# Design and Construction of Two-lift Concrete Pavements for Pennsylvania

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IRISE ANNUAL MEETING

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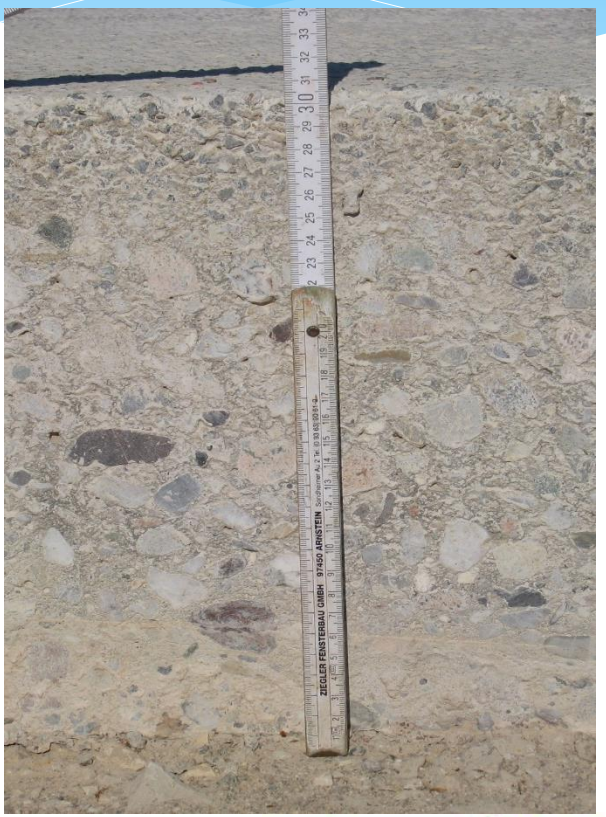
# The Problem

- Concrete pavements in PA are
  - Overdesigned
  - Difficult to construct smooth do to excessive thickness
  - Overly expensive
- Two-lift paving
  - reduce cost
  - increase sustainability



# Project Objectives

- Develop design and construction recommendations for two-lift concrete pavements for Pennsylvania conditions
- Develop NDE technology for QA/QC control of PCC/PCC bond

# Project Approach

- Task A: Literature review
- Task B: Laboratory testing
- Task C: Development of the design guidelines
- Task D: Construction of experimental two-lift concrete pavement section
- Task E: Non-destructive evaluation of experimental two-lift concrete pavement section
- Task F: Draft final report
- Task G :Final report

# Literature Review

# Literature Review: US Experience with PCC/PCC

* The first concrete pavement constructed in the United States— in 1891 in Bellefontaine, OH—was a two-lift pavement. Several two-lift concrete pavements were built in the early 1900 in Duluth, MN
* Not common technique now
* PCC/PCC largely ignored by US researchers; limited existing US research focuses on…
  * Design methods (emphasis on debonding, shear at interface) that have become less relevant given MEPDG and wet-on-wet construction
  * Performance impact of lean concretes in lower lifts and concerns of debonding (again, wet-on-wet construction and EU experience suggests debonding not a concern)
  * Performance impact of base types

# EU Experience with PCC/PCC

* Two-layer composite PCC pavements have been constructed in EU since the 1950s
* Countries who have used two-layer PCC include: Austria, Belgium, France, Germany, Netherlands, and Switzerland
* Austria has been regularly constructing two-layer PCC since 1960s and is most experienced in the field
* Two-layer design is the standard for PCC in Austria and is slated to become the standard in Germany
* Great deal of quality EU research and construction expertise, including use of exposed aggregate concrete (EAC) textures on PCC-PCC

# US PCC/PCC Case Studies

- Florida US-41 (1978)
  - "Econocrete" lower layer and standard PCC in top layer, variation among sections in base layers
  - RIPPER study reported minimal differences in performance
- Kansas K-96 (1998)
  - 3 two-layer sections to study RAP in lower layer; use of high quality—but ASR inducing—aggregate in top layer; and effect of different material properties in PCC layers on bonding
  - Final section study (effects of differences in layers) addressed by Springenschimd from Munich Tech in early 1990s
- Michigan I-75 (1993)
  - Two-layer JRCP, EAC construction near Detroit used European design and contractor (Ruboco from Belgium) for texturing
  - Problems with construction (texture and joint reinforcement)

# US PCC/PCC Case Studies

- Kansas I-70 (2008)

