FRICTION STUDY ON LTPP SECTIONS IN CONNECTICUT

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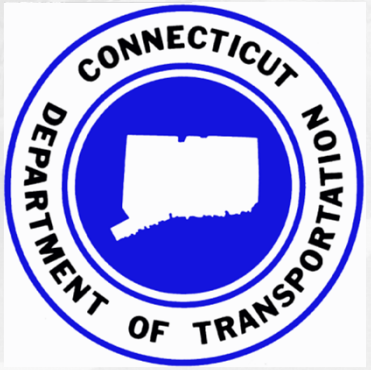


Who needs pavement friction?

I-84 in Manchester, Connecticut

Motivation

- To present a historical overview of pavement friction testing in CT.
- To report in the context of presenting a real-world State Highway Agency's experience (ConnDOT's)
- To present an academic perspective (UConn's) of data collected using statistics.

History - May 1968

Bureau of Public Roads (FHWA)

Demonstration in Connecticut

PAVEMENT FRICTION TESTING IN CT

HISTORICAL OVERVIEW

TRB PAPER 10-0426

In 1970, ConnDOT's first pavement friction tester was this 'one-of-a-kind' unit from TestLab Corporation of Chicago

K J Law Engineers Friction Testers

1978

1978

1989

1989

Dynatest Corp.
2005

High-Speed Laser Instrument Mounted to Dynatest Pavement Friction Tester

2005

2007 - Circular Texture Meter (CTMeter)

2008 - Transportation Pooled-Fund Study TPF-5(141)

Study Partners:

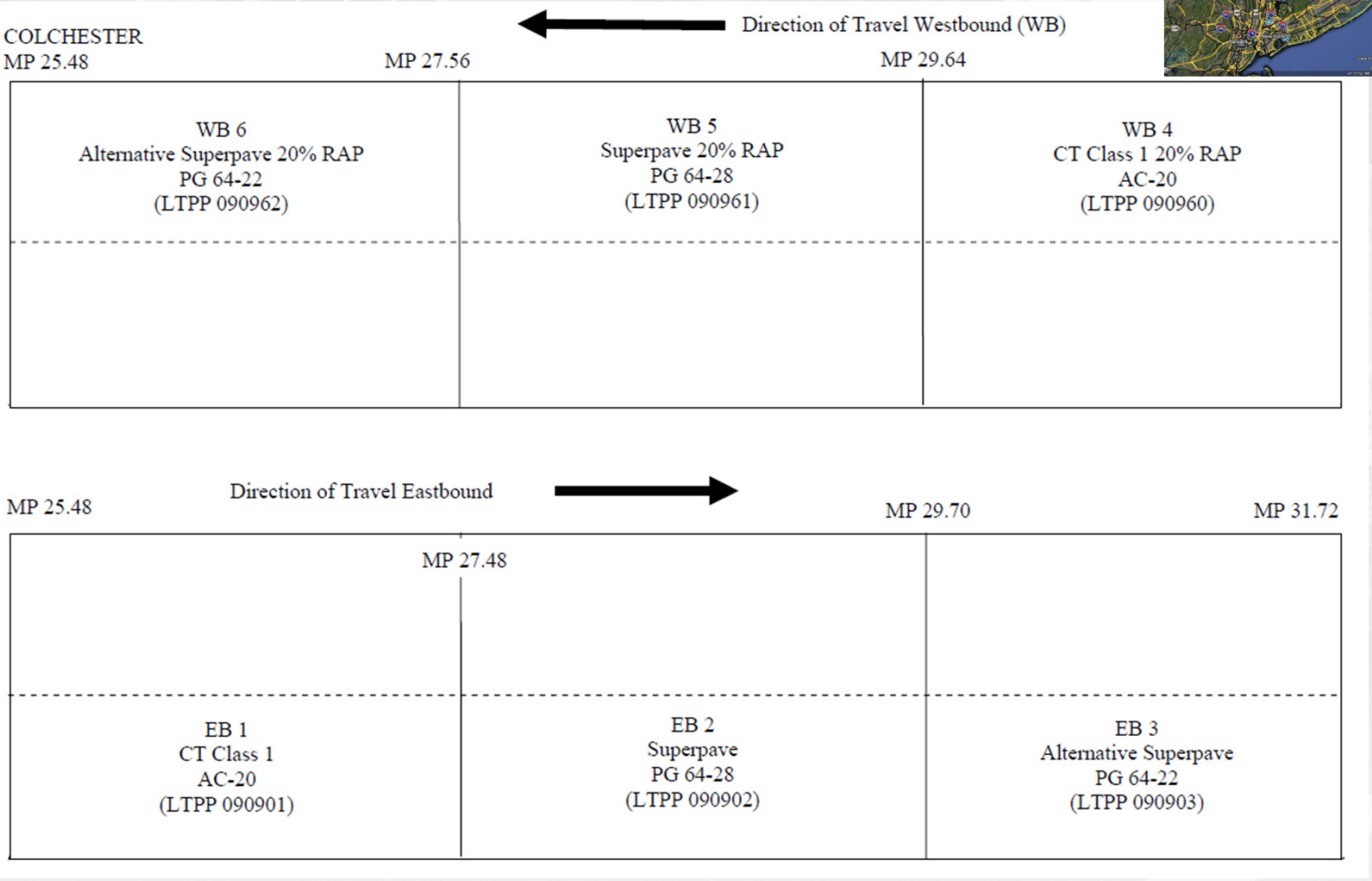
- FHWA
- CT
- GA
- MS
- PA
- SC
- VA

Pavement Surface Properties Consortium: A Research Program
Contractor: Virginia Tech
Sponsoring Agency: Virginia DOT

2009 - GripTester™ Loan to ConnDOT

Pavement Characterization

Rt. 2 LTPP (SPS-9A) Sections



Equipment and Testing Protocols

ASTM E-274 locked-wheel tester

- V=40±1 mi/hr
- 100% slip
- SN_{40R} and SN_{40S} measured at start /end of ea. section
- 3 passes
- Macrotexture measured with high-speed laser
- Mean profile depth (MPD) and estimated texture depth (ETD) reported

Equipment and Testing Protocols

GripTester™ fixed-slip tester

- Borrowed from VTTI
- V=40±2 mi/hr
- ~15% slip
- GN reported
- 5 passes per section

Equipment and Testing Protocols

CTMeter

- ASTM E 2157 for measuring macrotexture.
- 5.6 inch radius circle.
- MPD measured every 50 ft.
- 8 measurements per section.

