IOWA HIGHWAY RESEARCH BOARD (IHRB)

Minutes of February 22, 2019

Regular Board Members Present

D. Claman
W. Dotzler
T. Nicholson
S. Okerlund
R. Knoche
A. Bradley
D. Sanders
P. Geilenfeldt III
L. Bjerke
B. Skinner
J. Thorius
T. Kinney
B. Wilkinson

Alternate Board Members Present

D. Harness
A. McGuire

Members with No Representation

W. Weiss

Executive Secretary – V. Goetz

Visitors

Tammy Bailey	Iowa Department of Transportation
Halil Ceylan	Iowa State University
Yang Zhang	Iowa State University
Ashley Buss	Iowa State University

The meeting was held at the Iowa Department of Transportation Ames Complex, Materials East/West Conference Room, on Friday, February 22, 2019. The meeting was called to order at 9:00 a.m. by Chair Allen Bradley with an initial number of 13 voting members/alternates at the table.

1. **Agenda review/modification**

   Motion to Approve by J. Thorius; 2nd S. Okerlund
   Motion carried with 13 Aye, 0 Nay, 0 Abstaining

2. **2019 Membership**

   Motion to Approve by S. Okerlund; 2nd L. Bjerke
   Motion carried with 13 Aye, 0 Nay, 0 Abstaining

3. **Minutes Approval from the December 2018 meeting**

Motion to Approve by R. Knoche; 2nd P. Geilenfeldt III
Motion carried with 13 Aye, 0 Nay, 0 Abstaining

4. **Final Report – TR-708B,** *"Hybrid Concrete for Advancing Pavement Performance"***,** Kejin Wang, InTrans/Iowa State University, $40,000, (15 min).

BACKGROUND

CCAMs were first designed in the 1950s to protect the surface course from oils and fuels. It has been used since that time throughout Europe and Asia, and the asphalt mixture has performed well in withstanding stress induced from heavy traffic loads and sudden braking. Research has demonstrated that CCAMs can significantly improve rutting resistance on flexible pavements.

While the asphalt mixture has worked well on pavements in warmer climates, methods utilizing grouting materials are currently being developed to improve its low-temperature performance and moisture susceptibility.

OBJECTIVES

The goals of this project were to explore the advantages, challenges, and feasibility of using a hybrid, semi-flexible, semi-rigid concrete for highway pavements, bridge decks, and overlays. Specifically, the objectives were as follows:

- Develop a hybrid concrete, a casting cement asphalt mixture (CCAM), using raw materials sourced locally in Iowa
- Evaluate key engineering properties, including rutting, shrinking, and freeze-thaw resistance, for the hybrid concrete in Iowa's environment and for its transportation needs
- Provide insights and recommendations to develop guidelines for applying the CCAM in practice

BENEFITS

The hybrid concrete mixture has potential benefits not seen in traditional counterparts, including opening to traffic sooner than on a conventional cement concrete pavement, and a longer service life, a higher resilient modulus, and better rutting performance than traditional asphalt mixtures. This hybrid concrete uses Iowa materials and shows promising signs of reducing rutting in wheel paths, among other benefits.
While the research team successfully developed a CCAM that is designed for use on Iowa roadways and other cooler climate environments, further study is needed on its key properties, particularly freeze-thaw durability, before it can be applied to Iowa pavements.

DISCUSSION

Q. Is this looked as an overlay to existing pavement?
A. Yes, this is looked at as overlay material.
Q. Would this be suited for heavy traffic intersections only or main line pavement?
A. The sections now are put in intersections with heavy traffic, you have heavy loads and slow-movement, and this is where you have most rutting.

Motion to Approve by R. Knoche; 2nd T. Nicholson
Motion carried with 13 Aye, 0 Nay, 0 Abstaining

5. **PROPOSAL IHRB-261:** *"Performance Evaluation of Polyester polymer Concrete Overlays",* Mohamaed Elbatanounty, Wiss Janey & Elstner, $249,820, (15 min).

