IOWA HIGHWAY RESEARCH BOARD (IHRB)

Minutes of September 28, 2018

Regular Board Members Present

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

Alternate Board Members Present

J. Fantz
B. Billings
T. Wipf

Members with No Representation

Secretary – V. Goetz

Visitors

Tammy Bailey	Iowa Department of Transportation
Brian Worrel	Iowa Department of Transportation
Bob Dawson	Iowa Department of Transportation
Eric Cowles	Iowa Department of Transportation
Khyle Clute	Iowa Department of Transportation
Francis Todey	Iowa Department of Transportation
Todd Kenney	Iowa Department of Transportation
Mike Nop	Iowa Department of Transportation
Ping Lu	Iowa Department of Transportation
Chris Brakke	Iowa Department of Transportation
Yang Zhang	Iowa State University
Katelyn Freeseman	Iowa State University
Franek Hasiuk	Iowa State University
Sri Sritharan	Iowa State University
Alice Alipour	Iowa State University
Ashley Buss	Iowa State University
Greg Mulder	Iowa Concrete Paving Association
Dan King	Iowa Concrete Paving Association
Jon Markt	HDR
Peter Taylor	CP Tech Center

The meeting was held at the Iowa Department of Transportation Ames Complex, Materials East/West Conference Room, on Friday, September 28, 2018. The meeting was called to order at 9:00 a.m. by Ahmad Abu-Hawash with an initial number of 13 voting members/alternates at the table.

1. **Agenda review/modification**

Item 5 will be presented at the October IHRB Meeting.

Motion to Approve by R. Knoche; 2nd J. Thorius

Motion carried with 15 Aye, 0 Nay, 0 Abstaining

2. **Motion to approve Minutes from the July 2018 meeting**

Motion to Approve by M. Parizek; 2nd B. Skinner
Motion carried with 15 Aye, 0 Nay, 0 Abstaining

3. **Innovative Project Final Report – TR-708A, "Initial Characterization of Geopolymer-Based UHPC Material Properties", Jay Shen, Iowa State University (15 min)**

BACKGROUND

Increasing concerns about the environmental issues caused by the use of Portland cement in concrete have led to the development of a geopolymer binder that is a product made from the reaction of industrial aluminosilicate wastes (e.g., fly ash, slag, and metakaolin) and alkali solution.
UHPCs often contain significant amounts of Portland cement, along with other materials that help strengthen concrete. A unique ultra-high-performance geopolymer (UHPG) has been developed in China, where geopolymer composites are used to replace Portland cement in conventional UHPC.
While some study has been done to replace Portland cement with UHPGC, there has been little research reported particularly on fly ash-based UHPG.

OBJECTIVES

The objective of this innovative pilot research project was to evaluate the important material properties of a cost-effective and environmentally-friendly geopolymer-based UHPC, also called ultra-high-performance geopolymer (UHPG), that may be a very attractive option for future bridge construction and repair.

BENIFITS

The results of this study indicate that UHPG can be achieved through engineered formulation using locally available concrete materials. Further development of UHPG has the potential to be a more cost-effective and environmentally friendly option than UHPC.

DISCUSSION

Q. Do you recommend using this product?
A. At this moment because the activity is not so good, we need more time and research.
Q. Did the ingredients come from outside the US? The material you tested in the lab is local material?
A. The fiber is the only ingredient that comes from outside the US. All of the material that is tested in the lab is local material.
Q. Is the product in China very mature?
A. I would like to say that the maturity is higher than here.

V. Goetz stated that the Highway Research board sponsors the innovated project proposals, were IHRB provides an amount of seed funding to prove the concept for those projects that may be a higher risk but may have a higher reward. This is one of those projects which IHRB funded back in 2016 and provided $40,000 dollars in partnership with the Midwest Transportation Center at InTrans. It would be for future consideration from the Board if they would like to continue seeing this work being funded. This is just a final presentation form the initial innovative project investment.

Motion to Approve by A. Abu-Hawash; 2nd T. Nicholson
Motion carried with 15 Aye, 0 Nay, 0 Abstaining

4. **Innovative Project Final Report – TR-708C, "Enhancing the Fundamental Knowledge and Use of Asphalt Emulsions Using Systematic Scientific and Engineering Approaches",** Ashley Buss, Iowa State University (15 min)

BACKGROUND

Asphalt emulsions are gaining in popularity in the US and worldwide due to their lower application temperature, lower energy consumption, and lower viscosity than hot applied asphalts. About 3 million tons of emulsion is produced in the US, which accounts for 5% to 10% of the total asphalt consumption. However, much of the available information on asphalt emulsions is contained in patented literature rather than in easily accessible peer-reviewed journals, which leads to a lack of understanding about their applications, i.e., which type of emulsion to use in a particular situation.