Analysis of the Results

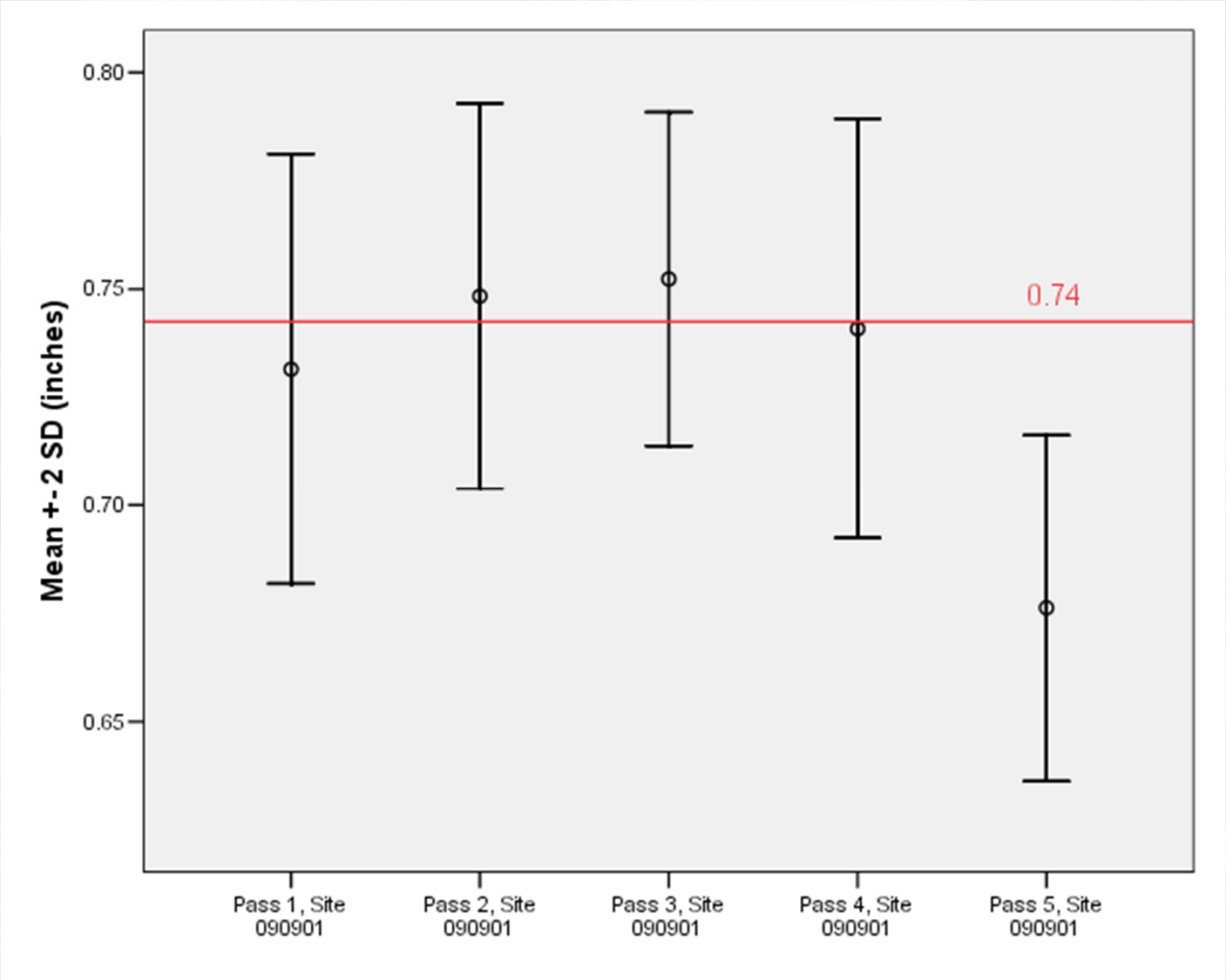
- Methodology
  - Friction indicators:100*GN, SN_{40R}, SN_{40S}
  - Texture indicators: CTMeter MPD, High-speed Laser ETD, High-speed Laser MPD
  - Cross-correlation analysis of friction/texture measurements
  - Regression analysis of correlation between friction/texture and material properties

Grip Numbers (GN), Site 090901 (typical of EB Sections)

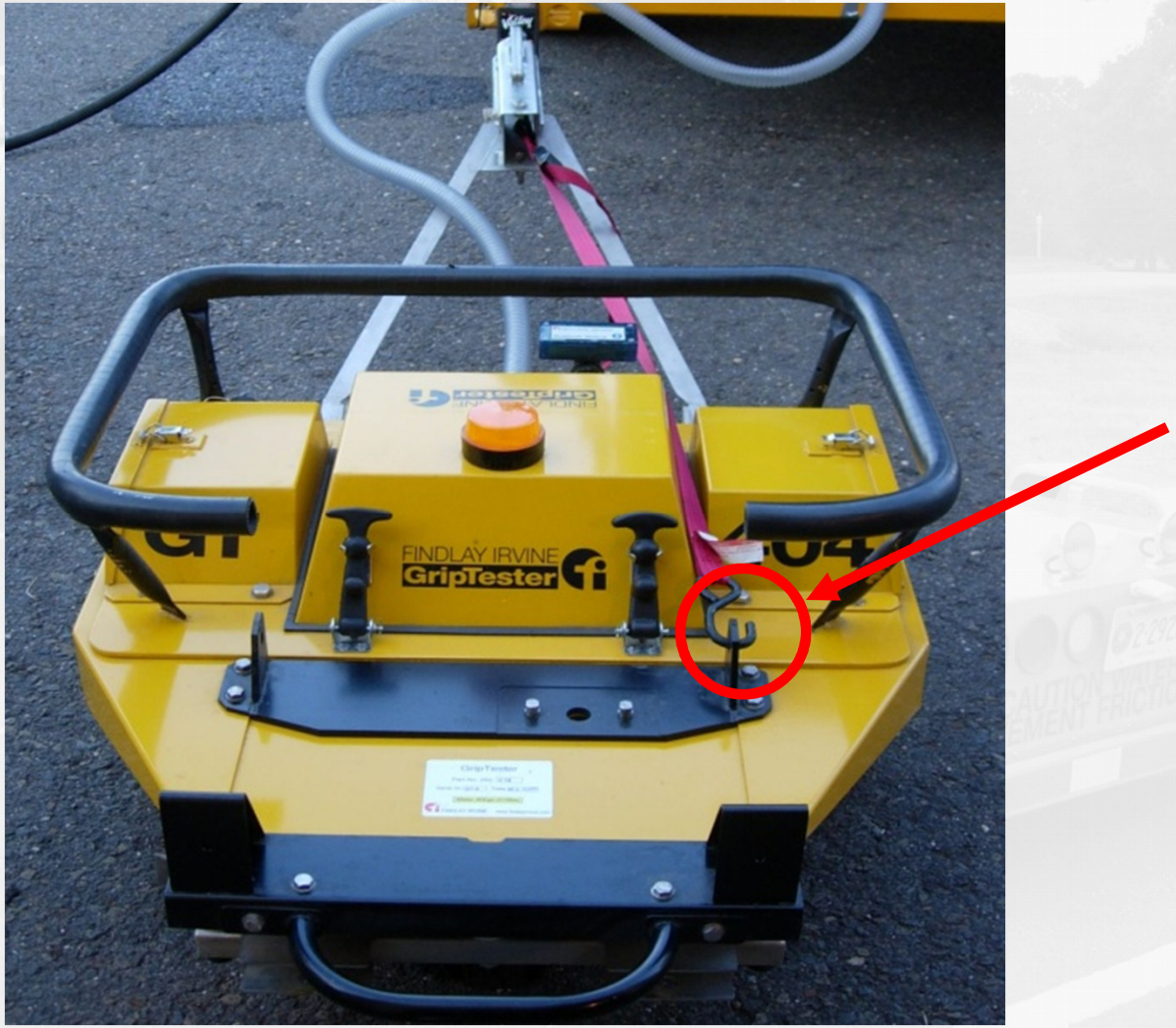
Descriptive Statistics

	N	Mean	Std. Deviation
Pass 1	169	.73	.02
Pass 2	169	.75	.02
Pass 3	169	.75	.02
Pass 4	172	.74	.02
Pass 5	170	.68	.02

