Mid-Continent
TRANSPORTATION
RESEARCH Symposium

2013 Mid-Continent Transportation Research Symposium

Event Program

Using Research to Enhance Decision Making.

IOWA STATE UNIVERSITY
Institute for Transportation

Iowa Department of Transportation

Mid-Continent Transportation Research

About the Symposium

The Mid-Continent Transportation Research Symposium provides an opportunity for transportation professionals from the Midwest and beyond to network with their peers, learn about advancements and applications in their fields, and future directions for research.

Researchers and practitioners from around the country will present papers at this eighth biennial event at Iowa State University. The day-and-a-half symposium will cover a broad spectrum of transportation issues with sessions on both basic and applied research.

Special Speakers

Opening Session Speakers

John Selmer, Director, Performance and Technology, Iowa DOT

Neil Pedersen, Deputy Director, Implementation and Communication, Transportation Research Board (TRB)

Michael Pack, Director, Center for Advanced Transportation Technology Laboratory, University of Maryland

Luncheon Speaker

Ron Cox, Director, Center for Industrial Research and Service (CIRAS), and Assistant Dean for Economic Development, ISU College of Engineering

Jonathan Wickert, Senior Vice President and Provost

Banquet Dinner Speaker

Earl Swift, Author of *The Big Roads*, Virginia Foundation for Humanities, University of Virginia

Symposium Sponsors

Iowa Department of Transportation

Iowa State University's
Institute for Transportation;
Department of Civil, Construction, and Environmental Engineering

The University of Iowa's
Public Policy Center,
National Advanced Driving Simulator

University of Wisconsin's
National Center for Freight & Infrastructure Research & Education

Wisconsin Department of Transportation

Mid-America Transportation Center

Symposium

Schedule of Events // August 15–16, 2011

Thursday, August 15th

Continental Breakfast Registration — 7:30 a.m.

8:00

Plenary Session Speakers:
John Selmer, Director, Iowa DOT
Neil Pedersen, Deputy Director, TRB
Michael Pack, Director, University of Maryland

8:30

9:00

9:30

Break

10:00

Concurrent Session 1

SHRP 2	Traffic and Safety	Pavements and Materials	Structures/ Construction	Technology/ Operations	Planning, Mobility, Logistics

11:00

12:00 p.m.

Luncheon speaker:
Ron Cox, Director, CIRAS, Assistant Dean, ISU College of Engineering
Jonathan Wickert, Senior Vice President and Provost

12:30

1:00

1:30

Concurrent Session 2

SHRP 2	Traffic and Safety	Pavements and Materials	Structures/ Construction	Technology/ Operations	Planning, Mobility, Logistics

2:00

3:00

Break

3:30

Concurrent Session 3

Asset Management	Traffic and Safety	Pavements and Materials	Structures/ Construction	Geotechnical	Local Roads Considerations

4:00

5:00 p.m.

Thursday, August 15th

Poster Session and Reception — 5:00 p.m.

5:30

6:00

Break

6:30

Banquet and Speaker:
Earl Swift, Author of *The Big Roads*, Virginia Foundation for Humanities, University of Virginia

7:00

8:00

8:30 p.m.

Friday, August 16th

Continental Breakfast Registration — 7:30 a.m.

8:00

Presentation:
Mark Swanlund, Senior Engineer, FHWA

Panel Discussion:
Paul Trombino, Director, Iowa DOT
David Oliver, Interim Vice President for Research & Economic Development, ISU

8:30

9:00

9:30

Break

10:00

Concurrent Session 4

MAP-21	Traffic and Safety	Pavements and Materials	Freight	Geotechnical	Road Maintenance/ Weather

10:30

11:00

11:30

12:00 p.m.

Concurrent Sessions — Thursday, August 15th — 10:00 a.m. — 12:00 p.m.

Session 1A
SHRP 2

1. **SHRP 2 Beyond the Research: The Implementation Program**
   Neil Pedersen, Deputy Director, Implementation & Communication, SHRP 2
2. **SHRP 2 Safety Program: FHWA Perspective (Implementation and Operation)**
   Monique Evans, Director, Safety R&D, FHWA/TFHRC
3. **SHRP 2 Program: State DOT Perspective (Research into Practice)**
   Paul Trombino, Director, Iowa DOT

Session 1B
Traffic and Safety

1. **Evaluation of Low-Cost Traffic Calming for Rural Communities**
   Neal Hawkins, InTrans, Iowa State University
   Shauna Hallmark, InTrans, Iowa State University
2. **Kadyn's Law**
   Neal Hawkins, Institute for Transportation
3. **Iowa Strategic Highway Safety Plan**
   Jeremey Vortherms, Iowa Department of Transportation

Session 1C
Pavements and Materials

1. **Performance Engineered Mixtures for Concrete Pavements**
   Peter Taylor, CP Tech Center
2. **Characterization of Variability in Highway Pavement Materials and Construction**
   Litao Liu, Texas A&M University
3. **Use of Unconventional Specimen Sizes to Determine PCC Strength**
   Jianing Cao, Civil, Construction, and Environmental Engineering, ISU
   Fatih Bektas, Institute for Transportation, ISU
4. **Longitudinal Cracking in Jointed Plain Concrete Pavement: Synthesis of Practices and Performance in the Midwest**
   Robert Schmitt, University of Wisconsin-Platteville
   Samuel Owusu-Ababio, University of Wisconsin-Platteville
5. **Shrinkage and Cracking Behavior of HPC Used for Bridge Deck Overlays**
   Hasitha Seneviratne, CCEE Department, Iowa State University
   Kejin Wang, CCEE Department, Iowa State University
   Scott Schlorholtz, Department of Biotechnology, Iowa State University
   Sri Sritharan, CCEE Department, Iowa State University

Session 1D
Structures/ Construction

1. **Lateral Live-Load Distribution for Timber Girder Bridges subjected to Implements of Husbandry**
   Dr. Junwon Seo, Civil Engineering Department, Iowa State University
   Dr. Brent Phares, Iowa State University Bridge Engineering Center
   Chandra Kilaru, Iowa State University Bridge Engineering Center
   Dr. Ping Lu, Iowa State University Bridge Engineering Center
2. **Field Investigation of Iowa DOT Deck Epoxy Injection Process**
   Brent Phares, Bridge Engineering Center, ISU
   Justin Dahlberg, Bridge Engineering Center, ISU
   Ahmad Abu-Hawash, Iowa Department of Transportation
   Mark Dunn, Iowa Department of Transportation
3. **Laboratory Investigation of Iowa ABC Connection: Cass County HWY 92 Lateral Slide Bridge**
   Brent Phares, Bridge Engineering Center, ISU
   Justin Dahlberg, Bridge Engineering Center, ISU
   Ahmad Abu-Hawash, Iowa Department of Transportation
   Dean Bierwagen, Iowa Department of Transportation
   Jim Nelson, Iowa Department of Transportation

Concurrent Sessions — Thursday, August 15th — 10:00 a.m. — 12:00 p.m.

Session 1E
Technology/ Operations

1. **Traffic Management Centers and Incident Management Systems**
   Cameron Kergaye, Utah DOT
2. **The Path to Implementation: Field Data Collection with Tablets**
   Matthew Haubrich, Iowa Department of Transportation
   Shawn Blaesing Thompson, Iowa Department of Transportation
3. **What We Don't Know about Autonomous Vehicles**
   Chris Schwarz, National Advanced Driving Simulator

Session 1F
Planning, Mobility, Logistics

1. **An Investigation on Guidance of the Trip Generation Model Transferability between MPO's in the U.S.**
   Judith Mwakalonge, South Carolina State University
   Chandani Malla, South Carolina State University
2. **Minnesota's Approach to Developing a Statewide Transportation Asset Management Plan**
   Mark Nelson, Minnesota Department of Transportation
3. **IDIQ Contracting Implementation by the Minnesota Department of Transportation**
   Douglas Gransberg, Iowa State University - Dep. of Civil, Construction, and Environmental Eng.
   Jorge Rueda, Iowa State University - Dep. of Civil, Construction, and Environmental Eng.
4. **Roadway Design Models: Streamlining Conversion for Driving Simulation**
   Shawn Allen, The National Advanced Driving Simulator
5. **Validation of Micro-Simulation Model Output for Mobile Source Emissions Modeling**
   Shauna Hallmark, Iowa State University
   Nicole Oneyear, Iowa State University

Concurrent Sessions — Thursday, August 15th — 1:30 p.m. — 3:00 p.m.

Session 2A
SHRP 2

1. **SHRP 2 Safety: Roadway Information Database (RID)**
   Omar Smadi, RIMOS Director, InTrans
2. **SHRP 2 Safety Analysis Project: Lane Departures on Rural Two-Lane Curves**
   Shauna Hallmark, Director, InTrans
3. **SHRP 2 Safety: Naturalistic Driving Study (NDS)**
   John Hankey, VTTI
4. **SHRP 2 Safety Analysis Project: Offset Left-Turn Lanes**
   Jessica Hutton, MRI Global

Session 2B
Traffic and Safety

1. **Traffic Safety Culture: Definitions, Conceptual Frameworks, & Recommendations for Change**
   Corinne Peek-Asa, Injury Prevention Research Center, The University of Iowa
   Laura Schwab Reese, Injury Prevention Research Center, The University of Iowa
2. **Traffic Safety Culture in Iowa–Public versus Expert Opinions**
   Nadia Gkritza, ISU CCEE/InTrans
   Chris Albrecht, InTrans
3. **Traffic Safety Culture in Iowa: A Sociological Perspective**
   Ki H. Park, University of Northern Iowa Center for Social and Behavioral Research
   Erin O. Heiden, University of Northern Iowa Center for Social and Behavioral Research
   Gene M. Lutz, University of Northern Iowa Center for Social and Behavioral Research

Concurrent Sessions — Thursday, August 15th — 1:30 p.m. — 3:00 p.m.

Session 2C
Pavements and Materials

1. **Hardening Concrete Pavement Against Friction Loss Due to Aggregate Polishing**
   Douglas Gransberg, ISU
   Dominique Pittenger, University of Oklahoma

2. **Quality Control/Quality Assurance of Asphalt Mixtures Using Surface Wave Methods**
   Jeramy Ashlock, Iowa State University
   R. Christopher Williams, Iowa State University
   Hosin (David) Lee, University of Iowa
   Shibin Lin, Iowa State University

3. **Establishment of Relation between Pavement Surface Friction and Mixture Design Properties**
   Hussain U. Bahia, University of Wisconsin-Madison
   Mozhdeh Rajaei, University of Wisconsin-Madison
   Nima Roohi, University of Wisconsin-Madison

4. **TERRA Presentation**
   Stephanie Malinoff, Center for Transportation Studies, University of Minnesota
   Rory Rhinesmith, Wisconsin DOT

Session 2D
Structures/ Construction

1. **Design, Construction and Testing of UHPC Waffle Deck**
   Dean Bierwagen, Iowa DOT

2. **Development of ABC Policy in Iowa**
   Norman McDonald, Iowa DOT

3. **Implementation of Web Based Bridge Inspection Document System**
   Scott Neubauer, Iowa DOT

Session 2E
Technology/ Operations

1. **Intelligent Navigation of Transportation Information: Research Resources for Transportation Topics**
   Leighton Christiansen, InTrans, Iowa DOT

2. **Comparing Adaptive Traffic Control to Optimized Timing Plans: Simulations of Typical and Extraordinary Traffic Conditions**
   Eric Gannaway, Department of Civil, Enviornmental and Geomatics Engineering at FAU
   Aleksander Stevanovic, Department of Civil, Enviornmental and Geomatics Engineering at FAU

3. **Wrong Way Driver Detections and Treatments Along U.S. 30 near Ames, Iowa**
   Willy Sorenson, Iowa DOT

4. **Evaluation of Automated Camera Enforcement on Red Light Running Violations by Time into the Red Phase**
   Shauna Hallmark, Iowa State University
   Nicole Oneyear, Iowa State University

Session 2F
Planning, Mobility, Logistics

1. **The Impact of Transportation Projects in the Community**
   Catalina Miller, ISU

2. **An Analytical Hierarchy Process (AHP) Approach to Quantifying Perceptions of Livability**
   M.V. Hart, National Center for Freight & Infrastructure Research & Education

3. **A Statistical Analysis of the Role of Benefit-Cost Analysis in Awarding TIGER Grants**
   Alex J. Marach, Center for Freight and Infrastructure Research and Education
   Teresa M. Adams, University of Wisconsin-Madison
   Anthony C. Homan, US Department of Transportation

Concurrent Sessions — Thursday, August 18th — 3:30 p.m. — 5:00 p.m.

Session 3A
Asset Management

1. **"TAMPering with Research" – How research was used in developing GDOT's TAMP (Transportation Asset Management Plan)**
   Georgene Geary, Georgia DOT

2. **Asset Management**
   Thomas Palmerlee, TRB

3. **Weibull-Based Bridge Deterioration Models for Iowa Bridges**
   Basak Aldemir Bektas, Iowa State University
   Dimitrios Bilionis, Iowa State University

4. **Three-Tiered Data & Information Integration Framework for Highway Project Decision-Making**
   Hossein Khaleghian, Author
   Michael Lewis, Author
   Hyung Seok "David" Jeong, Author
   Asregedew Woldesenbet, Author

Session 3B
Traffic and Safety

1. **Evaluation of Large Truck Crashes at Horizontal Curves on Two-Lane Rural Highways in Kansas**
   Steven Schrock, University of Kansas
   Eric Fitzsimmons, University of Kansas
   Tomas Lindheimer, University of Kansas

2. **Impact of family communication pattern on parent and teen risky driving behaviors**
   Corinne Peek-Asa, The University of Iowa Injury Prevention Research Center
   Daniel McGehee, The University of Iowa
   Lisa Roth, Blank Children's Hospital
   Cara Hamann, The University of Iowa Injury Prevention Research Center
   Jingzhen Yang, Kent State University

3. **National and Regional Level Analysis of the Large Truck Accidents in the US**
   Murat Ozen, Middle East Technical University
   Shashi Nambisan, Iowa State University

4. **Safety performance differences between unionized and non-union motor carriers**
   David Cantor, Iowa State University

Session 3C
Pavements and Materials

1. **Use of High-Friction Surface Treatments at High-Crash Horizontal Curves**
   Jerry Roche, FHWA - IA
   Dave Jolicoeur, FHWA - WI
   John Vu, Iowa DOT

2. **Volumetric Properties of High RAP Mixtures Based on Calculated Bulk Specific Gravities of RAP and Constituent Aggregates**
   Mustaque Hossain, Kansas State University
   Nassim Sabahfar, Kansas State University

3. **Coefficient of Thermal Expansion of Concrete: Some Rational Modifications to Improve the Reliability of Current Testing Practices**
   Davis Fowler, Secondary author
   Sarwar Siddiqui, Primary author

Session 3D
Planning, Modeling and Logistics

1. **Prestressed Concrete-Steel Composite Girders for Bridges**
   George Morcous, Durham School of Architectural Engineering and Construction, UNL
   Yaohua Deng, Bridge Engineering Center, Institute for Transportation, ISU

2. **The Massena Lateral Bridge Slide: Design and Construction**
   Jim Nelson, Iowa DOT

3. **Assessment of Weathering Steel Bridge Performance in Iowa**
   Michael Todsen, Iowa Department of Transportation
   John Fraczek, Wiss, Janney, Elstner Assoc., Inc.
   Kurt Hollway, Wiss, Janney, Elstner Assoc., Inc.
   Douglas Crampton, Wiss, Janney, Elstner Assoc., Inc.

Concurrent Sessions — Thursday, August 18th — 3:30 p.m. — 5:00 p.m.

Session 3E
Geotechnical

1. **Application of Ground Penetrating Radar for Civil Infrastructure Assessment**
   David Eisenmann, CNDE, ISU
   Frank Margetan, CNDE, ISU
   Ahmad Abu-Hawash, DOT

2. **Impacts of Automated Machine Guidance (AMG) on Earthwork Operations**
   David White, Iowa State University
   Pavana Vennapusa, Iowa State University

3. **A Comparison of Pavement Foundation Stabilization Technologies**
   Peter Becker, Iowa State University, Center for Earthworks Engineering Research
   David White, Iowa State University, Center for Earthworks Engineering Research

4. **Post-Grouting, Load Testing, and Long-Term Performance of Drilled Shafts on Broadway Viaduct Project**
   Jeramy Ashlock, Iowa State University
   Brent Phares, Bridge Engineering Center, ISU Institute for Transportation
   Ahmad Abu-Hawash, Office of Bridges and Structures, Iowa Department of Transportation

Session 3F
Local Road Considerations

1. **The Economics of Closing Bridges on Very Low Volume Rural Roads in Kansas**
   Eric Fitzsimmons, University of Kansas
   Thomas Mulinazzi, University of Kansas

2. **Evaluation of Mitigation for Safety Concerns on Low Volume, Unpaved Rural Roads in Iowa**
   Thomas McDonald, Iowa LTAP

3. **Efforts to Reduce Crashes on County Roads in Iowa**
   Jan Laaser-Webb, Iowa Department of Transportation
   Steven Schroder, Iowa Department of Transportation
   Terry Ostendorf, Iowa Department of Transportation

4. **Local Roads - MATC Project**
   Keith Knapp, Institute for Transportation

Posters Thursday, August 15th 5:00 p.m. — 6:00 p.m.

Iowa Department of Transportation Centennial: 100 Years of Contributions Transportation Research and Engineering
Leighton Christiansen, InTrans, Iowa DOT

Distracted Biking: A Review of the Current State of Knowledge
Judith Mwakalonge, South Carolina State University
Saidi Siuhi, Abu Dhabi University
Jamario White, South Carolina State University

Truck Parameters and Occurrences of Ambient Traffic in Iowa
Yaohua Deng, Bridge Engineering Center, Institute for Transportation, ISU
Brent Phares, Bridge Engineering Center, Institute for Transportation, ISU
Ping Lu, Iowa Department of Transportation
Lowell Geimann, Bridge Engineering Center, Institute for Transportation, ISU

Laboratory Investigation of ABC Connection Details Using Grouted Couplers
Travis Hosteng, Bridge Engineering Center, ISU
Ahmad Abu-Hawash, Offices of Bridges and Structures, Iowa DOT
Brent Phares, Bridge Engineering Center, ISU
Dean Bierwagen, Office of Bridges and Structures, Iowa DOT

Investigation of Alternative Methods for Concrete Bridge Deck Removal
Brent Phares, Bridge Engineering Center, ISU
Gary Novey, Iowa Department of Transportation
Justin Dahlberg, Bridge Engineering Center, ISU
Hongtao Dang, Bridge Engineering Center, ISU
Ahmad Abu-Hawash, Iowa Department of Transportation

Effect of Biopolymers on Cementation Process
Kejin Wang, CCEE Department, Iowa State University
Jianing Cao, CCEE Department, Iowa State University
Volodymyr Ivanov, CCEE Department, Iowa State University

Iowa Asphalt Concrete Overlay Design Procedure Revisited
Halil Ceylan, Iowa State University
Kasthurirangan Gopalakrishnan, Iowa State University
Sunghwan Kim, Iowa State University
Shuo Yang, Iowa State University

A Path to Enterprise Asset Management - Pulling Data from the Source
Shawn Blaesing Thompson, Iowa Department of Transportation

Estimating Model for Design Cost for State Highway Projects
Kate Hunter, Iowa State University

Well-Bonded Superpave Overlays on HMA
Daniel Mealiff, Kansas State University
Greg Schieber, KDOT
Mustaque Hossain, Kansas State University

University Students' Mode Choice and Its Determinants in College Towns: A Case Study of Iowa State University
Jiangping Zhou, Iowa State University

Train Scheduling and Operating Capacity on a Single Track Shared Passenger and Freight Corridor with Demand Considerations
Ahmadreza Talebian, University of Illinois at Chicago
Bo Zou, University of Illinois at Chicago

Effect of Compaction Temperature on Asphalt Mixture Internal Aggregate Structure and Relation to Performance
Hussain U. Bahia, University of Wisconsin-Madison
Nima Roohi, University of Wisconsin-Madison
Andrew Hanz, University of Wisconsin-Madison

Twin Ports Water Taxi Feasibility Study
Andrew Bettilyon, University of Wisconsin-Superior
Hikaru Shimazaki, University of Wisconsin-Superior
Ryan Hill, University of Wisconsin-Superior
Bryce Harp, University of Wisconsin-Superior
Peter Suska, University of Wisconsin-Superior
Charles Skarman, University of Wisconsin-Superior
Jeredt Runions, University of Wisconsin-Superior
Derek Krivinchuk, University of Wisconsin-Superior

Impact of Increasing Freight Loads on Rail Infrastructure from Fraccing Sand Transport
Damien Hesse, University of Wisconsin-Madison
Tuncer Edil, University of Wisconsin-Madison
James Tinjum, University of Wisconsin-Madison

Development of Testing Tools for Warning System and Inspection for Maintenance of Freight Railways
James Tinjum, University of Wisconsin-Madison
Dante Fratta, University of Wisconsin-Madison
Abdullah Alsabhan, University of Wisconsin-Madison

Concurrent Sessions — Friday, August 16th — 10:00 a.m. — 12:00 p.m.