OBJECTIVES

This research aimed to provide a better understanding of asphalt emulsions; explore their use in sustainable pavement construction, preservation, and rehabilitation; and identify future areas of study.

BENEFITS

Asphalt emulsions are a low-temperature alternative to hot applied asphalts that can provide an opportunity for energy savings and that are considerably easier to handle and store.
This research will help disseminate knowledge on asphalt emulsions and help fuel a better understanding of emulsion components to improve standards and test methods for emulsions.
The ability to formulate and manufacture emulsions by varying different parameters will help benchmark and evaluate current practices and drive further innovation in the field of pavement preservation and rehabilitation.

DISCUSSION

Q. Will there still be a patented literature going on with this, you mentioned it isn't easy to find information?
A. The emulsifier suppliers, there is no secret for how you make a good emulsion. But with the technical expertise we offer, they are happy to help advance the science so that we can all benefit from good emulsions.
Q. You mentioned emulsions using mineral fillers. Aren't micro surfacing emulsions using mineral fillers? Is cement an active filler?
A. Yes, it is very active. It is used n CIR when you want to achieve that early strength, which is great for rutting, but the drawback is you might be losing some of the flexibility for later on to help with cracking.
Q. You stated you are getting uniform particle size distribution, how are you doing this?
A. We are getting this from a high-quality mill. With the single pass through mill you can get more single size particle distribution and you can keep your high viscosity in the emulsion.

Q. You are working on this in the lab, are you working on being able to do this in the field?
A. To have emulsion you must have uniform particles sized distribution. The mill speed of the lab mill is how you would correlate with a big mill.

Motion to Approve by R. Knoche; 2nd W. Dotzler
Motion carried with 15 Aye, 0 Nay, 0 Abstaining

5. **Final Report TR-714, "Guide to Life-Cycle Data and Information Sharing workflows for Transportation Assets",** David Jeong, Iowa State University, $50,000 (15 min)
*****Moved for Final Presentation in December. October meeting was cancelled*****

6. **Final Report – TR-732, "Develop an Improved Selection Methodology for Safety Improvements at Public Highway-Railroad Grade Crossings Project",** Chris Goepel, HDR Engineering, Inc., $89,996.00, (15 min)

BACKGROUND

The purpose of this Develop an Improved Selection Methodology for Safety Improvements at Public Highway-Railroad Grade Crossings project by Iowa DOT and its consultant HDR Engineering, Inc., is to conduct research and develop findings that will help to inform Iowa DOT of the most current approaches to identify and prioritize public highway-railroad grade crossing improvements which will aid in developing recommendations and actionable steps for implementing changes into Iowa's current prioritization methodology. The research results and the tools developed during the project are expected to provide Iowa's highway authorities, railroads, and other stakeholders with an enhanced means of identifying needs and opportunities for potential improvements to the public highway-railroad grade crossings under their jurisdiction and streamlining the process to pursue Section 130 program grant funds through Iowa DOT to develop these improvements. Iowa DOT can apply the research results and tools to drive internal processes and maximize the positive impact of Iowa's highway-railroad grade crossings safety program and its partnerships with the state's highway authorities and railroads.

OBJECTIVES

Following completion of the research, HDR developed recommendations via a list of activities that Iowa DOT could undertake through the remainder of the project. Iowa DOT selected the specific action items based on the highest priorities of Iowa DOT and determined a related final workplan for HDR. Through this approach, Iowa DOT addressed its most important needs, achieved its highest objectives, and provided the most initial value in terms of enhanced safety and public benefits to Iowa.

DISCUSSION

Q. The resulting recommendation coming from this, were they showing a benefit cost of greater than one?
A. All this project did was give us tools not a change. There are projects coming forward that are cost effective to the public.

