FY 2012 ANNUAL REPORT

Research, Intelligent Transportation Systems, and Technology Transfer Activities

Research and Technology Bureau

A Driving Force of Innovation

www.dot.state.ia.us/research/index.htm

Iowa Department of Transportation

Executive Summary

Transportation research makes a difference for Iowans and the nation. Implementation of cost-effective research projects contributes to a transportation network that is safer, more efficient, and longer lasting. Working in cooperation with our partners from universities, industry, other states, and FHWA, as well as participation in the Transportation Research Board (TRB), provides benefits for every facet of the DOT. This allows us to serve our communities and the traveling public more effectively. Pooled fund projects allow leveraging of funds for higher returns on investments. In 2012, Iowa led 15 active pooled fund studies, participated in approximately 30 others, and was wrapping-up, reconciling, and closing out an additional 6 Iowa Led pooled fund studies. In addition, non-pooled fund SPR projects included approximately 19 continued, 21 new, and over a dozen reoccurring initiatives such as the technical transfer/training program. Additional research is managed and conducted by Iowa Highway Research Board, the Office of Traffic and Safety and other departments in the Iowa DOT.

In 2012, research efforts primarily focused on these six areas:

- **Safety** – The centerpiece of safety research is the annual Transportation Safety Improvement Program. In addition, Iowa DOT leads two national pooled fund traffic safety projects and administers other widely varied safety projects such as a study of teen crash fatalities, Iowa Traffic Safety Alliance "Changing the Culture" Younger Drivers, and commercial driver fatigue.

- **Winter Maintenance** – Iowa continues to lead a significant pooled fund project (Aurora) centered on winter maintenance, and participates in several others. In-state research is funded with State Planning and Research money and includes safety and mobility impacts of winter weather. The Office of Maintenance also conducts a variety of research initiatives every winter, testing new equipment and processes with operation forces and budget.

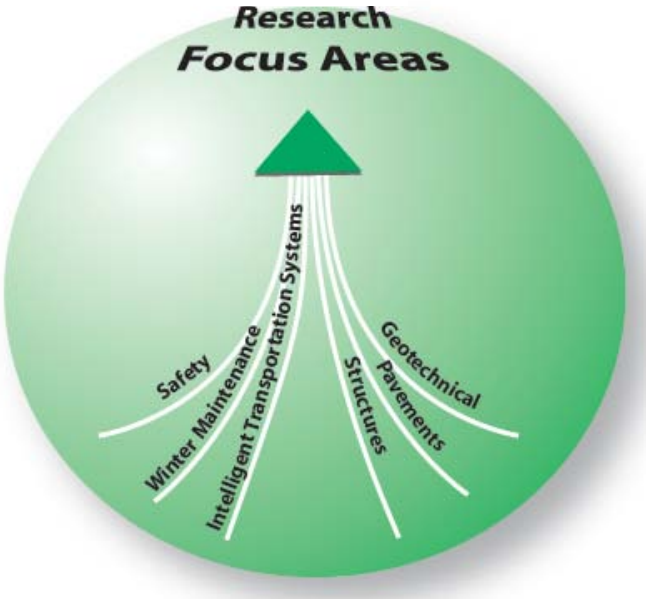
- **Pavements** – With assistance from the Concrete Pavement Technology (CPT) Center at Iowa State University, the Iowa DOT leads four national concrete pavement pooled fund projects. Objectives include improvements for: pavement design, mix and materials, construction and maintenance methods, and procedures for building more durable, cost-effective concrete pavements.

- **Structures** – The Bridge Engineering Center at Iowa State University has collaborated with Iowa DOT staff for several years developing cutting-edge technology systems for monitoring structural health of new and existing bridges. Iowa has taken the lead on three national pooled fund bridge studies. Other promising research centers on using precast pavement sections for bridge approaches to reduce construction time, reducing inconvenience to motorists, and eliminating “the bump at the end of the bridge.”

- **ITS** – Promoting efficient travel reduces congestion, resulting in increased traveler safety. TripGuide systems have been deployed in the Iowa City and Quad Cities areas, allowing web users to view real time video of roadway conditions. Preparations for similar systems in Council Bluffs and Sioux City are currently underway. Development of the Statewide ITS Management Software (SIMS) project will enable DOT personnel and partner agency staff to control and configure existing and future deployments of ITS devices statewide.