- SHRP R21 Minnesota I-94,(2010)
  - 2 two-layer sections to evaluate
  (1) RA in lower layer a
  (2) exposed aggregates
- Illinois Tollway (2021)
  - Use one paver
  - Use RAP in the lower lift

# Literature Review: SHRP R21 Project

**Project Team**

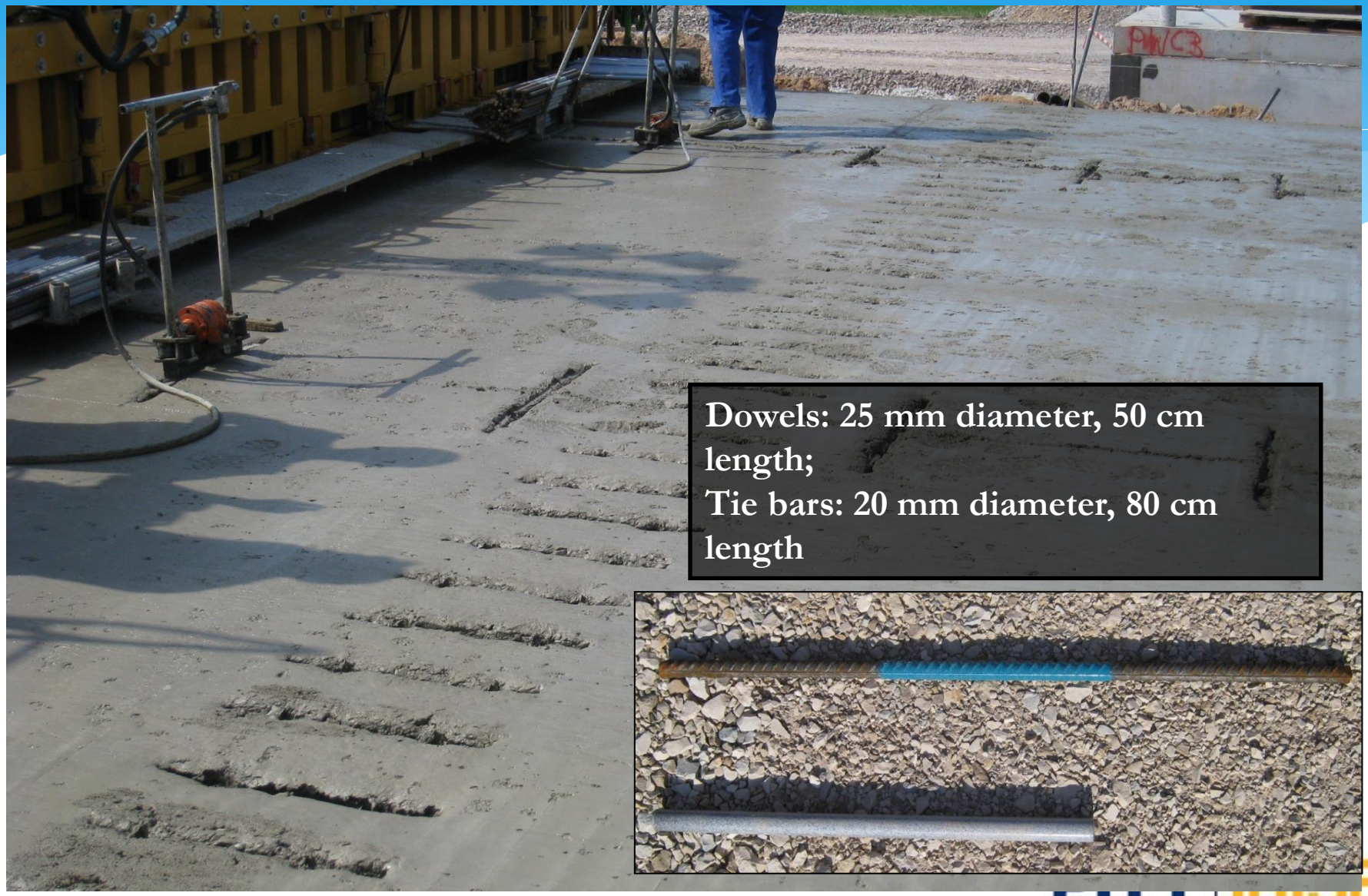
1. PI: Dr. Mike Darter, ARA
2. Co-PI: Dr. Lev Khazanovich, University of Minnesota
3. Co-PI: Dr. Julie Vandenbossche, University of Pittsburgh