BACKGROUND

PPC overlays have been used to extend the service life of in-service bridge decks as well as for preventive maintenance for newly constructed bridge decks. In 2017, WJE completed a research project for Iowa DOT to investigate the optimum timing to apply polymer overlays and/or sealers on new bridge decks to extend the service life of bridge decks and achieve the best cost-benefit ratio from the application. The report, titled "Use of Polymer Overlays or Sealers on New Bridges," included a summary of the available literature regarding best practices for applying polymer overlays along with service life modeling and life cycle cost analysis for a typical Iowa bridge deck. The study showed that the highest benefit to cost ratio and service life extension are achieved if the overlay is applied to a new a bridge within the first 5 years after construction and prior to the deck having extensive corrosion and concrete repair. However, overlays can still provide deck life extension on older, more deteriorated decks.
Iowa DOT is currently planning to use polyester polymer concrete (PPC) on two bridge decks in Jasper and Linn counties. The Jasper county bridge is located on the eastbound I-80 and has original plans dated February 1959 while the Linn county bridge is located on 8th street NE over I-380 with original plans dated July 1971. Both bridge decks have been previously rehabilitated using a Portland concrete overlay. As both bridges will be partially open to traffic during construction, the use of PPC overlays for these bridge decks are advantageous as these systems require short curing time compared to conventional overlay materials also provide superior protection to the original concrete by inhibiting the ingress of chlorides, chemicals, and moisture and by slowing active corrosion. As this is the first trial placement for PPC overlay in Iowa, it will be beneficial to: (a) document the construction procedures, (b) evaluate the short term and long-term performance over a period of 5 years, and (c) summarize the experience and lessons learned from the project.

OBJECTIVES

The main objective of this study is to evaluate the performance of PPC overlays to be applied on two older bridge decks in Iowa and develop guidelines for Iowa DOT that can aid in the implementation, design, and construction of PPC overlays based on challenges and successes observed in the two case studies. This project will aid in future bridge deck overlay decision making and provide design, construction, and QA/QC guidance for future practice.

BENEFITS

This project will assess the benefits and limitations of using PPC overlays in Iowa. The qualitative observations and quantitative quality assurance may be used immediately by the Iowa DOT and any future contractors using PPC to improve construction procedures.

The data from this project is particularly important because there are currently no other cost or service life studies of PPC overlays in Iowa. This information will allow the Iowa DOT to compare different bridge deck maintenance strategies more accurately and implement more cost-effective strategies in the future.

DISCUSSION

Q. Do you always use a thicker layer?

A. Yes, we are using a thicker layer, usually .75 to 1 inch in this case the Iowa DOT is using 2 inches because the existing overlay is already 2 inches.

Motion to Approve by D. Claman; 2nd D. Sanders
Motion carried with 13 Aye, 0 Nay, 0 Abstaining

****Member joined the table****

6. **PROPOSAL IHRB-203**: *"Development of Non-Proprietary Ultra-High Performance Concrete (UHPC) for Iowa Bridges",* Behrouz Shafei, InTrans/Iowa State University, $135,000.

BACKGROUND

Among the past studies, El-Tawil developed a cost-effective UHPC by using no silica powder and replacing half of cement with ground granulated blast furnace slag. Ghafari provided an analytical model for developing a UHPC mix with minimum cement content based on a statistical mixture design. This study succeeded in attaining a 22 ksi strength without using steam curing only by optimizing the cement content. Yu replaced a portion of cement with filler materials like limestone and quartz powder without experiencing any significant adverse effects on the strength of UHPC mixes. Shi replaced a portion of cement with fly ash/slag with a proper particle size distribution. The developed UHPC mix exceeded the 22 ksi strength, even with regular curing. Soliman and Tagnit-Hamou replaced half of quartz with a less expensive glass powder and 70% of silica fume with a fine glass powder. Similar compressive strengths were reported after both replacements. Wille and Boisvert-Cotulio used a range of readily available materials to find the least expensive combination for UHPC mixes. This study concluded that a 22 ksi strength can be attained with ordinary mixers and no special curing. The UHPC developed by Wille and Boisvert-Cotulio was predicted to cost $516/yd3 without and $1029/yd3 with steel fibers. Yail developed non-proprietary UHPC mixes for Colorado Department of Transportation using locally available materials and reported a cost reduction up to 74%. Berry used masonry sand as a filler and fly ash as the supplementary cementitious material for the development of non-proprietary UHPC mixes. Using the Anderson- Andreason model, the referenced study was able to develop a non-proprietary UHPC with a compressive strength of 20 ksi that cost under $500/yd3. A study completed by FHWA outlined promising advances made in the development of non-proprietary UHPC mixes with a material cost ranging from $355 to $500/yd3, excluding the cost of fibers. Addition of fibers was reported to increase the total costs by up to $470/yd3. The reported studies have proven the promise of developing non-proprietary UHPC mixes that can reduce the expected cost in a significant way. In a very recent effort at Iowa State University (ISU), the proposing team completed a preliminary study and confirmed the potential for the development of non-proprietary UHPC mixes made with materials readily available in Iowa. It was found that the total material cost can be reduced to $450/yd3 for non-proprietary UHPC mixes that provide a strength and durability similar to those of commercially available UHPC mixes. Detailed investigations, however, are required to optimize the developed mixes for various applications and performance requirements.