- **Geotechnica**l – The Partnership for Geotechnical Advancement (PGA) mission has been expanded into the new Earthworks Engineering Research Center (EERC) at Iowa State University (changed to Center for Earthwork Engineering Research, CEER, in 2011). Iowa also leads a pooled fund study on Improving the Foundation Layers for Concrete Pavements and began a new pooled fund project: Technology Transfer Intelligent Compaction Consortium (TTICC).

Research is a driving force of innovation contributing to the future of transportation and the stability of our nation's infrastructure. New, cost-efficient products and technologies are continually investigated. Those that increase safety, product performance, and long-term viability are implemented, building a future transportation network today based on solid methodologies and cutting-edge investigations.



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Introduction

The purpose of this report is to provide an overview of research, Intelligent Transportation Systems (ITS), and technology transfer activities managed by the Iowa Department of Transportation's (DOT) Research and Technology Bureau (R&T Bureau). The R&T Bureau enhances Iowa DOT's ability to deliver efficient and effective transportation services by actively promoting research, university and industry partnerships, knowledge and technology transfer, ITS and information technology.

Bureau responsibilities include:

- Coordinate, manage, and administer the research portion of the State Planning and Research Program (SPR).
- Coordinate, manage and administer work of the Iowa Highway Research Board (IHRB). The IHRB program and SPR program are coordinated to ensure a continuing effective Iowa highway research program.
- Lead collaborative research efforts with FHWA, other states, universities and industry through national pooled funds and the Iowa Transportation Research Collaboration Agreement. Coordinate, manage, and administer the pooled fund studies.
- Identify, fund, manage, track, and implement research.
- Participate in national and emerging regional ITS programs and administer ITS initiatives.
- Provide leadership for research and technology initiatives within the Iowa DOT.
- Promote participation with other states in emerging research and technology such as 511 travel information system and Highway Advisory Radio/Low Powered FM.

Additional research, technology transfer and implementation activities are carried out in other divisions and offices of the Department. These include:

- The Office of Traffic and Safety administers the Iowa Traffic Safety Improvement Program as well as the Safety Management System, a diverse partnership of Iowa highway safety practitioners in engineering, enforcement, education, and emergency services dedicated to reducing the number and severity of crashes on Iowa's roadways.
- The Office of Maintenance conducts extensive research into winter weather operations and road weather reporting and reports on their work.
- The Office of Bridges and Structures administers the federally funded Innovative Bridge Research/Construction Program.
- The Living Roadway Trust Fund awards research and demonstration grants for integrated roadside vegetation management.
- The Office of Materials conducts materials and testing equipment research and reports on their work.

I. Bureau of Research & Technology Programs

A. State Planning & Research Work Program (SPR)

Title 23 of the United States Code provides federal funding for state research programs by requiring that at least a minimum of ½ percent of certain federal funds apportioned to a state be used for research, development, and technology transfer (RD&T) programs. The R&T Bureau is responsible for formulating the research portion of the annual SPR plan, administering contracts, tracking progress, promoting pooled fund studies, and tracking implementation. Iowa's Federal SPR Part II allocation for FY 12 was $2,420,917.

The research portion of the SPR program covers the four areas listed below. The numbers in parentheses indicate the function code applied to each area.

- General Administration (771) includes contributions to the Transportation Research Board and support of the Iowa DOT Library.
- Research and Technology Transfer (774) includes internal research projects as well as support for technical organizations (National Cooperative Highway Research Program (NCHRP), AASHTO committees, ITS groups), training, and special pilot or demonstration projects
- Research Support (775) covers the cost of specialized equipment purchased to accomplish a research project or to be tested itself.
- Pooled Fund Studies (776) covers the cost of contributions to regional and national studies in which multiple states participate.

Following in this section is a general description of each line item in the FY 12 SPR work program along with a brief statement of its impact on Iowa DOT operations.

