Most Promising Research
Research Peer Exchange
August 16-17, 2011

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INTRODUCTION

The Iowa Department of Transportation held a Research Peer Exchange on August 16-17, 2011 in Ames, Iowa. RAC members from Region 3 (Minnesota, Iowa, Missouri, Ohio) and the following states, Louisiana, Washington, Oregon, South Dakota, Arizona and Utah attended. FHWA, TRB and NCHRP representatives were also invited. The topic of the peer exchange was "Most Promising Research."

On Tuesday, August 16, the first day of the exchange, participants were asked to provide examples and a short presentation on their state's most promising research projects. In addition to providing examples, participants addressed four questions:

- What are your most promising projects?
- How did you develop the project?
- How will you evaluate its effectiveness?
- What are your implementation and tech transfer plans?

Wednesday afternoon was a peer exchange wrap-up meeting to summarize results of the exchange.

Peer Exchange Participants

Ann Ellis, Arizona DOT
Barney Jones, Oregon DOT
Cameron Kergaye, Utah DOT
Sandra Larson, Iowa DOT
Dave Huft, South Dakota DOT
Crawford Jencks, NCHRP
Mark Dunn, Iowa DOT
Debra Elston, FHWA
Max Grogg, FHWA Iowa Division
Bill Stone, Missouri DOT
Bruce Holdhousen, Minnesota DOT
Cynthia Gerst, Ohio DOT
Leni Oman, Washington DOT
Doc Zhang, Louisiana DOT
Lisa Rold, FHWA
Linda Narigon, Iowa DOT
Vanessa Goetz, Iowa DOT
Willy Sorenson, Iowa DOT

August 18 and 19, 2011, participants attended the Mid-Continent Transportation Symposium.

Presentation topics at the Mid-Continent Transportation Research Symposium:

Leni Oman: State Highways as Main Streets: A Study of Community Design and Visioning

Bruce Holdhusen: Assessment and Recommendations for the Operation of Standard Sump Manholes as a Best Management Practice for Stormwater Treatment

Dave Huft: Application of Paleoflood Survey Techniques in the Black Hills of South Dakota

Crawford Jencks: NCHRP Initiated Project 12-12. "Highway Maintenance Quality Assurance" & Projects 20-24 (11) and 08-69, AASHTO Asset Management Guide: Volumes I and II

Ann Ellis: Arizona Transportation History

Bill Stone: New LiDAR Technology Offers Faster, Less Expensive Field Data; MTI Geotechnical Research Program

Doc Zhang: DARWIN-ME Pavement Design System

Cynthia Gerst: Ohio DOT Pavement Management Information System

Cameron Kergaye: Adaptive Traffic Signal Control; Accelerated Bridge Construction

Barnie Jones: Imaging Tools for Evaluation of Gusset Plate Connections in Steel Truss Bridges

The Requirement for a Peer Exchange

Under 23 United States Code of Federal Regulations 420.209 (a)(7), as a condition for approval of Federal Highway Administration (FHWA) planning and research funds for research activities, each state's department of transportation (DOT) is required to periodically conduct a peer exchange. FHWA defines "periodic" as once every three to five years. The use of peer exchanges was established to provide state DOT research, development, and technology programs with an opportunity to examine and evaluate their known programs with a collaborative team of peers, experts, and colleagues. The process encourages the exchange of visions, ideas, and best practices that could be fostered for the benefit of the host agency and peer team participants.

The basic approach is to invite an outside panel of managers from state DOT research divisions, FHWA, other public agencies, and the private sector to meet with the host agency to discuss and review a specific focus area. During the peer exchange, the group analyzes the agency's policies and practices, shares case studies and experiences, and develops recommendations for improvements. The information gathered from the exchange is presented to agency and FHWA management, and is documented in a written report.

PRESENTATION SUMMARIES

Mark Dunn – Iowa DOT, Iowa Highway Research Board

Background/History of IHRB

- Approximately 60 projects considered
- 10-12 projects annually from priority list
- 15-20 total projects funded
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Pavement Marking vs. Safety

- Study the relationship between 5 years of pavement marking retroreflectivity data and corresponding crash and traffic data
- Conclusion: For white edge lines and yellow center lines, crash occurrence probability was found to increase by decreasing values of longitudinal pavement marking retroreflectivity.
- Implementation:
    - Use data to determine appropriate paint treatment for a given location, based on geometrics and crash data
    - Higher risk locations can justify more expensive, but more durable, effective, etc.

Non-destructive Bridge Deck Evaluation

- Two Phases
    - Phase I Rutgers University
    - Comprehensive evaluation of various technologies
    - Improved performance when multiple technologies are overlaid
    - Phase II Wiss, Janney, Elstner Assoc.
    - Develop an evaluation program utilizing appropriate technologies
    -

Epoxy Injection of Bridge Decks

- Objectives:
    - Determination of effectiveness, durability, and typical service life of epoxy injection - 26 Bridges
    - Evaluation of the current state of the practice for epoxy injection – Iowa & nationally
    - Development of procedures and specifications for epoxy injection – In-house & contract

Willy Sorenson– Iowa DOT, ITS Project

Iowa State Fair - a Special Event

- The Iowa DOT hired a professional traffic engineering consulting team—ITERIS
- Objectives were to analyze both traffic and pedestrian flow.
- Project deliverable was a report containing both short and long term recommendations.

Iowa State Fair-Nothing Compares--Attendance

- Eleven day event
- Over 1,000,000 visitors every year
- This year Aug 12-22
- Daily average just under 100,000
- People come from all over the world due to our world leading agricultural economy

Parking—only enough parking for about 15,000 cars; about ½ of the visitors can park on the grounds. Others park in people's yards.

Media and Shuttles—parking available at various locations near the Fairgrounds with large parking areas and shuttle people to the fair grounds.

DMS Usage--to promote parking alternatives

ITS-usage of portable ITS devices and 511\

Gate Observations

- ITERIS observed traffic the first weekend of the fair at various locations around the event.

Recommendations

- Use Gate 1.
- Add left turn at Gate 3

Shuttle Management

- Handicapped accessibility
- Curb cut for pedestrians

Visibility of Traffic Control Personnel-wear reflective vests

Weather Related Traffic parking

- Short term: develop an alternate plan if the grass parking cannot be used for rain
- Removed parking along Dean Avenue at State Fair grounds

Doc Zhang – Louisiana DOT

Evaluation of the Surface Resistivity Measurement as an Alternative to the Rapid Chloride Permeability Test for Quality Assurance and Acceptance

LTRC Project 10-1C, ($103,000, 15 months)

- Development of New Surface Friction Guidelines for LADOTD
  - Challenge: manpower, budget, time & expertise.
  - Many entities use permeability specifications in Portland cement concrete (PCC) structures.
  - Two test methods: ASTM C1202 or ASTM C642.
    - Drawback: 56 days to cure before testing and 2 days to conduct the tests.
    - Benefit: surface resistivity device can test concrete at 28 days of age with a testing time of 5 minutes.
  - Recommend replacing rapid chloride permeability test with surface resistivity test to save time, money and manpower.
  - Effectiveness evaluated by a cost-benefit analysis and quantifying the dollars saved in the construction and testing process.
  - To help the implementation of the research results, the project manager worked with PI and PRC to develop a report, which gives the details of planned implementation strategy, activities and timeline.
  -

LTRC Project 09-2B, ($145,000, 24 months)

- Developing Inexpensive Crash Countermeasures for Louisiana Local Road
- Requested by the Materials Engineer of the department in the LTRC
- Procedure allows estimating the friction resistance of an asphalt mixture during its mix design stage.
- Short term Evaluation: modification to the Design Memo that identifies changes to the current friction guideline.
- Long term Evaluation: improvement of field friction resistance data collected by our pavement management system.
- An implementation assessment plan was developed by the project review committee with the PI's.
- Task force will identify friction requirements based on traffic volumes and levels of service and incorporate the findings into the Design Memo with suggestions.