- ConnDOT Class 1 Mix
- 12.5-mm Nominal Max Size Aggregate



Reason for Pass 5 Outliers?

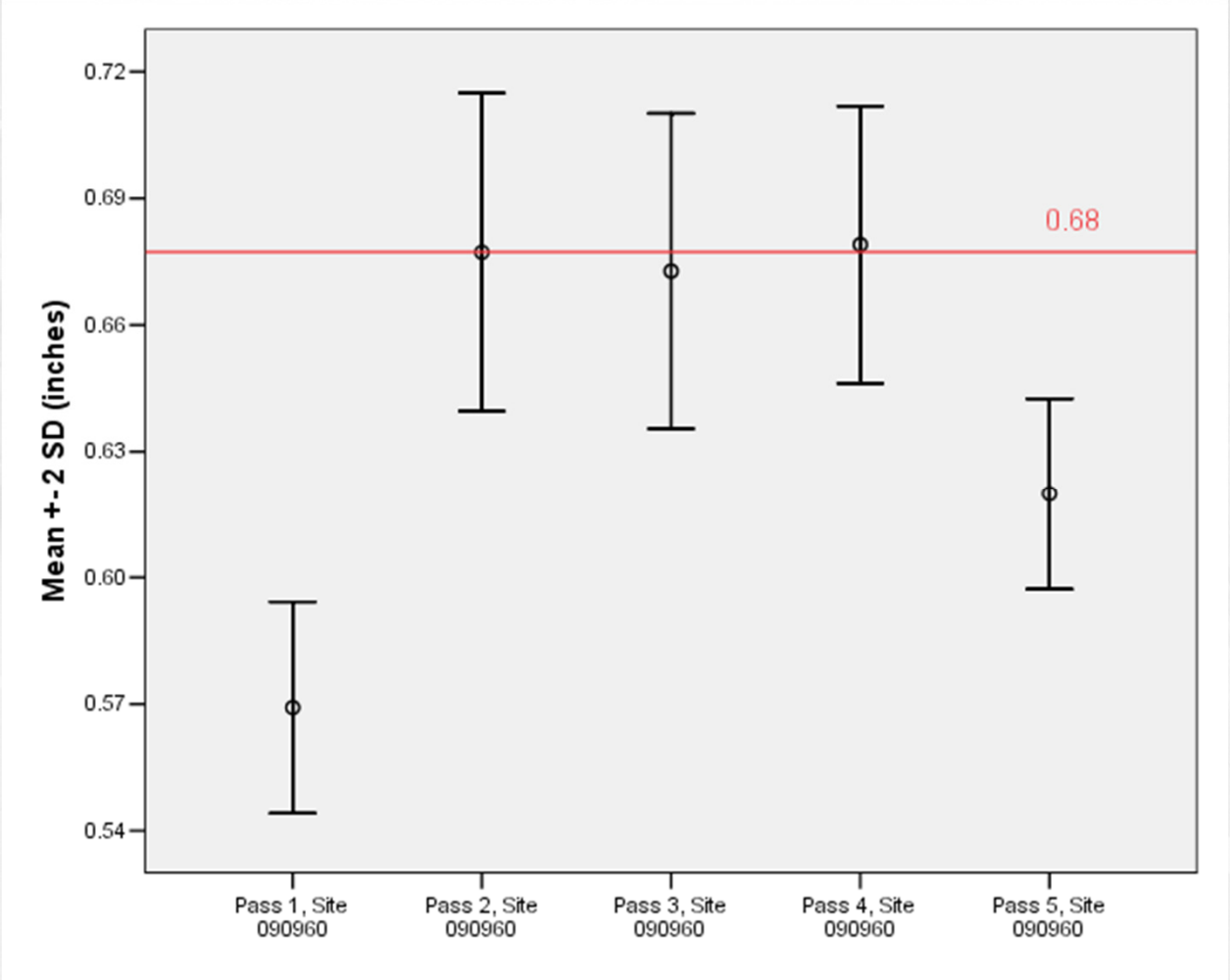


Grip Numbers (GN), Site 090960 (typical of WB sections)

Descriptive Statistics, 090960

	N	Mean	Std. Deviation
Pass 1	170	.57	.01
Pass 2	169	.68	.02
Pass 3	170	.67	.02
Pass 4	166	.68	.02
Pass 5	168	.62	.01

