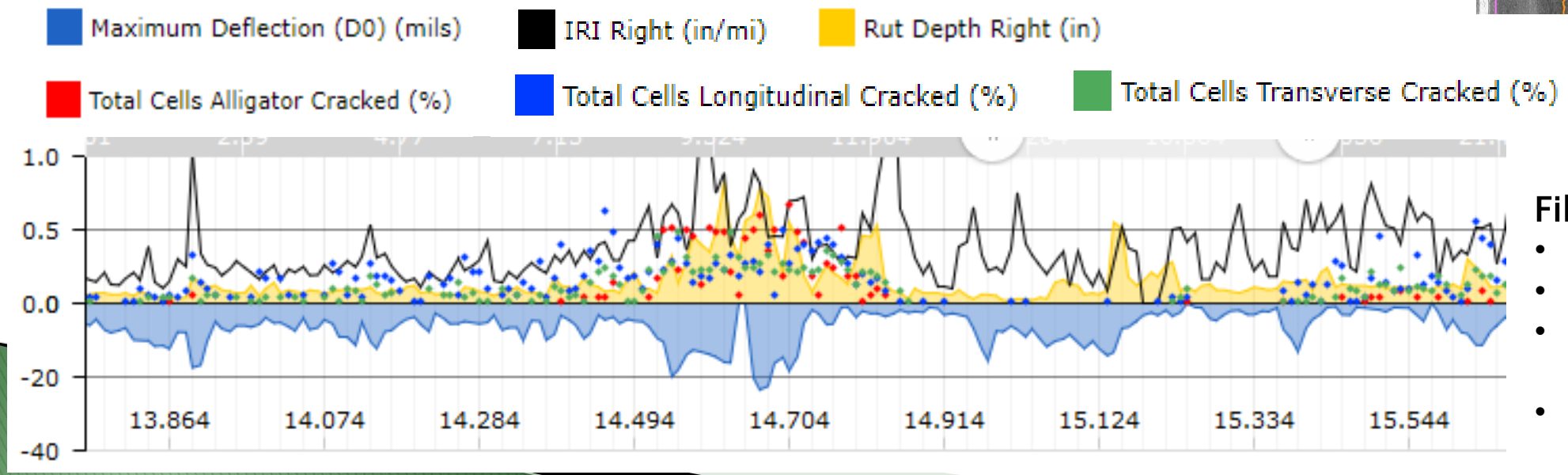
PAVEMENT PROFILE, ROUGHNESS AND TEXTURE

RUT MEASUREMENT

DISTANCE AND LOCATION MEASUREMENT