The SPR work program (*Attachment 2*) represents a collaborative process of setting research priorities, selecting research activities, and reporting results. New projects are added from needs identified by various offices, solicitations by Federal Highway Administration (FHWA) and American Association of State Highway Transportation Officials (AASHTO), and invitations from individual sponsoring lead states throughout the year upon approval from FHWA. *Attachment 3* illustrates the dollar amounts to SPR program categories. Each year's program is formulated to be diverse, including a variety of work areas such as design, construction, materials, maintenance, safety, structures, and environment. *Attachments 4 and 5* show the distribution of SPR funding among various types of work.

General Administration (771)

The objectives of this section of the SPR program are to monitor transportation research activities at the national and regional levels, keep staff informed of current developments, prepare research proposals and work plans, administer research contracts, and provide assistance to staff and activities that support research in the department.

Accomplishments in FY 2012

Staff continued to review transportation research activities and to participate in the dissemination of research results throughout the department. Staff also provided statistical support to ongoing research activities. The DOT library is jointly supported by the DOT and Iowa State University's Institute for Transportation (InTrans), with InTrans providing the staffing for the library.

Transportation Research Board (TRB)
TRB conducts a variety of programs and activities designed to support dialogue and information exchange among researchers, practicing transportation professionals and others concerned with transportation. A more detailed description of Iowa DOT involvement in TRB can be found in Section III of this report.

★ ***Result:*** Access to new nationwide research and technology developments

DOT Library
The Iowa DOT library is jointly supported by the DOT and Iowa State University's Institute for Transportation (InTrans), with InTrans providing staffing for the library. SPR funds are used to supplement InTrans staffing and to purchase books, periodicals and other relevant materials. The library's web site is http://www.iowadot.gov/research/lib_home.htm.

★ ***Result:*** Support for Iowa DOT staff seeking broader knowledge and expertise

2012 Work Program

Research administration will continue to provide direct support to research and technology transfer activities and to provide analytical expertise to related activities. Continued support will be provided to the DOT Library. A work plan detailing this cooperative effort is available.

Research and Technology Transfer (774)

Technology transfer means those activities that lead to the adoption of a new technique, process, or product by users and involves dissemination, demonstration, training, and other activities that lead to eventual innovation. These activities foster research implementation, utilize staff expertise, and keep the transportation community apprised of the latest advances in the field.

Projects from Earlier Programs That Were Voided in FY 2012

Multiple Blade Under Body Snow Plow

The Iowa DOT has been experimenting with multiple blade snow plows for the past several years and has helped develop a front plow that uses a flexible carbide edge for removing the bulk of the snow from the road, a scarifier blade used for removing hard packed snow followed by a rubber squeegee blade used for removing any material left by the first two blades as well as any slush or water on the road. This concept has proven to be very useful and popular with several Snow Belt states.

There are still problems with using a front plow such as: snow coming over the plow onto the front windshield, spray coming off the plow and degrading the fins of the radiator and less control of the steering due to the plow being in front of the front wheels instead of the middle of the truck. These issues could be solved by developing an under body multiple blade snow plow that incorporates the features found to be useful in the past research. This project will research a new style underbody snow plow that incorporates all the features of the multiple blade plow but puts the blade under the truck so it is more stable, does not need to be mounted and taken off during the off season and can solve a lot of the problems experienced with the plow being out in front of the truck.

Precast Concrete Box Culvert Survey and Recommendations

The use of precast concrete box culverts is becoming more prevalent in the State of Iowa. Counties are especially intrigued with their potential for rapid installation and the resulting limited disruption to their road system. A survey of existing precast structures is required to aid the Iowa DOT, Office of Bridges & Structures, and local counties, to evaluate the success and possible problems, of current installations. The survey would identify successful practices, problem areas and recommendations for improving the current design. Specific objectives: Determine the prevalence of precast culverts and the most common sizes used in the state; Rate precast box performance; Determine and document any problem areas in the installation; Make recommendations for improving the use and applicability of precast concrete box culverts.

Statewide ABC Constructability Review

Accelerated bridge construction (ABC) is recognized as a viable program offering measurable benefits to the owner and the public. ABC does not simply mean assembling a number of precast bridge components. Iowa DOT has been on the leading edge of ABC as evidenced by the recent national workshop in Des Moines that gathered owners, designers and contractors from across the US. Additional evaluation is needed to better utilize ABC for bridges across the state.