Motion to Approve by T. Nicholson; 2nd C. Poole
Motion carried with 15 Aye, 0 Nay, 0 Abstaining

7. **Proposal – "Design of Drilled Shafts in Iowa – Validation and Design Recommendations",** Sri Sritharan, Iowa State University, $150,000 (15 min)

BACKGROUND

The DSHAFT electronic database of load tests collected from Iowa and several neighboring states was developed by Garder et al. (2012) for the proposed resistance factor calibration. Similar to the PILOT database for driven pile load tests, the DSHAFT database was developed using Microsoft Office AccessTM to conveniently gather and review all load test information. The database initially contained 41 load tests with 28 having all the necessary information for calibration. After incorporating updates from subsequent tests, the current version of the database presently contains a total of 51 load tests, with 38 usable for calibration. Consistent with the resistance factors recommended in AASHTO, the First Order Second Moment (FOSM) reliability method was used to develop regional resistance factors for Iowa. Skin friction resistance factors developed by Ng et al. (2014) and Kalmogo et al. (2017) are presented in the following tables and compared to those recommended in AASHTO. The resistance factors by Kalmogo et al. (2017) were developed with no extrapolation of non-failed tests, while the resistance factors in contain extrapolation of non-failed tests. In each case, resistance factors were calibrated following two procedures including a Layered Approach and a Global Approach. In the Layered Approach, shear zones of the same geomaterial type in a given test shaft are treated independently and the resistance bias is calculated as the ratio of the measured to predicted resistance for each individual shear zone, whereas in the Global Approach, the resistance bias is calculated as the sum of the measured to predicted resistances from shear zones of the same geomaterial category. Though extrapolation could be considered unconservative, its potential benefits can be seen from some of the higher resistance factors presented in illustrating the importance of conducting load tests to significantly large displacements or complete failure.

OBJECTIVES

The overall goal of the proposed project is to provide final recommendations for the design and construction of drilled shafts in Iowa (in accordance with the LRFD framework) using additional load test data, while also ensuring that the associated settlements of drilled shafts are below the design limits. The DSHAFT database will be further expanded using additional field tests performed in Iowa for future analyses.

BENEFITS

The research outlined in this proposal has several direct benefits to bridge infrastructure in Iowa. First, the research project will provide an LRFD design procedure for drilled shafts that will ensure uniform reliability for the design of bridges foundations across Iowa. Second, the outcomes will elevate the cost-competitiveness of drilled shafts as an alternative deep foundation solution in Iowa that can provide certain advantages over well-established driven piles. Third, the DSHAFT database will be utilized to provide the opportunity for developing regionally calibrated LRFD resistance factors for drilled shafts in Iowa, which will reflect local design and construction practices, as well as regional soil conditions. Fourth, adding and continuing to expand DSHAFT will benefit future research related to drilled shafts in Iowa.

Motion to Approve by A. Abu-Hawash; 2nd T. Wipf
Motion carried with 15 Aye, 0 Nay, 0 Abstaining

8. **Matched Funding Proposal: "Use of Concrete Grinding Residue as a Soil Amendment",** Bora Cetin, Iowa State University, $35,000 (15 min)

BACKGROUND

Grooving and grinding pavement surfaces developed into global activities during the previous century. In 1972, International Grooving and Grinding (IGGA), a non-profit industry trade association, was founded to provide technical and professional guidance for properly grinding and grooving pavement surfaces. Based on several studies related to CGR characteristics, the major negative consideration related to slurry waste is the contamination to the local environment, especially bodies of water. To prevent such contamination, the IGGA developed the best management practices (BMPs) for proper disposal of slurry by-products. The IGGA BMPs provided three methods to manage CGR. In some cases, CGR can be spread along roadsides in rural areas, while CGR generated in the urban area can be hauled and transported to dedicated ponds for decanting or to waste treatment facilities for processing. It should be noticed that spreading of CGR in sensitive areas or drainage facilities (e.g., culverts, drain inlets) is prohibited by guidance due to its high pH and metal contents. Interestingly, numerous previous tests indicated that CGR is a nonhazardous material, and other studies conducted by DeSutter, et al., and Mamo, et al., pointed out that CGR application may even have a positive impact on plant growth. In addition to the recommended proper CGR disposal methods, the developed BMP guidance also proposed that pH values of CGR should be monitored and maintained at ranges between 2 to 12.5.

