

## Comparison of Automated and Manual Data Collection for Pavement Distresses

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## Outline

- Test Course Summary
- Participating Vendors
- Results from Asphalt Pavement Surveys
  - NCDOT Survey
  - LTPP Survey
- Results from PCC Pavement Surveys
  - NCDOT Survey
  - LTPP Survey
- Summary

## Test Course Summary

- 90 mile test course consisting of asphalt concrete (AC) and Portland cement concrete (PCC) sections
- AC sections – 66 miles
  - Interstate (I-440, I-40, I-540)
  - Principle arterial (US-70, US-1, US-64)
  - Secondary (NC-98, NC-39)
- PCC sections – 24 miles
  - Jointed concrete pavement
  - Interstate (I-440, I-40)

## Participating Vendors

- Fugro Roadware, Inc.
  - All asphalt and concrete pavements
- Pathway Services, Inc.
  - All asphalt and concrete pavements
- Mandli Communications, Inc.
  - 17 miles of asphalt pavements

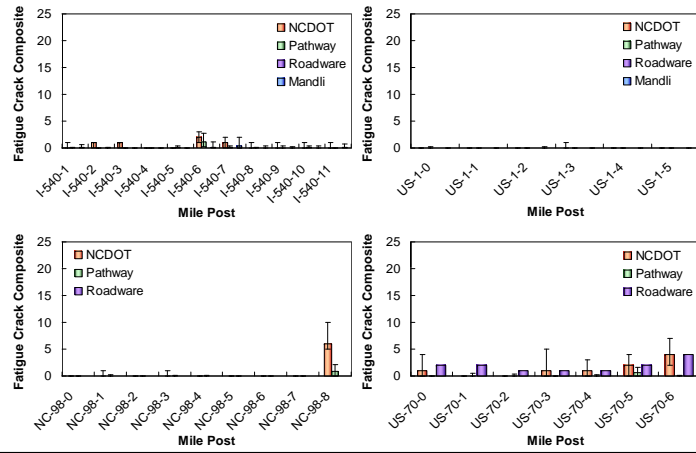
## “Ground Truth” Data

- Data collected by an independent group of experienced raters using current survey methods
  - NCDOT windshield survey
  - LTPP manual survey
- Vendors are given survey manuals and limited instructions
  - Possibility for misunderstanding caused by different definitions
  - Additional analyses of the vendors' data may be necessary.

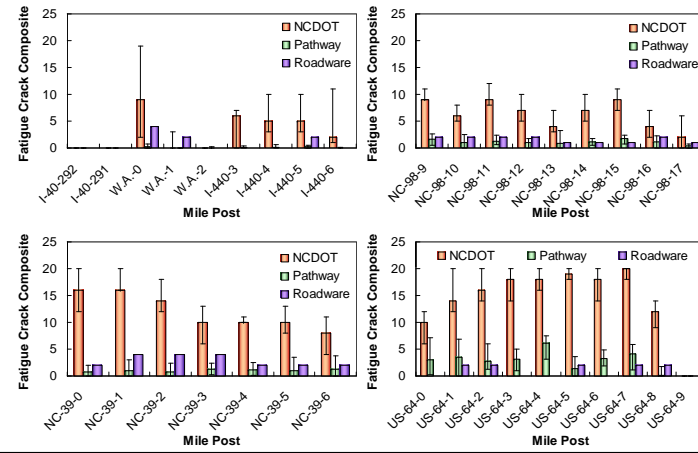
## Asphalt Concrete Survey

- Asphalt concrete survey elements
  - Cracking
    - ✓ Fatigue
    - ✓ Transverse
    - ✓ Block (LTPP Only)
    - ✓ Edge (LTPP Only)
    - ✓ Longitudinal (LTPP Only)
  - Surface Characteristics
    - ✓ Rutting
    - ✓ Raveling
    - ✓ Oxidation (NCDOT Only)
    - ✓ Bleeding
    - ✓ Ride quality (NCDOT Only)
    - ✓ Patching

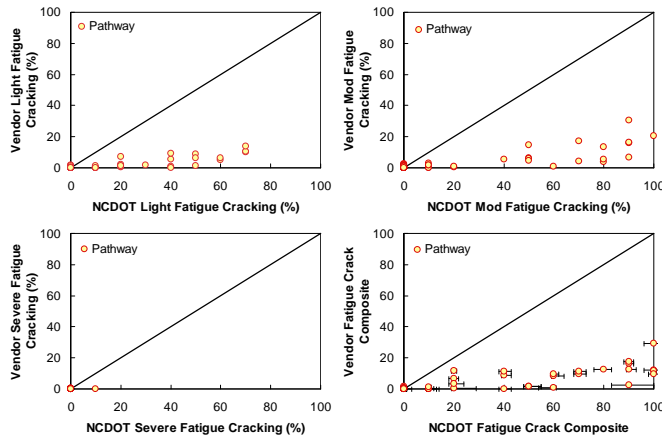
## NCDOT-AC Survey Fatigue Cracking – Best Comparison



