

Future Research Focus Group

Recipient: ICPI Foundation for Education and Research

Grant: \$85,000

Completion: 2024

Project Summary: 35



Background and Need

The mission of the ICPI Foundation is to fund targeted educational and research programs, as well as industry tools, that benefit the segmental concrete paving industry. To support this mission, a focus group was assembled to bring together representatives from academia, the private sector, government agencies, industry, and Concrete Masonry and Hardscapes Association (CMHA) staff. With David K. Hein, P.Eng. as the facilitator, this group concentrated on various concrete pavement solutions, including conventional and permeable interlocking concrete pavement (PICP), concrete paving slabs, concrete planks, and concrete grids.

Objectives

The primary objectives were to identify gaps in current knowledge and to outline activities and research necessary to address these gaps. The attendees were divided into three groups to document challenges, gaps, and opportunities as follows: Group 1 focused on Design and Specifications, Group 2 on Materials and Construction, and Group 3 on Maintenance and Education. Each group included representatives from each of the five practice sector categories, with 5 to 7 participants per group. They discussed challenges, gaps, and opportunities. Each group presented their findings to all attendees, after which additional comments were further discussed and recorded.



Outcomes

The full report is [available online](#). Below is a summary of the 11 most critical gaps and opportunities identified by the focus group and detailed in the report. These findings will enable the ICPI Foundation to solicit proposals for essential research and education programs.

1. Promotion and Enhancement of Mechanistic-Empirical Design: A current ICPIF project is compiling the state-of-practices for the structural design of segmental concrete pavements. The project will deliver a mechanistic-empirical model and web catalog for ICP. The next step is to evaluate key design features such as unit size and shape, laying pattern, bedding and joint sand, traffic, environment, geosynthetics, and recycled materials. This will help codify the anecdotal information currently used to assess ICP performance.

2. Holistic Hydrologic Design for PICP: Significant work has been done on the hydrologic design of PICP, current models do not holistically address water balance, including surface flow, evaporation, infiltration, drainage, and the impact of subsurface features. Additionally, existing models focus on individual PICP installations and do not integrate seamlessly with large-area hydrology design. Comprehensive integration of PICP into water balance assessments is crucial for evaluating its benefits to climate change, water recycling, temperature reduction, and overall infrastructure resilience.

3. Promote Specifications: Transportation agencies use a wide range of construction material and placement specifications, with many adopting performance-based specifications that predict pavement performance through mechanistic-empirical design. These agencies should be encouraged to adopt CMHA guide specifications for segmental concrete pavements due to their long performance life.

4. Product Category Rules and Environmental Product Declarations (EPDs): The requirement for EPDs is growing, with some agencies restricted from specifying products without them. Both the asphalt and concrete pavement industries are focusing on EPD compliance. This initiative aims to develop a framework for segmental pavement EPDs to help members create their own.

5. Induction Charging for ICP Pavements: As electric vehicles replace carbon-fueled ones, there is a surge in in-pavement induction-based charging systems. Segmental concrete pavements offer advantages over asphalt or concrete surfaces because they can be "unzipped" for access to infrastructure, then "zipped" back with minimal damage. This project aims to assess the efficiency and benefits of induction charging systems for segmental concrete pavement in parking areas

6. Quality Control and Assurance Plans: Pavement owners impose higher standards of performance and aesthetics on segmental concrete pavements compared to asphalt and concrete surfaces. However, owners and construction inspectors are less familiar with quality control and assurance requirements specific to segmental concrete pavement systems. This project aims to develop comprehensive quality control and assurance programs for segmental pavement systems, including training courses and promoting new construction methods like the Light-Weight Deflectometer.

7. Innovation in Sustainable Pavement Materials: Many manufacturers struggle to keep pace with understanding the benefits of alternative materials like supplemental cementitious materials, recycled products, and "green" technology. This project aims to conduct a global literature survey to gather and analyze data on innovative materials, pavement design, production, construction, and asset management. The goal is to enhance performance, efficiency, cost-effectiveness, and environmental stewardship for the segmental concrete pavement industry.

8. "Hey CMHA" Artificial Intelligence for CHMA Website: To enhance segmental concrete pavement design and construction, facilitating user access to industry best practices is crucial. While

valuable information exists in research reports, technical notes, and specifications, simplifying its dissemination is key. The hot-mix asphalt industry implemented an artificial intelligence tool on their website, "Hey NAPA," allowing users to access NAPA's knowledge base by asking questions directly.

9. Field Guides and Agreements for Maintenance: A common issue with segmental concrete pavements is the unfamiliarity of these products among operations and maintenance staff of owners and agencies. This project aims to provide straightforward guidance for pavement maintenance personnel. It will develop step-by-step field guides and model agreements for outsourced maintenance activities.

10. Documenting Pollution Reduction for PICP: While progress has been made in documenting the pollutant reduction potential of permeable pavements, there is a need to move from proof of concept to standard practice. This involves quantifying and prioritizing benefits such as water temperature (cooling potential), nitrogen reduction, microplastics, and 6PPD-Q from tire wear.

11. Body of Knowledge and Maintenance Training: For Item 9 support, the compiled body of knowledge can serve as a foundation to plan industry-funded training for public agency operations and maintenance staff. This includes pre-conference workshops, academic licensing of civil design materials, and focusing on knowledge transfer through educational programs to enhance understanding of segmental concrete pavements.