IOWA HIGHWAY RESEARCH BOARD (IHRB)

Minutes of May 30, 2008

Regular Board Members Present

A. Abu-Hawash
J. Adam
J. Berger
S. Gannon
B. Moore
J. Waddingham
D. Waid

Alternate Board Members Present

D. Ahart for J. Rasmussen
J.D. King for M. Nahra
S. Sritharan for J. Alleman
S. Rinehart for District 3 County Member
W. Zitterich for V. Dumdei

Members With No Representation

K. Hornbuckle
J. Joiner
J. Krist

Secretary - M. Dunn

Visitors

Brian Keierleber	Buchanan County
Max Grogg	Federal Highway Administration
Ed Engle	Iowa Department of Transportation
Sandra Larson	Iowa Department of Transportation
Mary Starr	Iowa Department of Transportation
	Iowa State University/CTRE
Sang Kim	Iowa State University/CTRE
David Plazak	Iowa State University/CTRE
Duane Smith	Iowa State University/CTRE
Hao-Che Ho	The University of Iowa/IIHR
Mohamed Elhakeem	The University of Iowa/IIHR

The meeting was held at the Ames Holiday Inn Conference Center, 2609 University Blvd., Ames, Iowa. The meeting was called to order at 9:00 a.m. by Vice Chairperson Jim Berger with an initial number of 12 voting members/alternates at the table.

Agenda

No changes were made to the Agenda.

Approval of the minutes

Motion by B. Moore to approve minutes from the April 25, 2008 meeting. 2nd by A. Abu-Hawash. Carried 12 aye, 0 nay, 0 abstaining.

FINAL REPORTS

Final Report TR-557, "Evaluation of Lignin Derived from Agricultural Co-Products as an Antioxidant in Asphalt," Chris Williams, Iowa State University/CTRE ($50,000)

BACKGROUND
Oxidation is the primary cause of long-term aging in asphalt pavements. As a pavement oxidizes, it stiffens and can eventually crack. The use of an antioxidant as a performance enhancer in an asphalt binder could delay aging, thus increasing the life of an asphalt pavement. Lignin is a highly available and well-studied antioxidant. A wet-mill ethanol plant produces several co-products that contain lignin. The use of lignin from ethanol production could provide a benefit to asphalt pavements and also give more value to the co-products.

OBJECTIVES
The objective of this study was to evaluate the effects of lignin-containing ethanol co-products for use in asphalt binder. This was a first-phase study that evaluated whether the co-products had an overall positive or negative effect on the binders. Work was performed to analyze how the lignin-containing co-products chemically and physically interacted with samples of asphalt binder.

CONCLUSIONS
The addition of corn lignin-containing co-products to different asphalt binders can benefit the overall properties of the asphalt depending upon the type and amount of co-product added. In general, the addition of more co-product resulted in a greater increase in the stiffening effect. The stiffening effect benefits the high temperature properties but worsens the low temperature properties. However, in many cases the low temperature stiffening effects were not significant. Co-products had an overall effect of widening the binders' temperature range.

This result suggests some antioxidant activity between the binder and the lignin. Testing with a fourth co-product with no lignin supported the idea that lignin acts as an antioxidant. The samples with no lignin aged significantly more than the samples with lignin. Infrared spectrometry also supported the idea that lignin acts as an antioxidant by observing decreases in some oxidative aging products

Q: What's the next step? Do you need to have demo project through a second phase?
A: Yes, a proposal needs to be written but first, we'd like to have a county or the state volunteer a test site.

Q: The findings discuss a worsening of the low temperature properties – what's the magnitude of that?
A: It increased the low temperature grade yet on the high temperature range it increased much more than on the low temperature. This can all be addressed in the formulation of the binders used on the project.

Q: Will this lignin be a consistent project from mill to mill?
A: I'm confident it would be consistent.

Q: How would it be priced?
A: Probably (depending on the level), you might expect it to run around $200/ton; about one half to a third the price of asphalt. About a 6% savings from the start.