LTRC Project 10-5SS, ($100,000, 24 months)

- Implementation of Rolling Weight Deflectometer (RWD) in PMS and Pavement Preservation
- Developed from solicitation process.
- Louisiana Local Technical Assistance Program (LTAP)
- Louisiana is among the 10 worst states with respect to safety performance in the U.S.
- No current local road improvement program due to lack of data on those roads; causes "Black Spots".
- Research plans to use the GIS information to determine as many safety performance factors as possible.
- Develop a low cost method

- Effectiveness will be assessed by comparing the accident and fatality rates prior and post implementation or research recommendations.
- Implementation Plans:
    - Identify/classify roads based on their expected safety performance
    - Locate the "riskiest" local road classifications using the expected safety performance functions and over-represented crash types
    - Identify packages of low-cost safety improvements for locations or road classifications
    - Estimate the cost of low-cost countermeasures
    - Identify candidate locations for inclusion in a systematic safety improvement

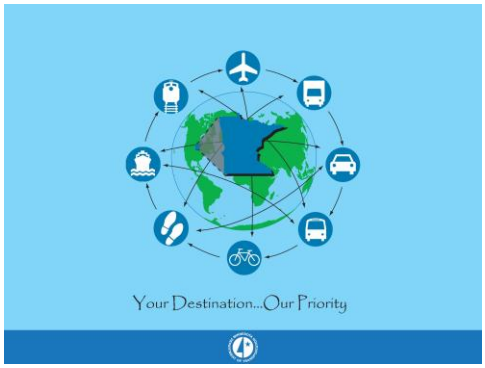
LTRC Project 09-2P, ($135,000, 30 months)

- Development of DOTD GPS Technology Management Plan
- Developed with engineers in LADOTD PMS
- Surface deflection is a popular method
- Use of rolling wheel deflectometer, offers potential to characterize the structural capacity of the road network in a cost-effective way without major delays.
- Objective: develop a methodology to integrate RWD data into the existing pavement management system so that the PMS will provide the surface and structural conditions of existing pavements with info on structurally deficient pavements.
- Evaluation: A RWD based index is added to the current PMS system so that PMS users can have the information on structural condition of asphalt pavements available.
- Research work will be finished by the end of the year.
- Plan to test 8 other local districts of Louisiana.

LTRC Research Project 11-2P, ($50,000, 8 months)

- Directly requested by the upper management of LADOTD
- Initiated by LTRC research managers in response to the requests of LADOTD engineers
- Objective: develop a GPS technology management plan on best practices.
- Establish a GPS taskforce committee that includes members of relevant sections within the Department to guide the implementation of LADOTD GPS Technology Management Plan within the Department.
- Provide Department-wide training on the GPS Management plan
- Update of develop the current LADOTD policies on GPS data acquisition and transport including permit and form system to allow records of GPS directly saved to the database.

Bruce Holdhousen – Minnesota DOT



- MnDOT Research Services web site
  - http://www.dot.state.mn.us/research/index.html
- Local Road Research Board web site & publications database
  - http://www.lrrb.org/search.aspx
- Collaboration web site (demonstration)
  - http://mndot-lrrb.ideascale.com
  - We are currently using this external web site to collect research needs/ideas (summer/fall)
  - We used this web site to coordinate our Implementation Funding program (winter/spring)

<u>Our 7 Topic Areas</u>

- Multi-modal
- Bridge, Structures and Hydraulics
- Traffic, Safety and Geometrics
- Maintenance Operations and Security
- Policy, Planning and Land Management
- Environment
- Materials and Construction
  –

<u>Promising Research and Implementation Projects</u>

- Multimodal topic area
  - Complete Streets planning guidance
  - Complete Streets design standards project
  - Bike trail crossing planning and design
  - Online bike & transit multimodal trip planner (Cyclopath)
  - Personal Rapid Transit MSP airport evaluation and workshop
- Bridge, Structures and Hydraulics
  - Bridge deck delamination technology evaluation
  - Bridge deck cracking factors study
  - Hand-held thermographic inspection of bridge structures
  - Scour monitoring technology implementation
  - Validation of Pre-stressed Concrete I-Beam Deflection and Camber Estimates
- Traffic, Safety and Geometrics
  - Best practices for sign reduction on the local system
  - Implementation of the SMART Signal system
  - Pavement markings management database
  - Pavement markings under challenging surface conditions
  - Investigation of Pedestrian/Bicyclist Risk in Minnesota Roundabout Crossings
- Maintenance Operations and Security
  - Clear Roads pooled fund project
  - Implementation of snow plow salt spinner calibration
  - Anti-icing implementation and best practices
  - Guard rail inventory using mobile laser scanning
  - Zipper merge for maintenance projects

- Policy, Planning and Land Management
    - Access to Destinations performance measure
    - Transportation "Quality of Life" focus groups
- Environment
    - Stormwater sump manholes SAFL Baffle retrofit
    - Stormwater treatment performance of roadside swales
    - Concrete slurry, wash and loss water mitigation
    - Shingles for dust control on shoulders and haul roads
    - Salt-Tolerant Sod Mixtures for Use as Roadside Turf
- Materials and Construction
    - Diamond grinding of concrete pavements
    - Smoothness incentive specifications for pavement
    - MnRoad farm equipment study (pooled fund)
    - New optimum moisture method for soil compaction
    - Unbonded concrete overlay implementation
    - MASW implementation for subsurface investigations

Barnie Jones—Oregon DOT

New Tools for Inspection and Evaluation of Steel Truss Bridge Gusset Plates

Oregon Department of Transportation

What does it do?

- Simplifies inspection of gusset plates.
- Sharply limits time in the field and moves some activities from the field to the office.
- Simplifies access.
- Partially automates acquisition of geometric data for load rating.

How does it work?

- Capture images in field with digital cameras (snooper, climbing, from ground level)
- Process images into scaled orthophotos
- Query and extract geometric data
- Produce CAD drawings (like AutoCAD)
- Produce FE models (ABAQUS)
- Run nonlinear finite element analyses to rate connections (ABAQUS)
- No high-level training required (scripted CAD drawing and FE modeling) Excel is interface.
- Integration from construction inspection to rating and archiving

Range of Uses

- Data for load rating.
- Document differences in "as built" from design drawings.
- Monitor changes over time.
- Additional Features
- Working around obstructions
- Combining multiple images
- Multi-scale images

How was it developed?

- Three-phase project
    - Phase 1 proposed by investigator
        - Initially unsuccessful with ODOT
        - Funded by OTREC
        - Match cobbled together from multiple sources
    - Phase 2 funded out of sequence by ODOT Research and Bridge Sections
    - Phase 3 is going forward as a pooled fund project.

Implementation

- Our internal implementation of phase 1 is largely complete.
- Host a half-day workshop to introduce phase 2 enhancements.

National?

- Help from FHWA
- TIG?

Current and Future Work.

Higgins, C and Q. G. Nguyen, *Digital Image Rectification Tool for Metrification of Gusset Plate Connections in Steel Truss Bridges,* Oregon Department of Transportation, March 2009

Turan, O. T., and C. Higgins, *Enhancements for Digital Imaging of Gusset Plate Connections: Fisheye and Image Stitching* Oregon Department of Transportation, Publication Pending.

Pooled Fund Study #1302: *Imaging Tools for Evaluation of Gusset Plate Connections for Steel Truss Bridges.*

Pooled Fund Project Objectives

1. Automate identification/optimization of reference target points, and the extraction of gusset plate geometric data.
2. Develop finite element modeling and analysis techniques to directly rate gusset plates using extracted digital image data.
3. Create an image management system.
4. 3-D imaging to collect surface geometry and out-of-plane deformations.

Linda Narigon—Iowa DOT

The Big 4

- Safety
- Winter Maintenance
- Structures
- Concrete Pavements

- Growing areas
- Human Factors
- Intelligent Construction

BAIID-Breath Alcohol Ignition Interlock Devices: Policy & Implementation Implications

- IID is a device attached to the ignition of a vehicle, sensor, control unit under the hood
- The operator is required to provide a breath sample to start the vehicle and often to provide a "rolling retest" at random intervals
- The system is generally inspected every 30 to 60 days
- Goals and Tasks
- Determine & recommend effective administrative and judicial elements for an evidence-based IID program in Iowa
- Identify educational strategies to best inform legislative, judicial, public and law enforcement entities.
- Review of legislative efforts in other states.
- Administrative review of DOT policies and procedures.
- Evaluation of Cost/Benefit; Societal benefits

Use of Video in Teen Driving: Age vs. Experience

- Motor vehicle crashes are the most common cause of injury and mortality in teens, and the first six to 12 months of independent driving is the most crash-prone period.
- There has been substantial simulator research of teen driving behavior, but a disconnect between research and the real-world. This research is for newly licensed teen drivers. In Iowa, school driving permits may be granted to drivers as young as 14 year olds.

