IOWA HIGHWAY RESEARCH BOARD (IHRB)
Minutes of February 24, 2017

Regular Board Members Present

K. Jones
C. Poole
S. Okerlund
R. Knoche
P. Hanley
J. Thorius
M. Parizek

Alternate Board Members Present

W. Klaiber
P. Geilenfeldt III
B. Skinner
D. Claman
D. Sprengeler
T. Kinney
A. McGuire
K. Clute

Members with No Representation

L. Bjerke
S. Rinehart

Secretary – V. Goetz

Visitors

Tammy Bailey	Iowa Department of Transportation
Brian Worrel	Iowa Department of Transportation
Logan Wells	Iowa Department of Transportation
Chris Brakke	Iowa Department of Transportation
Francis Todey	Iowa Department of Transportation
Dean Bierwagen	Iowa Department of Transportation
Wayne Sunday	Iowa DOT - Retired
Danny Waid	Iowa County Engineers Association
Darla Hugaboom	Federal Highway Administration
F. W. Klaiber	Iowa State University
Brent Phares	Iowa State University
Chris Williams	Iowa State University
Sunghwan Kim	Iowa State University
Sharif Gushgari	Iowa State University
Jeremy Ashlock	Iowa State University
Katelyn Freeseman	Iowa State University
Greg Mulder	Iowa Concrete Paving Association
Gordon Smith	Iowa Concrete Paving Association
Marian Muste	Iowa Institute of Hydraulic Research
Sean Litteral	Iowa Federal Highway Administration

The meeting was held at the Iowa Department of Transportation Ames Complex, Materials East/West Conference Room, on Friday, February 24, 2017. The meeting was called to order at 9:00 a.m. by Vanessa Goetz with an initial number of 12 voting members/alternates at the table.

1. **Agenda review/modification**

2. **Select New Vice-Chair**

Myron Parizek nominated Wade Weiss as Vice-Chair.

Motion to Approve by M. Parizek; 2nd J. Thorius
Motion carried with 12 Aye, 0 Nay, 0 Abstaining.

3. **Motion to approve Minutes from the December 8, 2016 meeting**

Motion to Approve by K. Jones; 2nd J. Thorius
Motion carried with 12 Aye, 0 Nay, 0 Abstaining.

4. **Final Report: TR-713,** "Load Ratings for Standard Bridges", Andrea Bickford, P. E., Stanley Consultants ($104,689)

BACKGROUND

Bridge standard designs are load rated to evaluate of the capacity of the bridges to carry vehicle loads. The resulting ratings are tabulated by bridge type. The following bridge standards are load rated: H30-94, J24-87, J30C-87, J24-06, J30-06, J40-06, J44-06, RS40-04 and RS40-10. The following vehicles are evaluated: Special Hauling Vehicles (SU4, SU5, SU6, and SU7) at the operating level, Legal Trucks (Types 4, 3S3A, 3-3, 3S3B and 4S3) at the operating level, and HS20-44 truck at the inventory and operating level. The rating procedure utilizes Load Factor methodology and LARS Bridge software. Load rating results listed are in compliance with the 2011 AASHTO Manual for Bridge Evaluation, second edition.

Discussion

Q. Is this something we do every year?
A. Yes, we load rate standards every several years. This was due to FHWA new requirements on Special Haul Vehicles.

Motion to Approve by M. Parizek; 2nd R. Knoche
Motion carried with 12 Aye, 0 Nay, 0 Abstaining.

5. **Proposal:** *Development of Self-Cleaning Box Culvert Design – TR-619 Phase III"* Marian Muste, University of Iowa, ($148,702)

Background
The proposed research builds on of a sequence of IHRB projects focused on sedimentation at culverts. The self-cleaning culvert concept was extensively tested at IIHR through laboratory and numerical simulation modeling and performed well in laboratory conditions.
Combined funds from IDOT and Iowa City were used to retrofit the upstream part of the culvert. Monitoring of the culvert after culvert cleanup and after the culvert was retrofitted with the self-cleaning design was accomplished through TRB-619, Phases I and II between 2010 and 2013 (Muste and Ho, 2013). During three years of post-retrofitting operation, the culvert performance with respect to sediment and hydraulic conveyance has been excellent as illustrated regardless of the year's season.

