



SHRP2 SOLUTIONS
TOOLS FOR THE ROAD AHEAD

Review of the SHRP R06C Deployment Results

Peer Exchange Meeting

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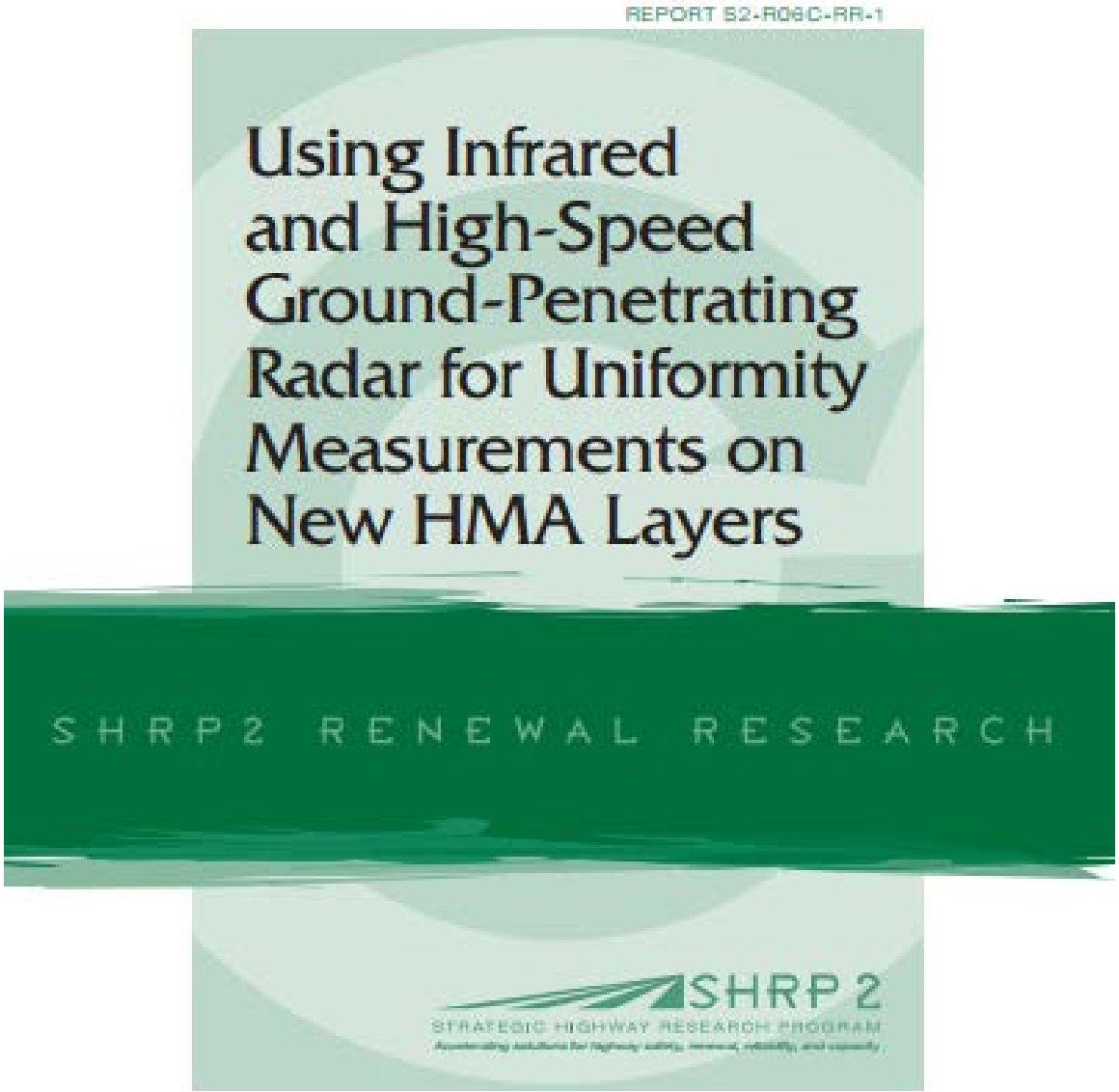
U.S. Department of Transportation
Federal Highway Administration

American Association of State Highway and Transportation Officials
AASHTO

SHRP2 at a Glance

- **SHRP2 Solutions** – 63 products
- **Solution Development** – processes, software, testing procedures, and specifications
- **Field Testing** – refined in the field
- **Implementation** – More than 430 transportation projects; adopt as standard practice
- **SHRP2 Education Connection** – connecting next-generation professionals with next-generation innovations

SHRP2 R06C


REPORT S2-R06C-RR-1
Using Infrared and High-Speed Ground-Penetrating Radar for Uniformity Measurements on New HMA Layers
SHRP2 RENEWAL RESEARCH
SHRP 2
STRATEGIC HIGHWAY RESEARCH PROGRAM

SHRP2 R06C Implementation

- Objectives:
  - Evaluate RDM equipment
  - Make recommendation for feasibility of implementation
  - Provide support to states in implementing RDM
- Partnership
  - FHWA, AASHTO, CH2M Hill, and ARA
  - GSSI, Inc.
  - University of Minnesota
  - MnDOT, Maine DOT, and Nebraska DOT
- Field Trials
  - Maine
  - Nebraska
  - Minnesota

Rolling Density Meter

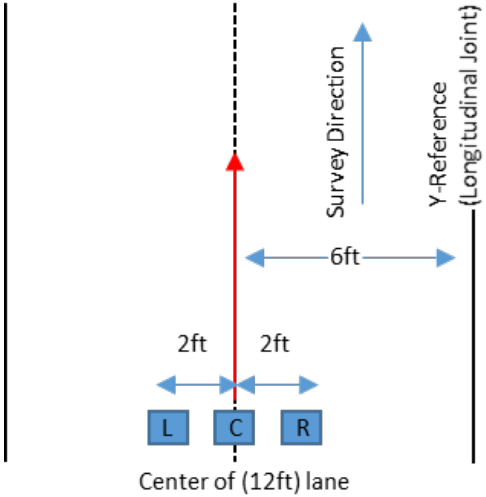
Test Protocol

- Survey Setup
  - General survey considerations
  - Survey types
  - Survey distance
- Survey Data Collection
  - RDM data collection
  - Core data collection
- Data Processing
  - Exporting data
  - Air void vs Dielectric Calibration
- Data Analysis and Applications

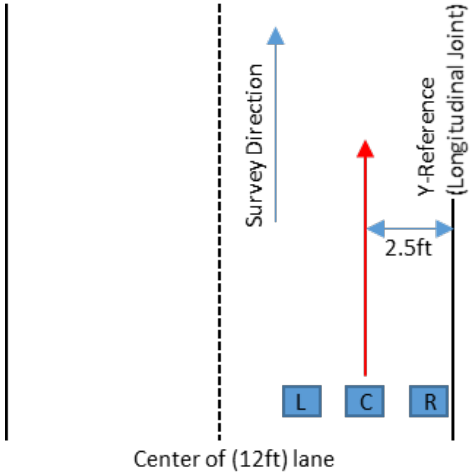
Survey Distance

- 500 ft survey recommended
- Makes data entry easier
- Limits user input and processing errors
- Any data loss is limited to 500 ft
- Minimizes walking distance when returning for cores
- Small section allows RDM survey to stay close to paving crew during moving operations