Q: Are these products local?
A: Yes – Grain Processing Corporation (GPC) is in Muscatine.
C: From the Iowa DOT standpoint, we'd be willing to support this and help find a test site.

Motion to Approve
Motion by D. Waid. 2nd by J. Waddingham.
12 aye, 0 nay, 0 abstaining.

PROPOSAL DISCUSSION – IHRB 07-09 ***Bridge Rails and Approach Railing for Low-Volume Roads in Iowa*****,** Brent Phares, Iowa State University/CTRE ($50,000)

BACKGROUND
Bridge and approach guardrails need to withstand impacts of vehicular crashes yet smoothly redirect vehicles without causing abrupt stops, snags or rollovers. The installation of guardrail systems add costs to the bridge and additional safety and maintenance problems that can outweigh benefits when used on low (ADT < 400vpd) and very low-volume roads (ADT < 100vpd).

Currently, the Federal Highway Administration requires bridge and approach guardrails on all national highway system roadways; however, low-volume roads are left to the jurisdiction of the state or county.

OBJECTIVES
Research will provide guidance to county engineers for replacement or upgrading bridge and bridge approach guard railing by:
• Determining the criteria and guidelines used by other states for bridge and approach guardrail implementation for low and very low-volume roads.
• Performing benefit/cost analysis for using bridge and approach guardrails based on traffic levels and road classifications.
• Investigating the use of non-standard and innovative bridge and approach guardrails for low-volume roads.
• Utilizing the Iowa DOT crash and geographic information management systems (GIMS) databases to quantify several system-wide and site-specific crash related metrics, including exposure, frequency, rate and loss.

Motion to Approve by J. Adam. 2nd by A. Abu-Hawash.
12 aye, 0 nay, 0 abstaining.

PROPOSAL DISCUSSION – IHRB 07-03 ***Infrastructure Impacts of Iowa's Changing Economy***, David Plazak, Iowa State University/CTRE ($120,000)

BACKGROUND
Iowa has quickly become a leader in the bioeconomy and sustainable energy production. A production center for biofuels such as grain-based ethanol and soy bio-diesel as well as a leader in wind energy generation, Iowa currently has several wind generation equipment manufacturing facilities (established within the past three years). A new economy—the bioeconomy, is rapidly evolving in Iowa.

The market for biofuels is still rather limited and is concentrated to the Midwest; fundamentally, a *regional market* product today (with the notable exception of California, where ethanol is mandated as a transportation fuel oxygenator for air quality considerations) and with the next generation of biofuels—cellulosic biofuels—expected to dramatically change the patterns of commodity shipping.

For both the cellulosic biofuels industry and the wind power industry in Iowa there is a need to understand the need for supporting transportation infrastructure. Even more, there is a need to ensure that the transportation infrastructure support needs of these industries are addressed in a fiscally sustainable manner. Otherwise, these industries will not be able to compete in the long-run.

OBJECTIVES
There are five major objectives proposed for this research effort. They are:
1) Develop a reliable set of traffic and fiscal assessment tools to understand the impact of the development of the biofuels and wind power industries on Iowa's highway transport infrastructure, particularly the secondary road system.

2) Inventory the types of large and heavy vehicles likely to be used as the cellulosic biofuels and wind power industries develop in rural Iowa. Develop turning movement templates and typical axle loading characteristics and specifications for these vehicles.
3) Document the current physical and fiscal impacts of Iowa's existing bio-fuels and wind power industries. Assess the likely physical and fiscal impacts (and infrastructure needs) of the further development of the biofuels and wind power industries in Iowa in the next 15-20 years using a multi-county, case study approach; quantify and visualize the impacts to the extent possible.
4) Develop a brief set of public policy recommendations given the need to provide adequate roadway and bridge infrastructure to support the biofuels and wind power industries during the next 15-20 years in Iowa.
5) Develop a "Road Map" for technology transfer for this issue, which could lead to additional outreach activities in the future by CTRE and other organizations should additional resources become available.