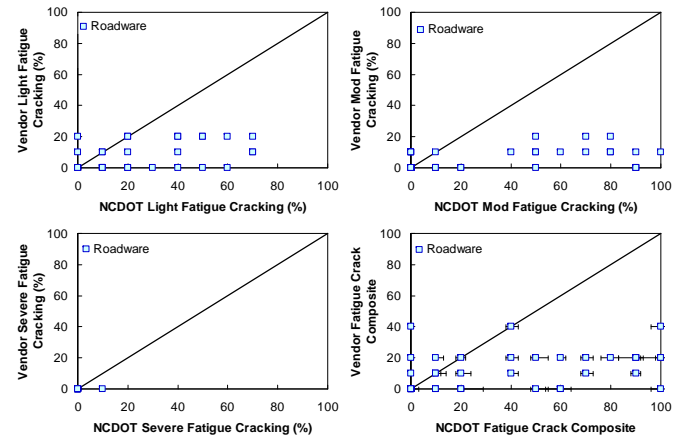
## NCDOT-AC Survey Fatigue Cracking – Worst Comparison



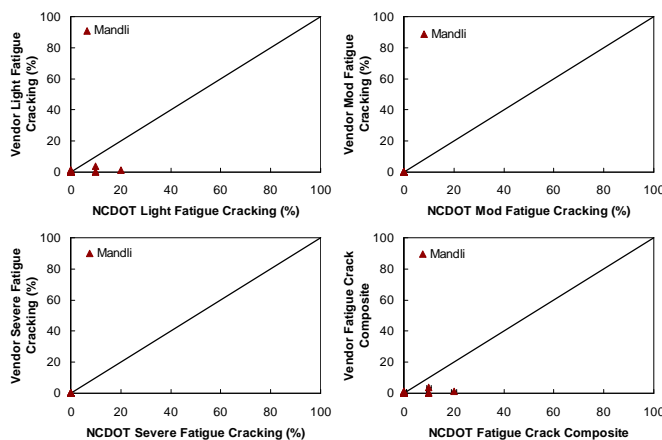
## NCDOT-AC Survey Fatigue Cracking, Pathway



## NCDOT-AC Survey Fatigue Cracking, Roadware



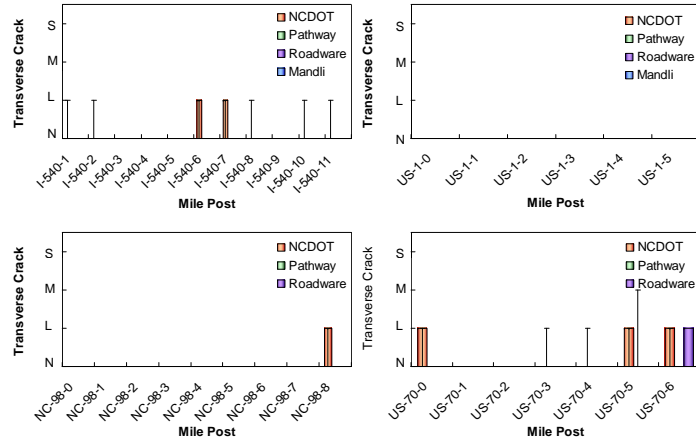
## NCDOT-AC Survey Fatigue Cracking, Mandli



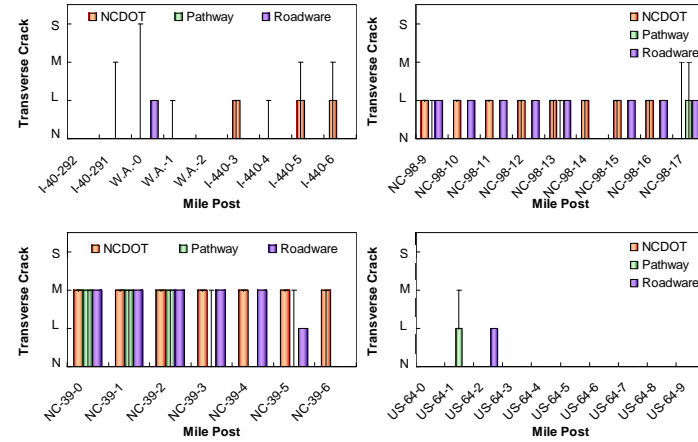
## Possible Causes for Underestimation of Fatigue Cracking

- NCDOT categories for cracking data are only fatigue cracking and transverse cracking – How are edge cracking, block cracking, and longitudinal cracking reported in the NCDOT survey?
- Is it possible that the vendors reported *true* fatigue cracking data while the NCDOT raters included edge cracking, block cracking, and longitudinal cracking into fatigue cracking?