- Class 1 ~20% RAP
- 12.5-mm Nominal Max Size Aggregate

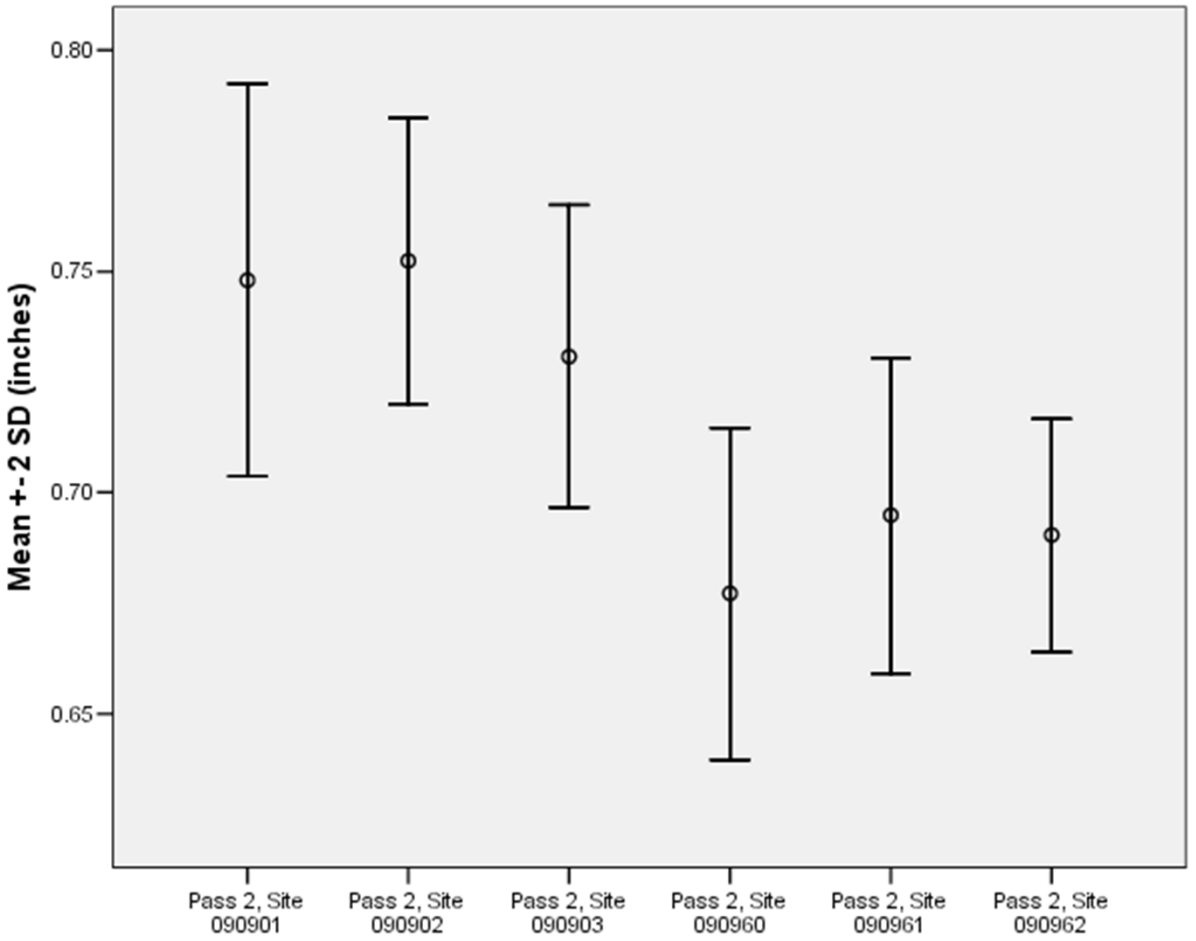


Grip Numbers (GN), Pass 2

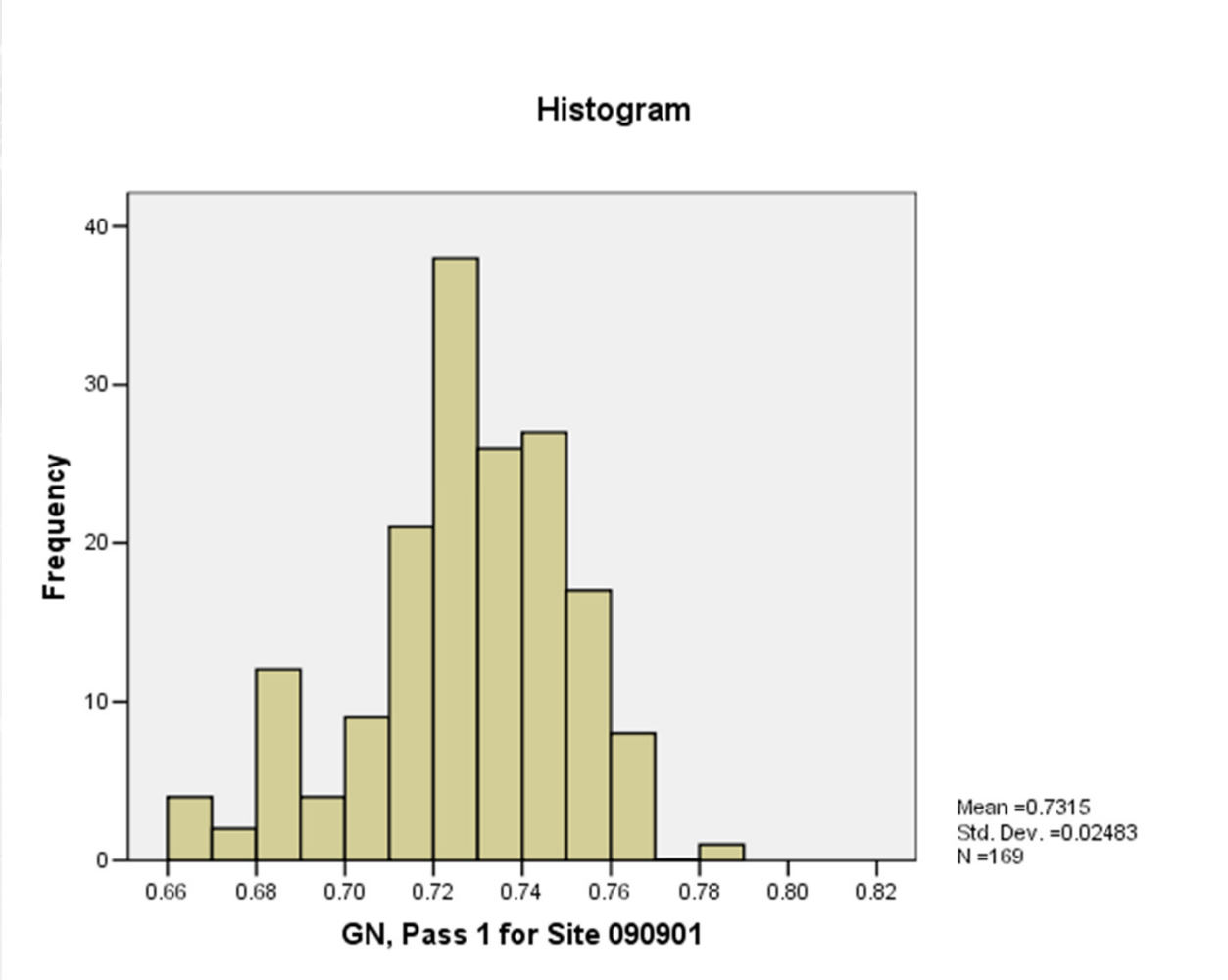
Descriptive Statistics

	N	Mean	Std. Deviation
Pass 2, Site 090901	169	.75	.022
Pass 2, Site 090902	167	.75	.016
Pass 2, Site 090903	173	.73	.018
Pass 2, Site 090960	169	.68	.019
Pass 2, Site 090961	170	.69	.018
Pass 2, Site 090962	171	.69	.013