Objective
The **overall objective** of the Phase III proposal is to evaluate the performance of new self-cleaning designs for mitigating sedimentation at culverts by deploying observational equipment, collecting data and information, and analyzing and synthesizing the ground-truth observations collected during the culvert monitoring.

The **specific objectives** of this study are:

O.1. Implementation of the self-cleaning design downstream Hwy 1 culvert (FHWA #031711) using guidelines developed through previous TR 619 research.
O.2. Monitor and asses the overall behavior of the 3-box culvert (FHWA # 364790) located immediately downstream from Hwy 1 culvert
O.3. Design, implement, and monitor a new self-cleaning culvert design based on the pool-based concept at FHWA #364790 culvert.
O.4. Synthesize the findings of pre- and post-construction observations on the hydraulic and sediment-mitigation performance for the two self-cleaning designs applied to FHWA # 031711 and FHWA # 364790 culverts

Discussion
Q. Have you looked at using Inverted Curtain Walls?
A. I am not prepared to take your question at this time but would like to take your name and number. We would like to learn more about this design.

Motion to Approve by D. Claman; 2nd B. Skinner
Motion carried with 12 Aye, 0 Nay, 0 Abstaining.

6. **Proposal:** *Development of Bio-Based Polymers for Use in Asphalt – Phase 2",* Chris Williams, Iowa State University, ($175,000)

Background
Recent advances in polymerization technology have led to the development of elastomeric block copolymers produced with polystyrene and polymerized soy-derived triglycerides. While the past two decades of plant-oil based polymer research has yielded only thermosets, the produced polymers are highly processable thermoplastics. A laboratory investigation was conducted to characterize the PS-PAESO-PS and PS-PASEO biopolymers and to evaluate their effectiveness as an asphalt binder modifier. Asphalt modified with the biopolymers was compared to asphalt modified with two commercially available Kraton polymers, D1101 (SBS) and SB D1118 (SB). Rheology test results

showed the biopolymer has the ability to widen the grade range of asphalt and reduce its temperature susceptibility. The biopolymers significantly enhanced the performance properties of the base asphalt. By adding two percent of biopolymer to an asphalt binder, the rutting resistance and temperature performance range of an asphalt pavement is significantly improved.

Objective
The benefits of this research are potentially utilizing Iowa source materials (e.g. soybean oil) for producing biopolymers for use in Iowa asphalt binders. Current market analysis illustrates that the material cost of the biopolymers is 40 percent lower than using butadiene with additional savings being provided via lower production costs. These lower costs will translate into lower costs of polymer modified asphalt. The handling of vegetable oils in producing the bioelastomers and subsequent linking with styrene is also much safer and has less impact on the environment. This should also create improved economic opportunities for soybeans resulting in economic value to the State of Iowa and maintaining soil qualities through a balanced crop rotation.

Discussion
Q. Do you anticipate contractors wanting more money?
A. No, I don't think so, it should be just turn key.
Q. How much mix do you plan on using?
A. We can produce in our pilot plan one ton per day.

