Department of
Civil, Environmental,
and Geo- Engineering

COLLEGE OF
Science & Engineering
UNIVERSITY OF MINNESOTA

TPF(5)-169, Development of an Improved Design Procedure for Unbonded Concrete Overlays

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Project Tasks

- Task 1: **Literature review and database assembly**
- Task 2: **Laboratory and field testing**
- **Task 3: Structural model development**
- **Task 4: UBOL procedure development**
- Task 5: Procedure user guide development
- Task 6: Evaluate guidelines on suitability of UBOL
- Task 7: Draft final report
- Task 8: Final report
- **Task 9: Additional laboratory testing**

Task 1 & 2 highlights

- Field observations
- Drainage review
- Lab study observations

Field observations

- Transverse mid-slab cracking is not very common
- Transverse new joint cracking
- Longitudinal cracking
- Corner cracking

Field observations

Longitudinal cracks on US 10 near Coleman
(cracks digitally enhanced)

Field observations

Corner breaks

Task 1 & 2 highlights

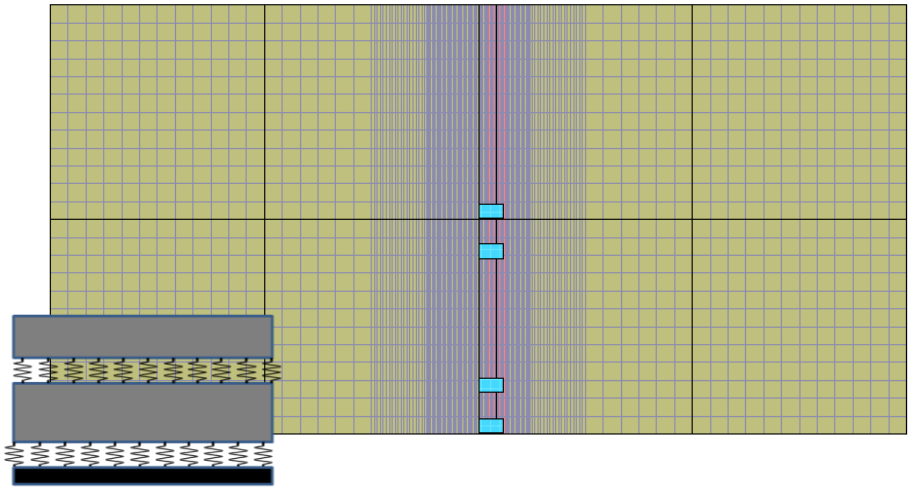
- Field observations
- **Drainage review – Dr. Snyder**
- Lab study observations

Task 1 & 2 highlights

- Lab Study Observations
  - No reflective cracking was replicated in lab study
  - Significant deterioration of the interlayer may lead to cracking in the overlay
  - Permanent deformation, consolidation, and erosion observed under joint loading

Task 3, Overview of modeling (1)

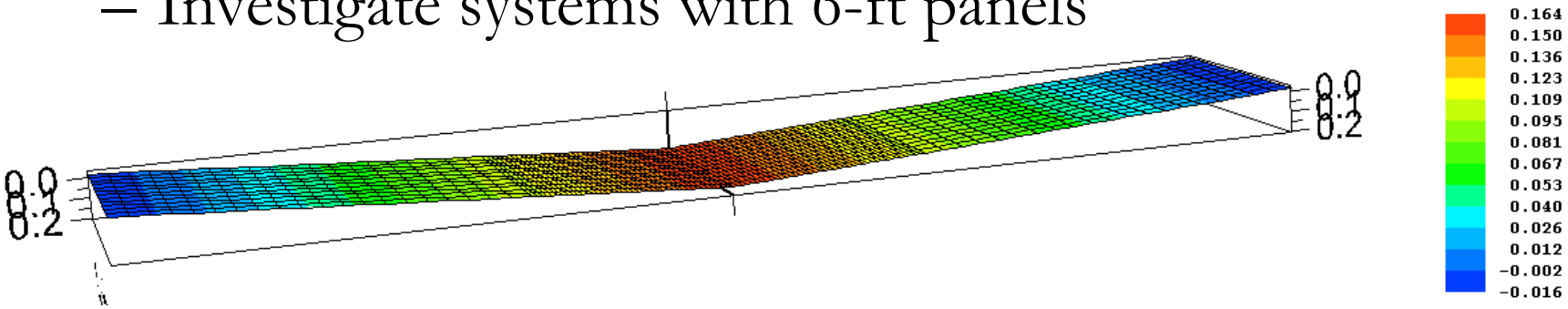
- Model accounts for
  - overlay
  - interlayer
  - existing slab
  - subgrade support



