University of Pittsburgh Transportation Research

Benefits of Research

Ongoing Research

1. Developing Methodologies to Predict and Quantify the Benefits of IRISE Research: Methodologies are being developed and applied to each of six IRISE research projects in order to quantify the benefits of the research results. The methodologies will be applied using and extrapolating data available from IRISE partners and other publicly available information on a national or state scale for highway infrastructure and user costs.

Website Link: https://www.engineeringx.pitt.edu/IRISE/Research-Projects/Active-Projects/

Bridges

Completed Research

1. Steel Bridge Corrosion Prevention and Mitigation Strategies: This report provides a comprehensive literature review that highlights important issues related to corrosion in steel bridges with the objective of identifying shortcomings in current practice in Pennsylvania and identifying novel methods for further study and/or possible implementation. Promising corrosion prevention, mitigation and repair solutions are recommended.

Website Link: https://www.engineeringx.pitt.edu/IRISE/Research-Projects/Completed/

Ongoing Research

1. Improving Bridge Assessment Through the Integration of Conventional Visual Inspection, Non-Destructive Evaluation and Structural Health Monitoring Data: The primary purpose of this study is to establish a framework capable of leveraging emerging Structural Health Monitoring (SHM) and Non-Destructive Evaluation (NDE) techniques to provide improved performance assessment of bridges.

Website Link: https://www.engineeringx.pitt.edu/IRISE/Research-Projects/Active-Projects/

2. Integrating Additive Manufacturing with Accelerated Bridge Construction Techniques: This project is exploring the feasibility of integrating additive manufacturing with ABC techniques in Pennsylvania. The focus is on identifying, fabricating and mechanically testing a range of 3D printable prefabricated bridge elements currently used in ABC projects.

3. Data Management, Mining, and Inference for Bridge Monitoring: The purpose of this project is to investigate advanced data management, analysis, mining and inference approaches for health
monitoring, safety evaluation, reliability, and resilience assessment of instrumented bridges in Pennsylvania.

4. **Corrosion Repair Strategies for Steel Girder Ends Using High Performance and Traditional Materials:** This project is developing and evaluating practical repair strategies for a range of girder geometries and corrosion levels using traditional as well as high performance materials (including ultra-high performance concrete).

**Geotechnical**

**Completed Research**

1. **Exploring Approaches to Managing Landslide Risks: Summary Report:** 121 individuals representing over 40 organizations in the public, private and academic sectors participated in a workshop aimed at developing consensus on needed landslide research and development activities that will help state and local transportation systems direct their limited resources to the highest risk problem areas.

   Website Link: [https://www.engineeringx.pitt.edu/Sub-Sites/Consortiums/IRISE/_Content/Achievements/Products/](https://www.engineeringx.pitt.edu/Sub-Sites/Consortiums/IRISE/_Content/Achievements/Products/)

2. **Landslide Capacity Building Seminars:** Approximately 400 professionals and students participated in a series of three seminars devoted to the topics of 1) landslide recognition and monitoring and 2) new technologies. The seminar series provided an opportunity for professionals to interact with each other and served to engage and familiarize participating students with problems and solutions.

   Website Link: [https://www.engineeringx.pitt.edu/IRISE/Events/](https://www.engineeringx.pitt.edu/IRISE/Events/)

**Ongoing Research**

1. **Landslide Best Practices:** A best practices compilation document is being prepared that will: (a) Identify class/types of landslides impacting Southwestern Pennsylvania; (b) Identify corrective actions taken for each landslide class/type; and (c) Identify challenges in design procedures and permitting processes, including recommended revisions to design specifications.

   Website Link: [https://www.engineeringx.pitt.edu/IRISE/Research-Projects/Active-Projects/](https://www.engineeringx.pitt.edu/IRISE/Research-Projects/Active-Projects/)

2. **Development of a Regional Landslide Inventory to Advance Hazard and Risk Estimates for Southwestern Pennsylvania:** This project is: (a) Designing a structure for a unified inventory of landslides that addresses the needs of stakeholders; (b) Initiating a data collection effort focused on historical landslide observations to establish a working database and document
workflows that enable the collection, sharing, and analysis of new data across agencies; (c) demonstrating the power of comprehensive data through evaluation of collected data.

Pavements and Materials

Completed Research

1. **Toward Using Microbes for Sustainable Construction Materials: A Feasibility Study:** This study evaluated the feasibility of increasing the durability, resiliency and sustainability of reinforced concrete structures by using microbes to provide self-healing properties to prevent water and chloride ingress through structural and/or environmental cracking.