Motion to Approve by J. Waddingham. 2nd by W. Zitterich.
12 aye, 0 nay, 0 abstaining.

INNOVATIVE PROPOSAL VOTING
Mark: We've targeted around $200K for total funding for Innovative projects FY '08. This should include three projects at most. Each member receives three votes total in the approval process for Innovative proposals. After discussion of each (six) Innovative proposals and voting is completed, we'll vote again if we don't have a total of three projects approved with eight votes.

INNOVATIVE PROPOSAL PRESENTATIONS AND DISUCSSION

Structural Evaluation of Bamboo as a Green Solution for Timber Bridge Superstructures, Brent Phares, Iowa State University, Associate Director, Bridge Engineering Center ($75,000)

The need for sustainable and environmentally friendly materials is a new challenge of the 21st century for design and construction practices. To fulfill this need for Iowa highway projects, the study of non-traditional materials, such as bamboo, is needed to determine their viability for structural integrity as a bridge element, and its environmental and economic feasibility for Iowa. A research team with technical backgrounds in wood engineering, wood adhesives, wood deterioration, and bridge engineering proposes to address these needs.

Q: Has anyone else already done a study like this?
A: There is very cursory work looking at bamboo bridges, but those have been taking the cross section as it naturally exists and creating a cross-section. What we're proposing is to create a more efficient and engineered shape that takes better advantage of the good properties of bamboo.

Q: Will this be a strand-type of glue-laminated product? Shredded?
A: The natural cross-section could be split into eight pie-shaped pieces and reconfigured to create laminates; but they would be discontinuous laminates. That needs to be explored, including what adhesives work.

Q: What about needing preservatives?
A: Bamboo needs to be kept dry. It is not substructure material. *Dry in the sense that it cannot remain submerged.*

C: We could modify this to look at deck panels.
C: If you grow bamboo in Iowa you can't treat it in Iowa and you have ship it somewhere for treatment. That cost, for us, is too much.

C: Bamboo is good at resisting rot and decay as long as it can dry.

Utilization of Lignocellulosic Residues in Dust Control Applications for Roads, (Rangan Gopalakrishnan for) Halil Ceylan, Iowa State University, CTRE ($74,577) Buchannan County Engineer Brian Keierleber also spoke in support of this project.

The application of the lignocellulosic residues, which are by-products of local ethanol production plants, is a cost-effective and sustainable solution that is expected to produce a road surface that is firm, smooth, dust free, and comfortable to drive. Iowans are increasingly concerned about possible environmental damage associated with chemical dust control materials such as calcium chloride. The use of lignocellulosic residues is a feasible and viable alternative as it is biodegradable and contains no oil based contaminants.

The researchers have submitted a proposal on this topic in response to 2008 Grow Iowa Value Funds (GIVF) RFP. An overwhelming response from both Iowa-based agencies as well as international research corporations was received in support of this proposal.

C: Last year in Buchannan County, we got 800 gallons of lignin from the local ethanol plant. They have a high level of moisture but water is driven off rather than transporting the product to Texas and Kansas where there is a large livestock industry to use them. We've tried several combinations in adding back moisture.

C: The public demands the county invest in dust control. We need to do this or the result is more pressure to pave the roads. We don't have the money to do that.

C: Calcium Chloride is an alternative as long as it's still allowed; however, we need to find other answers.

C: Another project could examine how these products hold up through freeze-thaw cycles.

Rapid Load Testing of Medium Span Bridges: an Assessment of a New Measurement Technology, (Matt Rouse for) Terry Wipf, Iowa State University, CTRE ($75,000)

This project will evaluate the adaptation and use of advanced auto-tracking total stations that are currently used in the construction industry to monitor and control final grading operations. The intent in this proposed project is to adapt an existing grading setup using active targets to the rapid collection of position and deck elevation data under or near the weighted vehicle in a typical load test. In discussions with the technical staff at Ziegler, Inc., the expected resolution of profile measurements will be better than 0.050 inches for this project, and perhaps even better for medium span bridges.