OBJECTIVES

The main goal of this proposed research is to develop a new cost-effective market for soil liming agents for transportation projects and reduce stockpiles of diamond grinding wastes. To achieve this goal, this project will conduct laboratory experiments to investigate the performance of soils treated with CGR and provide guidance about the use of CGR as a stabilizing agent. The specific research objectives are listed below:

1. *Determine stiffness/strength of soils mixed with CGRs,*
2. *Determine erosion resistance of soils mixed with CGRs,*
3. *Determine the environmental impact of these mixtures, and*
4. *Determine the optimum amount of CGR in these mixtures based on mechanical and environmental evaluations.*

BENEFITS

The results of this study will help RMRC and participated DOTs to understand CGR related practices and its environmental impacts. Currently, there are no guidance documents for utilization of CGR in soil improvement applications. Current design recommendations use standard recipes without regard for actual pH adjustment or buffer requirements. Results of this project will implement changes to the department of transportation agencies standard specifications for chemical soil stabilization. Outcome of this study will lead to a stronger understanding of the potential use and management of these waste materials in a sustainable way. It is expected that successful implementation of the CGR in such applications would eliminate the environmental related concerns and improve the performance of subgrade soils.

DISCUSSION

Q. It's difficult to capture CGR, how do you plan on obtaining the material?

A. We collected some material from a previous project and have it available for testing. We also hope to work with interested project on how to collect.

Q. Are you hoping for a leading-edge kind of research?

A. Yes, we expect to be able to produce good intellectual property from this project.

Motion to Approve by B. Skinner; 2nd J. Thorius

Motion carried with 15 Aye, 0 Nay, 0 Abstaining

9. **RFP Proposal – IHRB-18-04: "Evaluation of Penetrating Sealers for Concrete",** Peter Taylor, Iowa State University, $149,308

BACKGROUND

The main factors negatively impacting concrete joint durability in Iowa are governed by moisture saturation and deleterious chloride ion reactions from de-icing salts (Taylor et al. 2016; Weiss et al. 2016). Penetrating sealers are a class of materials that show promise for increasing concrete durability by reducing moisture and chloride ion penetration. Specifically, extending time to critical saturation will reduce freeze-thaw exposure conditions, and limiting chloride ingress will reduce the potential for oxychloride formation. Numerous products exist in the sealer marketplace with a range of performance claims. Lack of clear performance guidelines are hindering potential beneficial use since design engineers, contractors, and owner agencies are unable to evaluate or compare such products. Sealers can be categorized based on the chemical structure, functional type, amount of active chemical, carrier solution, and the action mechanism, and vary widely in performance. Indeed, the parameters to define satisfactory performance are not agreed upon. There is a need to establish a suite of performance criteria to define acceptability of a given product, and a protocol for agencies to evaluate a product submitted for approval. The aim of the proposed work will meet those needs.

OBJECTIVES

Although penetrating sealers show great promise for improving joint and concrete durability, significant questions must be answered before DOTs and owners can be assured of a positive cost-benefit. The objectives of this research include the following:

- To thoroughly evaluate recommended protocols and standards for testing the penetrating sealers with a focus on characteristics affecting the joints subjected to chemical attacks and freeze-thaw actions,
- To select, modify, or update the most appropriate testing protocols to reflect performance of the most commonly used penetrating sealers,
- To examine the selected sealer performance in the laboratory and extend the findings to field implementation projects in urban and/or rural areas where joint performance can be monitored for long term, and
- To develop guidelines and protocols for investigating the short- and long-term performance of the sealers used for enhancing joint durability.

BENEFITS

The Iowa DOT has always been at the forefront of innovation. It is our goal to help the Iowa DOT bring the state-of-the-art of research into practice. Given the positive impacts of using sealers in pavement joints, it is expected through this research to develop testing guidelines and materials selection criteria that can successfully bring the sealers into Iowa DOT projects.

Having a proper understanding of how to evaluate the performance of penetrating sealers for use in Iowa DOT projects, the reduction in premature joint concrete deterioration, especially in joint areas, can secure long-term quality of Iowa pavements. Given the streamlined test methods and guidelines provided, the use of sealers can increase the service life and reduce the life-cycle cost of rigid pavements in Iowa and nationwide. It goes without mentioning that the successful use of concrete sealers can extend the service life of the transportation infrastructure, hence reducing maintenance costs, minimizing lane closures, and avoiding safety concerns associated with work zones.

DISCUSSION

Q. With all the pavement sealers, has there been any study on traction impact when things are wet?
A. I am not aware of any.
Q. By extension, what about pavement markings and their ability staying stuck to the pavement?
A. I am not aware of studies that address that.