Research Includes:

- Evaluation of driving characteristics
- Evaluating impacts of feedback (from researcher to driver and parents)

Go Team Project: Understanding Teen Fatalities in Iowa Department of Transportation

- 40 to 50 teenage fatalities each year in Iowa from vehicular crashes.
- While all states keep and analyze crash records, the amount of detail from each state varies. Specific crash-related factors may not reveal themselves in the overall state-based crash statistics.
- Driver of at least one of the vehicles involved under the age of 19 (did not include chain-reaction crashes).

- 88 Fatal crashes evaluated. Four of these included more than one teen driver. 29 full ejections and 8 partial ejections.

Portable Computerized Assessments of Sleepy Drivers in Operational Environments

- Excessive daytime sleepiness is related to a large number of reported motor vehicle crashes.
- This research evaluated cognitive tests to assist enforcement in identifying at-risk drivers as potentially driving in a sleep deprived state based on erratic driving behavior.
- Evaluate whether computerized tests of attention and memory would be sensitive to sleepiness effects and compare this to PVT.
- Evaluate whether objective and subjective indices of acute and cumulative sleepiness predicted cognitive performance.

Intelligent Compaction: Implementation Plan

- Three Phases
    1. Three field demonstration projects using RICM on earthwork and HMA compaction.
    2. Development and use of Special Provisions SP that requires pass coverage, temperature, and stiffness related compaction data for three HMA projects.
    3. Proposed: Evaluate the use of the SP on a full depth HMA project.

Roller Integrated Compaction Monitoring Technology Research and Implementation – Phase II (Hot Mix Asphalt)

New SP-090048 requiring RICM coverage with temperature, pass count, roller-integrated CCV information on break-down roller.

Phase II : Implementation Findings

- Indication that over 95% compaction was achieved within 1 to 2 break down roller passes at most locations.
- Contractor's targeted rolling vs. data revealed.
- Results indicate that real-time temperature and pass coverage data can be valuable for HMA overlay construction projects.
- Stiffness related compaction data (CCV data) provided valuable information with a strong correlation to the underlying layer support conditions, but did not correlate well to HMA density.
- Research indicates that weak pavement foundation (subbase and subgrade) layer conditions contribute to failure of HMA surface layers.
- Implement RICM with required pass coverage, temp, and stiffness related compaction data on a full depth HMA project. Include mapping of the underlying subbase layer and stiffness prior to paving.
- Continue the evaluation of cohesive embankment soils on earthwork construction projects.
- Evaluate surface data and underlying data and investigate new methodologies and target values for QC/QA dependent on support conditions.
- Develop and education/training program for state and contractor personnel including videos and guide manuals with input from roller manufacturers.

Cameron Kergaye—Utah DOT

Project Preview

- UAV Technology
- Improving Utility Data Management
- Wildlife Crossing Structures
- Culvert Roughness Elements for Native Utah Fish Passage
- Construction Machine Guidance
- Accelerated Bridge Construction 4500 South/ I-215
- Measuring The Benefits of UDOT's Transportation Research Projects

Evaluation of UAV Technology

- Improve high resolution imagery along highway corridors:
  - Monitor wetlands and invasive plant species
  - Track construction projects
  - Locate structures for inventories
- Study flight areas:
  - Site 1: New freeway construction in Southern Utah
  - Site 2: New highway/wetland areas by Utah Lake
- Low-cost; need FAA approval
- Frequent image updates in GIS databases (inventories/comparisons)
- Plan: economical wetland mitigation decisions with accurate data

Improving Utility Data Management

- Collecting/submitting digital utility data within the UDOT right-of-way
  - Pre-construction utility surveys
  - Construction as-built plans
  - Utility permits /as-built plans
- GIS-based architecture for a utility data repository
- Save cost: better utility coordination, less utility damage and project delay
- Reviewed existing practices
- Reviewed geospatial software tools/standards
- Transferred technology from TTI for TxDOT
- Next phase: Pilot test of database in UDOT Region 3
- Improve utility data accuracy/access for planning, design, and construction
- Improve safety measures

Evaluation of Wildlife Crossing Structures

- Culvert and bridge designs for passing mule deer, elk, and wildlife
- Maintain wildlife connectivity and avoid vehicle collisions
- Observed repelling rate/correlate structure size and shape :
  - 35 digital cameras with motion sensor
  - 14 wildlife crossings
  - 21 existing structures

    - Year 2008 to 2011
- Bridges with under-crossings (mule deer)
- Best: Short distance, wide, and high culverts (mule deer)
- Utah's only wildlife overpass (both deer and elk)
- Recommend:
    - Wildlife culverts <120 ft. long and maximizing width
    - Use bridges with wide spans or new arch spans (elk)
    - Plan for better structure design and improve roadway safety

Evaluation of Culvert Roughness Elements for Native Utah Fish Passage

- Effect of artificial refuge in laboratory flume on upstream passage rates of small non-salmonid fish
- Simulate three separate culvert conditions:
    - Smooth boundary (control)
    - Smooth boundary with concrete cylinders
    - Rock substrate as boundary
- Mapped the velocity field near boundary & compared energy expenditure (based on swim path)
- (Rocks)best refuge for fish behavior and reduced energy expenditure
- Recommend:
    - Place rocks to fish size (1:1) to improve upstream passage in existing culverts
    - Test substrate in field culverts (Phase II)

Construction Machine Control Guidance

- To develop procedures to use CMCG:
    - To change current specifications
    - To describe contract negotiations
    - To define design survey requirements
    - To analyze the design process
    - To examine advertising requirements
- Reviewed existing specifications
- Visited CMCG projects:
    - Earth moving , Grading, Utility installation, and concrete paving operations
- Developed guidance for design and construction
- Refined an implementation process
- Recommended project inspector training
- Outlined survey control needs for design
- Final Report:
- http://www.udot.utah.gov/main//uconowner.gf?n=1824302362856430
- Accelerated Bridge Construction
  4500 South over I-215
- Demonstrate ABC in removal and replacement of a bridge
    - Evaluate innovative bridge construction techniques
    - Analyze user cost savings
- Used $1 M of HFL funds to offset $0.8 M increase
- Self-Propelled Modular Transporter (SPMT) removed and replaced existing bridge

- Project saved $4.2 million in user costs
- Impact to public was reduced
    - Bridge moved over weekend
    - Cross street closed (10 days)
    - Eliminated 110 days of closures
- ABC now standard consideration

- Measuring The Benefits of UDOT's Transportation Research Projects
- Estimated benefits of research at UDOT:
    - Estimated B/C ratio
    - Feedback on process/direction
- Reviewed research projects from 2006 to 2008:
    - Evaluated and classified 41 projects
    - Interviewed key champions to quantify implementation
    - Compiled and calculated B/C ratio
    - Determined greatest payback per classification
- 46 deliverables benefit-cost (17:1)
    - 46 deliverables were produced
    - $4.81 million cost of projects
    - $80.8 million of estimated benefit
    - Highest benefits achieved by studies on big ticket items:
        - Highways, bridges, traffic control, and right-of-way
        - Safety studies also show significant returns
    - Portion of Research Division resources dedicated to implementation

Paul Weigand—ISU InTrans/Director of Iowa SUDAS
**Provided a short background about the organizational structure.

SUDAS (pronounced "soo'dahs") is short for Statewide Urban Design and Specifications. The Institute for Transportation at Iowa State University maintains Iowa's SUDAS manuals for public improvements. Developing and maintaining Iowa's unique SUDAS manuals is the result of a lengthy and painstaking effort by more than 300 stakeholders across the state.