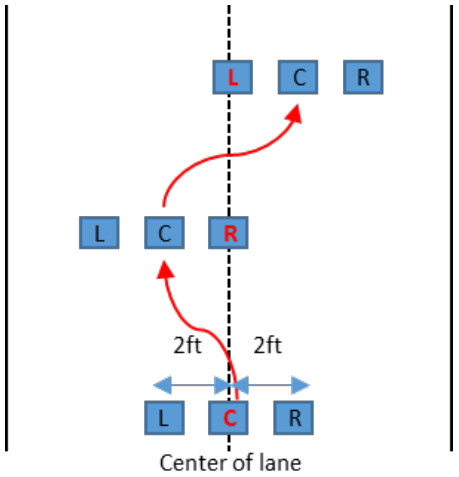
Survey Methods: Survey



Lane pass survey:
The center sensor is offset 6ft from the longitudinal joint

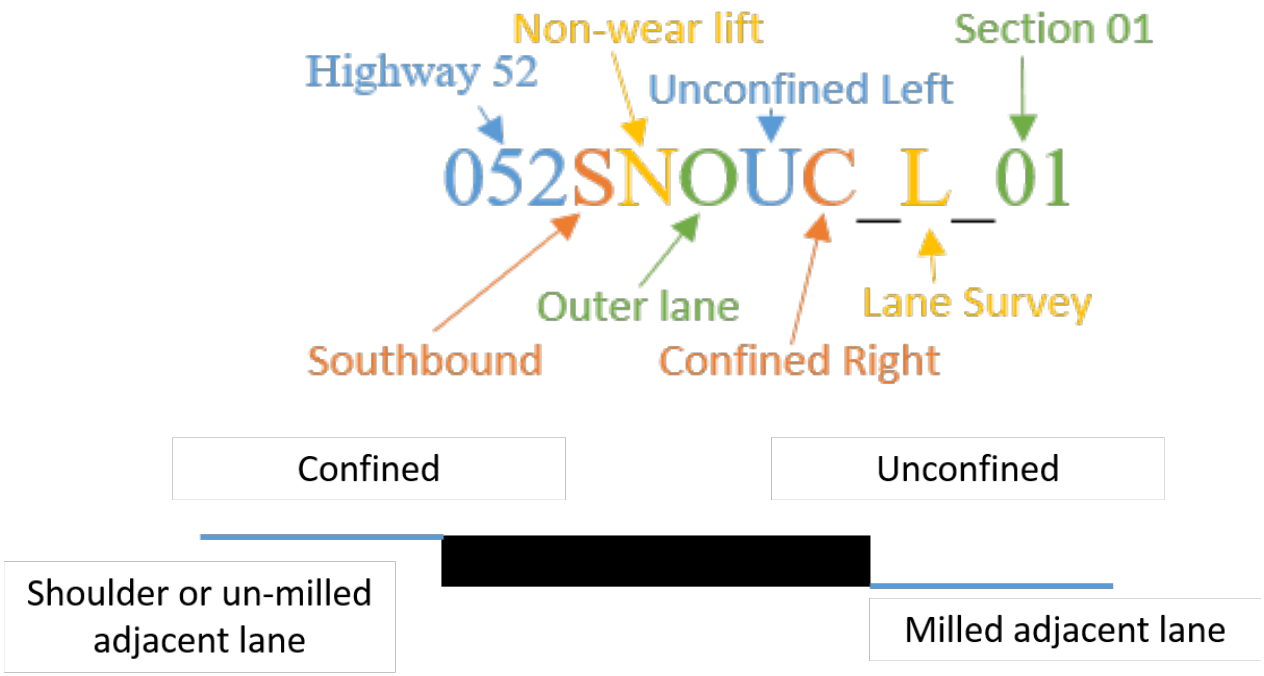


Joint pass survey:
The center sensor is offset 2.5ft from the longitudinal joint



Swerve survey:
The center sensor is offset 6ft from the longitudinal joint and the cart is swerved

Survey Data File: File Root Name

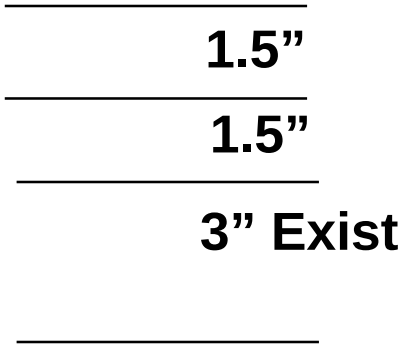


Case Studies

- TH 52 near Zumbrota, Minnesota
- HWY 2 in Lincoln, Nebraska
- US-1 near Cherryfield, Maine
- State Rte 9 near Clifton, Maine
- I-95 near Pittsfield, Maine
- TH 14 near Eyota, Minnesota

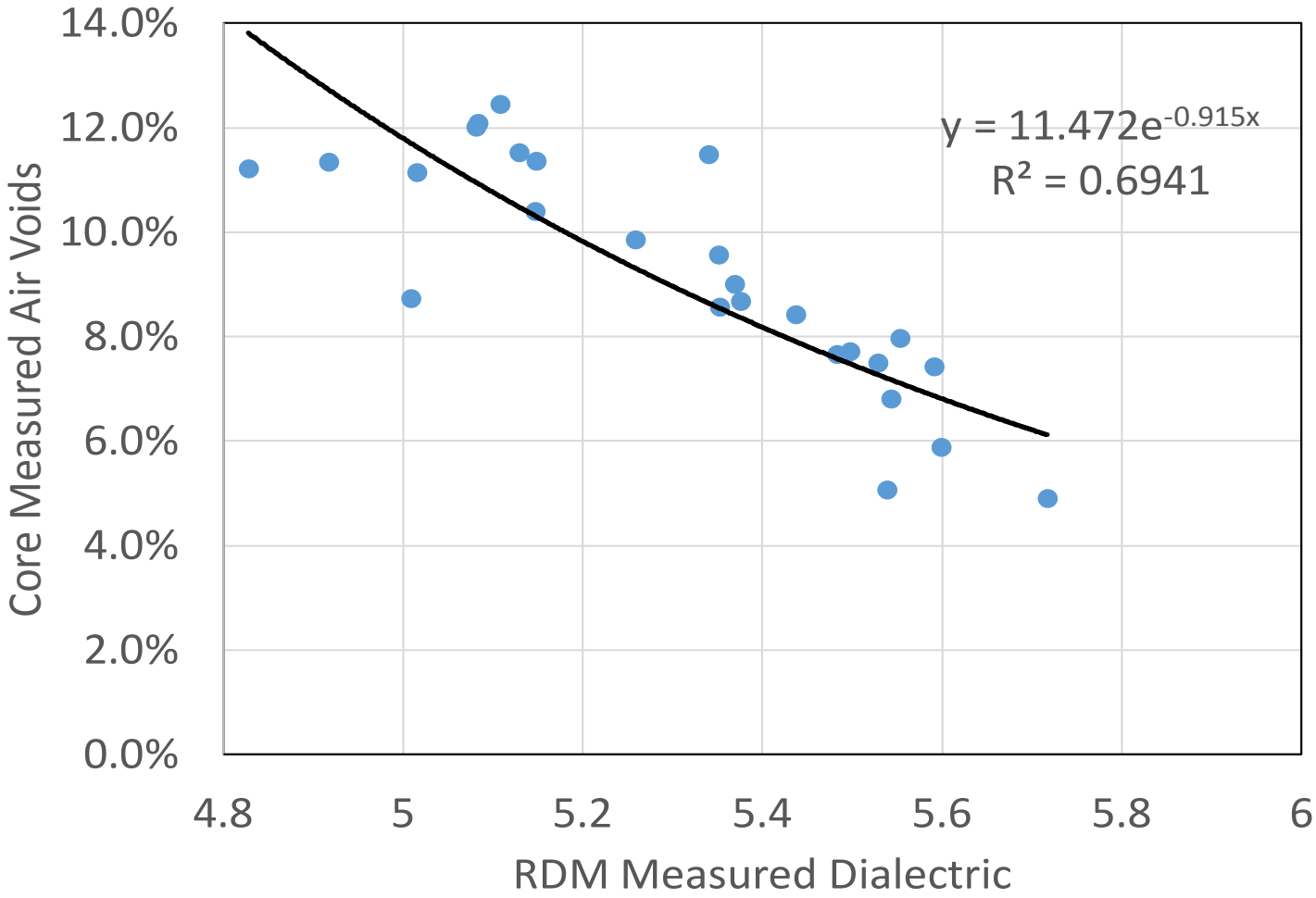
MN Project TH52

- ~7 miles
- M&O: Mill 1.5” and overlay 2x1.5”
- 4 Test Sections (FHWA/AASHTO funding)
  - No added binder + 4 rollers (control)
  - Added binder (+0.5%) + 4 rollers
  - No added binder + 5 rollers
  - Added binder (+0.5%) + 5 roller
- The entire 7 mile project was scanned