Session 4A
MAP-21

1. **MAP-21: A Performance Management Perspective (National Performance Measures)**
   Francine Shaw-Whitson, FHWA Office of Transportation Performance Management

2. **MAP-21: An Asset Management Perspective (Asset Management Plans)**
   Butch Wlachin, FHWA Office of Asset Management

3. **MAP-21: A State DOT Perspective (Implementation)**
   John Selmer, Iowa DOT Performance & Technology Division

Session 4B
Evaluation of Low-Cost Treatments on Rural Two-Lane Curves

1. **Evaluation of Low-Cost Treatments on Rural Two-Lane Curves**
   Neal Hawkins, Iowa State University
   Omar Smadi, Iowa State University
   Shauna Hallmark, Iowa State University

2. **Evaluating Robustness of Signal Timings for Conditions of Varying Traffic Flows**
   Cameron Kergaye, Utah DOT

3. **Updates on Go Team Findings**
   Dan McGehee, University of Iowa

Session 4C
Pavements and Materials

1. **Ultrasonic In-situ Monitoring of Stiffening Process of Concrete for Predicting Saw-Cutting Windows of Concrete Pavements**
   Peter Taylor, National Concrete Pavement Technology Center
   Kejin Wang, Iowa State University
   Xuhao Wang, Iowa State University

2. **Evaluation of Cracking Resistance of Superpave Mixtures Using Texas Overlay Test**
   Mustaque Hossain, Kansas State University
   Syeda Rubaiyat Aziz, Kansas State University
   Greg Schieber, Kansas DOT

3. **Effect of Matric Suction on Resilient Modulus of Compacted Recycled Pavement Material**
   Kongrat Nokkaew, University of Wisconsin-Madison
   Tuncer Edil, University of Wisconsin-Madison
   James Tinjum, University of Wisconsin-Madison

4. **Tack Coat Optimization and Implementation Recommendations in Illinois**
   Megan Swanson, Illinois DOT

Session 4D
Freight

1. **The Impacts of Extended Interstate Closures to Regional Freight Logistics: A Case Study of the 2011 Interstate 29 Closure**
   Dr. Jiangping Zhou, Iowa State University
   Tracy Troutner, Federal Highway Administration
   Dr. Bobby Martens, Iowa State University
   Dr. Konstantina Gkritza, Iowa State University

2. **Moving Ahead with Freight: Integrating State and Regional Freight Development in a National Freight Planning Context**
   Ben Zietlow, CFIRE at Uniiversity or Wisconsin - Madison
   Alex Marach, CFIRE at Uniiversity or Wisconsin - Madison
   Teresa Adams, University or Wisconsin - Madison
   Ernie Perry, CFIRE at Uniiversity or Wisconsin - Madison

3. **Environmental Aspect of Trucks Policy Analysis in Chicago Region**
   Seyed Mehdi Mahmoudifard, Department of Civil and Materials Engineering
   Abolfazl Mohammadian, Department of Civil and Materials Engineering

4. **Effects of Panama Canal Expansion on Total Truck VMT in the U.S.A**
   Seyed Mehdi Mahmoudifard, Department of Civil and Materials Engineering
   Abolfazl Mohammadian, Department of Civil and Materials Engineering
   Sanghyeon Ko, Department of Civil and Materials Engineering

Session 4E
Geotechnical

1. **Impacts of 2011 Missouri River Flooding on Secondary Roads in Western Iowa**
   Pavana Vennapusa, Center for Earthworks Engineering Research
   David White, Center for Earthworks Engineering Research

2. **Evaluation of Aggregate Base Compaction for Density and Modulus Based Specification**
   Hani Titi, UW-Milwaukee
   Emil Bautista, UW-Milwaukee
   Andrew Druckrey, UT-Knoxville
   Habib Tabatabai, UW-Milwaukee
   Ahmed Faheem, UW-Platteville
   Erol Tutumuler, UIUC

3. **Investigation of Bearing Capacity of Geotextile-Reinforced Paved Roads**
   Brett Odgers, TenCate Geosynthetits North America
   Milad Saghebfar, Kansas State University Department of Civil Engineering
   Bruce Lacina, TenCate Geosynthetits North America
   Mustaque Hossain, Kansas State University Department of Civil Engineering

4. **Geotechnical Properties of Recycled Materials for Use as Highway Embankment Fill**
   Angela Pakes Ahlman, Wisconsin Highway Research Program
   Tuncer Edil, Wisconsin Highway Research Program
   Ali Soleimanbeigi, University of Wisconsin-Madison

Session 4F
Road Maintenance/ Weather

1. **Heated Transportation Infrastructure: Prevention of Ice Formation on Paved Surfaces**
   Halil Ceylan, Iowa State University
   Kasthurirangan Gopalakrishnan, Iowa State University
   William Cord, Iowa State University
   Sunghwan Kim, Iowa State University

2. **Prioritization Techniques to Rank Sites for Winter Safety Improvements in Iowa**
   Inya Nlenanya, Institute for Transportation
   Kontantina Gkritza, Iowa State UNiversity
   Mohammad Shaheed, Iowa State University
   Zach Hans, Institute for Transportation
   Neal Hawkins, Center for Transportation Research and Education

A Comparison of Pavement Foundation Stabilization Technologies

Peter J. Becker[1] and David J. White[2]

Abstract

The strength and stiffness of pavement foundations including subgrades are critical components of pavement performance. Pavement foundations that are weak, compressible, and susceptible to environmental stresses (e.g., freezing and thawing) drastically reduce pavement performance and shorten pavement lifespans. Stabilization optimizes pavement performance by increasing pavement foundation strength, stiffness, and durability. This paper compares the constructability, cost, and performance of 16 stabilization technologies that were installed at the Boone County test site in 24 experimental sections over 4.8 miles of roadway with primarily CL or A-6(5) subgrade. These stabilization technologies were installed: geosynthetics (biaxial and triaxial geogrids, woven and non-woven geofabrics, 4 in. and 6 in. high geocells, and polypropylene and monofilament polypropylene fibers), mechanical stabilization, chemical stabilization (cement treated subgrade, cement treated subbase, and fly ash treated subgrade), and high energy impact compaction. In situ results from light weight deflectometer (LWD), falling weight deflectometer (FWD), and dynamic cone penetrometer (DCP) tests and intelligent compaction; laboratory test results from unconfined compressive strength tests, freeze-thaw tests, and soil index property tests; and cost data are presented. Figure 1 shows preliminary results comparing average subbase elastic modulus measurements from (a) FWD tests and (b) LWD tests on each segment.

---

[1] Iowa State University, Center for Earthworks Engineering Research (CEER), 418 Town Engineering Building, Ames, Iowa 50011; Phone (515) 450-7966; email: pbecker@iastate.edu

[2] Iowa State University, Center for Earthworks Engineering Research (CEER), 422 Town Engineering Building, Ames, Iowa 50011; Phone (515) 294-1463; email: djwhite@iastate.edu

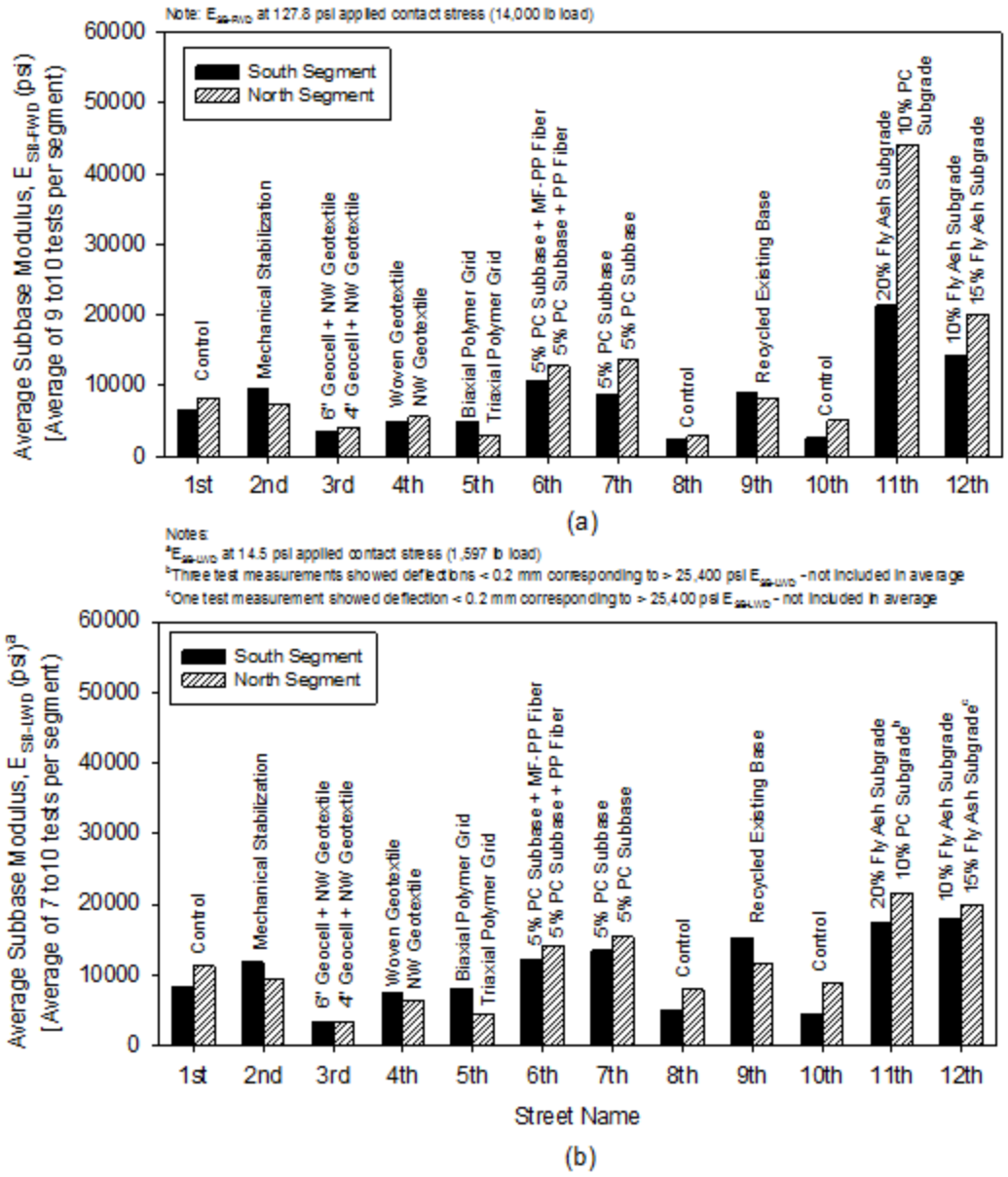

Figure 1. Average subbase elastic modulus measurements from (a) FWD tests and (b) LWD tests on each segment.

These research results will be of interest to pavement designers who select design parameters for stabilizing pavement foundation layers and to those who design and maintain low volume roads.

Keywords: Intelligent compaction—soil stiffness—stabilization

A generalized integrated corridor diversion control model for freeway incident management

Yue Liu, Jie Yu, Peng Li, Kevin Wehner

Abstract

This paper presents a generalized diversion control model for freeway incident management that is capable of concurrently optimizing the detour rates and arterial signal timings over multiple roadway corridor segments between the freeway and its neighboring arterial. To capture various operational complexities due to the interactions between multiple diversions, this study has developed an extended corridor traffic flow model and integrated it in the overall optimization process. A bi-objective control model is developed to maximize the utilization of available corridor capacity while not significantly increase the total time spent by travelers on the detour route to ensure their compliance to the routing guidance. Genetic algorithm integrated with the rolling time horizon approach is employed to solve the proposed model. Case studies with a stretch of the I-94 corridor westbound from downtown Milwaukee to Waukesha have demonstrated the potential of the developed model for use in non-recurrent congestion management.

Keywords: Freeway operation—traffic flow models—integrated control—diversion—incident management

A Path to Enterprise Asset Management - Pulling Data from the Source

Many public transportation agencies around the country are struggling with the idea of asset management and asking questions. What is the best way to locate our assets, gather information about our assets and maintain that information over time for use in the decision making process? Iowa DOT is working on the development of an enterpise asset management system. The plan is to leverage existing systems such as pavement management, bridge, sign and roadway network information. There is a big gap between when tranportation features such as culverts, guardrail, lighting, etc are placed during construction and when the field, analysts and management can start using that information to make decsions and maintain the network. IDOT is undergoing a process to test the idea of storing As-Let and As-Built data in CAD/Databases for extraction into existing or new spatial asset databases to be part of the larger asset management system. Undergoing changes in our workflow process for how we manage this information has the potential for us to make better decisions faster using technology invations as part of the process.

A Statistical Analysis of the Role of Benefit-Cost Analysis in Awarding TIGER Grants

Anthony C. Homan [1], Teresa M. Adams [2], and Alex J. Marach [3]

Abstract

As directed by the American Recovery and Reinvestment Act of 2009, the US Department of Transportation (DOT) created the Transportation Investment Generating Economic Recovery (TIGER) discretionary grant program for surface transportation infrastructure projects. TIGER used a multi-step competitive application process to award surface transportation funds. TIGER applications were initially screened by US DOT's staff of technical and economic experts and the final awardees were selected by a Review Team of Modal Administrators and DOT Office of the Secretary level officials. The purpose of the research was to determine if the most deserving projects, based on an applicant's benefit-cost analysis and the likelihood that benefits exceeded costs, were more likely to receive grant funding. We base the findings on pair-wise comparisons and on logistic regression models. Based on these analyses, we found that the outcome of the benefit-cost analysis (both quality and expected net benefits) was not a statistically significant factor.

Keywords: American Recovery and Reinvestment Act (ARRA), Benefit Cost Analysis, TIGER Grants, Logit Model, Transportation Investments

[1] US Department of Transportation - Office of the Secretary; 1200 New Jersey Ave., SE Washington, DC 20590; Phone: (202)-366-5406; email: Anthony.homan@dot.gov

[2] University of Wisconsin-Madison; 1415 Engineering Drive, #2205 Madison, WI 53706; Phone: (608)-263-3175; Fax (608) 263-2126; email: adams@engr.wisc.edu

[3] Center for Freight and Infrastructure Research and Education; 1415 Engineering Drive, #2205 Madison, WI 53706; Phone (608) 262-6543; email: amarach@wisc.edu

An Analytical Hierarchy Process (AHP) Approach to Quantifying Perceptions of Livability

M.V. Hart[1], T.M. Adams[2], and M. Doherty[3]

Livability, from a stakeholder's perspective, is both subjective and multifaceted making it difficult to define –and hence measure. Livability is also contextual, differing from city to city, and neighborhood to neighborhood, and urban, suburbanized or rural settings. Framing livability from a values perspective is an approach that allows for a customization of livability strategies for a given community. This presentation reviews a methodology used to capture a communities' values and the rankings of those values.

The methodology used is the Analytic Hierarchy Process (AHP), a problem-solving technique for organizing and analyzing complex, multi-criteria and multi-stakeholder decisions based on quantifiable and unquantifiable variables. By using relative rankings among pairs of livability criteria, this approach forces decisions among criteria and produces a representation of stakeholders' judgments and values. Prioritized and weighted livability values are the metrics for evaluating effective public and private policy strategies. This decision-making technique has been applied to many fields.

This technique will be applied to a case study in Memphis, TN in neighborhoods bordering areas of high freight activity, areas that may have different notions of livability than those found in literature.

This topic would be of interest to planners looking at alternate ways to integrate complex results of a perceptions study into the mix of transportation infrastructure improvements for a given corridor.

Keywords: Livability—Analytical Hierarchy Process—stakeholder—perceptions—planning

---

[1] National Center for Freight & Infrastructure Research & Education, Department of Civil and Environmental Engineering, University of Wisconsin-Madison, 1415 Engineering Drive, Room 2205, Madison, WI, 53706, PH. (608) 262-6639; FAX (608) 263-2512; email: mhart@engr.wisc.edu
[2] National Center for Freight & Infrastructure Research & Education, Department of Civil and Environmental Engineering, University of Wisconsin-Madison, 1415 Engineering Drive Room 2205, Madison, WI, 53706, PH (608) 263-3175; FAX (608) 263-2512; email: adams@engr.wisc.edu
[3] National Center for Freight & Infrastructure Research & Education, Department of Civil and Environmental Engineering, University of Wisconsin-Madison, 1415 Engineering Drive Room 2205 Madison, WI, 53706, PH (773) 315-9503; FAX (608) 263-2512 email: doherty3@wisc.edu

An investigation on Guidance of the Trip Generation Model Transferability between MPO's in the US.

Chandani Malla[1], Judith Mwakalonge[2], and Saidi Siuhi[3]

ABSTRACT:

Trip generation is one of the four steps in Urban Travel Modeling System, which determines the travel pattern in the study area. Metropolitan Planning Organizations (MPO) collects travel survey data for use to predict the travel demands within the respective areas. These surveys are very expensive and for many small and medium-sized MPO's the cost of survey exceed their annual budget Therefore, sometimes it is cost effective to transfer the trip generation model developed from one MPO to another. Historically having similar population was the key factor for transferring trip generation models from one to another. In reality, similar the various socioeconomic, land use and demographic factors are, the more likable is the transferability between those MPOs. This research will quantify the similarity in different socio economic, land use and demographic parameters between two MPO's and the likelihood of the model transferability between them. This quantification will provide guidance to MPO's on model transferability.

[1] Graduate Student, Civil and Mechanical Engineering Technology and Nuclear Engineering, South Carolina State University, 300 College Street, Orangeburg, South Carolina 29117; E-mail: cmalla@scsu.edu

[2] Assistant Professor, Civil and Mechanical Engineering Technology and Nuclear Engineering, South Carolina State University, 300 College Street, Orangeburg, South Carolina 29117; Phone (803) 536 8321; Email: jmwakalo@scsu.edu

[3] Assistant Professor, Civil Engineering, Abu Dhabi University, P. O. Box 59911, Abu Dhabi, United Arab Emirates; Phone (971) 2 501 5555; Email: siuhis@gmail.com

Application of Ground Penetrating Radar for Civil Infrastructure Assessment

Authors: David Eisenmann, (CNDE), Frank Margetan, (CNDE), Ahmad Abu-Hawash (DOT)

Speaker: David Eisenmann

In this talk we will discuss the application of ground penetrating radar (GPR) to two problems: (1) detecting corrosion-induced thinning of rebar in concrete bridge structures, and (2) detection of substructures and defects in earthen dams and levees. Our overall approach is to begin with methods and analysis tools developed in the past for ultrasonic inspections, and to adapt those to GPR inspections.

For rebar defect detection we consider a simple pulse/echo amplitude-based inspection, positing that the backscattered response from a thinned rebar will be smaller than the similar response from a fully-intact rebar, other factors being equal. That assumption appeared to work well both for measurements on laboratory specimens and in a subsequent field trial at a local highway bridge.

For defect detection in earthen structures, we consider a similar pulse/echo amplitude based system. There, however we must contend with soil variability, including the moisture-dependent properties of signal attenuation (controlling penetration depth) and dielectric constant (controlling wave speed). For assessing and improving levee and dam inspections we are making use of a novel "test levee" which has been constructed on the ISU campus.

We will also discuss early efforts to model the GPR instrument and the inspection process. This includes efforts to map the antenna radiation pattern, to predict how backscattered responses will vary with defect size and location, and to assess detectability improvements via synthetic aperture focusing techniques (SAFT).

Assessment of Weathering Steel Bridge Performance in Iowa and Development of Inspection and maintenance Techniques

Douglas D. Crampton[1], Kurt P. Hollway[2], John Fraczek[3], and Michael J. Todsen[4]

Weathering steel is commonly used as a cost-effective alternative for bridge superstructures, as the costs and environmental impacts associated with the maintenance/replacement of paint coatings are theoretically eliminated. The performance of weathering steel depends on the proper formation of a surface patina, which consists of a dense layer of corrosion product used to protect the steel from further atmospheric corrosion. The development of the weathering steel patina may be hindered by environmental factors such as humid environments, wetting/drying cycles, sheltering, exposure to de-icing chlorides, and design details that permit water to pond on steel surfaces.

Weathering steel bridges constructed over or adjacent to other roadways could be subjected to sufficient salt spray that would impede the development of an adequate patina. Addressing areas of corrosion on a weathering steel bridge superstructure where a protective patina has not formed is often costly and negates the anticipated cost savings for this type of steel superstructure. Early detection of weathering steel corrosion is important to extending the service life of the bridge structure; however, written inspection procedures are not available for inspectors to evaluate the performance or quality of the patina. This project focused on the evaluation of weathering steel bridge structures, including possible methods to assess the quality of the weathering steel patina and to properly maintain the quality of the patina. The objectives of this project are summarized as follows:

- Identify weathering steel bridge structures that would be most vulnerable to chloride contamination, based on location, exposure, environment, and other factors. These bridges are more likely to exhibit unsatisfactory performance of the weathering steel patina.
- Identify locations on an individual weathering steel bridge structure that would be most susceptible to chloride contamination, such as below joints, splash/spray zones, and areas of ponding water or debris.
- Identify possible testing methods and/or inspection techniques for inspectors to evaluate the quality of the weathering steel patina at locations discussed above.
- Identify possible methods to measure and evaluate the level of chloride contamination at the locations discussed above.
- Evaluate the effectiveness of water washing on removing chlorides from the weathering steel patina.
- Develop a general prioritization for the washing of bridge structures based on the structure's location, environment, inspection observations, patina evaluation findings, and chloride test results.

[1]Project Manager, Wiss, Janney, Elstner Assoc., Inc., 330 Pfingsten Road, Northbrook, IL, 60062, Tel: 847-272-7400, dcrampton@wje.com
[2]Project Associate, Wiss, Janney, Elstner Assoc., Inc., 330 Pfingsten Road, Northbrook, IL, 60062, Tel: 847-272-7400, kholloway@wje.com
[3]Project Advisor, Wiss, Janney, Elstner Assoc., Inc., 330 Pfingsten Road, Northbrook, IL, 60062, Tel: 847-272-7400, jfraczek@wje.com
[4]Special Projects Engineer, Iowa DOT, 800 Lincoln Way, Ames, IA 50010, michael.todsen@dot.iowa.gov

KEYWORDS – Weathering Steel, Bridge Inspection

2013 Mid-Continent Transportation Research Symposium, Ames, Iowa, August 2013

Characterization of Variability in Highway Pavement Materials and Construction

Litao Liu[1]

ABSTRACT

Pavement materials and construction (M&C) are inherently variable. Unavoidable inhomogeneous materials, inconsistent construction methods and equipment, and changing weather conditions during construction, among other factors, result in M&C variability. Motivated by the need to provide realistic inputs to pavement quality assurance programs, design procedures, and reliability analysis, this paper presents the results of an investigation of variability in key acceptance quality characteristics (AQCs) for both HMA and PCC pavements using empirical data (field and laboratory test results from recently-completed construction projects) . Variability is measured at three levels: within-lot, within-project, and within-state. The variability values found in this study are compared to the variability values reported about 14 years ago. It is encouraging to state that major progress has been made over the past 14 years in reducing variability in pavement materials and construction..

Key words: Variability, PWL, Standard Deviation, COV, Specifications.

[1] Texas A&M University, 3136 TAMU, College Station, TX 77843; Phone (979) 676-3819; email: liulitao11@tamu.edu

Coefficient of Thermal Expansion of Concrete: Some Rational Modifications to Improve the Reliability of Current Testing Practices

Sarwar Siddiqui[1] and David W. Fowler[2]

The University of Texas at Austin

[1]PhD Candidate
The University of Texas at Austin
Construction Materials Research Group
10100 Burnet Rd, Bldg 18B
Austin, TX 78758
Phone: (785) 320-0743
Email: mssiddiqui@utexas.edu

[2]David W. Fowler
Professor
The University of Texas at Austin
Civil, Architectural and Environmental Engineering Department
International Center for Aggregates Resources
301 E. Dean Keeton St. Stop C1747
Austin, TX 78712-1068
Phone: (512) 232-2575
Email: dwf@mail.utexas.edu

Abstract

The coefficient of thermal expansion of concrete (COTE) is an important concrete property. This property has been recognized as one of the influencing factors that is responsible for environmental distresses in portland cement concrete pavements (PCCPs). Though important, this property has not been considered as an input parameter for PCCPs until recently. The Mechanistic-Empirical Pavement Design Guide (MEPDG) introduced COTE as a design parameter for PCCP. Designe thicknesses of the PCCPs are significantly affected by the COET of concrete. As a result, smaller deviations of concrete COTE from the actual value can result in unnecessarily thick pavement or inadequate thickness. Unnecessarily thick pavement increase the project cost, and inadequate thickness reduces the service life. Therefore, obtaining the reliable COTE of concrete is very important. Aggregate occupies the most volume of concrete

and understandably has the most influence on concrete COTE. Various environmental distresses have been observed in continuously reinforced concrete pavement (CRCP) of Texas when certain types of aggregate were used. It was also confirmed by recent research studies that thermal incompatibility between aggregate and cement paste is one of the major factors of these distresses. Very recently the Texas Department of Transportation (TxDOT) has limited the COTE value of concrete for CRCP projects as a qualifying criterion for aggregate. A reliable method to determine the COTE of concrete is key to impose this limit.