- Joints in the overlay do not necessarily match with joints in the existing pavements
- Unlike AASHTO M-E, the structural model does not convert the existing and overlay into a single-layer system

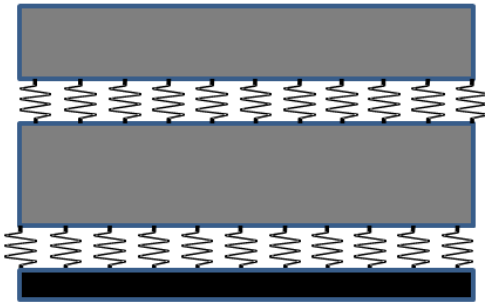
Task 3 Overview of modeling (2)

- Using UBOL system model:
  - Gain insight on effects of damage in existing PCC slab and effects of deterioration near joints
  - Can estimate single-layer structural equivalents for different UBOL systems (given a "worst case")
- Model modified/extended to
  - Simulate lab beams to estimate interlayer properties
  - Investigate systems with 6-ft panels



Totsky approach for interlayer modeling

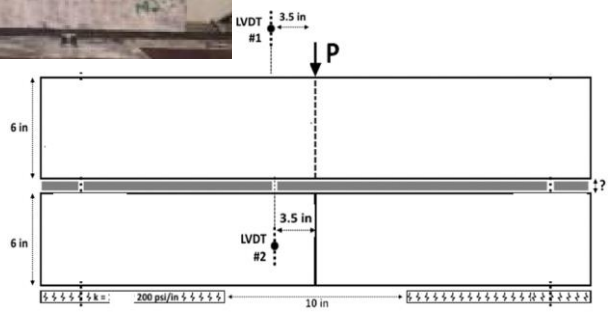
- Totsky approach models "cushioning" property of the interlayer using springs

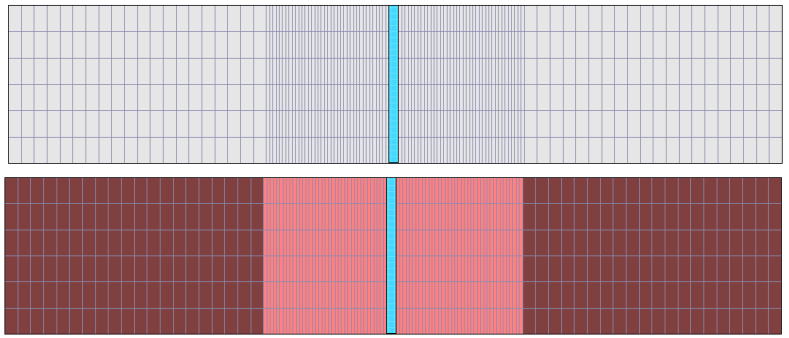


- Advantages of Totsky approach:
  - Computationally efficient (big concern for FEM)
  - Already incorporated into ISLAB2005 specifically for UBOL
  - Can be adopted for more sophisticated models (e.g. 3D joint faulting) without issue
- Requires estimate of interlayer spring coefficient

Modeling Task 2 reflective cracking beam behavior and interlayer response

- 2D finite element simulation of Task 2 reflective cracking beams using ISLAB2005
- Factorial of simulations created for exact beam dimensions and support conditions
  - Interlayer coefficient varied from 10 to 50,000





