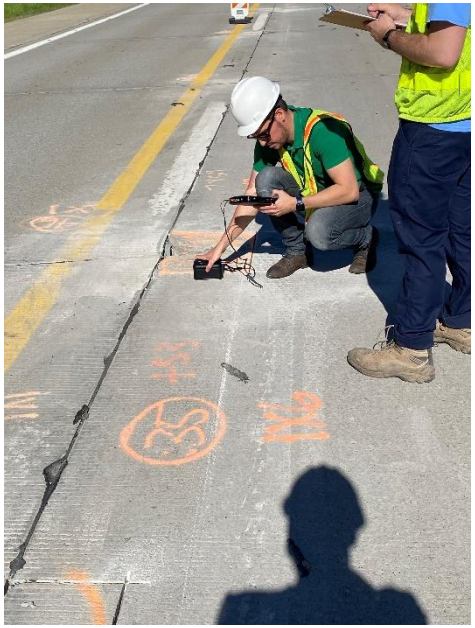
Material Compatible Repair Evaluation



Steve Sachs

IRISE ANNUAL MEETING

MAY 17, 2023

Research Problem

- Premature failures in partial depth repairs (PDRs)

- Incompatible thermal expansion
- Unequal deformation under traffic loads
- Excessive shrinkage
- Bond failure
- Compressive failure of repair material
- Insufficient consolidation
- Delayed curing

Project Objectives

- Assess PDR performance using results from previous IRISE study to develop material compatible repair (MCR) for field project
  - Use MCR and a standard repair material
  - Long-term field evaluations of repairs made
- Investigate the ability of ultrasonic tomography testing to provide:
  - reliable information for required partial depth repair dimensions
  - evaluate bond condition after repair placement

Performance Engineered Repair Mixture

- Two main steps toward developing a PERM:

1. Identifying the CTE of the in-situ concrete;

2. Using appropriate materials and proportioning so:
   - CTE of the PERM and the in-situ concrete are comparable,
   - Drying shrinkage of the PERM is minimized
   - Strength and durability requirements are met

Project Approach

- Task A: Project Selection and Evaluation
  - find suitable PCC rehab project where PDRs are to be performed
  - historical construction data and 4 cores from the roadway to evaluate CTE, E, and f'_c
  - develop a (Performance Engineered Repair Mixture) PERM for the project using the results from the year one MCR project
- Task B: Ultrasonic Tomography Testing of PCC Pavement Prior to PDR
  - Ultrasonic Tomography testing prior to the repair placement
  - Recommendations for repair dimensions (both horizontal and vertical) of the compared to conventional sounding methods
  - cores from Task A will be used to validate the testing

Project Approach

- Task C: Partial Depth Repair Construction
  - PERM specified for use on the project along with a standard repair material
  - Repairs placed using both mixtures w/ same placement and curing methods for both repairs
  - Companion specimens cast with both PERM and standard repair material to measure CTE, E, and f'_c, ε_{repair}

Traditional Repair

»

Material Compatible Repair

- Applied load
- Change in temperature
- Drying shrinkage

» *Elastic modulus,* $E_{repair} = E_{existing}$
» *Thermal coefficient,* $\alpha_{repair} = \alpha_{existing}$
» ε_{repair} *reduced*

Project Approach

- Task D: Performance Monitoring
  - Repair performance monitored for a period of five-years at a frequency of one observation per year
- Task E: Ultrasonic Tomography Testing of Partial Depth Repairs
  - Ultrasonic tomography used to evaluate repair strength development and bond between PDR and existing PCC
  - Testing will be conducted in all repairs constructed under Task B
- Task F: Final Report
  - Summarize project activities, results, and recommendations

Schedule/Status and Application of Research Results

- Tasks A – C complete
  - Rehab project on SR 22 in Westmoreland Co selected
    - Section EB between 819 and Hannastown Rd
  - Cores obtained and tested, PERM developed
  - Ultrasonic tomography testing performed prior to PDR
  - Test section constructed May 2022
- Monitoring phase of project to begin this summer

Results from year 1 MCR IRISE project being implemented in field trial to assess feasibility

Thanks!
PennDOT District 12 & Swank Construction