Advantages of using SUDAS

First of all, citizens simply appreciate uniform public improvements (e.g., similar sidewalk ramps) from town to town. In addition, by using standard designs and specifications Iowa's cities have

- Uniformity of urban design and specifications across the state
- Reduction of contractor confusion and mistakes due to differing specifications; encourages more bidders

- Mechanism to be proactive in research and studies for new and improved urban design and specifications
- Method for study and statewide implementation of latest techniques and material use
- Forum that allows state and local governments to collaborate with industry
- Reduced costs through uniformity, understanding, and acceptance (conservatively estimated at $16M/year if program is fully implemented)

InTrans keeps the statewide manuals up to date. This relieves individual communities of that burden and expense while ensuring they are informed about new products and procedures.

- 1,100 standard specifications and over 400 design manuals in circulation
- http://www.iowasudas.org/

Crawford Jencks—NCHRP

National Cooperative Highway Research Program

- Sponsored by: American Association of Highway and Transportation Officials (AASHTO)/State DOTs
- Managed by: Transportation Research Board (TRB)
- Assisted by: Federal Highway Administration

NCHRP Special Projects

- 20-5 Synthesis Program
- 20-6 Legal Studies
- 20-7 AASHTO Highways Committee
- 8-36 AASHTO Planning Committee
- 25-25 AASHTO Environmental Committee
- 20-65 AASHTO Public Transportation Committee
- 20-24 Adm. Of State DOTs (for CEOs)
- 20-30 NCHRP-IDEA
- 20-36 International Info. Sharing and Scans
- 20-68 US Domestic Scan Program
- 20-83 Long-Range Strategic Issues

Promising Research

- With decreasing resources, what has more promise than researching the optimization of those limited resources to accomplish agency goals?!
    - Research that includes evaluating the condition and/or performance of agency assets as the foundation of future strategic directions
    - Research that includes evaluating the consequences of various strategic options/investments (e.g. what-if scenarios)
- NCHRP contributions

- Highway Maintenance Quality Assurance
- Transportation Asset Management

NCHPR Project 14-12
Highway Maintenance Quality Assurance: 1995-1998

Purpose/Objective
- Develop a state-of–the-art maintenance QA program—a prototype/template
- Recommend procedures for assessing and maintaining levels of service (LOSs)
- Identify methods to determine investment needs to meet agency goals while maintaining acceptable levels of service (LOSs)

Successful Research
- An NCHRP panel of experts and champions (chief champion, the 14-12 panel chair, Leland Smithson, Iowa DOT)
- Panel promoted and incorporated implementation activities into the project.
- Excellent research team that included former state maintenance engineers who had the vision.
- State DOT volunteer support to help further implementation during the project's life.

Process
- Research to analyze and recommend practice.
- Developed "draft" user manual
- Panel requested additional funds to hold workshops to test the manual and educate DOT maintenance workers
- Agency held 6 regional workshops with the help of host state DOTs
    - Dubuque, IA
    - Lake Havasu, AZ
    - Bristol, VA
    - Galveston, TX
    - Kansas City, MO
    - Portland, OR
- Manual finalized and published as *NCHRP Report 422, Maintenance QA Program Implementation Manual*
- A major cultural change for State DOT maintenance divisions. Reportedly all State DOTs have adopted some form of "Maintenance Quality Assurance" programs.
- A precursor to the agency-wide practice of "transportation asset management" that goes beyond system preservation.

Impacts on Practice: *Quality assurance for the maintenance world*
- QA helps agencies make educated decisions about where to invest limited resources to optimize performance of the system.
    - Demonstrates LOSs achievable based on investments.
    - Provides structured processes for monitoring current LOSs across and among assets.
    - Creates what-if scenarios based on levels of investments and focus areas.

The message continues through the AASHTO Highway Subcommittee on Maintenance and further workshops.

- Not all research is implemented immediately; it takes time to make a cultural shift.
- The right people can make a difference (panels, researchers, staff).
    - Champions count, they really do make THE difference. There was passion on the NCHRP panel and the research team.
- State DOT volunteer assistance was crucial to implementation and the creation of momentum.
- Through the AASHTO Highway Subcommittee on Maintenance, interest and improvements continue.

Seminal NCHRP Efforts

- Project 20-24(11): AASHTO Transportation Asset Management Guide (Nov. 2002)—by Cambridge Systematics, Inc.
    - Defines TAM and its business processes
    - Provides self-assessment and good practice
- Project 08-69: AASHTO Transportation Asset Management Guide: A Focus on Implementation (Jan. 2011)—AECOM
    - Provides specific implementation strategies

Transportation Asset Management (TAM)

"TAM focuses on a DOT's business processes for resource allocation and utilization with the objective of better decision-making based upon quality information and well-defined objectives." (TAM Guide, Nov 2002)

- Maximizing the accomplishment of the agency mission
    - Optimizing resources to meet agency goals
    - Evaluating the consequences of various strategic options (what-if scenarios)

NCHRP Project 20-24(11)

- 1999: Problem initiated under the NCHRP Project 20-24 series because of interest by state DOT leadership.
- Initial interpretation: Only applies to system preservation.
- First NCHRP panel meeting: Panel expanded the concept to state DOT-wide business areas and issued an RFP.
- Research project: Successfully completed, but faced resistance. Memories of ISTEA mandated management systems.

AASHTO: Through efforts of a dedicated few, AASHTO eventually adopts the NCHRP report as its Guide. AASHTO's Special Committee on TAM becomes a Joint Subcommittee (Highways and Planning)

- FHWA: Office of Asset Management champions concept and provides financial support
- TRB: Conducts workshops/conferences with AASHTO and FHWA. Later conferences also receive support from individual states. Next: April 2012 in San Diego

Asset Management Guidance for Transportation Agencies [20-24(11)]

- Interim Products
    - Synthesis of Asset Management Practice
    - Asset Management Framework
    - Recommended Research Program

- AASHTO: *Transportation Asset Management Guid*e-Nov 2002
- Self-Assessment Brochure

NCHRP Project 08-69
Supplement to the AASHTO TAM Asset Management Guide: Vol. 2
A Focus on Implementation [08-69]

- Additional guidance for implementing TAM based on the framework presented in the earlier *Guide*
- Tools for evaluating return on investment and improving economic efficiency, resource allocation, and budgeting decisions
- Strategies for enhancing communication and information sharing among policy and technical decision makers as well as elected officials
- Enterprise Resource Planning (ERP) systems and TAM
- May 2010: FHWA and the AASHTO Joint Subcommittee on Asset Management sponsored a peer-exchange at the AASHTO 2010 Spring Meeting to introduce users to this NCHRP product. (*Research team's slide deck is available on project website*.)
- January 2011: AASHTO adopts NCHRP product and publishes as an AASHTO guide.

AASHTO: Transportation Asset Management Guide: A Focus on Implementation

- Part One: Getting Started and Developing the Transportation Asset Management Plan
- Part Two: Processes, Tools, and Data to Support Transportation Asset Management
- Part Three: Case Studies and Examples
    - Colorado
    - Missouri
    - New Zealand
    - Wyoming

NCHRP Synthesis

- *Synthesis 371: Managing Selected Transportation Assets: Signals, Lighting, Signs, Pavement Markings, Culverts, and Sidewalks* explores the state of the practice for managing transportation infrastructure assets other than pavements and bridges, and documents gaps in knowledge and areas in need of potential further study.
- And others……..see TRB.org/NCHRP website

Debra Elston—FHWA

Coordination Role in R&T

- Internal FHWA Program Coordination
    - Research & Technology Leadership Team
    - Legislation and Budget
    - *Every Day Counts* Initiative

- Small Business innovative Research Program (SBIR)
- Strategic Highway Research Program (SHRP2)
- Transportation Pooled Fund Program
- Exploratory Advanced Research
- US DOT: RITA and Modal Agencies, DOT R&T Planning Team, ITS/JPO, UTCs
- Value of Research Report
- Public Roads Magazine
- R&T Now Newsletter
- Focus Newsletter
- Technical Research Reports
- FHWA Research Library
- Web Site

SAFETEA-LU Title V
Surface Transportation Research, Development and Deployment
Budget by Function Area – FY 2010

- Federal responsibility.--Funding and conducting surface transportation research and technology transfer activities shall be considered a basic responsibility of the Federal Government when the work--
    - is of national significance;
    - delivers a clear public benefit and/or where private sector investment is less than optimal