This project will evaluate the constructability of the full range of accelerated bridge construction (ABC) means and methods for suitability with Iowa contractors. This project will also investigate the ability for contractors to submit alternative technical concepts or utilize early-contractor involvement early in the design phase. This evaluation would also include an economic analysis to assess competitive nature of specialized materials and technologies.

Alternative Bridge Deck Overlay Options for the State of Iowa

Moisture intrusion through deck cracking has significant impact on the life of the structure, specifically affecting reinforcing steel. In the past Iowa has not utilized an overlay process other than a low slump concrete as a rehab technique for mitigating moisture infiltration into the deck. Currently other states such as Kansas have researched and utilized polymer deck overlays. However, given the difference in weather conditions, road deicing techniques, and vehicle (snow plow, etc) differences further research is warranted regarding application of these methods/ materials in Iowa and states with similar weather related conditions. Due to traffic conditions, methods are necessary that limit the impact on the public and allow contractors to apply overlays to have bridges back in service quickly. Cost/benefit analysis may be pertinent to evaluate the relevance of the overlay for various input conditions (ADT, location, bridge condition, etc).

Accomplishments in FY 2012

Comprehensive Bridge Deck Deterioration Mapping of Nine Bridges by Nondestructive Evaluation Technologies (Non Destructive Evaluation of Bridge Decks)

A promising technology for detecting early deterioration in bridge decks has been developed and successfully tested by researchers at Rutgers University. This technology is the combined use of Impact Echo (IE) and Ground Penetrating Radar (GPR) to accurately assess bridge deck conditions. Researchers from Rutgers University used the technology to assess the condition of nine bridge decks in Iowa starting in May 2009. This was a true test of the effectiveness of this technology since the bridges being tested were scheduled for deck repairs shortly thereafter. This project will provide bridge owners with a tool that can increase the life of bridge decks through early deterioration detection and prompt repair. This will reduce maintenance cost, improve safety, and reduce congestion. The final report is available at the following link: http://www.iowadot.gov/operationsresearch/pdf/SPR-NDEB%2890%29--8H-00%29Final%20ReportNonDestructiveBrdgeDeckEvalApril2011.pdf.

Performance Evaluation of Epoxy Coated Bars in Iowa Bridge Decks

The purpose of this study was to determine how well the epoxy coating on reinforcing steel is working in bridge decks, and to determine potential causes for those locations where problems have occurred with the coatings. The scope of work for the proposed study includes: visual and delamination surveys of the bridge decks, sampling and testing of the existing concrete to determine chloride contents and to permit inspection of samples of the reinforcing, measurement of reinforcing bar covers, the evaluation of samples of the existing bars and the epoxy coatings, and electrical testing of the concrete and reinforcing to establish corrosion potential, corrosion activity, and electrical connectivity. Six bridges (two small, four medium sized) were selected from random locations around the state. A final report is currently being written.

Reduce Speed on High Crash Curves

The crash rate on curves is about three times that on tangent sections. Reducing speed on curves can be done in the short term and at much less cost than improving geometrics. This project will evaluate the effectiveness of low cost dynamic speed signs in reducing speeds on horizontal curves on rural roadways. It is part of a larger research project submitted to FHWA which called for a national field test of speed-activated warning signs to reduce crashes on curves. Researchers will identify a set of pilot study locations and control locations, install signs and evaluate their effectiveness, and summarize the resulting information in a format that can be easily communicated and used by practitioners. This project never materialized and the funding obligated for it has been deobligated.

Wind Monitoring of the Red Rock Reservoir Bridge for Wind Induced Vibrations with Remote, Cellular-based Notification (Monitor Red Rock Mile Long Bridge)

A data collection system similar to that installed on the Saylorville Reservoir bridge that was used to monitor wind speed and direction and provide notification to DOT personnel when preset thresholds (to be furnished by the DOT) have been reached. Vibration data is collected using controlled loading (with the DOT snooper truck) and ambient traffic loading events. The primary purpose of this is to collect information on the characteristics of the bridge under live load. The installed instrumentation system notifies interested parties, via cellular telephone, that preset thresholds have been reached. Also, when a threshold is breached, a limited amount of behavior data bursts are collected to help diagnose the impact of the wind event. All of the work completed during this project will be summarized in a concise final report/white paper. This report/paper will focus on the behavior of the bridge under the point in time event.