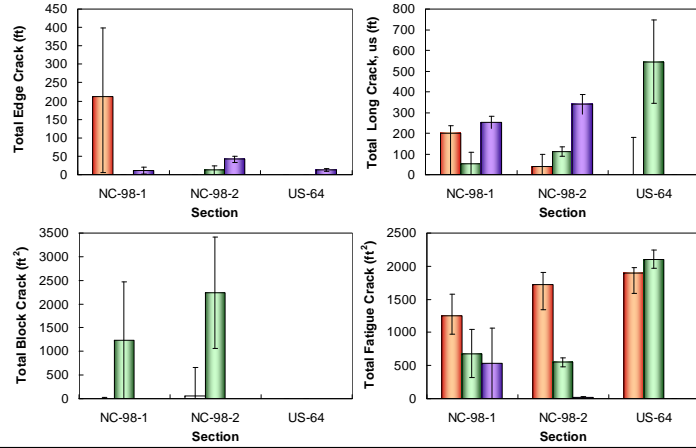
## NCDOT-AC Survey Transverse Cracking – Best Comparison



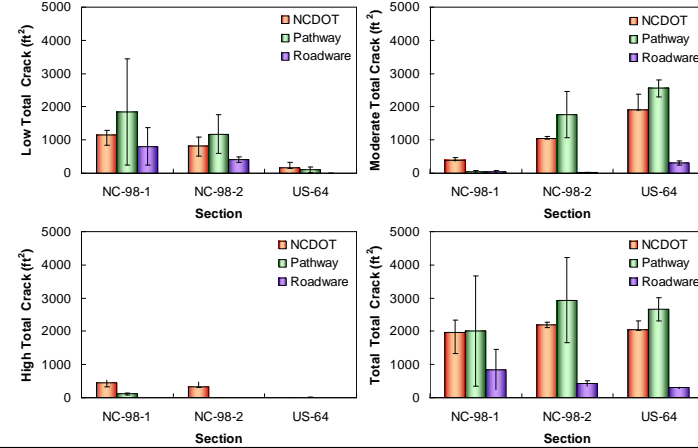
## NCDOT-AC Survey Transverse Cracking – Worst Comparison



## LTPP-AC Survey Cracking



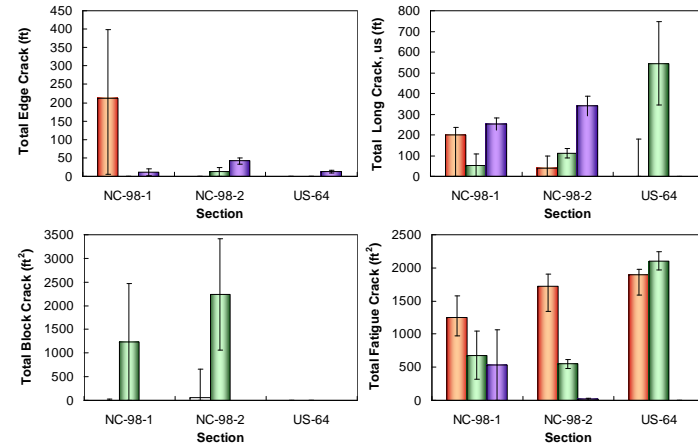
## LTPP-AC Survey Total Cracking



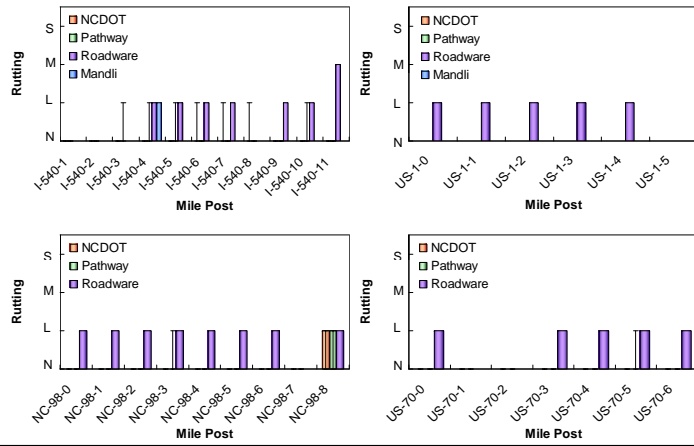
## LTPP Cracking Survey Explanation

- These trends possibly indicate that the ways of defining different cracks by the NCDOT surveyors and the vendors may not be the same.
- Block cracking vs. fatigue cracking?