IMAGING

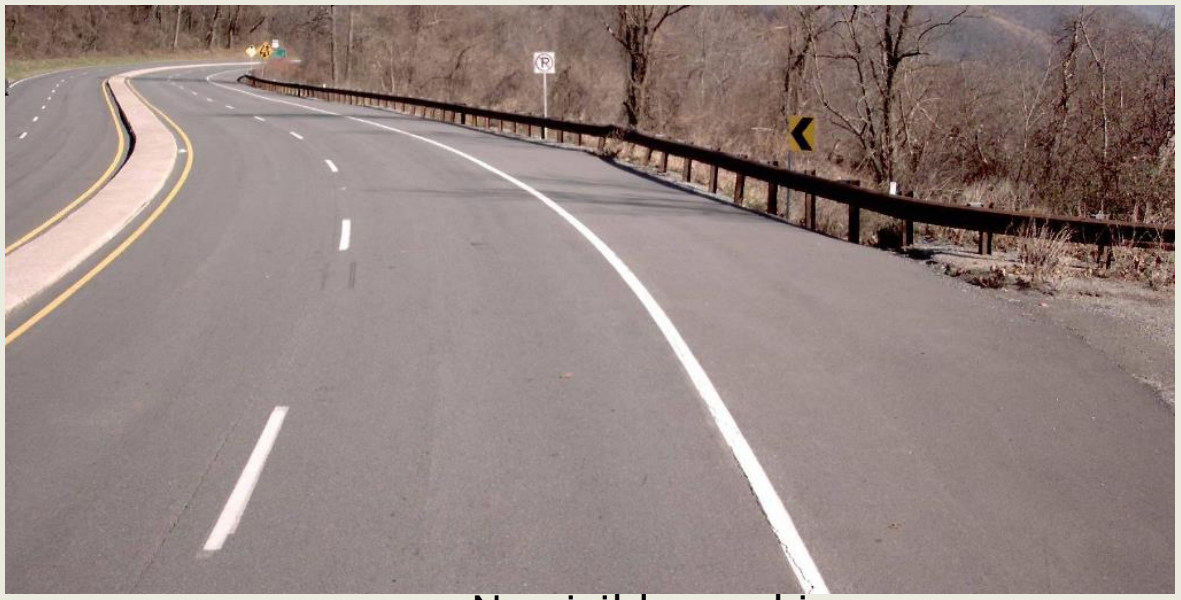




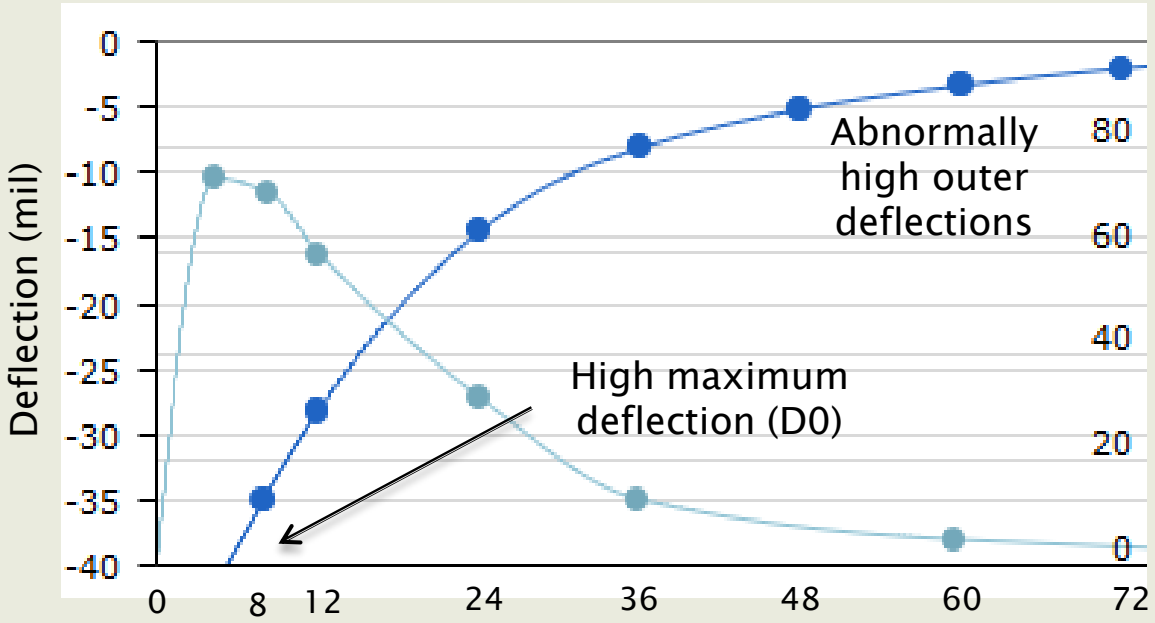
Filters:

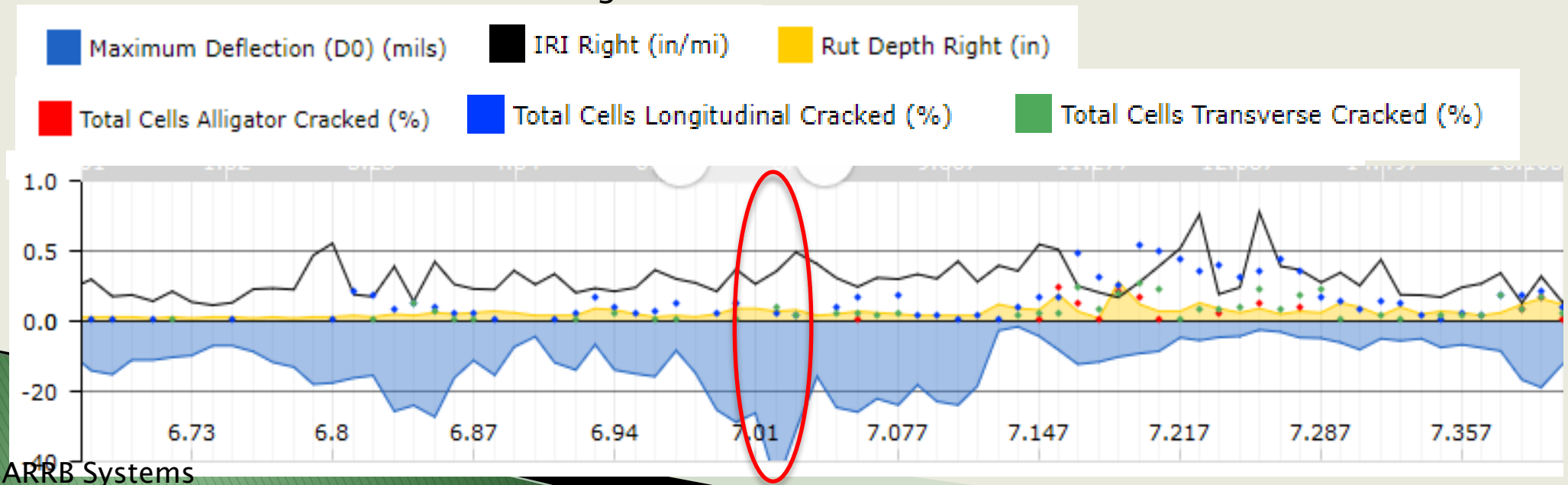
- IRI > 120
- Rutting > 0.3 in
- WP Cracking > 50%
- D0 > 21 mils

Looks great, but is it?



No visible cracking





Courtesy ARRB Systems

Crack Density

Crack Density and ASTM E3303: A change in thinking for cracking

Traditional Distress Definitions

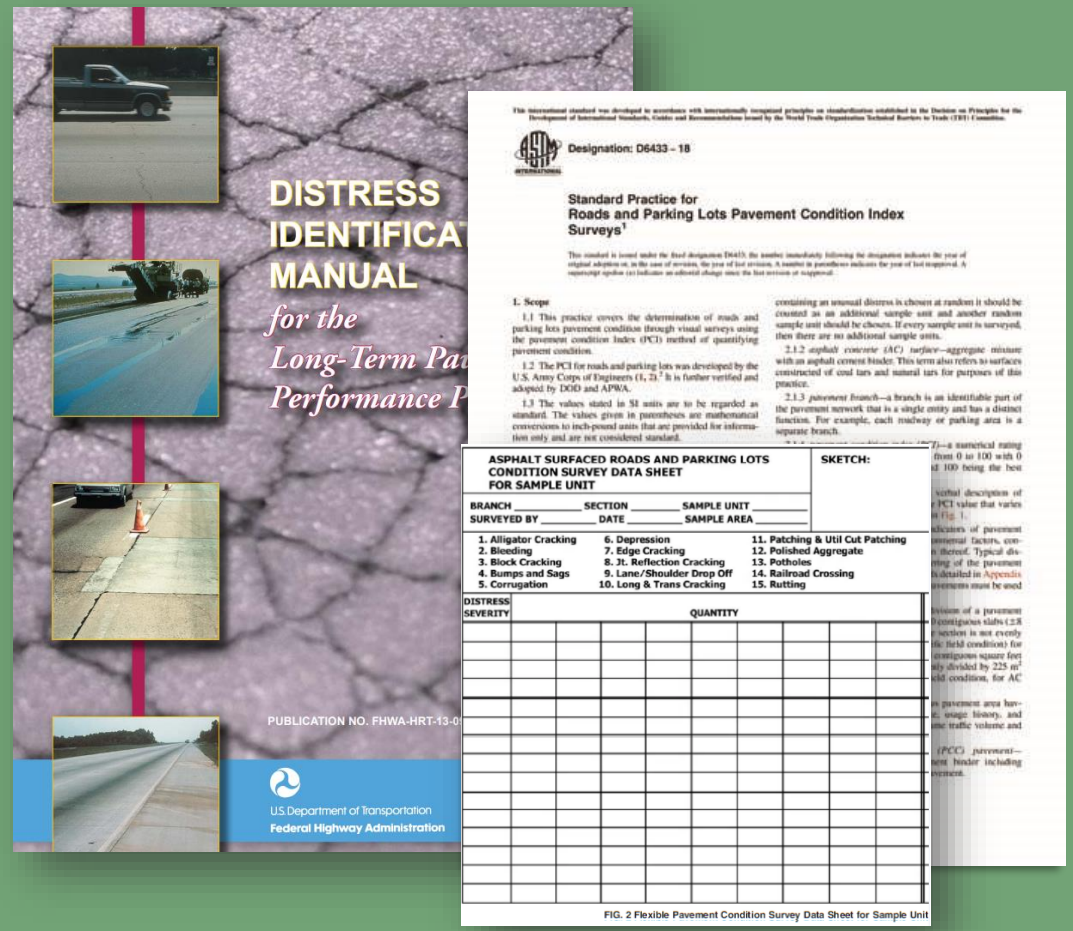
- Distress Type/Class
- Severity
- Quantity