Relating Dielectric Measurements to Air Void Content

Asphalt binder content: 5.2%; 4 roller passes



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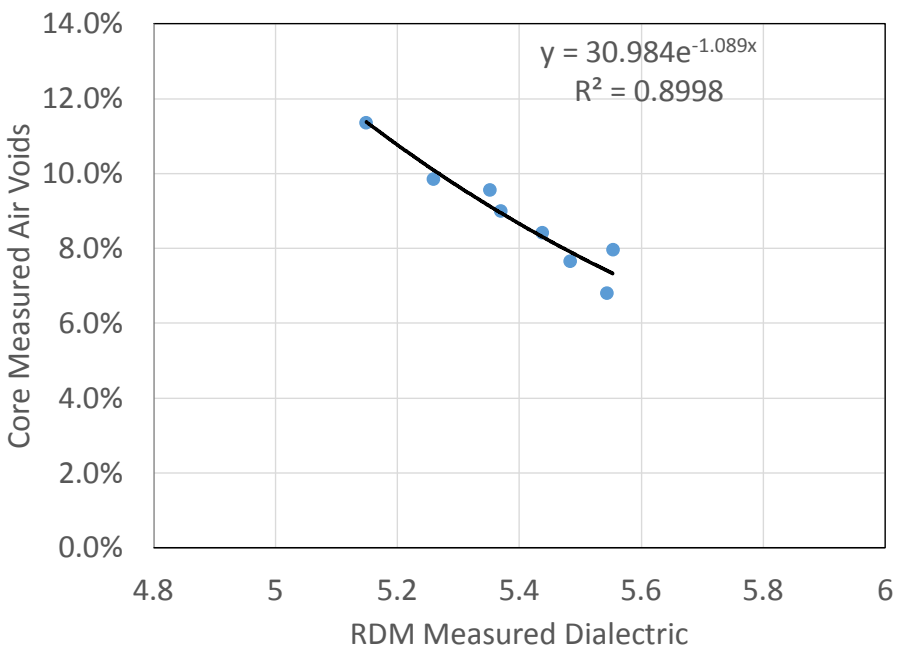
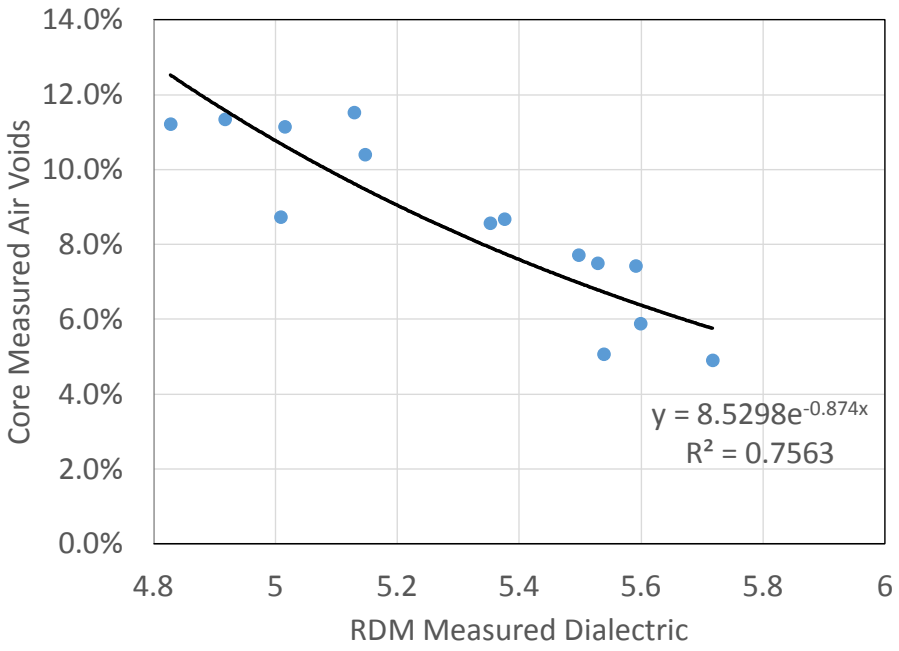