Current and Emerging Challenges

- *Improve safety*
- *Promote livable communities*
- *Enhance economic competitiveness*
- *Create environmentally sustainable transportation*
- *Maintain a state of good repair of our infrastructure*
- *Analyze existing and new policy issues*
- *Next Generation Solutions*

- Conduct of Research, Develop products and solutions, Deliver Innovation
- INNOVATION LIFECYCLE.--The term 'innovation lifecycle' includes identification of needs and research scope, agenda setting, conduct of research, development, deployment, testing of technologies and innovations, and impact evaluations."
- SAFETY: Fatalities and injuries on the nation's roads and highways cost Americans over $230 billion annually.
- Livable Communities: Changes must be achieved within right-of-way limitations and environmental, energy, and climate control objectives. Urban areas experience increasing traffic congestion. The U.S. population is expected to increase by 45 million persons in the next 20 years, adding more drivers and vehicles to the roads and highways. Vehicle-miles traveled have traditionally grown twice as fast as the population, and any economic recovery is expected to increase vehicle travel.
- Economic Competiveness: In addition, the volume of freight moved on the U.S. transportation system has grown dramatically over the past two decades and is projected to nearly double by 2020. States face significant challenges as cross-state movement of goods and just-in-time

delivery continue to be critical to the national economy. Changes in road design, operation, and transport coordination is needed to increase opportunities for multimodal transport of freight and passengers.

- Developing and implementing innovations through highway research is essential for ensuring a high quality transportation system that meets the nation's needs for mobility and economic vitality.
- Environmentally Sustainable: Accelerated deployment of innovations and technologies is an effective solution to improving and preserving the highway system and addressing the affects of decreased resources (funding and expertise). New products, processes, and technologies can bridge the gap between the downward trend of resources and the upward trend of needs.
- Strengthen planning and environmental linkages.
- Infrastructure: Much of the nation's highway infrastructure is or will be facing the need for repair or major rehabilitation. In light of these facts, the need for bold actions and effective investments in research and innovative technologies are obvious.
- Policy - Answers to key issues are needed to provide transportation leaders with information to guide future policy and program decisions that will improve the quality of life for the American people.

Research and Innovation Delivery Winners

- Ultra High Performance Concrete
- Nondestructive Evaluation
- Interactive Highway Safety Design Model
- Human Factors Systems
- Double Crossover Diamond Interchange

Ultra High Performance Concrete

- Superior strength properties
    - Exceptional durability
    - High compressive strength
    - Long term stability
- Benefits
    - Accelerated construction
    - Use of longer spans
- Recent use
    - Jakway Park Bridge, Buchanan County, Iowa

Nondestructive Evaluation for Bridges

- Develop or improve NDE technologies or inspection protocols
    - Multi-plate gusset inspection, Response Based Load Rating
- Promote best practices in NDE through improved information
    - Bridge Inspectors Nondestructive Showcase, Web Manual
- Coordinate with Long Term Bridge Performance (LTBP) Program
    - Use findings of LTBP to identify research needs, Convert LTBP research driven inspection protocols to an operational level

Interactive Highway Safety Design Model

- What is IHSDM?
  - A suite of tools for evaluating the safety and operational effects of geometric design decisions
- Includes 6 modules
  - Crash Prediction – Highway Safety Manual Predictive Methods (Part C)
  - Policy Review
  - Design Consistency
  - Intersection Review
  - Traffic Analysis
  - Driver / Vehicle

- **Number of downloads:**
– over 5600 (by 08/05/11)
- Number of support contacts:
– 1174 (by the end of June 2011)
- **Number of the users supported:**
– 342 (by the end of June 2011)

Human Centered Systems

- Highway Driving Simulation
- Behavioral Studies
  - Two-lane rural roads at night
  - Infrastructure Based Red-Light Violator Warning
  - Low-cost highway safety improvements
- Visualization Tool
  - Mini Roundabouts
  - Diverging Diamond Interchange/Double-Crossover Diamond

- PennDOT Study
    - Safety Enhancements and Nighttime Visibility on Rural Two-Lane Roads

- Exploratory Advanced Research
- Status
  - 5 Solicitations
  - 40 Projects Awarded
    - $41M Investment
    - $26M Federal
    - $15M Match

Focus Areas

- Integrated Highway Research System Concepts
- Nano-Scale Research
- Human Behavior and Travel Choices

- Energy and Resource Conservation
- Information Sciences
- Breakthrough Concepts in Material Science
- Technology for Assessing Performance
    -
- www.fhwa.dot.gov/research

Cynthia Gerst—Ohio DOT

Candidates

- **Geotechnical Data Schema**
- **Ice Prevention or Removal on Veterans Glass City Skyway Cables**
- **Development of Opportunity Zones**
- **Snow Removal Wastewater Disposal Alternatives**

Geotechnical Data Schema

- **What is it?**
- Pooled fund project was started in 2005
- **How did we develop it?**
- Feasibility confirmed by earlier synthesis study. Florida DOT was funding U of F in similar project so two combined.
- **How will you evaluate its effectiveness?**
    - Accessibility of Geotech data, including increased cooperation and coordination between DOT's.
- **What are the implementation and T2 plans?**
- DIGGS website http://www.diggsml.com

Ice Prevention or Removal on VGCS Cables

- **What is it?**
- Reaction to bridge safety issue
- **How did we develop it?**
- Special RFP in 2009, district & UTC
- **How will you evaluate its effectiveness?**
- Improved operations and safety of bridge
- **What are the implementation and T2 plans?**
- Ice Fall Dashboard 1.0 – predicts when ice will fall

Development of Opportunity Zones

- **What is it?**
- Framework for identifying optimal regions for economic development incorporating constraints in transportation network.
- **How did we develop it?**
- Ohio State researchers working in conjunction with ODOT technical liaison
- **How will you evaluate its effectiveness?**
    - Improved coordination between ODOT and ODOD
- **What are the implementation and T2 plans?**
- Use as part of a suite of programs for company attraction and infrastructure enhancement planning.

Snow Removal Wastewater Disposal Alternatives

- **What is it?**
- Actionable alternatives with cost & environmental benefits
- **How did we develop it?**
- District experts had a problem, we built consensus and chose researcher. Now recruiting all districts for test sites.
- **How will you evaluate its effectiveness?**
- Clear alternatives to inform district decision making, and avoidance of any environmental fines.
- **What are the implementation and T2 plans?**
- Provide alternatives to district decision makers. The fleet size, snowfall and weather impact cost and environmental issues.

Dave Huft—South Dakota DOT

Application of Paleoflood Survey Techniques in the Black Hills Area (SD2008-01)

- The problem – a need for better flood-frequency information for design of highway infrastructure
- Previous reconnaissance-level study (SD2005-12) was completed in September 2007

Results available on www at: SDDOT Office of Research or sd.water.usgs.gov (click on Publications)

Project Objectives

1. Apply paleoflood hydrology techniques to obtain improved flood-frequency analyses for major streams within the study area.
2. Also investigate whether possible differences in storm potential across elevation gradients affect peak-flow potential.

What is "Paleoflood Hydrology"?

- The science of reconstructing the magnitude and timing of large floods that precede modern streamflow records
    - Approaches use geologic evidence and various other interdisciplinary techniques
    - More simply … an exercise in forensic hydrology
- Maximum flood stage can be approximated
- Hydraulic analysis can determine discharge
- Various methods for dating of flood evidence

Primary steps in process

1. Search for historical flood information pre-dating systematic peak-flow records.
2. Search along stream reaches for sites with flood evidence.
3. Conduct detailed site investigations in the best locations.
    A. Usually involves stratigraphic analysis of slack-water deposits
    B. Age-dating using radiocarbon analysis or other approaches
4. Detailed surveys of stream geometry for hydraulic analysis.
5. Estimate discharge associated with elevations of flood evidence using HEC-RAS flow modeling or other approaches.
6. Interpret the overall flood chronology for stream reach based on ages and discharges associated with flood evidence.
7. Perform frequency analyses incorporating systematic peak-flow records, historical accounts, and paleoflood information.

Major findings

1. Many locations with well-preserved flood evidence allowed development of viable long-term flood chronologies for primary stream reaches within the study area.
2. Flood-frequency analyses developed from the paleoflood chronologies represent a substantial improvement versus analyses from the relatively short-term systematic records available from streamflow gages.