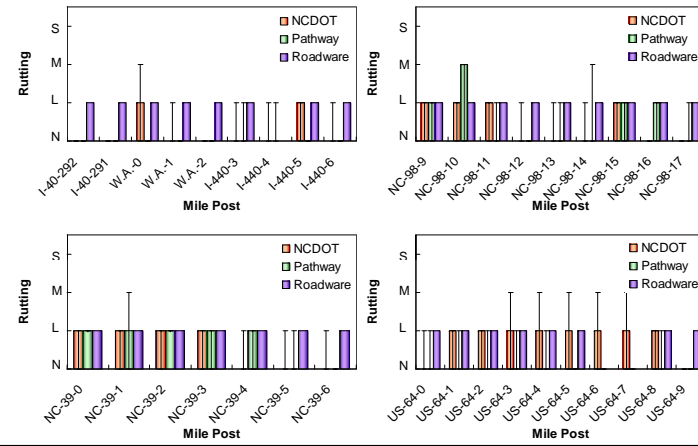
## LTPP-AC Survey Cracking



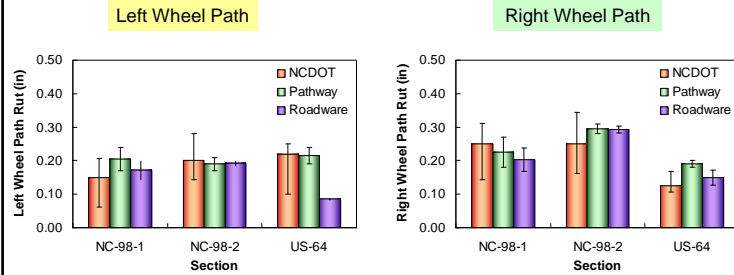
## NCDOT-AC Survey Rutting – Best Comparison



## NCDOT-AC Survey Rutting – Worst Comparison



## LTPP-AC Survey Rutting



## Reason for Poor Rut Depth Estimation in the NCDOT Survey

- Overall, the rutting along the test course was light in severity.
- Difficulty involved in estimating the light severity rut depth from the windshield survey
- The vendors' rut depth data match quite well with the rut depths measured by the NCDOT's LTPP survey with a straight edge and a ruler.
- The "ground truth" rut depths of the NCDOT survey may be less than the true rut depths.

## NCDOT-AC Survey Ride Quality

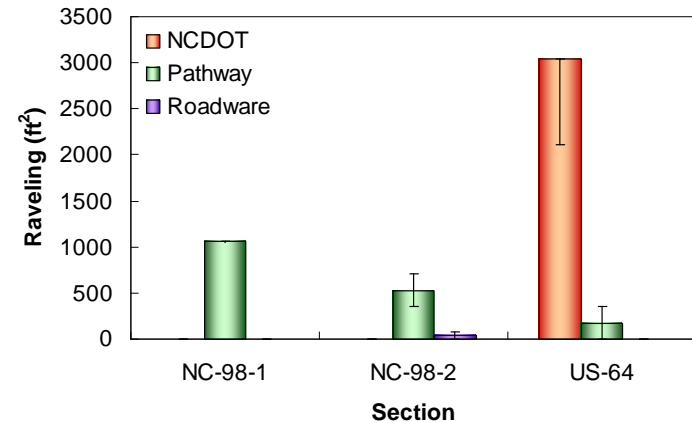
- Vendors rated ride quality by measuring IRI and applying some criteria are for conversion to the NCDOT qualitative ride quality index.