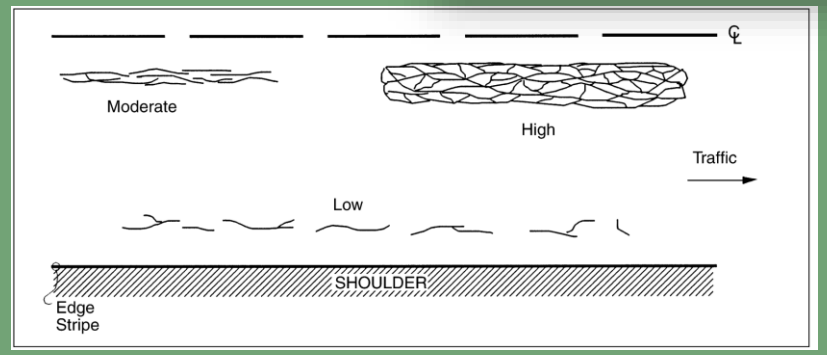
Cracking distresses are problematic to process

- Classification is an especially complex problem

Processing errors impact quality of data to be used in decision-making

Focus on what automated data collection does well





Crack density approach

Crack Density = Total length of cracks/unit area (ft/SY)

- E3303 also consider crack width

Magnitude can indicate:

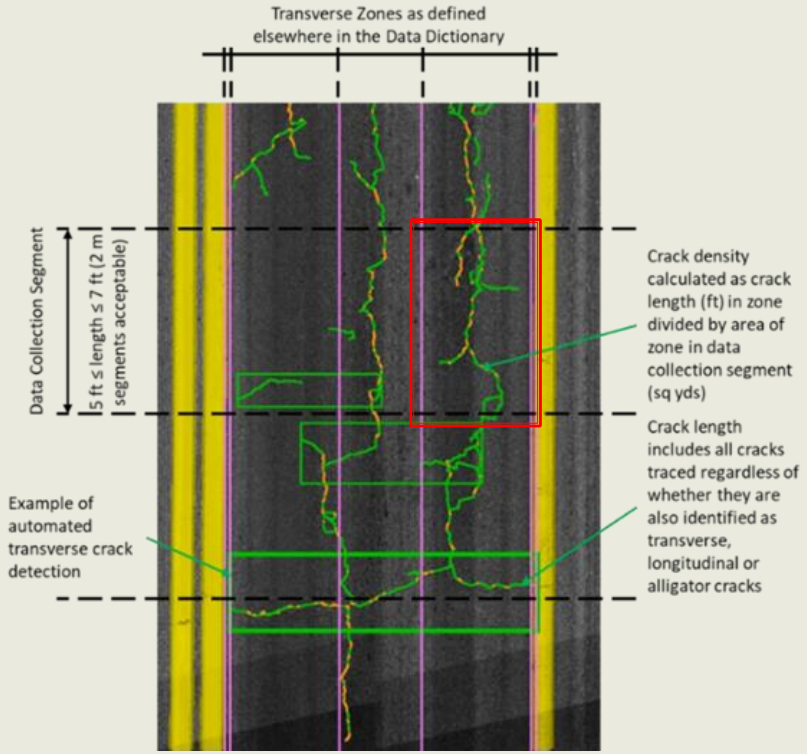
- Patterned cracking
- Non-patterned cracking