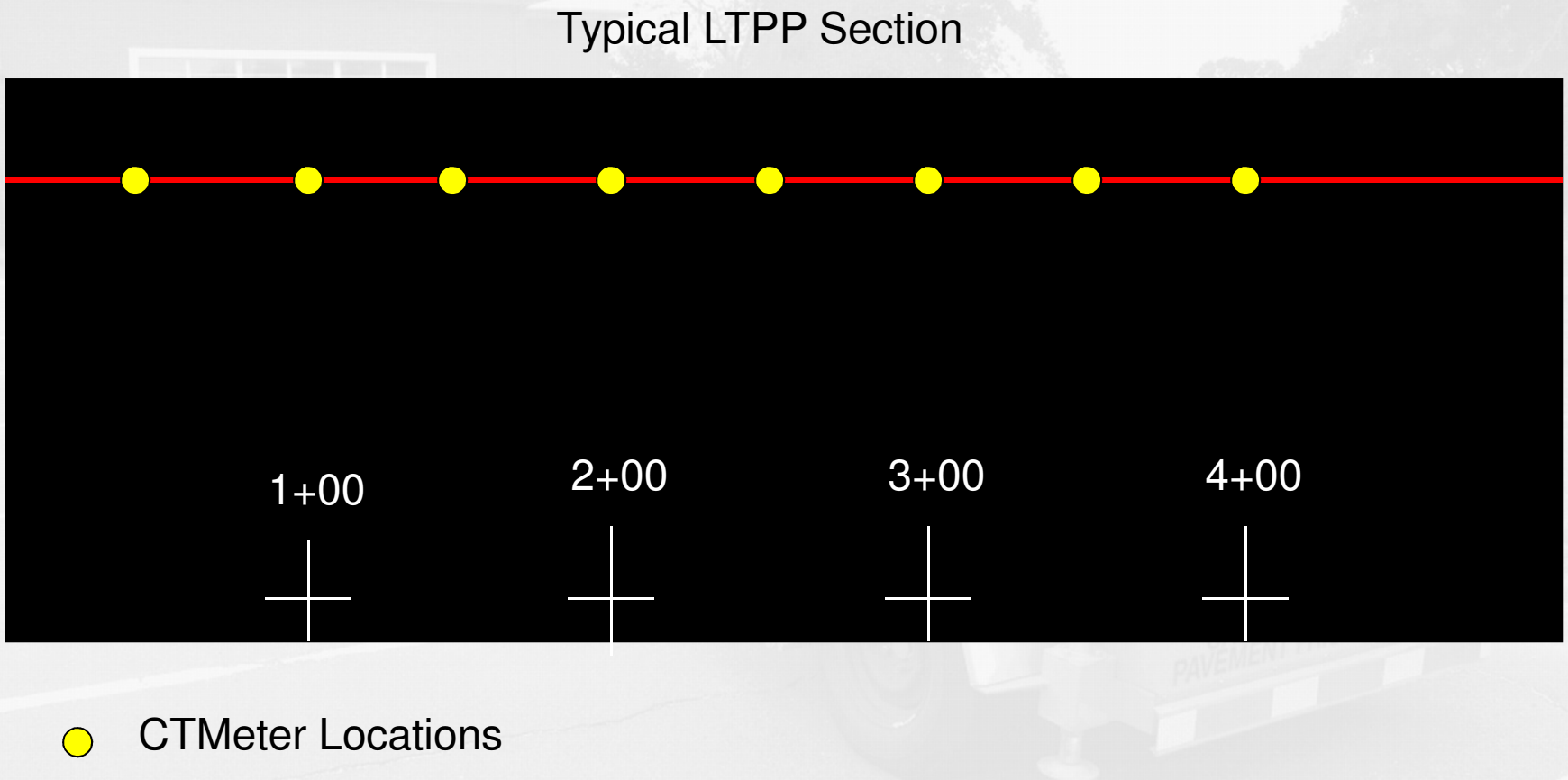
Perhaps lower values owe to changes in microtexture as a result of 20% RAP (black rock effect)?



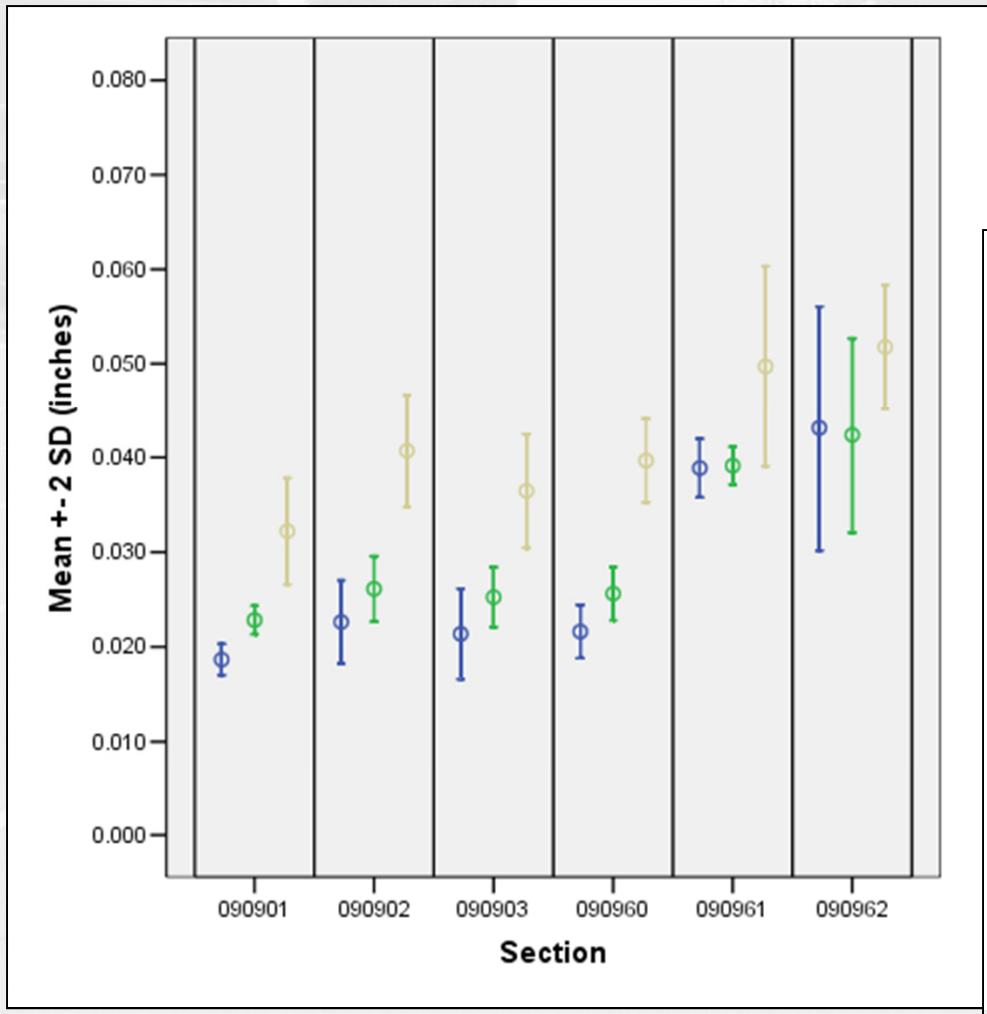
GN Histogram for Site 090901
Normal Distribution (Typical of Others)