Motion to Approve by K. Jones; 2nd M. Parizek
Motion carried with 12 Aye, 0 Nay, 0 Abstaining

8. Proposal: "Low-cost Rural Surface Alternatives Phase III: Demonstration Project", Jeremy Ashlock, Iowa State University, ($151,428)

Background
Some approaches currently used by County Engineers to deal with moisture-related damage include temporarily spreading rock on the affected areas, lowering or improving drainage ditches, tiling, bridging the areas with stone and geosynthetic covered by a top course of aggregate or gravel, coring boreholes and filling them with calcium chloride to melt lenses and provide drainage, and re-grading the crown to a slope of 4 to 6% to maximize spring drainage. However, most of these maintenance solutions are aimed at dealing with frost boils after they occur.
To prevent or minimize the occurrence of such freeze-thaw damage related problems in the first place, the proposed research project will examine several more potentially useful stabilization and construction methods for granular-surfaced roadways. To be effective, stabilization practices must address multiple issues simultaneously, including water migration, durability, cost, and performance under agricultural equipment and snow plow 2 blades. A range of potential stabilization technologies to address these issues were studied in a previous IHRB project, including chemical (e.g., fly ash, polymers), mechanical (e.g., geogrids, geocomposites), and biological (e.g., lignin, enzymes, organic liquids) methods. Several of these technologies were examined in the Phase II project (TR-664), most with successful results.

Objective
The objectives of the proposed Phase III project are to construct and monitor several more test sections around Iowa using additional stabilization methods employing different types of virgin and recycled materials. The economic and initial versus life-cycle maintenance costs for the different methods will be

studied as was done in the Phase II project (TR-664). It is proposed that four to five additional demonstration sections be constructed in Hamilton County, including one control section.
Similar demonstration sections will then be built in three additional counties distributed around Iowa (a total of 16 to 20 test sections over four counties), to cover a range of different aggregate sources, subgrade soil types, and weather conditions. All demonstration sections will then be tested and monitored through two winter freeze-thaw cycles, and the construction and maintenance costs will be tracked and analyzed as was done in the Phase II project.
The most effective and economical stabilization methods will be identified, and a "How-To" guide will be written for county and district engineers to implement the stabilization methods. Additionally, tests will be performed at several existing macadam-based granular roadways around Iowa, to try to identify the surface-course material properties and subgrade conditions that lead to good long-term performance of non-bitumen macadam bases under granular-surfaced roads.

Discussion

Q. What was the ADT in Hamilton County?
A. 230
Q. Are you planning on trying Fly Ash?
A. There are different types of Fly Ash, we think we would have better success if we did that again with a different type.
Q. We have a lot of composite pavements that are now in the fifty-year-old stage, have you thought of recycled material as one of your forty-four?
A. Yes, that would be an excellent way to recycle it by mixing the two together.
Q. Do you feel like the TAC is going to narrow down forty-four, forty-five and forty-six, what kind of information are you going to provide?
A. This depends on the County engineers on what's available locally as well as what participating counties are willing to try on their roads.
Q. Is there a chance of combing Aggregate columns with anything else?
A. I am glad you mentioned this, it was cheap and effective. We would like to do this again and be maybe more scientific as far as the depth, size and pattern spacing, reducing drainage basin calculations and optimize the size of the columns.

Motion to Approve by J. Thorius; 2nd B. Skinner
Motion carried with 12 Aye, 0 Nay, 0 Abstaining.

9. RFP Proposal: IHRB-16-15, "Increase Service Life at Bridge Ends through Improved Abutment and Approach Slab Details and Water Management Practices", Brent Phares, Iowa State University ($100,000)

Background

Ongoing problems with erosion and corrosion at integral and stub abutment bridge ends are causing performance issues and increasing maintenance. Tied approaches, semi-integral abutments and other details can help relieve erosion and corrosion issues, but may introduce new issues which need to be addressed.

Objective

1.) Perform a literature search with respect to the following particularly with respect to state DOTs. (There is already a significant amount of research in some of these areas. Compiling this information and filling in gaps is necessary.)