Simulating beam interlayer response to 1 kip line load in laboratory

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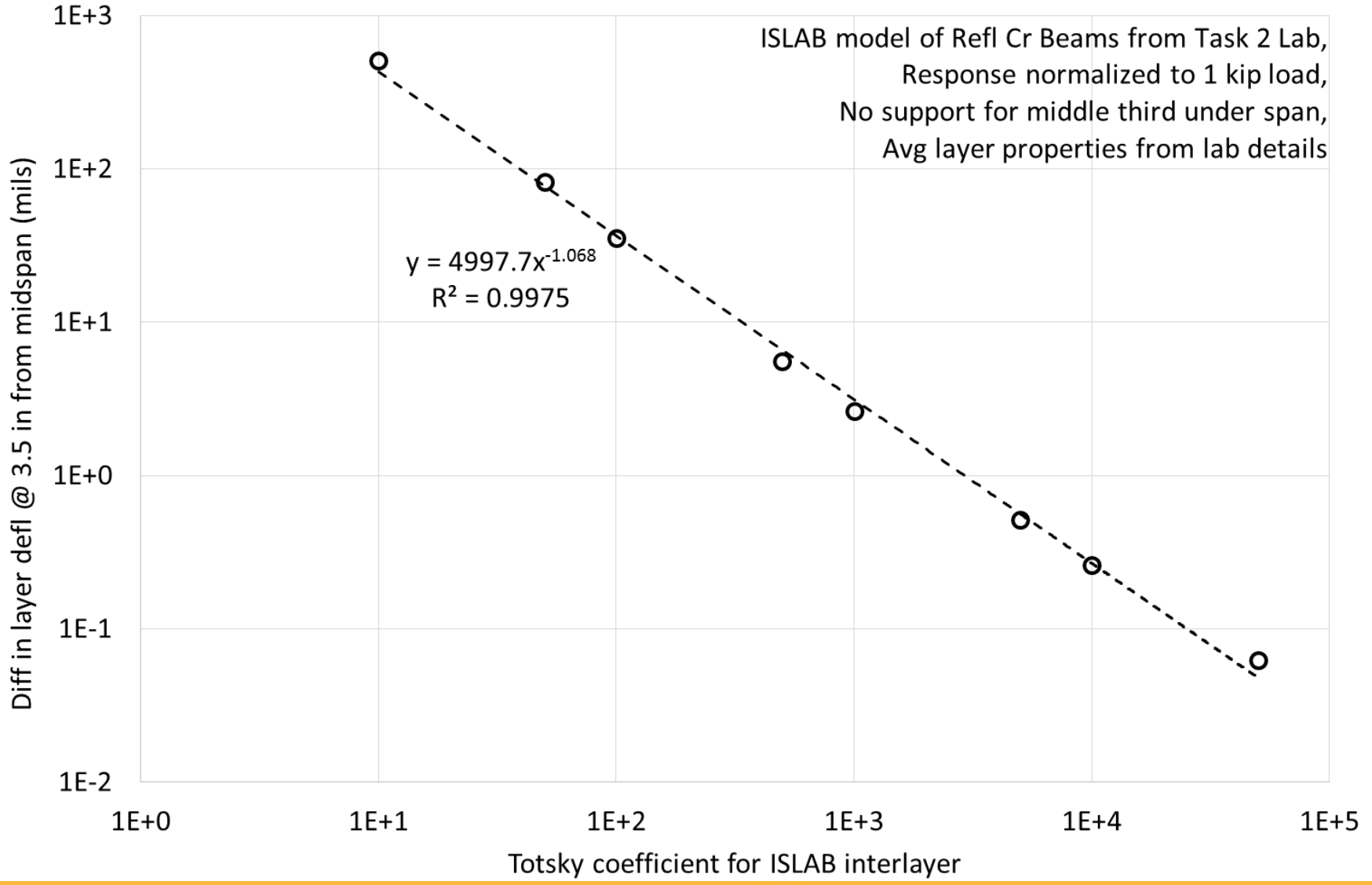

Project Status

- Task 1, 2, and 3 completed.
- Task 9: completed, report will be submitted shortly
- Task 4: Behind the schedule, significant progress was made

- PI, Prof. Khazanovich, will leave the University of Minnesota on December 31, 2016
- On January 1, 2017 he will start at the University of Pittsburgh