Recommendations

1. Frequency analyses developed from the paleoflood chronologies are suitable for most typical applications of flood-frequency analyses.
    - A qualifier is that the analyses are best suited for the upper end of the frequency curves.
2. Resulting flood chronologies are applicable for important purposes beyond incorporation in peak-flow frequency analyses.
    - Given the potential for devastation from the extremely large floods, which frequently have exceeded 1972-scale flooding, future adaptation of flood management criteria might be warranted for the Black Hills area.
3. Decisions regarding appropriate application of frequency analyses for Rapid Creek will need to be made by future users because of complications associated with recent flood-control regulation.
4. Patterns of reduced potential for exceptionally large floods in high-elevation areas, relative to lower elevations (addresses the second project objective) are becoming better understood; however, additional research will be needed for full quantification of these patterns.
5. Future paleoflood studies in the southern and northern parts of the Black Hills would provide additional beneficial information.

- Study SD2005-12 indicated excellent potential for sites with suitable paleoflood evidence in these areas.

6. Finally, comprehensive regional analyses following the separate (sub-regional) investigations throughout the Black Hills area would be highly beneficial.
    - Assimilating results from throughout the entire area probably would identify regional patterns that can be used to improve final peak-flow characterization for specific streams or stream reaches.

Leni Oman—Washington DOT

Research Programs

- SPR Projects (biennial selection)
    - These are our core program and constitute projects funded through the Research Office with SPR Part 2 funding. A program of projects are selected every two years. Projects generally range from $75K to $200K and one to two years in length.
- Transportation Pooled Fund Program
    - We fund $150K in TPF contributions each year. WSDOT sponsors can request funding from the Research Office or provide funding for projects. We encourage other offices to make their contributions through us.
- Quick Response Research –
    - $200K is provided each biennium for short turn around projects that address high priority and emergent needs or help us take advantage of opportunities to gain knowledge we can use with low investment. The Research Office contribution is typically $20K or less and projects achieved within a year or less.
- Student Studies/Public Service Workshop
    - Student Studies/Public Services Workshop – In the past we have provided $120K for student studies but this is on hiatus due to the economic downturn. The program is to provide salary for students – frequently undergraduate – to conduct simple studies such as literature reviews, surveys, or information collection in the field. We are continuing to work with the University of Washington's Evans School of Public Affairs Public Services Workshop. This program seeks study topics from public agencies. Students select topics they are interested in and work out a scope of work with the agency technical contact and the work conducted over the next semester.
- Client Sponsored Research
    - This includes all research activities contracted through the Research Office that are funded by budgets not under our control (federal earmarks, local government, other offices). This comprises the bulk of our contracted research.
- Synthesis Reports

        - We conduct synthesis studies requested by department employees. Information is collected from literature, surveys, web pages, and phone calls.
- Reference/Literature Research
    - The WSDOT Library researches information about the agency and in the literature.
- National Programs (CRP, FHWA, SHRP 2)\
    - We solicit research problem statements, provide review and feedback, and submit them. We also facilitate nominations to national research panels and committees.

Research Pays Off –examples from our portfolio

- Of 920 bridges in high risk seismic zones, at least 545 have been improved with the products of research projects
- Over 300 miles of Portland Cement Concrete Pavement have been retrofitted using dowel bars. Saves ~$90K per lane mile compared to asphalt overlay
- Several miles of cable median barrier have been installed, preventing crossover accidents and saving lives
- Stormwater flow control research led to exemptions that have saved over $200 million in pond-related construction costs
- Research on incident patterns guided the deployment of incident research teams, minimizing incident-induced delay & optimizing deployment
- Developed software to analyze freeway usage and performance providing a foundation for the WSDOT flow map found on the agency website
- 500 miles of state highway serve as main streets, research found that applying community-design and visioning considerations during project development helped avoid costly changes to the project's scope and schedule and improved project delivery times

<u>Project Delivery RAC</u>

- Bridges and Structures
- Construction and Materials
    - Geotechnical
    - Pavements
- Design
    - Context Sensitive Design
    - Design Build
    - Geometric Design
    - Hydraulics
    - Safety
- Environment
- Real Estate

Bituminous Surface Treatment Research

Over the past 5 years, WSDOT has conducted multiple studies on the use of chip seals on higher volume highways.

Based on research findings:

- Implemented changes in our paving program allowing chip seals on road with daily traffic of up to 5,000
- Savings valued at ~ $10 million per year

- *http://www.wsdot.wa.gov/research/reports/fullreports/684.1.pdf*
- *http://www.wsdot.wa.gov/research/reports/fullreports/684.2.pdf*
- *http://www.wsdot.wa.gov/research/reports/fullreports/684.3.pdf*

Storm water Treatment

WSDOT has conducted multiple studies on storm water treatment.

- Flow control exemptions are estimated to have saved over $200 million in pond-related construction costs associated with western Washington transportation projects
- General Use Level Designation for basic and enhanced treatment for the compost amended bioswale

Seismic Retrofitting Research

Over the last decade:

- WSDOT has conducted more than 13 research projects on retrofitting existing bridges to withstand seismic activity
- Cost of these projects: ~$1.5 million
- This research has led to the retrofit of almost half of the bridges in the high risk seismic zone in Washington

Operations RAC

- Communications
- Congestion
- Intelligent Transportation Systems
- Traffic Management
- Maintenance
- Roadside Management
- Safety
- Security

Research has played a pivotal role in advancing traffic systems in Washington state over the last 20 years

- Developed data archives that store and summarize roadway data to assist in measuring roadway performance.
- Continually improving the statewide real-time traveler information system.

Evaluating the benefits of the High Occupancy Toll (HOT) operations and active traffic management solutions.

- Developed a self-adaptive toll rate calculation method based on real-time measurements to maximize our tolling operations
- Objective of this research is to reach HOT lane control targets quickly and effectively for various traffic flow conditions to keep traffic

State Highways as Main Streets: A Study of Community Design and Visioning

The Issue

- 500 miles of State Highways in Washington serve as the main street providing local access as well as regional mobility
- Design affects community livability and safety: these roads among the highest rates of pedestrian and traffic collisions in the state.
- Late stage design changes in these projects have increased costs and delayed projects.

What We did

- WSDOT tested the use of community design and visioning during project development in three locations
- Research conducted by the University of Washington in 12 months for under $50K

What We Found

- By actively building consensus and addressing a range of both agency and community concerns, community design:
    - Helped ensure traffic flow, livability, safety, & tourism
    - Supported efficient project delivery with fewer changes – keeping delays and costs down
    - Estimated to save $9M per project

Statewide freight network performance monitoring system
Washington State Truck Performance Measure program
Purchasing large quantities of truck data covering the state's major freight corridors from national GPS vendors
Using the speed data to begin to measure the results of investments and/or operational changes in the highway program for truck traffic

<u>Mobile LiDAR</u>
Research to evaluate the use of mobile Light Detection and Ranging (***LIDAR***) technology to determine if deploying it for use in collecting transportation data and other business operations would improve efficiency and accuracy.

- Final report in review but very promising
- Quality of data for business practices assessed
- Cost benefit analysis was conducted
- Strong interest in many programs

<u>Role of the Research Executive Committee</u>

- Define research goals that are the basis for project selection
- Establish the selection committees
- Approve the funded research program
- Review key research findings
- Evaluate and finalize recommendations for implementation of research findings

<u>The REC members are:</u>

- Assistant Secretary, Engineering and Regional Operations Division
- Director, Strategic Planning and Programming
- Director, Environmental and Engineering Programs
- Director, Maintenance and Operations Programs
- Chief of Staff, or designee

- Regional Administrator, Eastern Washington
- Regional Administrator, Western Washington
- Creation of research problem statements
- Prioritize research needs : address critical agency issues and aligns with the strategic direction of the agency
- Recommend problem statements to the REC
- Recommend technical monitors for the selected projects
- Provide a forum to discuss competing needs and help better define an appropriate balance
- Receive reports and presentations on research results, discuss the recommendations and funding options for implementation
- Provide information on research focus areas
- Provide input for national research participation
- Provide input and feedback on research programs and procedures.