- Compile bridge geometry limits (e.g. bridge length, skew, etc.) for integral abutments and semi-integral abutments. Indicate what factors contribute to limits. Include description of relevant details (e.g. abutment geometry, pile orientation, water stops). Indicate performance.
- Compile information on the use of tied approaches from state DOTs for integral and semi-integral bridges. Include details on approach length (and assumed span length), thickness, and reinforcement in approach slabs. Include tie details such as orientation of tie and amount of tie reinforcement. Consider details that mount the barrier on the approach rather than abutment wings. Report on support details at the bridge end (water stops, support length, and use of tar paper, bond breakers, joint fillers, neoprene, etc.) and at the road end (with or without sleeper slabs supported on soil or piles). Include discussion of friction reduction techniques underneath approach slab. Indicate performance.
- Compile information on expansion joint types (compression, strip seal, finger plate, etc.) used at approach ends. Include information on skew and drainage. Indicate performance (particularly with respect to controlling rotation of sleeper slab/rideability).
- Compile information from state DOTs on backfill used behind the abutments and beneath the approach and sleeper slab. Include material types, gradations, levels of compaction and use of geosynthetic, geotextile, compressible inclusions etc. Include information on drainage mechanisms. Indicate performance.
- Compile information on pile corrosion protection. Indicate performance.
- Compile information on deck drainage practices on the bridge and approaches. Indicate performance.
- Compile information on erosion control at the abutments. Indicate performance.

2.) Conduct a survey of other state DOTs where information is lacking.
3.) Inspect and report on Iowa bridges which include semi-integral abutments and tied approach details.
4.) Develop a list of successful practices and details.
5.) Consider small-scale testing and/or computer modeling of specific details (e.g. testing of tie details, limits on approach slab length that can be pushed and pulled due to bridge expansion and contraction, skew effects on approach slab movements, etc.). IHRB-16-15 9/20/2016
6.) Generally, develop design guidelines and details for selected alternatives.
7.) Develop specific recommendations for the demonstration bridge.
8.) Monitor the construction and performance of the bridge ends at the demonstration bridge for one year. Integral abutments have successfully replaced stub abutments for short to mid-range bridge lengths based on their superior performance in reducing deterioration caused by leaky expansion joints. One of the goals of this research project is to not only continue to improve the performance of integral abutments, but also to investigate abutment replacement options for stub abutments which are still used on longer bridge lengths. One semi-integral abutment option that has some promise is shown below. The intent of the demonstration bridge is to use a version of this option along with the recommendation from #7. Constructability of any new details should also be addressed.

Motion to Approve by K. Jones; 2nd W. Klaiber
Motion carried with 12 Aye, 0 Nay, 0 Abstaining.

10. RFP

a. **Proposal: IHRB-17-05**, "Role of Coarse Aggregate Porosity on Chloride Intrusion in HPC Bridge Decks".

Motion to Approve by K. Jones; 2nd B. Skinner
Motion carried with 12 Aye, 0 Nay, 0 Abstaining.

11. Additional Continuation Project Requests Ranking

IHRB members submitted their priority ranking online. Project on low cost rural surface phase 4 was requested to be moved higher and to be presented in March, as well as the joint spacing study. The current ranking of continuing project requests is below:

Continuation Phase Projects Ranking

	Project Title	Proposed Budget	IHRB Meeting Review
1	Low-Cost Rural Surface Alternatives Demonstration Project Phase III	$150,000	Approved - Feb
2	Validation of a proof-of-concept self-cleaning culvert design	$175,000	Approved - Feb
3	Implementation of the Negative Moment Reinforcing Detail Recommendations	$160,000	Approved - Feb
4	Development of Bio-Based Polymers for Use in Asphalt-Phase 2 Study	$175,000	Approved - Feb
5	Optimized Joint Spacing for Concrete Overlays - field demonstration	$124,000	Review in March
6	Low Cost Rural Surface Alternatives Phase IV: Frost Depth Monitoring and Prediction	$300,000	Review in March
7	Load Rating of Short Span Box Beam Standards	$25,000	TBD
8	Holding Strategy Treatments for Composite Pavements	$100,000	TBD
9	Predicting Future Major Equipment Repairs To Minimize Operating Costs	$100,000	TBD
10	LRFD Calibration of Geotechnical Resistance Factors for Pile Bearing on Rock	$50,000	TBD
11	Development of Drilled Shafts LRFD Resistance Factors	$200,000	TBD
12	Reducing uncertainties in snow fence design: Development of image based methods to estimate snow drifting and the snow relocation coefficient	$80,000	TBD