Motion to Approve by S. Okerlund; 2nd T. Wipf
Motion carried with 15 Aye, 0 Nay, 0 Abstaining

10. **Proposal – IHRB-18-08: "Evaluation of Galvanized and Painted-Galvanized Steel Piling,"**, Katelyn Freesman, Iowa State University, $113,218

BACKGROUND

According to the American Society for Testing and Materials (ASTM), corrosion is the chemical or electrochemical reaction between a material, usually a metal, and its environment that produces a degradation of the material and its associated properties. Corrosion is initiated when two different metals or two points on the same metal come into contact with an electrolyte. The electrolyte may be water and/or soil depending on the environment to which the metal is exposed. Because of the potential difference existing between the two metals or two surfaces on the same metal, a current is generated between the anodic area and the cathodic area. This potential difference is a function of several factors such as the nature of the metal, the nature of the electrolyte, a difference in the amount of oxygen present, and/or a difference in temperature. Corrosion affecting metals in general, and steel piles in particular, can be classified as atmospheric corrosion, fresh water corrosion, sea water corrosion (not applicable to Iowa locations and not discussed further), and soil corrosion. The corrosion rate of each type is influenced by various factors.

Steel piles exposed to the atmosphere have access to a large amount of oxygen, thus the corrosion in this environment is mainly driven by the presence of humidity which acts as an electrolyte. A relative humidity of 70% to 80% combined with a temperature above 32° F will result in the corrosion of carbon steel. Other factors, such as the air pollutant concentration, the air salinity, temperature, and rainfall can contribute to accelerated corrosion of steel piles. The piles may be subjected to a rural environment, an urban environment, an industrial environment, or a marine type environment, and this difference in the type of exposure has a significant effect on the corrosion rate.

OBJECTIVES

The primary objective of this research is to evaluate the effectiveness of galvanized and painted-galvanized piles at extending bridge service life in a cost-effective manner. This will be achieved through a systematic laboratory and field investigation, coupled with a Monte Carlo simulation of life-cycle costs. This project will begin with a comprehensive literature search which will supplement the knowledge and experience of the research team in working with substructure components. In the laboratory, a series of pile sections will be evaluated via an accelerated corrosion testing protocol. During this testing, various types of piles and coating systems will be evaluated – including traditional bare, steel piles. This testing will provide side-by-side performance data as well as valuable inputs for the life-cycle cost analysis. In addition, a unique opportunity exists to evaluate the in-place performance of a bridge constructed using galvanized steel components. The performance of this bridge will be evaluated for its long-term corrosion resistance performance. A comprehensive service life analysis will then be performed to understand the costs and benefits associated

with using substructure coatings. This will be an important step in making the decision to implement the investigated coatings on a broader scale.

BENEFITS

Bridges in Iowa, like other neighboring states, are commonly designed for a service life of 75 years. However, there is a national push to extend those design lives even further. While some elements of a bridge are easy to rehabilitate or replace, the piling are not easily replaced nor rehabilitated. Therefore, it is essential that new bridges be constructed with substructure materials that will be able to last as long as long as other components.

Motion to Approve by A. Abu-Hawash; 2nd T. Wipf
Motion carried with 15 Aye, 0 Nay, 0 Abstaining

11. RFP Proposal – IHRB-18-10: "Fiber Reinforced Concrete in Bridge Decks"

a. Proposal 1: Mohamed ElBatanouny, Wiss, Janey, Elstner Associates, Inc. $120,000
b. Proposal 2: Behrouz Shafei, Iowa State University, $120,000
c. Proposal 3: Manik Barman, University of Minnesota Duluth, $119,086

b. Proposal 2: *"Fiber-Reinforced Concrete in Bridge Decks",* Behrouz Shafei, Iowa State University, $120,000 was selected out of the three proposals.

BACKGROUND

Cracking of concrete bridge decks due to plastic, drying, and autogenous shrinkage, as well as thermal stresses (as a result of heat of hydration and ambient temperature fluctuations) has long been an issue of concern for those involved in the construction and maintenance of bridges. The formation and propagation of cracks in concrete bridge decks often lead to strength and durability problems, mainly because such cracks permit the ingress of water, chlorides, sulfates, and other potentially corrosive agents into the bridge deck. Over time, the number and size of cracks increase, embedded steel rebars start experiencing corrosion, and further structural deterioration occurs in the form spalling of concrete and loss of cross-sectional area of steel rebars. This requires frequent maintenance and repair activities, which not only put an extra demand on available resources, but also cause direct and indirect costs due to bridge closures. To prevent structural deterioration from the very beginning, concrete must not be allowed to crack (to the extent possible), especially at early ages. Among various strategies to achieve this ultimate goal, addition of fibers to concrete mix is proven to be a promising strategy to control the cracks that can be initiated due to early-age shrinkage and temperature effects in the unhardened concrete and also mechanical and environmental stressors in the hardened concrete.