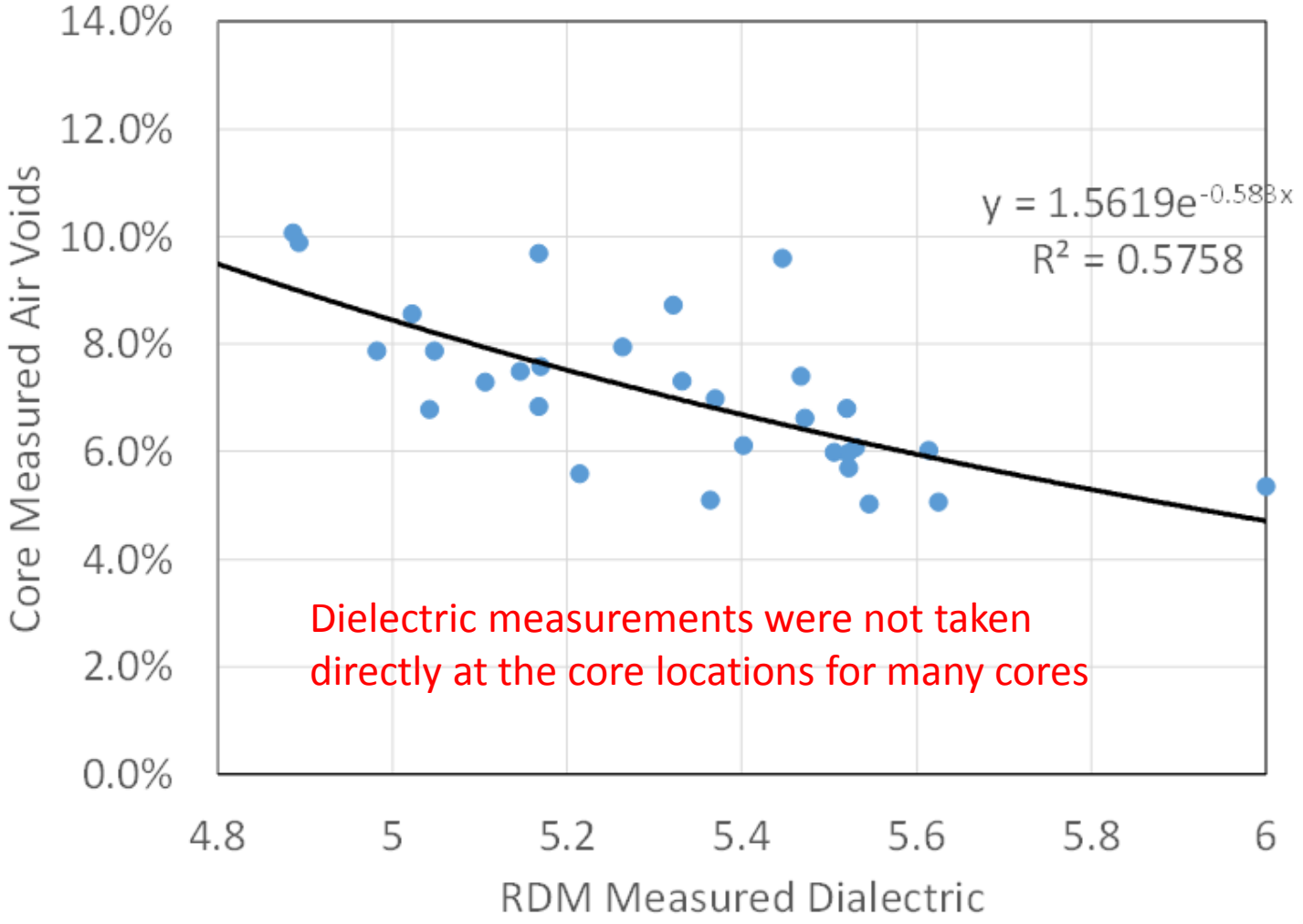
Non-wear lift



Wear lift

Relating Dielectric Measurements to Air Void Content

Asphalt binder content: 5.7%; 4 roller passes



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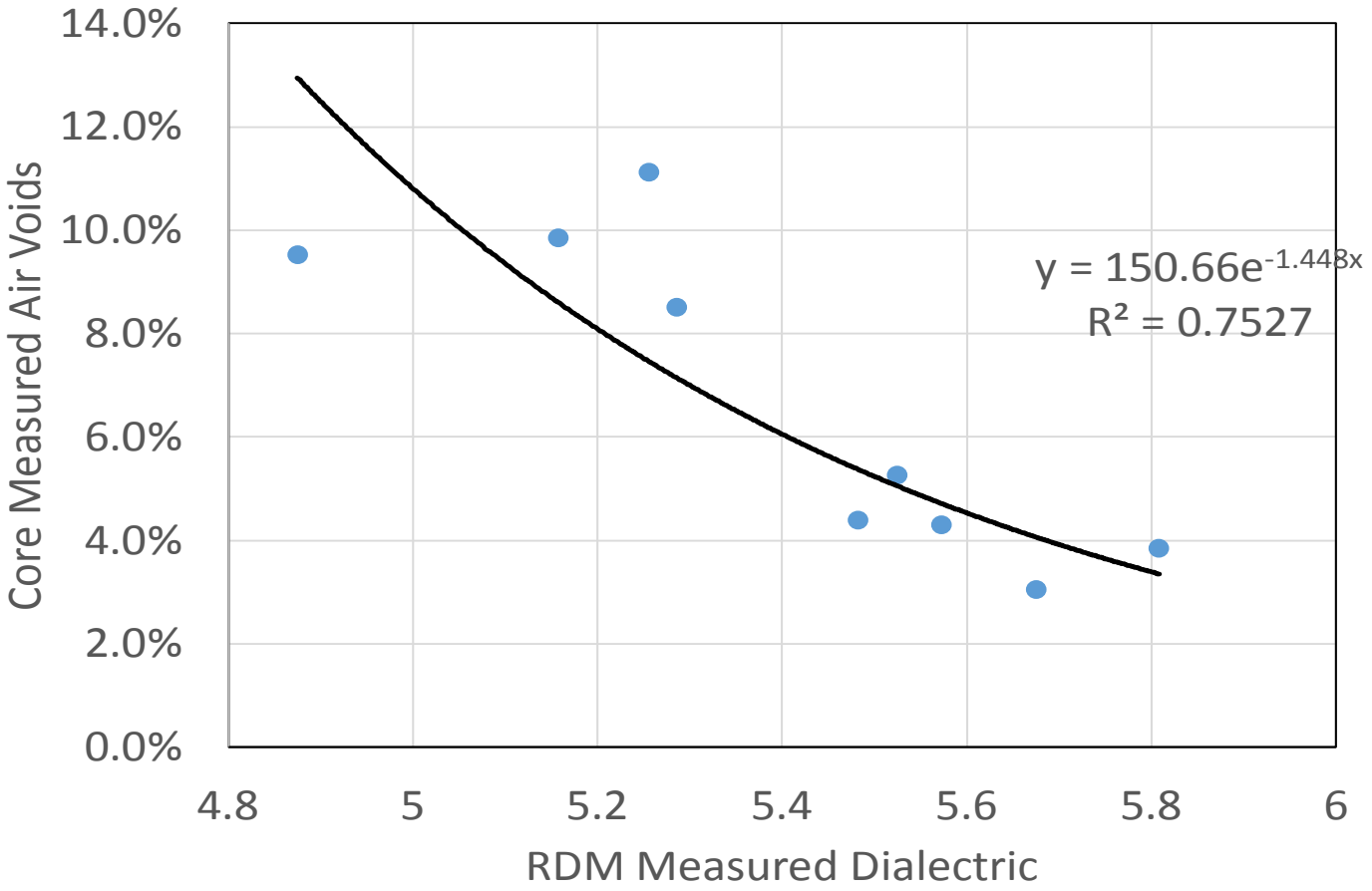

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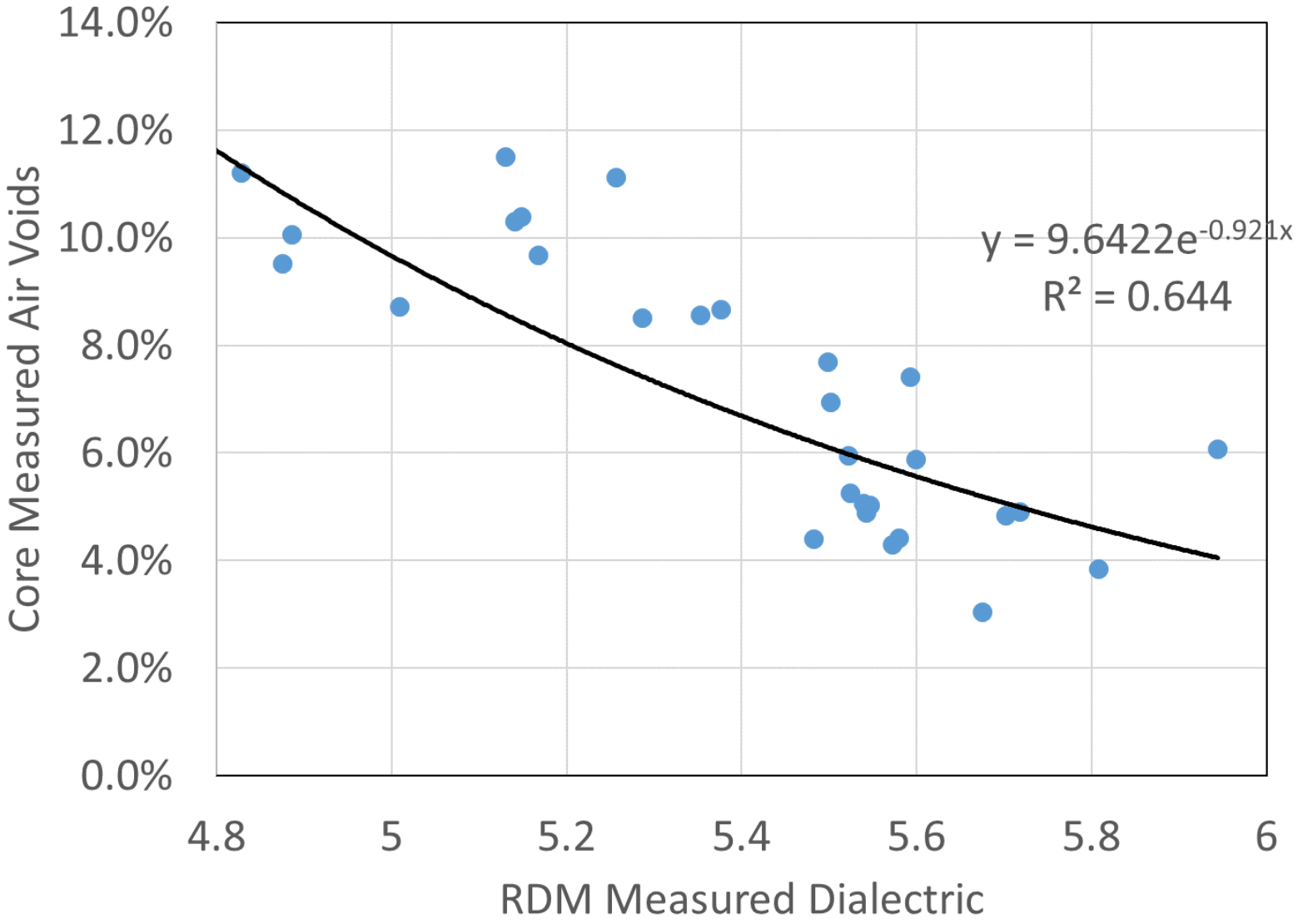

