IOWA HIGHWAY RESEARCH BOARD (IHRB)

Minutes of February 23, 2018

Regular Board Members Present

B. Skinner
J. Thorius
W. Weiss
M. Parizek
T. Nicholson
C. Poole
K. Jones
A. Abu-Hawash
T. Wipf
P. Geilenfeldt III
S. Okerlund
R. Knoche
L. Bjerke

Alternate Board Members Present

B. Billings
A. McGuire

Members with No Representation

Secretary – V. Goetz

Visitors

Tammy Bailey	Iowa Department of Transportation
Brian Worrel	Iowa Department of Transportation
Nicole Fox	Iowa Department of Transportation
Dean Bierwagen	Iowa Department of Transportation
Malcom Dawson	Iowa Department of Transportation
Bob Younie	Iowa Department of Transportation
Danny Waid	Iowa County Engineers Association
Khyle Clute	InTrans/Iowa State University
Ashley Buss	In Trans/Iowa State University
Bora Cetin	Iowa State University
Ben Claypool	Iowa State University
Yang Zhang	Iowa State University
Cassie Rutherford	Iowa State University
Dan King	Iowa Concrete Paving Association
Gordon Smith	Concrete Pavement Technology Center

The meeting was held at the Iowa Department of Transportation Ames Complex, Materials East/West Conference Room, on Friday, February 23, 2018. The meeting was called to order at 9:00 a.m. by Chair Wade Weiss with an initial number of 13 voting members/alternates at the table.

1. Agenda review/modification

V. Goetz stated modifications to agenda were to correct the amounts on two proposals, number five was listed as $296,000 changed to $263,906 and number six was listed as $50,000 changed to $75,000.

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

2. Motion to approve Minutes from the December 2017 meeting

V. Goetz stated there were errors in the minutes that need corrections. Minutes for December 2017 will be voted on at the March IHRB meeting.

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

3. 2018 IHRB Membership

V. Goetz stated that W. Weiss is Chair and P. Hanley will serve as Vice Chair for 2018.

4. IHRB-18-02 PROPOSAL: "Development of Operations Management System for Iowa Secondary Road Departments", Steve DeVries, Iowa County Engineers Association Service Bureau, $478,160.36

Background

The Iowa County Engineers began to be interested in developing an Operations Management System (OMS) in 2011 to 2013, when the first counties began acquiring Automatic Vehicle Location (AVL) equipment for their fleets. These pioneers reported that they were finding utility in tracking the location and movement of men and equipment, in being able to check work route traces, and in assessing how often or when a road had been serviced. But they also found that the third-party interrogation and analysis tools provided by their vendors did not truly fulfill county road maintenance tracking needs. So, at ICEA Computer and Information Technology Committee meetings, they began exchanging ideas and developing a joint vision of a customized set of tools that could be accessed in the office, at the shop or in the field, with information, roles, and authorities fitted to actual employee job types.

Between 2013 and 2015, the Computer Committee, consisting of about 25 individuals with diverse backgrounds, came together multiple times to synthesize and refine a vision for an Operations Management System. The ICEA Service Bureau acted as facilitator and recorder of these envisioning sessions and conducted independent field work to better understand how the

technology was being used by counties who had already invested in AVL systems. After a time, this work lead to the formulation of what the group called an 'application suite diagram' [See appendix A] that listed all desired functions and structured them into logical groupings. The diagram enabled the committee to identify and integrate existing applications, such as online Work Orders, Sign inventory tool, and inter-county communications with new concepts for an AVL panel, a staff time and general accounting module, an intra-departmental calendar and communications system, and a package of decision support resources.

Starting in 2016 the ICEA Service Bureau and the C.I.T. Committee refine the detail and specificity of the OMS vision [See appendix B] and shared it with other county engineers to assess interest and obtain additional ideas. This more precise template was then presented for consideration at the 2017 County Engineer Research Focus Group meeting, held in Ames on Feb 15, 2017. Attendees rated the proposed project in the top five of nearly forty ideas brought forth at this gathering and sent a recommendation of support to the Iowa Highway Research Board. That body, in turn, ranked the concept high and identified it as one for which proposals would be solicited.