High-Speed Laser and CTMeter Measurement Locations



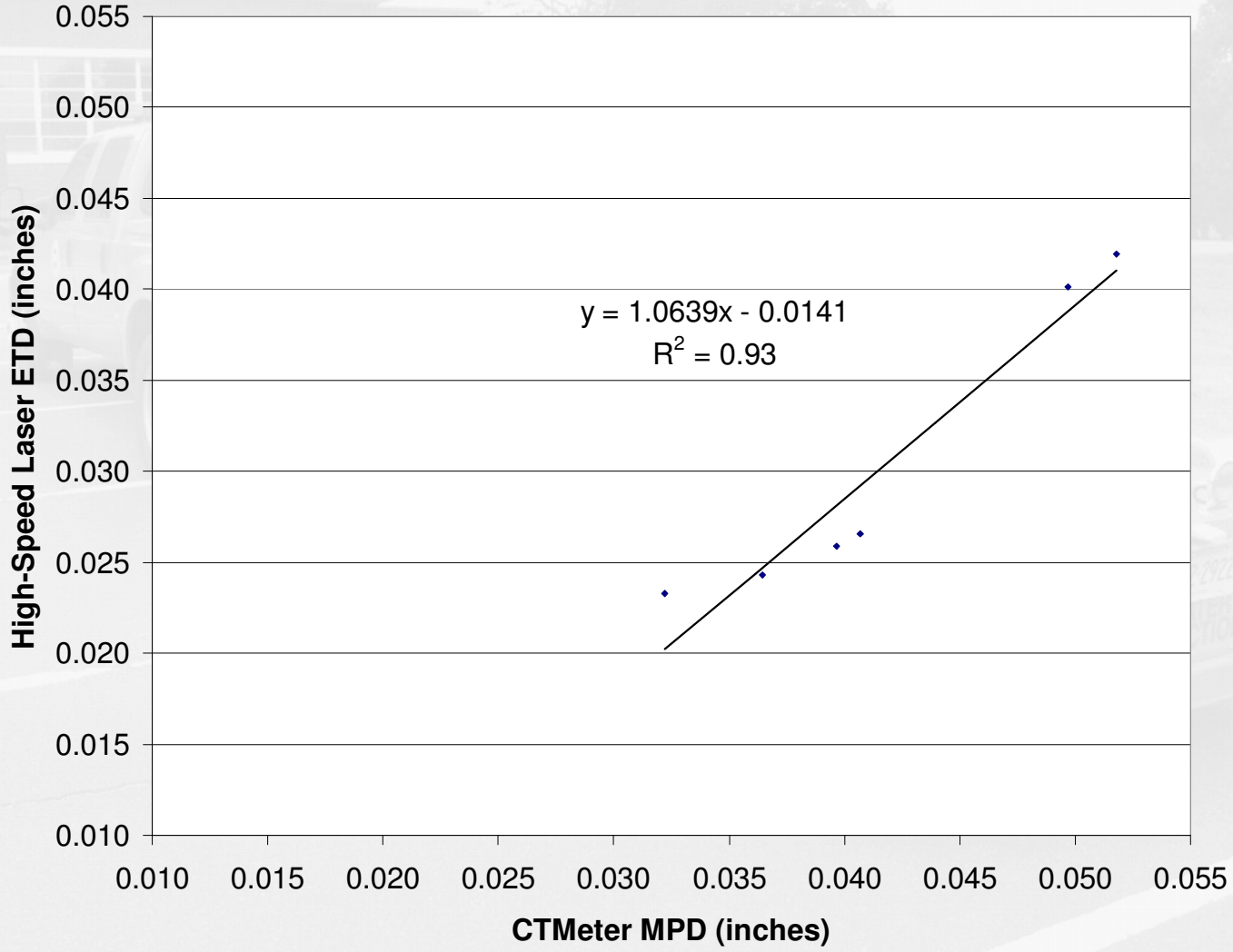
High-Speed vs. Static Texture Measurements



Descriptive Statistics

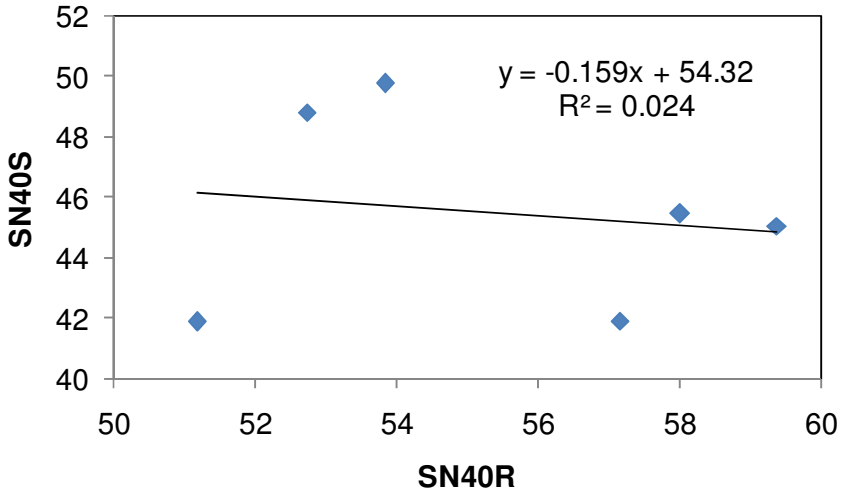
Section		N	Mean	Std. Deviation
090901	High-Speed MPD	29	.019	.0017
	High-Speed ETD	29	.023	.0013
	CTMeter MPD	6	.032	.0028
090902	High-Speed MPD	30	.023	.0030
	High-Speed ETD	30	.027	.0025
	CTMeter MPD	8	.041	.0030
090903	High-Speed MPD	31	.020	.0023
	High-Speed ETD	31	.024	.0018
	CTMeter MPD	8	.036	.0030
090960	High-Speed MPD	28	.022	.0011
	High-Speed ETD	28	.026	.0010
	CTMeter MPD	8	.040	.0022
090961	High-Speed MPD	29	.040	.0040
	High-Speed ETD	29	.040	.0032
	CTMeter MPD	8	.050	.0053
090962	High-Speed MPD	30	.043	.0039
	High-Speed ETD	30	.042	.0031
	CTMeter MPD	8	.052	.0033