**Three tests:**

1. Visit of pavement sections in Germany and Austria
2. Development of the design guidelines
3. Construction of test sections at MnROAD

# Lower Layer Paver

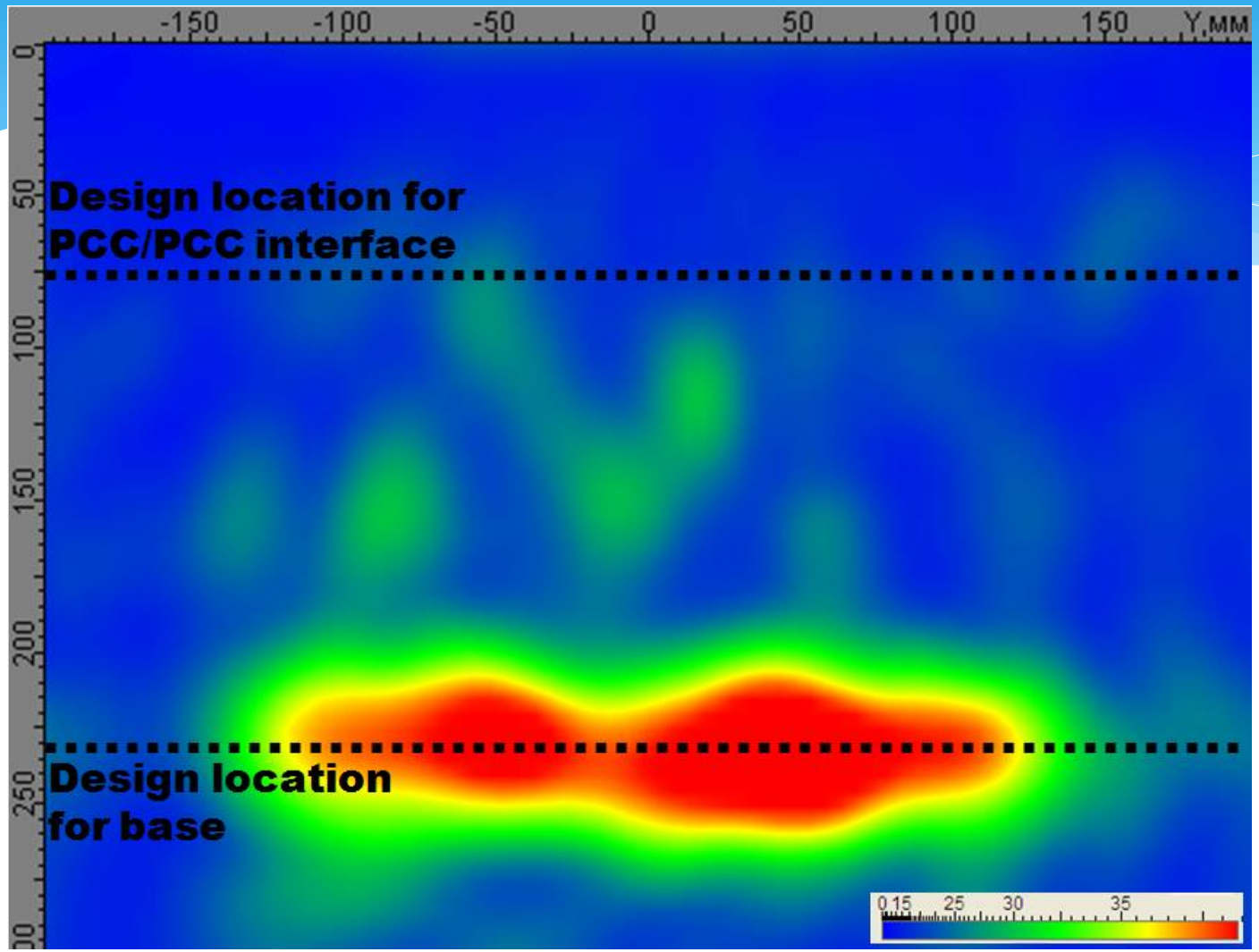
# Lower Layer Paver with DBI




**Dowels: 25 mm diameter, 50 cm length;**
**Tie bars: 20 mm diameter, 80 cm length**

# Upper Lift Paver

# R21. Tomogram of sound PCC-PCC interface




# Project Schedule