The American Association of State Highway and Transportation Officials (AASHTO) and TxDOT have developed the two most widely used methods for measuring COTE of concrete. However, both of these methods are often criticized for the variability of the results. None of these methods considers the effect of pore and gel water pressure on the length change of concrete sample. Both of these methods use Linear Variable Differential Transformers (LVDT) as the length change measuring device. But, recently TxDOT has begun to use the Differential Variable Reluctance Transducer (DVRT) after observing inconsistent COTE results for the same concrete when the length of the cylinders was changed. The calculation method is also different for these two methods. This study will focus on the difference of these two methods and will also evaluate the effects of these differences on the COTE values. There is no significant effect of length change measuring devices on COTE. However, TxDOT calculation techniques generally result in higher COTE values compared to AASHTO calculation techniques. Preconditioning the COTE sample in several cycles of heating and cooling also significantly improves the repeatability of COTE values. Finally, this study will explain the effect of pore and gel water pressure on the obtained COTE results and propose a rational way to significantly reduce the effect of pore and gel water pressure on the COTE values.

Key words: Concrete, Pavement, CRCP, Thermal distress, Coefficient of thermal expansion.

Comparing Adaptive Traffic Control to Optimized Timing Plans:

Simulations of Typical and Extraordinary Traffic Conditions

Aleksander Stevanovic, PhD, P.E [1]

Abstract

One of the common questions when evaluating an adaptive traffic control system (ATCS) is how well it compares to recently implemented time of day (TOD) plans. This session presents one such comparison supported by a recent microsimulation study of InSync adaptive control and several optimized TOD plans by Aleksandar Stevanovic, PhD, P.E., an expert in traffic signal control systems and simulation. The study evaluates the traffic signal regimes on the intersection, corridor and network-wide levels—as well as main-street versus side-street performance—for a number of traffic efficiency MOES, including percentages in travel time, intersection delay and stop reduction as well as environmental and safety performance. The study replicates field traffic conditions with a 12-intersection VISSIM model based on multiple sets of field traffic data. Two sets of TOD plans are calibrated to produce optimal traffic flow on the study corridor—a Single Section (SS) approach with all intersections operating under the same cycle length and a Multiple Sections (MS) approach with different cycle lengths. The TOD plan currently operating in the field is also simulated. To test the ATCS's adaptability, it is critical to evaluate its performance in variable traffic. Data presented includes comparison of the traffic signal regimes in the following situations: a nearby freeway incident, inclement weather, frequent preemption and a sudden surge of traffic. The results of experiments performed in this study show InSync is a versatile, adaptable system that outperformed TOD plans on the studied corridor for both regular and irregular traffic conditions.

Keywords: Adaptive Traffic Control —VISSIM Simulation—Signal Regime Comparison----Irregular Traffic Conditions----Adaptive Performance

---

[1] Florida Atlantic University, FAU Civil, Environmental and Geomatics Engineering 7777 Glades Road – EG 36/Rm 225, Boca Raton, FL, 33431; Phone (561) 297. 3743; Fax (561) 297 - 0493; email: astevano@fau.edu

Development of Testing Tools for Warning System and Inspection for Maintenance of Freight Railways

A. Alsabhan[1], D. Fratta[2], J. Tinjum[3], T. B. Edil[4]

Abstract

One issue that compromises rail track safety is ballast fouling. Fouling compromises the structural integrity of the railway track and it may lead to track deformation and ultimately train derailment. This problem is quite costly for the railway industry thus, preventing train derailment while optimizing maintenance is very important for reducing the overall cost of freight and passenger transportation. This study presents a proposed methodology for that extends the use of fiber optic sensors (FOS) to measure track deformation along with electromagnetic waves techniques to detect ballast fouling. The methodology aims at creating an early warning system that would allow railway engineers to develop a symptomatic approach to ballast maintenance procedures. This study shows that one suitable FOS technique in railway applications is Fiber Bragg Grating (FBG) sensors because of its high range (100 km) and high resolution (1με) of the quasi-distributed sensor array. The technique is being validated with a large scale experimental setup. A numerical model was used to guide the design of the container used to hold the track, ties and ballast. The numerical model shows a symmetric distribution of stresses along the length of the tie and the amount of vertical deformation increases as the thickness of fouled material increases mainly as function of the ballast stiffness and that the stiffness of the ties does not govern the mechanical response of the substructure. Finally, the numerical model shows that the minimum number of ties to needed to simulate the field conditions is five ties.

Keywords: railway, freight, ballast, fouling, fiber optics, ground penetrating radar

[1] Civil and Environmental Engineering, University of Wisconsin-Madison, 1415 Engineering Drive, Madison, WI 53706; email: alsabhan@wisc.edu

[2] Geological Engineering, University of Wisconsin-Madison, 1415 Engineering Drive, Madison, WI 53706; email: fratta@wisc.edu

[3] Engineering Professional Development, University of Wisconsin-Madison, 1415 Engineering Drive, Madison, WI 53706; email: tinjum@epd.engr.wisc.edu

[4] Civil and Environmental Engineering, University of Wisconsin-Madison, 1415 Engineering Drive, Madison, WI 53706; email: tbedil@wisc.edu

Distracted Biking: A Review of the Current State of Knowledge

Jamario White[1], Judith Mwakalonge[2], and Saidi Siuhi[3]

ABSTRACT

Cyclists, much like drivers, have always been engaged in multi-task like using hand-held devices, listening to music, snacking, or reading while biking. The effects are similar to those experienced in distraction behind the wheel of a moving vehicle. However, distracted biking has not received similar interventions and policies to reduce safety related issues. The market penetration of electronic devices among non-motorists and motorists is on the rise and so is safety issues related to distracted biking. In the United States, already in some large cities such as Philadelphia, legislation has crossed over to include a texting ban while operating a vehicle or a bicycle. Few awareness programs intended to curb distracted biking have been implemented by some agencies. Though the problem is eminent, no study was found to have examined the extent of the problem, which is critical in data collection for research, and quantification of distracted biking. Recognizing the data and research needs on distracted biking, this study present a review of the state of knowledge on policies, programs, data source for current studies if any, and identifies data collection opportunities and research needs.

[1] Graduate Student, Civil and Mechanical Engineering Technology and Nuclear Engineering, South Carolina State University, 300 College Street, Orangeburg, South Carolina 29117; E-mail: mariojadajanaye@yahoo.com

[2] Assistant Professor, Civil and Mechanical Engineering Technology and Nuclear Engineering, South Carolina State University, 300 College Street, Orangeburg, South Carolina 29117; Phone (803) 536 8321; Email: jmwakalo@scsu.edu

[3] Assistant Professor, Civil Engineering, Abu Dhabi University, P. O. Box 59911, Abu Dhabi, United Arab Emirates; Phone (971) 2 501 5555; Email: siuhis@gmail.com

Effect of Biopolymers on Cementation Process

Jianing Cao[1], Kejin Wang[2], Ivanov Volodymyr [3]

Abstract

Sewage sludge, sludge ashes or dewatered dry sewage sludge of municipal wastewater treatment plants are widely used in the cement and concrete industry - as a fuel or a raw material for cement production or a replacement for cement in concrete. In addition to having a cementing property, the sludge also contains various biopolymers, such as line and branched chains of polysaccharides, globular proteins, and chains of DNA. The objective of this research is to study the effects of these biopolymers on cement hydration and strength development.

In the present study, four different biopolymer powders, xanthan gum, albumin, DNA and amylopectin, are investigated. Cubic paste samples (2"x2"x2") were made with Type I/II cement and each type of the biopolymers, at an addition level of 0.1% of cement weight. All pastes had a water-to-cement ratio of 0.40. Two different mixing and curing methods were employed. After cured for 3, 7, 14 and 28 days, the samples were tested for strength according to ASTM C109/109M.

The test results indicate that all paste samples with 0.1% addition of biopolymer had higher strength than the samples without biopolymer at the age of 3 days, regardless different mixing methods or curing conditions. However, after 7 days, the strength of paste samples without biopolymers was higher than that of samples with biopolymers. It seems that the biopolymers might form a biofilm network in the cement pastes, which improved strength at the very early age; however, it hindered cement hydration or reduced the paste strength development at the later age. Further research is needed to find out the interaction of the biopolymers with cement.

Keywords: Biopolymer-cement

[1] Graduate Research Assistant, Civil, Construction and Environmental Engineering, Iowa State University, Ames, IA 50010, Phone: 515-509-8593, E-mail: billcao@iastate.edu

[2]Professor, Civil, Construction and Environmental Engineering, Iowa State University, Ames, IA 50010, Phone: 515-450-354, E-mail: kejinw@iastate.edu

3 Visiting Professor, Civil, Construction and Environmental Engineering, Iowa State University, Ames, IA 50010, Phone: 515-294-2140, E-mail: vivanov@iastate.edu

Effect of Compaction Temperature on Asphalt Mixture Internal Aggregate Structure and Relation to Performance

Nima Roohi[1], Andrew Hanz[2], and Hussain U. Bahia[3]

Abstract

The introduction of modified binders, recycled materials, WMA, and other technologies has resulted in a substantial increase in the complexity of hot mix asphalt placed in the field relative to conventional products due to interactions between the modifiers and other mix components and extension in the range of production temperatures used in the field. As a result, use of conventional viscosity based methods to select mixing and compaction temperatures and evaluation of mix designs based solely on volumetrics is insufficient. The objectives of this research were to first introduce the use of planar imaging to quantify aggregate structure then to apply image analysis to investigate how aggregate structure is influenced by mix design components (i.e. virgin binders, gradation, recycled materials, and fillers) and conditions (i.e. compaction temperature).

Previous research indicates that the aggregate structure developed during compaction is sensitive to compaction temperature and that aggregate structure is strongly related to and mixture performance at high and low temperatures. This project aims to build on previous findings in by creating the aggregate structure vs. compaction temperature profile for mixes designated by WisDOT three levels of traffic (1 million, 3 million, and 10 million ESALs) to confirm that the current mixture design specifications in place result in significantly different aggregate structure and to identify the range in compaction temperatures associated with optimum aggregate structure. This work has potential to impact Table 460.2 in WisDOT standard specifications by reducing the number of mix categories specified or changing mixture volumetric targets.

Keywords: Driver safety—Asphalt Mixture Design – Performance – Image Analysis – Aggregate Structure

[1] University of Wisconsin Madison, 1415 Engineering Dr., Rm. 3352, Madison, WI 53706; Phone (608) 890-3321; email: roohisefidma@wisc.edu

[2] University of Wisconsin Madison, 1415 Engineering Dr., Rm. 3356, Madison, WI 53706; email: ajhanz@wisc.edu

[3] University of Wisconsin Madison, 1415 Engineering Dr., Rm. 3350, Madison, WI 53706; email: bahia@engr.wisc.edu

Effect of Matric Suction on Resilient Modulus of Compacted Recycled Pavement Material

Kongrat Nokkaew[1], James M. Tinjum, PhD, PE, M. ASCE[2], and Tuncer B. Edil, PhD, PE, DGE, F. ASCE[3]

Abstract

Recycled pavement material (RPM) is commonly used as an unbound base course in highway reconstruction or rehabilitation due to its economic and environmental benefits. In the field pavement substructure is generally placed above the ground water table, and is thus unsaturated most of the time. Therefore, the response of base course under traffic loading needs to be characterized based on unsaturated soil mechanics approach with soil suction concept. This paper describes the impact of matric suction on resilient modulus for recycled asphalt base course with a cyclic triaxial testing cell fitted with a suction-control system. A series of cyclic loading was performed to each compacted RPM according to the new mechanistic-empirical pavement design protocol (NCHRP 1-37A Procedure Ia) to determine resilient modulus. The matric suctions of specimens were generated and controlled during testing by air aspirator. The information of resilient modulus and permanent deformation of RPM with varying initial matric suction were investigated, and compared to those of a dense-graded aggregate which is a base course commonly used in Wisconsin. The resilient modulus-matric suction-water content relationships of compacted RPM and conventional aggregate were developed in terms of the empirical equation proposed by the mechanical-empirical pavement guide (M-EPDG).

Keywords: recycled pavement material — resilient modulus — matric suction — M-EPDG — pavement

[1] Ph. D. Dissertator, Department of Civil and Environmental Engineering, University of Wisconsin-Madison, Madison, WI 53706; Phone (608) 262-3542; Fax (608) 262-5199, email; nokkaew@wisc.edu

[2] Assistant Professor, Department of Engineering Professional Development, University of Wisconsin-Madison, Madison, WI 53706; Phone (608) 262-3452; Fax (608) 262-5199; email:jmtinjum@wisc.edu

[3] Professor, Geological Engineering Program, University of Wisconsin-Madison, Madison, WI 53706; Phone (608) 262-3452; Fax (608) 262-5199; email: tbedil@wisc.edu

Effects of Panama Canal Expansion on total truck VMT in the U.S.A

Seyed Mehdi Mahmoudifard *(Corresponding Author)*
Ph.D. Student
Department of Civil and Materials Engineering
University of Illinois at Chicago
842 W. Taylor Street
Chicago, IL 60607-7023
Tel: (312) 375-9521
Fax: (312) 996-2426
Email: smahmo24@uic.edu

Sanghyeon Ko
Ph.D. Student
Department of Civil and Materials Engineering
University of Illinois at Chicago
842 W. Taylor Street
Chicago, IL 60607-7023
Tel: (312) 806-7686
Fax: (312) 996-2426
Email: SKO21@uic.edu

Abolfazl (Kouros) Mohammadian, Ph.D.
Associate Professor
Department of Civil and Materials Engineering
University of Illinois at Chicago
842 W. Taylor Street
Chicago, IL 60607-7023
Tel: (312) 996-9840
Fax: (312) 996-2426
Email: kouros@uic.edu

Abstract

Panama Canal is projected to be doubled in capacity by 2015 which will allow more and larger ships to move through this canal. But what would be the effect of this expansion on the entire truck network in the U.S.A. it`s reasonable to think that by making the Origins and Destinations closer, the total Truck Vehicle Miles Traveled (TVMT) will be reduced. However we already have congested network near east coasts. This issue is going to be investigated in this study. Using the results of Panama Canal Expansion model, the percentile of shifting between ports in terms of Imports and Exports will be achieved. Knowing this will result in a new Freight Analysis Framework (FAF) origin and destination matrix and consequently need a new network assignment. This will show us the changes in the whole truck network, congested areas and also the total TVTM after Panama Canal expansion.

Keywords: Panama Canal, FAF network, Total TVMT, Congested links

Efforts to Reduce Crashes on County Roads in Iowa

Jan Laaser-Webb,PE[1];Terry Ostendorf; Steven Schroder, PE

Abstract

This presentation would highlight efforts to support counties with programs that encourage low cost safety improvements. We would look at needs identification, the programs which support key safety initiatives, and the visions for fatality, injury, and crash reduction on the county road system.

Keywords: keyword 1—keyword 2—keyword 3—keyword 4—keyword 5

[1] Iowa Department of Transportation, Office of Traffic and Safety, 800 Lincoln Way, Ames, Iowa 50010; Phone (515) 239-1267; email: jan.laaser-webb@dot.iowa.gov

Environmental aspect of Trucks Policy Analysis in Chicago region

Seyed Mehdi Mahmoudifard *(Corresponding Author)*
Ph.D. Student
Department of Civil and Materials Engineering
University of Illinois at Chicago
842 W. Taylor Street
Chicago, IL 60607-7023
Tel: (312) 375-9521
Fax: (312) 996-2426
Email: smahmo24@uic.edu

Abolfazl (Kouros) Mohammadian, Ph.D.
Associate Professor
Department of Civil and Materials Engineering
University of Illinois at Chicago
842 W. Taylor Street
Chicago, IL 60607-7023
Tel: (312) 996-9840
Fax: (312) 996-2426
Email: kouros@uic.edu

Abstract

Freight Analysis frameworks (FAF) provides estimates of tonnages and values for different types of commodities between states and major metropolitan areas. This database establish a good resource for analyzing the movements and behavior of freight in the U.S.A. However FAF data is aggregated and transportation planners and decision makers need to disaggregate these data to obtain a better and more detailed picture of freight movements in any specific area. There are different types of disaggregation methods which will be covered in this study. Most of these methods rely on population and employment data. Considering the results of other studies, this study uses a comprehensive method which mostly depends on supplier firms for each commodity and local employment data for the state of Illinois to apportion the FAF data into county level. The focus of this study will be on 6 counties of Chicago Metropolitan area to investigate truck movements and their corresponding emissions according to different policies. One of these policies is curfew for trucks in Chicago region. In this specific policy some types of trucks cannot enter the city in some special hours. This study analyses this policy in terms of its environmental aspects and hope to answer questions. ~~like:~~ We explore the effects of relaxing some hours in total emission, congestion, etc. Initial results show that by relaxing some hours, total truck emissions will be reduced according to distributing truck movement in a more broad range of hours in a day.

Keywords: Truck emission, FAF disaggregation, Supplier Selection, freight policy

Establishment of Relation between Pavement Surface Friction and Mixture Design Properties

Mozhdeh Rajaei[1], Nima Roohi[2], and Hussain U. Bahia[3]

Abstract

In recent years, pavement designers are increasingly considering driver's safety issue in pavement design and material selection to mitigate traffic and road accidents, especially with regards to pavement surface friction considerations. To this end, a clear understanding of relationship between pavement mixture design properties and surface friction measurements is needed.

In the present study the laboratory experimental methods were used to estimate surface friction. In the first method, the "Surface Laser Profilometer" (SLP) device was used to scan the surface of laboratory compacted and field core samples, from which a linear surface texture profile was derived. Surface texture data for the sample was mathematically analyzed through Fourier transformations to calculate the "Mean Profile Depth" (MPD) and texture wavelength measures. The other method used in this study was the "British Pendulum Test" (BPT) test, which empirically estimates the skid resistance of the pavement sample surface in wet conditions through dissipation of the pendulum's potential energy through friction contact between the pendulum and the pavement.

The laser profliometer MPD and BPT results were statistically related to mixture design properties such as aggregate size, gradation shape, binder content, air voids, and volumetric properties was investigated and statistical models relating these factors to friction measures were developed and the relative importance and relevance of the mix design properties was established. The results can be used as guidance to mixture designers to optimize mixture design properties such as to achieve better pavement surface friction and thus enhance drivers' safety.

Keywords: Driver safety—Surface friction—Pavement mixture design—Laser Profilometer—British Pendulum Tester.

[1] University of Wisconsin Madison, 1415 Engineering Dr., Rm. 3354, Madison, WI 53706; Phone (608) 556-5634; email: rajaei@wisc.edu

[2] University of Wisconsin Madison, 1415 Engineering Dr., Rm. 3352, Madison, WI 53706; email: roohisefidma@wisc.edu

[3] University of Wisconsin Madison, 1415 Engineering Dr., Rm. 3350, Madison, WI 53706; email: bahia@engr.wisc.edu

Estimating model for Design Cost for State Highway Projects

Kate Hunter[1]

Abstract

Methods for estimating design cost are extremely varied between state Department of Transportations (DOT's) and it can also vary greatly with in DOT's. It is difficult to estimate the design cost especially to compare between in house vs. outsourced design fees. DOT's do not generally out source design services based on cost comparison it is usually out need for expertise or resources however a cost comparison should be made. The purpose of this research is to obtain a reliable method for accessing the Design Cost for State Highway Projects. This will be done by a Literature review to identify key states or countries who have design fee estimating methods and then these methods will be applied to data from historic projects throughout the country to find the most accurate design cost estimation model. The design fee models from Texas Council of Engineering Companies (TCEC) and the two methods from Illinois DOT's Consultant Compensation Scheme were applied to the data. After running the various models it could be seen that the TCEC model produced the most accurate estimate due to the factors accounting for project complexity.

Keywords: Preconstruction Services—Design Cost—Estimating—In house Design—Outsourced Design

[1] Kate Hunter, 423 Town Engineering, Ames, Iowa 50011; Phone (515) 817-3755; email: kdhunter@iastate.edu

Evaluation of Aggregate Base Compaction for Density and Modulus Based Specification

Hani H. Titi, Habib Tabatabai, Ahmed Faheem, Emil Bautista,
Erol Tutumluer, and Andrew Druckrey

Field and laboratory tests were conducted on 10 projects during base course layer construction to evaluate the quality of the constructed base layers. Base aggregates were also collected from these sites for laboratory testing. The field testing program consisted of the in place density by the sand cone method, the dynamic cone penetration (DCP) test, the light weight deflectometer (LWD) test, and the GeoGauge test. Laboratory tests conducted are the particle size analysis, the standard compaction test (AASHTO T 99), and the repeated load triaxial test (AASHTO T 307) for determining the resilient modulus.

Analyses were conducted on field and laboratory test results. High spatial variability in field density and moisture content exists in base course layers under construction, as demonstrated by the relative compaction test results. High variability exists along the depth of base course layers, as demonstrated by the dynamic cone penetrometer test results and the estimated profile of California Bearing Ratio (CBR) along the depth of the investigated base layers. Spatial variability and non-uniformity were also demonstrated by the results of the light weight deflectometer and GeoGauge, in which the layer modulus varies within a large range of values.

Evaluation of Automated Camera Enforcement on Red Light Running Violations by Time into the Red Phase

Nicole Oneyear[1] and Shauna Hallmark[2]

Abstract

Red light running is a problem in the United States which has resulted in 165,000 injuries and 885 fatalities annually from 2000 – 2009. Automated red light running enforcement cameras have been found to be an effective if controversial solution to reduce red light running. In addition to privacy issues and the potential for an increase in rear end crashes, one of the main concerns is that automated enforcement cameras only target early red light runners, and do not target drivers who are running the light later into the red phase when right angle crashes are more likely to occur.

This study evaluated violations by time into the red for 7 approaches at 4 intersections in Cedar Rapids, Iowa where red light running cameras had been installed. Only those vehicles which did not allow right or left turn on red were considered. A before and after analysis was conducted in order to determine if the cameras had an effect on violation rates at different times into the red phase. These times were 0.0 to less than 1.0 second into the red, when no crashes are expected, 1.0 to less than 3.0 seconds into the red, when left turn-opposed crashes are likely to occur, and more than 3.0 seconds into the red, when both left turn-opposing and right-angle crashes occur. Overall results showed the cameras had the greatest effect on red light runners who entered the intersection 3 or more seconds into the red.