OBJECTIVES

The main objectives of this project are to develop and characterize economic, non-proprietary UHPC mixes made with materials readily available in Iowa. These mixes are expected to be significantly less expensive than commercially available UHPC mixes, permitting to utilize the superior strength and durability of UHPC in more bridges in Iowa. To achieve this goal, a comprehensive review of published and unpublished literature will be conducted, followed by setting the performance criteria needed for various bridge

components and exposure conditions. A special effort will be made to identify the materials that are available in Iowa and have the potential to replace the proprietary UHPC ingredients. Based on the information obtained from the literature review and the experience of the proposing team, several non-proprietary mixes will be designed. A holistic set of laboratory tests will then be carried out to assess the performance of the developed UHPC mixes in both short and long term. The testing program will include the necessary experiments to ensure that the expected fresh, mechanical, transport, durability, and dimensional stability properties are achieved. Upon the completion of the laboratory tests, a cost analysis will be conducted to determine the most cost-effective, non-proprietary UHPC mixes for bridge applications. Noting that almost half of the total cost of a UHPC mix comes from steel fibers, the proposing team will explore the possibility of replacing them with other less expensive choices of fiber through an ABC UTC-sponsored project that will supplement the current project. This combined effort will be an important step forward to optimize and recommend the mixture proportion of non-proprietary UHPC mixes appropriate for a wide range of bridge applications in Iowa.

BENIFITS

With developing non-proprietary UHPC mixes that are made of materials available in Iowa, Iowa DOT and District Engineers will be provided with an economic, durable, and high-performance choice of concrete, which can be employed for a wide variety of bridge applications. Reduction in maintenance and repair activities, as well as the overall project cost are among the benefits of this project.

Motion to Approve by R. Knoche; 2nd J. Thorius
Motion carried with 14 Aye, 0 Nay, 0 Abstaining

7. **PROPOSAL IHRB-186**: *"Cold In-Place Recycling Project Selection and Guidance for Iowa Roadways", Dr. Ashley Buss, Iowa State University, $250,000.*

BACKGROUND

Iowa has a rich history of CIR. The CIR research in Iowa has made Iowa a leader in CIR best practices, foamed asphalt CIR mixture design with validation, construction recommendations and tracking long-term performance. Most of these projects have been led by members of the research team This background summary will briefly summarize published Iowa CIR research and CIR research from neighboring states led by the project team. The work summarized is directly related to this project and this proposal will leverage past research to continue improving CIR project selection and materials guidance by providing sound recommendations tailored for Iowa roads.

The research team already has publications and performance data compiled on numerous CIR projects. Iowa researchers found that CIR pavements last on average 15 to 26 years on roadways with <2000 ADT (Jahren et al. 1998) and later research extended the expected life to 21 to 25 years based on best fit regression (Jahren et al. 2007) and IHRB Project TR-502. These studies also emphasized the importance of project selection and adequate subgrade support. Performance studies of CIR pavements showed the treatment effectively mitigated reflective cracking in Iowa pavements (Jahren 1998; Jahren et al. 2007; Buss et al. 2016). Using survivability analysis in analyzing performance of pavement treatments for reflective cracking, Iowa CIR pavements outperformed the other alternative treatments which included: mill and fill, overlay, rubblization and heater scarification (Williams, Chen & Buss 2015); however, the challenge becomes not all roadways are good candidates for CIR.

