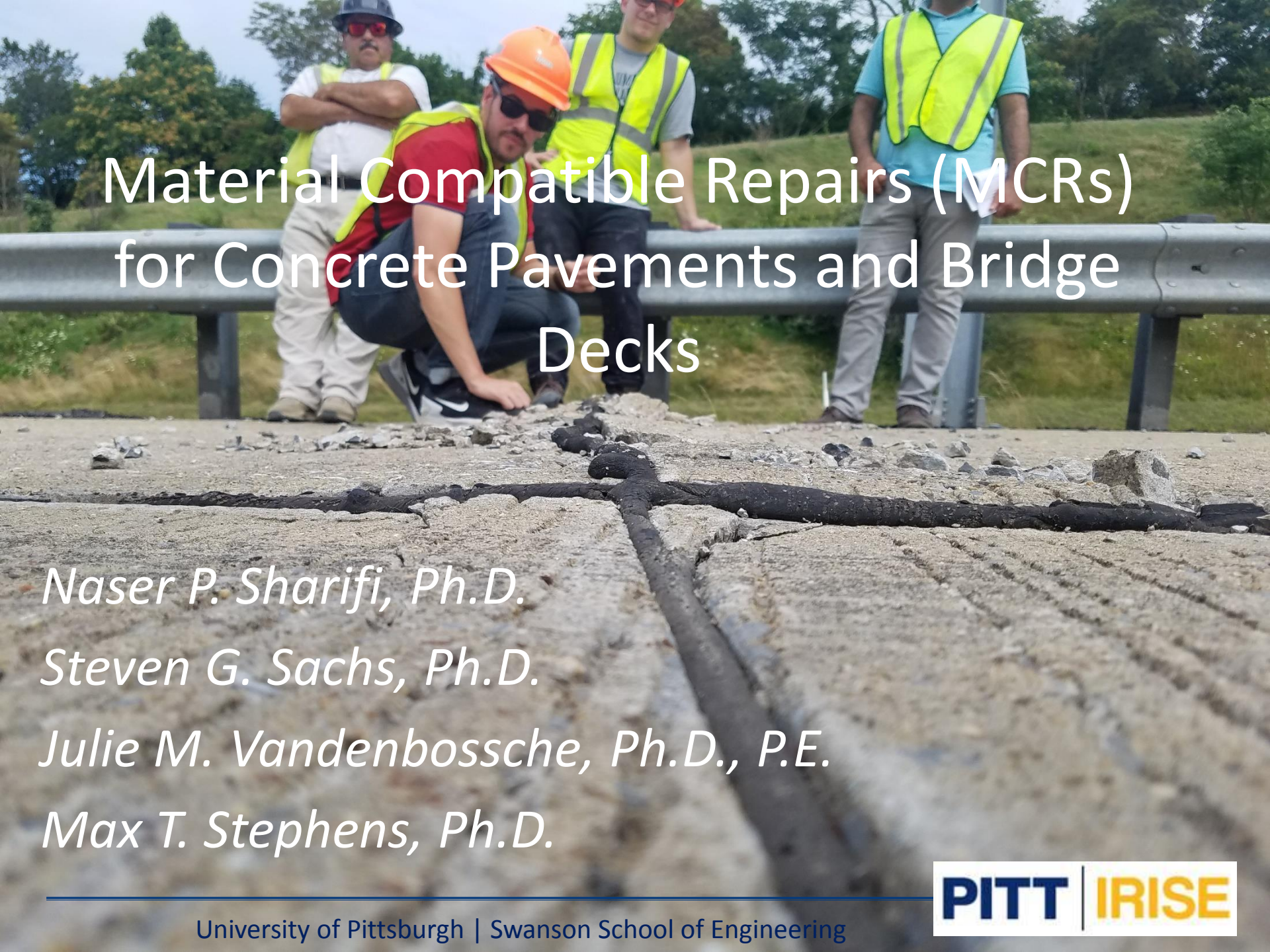

Material Compatible Repairs (MCRs) for Concrete Pavements and Bridge Decks

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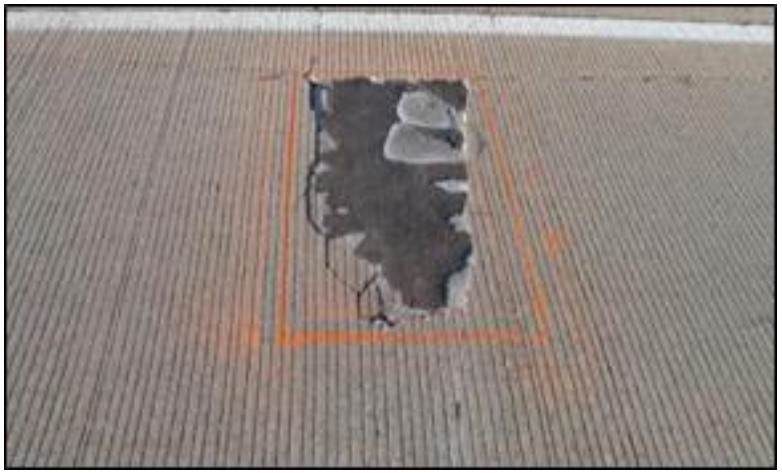
Research Problem

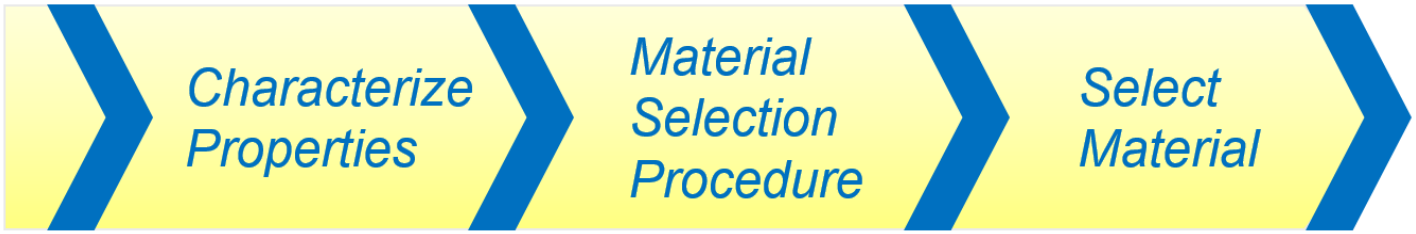
- Premature failures in partial depth repairs (PDRs)
  - Incompatible thermal expansion
  - Unequal deformation under traffic loads
  - Excessive shrinkage
  - Bond failure
  - Compressive failure of repair material
  - Insufficient consolidation
  - Delayed curing

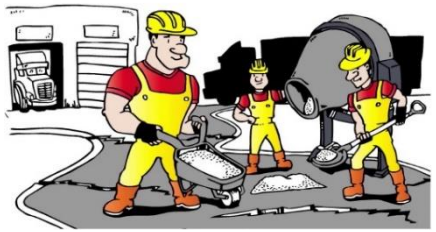


Project Objectives

- Develop material compatible repairs for concrete pavements and bridge decks

- Evaluate internal curing efficiency for long-lasting concrete repairs





Project Approach

1. Identify critical parameters for compatible repair mixture
2. Develop repair material selection framework
3. Propose new mix designs
4. Experimental evaluation of repair materials

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*

Conclusions

- Stiffness compatibility, thermal compatibility, and controlled shrinkage are three compatibility properties for an MCR
- Coarse aggregate type is the key parameter to achieve stiffness and thermal compatibility
- Presoaked lightweight aggregate (LWA) is a promising strategy to control the shrinkage of repair materials
- From modeling, a compatible material could reduce induced stresses in repair by more than 60%.

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 (internal curing can be beneficial),
    - Strength and durability requirements are met.

Status and Application of Research Results

- Project Completed - March 2020
  - Final report available (https://www.engineering.pitt.edu/Sub-Sites/Consortiums/IRISE/_Content/Achievements/Products/)

- Year 3 IRISE Project – MCR Field Evaluation
  - Use results from study to develop MCR for field project
  - Use MCR and a standard repair material
  - Long-term field evaluations of repairs made