The researchers will collect data from a single remote observation point without additional instrumentation. Bridge deflection data collected in this manner would dramatically increase the speed and reduce the logistics of load testing compared to currently implemented test methods and would complement results of these methods by providing an additional independent assessment data set. It would also create a measurement technique that does not readily exist for live load field tests on bridges with no under bridge access.

Q: Could you also use visual software to look at centers of axles and measure deflection that way?
A: There are references in the proposal to previous work with trying to use visual techniques to measure deflection. However, the resolution is a problem. With this technology if we can get within a couple hundredths of an inch of resolution, which we think we can, then we have something useful.

C: I think there will be some immediate use to confirm some strain measurements during load tests; also, measuring deflection when monitoring abutments for tilt deflection would prove useful.

A: When looking at screen data from load tests you see unusual things that aren't readily understandable; if you can profile deflection as a truck moves across the bridge, it's a great way for looking at what is going on with some of those strains and what's going on with the bridge.

C: This is a good tool for accessing the global behavior of a bridge; we don't think this will take the place of conventional load tests made with strain gauges.

Development of Non-Petroleum Based Binders for Use in Flexible Pavements, Chris Williams, Iowa State University, CCEE ($75,000)

The Center for Sustainable Environmental Technologies (CSET) will produce varying bio-oils from which various pyrolytic lignins will be derived for modifying asphalt binders. The production will be done by using the fast pyrolysis system at the BECON facility in Nevada, Iowa. Liter quantities of bio-oil from five different fractions will be obtained from the system. If necessary, pyrolytic lignin will be extracted from each bio-oil. The lignin samples will be analyzed for their properties such as acidity, char content, and stability, prior to sending them to the Department of Civil, Construction and Environmental Engineering.

The proposed process is essentially one converting the biomass (corn stovers, switchgrass, or woods) into liquid form from which pyrolytic lignin can be separated by extraction using water. The bio-oil produced will be collected into five separate fractions by using a bio-oil collection system consisting of a train of multiple condensers that has been developed at Iowa State University.

Q: Does industry support this phase?
A: At this point, a company is willing to commit .5M; however, ISU wants finish a pilot plant with 5/ton per day input of biomass. The company wants more output. Negotiations are in progress.

Q: Is this a situation where developed biomass binders will be sidetracked into fuels?
A: I don't think so in this case; when looking at techniques that would have to be pursued, the cost is excessive.

Autonomous Measurements of Bridge Pier and Abutment Scour Using Motion-Sensing Radio Transmitters, Thanos Papanicolaou, The University of Iowa, ($57,000)

Bridge scour monitoring often requires manual inspection of bridge foundations during flood events. Current practices typically include probing the streambed adjacent to piers and abutments with long poles or lowering a tethered sounding weight from the bridge deck. Regardless of the detection mechanism, these methods require maintenance personnel to be physically present at the bridge site for inspections. There are invariably more bridges needing inspection during flood events than there are personnel to perform the inspections.

Radio Frequency Identification (RFID) is a wireless, automatic identification system that consists of three parts: a transponder (derived from transmitter/responder), a reader, and an antenna. Each transponder has a resonant circuit that is energized by an electromagnetic field radiated from an antenna. The basis for RFID technology is the transfer of information using radio waves between a transponder and a reader. The transponder consists of a small antenna and a circuit to store and send information to the reader. The reader consists of an antenna and the circuitry capable of interpreting the radio wave signal from the transponder and converting it into a signal (such as a LCD display readout) or by a computer (such as a computer language like ASCII).
C: The point of these chips is that county engineers with scour critical bridges can be off site and by planting these sensors around the pier, monitor them. If you have an event and one or a group of these sensors goes downstream or moves from the hole, maybe it's time to shut down the bridge. If all the sensors are there, the

soil's there. The sensors are passive chips; all the energy comes from the reader. The sensors will last forever (three years recorded at present). So you'll know how deep the hole is; the chips could also be used in concrete.