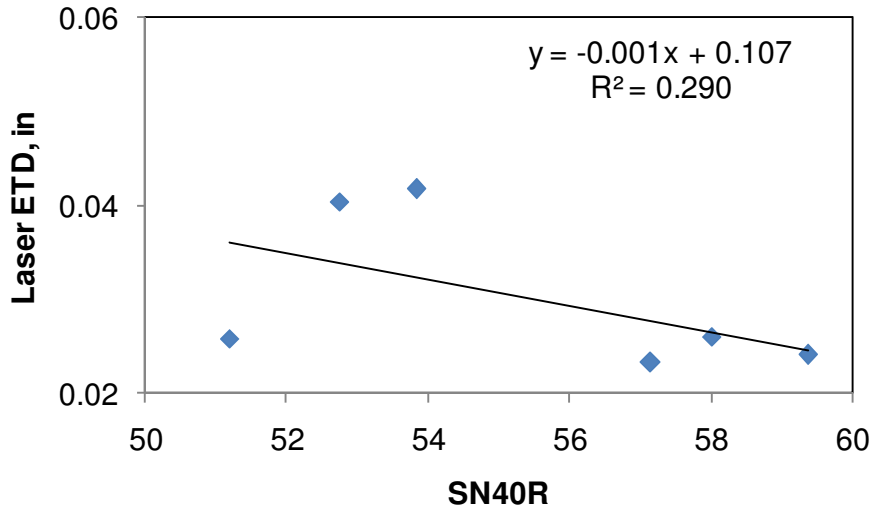
High-Speed ETD vs. Static MPD



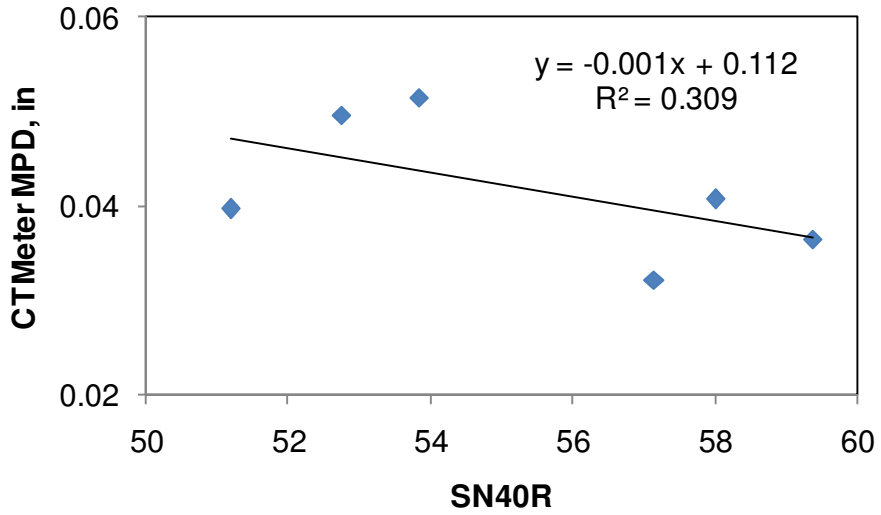
Analysis of the Results

Cross-Correlation

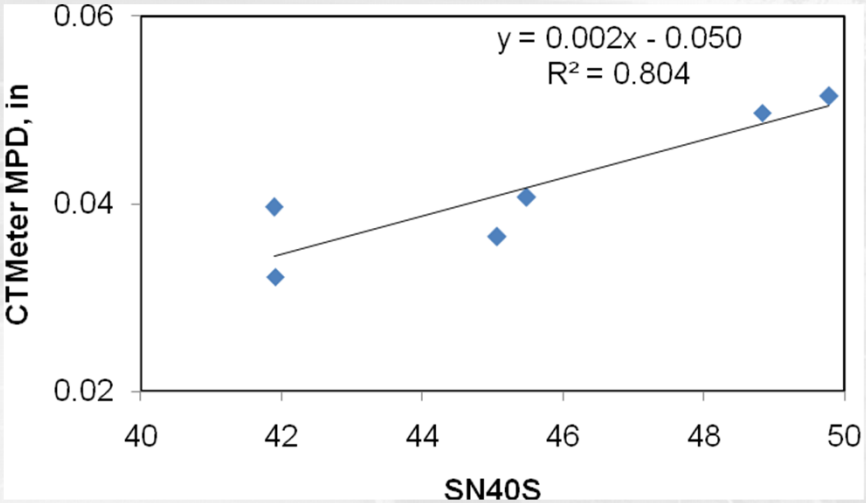


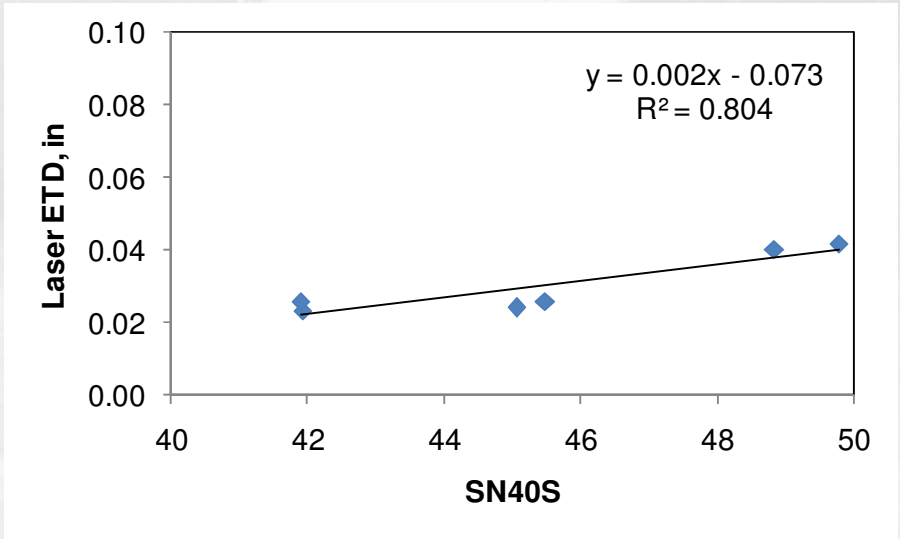


- No correlation between ribbed and smooth tire.
- Very low correlation between ribbed tire and texture (R^2 =0.3).