Keyword: automated enforcement – safety

[1] Graduate Student, Iowa State University, Civil, Construction and Environmental Engineering, 2711 South Loop Drive, Suite 4700, Ames, IA 50010, Tel: 515-294-6468, Email: noneyear@iastate.edu

[2] Professor, Iowa State University, Civil, Construction and Environmental Engineering, 2711 South Loop Drive, Suite 4700, Ames, IA 50010, Tel: 515-294-5249, Email: shallmar@iastate.edu

Evaluation of Cracking Resistance of Superpave Mixtures Using Texas Overlay Test

Syeda R. Aziz[1], ***Mustaque Hossain***[2] ***& Greg Schieber***[3]

Abstract

Reclaimed Asphalt Pavement (RAP) is a useful alternative to virgin aggregates in hot-mix asphalt (HMA) as it reduces cost, conserves energy and enables reuse of asphalt pavement. However, use of higher percentage of RAP sometimes leads to drier mix which is often susceptible to early cracking. The Texas Transportation Institute (TTI) has developed the Texas overlay test to simulate opening or closing of joints, which accelerates crack initiation and propagation. This test can characterize cracking resistance of asphalt mixtures. In this study, cracking resistance of Superpave mixtures with varying RAP content will be evaluated. Overlay tests will be performed in order to investigate cracking resistance of HMA mixtures containing three RAP percentages (20%, 30% and 40%) from two different sources. In addition, results from the Semi-Circular Bending (SCB) tests on these mixtures will be compared to that of the overlay tests. Detailed results will be included in the final presentation.

Keywords: Overlay Test—Cracking Resistance—Reclaimed Asphalt Pavement—Semi-Circular Bending Test—Superpave Mixtures

---

[1] Master's Student, Kansas State University, Dept. of Civil Engineering, 2118 Fiedler Hall, Manhattan, KS-66506; Phone (785) 532-5862; Fax (785) 532-7717; email: sraziz@ksu.edu

[2] Munger Professor, Kansas State University, Dept. of Civil Engineering, 2118 Fiedler Hall, Manhattan, KS-66506; Phone (785) 532-5862; Fax (785) 532-7717; email: mustak@ksu.edu

[3] Assistant Bureau Chief, Bureau of Materials and Research, Kansas Department of Transportation, 700 SW Harrison St., Topeka, KS 66603, Phone (785) 296-6618, Fax (785) 532-6665, email: gregs@ksdot.org

Evaluation of Large Truck Crashes at Horizontal Curves on Two-Lane Rural Highway in Kansas

Steven D. Schrock[1], Eric J. Fitzsimmons[2], and Tomás E. Lindheimer[3]

Abstract

The objective of this study was to investigate the relationship between roadway and environmental-related factors and truck crash severity at horizontal curves located on rural, two-lane state highways in Kansas. Single vehicle truck crashes and multi-vehicle crashes involving at least one truck were extracted from the Kansas Department of Transportation's crash and roadway databases for the years 2006-2010, resulting in 452 possible crash records. Descriptive statistics and 95 percent confidence intervals were constructed for an odds ratio analysis comparing single-vehicle truck crashes to multi-vehicle crashes involving at least one truck for the variables that were included in both databases. Overall, the odds ratio analysis indicated that single vehicle truck crashes were less likely to occur on wet pavement with shoulder rumble strips present and during non-adverse weather conditions compared to multi-vehicle crashes involving at least one truck. Single-vehicle truck crashes were also more likely to result in an injury crash compared to multi-vehicle crashes involving at least one truck. The latter were more likely to result in a fatality or property damage only crash. The study was designed to be an exploratory analysis, providing preliminary guidance to further investigate truck crashes at horizontal curves.

Keywords: Horizontal Curves—Large Trucks—Odds Ratio

[1] Associate Professor, University of Kansas, 2159B Learned Hall, 1530 West 15th Street, 1530 West 15th Street, Lawrence, Kansas, 66045; Phone (785) 864-3418; Fax (785) 864-5631; email: schrock@ku.edu

[2] Lecturer / Post Doctoral Researcher, University of Kansas, City, 2159A Learned Hall, 1530 West 15th Street, Lawrence, Kansas 66045; Phone (785) 864-1921; Fax (785) 864-5631; email: fitzsimmons@ku.edu

[3] Graduate Research Assistant, University of Kansas, 2160 Learned Hall, 1530 West 15th Street, City, Kansas 66045; Phone (785) 555-4199; Fax (785) 864-3418; email: t031l691@ku.edu

Evaluation of Low Cost Traffic Calming for Rural Communities

Shauna Hallmark and Neal Hawkins

Small rural communities often lack the expertise and resources necessary to address speeding and the persistent challenge of slowing down high-speed through traffic. Community entrance areas are especially problematic given that the drivers must transition from a high-speed, often rural, roadway setting to a low-speed community environment. The rural roadway provides high-speed mobility outside the community, but within the community the same road provides local access and accommodates pedestrians of all ages, on-street parking, bicycles, and other features unique to the character of a small community. Drivers who have been traveling for some distance on the high-speed road and are traveling through the community may not receive the appropriate clues that the character of the roadway is changing and may not adjust their speeds appropriately.

Addressing speeding issues is an even greater challenge given that smaller communities typically lack engineering staff and resources and at times decisions may be made that do not conform to accepted design guidance and good engineering practice. For instance, many rural communities set transition zones with low speeds that begin at a significant distance outside the community, before there is any practical need for drivers to slow down. Communities may also have unrealistic expectations about what speed reductions are practical and, in some cases, may even implement strategies to reduce speeds that are not appropriate for the situation. For instance, some small communities in Iowa that are frustrated with speeding issues simply use stop signs to slow traffic which diminishes both enforcement and compliance.

A number of traffic calming devices were evaluated to determine their effectiveness in reducing speeds along the main road through a small rural community. Five different treatments were selected and installed in six rural Iowa communities. This presentation summarizes the effectiveness of the various treatments.

Evaluation of Low-Cost Treatments on Rural Two-Lane Curves

Shauna L. Hallmark, Neal Hawkins, and Omar Smadi

The objective of this project was to evaluate low-cost measures to reduce speeds on high-crash horizontal curves. The researchers evaluated two low-cost treatments in Iowa to determine their effectiveness in reducing speeds on rural two-lane roadways. This report summarizes how the research team selected sites and collected data, and the results.

The team selected six sites. Retroreflective post treatments were added to existing chevrons at four sites and on-pavement curve markings were added at two sites.

The researchers collected speed data before and after installation of the two treatments. The study compared several speed metrics to assess the effectiveness of the treatments. Overall, both were moderately effective in reducing speeds. The most significant impact of the treatments was in reducing the percentage of vehicles traveling over the posted or advisory speed by 5, 10, 15, or 20 or more mph. This result suggests that the treatments are most effective in reducing high-end speeds.

Evaluation of Mitigation for Safety Concerns on Low Volume, Unpaved Rural Roads in Iowa

The State of Iowa boasts a transportation system of over 114,000 miles of roadway, most of which are within the jurisdiction of local agencies and the majority of which are unpaved with a granular aggregate surface. Recent statistics have shown that approximately half of all vehicle crashes, including those resulting in deaths or serious injuries occur on these rural local roadways. In contrast however, almost all safety emphasis and safety improvements have been invested in the system of paved roadways in Iowa, those under the jurisdiction of the Iowa Department of Transportation as well as cities and counties.

In addition to an extensive roadway system, the State of Iowa also has developed and maintained a comprehensive crash database, recording all reportable crashes on all public roads in the state over many years of history. While many other states compile and maintain crash records for the higher volume roadways, none can compare with Iowa on lower volume roads, especially those unpaved. Using these data, the Institute for Transportation at Iowa State University completed research project titled "Safety Analysis of Low Volume Rural Roads in Iowa" in 2010. One of the findings from that analysis was that a significantly higher frequency and rate of crashes were recorded on unpaved rural roads with traffic volumes higher than 100 vehicles per day.

Using that knowledge and with invaluable cooperation of the local agencies involved, the subject research examined a small sample of this limited mileage roadway type to study crash characteristics and, using an multi-disciplinary approach, develop mitigation to address frequent crash causes and types. While the crash data yielded important information, a proactive approach was also employed to select and employ crash mitigation options, including low cost engineering improvements, enhanced law enforcement efforts, and, where applicable, visits with local school officials and driver education instructors in an effort to raise safety awareness among younger, inexperienced drivers. Public information efforts may also prove a valuable asset in raising awareness with all drivers of crash history on specific roadways and efforts to address those safety concerns. While results of these efforts cannot be fully analyzed for several years, due to the low volume of traffic involved, knowledge of these initiatives can be a valuable asset for low agencies for improving safety on low volume unpaved roads within those jurisdictions.

Field Investigation of Iowa DOT Deck Epoxy Injection Process

Justin Dahlberg[1], Brent Phares[2], Ahmad Abu-Hawash[3], Mark Dunn[4]

Abstract

The methods used for the maintenance and repair of bridge structures are becoming ever more important as the nation's infrastructure progressively ages. Often, bridges can be rehabilitated or repaired rather than replaced as most of the structure is considered in good condition. In Iowa, bridge decks are commonly the first component of a bridge that requires extensive rehabilitation, mostly because of the use of salts, plows, and overall traffic wearing. Since the 1970's, the Iowa Department of Transportation (DOT) has used concrete overlays on concrete decks to restore the surface and to lengthen the service life of the bridge deck. This method has proven to be an effective means to inhibit chloride and water intrusion into the bridge deck, thus extending the deck service life.

Many of the overlays, however, are now in need of repairs as they have been subjected to the same elements which caused deterioration to the original deck. Frequently, the overlay delaminates from the original deck creating a plane between the two surfaces where water can intrude and expedites the deterioration of the overlay. It has been observed that the life of the overlay can be extended, and thereby delay more significant repairs, by injecting epoxy into the void caused by the delamination. Currently, although this injection process is performed by all six of the Iowa DOT district bridge crews, the process and procedures used to complete this process varies slightly from one district to another. Therefore, an evaluation of epoxy injection performance in each district and the creation of a more formal procedure which takes from the best practices of the Iowa DOT and others are needed; this will allow the DOT to better predict the longevity of the repair and when other future maintenance activities might be necessary. The three objectives of this project include: 1) to determine the effectiveness, durability, and typical service life of epoxy injection of delaminated decks; 2) to evaluate the current state of the practice of the Iowa DOT and the epoxy injection industry; and 3) to develop procedures and specifications for epoxy injection.

This is a multi-year project due to the nature of the investigation. To this point, numerous bridges have been identified as epoxy injected within the past 10 years and were recently sounded to locate any delaminated portions and to gage the overall performance of the injection over the years. Others that have been recently injected were sounded before the injection process and then again thereafter. Re-soundings will occur annually for several years to track the condition of the bridge deck and performance of the injection. To date, some preliminary best practices have been identified and are being conveyed to the bridge crews. This presentation will focus on the injection practices of Iowa DOT crews, the sounding results obtained from previously injected bridges, , and the preliminary findings of best practices within the state.

Key Words: Deck Overlay, Deck Delamination, Epoxy Injection

[1]Bridge Research Engineer, Bridge Engineering Center, Iowa State University, Ames, IA 50011, Tel: 515-294-9360, Email: dahlberg@iastate.edu

[2]Director, Bridge Engineering Center, Iowa State University, Ames, IA 50011, Tel: 515-294-5879, Email: bphares@iastate.edu

[3]Chief Structural Engineer, Office of Bridges and Structures, Iowa Department of Transportation, Ames, IA, 50010, Tel: 515-239-1393, Email: Ahmad.Abu-Hawash@dot.iowa.gov

[4]Operations Research Engineer, Office of Research and Analytics, Iowa Department of Transportation, Ames, IA 50010, Tel: 515-239-1447, Email: Mark.Dunn@dot.iowa.gov

Geotechnical Properties of Recycled Materials for Use as Highway Embankment Fill

Ali Soleimanbeigi[1], Tuncer B. Edil[2], and Angela P. Ahlman[3]

Abstract

Use of recycled materials is one way to provide more sustainable roadway construction. In this study, engineering properties of a number of recycled materials were reviewed for use in highway embankment fill. Compaction characteristics, hydraulic conductivity, shear strength and compressibility of recycled asphalt pavement (RAP), foundry slag (FS), bottom ash (BA), and recycled asphalt shingles (RAS) that are produced in large quantities in the US were characterized. From the standard compaction test results, the four recycled materials have lower dry unit weight than compacted sand. Results of triaxial compression tests showed that shear strength of these materials are appropriate to provide stability for typical highway embankments. The measured hydraulic conductivities provide sufficient drainage capacity for embankment fill. Results of one-dimensional compression tests showed that bottom ash and foundry slag have comparable compressibility to that of compacted sand up to vertical effective stress ($\sigma_v^{'}$) of 200 kPa. At $\sigma_v^{'}$ higher than 200 kPa, bottom ash exhibits 40% higher strain than sand. The compressibility of foundry slag significantly increases primarily due to crushing of individual particles. Compressibility of RAS is significantly higher than that of sand which makes the material unacceptable as embankment fill. RAP consistently has higher compressibility than glacial sand; however, settlement of typical highway embankments constructed with RAP is below the maximum limit. Bottom ash, foundry slag, and RAP have appropriate engineering properties for use as structural fill in typical highway embankments. Recycled asphalt shingles should be mixed with at least 50% of granular additive to reduce the compressibility to an acceptable limit. Increasing temperature increased the compressibility of compacted RAS and RAP. To minimize settlement of embankments constructed with RAP and RAS, embankment construction is recommended during summer to induce preloading at higher temperatures.

Keywords: recycled materials-sustainability-engineering properties-highway embankment

[1] Research Associate, Civil and Environmental Engineering Department, University of Wisconsin-Madison, 2243 Engineering Hall, 1415 Engineering Drive, Madison, WI 53706, Phone (608) 444-3460; Fax (608) 262-5199; email: soleimanbeig@wisc.edu

[2] Director, Wisconsin Highway Research Program, Civil and Environmental Engineering Department, University of Wisconsin-Madison, 2226 Engineering Hall, 1415 Engineering Drive, Madison, WI 53706; Phone (608) 262-3225; Fax (608) 262-5199; email: tbedil@wisc.edu

[3] Technical Director, Wisconsin Highway Research Program, Civil and Environmental Engineering Department, University of Wisconsin-Madison, 2204 Engineering Hall, 1415 Engineering Drive, Madison, WI 53706; Phone (608) 890-4966; Fax (608) 262-5199; email: apakes@sustainability.wisc.edu

Hardening Concrete Pavement Against Friction Loss Due to Aggregate Polishing

Douglas D. Gransberg, PhD, PE [1], and Dominique M. Pittenger, PhD, AC [2]

Abstract

This presentation discusses the use of lithium based concrete hardener applied over shotblasting as a concrete pavement preservation treatment for locations that are subject to aggregate polishing and rutting due to studded tires, snow chains and snow plowing. Lithium-based concrete hardeners have long been used to preserve industrial concrete floors from wear due to forklift and other traffic in warehouses and parking lots. However, the concern with the treatment's ultimate effect on skid resistance has limited its use.. This study combines field tests in California, Delaware, and Oklahoma and shows that when the concrete pavement surface is first retextured using shotblasting and then treated with the concrete hardener that not only does it reduce wear/rutting due to abrasion but it also maintains safe skid numbers for periods of up to 3 years. A life cycle cost analysis shows this treatment to be a cost effective pavement preservation tool to extend the life of concrete pavements on roads prone and friction loss due to polishing and rutting.

Keywords: concrete pavement—pavement preservation—rutting—skid resistance—shotblasting

[1] Professor, and Greenwood Chair, Civil, Construction and Environmental Engineering Department, Iowa State University; 494 Town Engr Bldg, Ames, IA 50010; email: author.dgran@iastate.edu

[2] Research Assistant Professor, College of Engineering, University of Oklahoma, Norman, OK, 73014; Phone (405) 317-5723; email: dominiquep@ou.edu.

Heated Transportation Infrastructure: Prevention of Ice Formation on Paved Surfaces

Halil Ceylan[1], William Cord[2], Sunghwan Kim[3], and Kasthurirangan Gopalakrishnan[4]

Abstract

Ice and snow on transportation infrastructure systems cost the American economy in snow removal, damaged pavement and bridge surfaces and lost man-hours due to travel delay. Common practices for removing ice and snow from surfaces in transportation infrastructure include spraying large quantities of anti-ice chemicals on the ground and deploying a great number of snowplowing vehicles. However, these methods are labor intensive and have environmental concerns with possible contamination of nearby water bodies. Heated pavement systems using electrical resistance, hydronic heating and conductive concrete have gained attention as desirable alternatives to current methods of removing ice and snow. Several approaches on heated pavements systems have been proposed for different transportation infrastructure applications. Each of these approaches has its own advantages and limitations. A method which holds promise for bridge systems may not always be promising for highway and airfield pavements. This paper examines the current state-of-practice and state-of-art in heated pavement infrastructure applications for bridge decks, roadway pavement, and airport runways and suggests the most promising stand-alone or hybrid heated pavement systems.

The current state-of-practice for heated roadways include electrical and geothermal (hydronic) heating. Some state-of-the-art research studies are investigating the concept of self-heating pavement utilizing electrically conductive fibers in a regular concrete mix and interlayers and the use of pavement itself as a solar energy collector.

Bridge decks currently utilize electrical, geothermal, and other hydronic heating systems. The state-of-research for heated bridge decks include solar energy collector (such as the SERSO project in

[1] Associate Professor, Iowa State University, 406 Town Engineering Building, Ames, IA 50011; Phone (515) 294-8051; Fax (515) 294-8216; email: hceylan@iastate.edu

[2] Undergraduate Researcher, Iowa State University, 311 Ash Ave, Ames, IA 50014; Phone (712) 249-9802; email: wocord@iastate.edu

[3] Post Doctorate Research Associate, Iowa State University, 24 Town Engineering Building, Ames, IA 50011; Phone (515) 294-4698; Fax (515) 294-8216; email: sunghwan@iastate.edu

[4] Research Assistant Professor, Iowa State University, 354 Town Engineering Building, Ames, IA 50011; Phone (515) 294-3044; email: rangan@iastate.edu

Switzerland) as well as conductive concrete. The heated pavement system most appropriate for a bridge deck should be decided on a case by case basis based on cost, bridge construction method and hydrological features at the site. For most bridges, conductive concrete appears to be the best option. Conductive concrete is easily repairable, and the initial and operating cost of conductive concrete is comparable to hydronic systems.

Airport runways currently only use electrical resistance systems for heating pavement. Research for melting snow on runways include using solar energy and battery banks to control costs of heating the runway and utilizing a geothermally heated airport apron. Also, recent progress made toward understanding the use of lotus-leaf-inspired super-hydrophobic surfaces for the prevention of ice formation can have potential positive implications for bridge, roadway and runway deicing.

Keywords: heated pavements—icy roads—hydronic—conductive concrete—renewable energy

IDIQ Contracting Implementation by the Minnesota Department of Transportation

Jorge A. Rueda Benavides
Graduate Student – Construction Management
Department of Civil, Construction and Environmental Engineering
423 Town Engineering Building
Iowa State University, Ames, IA 50011-3232
E-mail: jrueda@iastate.edu
Phone: 641-745-9422

Douglas D. Gransberg, Ph.D.
Donald F. and Sharon A. Greenwood Professor in Construction Engineering
Department of Civil, Construction and Environmental Engineering
494 Town Engineering Building
Iowa State University, Ames, IA 50011-3232
E-mail: dgran@iastate.edu
Phone: 515-294-4148

Abstract

Indefinite delivery/indefinite quantity (IDIQ) contracts have been widely used at federal level by different agencies since its creation in 1981 by the Department of Defense (DoD). During the last few years, this procurement method has been increasingly accepted by state and municipal entities, hence some Departments of Transportation still consider IDIQ as an innovative contracting method. Unlike federal agencies, state department of transportation prefer to use single-award contracts, which is the case of the Minnesota Department of Transportation (MnDOT). The presentation will discuss the different models for IDIQ contracting and propose conclusions on which models are most appropriate for implementation by MnDOT.

Keywords: Indefinite Delivery/Indefinite Quantity (IDIQ), Innovative Contracting Method, Single-Award Contracting, Multiple-Award Contracting.

Impact of family communication patterns on parent and teen risky driving behaviors

Cara Hamann [1], Jingzhen Yang [2], Dan McGehee[3], Corinne Peek-Asa[4] , and Lisa Roth[5]

Abstract

Purpose: Steering Teens Safe (STS) is a parent-focused program that teaches parents effective communication techniques to encourage their teen to engage in safe driving behavior. The randomized controlled trial to evaluate this program collected information about risky driving behaviors from parents and their teens. This analysis examines the impact of the intervention on risky driving reported by parents and teens, examines if parental communication styles influenced risky driving, and measures concordance between parent and teen risky driving behavior.

Methods: STS was evaluated through a randomized controlled trial with 145 parent-teen dyads (70 intervention and 75 control); 138 dyads with complete data were included in this analysis. Intervention parents received a 45-minute training session with four follow-up phone sessions, a DVD, and a workbook. Control parents received a standard brochure about safe driving. The 16-item, previously validated Risky Driving Score was the main outcome measure, which is a sum of the number of times each participant performed risky driving behaviors in the past week (e.g., talk on phone while driving) and was collected at 6 month follow-up. Family communication was measured through parent responses to the 10-item validated Family Communication Pattern Scale, which asks about the frequency of things

[1] Injury Prevention Research Center, The University of Iowa, Department of Occupational and Environmental Health , 200 Newton Rd, 2186 WL, Iowa City, IA 52242; Phone (319) 384-4193; Fax (319) 335-4225; email: cara-hamann@uiowa.edu

[2] College of Public Health, Kent State University, Department of Social & Behavioral Sciences, PO Box 5190 , Kent, OH 44242 ; Phone (330) 672-2679; Fax (330) 672-6505; email: jyang23@kent.edu

[3] Public Policy Center, The University of Iowa, 310 South Grand Ave, 205 SQ, Iowa City, IA 52242; Phone (319) 335-6819; Fax (319) 335-6801; email: daniel-mcgehee@uiowa.edu

[4]Injury Prevention Research Center, The University of Iowa, Department of Occupational and Environmental Health, 100 River St, S143 CPHB, Iowa City, IA 52242, Phone (319) 335-4895, Fax (319) 335-4225; email: corinne-peek-asa@uiowa.edu

[5]Blank Children's Hospital, 1206 Pleasant Street, Des Moines, IA 50309, Phone (515) 241-6713, Fax (515) 241-6732, email: rothlm@ihs.org

the parent may say to their teen during safe driving discussions (e.g, Say that he/she shouldn't argue with adults).

Results: Approximately one quarter of parents were in each of the family communication pattern (FCP) groups (pluralistic = 23.2%; protective = 19.6%; consensual = 26.8%, laissez-faire = 30.4%). The highest risky driving scores were among the protective FCP (Mean = 7.8, SD = 16.4) for parents and the laissez-faire FCP (Mean = 10.6, SD = 16.3) for teens. Parent and teen risky driving scores were not significantly correlated, with the exception of control group families with protective FCPs ($r = 0.72$, $p < 0.01$). Families with protective FCPs have parents who focus on obedience by the child and emphasize that the child should avoid social conflict and give in on arguments. Intervention families with protective FCPs (Parent Mean = 3.8, SD = 4.3; Teen Mean = 3.5, SD = 3.5) had average risky driving scores much lower than control families with protective FCP (Parent Mean = 11.1, SD = 21.4; Teen Mean = 6.3, SD = 9.0). Additionally, protective FCP families were the only ones with higher average risky driving scores for parents than for teens.