Objectives

The primary objective of this project is to conduct a final assessment of Secondary Road Department operations management needs by testing a prototype application interface with key intended users to find out what will be most effective and then to implement the system by developing desktop, thin-client and web-app modules to deliver that functionality to them.

Benefits

This project is designed to help counties improve their real-time knowledge of the status of their maintenance operations, with AVL, quantification, internal communication, and access to decision support information. This will allow them to use their labor, equipment, and materials resources more efficiently and help those resources become more effective. The ultimate benefit will be the ability to maintain rural roads and bridges in a better state of readiness and repair through improved utilization of operational assets.

After the system has been in place for a time and users have become accustomed to working with the new tools, it will also be possible for a county to begin measuring operational performance by querying the quantification data and assessing rates of production. This will, additionally, permit eventual establishment and measurement of performance goals.

V. Goetz stated that there is no presentation on this proposal. This is the project was selected by IHRB in the annual priority. It was also designated to be Secondary Road funding. This proposal is to be reviewed as submitted.

Motion to Approve by M. Parizek; 2nd B. Billings
Motion carried with 13 Aye, 0 Nay, 0 Abstaining

Member joined

5. **PROPOSAL:** "Field Implementation of Internally Cured Concrete for Iowa Pavement Systems – TR-676 Phase II", Peter Taylor, Iowa State University, $263,903, (15 min)

Background

Concrete curing is necessary for one reason: cement hydration. Cement hydration is a series of chemical reactions that require an adequate water supply and proper temperatures over an extended time Curing is defined as "action taken to maintain moisture and temperature conditions in a freshly placed cementitious mixture to allow hydraulic cement hydration and (if applicable) pozzolanic reactions to occur so that the potential properties of the mixture may develop".

Conventional concrete is typically cured using external methods. External curing prevents drying of the surface, allows the mixture to stay warm and moist, and results in continued cement hydration. Internal curing is a relatively recent technique developed to prolong cement hydration by establishing internal water reservoirs in a concrete mixture that do not adversely affect the concrete mixture's fresh or hardened physical properties. Internal curing grew out of the need for more durable structural concretes resistant to shrinkage cracking.

Concrete curing involves techniques and methods for maintaining the moisture and temperature of fresh concrete within desired ranges at early ages, allowing concrete to develop strength and durability. Various curing regimes, including external wet curing, insulation membrane curing, and IC, can be used for different applications and design characteristics. IC is designed to provide water reservoirs inside the concrete that aid curing without affecting the water-to-cementitious materials (W/C) ratio of the mixture. Lightweight aggregates (LWAs) are commonly employed in the US to achieve IC. IC concrete has several advantages over conventionally cured concrete:

- Improved hydration in terms of uniform moisture distribution;
- Reduced autogenous, plastic, and drying shrinkage, lessening the likelihood of shrinkage cracking;
- Reduced concrete permeability and enhanced resistance to sulfate attack;
- Improved strength and permeability at the interface transition zone (ITZ);
- Reduced MoE and enhanced residual stress relaxation due to presence of LWAs;
- Reduced moisture gradient along a concrete section, reducing warping in pavements;
- Reduced CTE and thermal conductivity, reducing temperature gradients throughout concrete and reducing curling in pavement.

Objectives

The primary objective of this research study is to perform a full-scale field demonstration of the IC technology and its efficient performance benefits for Iowa's city and county roadways and state highways. In consultation with the project TAC, two upcoming construction projects conducted by the city, county, or Iowa DOT will be identified for IC concrete field demonstration. As already noted, such technology is suitable for use in a variety of transportation infrastructure components, including roads, bridges, sidewalks, rest areas, etc.

Two potential sites of interest to Iowa county engineers are W61 Riverside Road in Washington County, Iowa, and County Road W34 in Winneshiek County, Iowa. At least one of these two sites, IC concrete technology would be implemented in a concrete overlay project to evaluate the performance of such pavement systems, and there is a strong likelihood that it would be found beneficial to implement both pavement sections using IC concrete technology.

Benefits

The outcome of this study would result in tools for substantially improving the internal- curing concrete design and implementation processes currently being done in Iowa. Results will be beneficial to the Iowa DOT as well as Iowa counties and cities for ensuring successful construction results and documenting the long-term performance of concrete pavement systems and concrete overlays.