Macrotexture vs. Smooth-Tire Friction Cross-Correlation

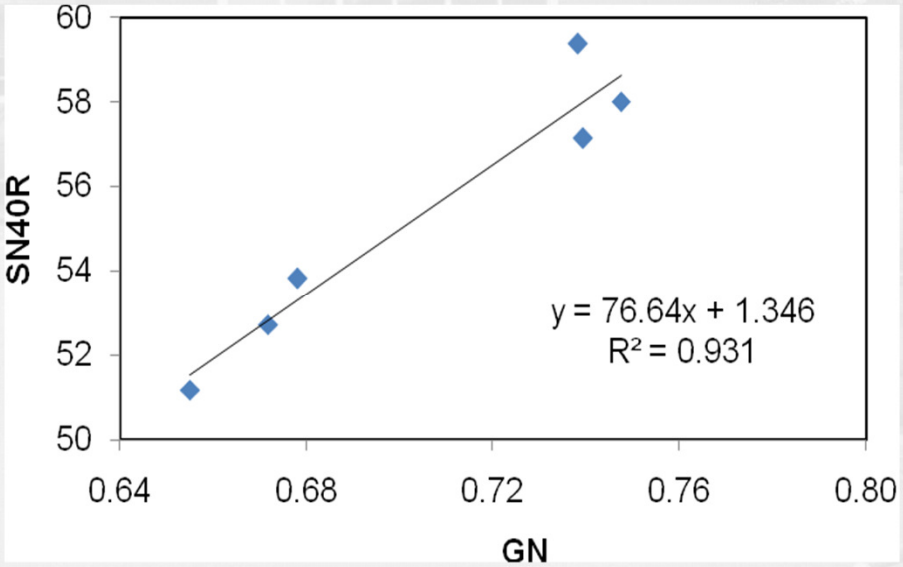


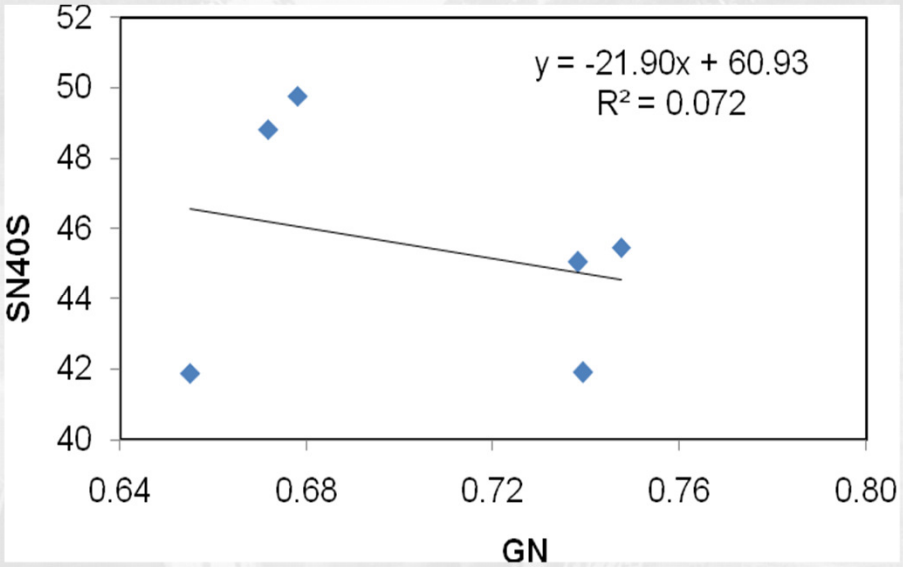


- Good correlation between smooth tire and texture (R^2 =0.8)
- Validates how smooth-tire measurements correspond with pavement macrotexture.

Analysis of the Results

Cross-Correlation (GripTester vs. ASTM E-274)





- High correlation between ribbed tire and GN (R^2 =0.93)
- No correlation between GN and smooth tire (R^2 =0.07)
- Suggests Grip Numbers relate more to pavement microtexture, rather than macrotexture.

Conclusions

- A high correlation between FN_{40R} and GN values was found ($R^2 = 0.93$).
- No correlation between FN_{40S} and GN values was found ($R^2 = 0.07$).

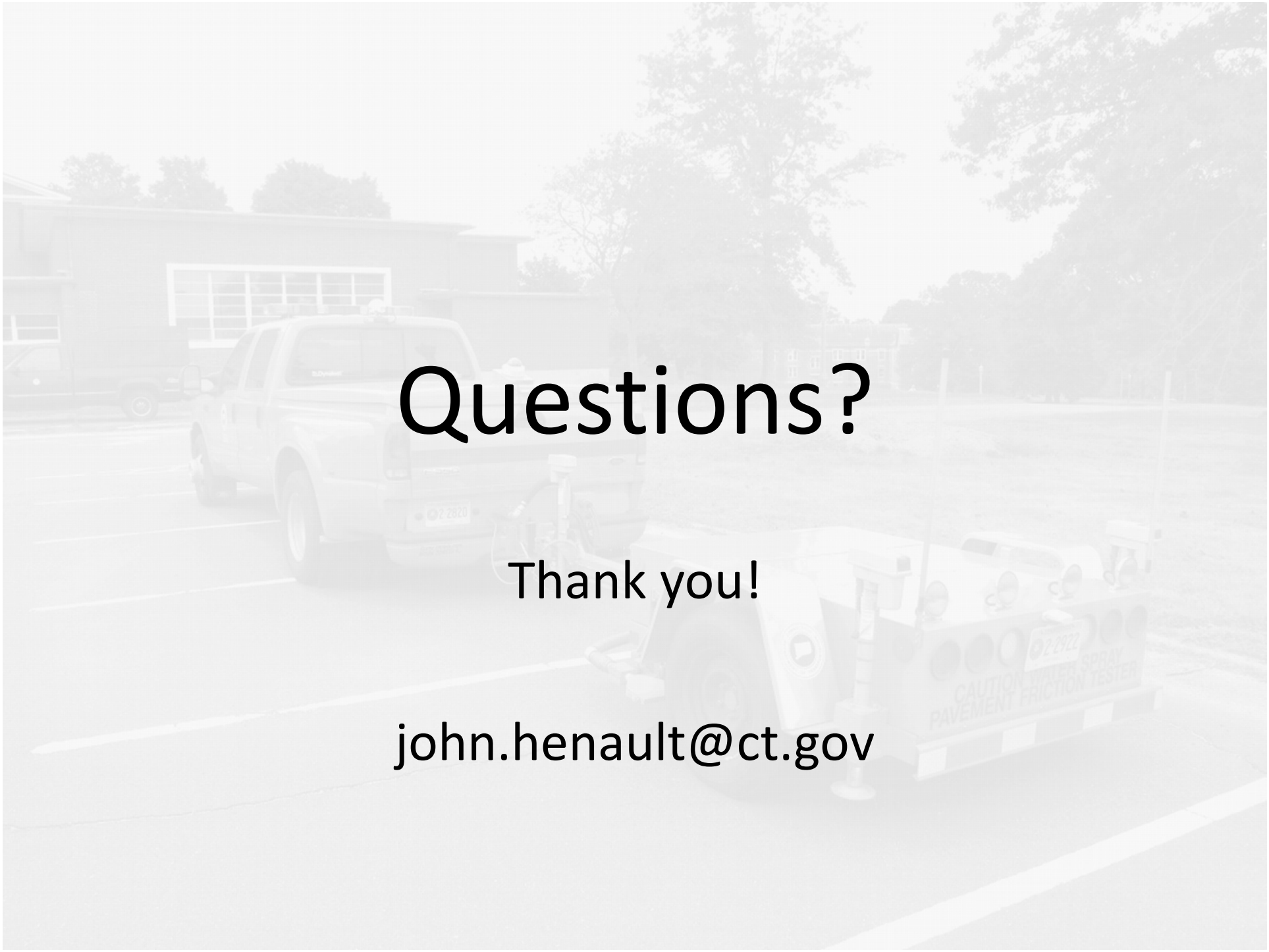
- Indicates Grip Numbers relate better to microtexture than macrotexture even though a smooth tire is used.

Conclusions

- Good correlation between FN_{40S} and texture was found ($R^2 = 0.8$).
- High-speed texture measurements corresponded very well with CTMeter measurements ($R^2 = 0.93$).

Acknowledgements

- The University of Connecticut
- FHWA
- Virginia DOT
- Virginia Tech



Questions?

Thank you!

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