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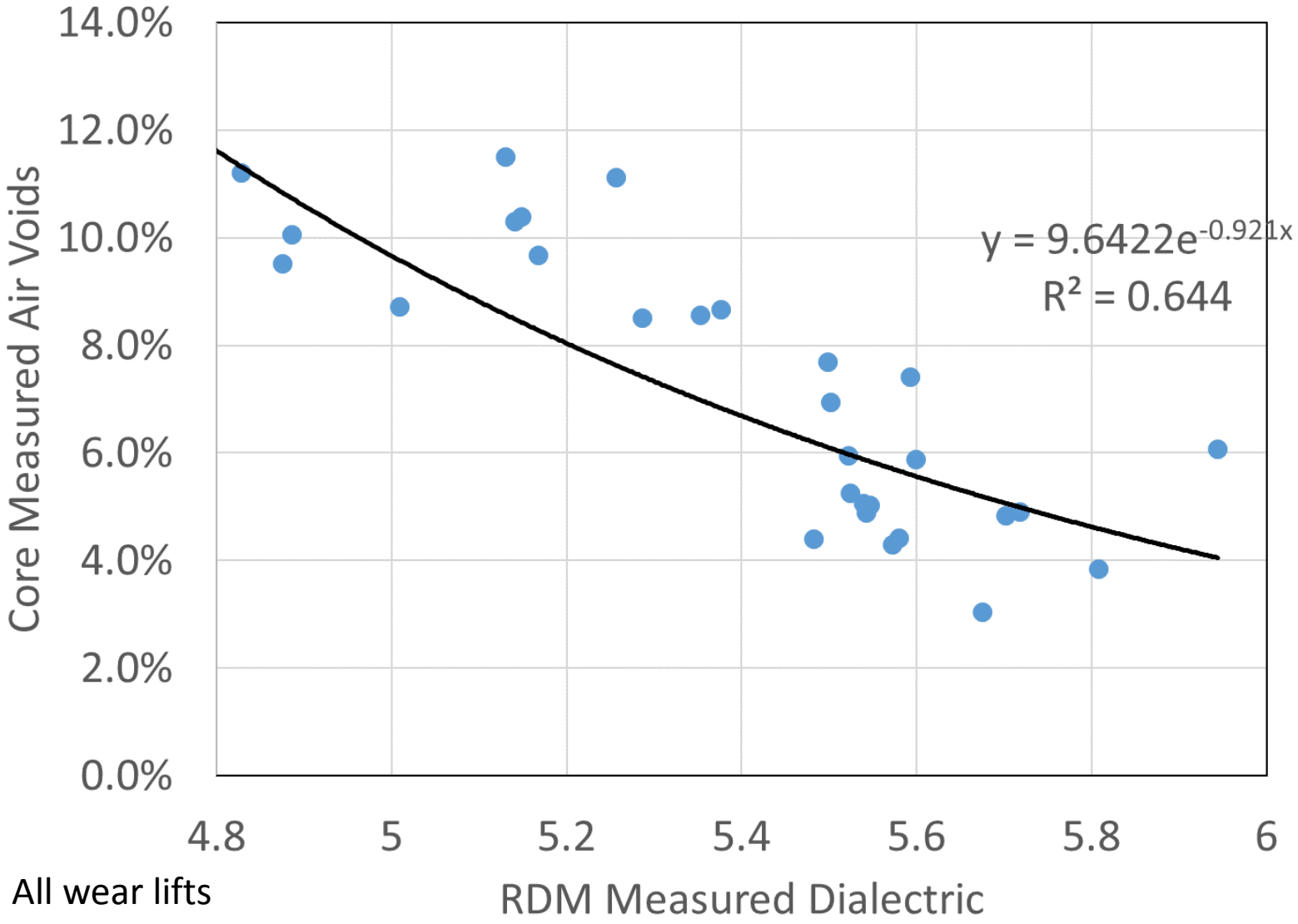

All wear lifts

US Route 1 Cherryfield, Maine

- July 13th, 2016
- 1.25-in HMA overlay
- 3 non-consecutive 500-ft sections
- Fast moving lane closure
- 5 cores were collected

US Route 1 Cherryfield, Maine

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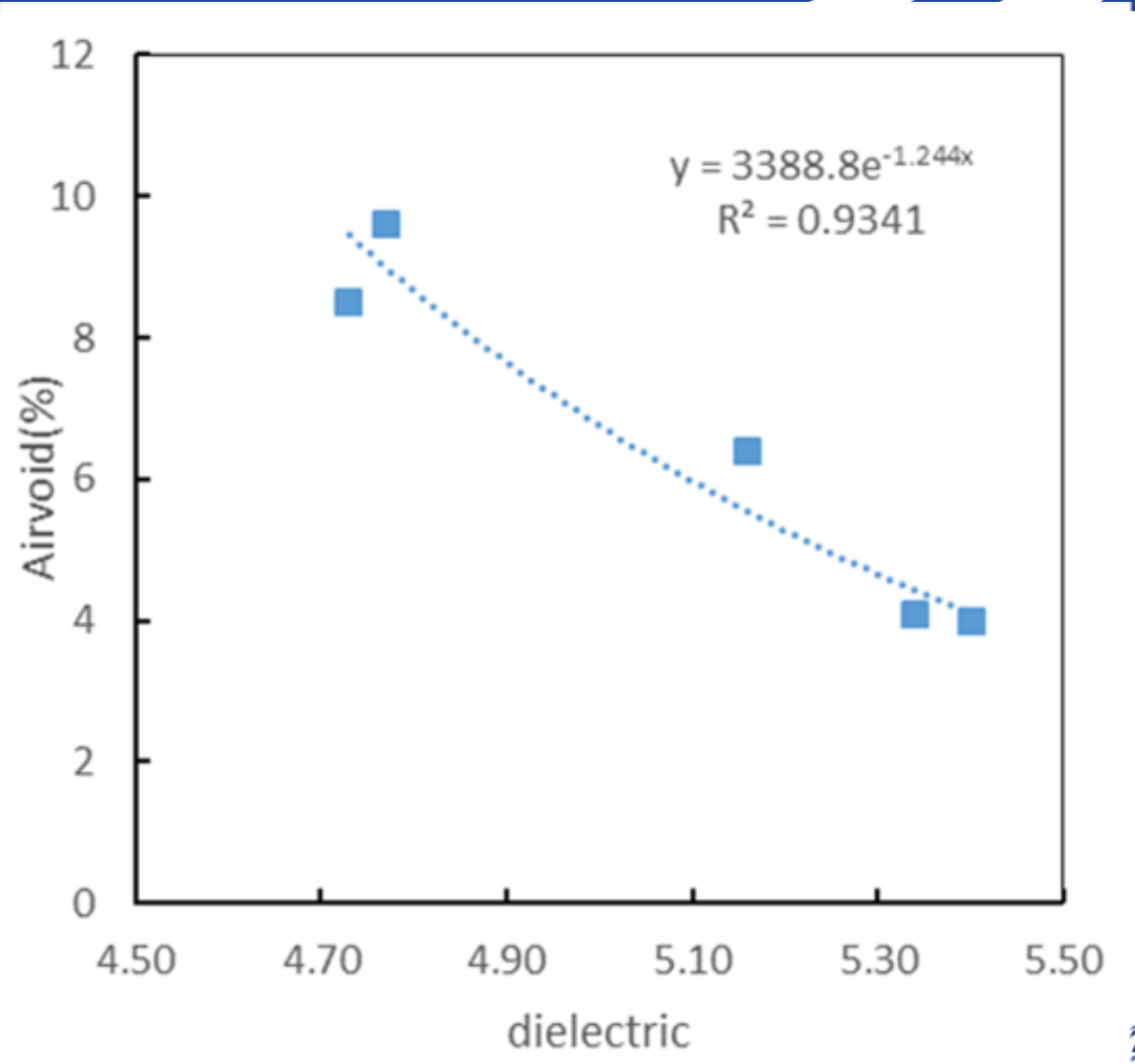
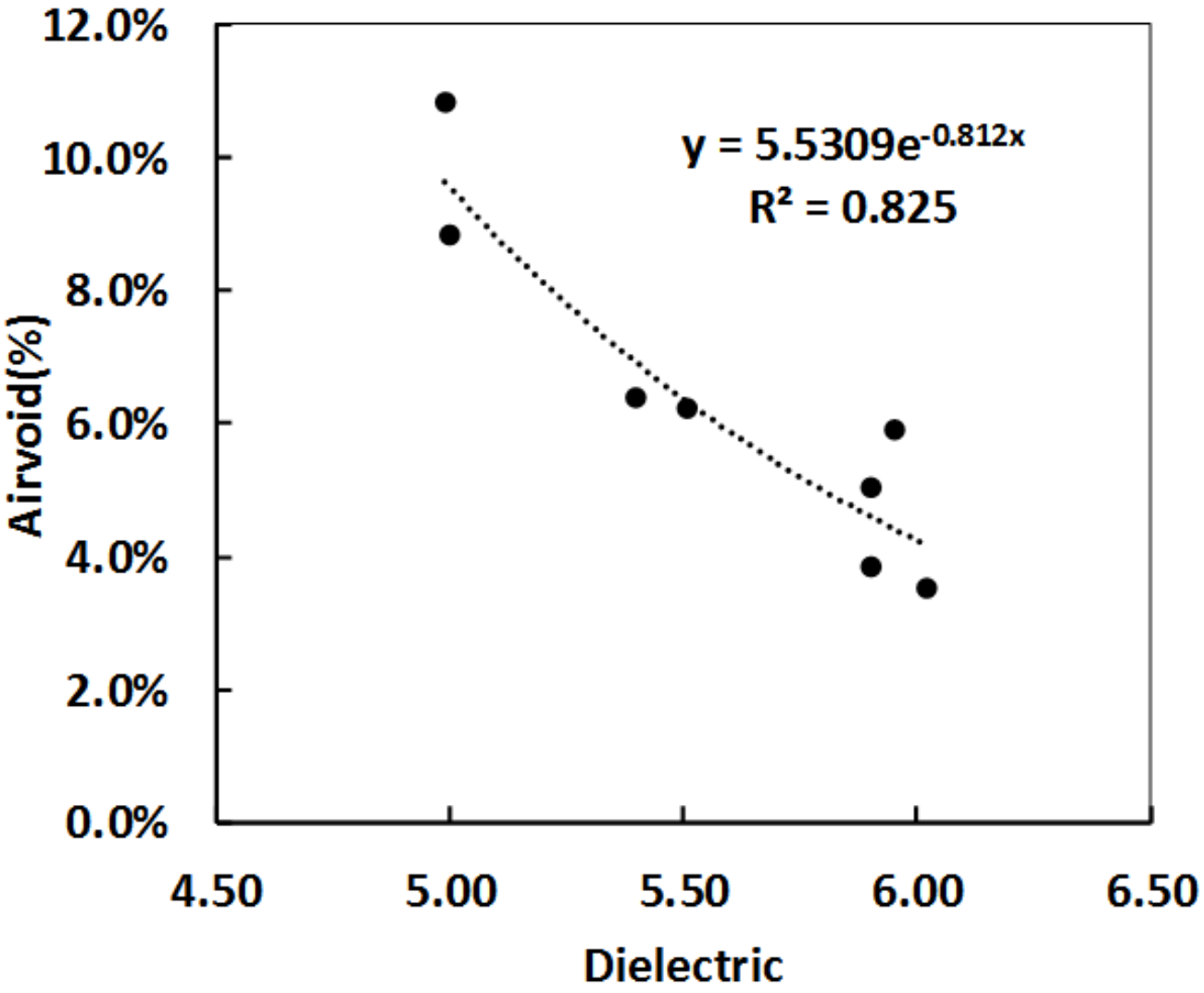