OBJECTIVES

The project focuses on strategies and end-user products that will be used to mitigate underperforming or failed CIR projects. The objectives include:

- Provide project selection guidance for CIR roadways in Iowa considering important factors such as pavement structure, traffic and subgrade support.
- Use past Iowa CIR research to build a comprehensive history of findings and recommendations as well as compile data used in projects which includes: material property testing, recommendations for CIR subgrade investigations, lists of past CIR project, construction data and performance data.
- Employ current testing methods on CIR materials and add recently collected performance data to the data from older projects and analyze this larger and comprehensive data pool to produce enhanced findings.
- Draw conclusions for the enhanced findings to provide guidance for CIR project selection and provide typical material characterization for good and poor performing projects.
- Develop a stand-alone technical brief covering Iowa project selection for cold in-place recycling.
- Develop a tool to evaluate the cost-effectiveness of CIR as a rehabilitation alternative.

BENEFITS

This research will be enhanced CIR project selection which will lead to reduced early-life failures.

Motion to Approve by W. Dotzler; 2nd T. Kinney
Motion carried with 14 Aye, 0 Nay, 0 Abstaining

8. PROPOSAL IHRB-18-97:

a. *"Late Life Low Cost Deck Overlays",* Basak Bektas, In Trans/Iowa State University, $43,452.
b. *"Late Life Low Cost Deck Overlays", Mohamad Elbatanouny, WJE $50,000.*

The board voted on and approved ***"Late Life Low Cost Deck Overlays", Mohamad Elbatanouny, Wiss Janey Elstner, $50,000.***

Motion to Approve by R. Knoche; 2nd D. Claman
Motion carried with 13 Aye, 0 Nay, 1 Abstaining

9. PROPOSAL IHRB-156: *"Concrete Box Culvert Earth Pressure Monitoring", Katelyn Freeseman, Ph.D., Iowa State University, $49,731*.

BACKGROUND

A culvert located in Ida County which consists of multiple 8'×12' concrete boxes was selected during the initial phase of this project and has been monitored for two years (Stage 1 of Design #1115). The monitoring system consists of six strain gauges and five pressure cells and was installed on 1/28/2016. After two full seasonal cycles, and with the amount of the accumulated data, a systematic analysis of the acquired data is now necessary. The goal of this project is to analyze the collected data from the Ida County culvert and develop practical Iowa-specific earth pressure recommendations that can be used in culvert design and load rating.

OBJECTIVES

The previously instrumented box culvert in Ida County provides valuable strain and pressure data over the course of two years, thus offering insight as to seasonal variations. The objective of this project is to analyze the data that has been collected and determine actual earth pressures associated with Iowa soil conditions for use during both the design and load rating of box culverts.

BENEFITS

The accurate determination of earth pressure on concrete box culverts, and the understanding of factors that affect this pressure, will allow for more informed decision making during both the design and load rating processes for box culverts. With this information, the service life of the structure is likely to improve due to both improved design inputs and more strategic maintenance planning efforts.

Motion to Approve by D. Claman; 2nd W. Dotzler
Motion carried with 14 Aye, 0 Nay, 0 Abstaining

10. RFP

a. IHRB-18-13 Benefit Cost Analysis of Full Width/Depth Shoulders Near Bridges.
The published RFP did not receive any proposals for consideration. Secretary Goetz will evaluate other options to move forward with the project.

Motion to Review a RFP by S. Okerlund; 2nd L. Bjerke
Motion carried with 14 Aye, 0 Nay, 0 Abstaining

11. New Topics from November 1

Submission#	Proposed Title
266	Evaluation of Grade 65 Rolled Steel Beams
272	Innovative Substructure and Superstructure with NUCOR/Skyline Steel
275	Design of Bridges for Minimum Maintenance: Phase I
283	Satellite Remote Sensing for Pavement Health Monitoring of the Network Level
286	Development of Iowa Granular Road Structural Design tool
288	Texturized Pavement Markings for reduced Crashes in Low-Light Conditions
289	Monitoring Unpaved Roads using Machine learning Based Texture Analysis

The Board will table the above New Topics until next review cycle.

12. New Business

13. Adjourn

The next meeting of the Iowa Highway Research Board will be held Friday, March 29, 2019 at 9:00 a.m. in the East/West Materials Conference Room at the Iowa DOT.

****The March IHRB Meeting was cancelled*****

Vanessa Goetz, IHRB Executive Secretary