Conclusions: Following our intervention, the only parent and teen reports of risky driving behavior that were correlated were among the control group parents and teens with protective FCPs. Teens in the intervention group with protective FCPs did not have risky driving scores that were significantly correlated with their parents, but the control group families did. This result suggests that teens accustomed to a protective FCP may give more weight to what they are told by their parents, rather their parents' actions. This research shows that protective FCPs influence risky driving and interventions with a focus on positive safe driving communication can reduce risky driving.

Keywords: communication—teen driving—parental—family—risk

Impact of Increasing Freight Loads on Rail Infrastructure from Fraccing Sand Transport

Damien Hesse[1], James M. Tinjum[2], Tuncer B. Edil[3]

[1]Graduate Student, University of Wisconsin-Madison, 1217 Engineering Hall 1415 Engineering Drive Madison, WI 53706, dhesse2@wisc.edu, (320)293-7260

[2]Assitant Professor, University of Wisconsin-Madison, 2214 Engineering Hall 1415 Engineering Drive Madison, WI 53706, tinjum@epd.engr.wisc.edu, (608)262-0785

[3]Professor, University of Wisconsin-Madison, 2226 Engineering Hall 1415 Engineering Drive Madison, WI 53706, edil@engr.wisc.edu, (608)262-3225

Key words: Rail, Fraccing Sand, Ballast, Large-Scale Cyclic Triaxial Test, Maintenance

The increased use of the hydraulic fracturing technique has implications for the Midwest region. Wisconsin, Minnesota, Iowa, and Illinois possess most of the minable sand market and with the growth in mines and production the transportation sector is experiencing substantial increases in use. The primary mode of transportation for this mined frac sand is by rail to the main areas of oil and natural gas production in the Texas, North Dakota, and Pennsylvania regions. This substantial increase in the rail transportation market will likely result in an increase in operation and maintenance costs. Understanding the implications of frac sand transport will help shape the future of the railway industry.

The impact of heavy axel loads has been studied in some detail; however, the impact of frac sand infiltration in the ballast as it is being transported is unknown. As the amount of frac sand in the ballast increases it is suspected that the water retention will also increase. The effect of water retention due to fouling from fine material such as coal has been studied previously and will be utilized to refine some of the methods of this study. The purpose of this study is to show any potential increases in deformation and deterioration above what is normally expected due to frac sand and moisture. The results of this study will be used to determine any increases in maintenance cycles and costs associated with proper upkeep of the railway ballast

system and to calculate a life cycle analysis for this expanding market of rail freight transportation.

For the study thus far, three ballast and three frac sand samples have been obtained and have been characterized for some of the basic properties needed to conduct the large-scale triaxial (LSCT) tests. The following properties have been studied on the ballast samples: particle size distribution, mineralogy classification, particle shape, bulk density, and void ratio. The following properties have been studied for the frac sand samples: grain size distribution, particle shape, hydraulic conductivity, soil water characteristic curve, density, and void ratio. These properties will be used to optimize the large scale triaxial tests.

It is crucial to identify the critical parameters that will have the largest potential to affect the deterioration and deformation of the ballast due to large cyclic loads. Therefore, the next step in this study is to conduct the LSCT tests to find critical fouling contents and moisture quantities that will result in the highest amount of plastic strain. Plastic strains that are too much for a desired capacity of freight require maintenance which generally includes tamping and rearranging of the ballast particles. However, as the ballast continues to be fouled it might reach the point where tamping has no effective benefit and the ballast must be replaced. Replacing ballast is much more expensive than tamping. Therefore, quantifying the amount of deformation from the transportation of frac sand is crucial for determining maintenance schedules and costs analysis. The results of the LSCT testing will help to determine the future of the railway system and how to best design for the impacts of fraccing sand transportation.

Ebrahimi, A. (2011). Deformational Behavior of Fouled Railway Ballast. University of Wisconsin - Madison.

Selig, E. T., & Waters, J. M. (1994). Track Geotechnology and Substructure Management (pp. 1–446). New York, NY: Thomas Telford.

Wisconsin DNR. (2012). Silica Sand Mining in Wisconsin (pp. 1–43). Madison, WI.

Wisconsin DOT. (2012). WiscDOT Multimodal Freight Network 2012 Non-Metallic Mining Commodity Profile (pp. 1–4).

Impacts of 2011 Missouri River Flooding on Secondary Roads in Western Iowa

Pavana Vennapusa[1] and David J. White[2]

Abstract

The 2011 Missouri River flooding caused nearly $60 million damage to the transportation infrastructure on primary and secondary roads in Western Iowa, of which the damage on secondary roads alone is estimated to be about $13 million. The damage was seen in all six counties along the Missouri River basin in Iowa – Woodbury, Monona, Harrison, Pottawattamie, Mills, and Freemont. The flooding resulted in closures on over 60 miles of primary roads and over 100 miles of secondary roads during summer 2011, causing severe inconvenience to residents and losses to local businesses. As the flood waters receded, the Iowa Department of Transportation (DOT) reported that there were cases where the extent of damage was obvious, i.e., where some segments of roadway has been washed away; but in many cases the damage was undetermined, i.e., where the damage was below the road surface layer or around bridges.

A research project was initiated by the Iowa DOT with the Center for Earthworks Engineering Research (CEER) at Iowa State University, to assist County and City Engineers by deploying and using advanced technologies to rapidly assess the damage to secondary roadways, and developing effective repair and mitigation strategies and solutions. This presentation will include information from field reconnaissance and in situ testing conducted by the researchers to assess the damage occurred to various paved and unpaved roads and its foundation layers, bridge approaches, and culverts in Western Iowa.

In situ testing was conducted on 12 test segments varied in length from about 500 ft to 2 miles and type of surfacing, i.e., gravel, thin chipseal coat over emulsified oil stabilized gravel base, portland cement concrete (PCC), and hot mix asphalt (HMA). The test segments were selected with an objective to monitor performance of the flooded versus un-flooded areas by evaluating their subsurface foundation layer performance characteristics over time, i.e., shortly and one month after flood waters receded, and during spring/thaw in 2012. In situ testing involved conducting falling weight deflectometer (FWD),

[1]Center for Earthworks Engineering Research (CEER), Iowa State University, 2711 South Loop Drive, Suite 4700, Ames, IA 50010; Phone (555) 294-2395; email: pavanv@iastate.edu

[2]Center for Earthworks Engineering Research (CEER), Iowa State University, 422 Town Engineering, Ames, IA 50011; Phone (515) 294-1463; Fax (515) 294-0467; email: djwhite@iastate.edu

dynamic cone penetrometer (DCP) testing, hand auger soil sampling, ground penetrating radar (GPR), and 3D laser scanning. FWD, DCP, hand augers, and GPR was used to evaluate damage of the foundation layers, while 3D laser scanning was utilized to calculate earthwork volumetric quantities at a location where a roadway segment was washed away during the floods.

Keywords: Missouri river flooding—low volume roads—in situ testing—falling weight deflectometer—laser scanning

Impacts of Automated Machine Guidance (AMG) on Earthwork Operations

David J. White[1], and Pavana Vennapusa[2]

Abstract

Automated machine guidance (AMG) links sophisticated design software with construction equipment to direct the operations of construction machinery with a high level of precision, improving the speed and accuracy of the transportation construction process. AMG technology has the potential to improve the overall quality and efficiency of transportation project construction. Many contractors are already using digital terrain models (DTMs) for estimating quantities, means and methods, constructability, quantity of the progress of work, and payment. This paper presents information regarding the following aspects of AMG, based on extensive literature review and survey conducted as part of the NCHRP 10-77 project: (a) potential productivity and cost gains, and (b) factors affecting the accuracy of the AMG process.

The equipment vendors indicated potential productivity gains of around 40% and potential cost savings of about 25 to 40% using AMG. On the other hand, a majority of the contractors indicated potential productivity gains of about 10 to 25% and cost savings of about 10 to 25% using AMG. The literature suggests productivity gains range from about 5 to 265% and cost savings range from about 10 to 68%, depending on the position measurement technology used and the application. Only a few case histories provide project specific productivity estimates for AMG for applications involving road construction, pipe trench excavation, and paving. A cost model is described in this presentation that relates productivity gain from AMG to cost savings.

The accuracy of the AMG process is primarily influenced by three variables: position measurement technology, construction process, and human errors. These parameters are either application-specific or machine- specific, and have not been thoroughly studied and or documented in the technical literature. The research team conducted interviews with various contractors to get feedback on various error detection and mitigation strategies.

---

[1]Center for Earthworks Engineering Research (CEER), Iowa State University, 422 Town Engineering, Ames, IA 50011; Phone (515) 294-1463; Fax (515) 294-0467; email: djwhite@iastate.edu

[2]Center for Earthworks Engineering Research (CEER), Iowa State University, 2711 South Loop Drive, Suite 4700, Ames, IA 50010; Phone (555) 294-2395; email: pavanv@iastate.edu

Survey results indicated that a majority (> 70%) of contractors, software/hardware vendors, and agencies who responded believe that the number of elevation data points used in creating the DTM is an important factor in the accuracy of the DTM. A gird of elevation data points was analyzed using six different interpolation methods to determine the absolute mean error (calculated as the average of absolute value of the difference between the actual and the estimate value). Results showed that the interpolation method and the spatial density of data points are important factors that contribute to the accuracy of the DTM.

A summary matrix was developed with attributes of accuracy, coverage range, measurement principle, and relative cost of various position measurement technologies that are typically used in construction applications. Laser, ultrasonic, robotic total station, RTK GPS, assisted GPS (via mobile phones), laser-augmented GPS, ultrasonic augmented GPS, GPS integrated with INS, locata (pseudolites), and infrared laser technologies are included in the matrix. Typical precision requirements and vertical accuracy requirements for earthwork and paving equipment/operations are summarized from sources identified in the literature.

Keywords: automated machine guidance—earthwork—grading—GPS—cost

Integrated Optimization of Lane Markings and Signal Timings for Roundabouts

Yue Liu

Abstract

Installing signals has been proved to be an effective and economic solution to increase capacity and treat unbalanced flows at modern roundabout. However, signal optimization methods for conventional intersections do not directly apply to roundabouts due to the complexity of operating signals at circulatory lanes, designing special phase structure and lane marking settings, and treating left-turn movements, particularly when there are more than two lanes at approaches of a roundabout. This paper contributes to develop an integrated optimization model that is able to simultaneously determine lane markings and signal timings for a signalized roundabout. A precedence graph is uniquely designed to formulate a unified phase structure at both approaches and circulatory lanes. Left-turn movement queuing section is represented by an approach with short lanes and upstream signals, where queuing diagram theory is employed to model the capacity, queue length, and queue clearance for left turns at the second stop line. Real-world operational constraints have also been taken into account in the optimization process to ensure feasibility and safety. Case study results demonstrate the effectiveness of the proposed model and provide guidelines for best application of the proposed control strategy.

Keywords: Roundabout—signal control—lane marking—optimization—intersection

Integrated Optimization of Pedestrian Phase Patterns and Signal Timings for a Signalized Intersection

Yue Liu

Abstract

This paper establishes quantitative criteria for selecting pedestrian phase patterns between the exclusive pedestrian phase (EPP) and the normal two-way crossing (TWC) with both safety and efficiency factors traded-off in an economic evaluation framework. The safety effect is assessed by modeling the number of pedestrian-vehicle exposures and pedestrian violations (i.e., pedestrian noncompliance) based on the traffic conflict technique (TCT); and the operational efficiency is measured with a new model considering pedestrian delay due to signal, conflicts, and detour. Both safety and efficiency performance indices are then converted to monetary values in an integrated model to simultaneously select pedestrian phase patterns and optimize signal timings of an intersection with two phases. Case study results have shown the promising property of the proposed approach to assist transportation professionals in properly selecting pedestrian phase patterns at signalized intersections.

Keywords: Exclusive pedestrian phase—signal control—optimization

Intelligent Navigation of Transportation Information: Research Resources for Transportation Topics

Leighton L Christiansen[1]

Abstract

The best decisions are based on the highest quality research and research literature. A key component of every research project is the literature review. In the myriad of journals, databases, and websites, how do we know we are getting the highest quality research reports to inform our own research decisions? And when we know the best tools, how do we use them efficiently and effectively? Iowa DOT Librarian Leighton Christiansen will discuss which tools are best when starting a transportation-related literature search. He will show tips for targeting a search, and tools, such as reference management software, for making bibliographies and resource citations nearly automatic. Further, he will discuss when and how to use general search engines more intelligently. Christiansen will also discuss what information is not on the open Internet--or even digital--and give tips on how to retrieve it. The presentation will end with a sample search, showing how to use the Transportation Research Thesaurus (TRT), the Transportation Research International Documentation (TRID) database, and reference management software efficiently and effectively.

Keywords: Information organization—Information services—Technology transfer—Research reports—Research projects

[1] InTrans and Iowa DOT, 800 Lincoln Way, Ames, Iowa 50010; Phone (515) 239-1200; email: leighton.christiansen@dot.iowa.gov

Investigation of Alternative Methods for Concrete Bridge Deck Removal

Justin Dahlberg[1], Brent Phares[2], Hongtao Dang[3], Ahmad Abu-Hawash[4], Gary Novey[5]

Abstract

In the quest to update and rehabilitate their deteriorating bridge inventories with limited funds, bridge engineers are forced to find cost-effective methods for extending the useful life of any structure if possible. In instances where the substructure and superstructure are still providing adequate strength and service life, one method for extending the life of the entire structure is simply replacing the deteriorated deck. However, doing so without damaging the superstructure elements is both critical and often difficult. When damage to the superstructure occurs, delays in reconstructions can be quite significant. Further, there is a need to remove the deck without damaging or polluting what lies below the bridge (e.g., roadways, train corridors, rivers, and streams). More efficient and reliable methods for concrete deck removal are needed. The objective of this project is determine the most, and/or develop new, cost-effective and efficient deck removal techniques for steel superstructures. The following criteria will be considered as part of the evaluation: Impact on the future performance of the superstructure, cost, time, safety, and noise.

Currently, contractors typically use saws to segment the deck, and then impact equipment (e.g., breakers, chipping hammers, etc.) to break the deck segments free from the superstructure elements. In order to improve on existing techniques, workshops including DOT personnel, contractors, and university researchers were conducted to better grasp the techniques currently being used and also to brainstorm what other methods exist or could be developed. As a result of the workshops, numerous ideas were discussed and several were chosen for laboratory investigation. Even more, it was clear from these discussions that one major limitation to more cost-effective methods of removal is the extensive and often delicate handwork required at or around shear connectors. This task is not simply done by machines without damage, thus requiring the handwork; even then damage is often unavoidable. Therefore, a parallel laboratory investigation was conducted to evaluate the necessity for complete concrete removal around the shear studs. Specimens consisting of three commonly used shear connectors (shear studs, angle plus bar, and channels) were fabricated and cast into a concrete slab. Concrete removal was performed on the specimens at varying degrees to simulate different levels of field removal, i.e., without handwork, minimal handwork, and major handwork. Next, the specimens were recast into concrete slab portions and subsequently tested for shear capacity at the steel/concrete interface.

This presentation will focus on the laboratory results obtained from investigation of alternative methods and varying degrees of concrete removal.

Key Words: Concrete Deck Removal, Alternative Methods, Shear Capacity

[1]Bridge Research Engineer, Bridge Engineering Center, Iowa State University, Ames, IA 50011, Tel: 515-294-9360, Fax: 515-294-0467, Email: dahlberg@iastate.edu

[2]Director, Bridge Engineering Center, Iowa State University, Ames, IA 50011, Tel: 515-294-5879, Email: bphares@iastate.edu

[3]Graduate Research Assistant, Bridge Engineering Center, Iowa State University, Ames, IA 50011, Email: hitdang@iastate.edu

[4]Chief Structural Engineer, Office of Bridges and Structures, Iowa Department of Transportation, Ames, IA, 50010, Tel: 515-239-1393, Email: Ahmad.Abu-Hawash@dot.iowa.gov

[5]Assistant Bridge Engineer, Office of Bridges and Structures, Iowa Department of Transportation, Ames, IA 50010, Tel: 515-239-1564, Email: Gary.Novey@dot.iowa.gov

Investigation of Bearing Capacity of Geotextile-Reinforced Paved Roads

Milad Saghebfar[1] , Mustaque Hossain[2], Bruce A. Lacina[3], Brett Odgers[4]

Abstract

Geotextiles have been widely promoted for pavement structure over the past 30 years. It has been claimed that geotextile at the subgrade-base course interface of a paved road can increase the number of load repetitions till failure or decrease layer thickness. These benefits are thought to be provided by providing separation, lateral restraint, and/or a tensioned membrane effect of the geotextile. However, well-instrumented full-scale experiments to support these claims are almost lacking. In this study, Full–scale accelerated pavement testing was done on eight lanes of pavement test sections. Six out of these eight sections were reinforced with different types of woven geotextiles. The reinforced sections and the control sections (with unreinforced base) were paved with Superpave hot-mix asphalt. Base and subgrade materials were the same for all sections while the test sections had different asphalt and base layer thicknesses. Falling weight deflectometer (FWD) were done on the test sections after construction and after 250,000 repetitions of an 80-kN single axle load. From the FWD test results, the modulus of each layer was backcalculated. Results indicate that the base layer moduli for the geotextile-reinforced sections increased after loading, unlike the control test sections.

Key words: Geotextile- Falling Weight Deflectometer – Accelerated Pavement Testing

---

[1] Doctoral student, Dept. of Civil Engineering, 2118 Fiedler Hall, Kansas State University, Manhattan, KS 66506, Tel. (785) 317-6539, Fax. (785) 532-7717, e-mail: milad@ksu.edu
[2] Munger Professor, Dept. of Civil Engineering, 2118 Fiedler Hall, Kansas State University, Manhattan, KS 66506, Tel. (785) 532-5862, Fax. (785) 532-7717, e-mail: mustak@ksu.edu
[3] Roadway Reinforcement Technical Manager, TenCate Geosynthetits North America, 365 South Holland Drive, Pendergass, GA 30567, Tel. (706) 693-2226, Fax. (706) 693-4400, e-mail: b.lacina@tencate.com

[4]Market Manager, TenCate Geosynthetits North America, 14064 S. Hagan St., Olathe, KS 66062, Tel. (913) 909-7150, Fax. (831) 665-5970, e-mail: b.odgers@tencate.com

Iowa Asphalt Concrete Overlay Design Procedure Revisited

Halil Ceylan[1], Shuo Yang[2], Sunghwan Kim[3], and Kasthurirangan Gopalakrishnan[4]

Abstract

Most highway agencies have shifted emphasis from the construction of new roads to the maintenance and preservation of existing highways. The structural condition assessment of existing, in-service pavements is part of the routine rehabilitated pavement structural design procedures. Nondestructive deflection testing (NDT) has been used to characterize the structural capacity and integrity of exiting pavement sections. Asphalt concrete (AC) overlay design procedure for exiting Iowa flexible, rigid and composite pavement was developed by Iowa Department of Transportation (DOT) in the 1980s.

The developed AC overlay design procedure is patterned closely after the AASHTO empirical pavement design procedures and it utilizes Road Rater based NDT measurements to estimate in-situ structural condition of existing pavement and subgrade support. The Structural Rating (SR), a concept similar to AASHTO Structural Number (SN), was introduced for existing pavements which indicates present structural capacity of existing pavement. The soil support k-value was adapted to estimate existing subgrade soil support condition to determine the required SN for AC overlay pavement structures through AASHTO empirical design monograph. The base relationships to convert Road Rater measurements to SR and k were developed and presented graphically. Temperature corrections were applied to deflection measurements for AC overlay on flexible pavement and to SR for AC overlay on composite pavement. The required AC overlay thickness could be determined using SR, the required SN and the coefficient of AC used in overlay layer.

The Falling Weight Deflectometer (FWD) test has become the current NDT practice, a big shift from Road Rater based NDT. This study was conducted so as to enable the use of FWD based measurements into Iowa AC overlay design procedure originally developed using Road Rater deflections. FWD-Road Rater deflection correlations from previous Iowa DOT research reports were utilized to adapt the overlay design procedure for FWD deflections. The procedure and results of implementation are presented in this paper to provide pavement designers a better understanding when using FWD measurements in the adapted Iowa AC overlay design method.

Keywords: pavements—design—nondestructive testing (NDT)—— rehabilitation——asphalt concrete (AC)

[1] Iowa State University, Ames, IA 50011; Phone (515) 294-8051; Fax (515) 294-8216; email: hceylan@iastate.edu

[2] Iowa State University, Ames, IA 50011; Phone (515) 294-4698; Fax (515) 294-8216; email: shuoy@iastate.edu

[3] Iowa State University, Ames, IA 50011; Phone (515) 294-4698; Fax (515) 294-8216; email: sunghwan@iastate.edu

[4] Iowa State University, Ames, IA 50011; Phone (515) 294-3044; Fax (515) 294-8216; email: rangan@iastate.edu

Iowa Department of Transportation Centennial: 100 Years of Contributions Transportation Research and Engineering

Leighton L. Christiansen[1]

Abstract

In 2013 the Iowa Department of Transportation is celebrating 100 years of contributions to transportation research and engineering that have shaped transportation decision making at the state, regional, and national levels. Beginning as the Iowa State Highway Commission in 1913, with offices in the engineering department at Iowa State College of Agriculture and Mechanic Arts, the engineers, designers, planners, and scientists made important impacts on the development of the Highway Research Board (now the FHWA), the design of highways and interstates, and the prototyping of equipment, such as the slip-form paver. Iowa DOT Librarian and member of the Iowa DOT 100th Anniversary Committee, Leighton Christiansen, will discuss these and other important contributions, illustrated with historic photos from the Iowa DOT Archives, made by the Iowa DOT that continue to affect research and decision making.

Keywords: Civil engineering—Transportation engineers—Materials—Vehicles and equipment—History

[1] InTrans and Iowa DOT, 800 Lincoln Way, Ames, Iowa 50010; Phone (515) 239-1200; Fax (555) 555-7717; email: leighton.christiansen@dot.iowa.gov

Iowa Strategic Highway Safety Plan

Jeremey Vortherms, PE[1]

Abstract

This presentation would share the key aspects of the newly developed Strategic Highway Safety Plan for Iowa including the process followed, data reduction, stakeholder engagement, strategies, the implementation plan, emerging Local Safety Plans and the connection to Toward Zero Deaths. The vision for the future comes with missing information and a need for continuing and new research.

Keywords: keyword 1—keyword 2—keyword 3—keyword 4—keyword 5

[1] Iowa Department of Transportation, Office of Traffic and Safety, 800 Lincoln Way, Ames, Iowa 50010; Phone (515) 239-1267; email: jeremey.vortherms@dot.iowa.gov

Hawkins

Kadyn's Law

In 2012, the Iowa legislature passed a bill for an act relating to school bus safety, including providing penalties for failure to obey school bus warning lamps and stop signal arms, providing for a school bus safety study and administrative remedies, and making an appropriation. The bill, referred to as Iowa Senate File (SF) 2218 or "Kadyn's Law," became effective March 16, 2012. A multiagency committee addressed three specific safety study elements of Kadyn's Law as follows:

- Use of cameras mounted on school buses to enhance the safety of children riding the buses and aid in enforcement of motor vehicle laws pertaining to stop-arm violations
- Feasibility of requiring school children to be picked up and dropped off on the side of the road on which their home is located
- Inclusion of school bus safety as a priority in driver training curriculum

This presentation will summarize the study findings.