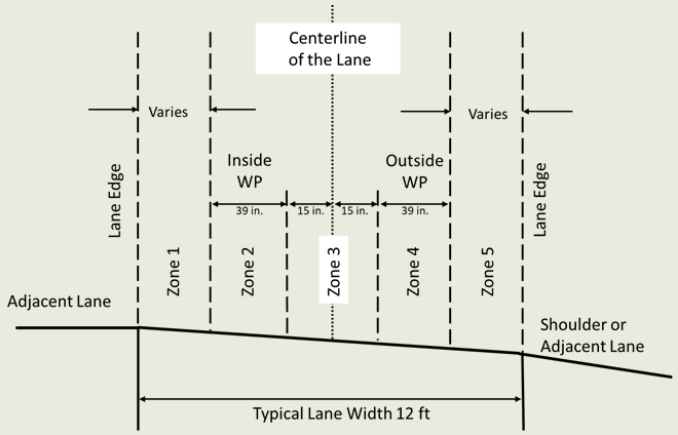
Crack Density Zones:

- Load-related cracking
- Non-load related cracking

Informs decision-making:

- Patterned cracking→ patching/rehab
- Non-patterned cracking → Crack sealing





Definition of Transverse Zones. Source: AASHTO R85-18

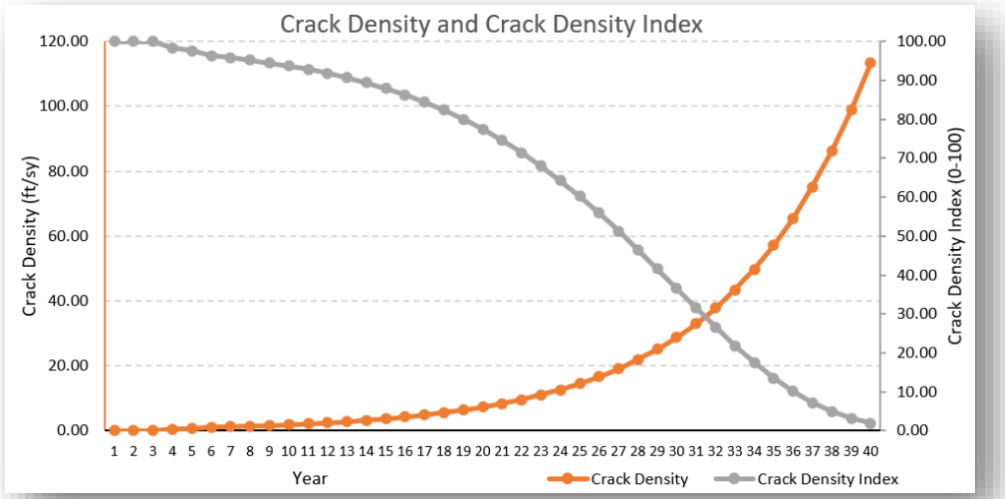
Benefits of using crack density

- Independent of vendor experience/bias and algorithms
- Allows agencies significant flexibility in aggregating data to condition scores
- Highly repeatable
- Less reliant on subjective definitions of distress types and severities