With a mounting demand for enhancing durability and extending the service life of bridge structures, high-performance concrete (HPC) has become a material of choice for bridge deck applications. The survey conducted by the CTL Group (D'Ambrosia et al., 2013) indicates that many states have started a transition to replace conventional concrete with HPC in bridge decks. This transition, however, has witnessed certain difficulties, especially with increasing the likelihood of early-age cracks. Compared to traditional concrete, HPC has a lower water-to-cement ratio, utilizes more mineral and chemical admixtures, and often has a higher mortar fraction. Such mix characteristics result in a faster setting time, quicker strength gain, higher heat of hydration (and thermal stress), higher autogenous shrinkage, and eventually greater potential for surface and through-slab cracking within only first few days after concrete placement. When Illinois DOT

first used HPC in bridge decks, cracks were found in nearly all of the cases. The cracking pattern was similar to that of traditional concrete, despite the extra cost and effort for using HPC (Lange et al., 2003). Mokarem et al. (2009) reported the cracking of HPC decks as a relatively common problem, which can defeat the purpose of providing a more durable concrete mix, as the cracks open a direct pathway for aggressive agents to penetrate into the deck and attack the embedded reinforcement.

Addition of fibers to HPC and development of high-performance fiber-reinforced concrete (HPFRC) can be a reliable solution for bridge decks. HPFRC combines the excellent durability properties of HPC with the strain-hardening and crack preventing/bridging characteristics of fiber reinforced concrete (FRC) to provide an alternative for conventional concrete mixes. The proposed project aims to develop HPFRC mixes that can deliver a satisfactory performance in both short and long term. For this purpose, current HPC mixes will be improved with the addition of fibers of various type, geometry, and dosage. Furthermore, other methods of crack mitigation, such as using shrinkage-reducing admixtures and shrinkage-compensating cements will be investigated. A comprehensive set of laboratory and field tests will be performed to ensure the adequate resistance of developed mixes to early-age cracking, transportation of aggressive ions, freeze/thaw cycles, and abrasion, while maintaining proper workability, strength, and toughness characteristics for bridge deck applications.

OBJECTIVES

The main objective of this research project is to design and evaluate the use of fibers in HPC mixes to prevent or reduce early-age cracking in bridge decks. This will be achieved through a systematic investigation supported by laboratory and field tests to ensure that the developed concrete mixes will meet both short- and long-term properties of interest. This project will begin with a comprehensive literature search and survey, which will supplement the knowledge and experience of the research team in working with FRC. A set of HPC mixes, including standard HPC, HPC with fibers, and HPC with fibers and admixtures will then be developed using fibers of different type, geometry, and dosage. A rigorous test plan will be pursued to evaluate and ensure the resistance of the designed mixes to early-age cracking, transportation of aggressive ions, freeze/thaw cycles, and abrasion, while maintaining proper workability, strength and toughness characteristics for bridge deck applications. Three of the best-performed mixes will be selected for a complementary field investigation that not only tests the mixes in real exposure conditions, but also provides inviable information about the practical aspects and considerations. A set of samples will be collected from each concrete deck placement. The samples will be further tested in the laboratory to ensure that the implemented concrete mixes meet all the performance requirements, in terms of fresh properties, dimensional stability, strength, and other transport and durability characteristics. Using a combination of visual inspection and nondestructive evaluation methods, the condition state of the bridge decks will be monitored beginning from immediately after construction for (at least) one year. This assessment will determine the effectiveness of adding fibers to mitigate crack formation and propagation in bridge decks. A comprehensive service life analysis will also be performed to understand the costs and benefits. This will be an important step forward to address the long-standing issue of early-age cracking in bridge decks, which directly contributes to improving the quality and longevity of bridge decks in service, thus, minimizing the need to repair and maintenance activities.