   Website Link: [https://www.engineeringx.pitt.edu/IRISE/Research-Projects/Completed/](https://www.engineeringx.pitt.edu/IRISE/Research-Projects/Completed/)

2. **Development of Simplified Mechanistic-Empirical Design Tool for Pennsylvania Rigid Pavements:** To accelerate the implementation of the AASHTO Mechanistic-Empirical Pavement Design Guide in Pennsylvania, a simplified design method and a localized design tool for concrete pavements were developed. The new procedure, PittRigid ME restricts design input parameters to the most influential and relevant for Pennsylvania conditions and matches the MEPDG predicted performance at a fraction of the computational cost.

   Website Link: [https://www.engineeringx.pitt.edu/IRISE/Research-Projects/Completed/](https://www.engineeringx.pitt.edu/IRISE/Research-Projects/Completed/)

3. **Material Compatible Repairs for Concrete Pavements and Bridge Decks:** This study investigated the effects of the incompatibility between the repair and existing concrete through a laboratory investigation and a computational study. A methodology was established for developing a performance engineered repair material to be used for performing a material compatible repair.

   Website Link: [https://www.engineeringx.pitt.edu/IRISE/Research-Projects/Completed/](https://www.engineeringx.pitt.edu/IRISE/Research-Projects/Completed/)

4. **Carbon Nanotube Additives for Structural and Highway Concrete:** This study investigated the potential to enhance the density, tensile strength, durability, abrasion resistance, and shrinkage reduction of concrete and pavements by including carbon nanotubes in the mixture. We performed a comprehensive literature review to inform the experimental plan, which included different carbon nanotube chemistries, wt% additives, and ASTM standard testing of 4” by 8” cylindrical concrete specimens.

Ongoing Research

1. **Early Opening of Concrete Pavements to Traffic:** An innovative mechanistic-based procedure for quantifying the risk of premature failure and long-term damage caused by traffic opening at various concrete strength levels is being developed.

   Website Link: [https://www.engineeringx.pitt.edu/IRISE/Research-Projects/Active-Projects/](https://www.engineeringx.pitt.edu/IRISE/Research-Projects/Active-Projects/)
2. **Preliminary Evaluation of Pavement Surface Distresses Related to Pavement Markings**: This project is investigating whether pavement markings are causing pavement surface deterioration and, if so, will develop approaches for mitigation of the problem.

Website Link: [https://www.engineeringx.pitt.edu/IRISE/Research-Projects/Active-Projects/](https://www.engineeringx.pitt.edu/IRISE/Research-Projects/Active-Projects/)

3. **Three-dimensional Micro-mechanical Characterization of the Effect of Vibration and Compaction in Concrete Pavements**: This project will create a set of guidelines to provide for more efficient construction of new pavements. It will explore advances in the description of the effects of vibration and compaction procedures that could lead to the definition of practical rules to perform optimized paving under different conditions.

4. **Depth to Bedrock Seismic Measuring Device**: The purpose of this project is to evaluate the use of passive seismic methods to estimate the depth to bedrock. The accuracy and efficacy of these methods are being compared to current and historic core borings taken by PennDOT with the goal to eliminate a portion of the borings currently being performed by the Department.

5. **Super Load Effect on Pavement Life**: This project will capture how to assess distress and damage caused by superloads to pavements in Pennsylvania, include recommendations for increased design loads, better design methodologies, different pavement thickness or type to handle these concentrated loads and suggestions for changes to Department standards and specifications.

**Worker Safety**

**Ongoing Research**

1. **Remote Controlled Technology Assessment for Safer Pavement Construction and QA/QC**: This project is identifying and reviewing new and emerging remote-controlled processes recently developed in the U.S. and abroad. The focus is on identifying potentially implementable technologies that will enable safer and more effective pavement construction and evaluation.

Website Link: [https://www.engineeringx.pitt.edu/IRISE/Research-Projects/Active-Projects/](https://www.engineeringx.pitt.edu/IRISE/Research-Projects/Active-Projects/)

2. **Investigating New Underground Utility Location Technologies and Novel Methods to Improve the Safety and Efficiency of Highway Construction**: This project will investigate current and emerging technologies that could more accurately determine lateral position and depth of known and unknown utilities to improve safety and optimize schedules for highway construction. It will develop requirements for the equipment and test protocols for data collection and data analysis.
3. **Identifying Major Causes of Construction Accidents for the Paving Industry in Pennsylvania:**

Dangerous scenarios related to highway and street construction in Pennsylvania will be identified and ranked. Recommendations for avoiding or minimizing dangerous scenarios in the future and for improvement of safety training and development of safety-related equipment will be developed.