13	Impact of Curling and Warping Phase II	$250,000	TBD
14	Development of Smart Sensing Technologies for Transportation Infrastructure Health Monitoring: Wireless MEMS Chloride Ion Detection System	$350,000	TBD

12. EDC-4 Implementation Plan Update: Sean Litteral, FHWA

The presentation showcased the role of the STIC and the available funding through STIC and AID Grants. Last fall there was the roll out of Every Day Counts initiatives round 4. We had representatives for the Iowa Highway Research Board attend the Summit in Minnesota. The goal of this summit was to showcase what the initiatives are and to start the dialog of what the State of Iowa would choose to implement. We have had several meetings with internal discussion and stakeholders, identifying which innovations that Iowa is willing to pursue. What we are outlining to pursue we needed to put an implementation plan together. The FHWA office in Ames will submit the plans to FHWA headquarters.

Vanessa stated during the December meeting we ranked the projects that we were going to propose for STIC funding as well as projects for applying for AID Grants for this year. For the AID funding we initially came to the board with two different types of proposals. One was for eligible sub recipients to one million dollars that would benefit the counties which was the box beam project implementation. The second project was to go for the million dollars for the State DOT. With the AID grant you can apply up to two million dollars, one for State and one for sub recipients. The project that has moved forward for the AID grant was Piloting and using plate load testing for sub grade work.

Vanessa stated after speaking with Federal Highway we received word from headquarters that the way we were proposing the project for Box Beams as a sub recipient does not qualify for a sub recipient, it has to be submitted as a project by the State DOT. The Iowa Highway Research Board members voted online via e-mail and the Box Beam Project is the one that will move forward for Federal FY17 and will be applying for this grant in March. If the AID gran for the Box Beam project is not awarded, we will move to apply for the plate load testing project. If the Box beam application is successful, the plate load testing will be submitted for FFY18 in October.

Chris Brakke is working on the proposal for the STIC project for $125,000.

13. Proposal, *"Implementation of the Negative Moment Reinforcing Detail Recommendations"* Brent Phares, Iowa State University, ($149,197).

Background
Requirements for the termination of negative moment reinforcing steel have largely been based upon judgement, previous performance, and existing practice. These requirements also vary from state to state. Additionally, work by the Federal Highway Administration has shown that it is possible to have secondary positive moments that offset the negative moments experienced over piers thus resulting in no negative moment at all. These contradicting viewpoints served as the motivation behind a study performed by Iowa State University in which the current Iowa DOT policy regarding b2 reinforcement was investigated. This study involved the live load testing of a number of bridges, with the results used to calibrate finite element models. The finite element results suggested that the transverse field cracks

over the pier and at 1/8 of the span length are mainly due to deck shrinkage (Phares et al. 2015). In addition, it was concluded that secondary moments affect the behavior in the negative moment region. This impact may be significant enough such that no tensile stresses in the deck may ever be experienced. The results of this previously funded research were recommended for implementation such that further evaluations could be completed to confirm the findings and result in the development of updated requirements for negative moment reinforcement in multi-span prestressed concrete beam bridges.

Objective

The objectives of the proposed research are to:

1) Review the literature on the requirements for negative moment reinforcement.

The emphasis of the review will be on the findings presented in the previous study performed by Iowa State. This study has previously compiled relevant literature on the topic.

2) Field instrument a bridge with varying reinforcement amounts.

Field instrumentation of the yet-to-be-constructed bridge on E57 over I35 will be performed. This bridge utilizes both conventional b2 amounts as well as proposed reduced amounts.