Crack Density Index

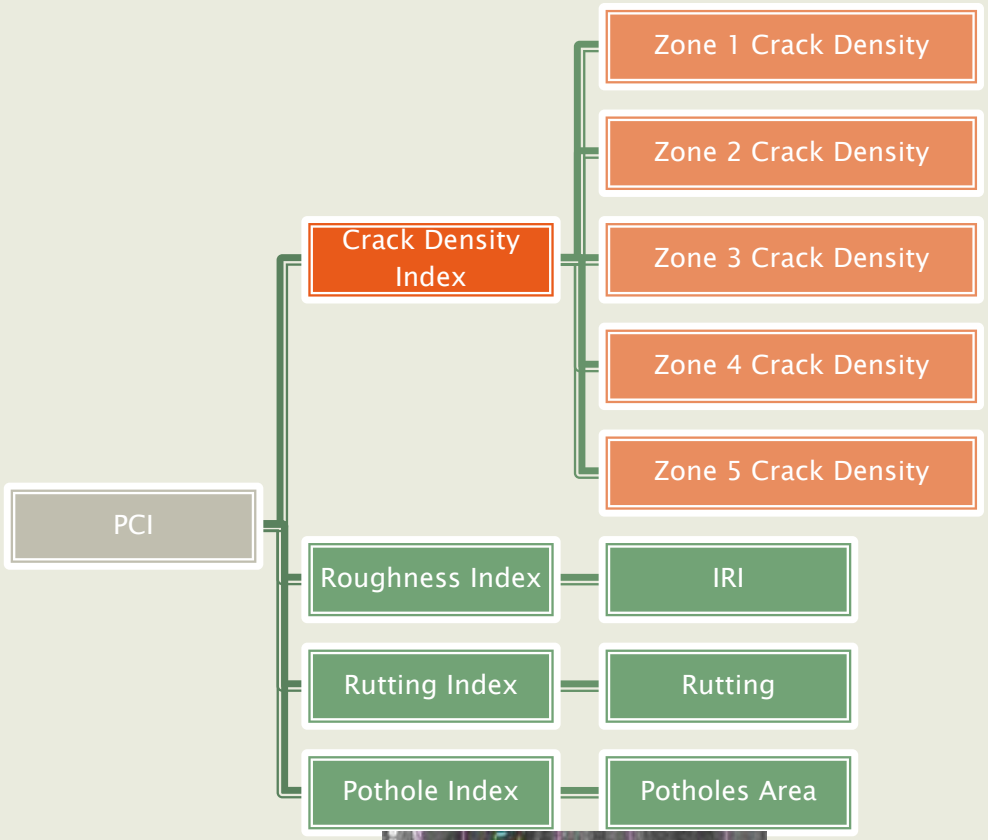
Pavement Management

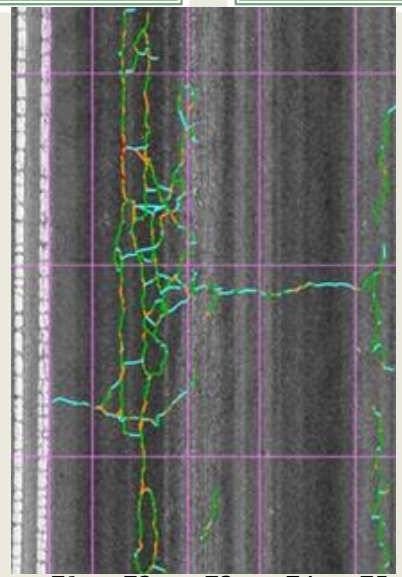
- Model Crack Density Progression
- Converted to a Crack Density Index (0-100 scale)



Crack Density→ Crack Density Index

- Identify optimal treatments based on:
  - Crack Density Index
  - Crack Density per zone





Next Steps

- Awaiting Data Output from Vendor
- Designing GIS and Linear Referencing Basis for analysis outputs
- Construction history data gathering
- Calibrating data to NCDOT PCR
- Developing appropriate E3303/crack density scores and models
- Analysis

Thank You!