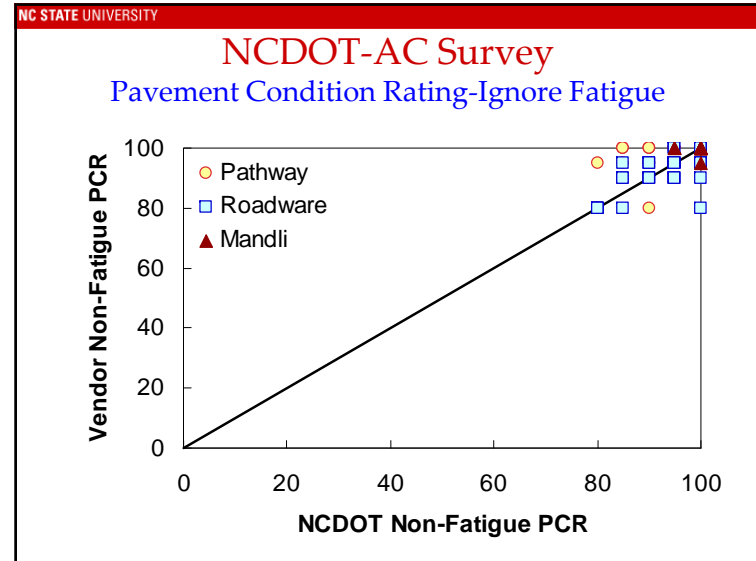
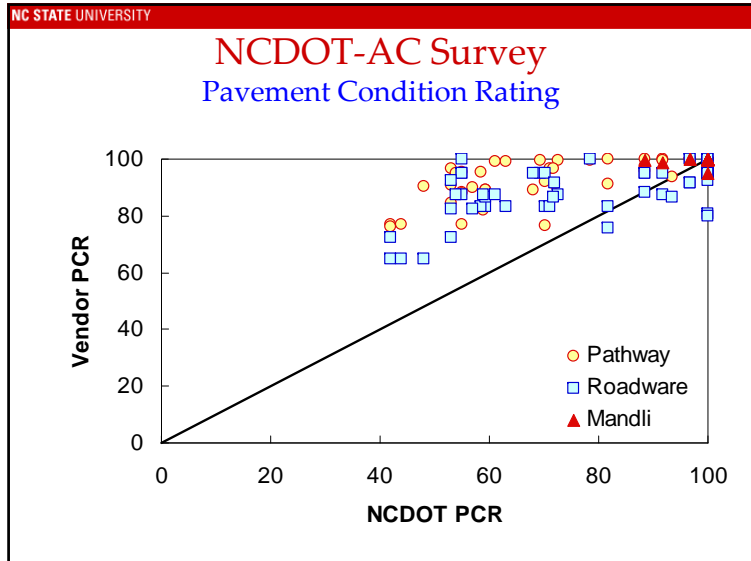
Vendor	IRI Range (in/mi)		
	Light	Moderate	Severe
NCDOT	No Accepted Method		
Fugro Roadware	< 150	150-300	> 300
Mandli	< 75	75-150	> 150
Pathway*	< 95	95-170	> 170

\* taken from FHWA National Highway System recommendations

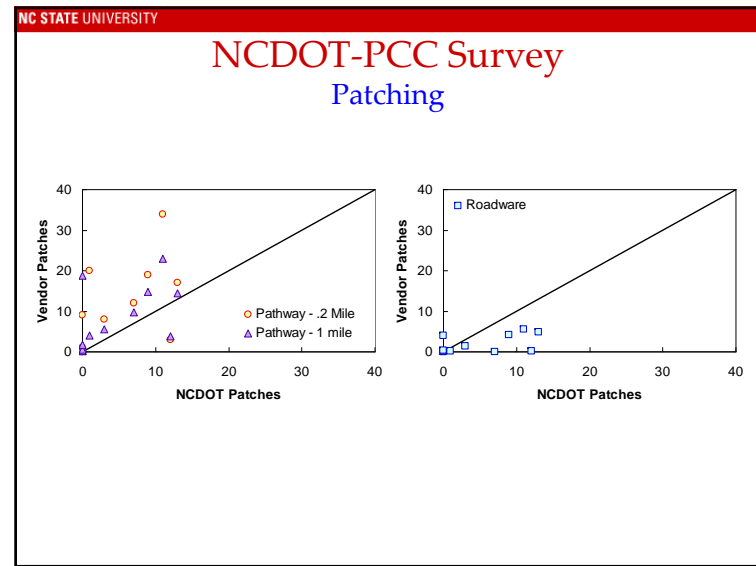
- IRI was not measured as part of the ground truth data collection.
- More study is needed with consistent definitions, and the findings will be presented in the final report.