HWY 2 in Lincoln, Nebraska

- 1.5-in HMA overlay
- 1000 ft of pavement
- Night time testing
- 8 cores collected

HWY 2 in Lincoln, Nebraska

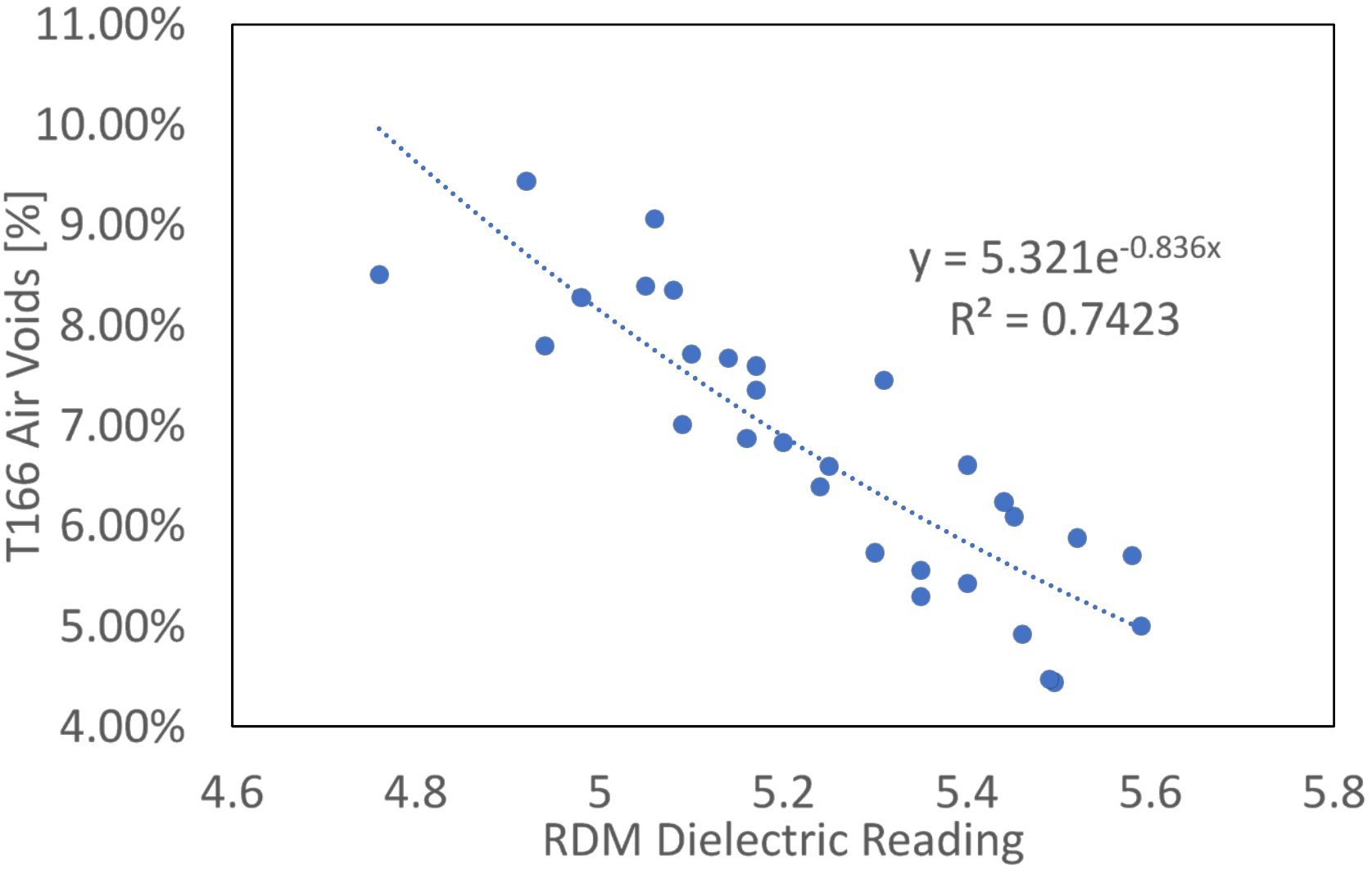
HWY 2 in Lincoln, Nebraska



MN Project TH14

- ~12 miles
- M&O: Mill 2” and overlay 2” and 1.5”
- 6 Test Sections:
  - ¾” mix + 3 rollers (control)
  - ¾” mix + 4 rollers
  - ½” mix + 3 rollers
  - ½” mix + 4 rollers
  - ½” mix (Evotherm) + 3 rollers
  - ¾” mix (Evotherm) + 3 rollers