Laboratory Investigation of ABC Connection Details using Grouted Couplers

Travis Hosteng[1], Brent Phares[2], Ahmad Abu-Hawash[3], Dean Bierwagen[4]

Abstract

External demands such as traffic volume and construction safety along with the ever present need for quality control have resulted in an increasing desire for bridge engineers to utilize accelerated bridge construction (ABC) techniques. As such, it is critical that bridge designers and contractors have confidence in details which are typically encountered in ABC designs. However, many of the ABC projects involve connection details that are either unfamiliar to the bridge engineer/contractor, are untested, or potentially both. In addition, previous laboratory testing of specific ABC connection details has indicated that not all connection details function in the bridge application as they are sometimes promoted by their developers. Thus it is critical that these connection details be evaluated in the form which they are or will be utilized in the ABC process to assess their integrity and performance, both short and long term. One such connection detail of interest is the grouted rebar coupler connection detail.

Currently, a research study is in progress sponsored by the Iowa Department of Transportation involving the laboratory testing of an ABC connection utilizing grouted rebar couplers. The objective of this study is to perform laboratory testing and evaluation of a grouted coupler connection detail to assess the performance of the connection made through comparisons with design assumptions, previous research (which typically only evaluates the coupler strength in a pure tension test), and physical performance of the coupled connections. In addition, this study also aims at assessing the effectiveness of the coupled connection to resist intrusion of water and chlorides. The laboratory testing will involve constructing three coupled specimens, each approximately 2ft x 2ft by 8ft long, utilizing #14 grouted couplers and #14 coated bars to evaluate the performance of the connection in bending (simulating a pier column connection to a drilled shaft or pier foundation). Further evaluation of the connection detail will be conducted to assess its resistance to moisture intrusion. Upon conclusion of the laboratory testing, recommendations for the use and construction of the grouted rebar coupler connection detail will be developed for use in future ABC projects.

This presentation will focus on the design and construction of the laboratory specimens used in the testing along with the proposed test setup. In addition, any laboratory test data and results available at the time of the conference will be included in the presentation.

Key words: grouted couplers – bridge testing – accelerated bridge construction – ABC – precast connections

---

[1]Bridge Research Specialist, Bridge Engineering Center, Iowa State University, Ames, IA 50011, Tel: 515-294-7197, Fax: 515-294-0467, Email: kickhos@iastate.edu

[2]Director, Bridge Engineering Center, Iowa State University, Ames, IA 50011, Tel: 515-294-5879, Fax: 515-294-0467, Email: bphares@iastate.edu

[3]Chief Structural Engineer, Office of Bridges and Structures, Iowa Department of Transportation, Ames, IA 50010, Tel: 515-239-1393, Fax: 515-239-1978, Email: Ahmad.Abu-Hawash@dot.iowa.gov

[4]Final Design Section Leader, Office of Bridges and Structures, Iowa Department of Transportation, Ames, IA 50010, Tel: 515-239-1174, Fax: 515-239-1978, Email: Dean.Bierwagen@dot.iowa.gov

Laboratory Investigation of Iowa ABC Connection: Cass County HWY 92 Lateral Slide Bridge

Justin Dahlberg[1], Brent Phares[2], Jim Nelson[3], Ahmad Abu-Hawash[4], Dean Bierwagen[5]

Abstract

Accelerated Bridge Construction (ABC) has become increasingly popular among state departments of transportation (DOT) as the duration of traditional bridge construction has become increasingly more unacceptable to the traveling public and businesses that have adopted "just-in-time delivery" practices. Simply stated, the inconvenience of additional time and money spent traveling due to traditional bridge construction has created a demand and this demand justifies the pursuit of accelerated construction methods. To date several DOT's have carried out ABC projects with varying levels of success. Methods and lessons learned from these projects are being circulated through various publications including those from the Federal Highway Administration, state DOT's, and university researchers. Even so, there is a significant void in the pool of knowledge for ABC construction, especially regarding the connection details, design, and performance. Additional studies are required to fully understand how current methods perform as well as how they can be improved. Plans by the Iowa DOT are underway to remove and replace a bridge using accelerated construction methods in Cass County, Iowa on Hwy 92. The overall objective of this study is to assess the performance of one of the connections being proposed for this reconstruction project.

Critical components to any ABC project are precast/prefabricated elements that can be constructed offsite or off the roadway then moved into place; in the case of the HWY 92 project, one of the precast elements includes precast abutment footings. Void forms constructed from corrugated metal pipe (CMP) are located in the abutment footing at the locations of driven steel H-piles. After the piles have been driven, this element will be lowered into place encompassing the piles and the void form grouted solid. It is this connection (the interface between piles, grout, and CMP) that was evaluated through laboratory testing. Moreover, an assessment of varying shear connector types and configurations for use between the steel pile and grout was completed.

Nine full cross-sectional-scale specimens, 11 ft. long to accommodate replication of girder positions, were constructed at the Iowa State University structures lab. Each specimen was constructed identically with the CMP void forms and H-pile sections with the only difference being that three specimens each consisted of a different shear connector configuration between the pile and void form grout: 1) shear stud connectors, 2) threaded bar and nuts, and 3) no shear connector. For all tests, the specimen was equipped with strain and deflection gages placed in strategic locations for data collection during loading; all loads were applied through the pile section. This presentation will focus on the results obtained for ultimate capacity of the connection and the long-term performance under cyclic loads.

Key Words: Accelerated Bridge Construction, Connections, Shear Connectors,

[1]Bridge Research Engineer, Bridge Engineering Center, Iowa State University, Ames, IA 50011, Tel: 515-294-9360, Fax: 515-294-0467, Email: dahlberg@iastate.edu

[2]Director, Bridge Engineering Center, Iowa State University, Ames, IA 50011, Tel: 515-294-5879, Email: bphares@iastate.edu

[3]Final Design Section Leader, Office of Bridges and Structures, Iowa Department of Transportation, Ames, IA 50010, Tel: 515-239-1143, Fax: 515-239-1978, Email: James.S.Nelson@dot.iowa.gov

[4]Chief Structural Engineer, Office of Bridges and Structures, Iowa Department of Transportation, Ames, IA, 50010, Tel: 515-239-1290, Fax: 515-239-1393, Fax: 515-239-1978, Email: Ahmad.Abu-Hawash@dot.iowa.gov

[5]Final Design Section Leader, Office of Bridges and Structures, Iowa Department of Transportation, Ames, IA 50010, Tel: 515-239-1174, Fax: 515-239-1978, Email: Dean.Bierwagen@dot.iowa.gov

Lateral Live-Load Distribution for Timber Girder Bridges subjected to Implements of Husbandry

Junwon Seo[1], Brent Phares[2], Chandra Kilaru[3], and Ping Lu[4]

Abstract

The AASHTO Standard and LRFD Specifications provide simplified formulas to determine live load distribution factors (LLDFs) for roadway timber bridges. The AASHTO formulas have been developed considering only the effects of typical highway vehicles. However, a significant number of timber bridges are on secondary roadways where heavy farm vehicles frequently operate. Farm vehicles have a wider range of geometries and weights than highway trucks; thus, their variability may result in different LLDFs compared to the AASHTO code-specified LLDFs. Therefore, it is essential to better understand the LLDFs for timber bridges under the effect of agricultural loadings. The focus of this study is the accurate determination of LLDFs for a timber bridge through field testing and numerical simulations. Several bridges were tested with four different farm vehicles and one highway truck. An analytical model of each bridge was then generated using commercially available finite element analysis (FEA) software and optimized with field data. Over one hundred of farm vehicles were then used as input loads in model simulations. Analytical DFs were determined from the simulations under the vehicles with multiple transverse locations. Results showed that the analytical LLDFs for most girders sometimes exceeded the AASHTO codified values.

Keywords: Timber Bridge, Live Load Distribution Factor, Field Testing, Codified Process, Numerical Simulation

[1] Assistant Research Professor, Department of Civil, Construction, and Environmental Engineering, Iowa State University, Ames, IA 50014; Phone: 515-294-3044; email: jseo@iastate.edu
[2] Director, Bridge Engineering Center, Iowa State University, Ames, IA 50014; Phone: 515-294-5879; email: bphares@iastate.edu
[3] Graduate Research Assistant, Bridge Engineering Center, Iowa State University, Ames, IA 50014; Phone: 941-323-0265; email: teja@iastate.edu
[4] Bridge Rating Engineer, Iowa Department of Transportation, Ames, IA 50010; Phone: 515-239-1290; email: ping.lu@dot.iowa.gov

Longitudinal Cracking in Jointed Plain Concrete Pavement: Synthesis of Practices and Performance in the Midwest

Samuel Owusu-Ababio[1] & Robert L. Schmitt[2]

ABSTRACT

A survey of six Midwestern states was conducted as part of a research study to develop guidance on the optimal panel width for improving jointed plain concrete pavement performance. This paper presents an analysis of the various elements associated with current panel width practices for jointed plain concrete pavements as reported by the Midwestern states. The elements include: policies and procedures for panel width selection on two- and multi-lane rural highways, commonly used panel widths, frequency of longitudinal cracking occurrence, probable causes of longitudinal cracking, and treatment methods.

The analysis revealed that there is considerable variation among the states on the elements. However, pavement thickness appears to be the dominant factor in the selection of panel width. While 12- and 15-ft panel widths are common on 2-lane 2-way rural pavements, the 12-ft panel section is likely to be used on rural multilane pavements. The 12-ft and 15-ft wide panels were reported to have higher longitudinal cracking frequencies compared to 13- and 14-ft wide panels. The higher frequencies were attributed to inadequate subbase compaction, poor joint saw-cut timing, misaligned dowel bars, and faulty vibrators. In addition, 12-ft panels on 2-lane facilities located in cut/fill sections and in the vicinity of highway structures were reported to exhibit higher cracking frequencies compared to 15-ft panels at similar locations.

Keywords: JPCP, Panel, Cracking, Performance, Midwest

[1]P.E., Professor., Dept. of Civil and Envr. Engr., Univ. of Wisc., Platteville, WI, 53818. Phone: 608-342-1554 Fax: 608-342-1566 owusu@uwplatt.edu.

[2]P.E., Professor, Dept. of Civil and Envr. Engr., Univ. of Wisc., Platteville, WI, 53818. Phone: 608-342-1239 Fax: 608-342-1566 schmitro@uwplatt.edu.

Moving Ahead with Freight: Integrating State and Regional Freight Development in a National Freight Planning Context.

Ernest B. Perry, Teresa M. Adams, Ben Zietlow and Alex Marach. Mid-America Freight Coalition and The National Center for Freight and Infrastructure Research and Education. University of Wisconsin-Madison. Contact at: ebperry@wisc.edu or 608-890-2310.

Abstract

The key freight planning advances recommended in MAP-21 include the development of state and national freight plans, and the collateral development of a national freight network as specified in the legislation. This research provides a three tiered approach to understanding how state freight planning can build to a national strategic freight plan, and how states can understand and frame their state and regionally important freight corridors within a national freight corridor network.

The first component of the analysis consists of an inventory of the breadth and status of state freight planning activities in the 10 MAFC states and compares these efforts to those across the nation. Secondly, the research examines a national priority freight network from the MAASTO state and regional perspective and compares state and regional corridors and connectors with the national system. The assessment of the MAASTO state freight system, including both the planning efforts and the state and regional corridor networks, are then related to MAP-21 freight policy developments and strategies. Based on a gap analysis, development strategies and policy initiatives are identified to increase awareness of the MASTO regions' freight resources in ongoing policy discussions, and to support the accommodation of the significant freight systems in the MAASTO states in national policy and network.

Keywords: MAP-21 -- Freight Planning — Freight Corridors — Mid-America Freight Coalition

National and Regional Level Analysis of the Large Truck Accidents in the US

Shashi Nambisan

Professor of Civil Engineering

Institute for Transportation (InTrans)

Iowa State University

2711 South Loop Drive, Suite 4700

Ames, IA 50010-8664

E-mail: shashi@iastate.edu;

Tel: +1-515-294-5209; Fax: 1-515-294-5209

Murat Ozen

Research Assistant

Middle East Technical University

Department of Civil Engineering

06800, Ankara-TURKEY

E-mail: mozen@metu.edu.tr

Tel: +90 312 2102437; Fax: +90 312 2105401

ABSTRACT

This paper summarizes the methods used and resulting findings of a study on large truck safety in the United States. The analyses were conducted at national and regional level for the years from 2000 to 2010 using data maintained by the US Department of Transportation. A measure of exposure used in the analyses was fatal crash rates per 100 million Truck Vehicle Kilometers. More specifically, this study focused on whether a new methodology adopted in 2007 by the US Department of Transportation to quantify the number of registered trucks and truck VKT affected the fatal large truck crash rates at a national and regional level.

Many statistical analyses and comparisons were provided to compare truck and non-truck fatal crash rates, urban and rural fatal truck crash rates, and truck crash rates on different highway types. Besides, fatal crash rates were compared across the 10 federal regions used by the US DOT and other US Federal Agencies before and after implementation of new methodology. The results showed that fatal truck crash rates and percentage of registered trucks and fatal truck crash rates were significantly affected by implementation of the new methodology. Implementation of new methodology affected fatal truck crash rates more significantly than the non-truck crash rates. In addition, regional fatal crash rates showed some geographical patterns. Northwest and the Upper Great Plains tend to be ranked near the bottom (better safety records) and South and Southeast tend to be ranked among the top (poorer safety records).

Keywords*:* Large truck crashes, crash rates, comparative safety analysis

Optimal Conversion of an Evacuation Network to Signalized and Uninterrupted flow intersections

Yue Liu, Zhenke Luo

Abstract

Due to the advantage over signals in expanding network capacity, the strategy of using uninterrupted-flow (or crossing-elimination) intersections has been viewed as one of the most effective means for managing evacuation traffic. However, implementing such a strategy may demand a large amount of manpower and resources, and often need some evacuees to take additional detours. To optimize the selection and distribution of signalized and uninterrupted flow intersections in an evacuation network, this article presents a mathematical model with equilibrium constraints to yield the maximum operational efficiency under the available budget. The proposed model, incorporating a parametric variational inequality (VI) to formulate the user equilibrium (UE) behavior of evacuees in route choice, is capable of providing effective solutions to the following critical questions that have long challenged transportation professionals for strategic planning of an emergency or special event: 1) how many intersections should be implemented with the signals and interrupted flow controls; 2) what would be the optimal spatial distribution for those intersections in the target network; and 3) how to best design turning restriction, channelization, and signal timings at those intersections? In view of the large number of variables and constraints for the proposed model, this study has developed an efficient heuristic approach embedded with a diagonalization algorithm to yield the meta-optimal solutions. An extensive numerical analysis with a sub-network in Washington DC is also performed to demonstrate the applicability and effectiveness of the proposed model.

Keywords: Evacuation network—spatial distribution—signalized intersections—uninterrupted flow intersections—heuristic solution

Performance Engineered Mixtures for Concrete Pavements

Peter Taylor

In an age where budgets are shrinking, demands are increasing, good materials are growing scarce and sustainability is growing in importance, there is a need to move away from traditional recipe based concrete mixtures.

This paper will present the current thinking on how concrete mixtures can be tuned to meet the needs of the pavement and the environment it is exposed to, using locally available materials, while minimizing cost and environmental impact.

The discussion will include how specifications need to be reconsidered, test methods developed and processes modified. A major part of the discussion will be a review of an innovative approach to mix proportioning that is being developed.

Post-Grouting, Load Testing, and Long-Term Performance of Drilled Shafts on Broadway Viaduct Project

Jeramy C. Ashlock[1], Brent M. Phares[2], and Ahmad Abu-Hawash[3]

Abstract

Pressure grouting beneath the tips of drilled shafts has been employed in many countries around the world to increase the mobilized unit end-bearing resistance of drilled shafts within service displacement limits. The 2010 Broadway Viaduct reconstruction project in Council Bluffs featured the first use of post-grouted drilled shafts by the Iowa DOT. Statnamic tests were previously performed at the site on one 55 ft long control shaft, and two shafts 55 and 65 ft in length which were post-grouted via the port sleeve (tube à manchette) approach. However, a lower than expected increase in end bearing resistance was observed for the grouted shafts in these tests. For the present study, O-cell load tests were performed on two additional 75 ft long test shafts in conjunction with the viaduct reconstruction, with one shaft post-grouted via the flat jacking approach. Despite the use of staged grouting and a rather large grout take of 5.7cubic yards, the design grouting pressure was not achieved. However, grouting on all 53 production shafts on the project was essentially successful, with most shafts reaching their design grouting pressure or uplift criterion. Grouting and load testing of the drilled shafts are discussed, in addition to a forensic investigation performed to determine the reason for the lack of performance of the 75 ft grouted test shaft. Long term performance monitoring data on four instrumented production shafts is also briefly discussed.

Keywords: Drilled shaft, deep foundation, post grouting, load test, performance monitoring

[1] Assistant Professor, Department of Civil, Construction and Environmental Engineering, 474 Town Engineering Building Iowa State University, Ames, IA 50011; Phone (515) 294-6176; Fax (515) 294-8216; email: jashlock@iastate.edu

[2] Director, Bridge Engineering Center, Iowa State University Institute for Transportation, Iowa State University, Ames, IA 50011; Phone (515) 294-5879; Fax (515) 294-0467; email: bphares@iastate.edu

[3] Chief Structural Engineer, Office of Bridges and Structures, Iowa Department of Transportation, 800 Lincoln Way, Ames, IA 50010; Phone (515) 239-1393; email: Ahmad.Abu-Hawash@dot.iowa.gov

Prestressed Concrete-Steel Composite Girders for Bridges

Yaohua Deng[1] and George Morcous[2]

Abstract

A large portion of the bridges in United States are constructed using the stringer/multi-girder system including steel and prestressed concrete girders. Steel girders are preferred in continuous, curved, and long span bridges due to their lightweight, flexibility (i.e., curved and non-prismatic), and strength. The disadvantages of steel girders include high material cost, high maintenance cost and being susceptible to corrosion due to chloride-contaminated splashes. Prestressed concrete girders are preferred in simple span, straight, and short-medium span due to their high stiffness, durability and low material cost. The disadvantages of prestressed concrete girders include heavy weight, difficulty of making them continuous or curved, and being susceptible to concrete cracking at end zone and the top flange at prestress release.

With the goal of enriching the existing types of bridges as well as combining the merits of steel and prestressed concrete girders, this study introduces a new Prestressed Concrete-Steel Composite (PCSC) girder system to provide a viable alternative for steel and prestressed concrete I-girders in bridges. The PCSC girder is composed of a lightweight W-shape steel section with shear studs on its top and bottom flanges to achieve composite action with the pretensioned concrete bottom flange and the cast-in-place concrete deck, as described in Figure 1. The PCSC girder is lightweight, economical, durable and easy to fabricate. A PCSC girder specimen was fabricated in the structural lab following the fabrication procedure as illustrated in Figure 2. The fabrication and service design procedures are validated against the monitored structural performance through 60-day instrumentation of the PCSC girder specimen. Flexural and shear tests were conducted to evaluate the flexural and shear capacities of the fabricated

specimen. The crack moment and ultimate moment of the PCSC girder are well predicted using design calculations. However, the ultimate shear of the PCSC girder is underestimated by only considering shear strength of the steel beam based on AASHTO LRFD Bridge Specifications.

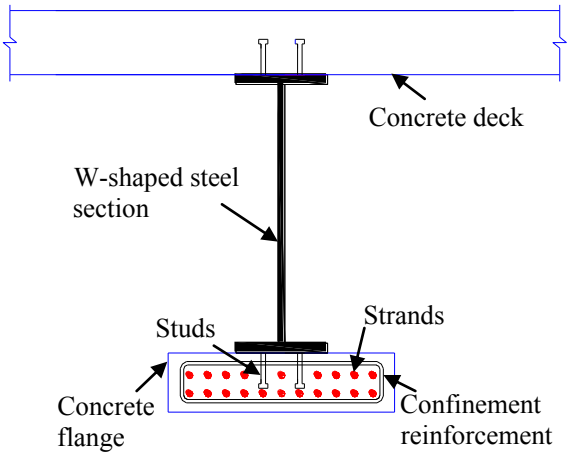

Figure 1. Cross-section of the PCSC Girder

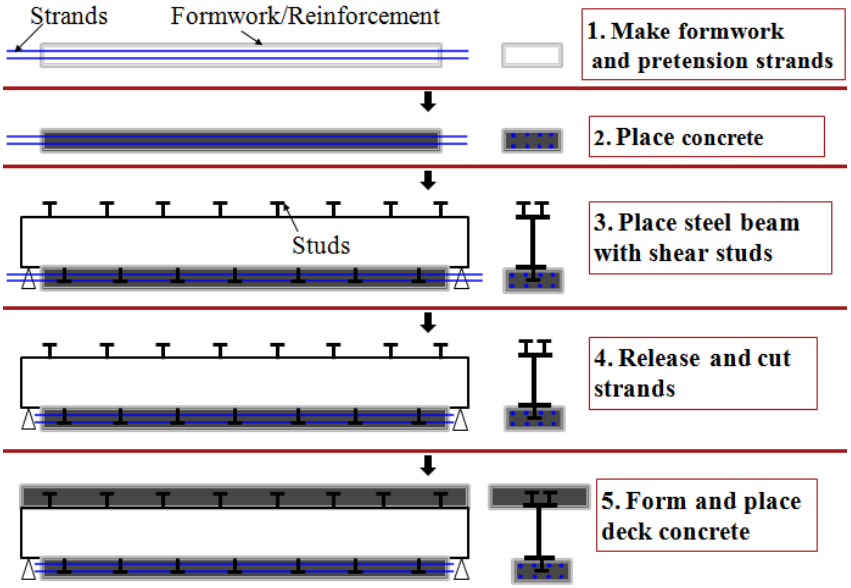

Figure 2. Fabrication Procedure

Key words: Prestressed Concrete-Steel Composite Girder—Lab Fabrication—Lab Testing—Design Validation—Ultimate Strength

[1]Postdoctoral Research Associate, Bridge Engineering Center, Institute for Transportation, Iowa State University Research Park, Ames, IA 50010; Email: jimdeng@iastate.edu; Tel: 515-294-2882.

[2]Associate Professor, Durham School of Architectural Engineering and Construction, University of Nebraska-Lincoln, Omaha, NE 68182; E-mail: gmorcous2@unl.edu; Tel: 402-554-2554.