## LTPP-AC Survey Raveling

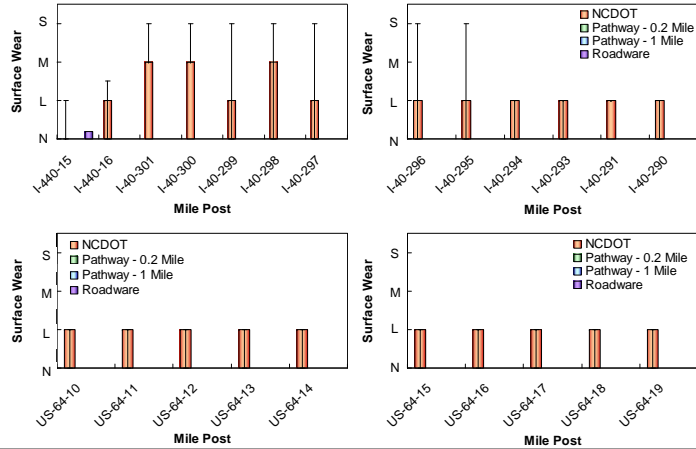




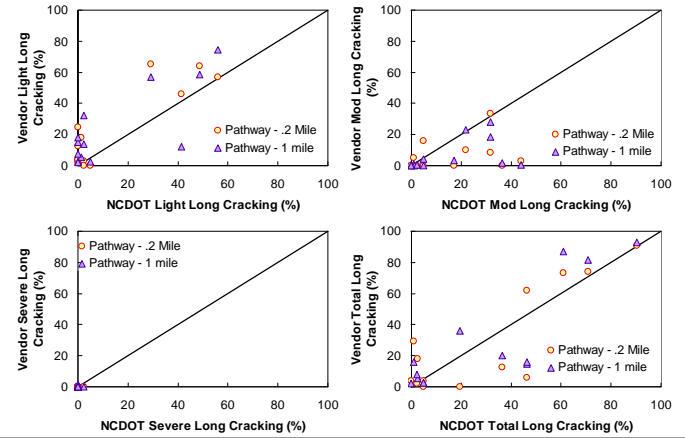
- NC STATE UNIVERSITY
- ### Portland Cement Concrete
- Portland cement concrete survey elements
    - Cracking
      - ✓ Longitudinal
      - ✓ Transverse
      - ✓ Corner break
      - ✓ Map (LTPP only)
    - Surface Characteristics
      - ✓ Patching
      - ✓ Pumping
      - ✓ Surface wear (NCDOT Only)
      - ✓ Ride quality (NCDOT Only)
      - ✓ Spalling
      - ✓ Joint seal damage
- achieve!



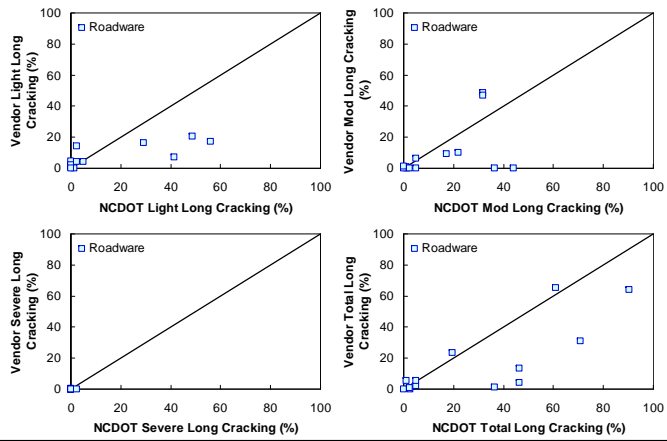
## NCDOT-PCC Survey Surface Wear



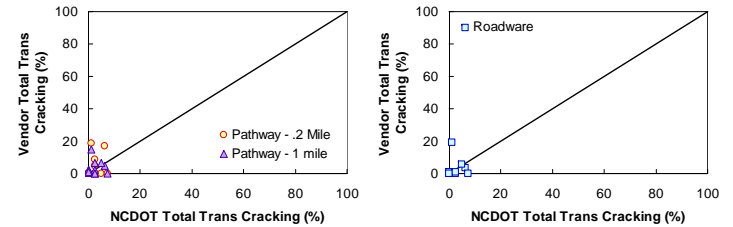
## NCDOT-PCC Survey Longitudinal Cracking, Pathway



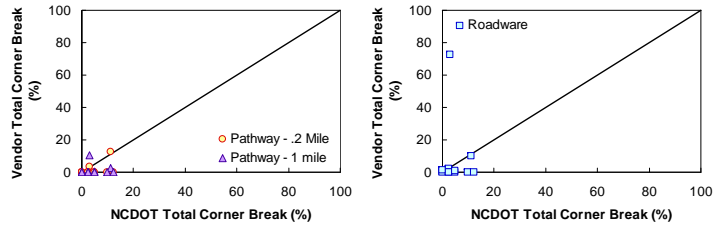
## NCDOT-PCC Survey Longitudinal Cracking, Roadware