Discussion

Q. Are you doing different test sections with different joint spacing or are we going to have one big joint spacing?
A. Two different joint spacings, this is how the projects are designed. One project is 12' spacings and the other project is 6' spacings.
Q. How long are the test sections?
A. Up to a half of a mile.
Q. With the donated internal curing material does that include transportation?
A. This does not include the transportation.

Motion to Approve by K. Jones; 2nd A. Abu-Hawash
Motion carried with 14 Aye, 0 Nay, 0 Abstaining

6. **MATCHED FUNDING PROPOSAL:** "*Use of Waste Quarry Fines as a Binding Material in Unpaved Roads*", Bora Cetin, Iowa State University, $75,000, (15 min)

Background

This research proposes to use quarry fines as a binding agent in unpaved roads. The road systems in the U.S. and Iowa consist, respectively, 50% and 60% of granular-surfaced (unpaved) roads. The sustainability of unpaved roads is very important to the rural economy, since these roads provide access to rural land and enable the transportation of agricultural products. Any interruption in access can have a significant impact on agricultural productivity and the economy. Heavy traffic loads and freeze-thaw cycles can cause extensive damage to unpaved roads, leading to material loss, surface erosion, rutting, and potholes. The rate of deterioration (or damage) is directly correlated to the quality of the granular aggregate materials matrix used in the design of unpaved roads. Performance and long-term sustainability of granular roadways are dependent to a considerable degree on the quality of the aggregate materials used, which varies considerably from one source to another. Sometimes the quality of coarse aggregates is low and crush under traffic load; this increases the fines content in the aggregate matrix. In other cases, the quality of the aggregates is high, but are floating on the road surface due to lack of an adequate number of fines within the aggregate matrix.

It is known that chemical stabilization can be applied to solve the binding issue of coarse aggregates in unpaved roads, however these methods are usually not economical and/or easy to apply and are also not sustainable. Therefore, it is important to find an alternative material to overcome this problem while making sure it is sustainable, economical and environmentally friendly. One of the alternative material is to use quarry fines, which are generated at the approximate rate of 159 million metric tons (175 million tons) per year. At this rate, as much as 3.6 billion metric tons (4 billion tons) of quarry fines have likely accumulated to date. Quarry fines have been successfully used to replace sands in concrete and asphalt mixtures. However, they

have not yet been widely used in unpaved road systems, where they have a great potential to be used as a source of high quality and economic fines. Dr. Cetin and Dr. Ashlock prepared a demo test section that uses waste quarry fines and observed that some of these fines possess high plasticity characteristics that perform well for binding coarse aggregates together. County engineers and their employees invest considerable effort in managing and maintaining granular roads. When maintenance and construction of granular roadways is costly, it is necessary for counties to spend a considerable portion of their budget (sometimes up to 28% of the total county budget) just to purchase granular materials (excluding placement and maintenance) to replace those lost during the service life of a granular road.

The problems commonly encountered with unpaved roads are, (1) unsuitable material usage, (2) inadequate material distribution, (3) surface deterioration through aggregate loss, (4) surface abrasion, (5) ineffective drainage, (6) insufficient road maintenance. The proposed study aims to test the problems associated with reasons 1 and 4. In this project, the research team proposes to conduct laboratory and field tests to examine the impact of inclusion of waste quarry fines in granular aggregate materials used in unpaved road designs, using materials collected from various quarries. Based on the laboratory test results, field test sections will be constructed using materials with different quarries. The field performance (abrasion resistance, freeze/thaw resistance, density, material loss, modulus, gradation change) of 2 sections built with different quarry fines will be compared. Then, a comprehensive cost-performance and life cycle cost analyses will be conducted to evaluate the cost effectiveness and sustainability of these unpaved roads to determine whether it is economically advantageous to add waste quarry fines into granular unpaved road materials.

Objectives

1) Determine the stiffness and strength of unpaved road materials blended with different quarry fines.
2) Determine the long-term performance of field test sections built with optimum quarry fines content
3) Analyze the life cycle cost and cost effectiveness of this approach

Benefits

The results of this study are expected to improve the performance, economics, and service lifespans of unpaved roads. This study will develop design charts that may help county engineers and planners predict the performance of unpaved roads based on results of a few common laboratory tests such as abrasion and sieve analysis tests. In addition, this research will investigate whether the use of quarry fines can provide an economical solution for counties and DOTs. The results and recommendations of this project will provide a foundation for further development of decision-making tools to evaluate the relative cost-effectiveness of quarry fines. This study will be conducted under the partnership between IHRB and RMRC with $75,000 from each institution.