Prioritization Techniques to Evaluate Sites for Improving Winter Safety in Iowa

Mohammad Shaheed[1], Zach Hans[2], Konstantina Gkritza[3], Inya Nlenanya[4], and Neal Hawkins[5]

Abstract

Each winter, hundreds of drivers are injured on Iowa's highways due to winter-weather related crashes. Though the transportation agencies spend millions of dollars on proactive and reactive maintenance for ensuring best possible pavement conditions and visibility for traveling motorists, there is no systematic method to identify potentially problematic winter weather-related crash locations in Iowa. The objective of this paper is to identify candidate locations to improve safety during winter weather conditions using different prioritization techniques and winter weather crash data from 2002-2009 for different types of roadways (interstate/freeway, multilane and two-lane highways). These techniques include evaluating sites by crash frequency, crash proportion, and crash severity, as well as a combined metric assigning equal weights on crash frequency, proportion, and severity. A moving average analysis was also conducted for 3-mile road segments on I-29, I-35, I-80, I-680, I-380 and US-20 roadways to take into account the spatial proximity of the segments in the ranking process. The paper concludes with a comparison of the results produced by the different methods. The results of this paper can assist state agencies to identify high crash locations during winter weather conditions and screen road networks for winter safety improvements.

Keywords: winter maintenance and operations—roadway screening—weather-related crashes

[1] Graduate Research Assistant, Iowa State University, Institute for Transportation, 2711 S Loop Drive, Ames, IA 50010; Phone (515) 708-5756; email: mshaheed@iastate.edu

[2]Research Engineer, Iowa State University Institute for Transportation, 2711 S Loop Drive, Ames, IA 50010; Phone (515) 294-2329; Fax (515) 294-0467; email: zhans@iastate.edu

[3] Assistant Professor, Iowa State University, Department of Civil, Construction & Environmental Engineering, 404 Town Engineering, Ames, IA 50011; Phone (515) 294-2343; Fax (515) 294-7424; email: nadia@ iastate.edu

[4] Transportation Research Specialist, Iowa State University, Institute for Transportation, 2711 S Loop Drive, Ames, IA 50010; Phone (515) 294-2373; Fax (515) 294-0467; email: inya@ iastate.edu

[5] Director, Iowa State University, Institute for Transportation, 2711 S Loop Drive, Ames, IA 50010; Phone (515) 294-7733; Fax (515) 294-0467; email: hawkins@ iastate.edu

Quality Control/Quality Assurance of Asphalt Mixtures Using Surface Wave Methods

Shibin Lin[1], Jeramy C. Ashlock[2], R. Christopher Williams[3] and Hosin (David) Lee[4]

Abstract

Preliminary results are presented for an ongoing Iowa DOT research project on evaluation of non-destructive quality control and quality assurance (QC/QA) methods for asphalt pavements. The project features a comparison of surface wave methods, electromagnetic gauges, MEMS sensors, the Humboldt Geogauge stiffness gauge, and laboratory tests on core samples. Surface wave methods involve the measurement of Quasi-Rayleigh waves (i.e. Lamb waves) travelling along the asphalt surface due to an impact, and can provide gains in efficiency and economy for in-situ QC/QA of asphalt pavements. The data enables calculation of a dispersion image describing the relationship between phase velocity and frequency. The dispersion image depends intimately upon the modulus or stiffness of the asphalt layer, which is directly related to long-term durability and performance of asphalt pavements. An economical customized surface wave acquisition and analysis system was developed by the authors using MATLAB software and hardware from National Instruments and PCB Piezotronics. A measurement microphone is also being evaluated as a more efficient noncontact sensor for surface wave testing, which eliminates the need to physically couple accelerometers to the pavement. Preliminary laboratory and field results are presented which show promise for application of the surface wave testing system to QA/QC of asphalt pavements.

Keywords: Asphalt, nondestructive evaluation, surface wave methods, quality control, quality assurance, stiffness

[1] Graduate Research Assistant, Iowa State University, Department of Civil, Construction and Environmental Engineering, 405 Town Engineering Building, Ames, IA 50011; email: slin@iastate.edu

[2] Assistant Professor, Department of Civil, Construction and Environmental Engineering, 474 Town Engineering Building Iowa State University, Ames, IA 50011; Phone (515) 294-6176; Fax (515) 294-8216; email: jashlock@iastate.edu

[3] Professor, Department of Civil, Construction and Environmental Engineering, 490 Town Engineering Building Iowa State University, Ames, IA 50011; Phone (515) 294-4419; Fax (515) 294-8216; email: rwilliam@iastate.edu

[4] Professor, University of Iowa, Department of Civil and Environmental Engineering, 4105 Seamans Center, Iowa City, Iowa, 52242; Phone: (319) 384-0831; Fax: (319) 335-5660; email: hlee@engineering.uiowa.edu

Rank traffic safety improvement projects with an importance segregated multi-objective optimization model

Yue Liu, Jie Yu, Jing Mao

Abstract

This paper presents a multi-objective optimization model to decide effective and beneficial portfolio for implementing traffic safety improvements under budgetary constraints. Different from the conventional multi-objective approaches, the proposed model segregates decision criteria into different importance levels and designs a successive optimization approach to obtain the final solution(s). Such modeling features offer the advantages to: 1) prevent the arbitrariness for transportation agencies to determine weights for decision criteria; 2) remedy the deficiency of over-weighting less important criteria in the traditional multi-objective optimization approach; and 3) minimize the number of potential solutions for final decision by transportation agencies with enhanced screening of the sub-optimal solutions. Case study results reveal that the proposed model is efficient not only for deciding the most suitable traffic safety countermeasure for a specific site, but also for determining the plans for implementing multiple countermeasures among multiple sites given the budget constraint. Comparative study results have also indicated that the proposed model outperforms the traditional criteria in objectively selecting traffic safety improvements in a multi-criteria decision-making process. The clarity of model inputs and the interpretation of results with respect to different selection criteria offer its best potential to be used as an effective decision-support tool for transportation authorities to assess and refine their safety improvement investments.

Keywords: Multi-objective decision making—Importance Segregation—Traffic safety—Countermeasure selection—Transportation engineering

Roadway Design Models: Streamlining Conversion for Driving Simulation

While providing recognized value in the fields of research and training, driving simulation application in the field of civil engineering roadway design has been slow to gain acceptance in the U.S. due partly to investment cost, long lead time for scenario and content development, and specialized expertise to support that investment.

Within these constraints it becomes necessary to develop a simplified process whereby public Transportation engineers continue to design roadway projects using standard methods, and then integrate those designs into a virtual proving ground simulation – trying the designs in the same fashion the project will ultimately be used – by experiencing it in the four dimensional world of a driving simulator.

This paper presents a project that created an automated software application which generates a driving simulator environment directly from a 3D transportation model. There were two overriding requirements: minimal user interaction, and visualization of the graphical representation of the engineering design. Variability in the design model (2D vs 3D) despite civil design standards was one challenge encountered during converter development. Especially problematic are junction elements that make up the logical road network used by the scenario vehicles to navigate around the model.

The end product is a tool that has been successfully tested on one grade separated freeway interchange design model. Future work for increasing the capabilities of the tool will focus on creating textured surfaces and solids, extending the junction processing to improve curve definition, and supporting multi-level interchanges and more complicated models.

Shrinkage and Cracking Behavior of HPC Used for Bridge Deck Overlays

Hasitha B. Seneviratne[1], Kejin Wang[2], Scott M. Schlorholtz [3]and Sri Sritharan [4]

Abstract

HPC overlays are an effective and economical repair method for bridge decks and they are increasingly used by state Departments of Transportation (DOTs). HPC mixes usually consist of large amounts of cementitious materials and tend to have high shrinkage cracking potential.

In the present study, shrinkage behavior and cracking potential of 11 HPC mixes, used by the Iowa DOT, are investigated. These mixes composed of 3 types of cements (Type I, I/II and IP) and various supplementary cementitious materials (Class C fly ash, slag and metakaolin at the cement replacement level of 20%, 15% and 5.6%, respectively). Limestone, with 2 different gradations, was used as coarse aggregate for 10 mixes, and quartzite was used for one mix. Free and restrained drying shrinkage of these concrete mixes were monitored with time. Elastic modulus, compressive and split tensile strength of the concrete were measured at different ages. Creep coefficients of the concrete were estimated using the B-3 and AASHTO Report 496 (2009) models, and the modeled creep coefficients are used to assess the cracking potential of the corresponding concrete mixes.

The results of the study indicate that the stresses resulting from the restrained shrinkage have good correlation with the stresses resulting from the free shrinkage of concrete. Not all mixes having a high shrinkage value cracked first. The stress in the concrete are primarily associated with the concrete shrinkage, elastic modulus and creep.

Keywords: shrinkage—elastic modulus—creep—cracking potential

[1] Graduate Research Assistant, Civil, Construction and Environmental Engineering, Iowa State University, Ames, IA 50010; Phone (515) 441-5089; email: hasitha@iastate.edu

[2] Professor, Civil, Construction and Environmental Engineering, Iowa State University, Ames, IA 50010; Phone (515) 294-2140; Fax (515) 294-2816; email: kejinw@iastate.edu

[3] Scientist, Department of Biotechnology, Iowa State University, Ames, IA 50010; Phone (515) 294-8761; Fax (515) 294-8216; email: sschlor@iastate.edu

[4] Professor, Civil, Construction and Environmental Engineering, Iowa State University, Ames, IA 50010; Phone (515) 294-5238; Fax (515) 294-8216; email: sri@iastate.edu

The Economics of Closing Bridges on Very Low Volume Rural Roads in Kansas

Eric J. Fitzsimmons[1] and Thomas E. Mulinazzi[2]

Abstract

The State of Kansas has approximately 25,464 bridges that are located on state, county, and city roadway networks. As of May 2012, approximately 1,229 bridges on very low volume roads were determined through inspection to be structurally deficient and a candidate structure to be potentially closed, replaced or repaired. County commissioners have a critical role in in deciding the fate of many of these bridges with limited resources, political pressure, and knowing that these structures may be the only way for some people to get to a paved roadway from their homes and businesses. This study was designed to provide critical information for Kansas county commissioners or practicing engineers such as (1) Where structurally deficient bridges on low volume roads are located within Kansas; (2) What distance is the shortest drivable detour if these bridges were to be closed; and (3) Whether to recommend closing or repair/replace the structurally deficient bridge based on both potential detour length and Average Daily Traffic (ADT). The results of the study indicated that many of Kansas' structurally deficient bridges on very low volume roadways had a detour less than two miles, were steel bridges, and candidate bridges recommended for closing had an ADT of under eight vehicles and detour length of nine miles or less.

Keywords: Very Low Volume Roadways—Deficient Bridges—Economic Analysis

[1] Lecturer / Post Doctoral Research, University of Kansas, 2159A Learned Hall, 1530 West 15th Street, Lawrence, Kansas 66045; Phone (785) 864-1921; Fax (785) 864-5631; email: fitzsimmons@ku.edu

[2] Interim Chair and Professor of Civil Engineering, University of Kansas, 2150 Learned Hall, 1530 West 15th Street, Lawrence, Kansas 66045; Phone (785) 864-2928; Fax (785) 864-5631; email: tomm@ku.edu

The Impact of Transportation Projects in the Community

Maria Catalina Miller[1]

Abstract

When making decisions about where to allocate the resources for transportation maintenance projects, engineers gather a wide range of performance indicators such as PSI (Pavement Serviceability Index), and/or IRI (International Roughness Index). These indicators attempt to measure the physical conditions of the assets. The Iowa DOT desires to transition its asset management program from one that prioritizes projects by "worst first" to one that understands the project's impact on economic, social and safety requirements, some DOTs also measure Average Daily Traffic, accident rates, speed, visibility, and life cycle cost, among others. This presentation will discuss the various options under consideration for providing a reliable and justifiable method to make infrastructure asset management decisions in Iowa

Many states like Georgia emphasize traffic volume to make resource allocation decisions. Hence, roads with low traffic volumes are unable to get a fair share of available funding. In Iowa, the economy is based on agriculture and the transportation network's ability to transport those commodities to market. Thus, equitable distribution of funds becomes more complex. If low volume roads are not funded to cover adequate maintenance a negative impact on the State's agricultural economy occurs. Therefore it is important to identify a comprehensive way to measure the impact of the assets on the community and in this way to add this indicators to the decision making process.

Non-profit organizations such as the World Bank have developed algorithms to integrate the social value of improved infrastructure to growth and equity in developing countries with agricultural economies. Other private and public entities are also interested in how to value social outcomes in monetary terms. Some methodologies like Social Return on Investment (SROI) provide a structured approach to evaluating social, economic and environmental outcomes of capital infrastructure investments. The presentation furnishes the results of comparative analysis of the different available methodologies and finds that it is possible to develop a model that accommodates a project's impact on all stakeholders not just ones in urban, high ADT areas and increases the fair distribution of available resources for the Iowa transportation asset management program.

.

Keywords: Transportation Assets Management— Social Return on Investment— Social Impact — Rural Roads —Agriculture

[1] Iowa State University, 165 Delft Dr, Pella, IA 50219; Phone (407) 276-7311; email: mmiller@iastate.edu

The Impacts of Extended Interstate Closures to Regional Freight Logistics:

A Case Study of the 2011 Interstate 29 Closure

This research utilized empirical Freight Performance Measure (FPM) data to localize and quantitatively assess the impacts of an interstate closure. The utilization of FPM data allows for a contemporary analysis beyond traditional theoretical modeling, simulations, windshield surveys or manual traffic counts. Specifically, this research examined the localized changes in regional freight flows with the specified origins/destinations of Kansas City, Missouri/Kansas and Omaha, Nebraska/Council Bluffs, Iowa during the Missouri River flooding of 2011, which caused 49 miles of Interstate 29 to be closed for 115 days. Based on this analysis, most of the truck traffic did not adhere to the State DOT designated detour routes, which aimed to keep the trucks on interstates or four-lane divided facilities. Other routes utilized were advantageous in regard to driver costs, vehicle costs, travel time, and vehicle miles traveled when compared with the designated detour routes. The impacts of the Interstate 29 closure to localized freight movements were quantified and include the following: vehicle and driver costs (+10.1%), travel time (+21%), and vehicle miles traveled (+12%). Finally, this paper examined if there was a progression of route selection over the four month period of the interstate closure. This analysis concluded that regional truck route selection progressed to the most efficient alternate routes between Kansas City and Omaha.

Iowa DOT is finalizing research to streamline field inventory/inspection of culverts while maximizing the use of tablet technologies. This is phase II of research which began in 2011 to develop some new best practices for field staff to assist in the inventory, inspection and maintenance of assets along the roadway. We have spent the past year working through the trials and tribulations related to locating the most appropriate tablet hardware. We have also identified several other safety related assets (signs, guardrail, and incidents) to be collected using the tablet interface. Data can be collected in disconnected or connected modes and we have an associated desktop environment where data can be viewed and queried upon being synched. We have developed a deployment plan and workflow processes that will eventually make this part of our larger asset management system.

Three-Tiered Data & Information Integration Framework for Highway Project Decision- Makings

Asregedew Woldesenbet[1], "David" Hyung Seok Jeong[2], Michael Phil Lewis[3], Hossein Khaleghian[4]

ABSTRACT

The advancement in digital data storage technology and devices, better database management systems and data warehouse technology has allowed State DOTs to collect, store and manage large amount of highway project data. These data range from surveying data during the planning phase to pavement condition data during the operation and maintenance phase. However, there is a huge concern if whether the data currently being collected provides the right information needed for decision-making. There are questions if these data and information are meaningful and interpreted in the same manner, or if they reflect the details of the original observation, or if they are recorded in consistent manner or include all the relevant and necessary data to support highway decision-makings. This study discusses the current level of use of collected data by State DOTs and develops an innovative data and information integration framework which can ultimately support various decisions over the life cycle of highway projects. The study uses two highway projects from Iowa DOT and Oklahoma DOT as case studies to identify the needs of various decision makers and current level of data collection and management effort in terms of data types, formats and availability across the life cycle of highway projects. The study develops

[1] Doctoral Student, Dept. of Civil, Construction & Environmental Engineering, Iowa State University, Ames, IA 50011, asre@iastate.edu, 405-762-3261
[2] Associate Professor, Dept. of Civil, Construction & Environmental Engineering, Iowa State University, Ames, IA 50011, djeong@iastate.edu, 405-744-7073
[3] Assistant Professor, School of Civil & Environmental Engineering, Oklahoma State University, Stillwater, OK 74078, phil.lewis@okstate.edu, 405-744-5207
[4] Doctoral Student, School of Civil & Environmental Engineering, Oklahoma State University, Stillwater, OK 74078, mkhaleg@ostatemail.okstate.edu, 405-744-5207

a gap analysis between currently available information and ideally required information for different types of decisions. The framework presents an active utilization plan of currently existing databases. The framework will help develop a new data collection and information/knowledge generation plan to support key decisions which historically were not well supported with information and data. In addition, it will allow DOT engineers understand the purpose of collecting specific data, how the data can be transformed into information and knowledge, and what types of decisions will benefit from the generated information and knowledge which in turn justifies the continuous and growing data collection efforts of State DOTs.

Key Words: data collection, data integration, highway project, decision-making

Traffic Safety Culture: Definitions, Conceptual Frameworks, & Recommendations for Change

Corinne Peek-Asa, PhD, MPH[1] & Laura Schwab Reese, MA[2]

Abstract

Transportation-related crashes result in more than 400 deaths, four million injuries, and 45 billion dollars in direct and indirect costs each year in Iowa. Interventions to reduce transportation-related injuries and deaths have historically focused on reducing risk through education, enforcement, engineering, and environmental design, usually through the use of one approach at a time. Although transportation crashes, along with the resulting injuries and fatalities, have been reduced as a result of these approaches, these interventions do not effectively integrate all factors related to traffic crashes.

Traffic safety culture is a powerful influence on driving behavior that has often been neglected when developing interventions. A culture that tolerates or encourages risky driving will generally resist safety interventions, hinder traffic safety policy, and propagate dangerous driving behaviors. Traffic safety culture is directly related to the frequency of transportation-related injuries and deaths in a community.

Despite increasing attention to the role of traffic safety culture throughout Western Europe, Australia, and the United States, there remains a critical gap in our knowledge about how to advance and improve safety culture throughout the population. This presentation defines the concept of traffic safety culture, introduces conceptual models that explain traffic safety culture, and reviews the implementation of culture change initiatives. The history of seat belts in motor vehicles will be used to demonstrate a framework for traffic safety culture.

Keywords: traffic safety culture— change theories—seatbelts—Toward Zero Deaths—culture transformation

---

[1] The University of Iowa Injury Prevention Research Center, 105 N River St, S143, Iowa City, IA 52242 ; Phone (319) 335-4895; Email Corinne-Peek-Asa@uiowa.edu

[2] The University of Iowa Injury Prevention Research Center, 105 N River St, N475, Iowa City, IA 52242 ; Email laura-schwab-1@uiowa.edu

Traffic Safety Culture in Iowa: A Sociological Perspective

Erin O. Heiden[1], Ki H. Park[2], and Gene M. Lutz[3]

Abstract

Iowa's traffic safety culture is influenced by laws and policies, enforcement methods, driver education, roadway engineering, and drivers' behaviors. The Center for Social and Behavioral Research (CSBR) at the University of Northern Iowa (UNI) was contracted by the Iowa Department of Transportation (IDOT) to conduct a general population survey of adult Iowans about a wide range of traffic safety topics (e.g. traffic safety policies, enforcement techniques, and distracted driving). This study utilized a cross-sectional design and a dual-frame (cell phone and landline) sampling method to conduct telephone interviews with 1,088 adult Iowans from October through December 2011. Descriptive analysis was conducted using a weighted dataset to improve the representativeness and generalizability of the study to the adult population of Iowa. Most Iowans said driving in Iowa is about as safe now as it was 5 years ago; however, one-fourth said driving in Iowa is less safe now.

The majority of adult Iowans consider several behaviors serious threats to traffic safety and never acceptable to do while driving, including sending text messages or emails while driving (88%), excessive speeding (76%), and driving without wearing a seatbelt (67%) (Table 1). Yet, many Iowans report seeing other drivers engaging in these behaviors and admit engaging in some themselves. For example, almost two-thirds of Iowans reported seeing other drivers send text messages or read emails, and nearly 1 in 5 adult Iowa drivers said they have sent or read a text message or email while driving in the past 30 days despite this being prohibited by law since July of 2011.

---

[1] Erin O. Heiden, Center for Social & Behavioral Research, University of Northern Iowa, 2304 College Street, Cedar Falls, IA 50614: Phone: 319-273-2105; email: erin.heiden@uni.edu

[2] Ki H. Park, Center for Social & Behavioral Research, University of Northern Iowa, 2304 College Street, Cedar Falls, IA 50614: Phone: 319-273-2105; email: ki.park@uni.edu

[3] Gene M. Lutz, Center for Social & Behavioral Research, University of Northern Iowa, 2304 College Street, Cedar Falls, IA 50614: Phone: 319-273-2105; email: gene.lutz@uni.edu

In follow-up to the 2011 survey, the IDOT asked the state's three public universities (Iowa State University, University of Northern Iowa, and University of Iowa) to develop white papers about Iowa's traffic safety culture discussing best practices and recommendations from public health, sociology, and policy perspectives. UNI's CSBR used a social norms approach, as one example from the field of sociology, to examine the differences in traffic safety culture in urban versus rural settings and for teen drivers. Social norms influence traffic safety culture at the individual, community, environmental, and policy level. The incongruence between what Iowans believe is unacceptable driving behavior, laws and policies that prohibit it, and actual observed or self-reported behavior suggests a discrepancy between Iowan's injunctive norms (belief's about what ought to be done) versus descriptive norms (what is actually done). In addition, the role of identity, peers, and technology on youth driving behaviors strongly influence perceptions of traffic safety. Findings from the UNI survey of traffic safety in Iowa will be presented. In addition, examples of strategies to shape traffic safety culture and influence positive traffic safety norms in Iowa will be discussed.

Table 1. Perceptions about driving behaviors compared to observed and self-reported driving behaviors

	Percent of adults who think it is NEVER acceptable	**Percent of adults who report seeing the behavior of other drivers every day or a few times per week**	**Self-reported driving behaviors in past 30 days**
Send text messages or emails while driving	88%	64%	19%
Drive without wearing their seatbelt	67%	Not reported	16%
Talk on a cell phone	46% (hand-held), 18% (hands-free)	90%	67%
Drive over 10 miles per hour over the speed limit on major Highway	34%	74%	48%

Keywords: traffic safety— safety culture—social norms—rural environments —teen drivers

Traffic Safety Culture in Iowa-Public versus Expert Opinions

Konstantina Gkritza[1], Chris Albrecht[2]

Abstract

In 2010, the Iowa Department of Transportation (DOT) asked researchers at Iowa State University's Institute for Transportation (InTrans) to study the traffic safety culture in Iowa through the eyes of a diverse range of experts. At that time, it was noted that, while Iowa and other states had worked tirelessly to produce a culture of safety through their comprehensive highway safety plan (CHSP) and other efforts, vehicle crashes remained among the leading causes of death in the US. In Iowa alone, an average of 445 deaths and thousands of injuries occur on public roads each year. The study completed in April 2011 included diverse perspectives from the disciplines of public health, education, law enforcement, public policy, social psychology, safety advocacy, and engineering. In addition to summarizing the "best practices" and effective laws in improving traffic safety culture, the study also recommended 11 high-level goals, each with specific actions to support its success.