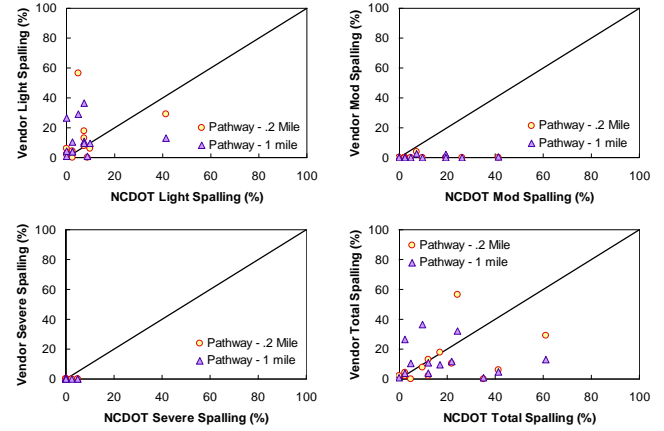
## NCDOT-PCC Survey Transverse Cracking



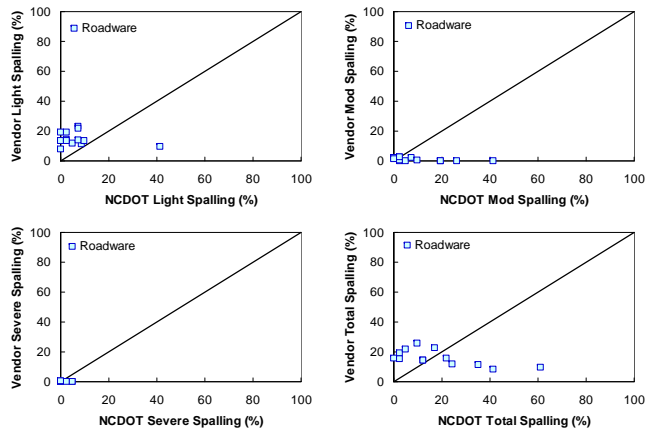
### NCDOT-PCC Survey Corner Break



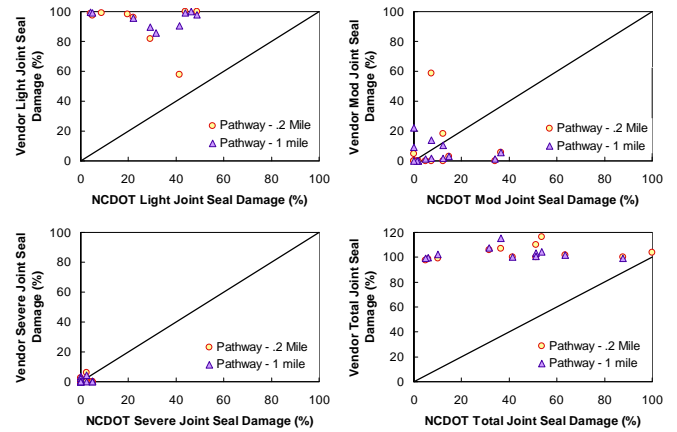
### NCDOT-PCC Survey Spalling, Pathway



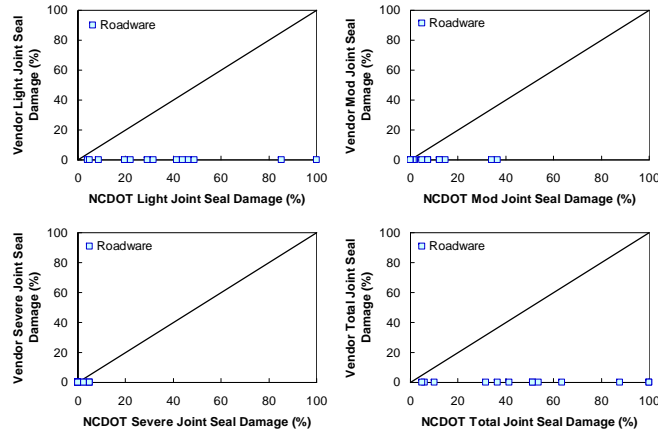
### NCDOT-PCC Survey Spalling, Roadware



### NCDOT-PCC Survey Joint Seal Damage, Pathway



## NCDOT-PCC Survey Joint Seal Damage, Roadware



## LTPP-PCC Survey Cracking

Data Element	Units	I-440		I-40		US-64	
		Pathway	Roadware	Pathway	Roadware	Pathway	Roadware
Corner Breaks Count	No.	91.0	235.0	2.0	11.0	0.0	2.0
Durability ("D") Cracking Count	No.	24.0	0.0	0.0	0.0	0.0	0.0
Durability ("D") Deterioration	ft <sup>2</sup>	112.3	0.0	0.0	0.0	0.0	0.0
Unsealed Long. Cracking	ft.	700.6	180.0	13837.6	7680.0	2.3	0.0
Sealed Long. Cracking	ft.	0.0	0.0	0.0	0.0	0.0	0.0
Trans. Cracking Count	No.	109.0	67.0	45.0	13.0	0.0	0.0
Unsealed Trans. Cracking	ft.	683.7	764.7	293.9	148.9	0.0	0.0
Sealed Trans. Cracking	ft.	0.0	0.0	0.0	0.0	0.0	0.0

## LTPP-PCC Survey Joint Deficiencies

Data Element	Units	I-440		I-40		US-64	
		Pathway	Roadware	Pathway	Roadware	Pathway	Roadware
Sealed Trans. Joint Seal	Y/N	Y	N	Y	N	Y	N
Sealed Trans. Joint Seal Count	No.	701.0	0.0	2665.0	0.0	2287.0	0.0
Sealed Long. Joint Count	No.	--	0.0	--	0.0	--	0.0
Long. Joint Seal Damage Extent	ft.	9876.8	0.0	58203.3	0.0	51668.9	0.0
Spalling of Long. Joints	ft <sup>2</sup>	32.7	0.0	2610.1	0.0	108.7	0.0
Spalling of Trans. Joints Count	ft.	1.0	60.0	133.0	522.0	16.0	131.0
Spalling of Trans. Joints Extent	ft <sup>2</sup>	1.8	690.9	204.3	5943.2	18.2	1485.4

## LTPP-PCC Survey Surface Defects

Data Element	Units	I-440		I-40		US-64	
		Pathway	Roadware	Pathway	Roadware	Pathway	Roadware
Map Cracking Count	No.	11.0	50.0	104.0	472.0	0.0	0.0