BENEFITS

Bridges in Iowa, like other neighboring states, are commonly designed for a service life of 75 years. In reality, however, although the design loads are specified for a 75-year recurrence interval, the existing bridge decks are found to be in need of repair or replacement prior to the expected service life. The degradation of bridge

decks is mainly due to the corrosion of steel rebars embedded in concrete, which can be initiated as soon as early-age cracks appear. Considering the time and labor required to address this critical issue, the current research project investigates new HPC mix designs, including fibers with and without admixtures. With successful implementation, the outcome of this project is expected to significantly reduce the direct costs originating from maintenance efforts required for bridge decks. Furthermore, by increasing the service life of bridge decks, the need to replace the bridge deck during the design life of the bridge will be minimized. This will eliminate the indirect costs due to bridge closure, disruption in traffic, and impact on surrounding environment. The outcome of this project is in direct alignment with the implementation of SHRP2 Project R19A to design bridges for extended service life.

Motion to Approve by A. Abu-Hawash; 2nd P. Geilenfeldt III
Motion carried with 15 Aye, 0 Nay, 0 Abstaining

12. **Proposal – IHRB-18-14: "Design and Detailing Requirements for Columns Under Collision"**, Alice Alipour, Iowa State University, $100,000

BACKGROUND

The study performed by Gomez and Alipour identified that the force generated in the column under vehicle collision varies with multiple factors, such as vehicle mass, stiffness, and velocity. Chung et al. investigated the impact behavior of prefabricated piers under vehicle collision. From the impact simulations results, a five-point piecewise linear approximation was developed to estimate the impact load. In a separate study, Buth reported that ESF (calculated with a 50-millisecond average) decreases with increasing the column diameter from 600 mm to 1200 mm. The pier considered in Buth, however, was modeled as a rigid pier, and thus, the analysis results showed the maximum possible force applied due to impact. In studies conducted by Chen, it was found that the recorded impact force time-history can drastically change once deformation is allowed in the pier, mainly because the energy can be dissipated through the pier as well. Chen performed impact simulations on both rigid and elastic piers. From the results obtained for rigid piers, the peak impact forces were found to decrease with increasing the column diameter. However, after the piers were modeled as elastic components, the trend was reversed, and the PDF values increased with increasing the column diameter.

OBJECTIVES

According to the posted RFP, the main scope and objectives of this project are:

1. Perform finite element modeling (FEM) of representative three-column frame pier systems including aspects of the superstructure. Consider two cases: 1) the frame pier without considering a median barrier and 2) the frame pier with a median barrier. Different diameters for the columns should be examined. Minimum requirements that result in acceptable performance from the pier system and the bridge shall be specified. A cost analysis of the best options in terms of performance objectives should be developed.
2. A FEM of representative T-pier systems will be generated. Consider the expected design load and perform a parametric study that will account for the type of the colliding object, the speed of collision, and the collision angle. Evaluate minimum tie requirements based on current practice within the FEM and evaluate the performance of the pier system. If the minimum tie requirements are insufficient, then perform parametric study on different reinforcement detailing in order to make recommendations. Examine the performance of all the components of the system under collision scenarios.
3. Deliverables shall include recommendations and specifications for design and detailing of frame piers and T-piers under collision loading with a cost analysis of different options.

BENEFITS

State and county engineers are in need of implementing state-of-the-art design to ensure the safety and performance of bridge piers, especially where there is a high risk of truck/train collision.
Despite past efforts on understanding the impact load characteristics and pier design requirements, there is no systematic study in the literature on how frame piers and T-piers must be designed and detailed taking into consideration possible lateral impact scenarios. The outcome of this project will address this knowledge gap by completing an extensive set of numerical simulations on validated pier models. This is anticipated to help understand the most influential factors, identify possible shortcomings in the current provisions, and recommend strategies to address them for not only piers, but also for the entire bridge system. The conclusions made from numerical simulation results will be supplemented with the data obtained from a service life analysis to determine the most optimal design alternatives based on an array of performance, cost, and constructability considerations.

Motion to Approve by T. Nicholson; 2nd R. Knoche
Motion carried with 15 Aye, 0 Nay, 0 Abstaining

13. **Proposal – IHRB-167: "Coarse Aggregate Deterioration in Granular Surfaces and Shoulders"**, Franciszek Hasiuk, Iowa State University, $258,637