The b2 bars over piers one and four were designed in a conventional manner. The design was based on a singly reinforced beam utilizing a composite cross section consisting of an interior prestressed beam and the associated deck tributary area. This beam was designed to carry 100% of the estimated negative moment based on AASHTO LRFD bridge design specifications. There was no attempt at including secondary moments in the loading.

The b2 bars over pier two were designed based on one percent of the deck cross sectional area. The basis for this design is the Iowa DOT's continuously welded plate girder bridges which currently perform well using one percent of the deck cross sectional area for their reinforcement.

The b2 bars over pier three were designed in a similar way to the b2 bars over piers one and four. However, the section was only designed to carry 50% of the estimated negative moment. This reduction in negative moment was chosen so performance could be observed with a reduction in steel without introducing significant risk.

The installed instrumentation will include both embedded and externally mounted sensors. This system will be used to monitor and report on bridge behavior and identify changes/differences in performance over time and with different reinforcing details. The instrumentation system will be supplemented with regular bridge inspections with the installed sensors interrogated during controlled load tests. The field instrumentation plan will allow for differing reinforcement levels to be monitored, and the associated performance of each to be determined.

3) Synthesize the findings to develop suggested reinforcement requirements.

This objective will be achieved by reviewing the data collected from the field investigation to determine negative moment reinforcement requirements based upon system performance. These recommendations can then be reviewed by the DOT for possible use in the design of future bridges.

.

Motion to Approve by W. Klaiber; 2nd R. Knoche
Motion carried with 12 Aye, 0 Nay, 0 Abstaining.

14. Innovative Projects Program Update

Vanessa has an update on the Innovative Pilot Program. Last year we tried to leverage some funding available through the Midwest Transportation Center where Iowa Highway Research Board contributed eighty thousand dollars towards the innovative projects. Our office of Research and Analytics put in an additional twenty thousand dollars. With Midwest Transportation Center at InTrans, they contributed Eighty thousand dollars, which totaled One Hundred and Eighty thousand dollars total, that was put together for innovative projects.

Vanessa stated last Summer we had twenty to twenty-five proposals submitted. We had an executive committee that represented both Iowa Research Board and InTrans. Kevin Jones, Sarah Okerlund, Ron Knoche and Vanessa Goetz representing the Iowa Highway Research Board. We also had members from MTC along with InTrans that were in this committee that reviewed these proposals. From the initial review we had about six to eight projects that made the first round of cuts, which were sent out for additional feedback from technical experts as far as the suitability of the proposals and last week we met again to award the top four. Each project was awarded forty-five thousand dollars each that we consider seed money, because is not enough to do a bigger research project but enough to prove the concept of something that has potential. InTrans/MTC are managing the actual projects, they are not going through our office.

Each recipient will be invited to present a brief overview of their project to the board. The 4 projects are:

- **a.** Initial Characterization of Geopolymer Based UHPC Material Properties, Ping Lu, ISU
- **b.** Hybrid Concrete for Advanced Pavement Performance, Kejin Wang, ISU
- **c.** Enhancing the Fundamental Knowledge and Use of Asphalt Emulsions Using Systematic Scientific and Engineering Approaches, Ashley Buss, ISU
- **d.** Estimating Energy Efficiency of Connected and Autonomous Vehicles in a Mixed Fleet, Jing Dong, ISU

Vanessa stated this is a good opportunity to ask the board if they have ideas or would like to try something different with the call for innovative projects? InTrans was not able to receive their UTC grant from Federal Highway so they do not have funding available this time to participate. More discussion will follow on when and how to do the next call for innovative projects.

15. New Business

16. Adjourn

Motion to Approve by K. Jones; 2nd R. Knoche
Motion carried with 12 Aye, 0 Nay, 0 Abstaining.

The next meeting of the Iowa Highway Research Board will be held Friday, March 31, 2017 in the East/West Materials Conference Room at the Iowa DOT. The meeting will begin promptly at 9:00 a.m.

Vanessa Goetz, IHRB Secretary