Discussion

Q. How long is our agreement, three or five years? [IA DOT is participating in pooled fund no. TPF-5(352) Recycled Materials Resource Center (RMRC)
A. IA Dot is participating with SPR II dollars for $40,000 dollars a year for four years. Nine States are participating.
Q. Does the existing aggregate on the County roads vary?
A. It changes from County to County with its condition.

Q. You are just looking at waste fines not looking at adding any other liquid or other stabilizing agents with the fines to help with that process?
A. As of right now we only have the fines, no additional liquid.
Q. Is the match funding of $75,000 going to be used for material, hauling or Delta cost?/ Are the hours listed for the complete project?
A. Some of the materials will be billed to one of the contract for $75,000. Other time will be billed to the students and the PI's for the other $75,000.

Motion to Approve by T. Nicholson**;** 2nd P. Geienfeldt III
Motion carried with 14 Aye, 0 Nay, 0 Abstaining

7. **MATCHED FUNDING PROPOSAL:** "*Characterizing the Behavior of a Machine-Placed UHPC Bridge Deck Overlay",* Sri Sritharan, Iowa State University, $75,000, (15 min)

Background
A beneficial characteristic of UHPC is its ability to flow and self-level, which has been taken advantage of in previous projects completed in Iowa. Using the same type of consistency on a bridge deck would be challenging because most decks have slopes and cross-slopes. Consequently, based on the requirements suggested by the PI, LafargeHolcim worked on a new UHPC overlay formulation that is as flowable as possible to facilitate placing, yet it can maintain a slope of up to 7% when placed on bridge decks. This formulation, which was comparable to the mix used on the Chillon viaducts, used components available in the U.S. and included 3.25% of steel fibers. These fibers were 0.008 in. in diameter and 0.5 in. in length.

Critical characteristics of the overlay mix include impermeable surface and strain hardening, which typically requires steel fibers. Steel fibers are costly and using them efficiently in a mix is important. Therefore, the amount of steel fibers used in the mix needs to be sufficient to allow stresses to be taken by the steel fibers without cracking the mineral matrix. Testing conducted by LarfargeHolcim suggested that 3.25% of steel fibers per volume would be optimal for the overlay application.

With funding from Iowa Highway Research Board, Iowa Department of Transportation (DOT) and Federal Highway Administration, the first UHPC bridge deck overlay was successfully completed in May 2016 (Sritharan et al. 2018). The structure used for this purpose is the three-span, two-lane, Mud Creek Bridge located on Buchanan county road D48 near Brandon, Iowa. This 102-ft long and 30-ft wide straight continuous concrete slab bridge has a 5% super elevation and was built in the mid-1960s.

The Mud Creek Bridge experience has brought several lessons in terms of applying the UHPC overlay on a regular basis to bridge decks. By improving batching and placement of the overlay and maintaining higher construction quality, the cost of the overlay can be reduced. Since completing the Mud Creek Bridge project, the PI has been interacting with WALO International Ltd.—a major construction company headquartered in Switzerland with a registered office in the U.S. (known as WALO USA). WALO is a 100-year old construction company, who has a track record of utilizing specialized machines in construction project for improving quality and cost effectiveness. With experience from placing UHPC as part of deck rehabilitation on Chillon

viaducts, WALO has engineered a paver to deploy UHPC overlay as developed for Iowa bridges. They have also developed a capacity to mix large volume of UHPC on site.

In an upcoming overlay project on a primary bridge in Sheldon, Iowa, with deck surface area three times as big as that of the Mud Creek Bridge upgraded with UHPC overlay, WALO will use a modified paver for the first time to place a thin UHPC overlay on a bridge deck. The deck surface will also be prepared using hydro demolition. All of this work will be completed by WALO as a subcontractor to Cramer & Associates, Inc. The research described in this proposal will characterize the behavior of machine-placed UHPC overlay and monitor the performance of bridge deck over 18 months. The collected results will be used to formulate recommendations for broader use of UHPC bridge deck overlays in a cost efficient manner. This project will be done in partnership with WALO USA which will contribute a matching fund in the amount of $60,000.