Relating Dielectric Measurements to Air Void Content



All sections

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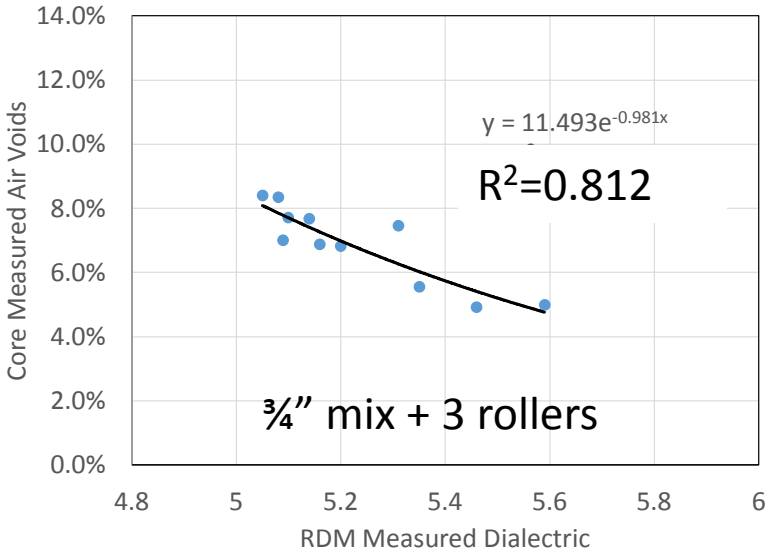

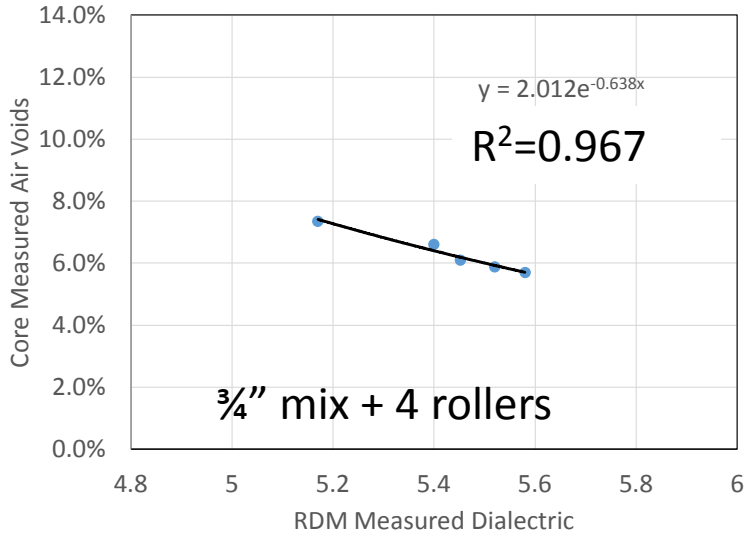

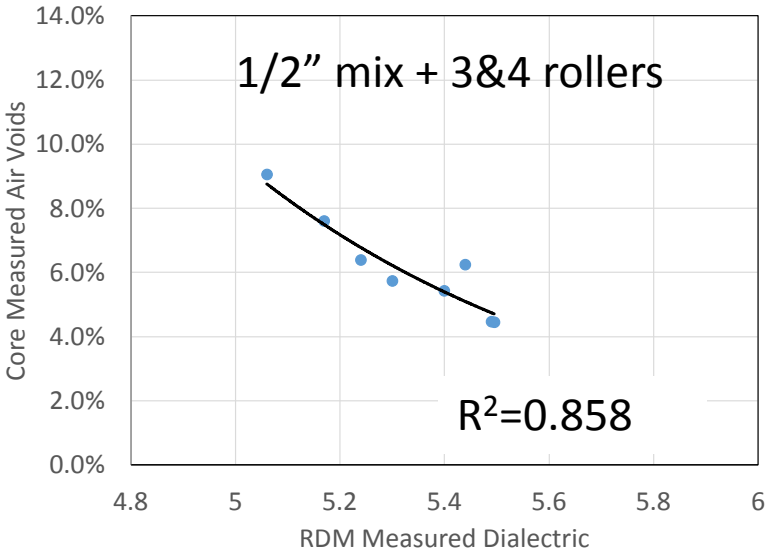

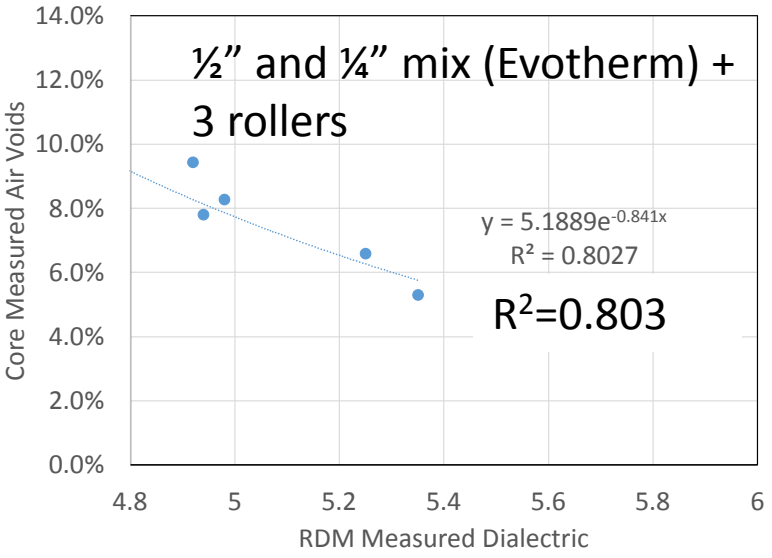

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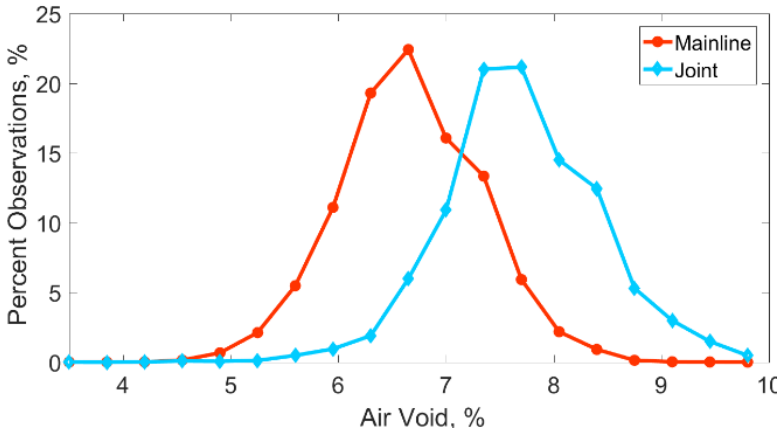
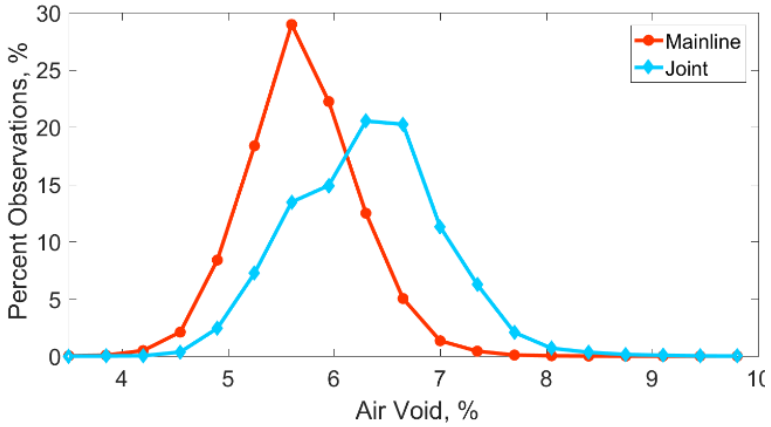