BACKGROUND

About 74% of Iowa's 89,000-mile road network consists of gravel roads (Iowa County Engineers Association, 2018). These roads provide the fabric for rural life and livelihood in Iowa by linking agricultural producers with markets, and rural residents with their communities. The fact that these surfaces must be renewed as often as every three years imposes financial stress on county highway departments. Coarse aggregates (CA) are a major constituent of granular surfaces and are known to undergo both physical and chemical changes due to weather and traffic that affect their properties and ultimately, their longevity. Despite the importance of these roads to the economic fabric of Iowa and their need for constant upkeep, we lack a robust understanding of not only the deterioration mechanisms that are most responsible for CA break down, but we also do not know the geological factors that make one CA perform better than another. This study aims to characterize the changes that occur in these coarse aggregates by characterizing changes in the geological fabric and properties of coarse aggregates from both in service roads and laboratory specimens. Using this information, highway engineers and geologists can act in the fiduciary interest of taxpayers to minimize costs while providing a safe and reliable transportation network for rural communities and producers.

OBJECTIVES

The objective of the proposed research is to characterize the microstructural changes in CA as it is exposed to weathering in granular surfaces and shoulders on Iowa roads. We will assess this though both petrophysical testing and petrographic inspection to identify the chemical (e.g., dissolution of primary minerals, precipitation of secondary minerals) and physical weathering processes (e.g., abrasion and freeze-thaw cycles) responsible for CA deterioration. We will assess how current Iowa DOT grading for concrete stone CA (e.g., Iowa Pore Index test) predicts performance of CA used in granular surfaces and shoulders. The ultimate outcome of the proposed research will be a set of guidelines to better predict the performance of CA used in granular surfaces and shoulders.

This project will continue collaborative research between geologists and engineers at Iowa State University, the Iowa Department of Transportation, and Iowa county governments towards developing a better understanding of CA quality.

BENEFITS

Granular surface materials must typically be replenished every 1-5 years to ensure proper maintenance of rural roads. This project will highlight how granular surface materials degrade over time with the goal of identifying the critical material properties that will lead to longer service lives and thus reduced life-cycle costs for granular surfacing.

Motion to Approve by J. Thorius; 2nd W. Dotzler
Motion carried with 15 Aye, 0 Nay, 0 Abstaining

14. NEW RFP

a. IHRB-18-07, "Late Life Low Cost Deck Overlays"
b. IHRB-18-13, "Benefit Cost Analysis of Full Width/Depth Shoulders near Bridges"
c. IHRB-186, "Cold In-place Recycling Project Selection and Guidance for Iowa Roadways"

Motion to Approve by B. Billings; 2nd W. Dotzler
Motion carried with 15 Aye, 0 Nay, 0 Abstaining

15. 2018 New Topics March to July Project Ranking

Approved for Project Development

#	Proposed Title
246	Effectiveness of Roundabouts in Iowa Compared to Standard Signalized Intersections
253	Iowa DOT Riverine Infrastructure Data Base (RIDB)
249	Geometric Design Criteria for Complete Streets Applications
251	Use of RAS to Improve the Performance of Unpaved Roads and Mitigate Dust Contamination

On Hold

252	Impact of ADA Standards on Streets with Steep Grades
257	Intelligent Urban Mobility – The Future of Smart Cities

Not Selected

247	Evaluation of Accident Experience with Flashing Left Turn Yellow Arrows
250	Reversible Lane Strategies

Motion to Approve by W. Dotzler; 2nd R. Knoche
Motion carried with 15 Aye, 0 Nay, 0 Abstaining

16. US DOT AID Grant Award: "Implementation of Innovative Contracting Method to Accelerate Replacement of County Bridges", $1,000,000

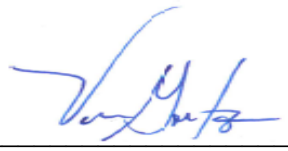
V. Goetz stated the Iowa Highway Research Board, which serves as the STIC for Iowa was awarded by FHWA $1 million Accelerated Innovation Deployment grant to replace 8 to 14 county bridges using Added-Options bidding, Box Beam County Bridge standards and UHPC joints in 8 counties. Proposed letting date is scheduled for April of 2019.

17. New business

Innovations in Transportation Conference – October 9-10, Ames, IA
Pavement Preservation Tools Workshop – October 10, Ames, IA
FHWA Every Day Counts 5 Summit – October 29-30, St. Louis, MO

18. Adjourn

The next meeting of the Iowa Highway Research Board will be held Tuesday, December 11, 2018 at the Iowa DOT's Motor Vehicle Division, 2nd Floor Conference room in Ankeny, IA. The meeting will begin promptly at 1:00 p.m.



Vanessa Goetz, IHRB Executive Secretary