Objectives

Considering the above discussion, and with the goal of promoting UHPC as a bridge deck overlay material, the objectives of the proposed project are to:
1. Perform compression, tension and flexural tests on UHPC overlay material and conduct flexural tests on mockup slabs.
2. Monitor the performance of buildup of strains at the interface in the actual bridge and justify the collected results with appropriate analyses.
3. Educate engineers and consultants of the new technology in Iowa and other states; and
4. Recommend design specification based on test results, and present design recommendations in a technical report.

Benefits

The concept of using UHPC as an overlay for bridges originated in Iowa through collaboration between Iowa State University and Iowa DOT. The first two phases have produced great success in terms of technology development and first trial on the Mud Creek Bridge deck. The progress to date on this research topic has created national interest, and Delaware DOT implemented the overlay on a small bridge using the steps used in Iowa. The proposed project elevates the overlay concept to the next level with an intention of using this technology on a regular basis in Iowa. The anticipated benefits of the project can, therefore, be summarized as follows:
• Quantification of the buildup of strains in the field, providing confirmation that shrinkage strain within the overlay would not have any long-term effects.
• Validation of machine-placed UHPC overlay in terms of ensuring improved quality.
• Experimentally validated analysis models for design calculations.
• Development of a design specification for broader use of UHPC overlay.

Discussion

Q. Using the mock up to be done at the contractor's yard are you going to utilize the equipment to find out if it will perform correctly, and if it doesn't are they still going to go ahead with the UHPC deck overlay?
A. It will perform.

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

8. Innovative Project Program for FY19

V. Goetz stated IHRB has done the innovative project proposal requests in the past where the board funds basic research ideas with seed funding. V. Goetz is asking the board to set aside $200,000 to $250,000 dollars in next year's budget for this again. This would be in a similar format requesting the innovative type of project ideas that might be high risk, but also might have a high reward if they are successful in proving the concept. The last round of Innovative Projects the board matched funding from the UTC at InTrans and Iowa State University. Iowa State did not get the UTC Grant again so they will not be participating. The idea would be to again target the same funding, $45,000 to $50,000 between four to five projects.

Q. Do we have projects that we have already approved?
A. No. This will be a call for new projects to be submitted.

V. Goetz stated the Iowa DOT, AASHTO and InTrans are partnering to do the second Innovations Conference again this year. One idea is to line up the proposals with the conference and see if there is opportunity to get so many proposals in and have the initial review down to the top eight. Have the final eight or so bring a poster to the conference to showcase their idea. We would gather general input with the people attending the conference as to what proposals are reasonable or which ones get them excited. One option could be to select the winners and make announcements at the conference, or bring back the proposals and feedback from the conference to the board final decision.

Motion to Approve by A. Abu-Hawash; 2nd T. Wipf
Motion carried with 14 Aye, 0 Nay, 0 Abstaining

9. New Business

V. Goetz stated March 1st is deadline for new topics for this fiscal year. Changes are going to be made in the way we are accepting projects. Next meeting there will be a presentation on how we are changing our annual cycle of topic of ideas, trying to move from an annual submission to a trimester submission where there will be opportunities three times during the year to accept and review ideas rather than once a year.

V. Goetz stated that periodically, the Secondary Road Research fund will accumulate a balance since it is based off a percentage of the road use tax fund. When this happens, the IHRB reviews opportunities to fund projects solely for the Counties benefit to draw down the balance. V. Goetz stated she plans on introducing this discussion with the next round of new projects for IHRB to pursue. New topics are due March 1st and the Research Office will do an internal review and the ideas that are submitted to IHRB, County board members can identify projects of interest to fund at one hundred percent from the County balance.

V. Goetz also stated she is working internally with the Research office talking about opportunities to increase the Primary road portion set in the five-year plan. The DOT will have additional funding for FY2019, shifting funding amounts for different programs and she will update the board with additional details at the start of next fiscal year.

10. Adjourn

The next regular meeting of the Iowa Highway Research Board is scheduled for March 30, 2018 at 9:00 a.m. in the East/West Materials Conference Room at the Iowa DOT.
VG