Program Outreach Activities

- Research folios
- WSDOT Research website
- Project summary document
- Gray Notebook Annual Summary
- Strategic Implementation Plan
- LTAP Newsletter
- TRAC Biennial Report
- Research Bulletin Board
- Viral messaging
- Project close-out presentations
- Elevator speeches
- Value of Research resource documents
- Research Reports
- Research Notes
- Workshop/Seminars
- Videos
- Hoh River and Cable Repair
- Subject Area Meetings
- Traffic and Freight Meetings
- Quarterly Forums
- Role of the Champion

Ann Ellis—Arizona DOT

Three Topic Areas

- Environment
- Materials and Construction
- Intelligent Transportation Systems

Promising Environment Research

- SPR-603: *Measures to Minimize Wildlife-Vehicle Collisions, State Route 260*
  - Study GPS-collared elk to determine where they cross, then construct fences to guide animal populations to underpass or bridge structures.
  - Project developed with Arizona Game & Fish Department as part of ongoing series of studies.
  - Effectiveness evaluated several ways:
    - Reduction in crashes/fatalities
    - Cameras at underpasses to monitor wildlife use
    - Ongoing elk population monitoring
  - Implementation in progress on SR 260 and Interstate 17 in northern Arizona.

Promising ITS Research

- SPR-604: *Real-Time Adaptive Ramp Metering*
  - Project objective is to optimize freeway ramp metering by integrating surface street volume.
  - Developed with University of Arizona researchers and ADOT Traffic Operations Center (TOC) staff.
  - System has been successfully tested in "real-time."
  - Mid-stream hardware change will necessitate further development work and testing before deployment and implementation can occur.

Promising Materials & Construction Research

- SPR-605: *Investigations of Environmental Effects on Freeway Acoustics*
  - Arizona uses Asphalt Rubber Friction Course (ARFC) for noise mitigation, conditional upon ADOT conducting a pilot program (QP3/ SPR-577, now in year 7).
  - Environmental factors such as wind and temperature inversions can affect acoustical measurements.
  - Developed with researchers at Arizona State University and ADOT Materials staff.
  - This study and SPR-577 are working in concert to evaluate the effectiveness of ARFC as a "quiet pavement."

Bill Stone—Missouri DOT

On-Going Research

- Geotechnical Research Program
- LiDAR – Light Detection and Ranging
- Diverging Diamond Interchange Evaluation and Lessons Learned
- Sonar River Work

Geotechnical Research Program

- General Objective
  - Achieve significant and recurring cost savings by developing improved, technically sound geotechnical design guidelines
- Deliverables
  - Improved LRFD guidelines for bridge foundations
  - New LRFD guidelines for earth slopes
  - Commentary documents to support guidelines

Comparison – "old" and "new"

- "Old" Guidelines
- Required shaft:
  - 4-ft diameter
  - 38-ft length
- Nominal cost:
  $22,500 per shaft

- "New" Guidelines
- Required shaft:
  - 4-ft diameter
  - 25-ft length
- Nominal cost:
  $15,000 per shaft
- New guidelines result in savings of approximately $7500 per shaft

Comparison – "minimal" & "expanded"

Minimal Investigation

- Required shaft:
  - 4-ft diameter
  - 25-ft length
- Nominal cost:
  $15,000 per shaft
- Expanded Investigation
- Required shaft:
  - 4-ft diameter
  - 17-ft length

- Nominal cost:
  $10,000 per shaft
- Benefit of added characterization
  is approximately $5000 per shaft

If we had this information from 2005-2010

- Bridges on Drilled Shafts-$45,000/bridge
  - Over $1.7 million (estimated)
- Bridges on spread footings - $6,000/bridge
  - $800,000 total savings

Implementation

- Incorporated into Engineering Policy Guide (EPG)
- MoDOT's position: not going to increase superstructure

LiDAR – Light Detection and Ranging

- General Objective
  - Evaluate Advantages (or disadvantages) of data collected from LiDAR technology compared to traditional photogrammetric and survey methods.
- Deliverables
  - Conventional Aerial is still the most cost effective method to collect traditional mapping features
  - LiDAR can provide potential cost savings over traditional survey providing additional information content can be "mined" in the office

Project Approach

- A 7.5 mile relocation project was selected for study by MoDOT where data was collected by standard photogrammetric processes
- Study would perform:
  - Aerial LiDAR
  - Mobile LiDAR
  - Static LiDAR
- Compare to traditional ground survey also

MoDOT's LiDAR Efforts

- MoDOT's Design Division has evaluated the potential uses of LiDAR technologies for the past 3 years.
- MoDOT has purchased two static LIDAR scanners for evaluation in real-world project use.
- Static units are from different vendors and will be evaluated for cost effectiveness.
- MoDOT Photogrammetry unit has entered into a contract for aerial LiDAR surveys in the 2011 flight program
- Includes four projects consisting of 85.2 miles for new or realigned roadways.
- Projects are a mix of both urban and rural terrain and are ones that would have been done by traditional photogrammetric methods.
- Aerial photography is also being obtained on these projects as a means of quality control.

Diverging Diamond Interchange

Operational Evaluation and Lessons Learned

- General Objective
    - Evaluate the Operation of the first DDI in the nation opened to traffic on June 21, 2009, in Springfield, Missouri through contract research
    - Develop "Lessons Learned" Document to share with others on MoDOT's experience in the developing DDI
    - Deliverables
    - "Lessons Learned" document posted on Innovation Library
    - Contract Research findings show the DDI has provided increased capacity and improved safety

Research Findings

- **Traffic operations**
    - Left turn movements experienced a noticeable decrease in traffic delay and traffic queuing.
    - Through movements experienced a slight increase in travel time because in part due to the slow speed through the crossover areas during off peak periods.
    - The DDI will handle increased traffic volumes when compared to a diamond interchange.
    - Over-dimension loads up to 18-foot wide and 200-foot long have successful moved through the DDI.
    - The overall traffic flow through the DDI is better.
- **Safety**
    - Total crashes were down by 46 percent in the first year of operation.
    - Left-turn type crashes were eliminated and left-turn, right-angle type crashes were down 72 percent because of how left turns are handled within the DDI (free-flow movements or yield control);
    - Rear-end type crashes were down slightly, which may be the results of how left turns are handled not under traffic signal control.
    - DDI's post-construction crash types are similar to any other signalized intersection, and no definite crash pattern was noticed.
- **Public Perception**
    - More than 90 percent of survey respondents said they had good understanding of how a diamond interchange works.
    - More than 80 percent of survey respondents said traffic flow had improved and traffic delay had decreased.

Sonar River Work – Scour Research

- General Objective
    - Utilized a side scan sonar to develop 3-D map of the river bottom of the Missouri River at MoDOT bridges in Kansas City
    - Deliverables
    - The results obtained from the bathymetric surveys of the channel can be used to assess the bridges for stability and integrity issues with respect to bridge scour, and provide characteristics of scour holes that may be useful in the development of predictive guidelines or equations for scour holes.

Upcoming Research for FY2012

Pavement Thrust Area

- General Objective
  - Significantly reduce the cost for maintaining and rehabilitating pavements on Missouri highways while maintaining or improving the level of service.
- Deliverables
  - Provide advances in equipment, materials, and procedures (guidance documents and Engineering Policy Guide updates) that can be readily incorporated into MoDOT's pavement management program

AREAS OF FOCUS

- Section 1 – Existing Pavement Tool: Improve the decision making process on what locations to treat and when thereby reducing funds for roadways. Decrease cost through more judicious and appropriate use of funds.
- Section 2 – Additional Assessments: Provide additional quantitative assessment data to facilitate better decision-making for roadway selection and prioritization for treatment. Reduce costs by not treating roadways that have effective service life remaining.
- Section 3 – Site Specific Assessments: Provide project-specific data for analysis and design or selection of treatment type. Reduce costs by better assurance that the selected treatment will be effective for the specific site.
- Section 4 – Historical Data & Deterioration Model: Provide a "Missouri"-calibrated pavement deterioration model and treatment effectiveness matrix for incorporation into roadway selection at the system level and for treatment-type selection at the project level.
- Section 5 – Pavement Maintenance Guide: Guidance document for selection and application of most appropriate treatment for a specific project. Reduces cost by reducing the likelihood of misappropriate treatment or under or over treatment.
- Section 6 – Treatment Implementation: Expanded guidance for engineers, technicians and field personnel involved in implementing recommended pavement treatments in the field. Improves quality of project and facilitates better performance.
- Section 7 – Performance Monitoring: Closes the loop (provides continuous feedback) on performance of the treatment enabling improvements in the pavement deterioration model and better forecasts of future pavement conditions.