Q: With your function of the wave or signal shape, could you attach these to the pile underneath the footing and track that?
A: You can get the 'X' and 'Y' of signal. You can know where the sensor is.
C: This is a cost-efficient way to monitor scour at bridges. Sensors can be placed in concrete and rebar placement, approach fill, etc. Because it's wireless, you can read it from your office. Chips could be placed around bridges under construction for readings from the hole and boring, but that's an entirely different aspect of potential use. Chips are inexpensive and environmentally friendly.
C: The range of cost is from about .50 cents to around $10, depending on the accuracy you're looking for; the ones we'll be generally be working with are about $2 each.
C: With about twelve transponders you will get significant data.

Insights into the Origin and Characteristics of the Sedimentation Process at Multi-Barrel Culverts in Iowa, Marian Muste, The University of Iowa, IIHR-Hydroscience & Engineering ($72,752)

Current knowledge on sedimentation processes at culverts is limited and the literature is scarce. Consequently, there are very limited guidelines on how to design sedimentation-free culverts or implement control measures to prevent sedimentation. The need for a systematic study of culverts and sedimentation is especially acute in Iowa, where soil erosion is high due to the predominance of agriculture.

This research initiates a comprehensive study to determine the specific conditions leading to culvert sedimentation in Iowa (a problem which results in chronic road maintenance problems for many secondary roads across the state). A three-prong field laboratory simulation investigation will establish a solid foundation for understanding sedimentation processes at culverts. The research will utilize: a) field inspection and measurement, b) physical modeling in laboratory, and c) numerical simulations.

C: A lot of money is spent cleaning culverts and erosion problems. Prevention can limit the exhaustive, labor-intensive task when personnel are busy with other things and not getting the job done.

INNOVATIVE PROPOSAL VOTING – A vote was taken giving each representative at the table three votes. The results were:

A. Structural Evaluation of Bamboo as a Green Solution for Timber Bridge Superstructures	**0**
B. Utilization of Lignocellulosic Residues in Dust Control Applications for Roads	**5**
C. Rapid Load Testing of Medium Span Bridges: an Assessment of a New Measurement Technology	**2**
D. Development of Non-Petroleum Based Binders for Use in Flexible Pavements	**10**
E. Autonomous Measurements of Bridge Pier and Abutment Scour Using Motion-Sensing Radio Transmitters	**12**
F. Insights into the Origin and Characteristics of the Sedimentation Process at Multi-Barrel Culverts in Iowa	**7**

The two highest ranking items (**D and E**) had sufficient votes for approval (eight). Item **F** was voted on again because it had only seven. The result was a unanimous vote for approval of item **F** (12 votes).
Projects **D, E and F** were funded.

NEW BUSINESS

Travel Meeting – The Travel Meeting will be held in September but the date has not been established at this time. IHRB will visit the Minnesota (MNRoad) test site. There is a technical advisory committee meeting in

June and more information will be available after that time. It is suggested that one day for travel (with either a tour or the meeting in the afternoon) and a second day for the alternate event and travel home be considered.

The number at the table that said they were interested in making the trip: Nine.

Pooled Fund Project – IHRB TR-480, "Investigation of the Long Term Effects of Concentrated Salt Solutions on Portland Cement Concrete" has participation in a Pooled Fund project that has a scheduled final report due. The presenters are in Michigan and would need to present through: 1) Electronic media, 2) Paper copies 3) Remote presentation or 4) travel a great distance. It was suggested that because the presenters are from the Midwest, they be asked to travel to the annual Travel Meeting in September (about half way) in Minnesota. Ed Engle will investigate these options with the researchers and report back to the Board at its next meeting on June 27, 2008.

ADJOURN
Motion to Adjourn
Motion by J. Adam. 2nd by S. Rinehart.
Motion carried with 12 aye, 0 nay, 0 abstaining.

The May 2008 meeting of the Iowa Highway Research Board will be held **FRIDAY, June 27, 2008 at 9:00 a.m. at the Ames Holiday Inn Conference Center, 2609 University Avenue, Ames, Iowa.**

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Mark J. Dunn, IHRB Secretary