¾” mix + 3 rollers



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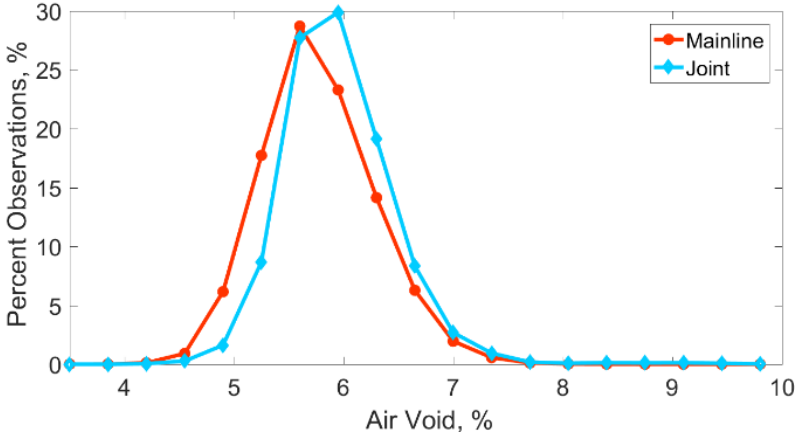
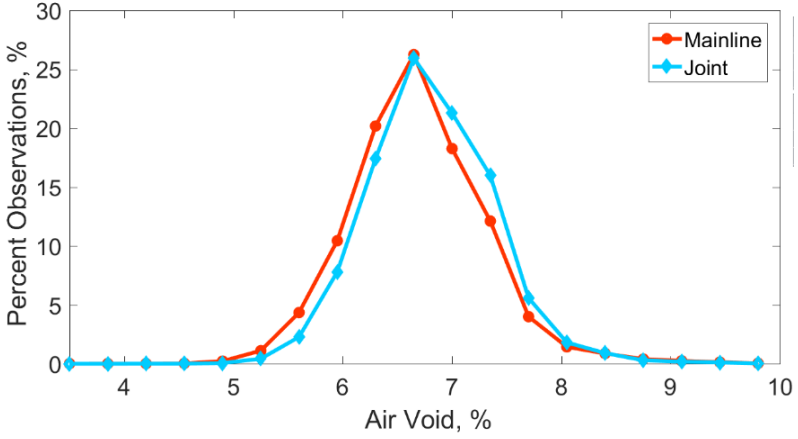


1/2” mix + 4 rollers



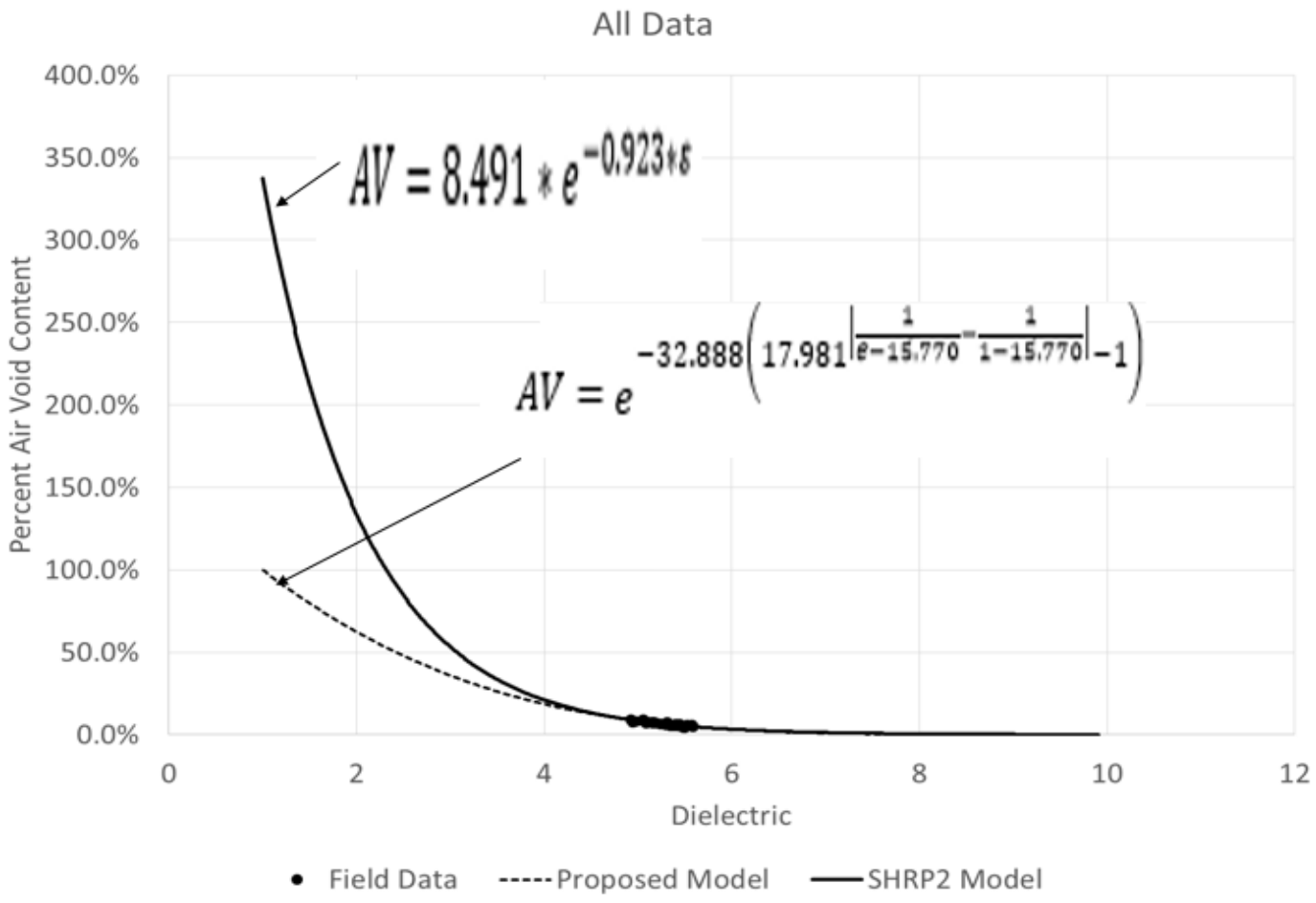
3/4” mix (Evotherm) + 3 rollers

Field Testing – Lessons Learned

- The current version of RDM is an implementation-ready device
  - Easy to operate
  - Can operate continuously for 6-8 hours
- Day and night testing was conducted without interfering with paving or delaying moving closure
- RDM is capable of providing real time assessment of in-place compaction uniformity
- Good dielectric – air void correlations were obtained for the majority of the projects
- Good core data collection protocol is a key

Calibration Improvements

Dai and Hoegh Model $AV = exp\left(-B\left(D\left|\frac{1}{e-C}-\frac{1}{1-C}\right|-1\right)\right)$



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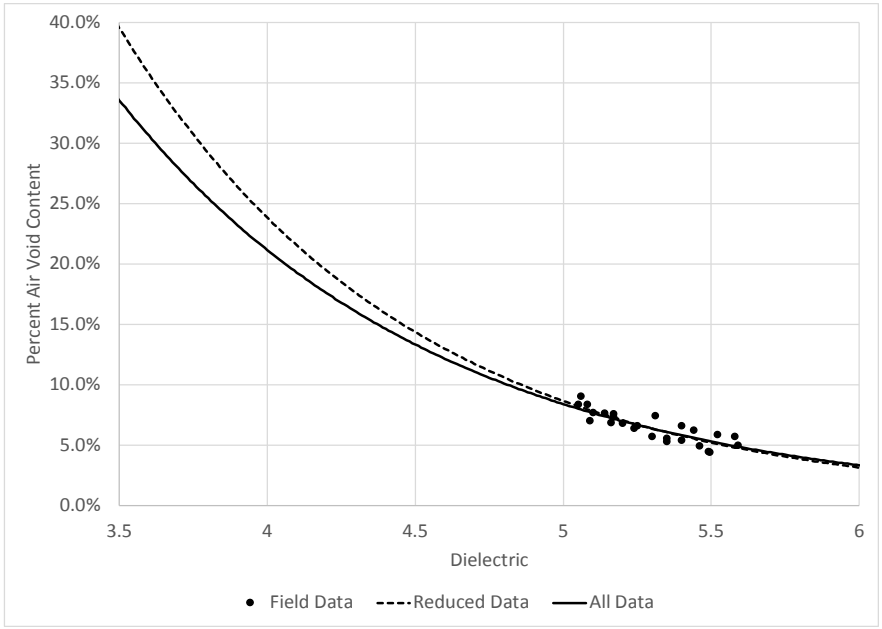

Conventional model

Dai and Hoegh model