Map Cracking Extent	ft <sup>2</sup>	44084.1	6458.6	574705.1	38831.6	0.0	0.0
Scaling Count	No.	0.0	0.0	0.0	0.0	0.0	0.0
Scaling Extent	ft <sup>2</sup>	0.0	0.0	0.0	0.0	0.0	0.0
Polished Aggregate	ft <sup>2</sup>	0.0	0.0	0.0	0.0	0.0	0.0
Map Cracking Count	No.	11.0	50.0	104.0	472.0	0.0	0.0
Map Cracking Extent	ft <sup>2</sup>	44084.1	6458.6	574705.1	38831.6	0.0	0.0

## LTPP-PCC Survey Miscellaneous Distresses

Data Element	Units	I-440		I-40		US-64	
		Pathway	Roadware	Pathway	Roadware	Pathway	Roadware
Blowups	No.		0.0		0.0		0.0
AC Patch Count	No.	106.0	47.0	459.0	305.0	11.0	0.0
AC Patch Deterioration	ft <sup>2</sup>	3419.0	346.6	7233.6	1721.5	692.5	0.0
PCC Patch Count	No.	--	0.0	--	13.0	--	17.0
PCC Patch Deterioration	ft <sup>2</sup>	--	0.0	--	351.6	--	692.5
Water Bleeding and Pumping Count	No.	1.0	9.0	0.0	5.0	0.0	0.0
Water Bleeding and Pumping Deterioration	ft.	0.0	47.5	0.0	26.4	0.0	0.0

## Summary

- Cracking in the asphalt pavements is underestimated by the vendors, which seems to be due to the different definitions used by the NCDOT raters and the vendors for different cracking distresses.
- Estimation of cracking for the concrete pavements is better than that for the asphalt pavements.
- The lack of sensitivity in the NCDOT's rutting distress survey causes a lower severity of rutting distress results than the vendors' rut depth data.

## Summary-Cont'd

- The difference between the NCDOT and the vendors in their use of ride quality definitions makes it difficult to compare the ride quality data.
- The lack of sensitivity in the vendors' measurements for the spalling and joint seal damage seems to be the reason for the poor estimation of these distresses.
- The LTPP survey data for concrete pavements are considerably different among the two vendors.

## Questions?