As a follow-up to the April 2011 study, a second phase was undertaken that brought together Iowa's three large public universities (Iowa State University, University of Northern Iowa, and University of Iowa) to focus on producing actions that would ultimately improve the traffic safety culture across Iowa. The focus of the second phase was on synthesizing the expert opinions solicited in Phase I with prevailing public views and/or opinions. More recent data on the opinions of Iowans and of people nationally contrasted with past data would help better define the public's position on top safety culture issues. The public perspective was gathered via a follow-up to Iowa's 2000 public opinion survey, which was administered by the University of Northern Iowa's Center for Social and Behavioral Research. The survey covered a wide range of traffic safety topics, including driver education, traffic enforcement, road design and engineering, distracted driving and other driving behaviors, and attitudes about traffic safety policies, procedures, and enforcement techniques.

The research team at InTrans identified key survey elements that were common between the 2000 and 2011 public opinion surveys and summarized changes in public opinion between the two surveys. In addition, this presentation will synthesize the results of public opinion surveys and expert interviews, as well as "best safety practices" in Iowa, and make recommendations to the Iowa DOT on actions that will make a tangible difference in improving traffic safety in Iowa.

Keywords: safety culture—Iowa—survey—public opinions

[1] Konstantina Gkritza, Department of Civil, Construction & Environmental Engineering, 404 Town Engineering Building, Iowa State University, Ames, IA 50011; Phone (515) 294-2343; Fax (515) 294-0724; email: nadia@iastate.edu

[2] Chris Albrecht, Transportation Research Specialist, Institute for Transportation, Iowa State University, Ames IA 50010; Phone (515) 294-7684; email: calbrech@iastate.edu

Train scheduling and operating capacity on a single track shared passenger and freight corridor with demand considerations

Ahmadreza Talebian, Bo Zou

Department of Civil and Materials Engineering, University of Illinois at Chicago

The shared use of rail corridors by heterogeneous passenger and freight traffic presents a capacity and delay issue, which is gaining growing attention recently, due largely to the emergence of higher speed rail lines in the US. This study proposes an integrated, hypergraph-based approach that considers constraints from infrastructure supply as well as passenger and freight demand in solving the train scheduling problem on a shared rail corridor. Different from previous studies, we explicitly examine the impact on the system demand of various scheduling factors, and the extent to which the absence of demand-side consideration could lead to suboptimal results in train planning.

Truck Parameters and Occurrences of Ambient Traffic in Iowa

Yaohua Deng[1], Brent Phares[2], Ping Lu[3], and Lowell Geimann[4]

Abstract

Highway bridges are subjected to traffic loads from a variety of vehicles, among which trucks are of primary interest to bridges. Having a thorough understanding of the truck loads on bridges plays a significant role in ensuring bridge safety and could represent an important step if site-specific design loads were ever to be considered. This study is to comprehensively characterize the specific characteristics of trucks crossing Iowa's Interstate bridges. This characterization was accomplished by studying Weigh-in-Motion (WIM) data, which were recorded at the Iowa DOT weigh stations locations in Jasper and Dallas Counties. Truck parameters studied here include gross vehicle weight, number of axles, axle weights, axle spacings, and speed. Frequency of truck occurrence can more discretely describe the typically used average daily truck traffic (ADTT) specified in the AASHTO Load and Resistance Factored Design (LRFD) Specifications and the AASHTO Load and Resistance Factored Rating (LRFR) Specifications. The procedure for processing, filtering and categorizing WIM data will be introduced. The typical types of trucks will then be summarized and compared with the Iowa Legal Trucks which include Group I (Type 3, Type 3S2 and Type 3S2) and Group II (Type 4, Type 3-3, and Type 3S3) trucks. Additionally, variations in truck parameters and occurrences for different time periods of each month and different seasons of each year will be presented. Finally, the general characteristics and frequency for typical trucks in Iowa will be summarized.

Key Words: Ambient Traffic—Truck Parameters—Truck Occurrences—Weight-In-Motion Data—Bridges.

[1]Postdoctoral Research Associate, Bridge Engineering Center, Institute for Transportation, Iowa State University Research Park, Ames, IA 50010; Email: jimdeng@iastate.edu; Tel: 515-294-2882.

[2]Director, Bridge Engineering Center, Institute for Transportation, Iowa State University Research Park, Ames, IA 50010; Email: bphares@iastate.edu; Tel: 515-294-5879.

[3]Bridge Rating Engineer, Iowa Department of Transportation, Ames, IA 50010; Email: ping.lu@dot.iowa.gov; Tel: 515-239-1290.

[4]Bridge Engineer, Bridge Engineering Center, Institute for Transportation, Iowa State University Research Park, Ames, IA 50010; Email: geimann@iastate.edu.

Twin Ports Water Taxi Feasibility Study

(Student Paper)

Derek Krivinchuk, Bryce Harp, Ryan Hill, Andrew Bettilyon , Jeredt Runions, Hikaru Shimazaki, Charles Skarman & Peter Suska

Abstract

Bicycle trail systems in Northeastern Minnesota and Northwestern Wisconsin have been expanding since 1994. Separating these two trail systems is the St. Louis River and St. Louis Bay. The purpose of this study was to find a water transportation means of connecting these trails. Currently, the only connectivity for these trail systems is a single-lane sidewalk, on an interstate highway bridge. The connections to the sidewalk are not only at ineffective locations away from existing bicycle paths, but the shared roads which the bicyclists use to get to the sidewalk are challenging. This paper explores a water taxi as an alternative for bicyclists traveling between the cities of Duluth, Minnesota and Superior, Wisconsin. A literature review was used to examine other water taxi operations, and focused on operations which experience similar climactic and geographical conditions. The reviewed operations were located in Wisconsin, Chicago, New York, and Burlington, Vermont. In addition, interviews with select experts from these services were conducted. A time, speed, and distance analysis was conducted for Duluth/Superior to examine potential routes from various dock locations. This analysis indicated a water taxi could offer a service which is up to six times faster than the existing bicycle routes. As part of the research, stakeholders were interviewed and public outreach seminars were held. This feasibility study provides potential routes, comparative analysis, expert opinions, and recommendations for further implementation of a water taxi service in the Duluth/Superior area.

Keywords: water taxi, bicycle trail connectivity, water transportation, ferry, Duluth, Minnesota, Superior, Wisconsin

Ultrasonic In-situ Monitoring of Stiffening Process of Concrete for Predicting Saw-Cutting Windows of Concrete Pavements

Xuhao Wang[1], Peter Taylor[2], and Kejin Wang[3]

Abstract

Concrete stiffness and strength development strongly influence scheduling of pavement construction operations, such as surfacing or trowelling and joining or saw-cutting. Saw cutting at the proper time is a delicate balance between the prevention of raveling (too early) and random cracking (too late). At present, the saw-cutting window is determined by arbitrary approaches, such as scratching the surface with a knife. In order to accurately assess the saw cutting time for pavements, the present study investigates another approach to monitor concrete microstructure, stiffness, and early strength development using ultrasonic compressional (P) wave transmission technique and to relate the P-wave test results to the saw-cutting window.

This paper presents the results from the first part of this study-monitoring stiffening process of concrete using P-wave. The P-wave transmission technique was used for both conventional concrete (CC) and self-consolidating concrete (SCC). The CC includes eight mixes with two slag types (grade 100 and 120) at 20%, 35%, and 50% replacement levels and eight patching mixtures with a Class F fly ash at 20% of fly ash replacement level for cement. The patching mixes also contain lightweight fine aggregate, integral waterproofer, and shrinkage reducing admixture. The SCC mixes, designed for bridge construction applications, are made with different aggregate sizes (¾", ½", and 3/8") and different cementitious materials and filler (fly ashes, slag, and limestone dust). Setting time, semi-adiabatic calorimetry, and 1-day compressive strengths of these concretes were measured.

The results revealed that the P-wave test used can properly monitor the stiffening process of various concrete mixtures. Both P-wave and calorimetric measurements are clearly related to set time test results. These relationships can serve a strong support of predicting saw-cutting windows of concrete pavements in the forthcoming study.

Keywords: ultrasonic pulse velocity; concrete stiffening; saw-cutting windows; setting time

---

[1] Research Assistant, Department of Civil, Construction and Environmental Engineering, Iowa State University, 136 Town Engineering, Ames, Iowa 50011, Tel: 515-294-2252, Email: wangxh@iastate.edu

[2] Associate Director, National Concrete Pavement Technology Center, Iowa State University, Ames, Iowa 50011, Tel: 515-294-9333, Email: ptaylor@iastate.edu

[3] Professor, Department of Civil, Construction and Environmental Engineering, Iowa State University, 492 Town Engineering, Ames, Iowa 50011, Tel: 515-294-2152, Email: kejinw@iastate.edu

University Students' Mode Choice and Its Determinants in College Towns

Jiangping Zhou[1]

Abstract

After presenting a framework regarding factors influencing mode choice of the general population and university students, this manuscript adopts a comparative approach to look into factors (in particular, how scale of the city) affecting university students' mode choice, using data collected from Los Angeles, California and Ames, Iowa. It shows that off-campus university students from college town are greener commuters than their urban-university counterparts. Thus, as a whole, scale of the city influences university students' mode choice. If measured by commute distance alone, scale of the city, however, does not significantly affect the rates of driving alone, biking or walking. This manuscript also finds that income and perceived travel time have the greatest impacts on university students' transit usage and walking mode in college town. For university students who bike to the campus, regardless the host city scale, they are more likely to be male. For the students who bike to the campus, they are sensitive to perceived travel time relative to that of transit or driving-alone. University students riding transit in college town are sensitive to both commute distance and perceived commute time; their counterparts from urban university, however, are only sensitive to perceived commute time. The above findings provide several policy implications regarding promoting alternative modes at universities.

Keywords: University students, mode choice, determinants, college town

[1] Iowa State University, 399 College of Design, Ames, IA 50011; Phone (515) 294-5470;; email: zjp@iastate.edu.

This presentation would discuss the application of high-friction surface treatments (HFST) on high-crash horizontal curves, highlighting one location in Iowa and one in Wisconsin. The presentation would include an overview of why friction-demand is often exceeded in horizontal curves, talk about HFST and the EDC-II effort, and then would cover the HFST installations in Iowa and Wisconsin and would also share before and short term (approx. 1-year) after safety results. Presenters would be John Vu – Iowa DOT, Dave Jolicoeur – FHWA Wisconsin Division, and Jerry Roche – FHWA Iowa Division.

Use of Unconventional Specimen Sizes to Determine PCC Strength

Jianing Cao[1], Fatih Bektas[2]

Abstract

DOTs in the US either specify compressive strength or flexural strength for PCC pavements. The norm is using 4×8-in cylinders and 6×6×22-in beams for compressive strength and flexural strength, respectively. These specimens may possess some impracticality. Before testing, cylinder ends require capping or grinding which could be tedious and time consuming. Cube specimens are being used in Europe and Asia for compressive strength and there is a good correlation between cube and cylinder specimens. On the other hand, each weighing around 65 lbs, flexural beams are heavy and not easy to transport.

The present study aims to investigate the feasibility of using nonconventional specimens for PCC strength —4-in cubes for compressive strength and 4×4×14-in beams for flexural strength. Normal- and high-strength concrete mixes were proportioned, and cylinders (4×8-in), cubes (4-in), small (4×4×14-in) and large (6×6×22-in) beams were cast. Flexural strength was determined at the same age for each concrete mix and the results obtained from small and large beams were compared. A similar comparison for compressive strength was made between cubes and cylinders. In addition, compressive strength was determined using the cubes cut from broken halves of flexural beams.

Keywords: compressive strength, flexural strength, cube, cylinder, beam

[1] Graduate Research Assistant, Civil, Construction and Environmental Engineering, Iowa State University, Ames, IA 50010, Phone: 515-294-2140, E-mail: billcao@iastate.edu
[2] Research Faculty, Civil, Construction and Environmental Engineering, Iowa State University, Ames, IA 50010, Phone: 515-294-5857, E-mail: fbektas@iastate.edu

Validation of Micro simulation Model Output for Mobile Source Emissions Modeling

Shauna Hallmark[1] and Nicole Oneyear[2]

Abstract

Project level transportation air quality analyses in the United States will require use of the recently developed United States Environmental Protecion Agency approved highway emission rate model, Motor Vehicle Emission Simulator (MOVES). Previous transportation emission models relied on aggregate estimates of average speed. The main advantage to MOVES is that it will be able to predict differences in emissions at the project level for different scenarios such as changes in traffic signal timing or implementation of a roundabout since it has the ability to model emissions based on changes in vehicle mode (acceleration, speed, time spent idling). However in order to capitalize on this ability, the model requires second by second vehicle data. Field data collection of this type of data requires use of chase cars or instrumented vehicles, Collection of even moderate amounts of data using either method is resource intensive and frequently not realistic for local agencies.

Micro-simulation models have the capability of being calibrated using inputs such as speed distributions, driver factors, fleet distributions, and vehicle characteristics such as acceleration ranges. Consequently, micro simulation models offer a powerful tool to estimate current and future conditions since the models can be calibrated to replicate current conditions and then parameters changed to meet future ones. Additionally, some micro simulation models have the capability of outputting instantaneous speed and acceleration which can be used as inputs to MOVES.

With these capabilities, micro simulation offers a valuable tool to conduct analyses requiring large amounts of data. However, simulation models usually employ theoretical profiles for the relationship between acceleration and speed. The algorithms were intended to model gross measures of traffic activity, such as changes in cycle length or the effect of an incident. Model output, however, remains unvalidated for predicting the level of vehicle activity output required for USEPA's MOVES. Additionally, the driver behavior aspects of micro simulation models have also not been well validated.

A case study was used to assess the utility of the micro simulation model, VISSIM, in developing output which can be used as input to MOVES. Four drivers were selected to drive a test vehicle (Ford Taurus 2005) instrumented with a portable emissions monitor (PEMS) which has a global positioning system that records instantanesous speed, acceleration, and position. Drivers drove a number of loops through a test corridor. The test corridor was a 4-lane corridor along Douglas Parkway in Des Moines, Iowa, USA. The corridor was selected since several types of traffic control along the corridor are present and volumes are relatively consistent

[1] Professor, , Iowa State University, Civil, Construction and Environmental Engineering, 2711 South Loop Drive, Suite 4700, Ames, IA 50010, Tel: 515-294-5249, Email: shallmar@iastate.edu

[2] Graduate Student, Iowa State University, Civil, Construction and Environmental Engineering, 2711 South Loop Drive, Suite 4700, Ames, IA 50010, Tel: 515-294-6468, Email: noneyear@iastate.edu

(around 4,560 vehicles per day). As a result, vehicle activity for different traffic control scenarios could be compared.

A model for the corridor was developed in VISSIM. Model output was compared to field colected speed/acceleration profiles data to assess the accuracy of micro-simulation models in providing realistic estimates of vehicle activity as input to MOVES.

Keywords*: mobile source air quality modelling, micro simulation, vehicle activity modelling*

Volumetric Properties of High RAP Mixtures Based on Calculated Bulk Specific Gravities of RAP and Constituent Aggregates

Nassim Sabahfar[1], Mustaque Hossain[2]

Abstract

Use of higher percentages of RAP in highway pavements is becoming more and more desirable not only because of recent increase in crude oil prices but also due to increasing global awareness in sustainability. Although RAP is allowed up to 30 percent in hot-mix asphalt (HMA) in most states, its current average usage is only about 12 percent. This is partly due to the required changes in mix design when higher percentages of RAP are being used and difficulties in controlling the Superpave volumetric properties. RAP bulk specific gravity (G_{sb}^{RAP}) is an important property since the combined bulk specific gravity of RAP and virgin aggregates is needed to calculate the voids in mineral aggregates (VMA) in the Superpave mix design. Even if the properties of virgin aggregate and binder are available, they are different from what is left in RAP and it is required to make a couple of assumptions, including asphalt absorption (P_{ba}), to calculate the G_{sb}^{RAP}. In this study, Superpave mixes with 20, 30, and 40 percent RAP and fractionated RAP where tested to find out how G_{sb}^{RAP} assumptions can influence volumetric properties of different Superpave mixes. In addition, G_{sb} tests were conducted on the aggregates obtained from RAP by the solvent extraction method in order to evaluate the effect of using RAP or aggregate properties when calculating volumetric properties.

Keywords: Reclaimed Asphalt Pavement – Bulk specific gravity – volumetric properties-Superpave

[1] Doctoral student, Dept. of Civil Engineering, 2118 Fiedler Hall, Kansas State University, Manhattan, KS 66506, Tel. (785) 532-1690, Fax. (785) 532-7717, e-mail: nnassim@ksu.edu

[2] Munger Professor, Dept. of Civil Engineering, 2118 Fiedler Hall, Kansas State University, Manhattan, KS 66506, Tel. (785) 532-5862, Fax. (785) 532-7717, e-mail: mustak@ksu.edu

Weibull-Based Bridge Deterioration Models for Iowa Bridges

Dimitrios V. Bilionis
Graduate Research Assistant/ MS Student
Institute for Transportation
Civil, Construction and Environmental Engineering
Iowa State University
Email: bilionis@iastate.edu

Başak Aldemir Bektaş, PhD
Associate Scientist
Iowa State University
Institute for Transportation (InTrans)
2711 South Loop Drive Suite 4700
Ames IA 50010-8664
Office Phone: (515) 294-4033
Email: basak@iastate.edu

Bridge management decisions at the network-level are majorly decisions among alternative maintenance, rehabilitation, and replacement (MR&R) efforts under a given budget. In order to help bridge managers make objective and data-based decisions, bridge deterioration models are developed to predict the future condition of bridges. These models are typical inputs to a bridge management system (BMS) or other decision-support tools used by bridge managers. Deterioration models are statistical relationships between a dependent variable, such as time-in-state or change in condition, and a set of explanatory variables including traffic, age, environmental factors, and design properties. These models show bridge managers how the bridges in their network deteriorate over time. Models based on a rich inspection history that sufficiently represent the bridge network can aid bridge managers in giving objective decisions.

In this study, deterioration models for National Bridge Inventory (NBI) condition ratings were developed for Iowa bridges based on inspection data from 1983-2010 duration. Among a variety of deterministic, stochastic or artificial intelligence deterioration models available in the literature; Weibull-based discrete-time, time-based models were selected for this study. Separate models were developed for deck, superstructure and substructure ratings. Initial results from the study were discussed with Iowa

DOT staff to refine and improve the models. The findings from the analysis and discussions with the Iowa DOT staff are going to be presented along with the final models and conclusions.

Well Bonded Superpave Overlays on HMA

Daniel Mealiff[1], Mustaque Hossain[2], Greg Schieber[3]

Abstract

Proper construction of hot mix asphalt overlays includes the use of a tack coating or similar adhesive to prevent de-bonding and slippage cracking. While many variations of content and quantity are used, optimization is desired for maximum strength at minimum cost, especially within the first few days. A study is being conducted which compares 3 commonly used tack coats at varied application rates and on different surface textures by performing direct tension pull off tests 2 days after construction. Bond energy is also calculated. This procedure is completed for laboratory compacted samples and compared to samples from an accelerated loading test strip. Results are pending.

Keywords: HMA—tack coat—bond—tension

[1] Master's Student, Kansas State University, Dept. of Civil Engineering, 2118 Fielder Hall, Manhattan, KS 66502; Phone (785) 738-0021; Fax (785) 532-7717; email: dmealiff@ksu.edu

[2] Professor, Kansas State University, Dept. of Civil Engineering, 2118 Fiedler Hall, Manhattan, KS 66502; Phone (785) 532-1576; Fax (785) 532-7717; email: mustak@ksu.edu

[3] Assistant Bureau Chief, Bureau of Materials and Research, Kansas Department of Transportation, 700 SW Harrison St., Topeka, KS 66603, Phone (785) 296-6618, Fax (785) 532-6665, email: gregs@ksdot.org

What We Don't Know About Autonomous Vehicles

Chris Schwarz[1]

Abstract

From the self-driving Google car to plain old cruise control, automation in vehicles is an important issue. We are interested in the topic of autonomous vehicles on U.S. roads and highways and have been engaged in research to collect knowledge and write a report for the Mid-America Transportation Center. We believe there is a need for knowledge dissemination on this topic to both the general public as well as transportation professionals. We have seen similar reports that survey the world and national markets and consider the socio-economic issues surrounding autonomous vehicles. The goal of this effort is to focus more on the technical issues (both engineering and human factors), some of which may be unfamiliar to transportation professionals, the intended audience for our report.

The promise and the requirements of autonomous vehicles can be summarized with a few key statements. First and foremost, autonomy in ground vehicles must not reduce the general level of transportation safety, but should enhance it. Autonomy should significantly increase the efficiency of the traffic system, allowing for increased density of traffic with reductions in slowdowns and jams. Autonomy should increase the overall level of repair in the fleet, and should bring with it increased diagnostic capabilities. Autonomy should benefit environmental sustainability by reducing stop-and-go driving and lowering net trip times, reducing the need to build new roads, and create new opportunities for ride-sharing and car-sharing.

Despite the rapid and impressive advancement in the technology of autonomous vehicles, there are still many open questions and research needs to be addressed. This presentation will cover some of the major ones identified to date including both short-term and mid-term needs. The common thread that ties them together is the state of flux and rapid innovation the technology currently finds itself in. Some of the major research needs are:

- Improved performance on snow-covered or otherwise obscured roads
- Handoff of control as the car changes automation level
- Strategies to manage mixed manual/automatic traffic
- Understanding the many combinations of sensors and AI
- Ensuring security and privacy in highly computerized vehicles

Future work at the NADS will hopefully advance understanding and standardization specifically in the second and third topics at the interface between drivers and automation.

---

[1] National Advanced Driving Simulator, 2401 Oakdale Blvd, Iowa City, IA 52242; Phone (319) 335-4642; Fax (319) 335-4658; email: cschwarz@nads-sc.uiowa.edu

Keywords: self-driving cars—automation—ITS

Wrong Way Driver Detections and Treatments Along U.S. 30 near Ames, Iowa

Willy Sorenson, PE[1]

Abstract

Over 80 wrong way drivers have been officially reported along the U.S. 30 corridor between Boone and Nevada, Iowa over the past five years. The Iowa DOT in concert with local enforcement agencies and InTrans have formed a multidisciplinary team to address this issue. Enhanced signing, painting, lighting and use of technology thru Intelligent Transportation System (ITS) tools are being used to detect and inform drivers and 911 centers. This presentation will step thru the process and treatments the team has used to reduce future wrong way drivers in this corridor.

Keywords: wrong way driver 1—WWD 2—911 3—ITS 4—detection 5

[1] Iowa Department of Transportation, Office of Traffic and Safety, 800 Lincoln Way, Ames, Iowa 50010; Phone (515) 239-1212; email: willy.sorenson@dot.iowa.gov