Placement and Evaluation of Two-Lift Pavement - Route 141 St. Louis

- General Objective
  - Placement of photocatalytic cement (TxActive) to take place in two-lift process in Late September with environmental evaluation of the air and water impacts to follow soon after placement.
- Deliverables
  - Provide Missouri with another tool with the placement of two-lift cement
  - Environmental evaluation of phototcataylitic cement

Photocatalytic process

- Titanium Dioxide occurs in nature
- Due to its brightness and high refractive index is used as white pigment – striping

- Creates a reaction when sunlight is introduced decomposes, by oxidation, organic and inorganic compounds existing in the atmosphere
- Helps to breakdown effects of pollution on color of concrete

Monitoring Plan

- Will not use Before/After study
- Monitor Control Section
- Monitor Test Section with Photo catalytic Cement
- Air monitoring has been confirmed in laboratory studies
- Water quality study will be conducted in conjunction with pervious shoulder sections

Polyurethane Foam In-Fill for Fiber Reinforcement Polymer (FRP) Bridge Deck Panels

- General Objective
  - Develop, test, and evaluate fiber-reinforced, polyurethane foams to replace the costly honeycomb construction currently used to manufacture FRP bridge deck panels.
- Deliverables
  - FRP bridge deck panel that is resistant to deicing chemicals and deterioration yet competitive with reinforced concrete on a first-cost basis.

Hybrid Composite Beam - Highways for Life

- General Objective
  - Implement bridge design innovations for reducing the cost of bridge construction and maintenance.
- Deliverables
  - Evaluate the in-situ structural behavior of the bridge to confirm to design assumptions
  - Conduct quality control/quality assurance testing on the bridge member
  - Evaluate potential serviceability and maintenance challenges

CTS Low-P Cement

- Product properties
  - High early strength
  - Low permeability and high bond strength
  - Added benefit of corrosion resistance
  - Minimal shrinkage
  - Excellent Freeze/Thaw Resistance
  - Easy to Place, High Slump, non-segregating

EVALUATION OF PEER EXCHANGE:

What opportunities for improvement have you heard?
What will you take back to your own agency?

Max Grogg:

- Need more of an open forum for new ideas: web posting, instead of waiting for the submission period.
- New ideas need to be shared as they come along, not just one time per year.

Lisa:

- Need more projects regarding environmental/materials issues.
- Would like to see more of these types of projects
- Would like a 511 App

Barnie:

- Maintenance projects
- Bring Local Agency into the research process

Take back:

  - Chloride permeability test; Louisiana has had good success
  - Intelligent compaction-mature technology and make information & demonstrations available.

Cynthia:

- ROI-need consistency to provide justification for projects
- Collaboration website
- Flexible ways to staff

Dave:

- SUDAS Program: opportunity/ there is a lot of benefit and will help small communities.
- Geo Tech- liked Cameron's presentation.
- Publication of reader-friendly summaries
- Make information more accessible

Deb:

- Research community
- Example: Diverging Diamond: worked on National basis
- Prefabricated Bridge Elements-from beginning to beyond
- How to we roll up all the great research in every state—keep each other informed. State to state.

Leni:

- MoDot Idea scale tool
- Evaluate expectations—how are people evaluating their research?
- Need a systematic approach.

Ann:

- Improve Multi-Modals
- Importance of Champions-need a strong sponsor
- Realign topic areas—underserved areas.

Bruce:

- Research assessment report- when to do?
- Follow up on snow removal and waste water
- Asset Management guidelines
- Mobile LIDAR Scanning
- Culvert-fish passage design

Sandra:

- Implementation of NCHRP
- Enjoyed Louisiana's presentation and research projects
- **Take Back:** NCHRP Report on user costs

Cameron:

- Staffing/funding
- Problem statement form
- Wildlife inferred cameras
- NCHRP guide
- Ramp Metering –optimizing
- **Take Back**: Thinking of combining engineer conference and UDOT Peer Exchange like Iowa does.

Mark:

- Oregon Pooled Fund-gusset plates
- Minnesota DOT sign removal research
- Bridge deck evaluation from MN, thermal graphic investigation
- Implementation plans
- LRFD Piles- info sharing on load tests

Vanessa:

- Low Cost or free-crash counter measures approach
- Un-Manned aerial vehicle- use for wetlands
- Interactive Highway Safety design model

Linda

- Supplement historical flood data
- Implementation: tools for TAC's and researchers (chart)
- Evaluation of research findings. How to document.
- How to disseminate the knowledge?
- 3D photo

Doc:

- Collaborate with other states and share info
- Also, how to share info within own state, use our resource and support
- Improve solicitation process, need a bigger window of time
- **Take Back**: Add a problem statement form.

Bill:

- Research Implementation Report
- Formalize it better
- Look for opportunities with LTAP
- Pavement marking vs. safety

Crawford:

- Idea Scale
- Oversight committee/have more interaction with contractors
- Professional offices/with regard to reports and production.

ATTACHMENTS

2011 Promising Research Iowa Peer Exchange Agenda

Tuesday, August 16 – Holiday Inn Des Moines Airport

12:30 – 1:30 Welcome and Introductions – Sandra Larson (515) 971-6329
Overview of the Peer Exchange – Sandra Larson
Lunch provided

1:30 – 5:00 Presentation roundtable (with refreshment break)
Each representative will discuss in detail the most promising research in their agency.

What are your most promising research projects?
How did you develop the project?
How will you evaluate its effectiveness?
What are your implementation and tech transfer plans?

1:30 – 2:00	Iowa DOT – Iowa Highway Research Board	Mark Dunn
2:00 – 2:30	Iowa DOT – ITS Project	Willy Sorenson
2:30 – 2:45	*… refreshment break…*	
2:45 – 3:15	Louisiana DOT	Doc Zhang
3:15 – 3:45	Minnesota DOT	Bruce Holdhousen
3:45 – 4:15	Oregon DOT	Barnie Jones

4:15-5:00 Tour Iowa State Fair ITS Project

5:00 Dinner – At the Iowa State Fair and drive to the Gateway Hotel in Ames, IA

Wednesday, August 17 – InTrans, Iowa State University

8:30 – 9:00 Welcome – Shashi Nambisian
Overview of the Institute for Transportation – Shashi Nambisian

9:00 – Noon Presentation roundtable continues (with refreshment break)

9:00 – 9:30	Iowa DOT – SPR and Implementation	Linda Narigon
9:30 – 10:00	Utah DOT	Cameron Kergaye
10:00 – 10:30	NCHRP	Crawford Jencks
10:30 – 10:45	*… refreshment break…*	
10:45 – 11:15	FHWA	Debra Elston
11:15 – 11:45	Ohio DOT	Cynthia Gerst
11:45 – 12:15	South Dakota DOT	Dave Huft

12:15 – 1:00 Mid-Continent Research Symposium Overview and Key Presentations – Sandra Larson
Lunch provided

1:00 – 5:00 Presentation roundtable continues (with refreshment break)

1:00 – 1:30	Washington DOT	Leni Oman
1:30 – 2:00	Arizona DOT	Ann Ellis
2:00 – 2:30	Missouri DOT	Bill Stone

3:00 – 6:00 Report Completion: Each representative will evaluate the peer exchange and discuss:

What opportunities for improvement have you heard?
What will you take back to your own agency?

6:00 New and Innovative Projects at Iowa DOT
Cryogenics – Linda Narigon
Missouri River Flooding – Vanessa Goetz
Iowa Highway Research Board – Mark Dunn
Dinner provided

Thursday, August 18 – Gateway Hotel and Conference Center

7:00 – 5:00 Mid-Continent Research Symposium, lunch provided
5:00 – 6:30 Symposium Poster Session
6:30 – 8:30 Banquet – Featured Speaker is Paul Trombino, III, Director of the Iowa Department of Transportation.

Friday, August 19 – Gateway Hotel and Conference Center

8:00 – 12:00 Mid-Continent Research Symposium continues