Concrete Drilled Shaft Testing Database

Concrete drilled shafts are being used more often, particularly in populated areas, as an alternative to driven piles in bridge construction. Bridges & Structures proposes to design and populate a data base for concrete drilled shaft load tests in Iowa based on the limited data available in state and similar databases used by other states. The data base will be used to help in the implementation of LRFD and determine design parameters for future drilled shafts.

Winter Operations Performance Measurement

Winter maintenance performance is often difficult to measure due to difficulties collecting enough meaningful measurements of the impact of our actions to the traveling public. Each storm is different, and each requires a slightly different level of effort to keep roads passable. Recently more work has been done on using traffic speeds during and after a storm as a way to measure the outcome of winter maintenance efforts. The actual speeds (as measured by RWIS, automatic traffic recorders, and third party travel time products) will be compared to the computed speeds to determine if maintenance efforts are keeping up to the requirements, given the winter weather conditions. We propose to build a winter maintenance reporting tool that can be used by an asset manager or garage supervisor to compute performance scores for user-defined time periods and areas, and show weather conditions, crew status, and other supporting information to help determine the conditions surrounding instances of good or bad performance.

Hybrid UHPC/HPC for Bridge Deck Applications

The cost of UHPC material is significantly higher than the normal strength concrete which may hinder the routine use of UHPC in bridge decks. Given that deck deterioration occurs due to formation of crack on the top surface, a most cost-effective yet highly durable bridge deck could be formed through a composite bridge deck by overlaying a thin Ultra High Performance Concrete (UHPC) layer over a Normal Strength Concrete (NC) slab. However, a dependable shear friction for the UHPC and NC interface and the factors influencing its behavior needs to be investigated to make this concept a reality for field applications.

This proposed research is a continuation of the work completed in earlier phase which included the structural characterization of different shear friction interfaces that may be appropriate for overlying UHPC on NC slabs and the identification of the most suitable interface for this connection with due consideration to constructability and the benefits of strength and durability characteristics of heat treated UHPC. The research findings of the project will be disseminated to designers and through technical presentations at the local/regional/national conferences. To further disseminate the significance and major outcomes of the project, one journal and one conference paper as well as a technology transfer sheet will be created.

Hydraulics Evaluation of Methods for Deflecting Debris from Bridge Piers

Debris accumulation on bridge piers is an on-going national problem that can obstruct the waterway openings of bridges and cause significant erosion/scour to stream banks and abutments. In some cases, the accumulation of debris can adversely affect the operation of the waterway opening or cause failure of the structure. In addition, removal of debris accumulation is difficult, time consuming and expensive for maintenance programs.

Researchers will identify cost effective methods for mitigating debris on bridges. The construction of several debris deflection methods will allow field evaluation and performance over time for potential implementation on other bridges throughout the State that experience debris problems. It is anticipated that one or more cost effective debris deflector methods will be recommended as part of the Phase I research. Once a cost effective method for mitigating debris on bridges is determined, it is anticipated that several bridge locations would be identified during Phase II of the research.

Mobile Mapping

Utilizing Mobile Mapping technology allows pavement elevations to be determined from LiDAR (Light Imaging Distance and Ranging) data captured at highway speeds from a vehicle using a Mobile Mapping System. Mobile Mapping is a system that incorporates the technologies of the Global Positioning System (GPS), Inertia Measurement Units (IMU), cameras, and multiple laser scanners for determining the 3D location of topographic features from a vehicle traveling at posted speeds.

The proposed pilot project would encompass the Warren Co. interchange of IA 92 and I-35. This area was selected because this is the type of project where acquiring pavement elevations is dangerous and difficult and because the survey pavement data to be used for a comparison to LiDAR was recently acquired. Performance of this technology will be determined on 4 lane

divided highway, bridges, super-elevated ramps, gore areas, bridge clearances, and divided side roads within these project limits.

Staff plans to enter into an agreement for collecting point cloud data with a firm that provides Mobile Mapping collection and processing services. Working with the consultant, they will gain an understanding of the tasks, timeframe and effort required in the process of Mobile Mapping. We will compare the data provided to survey data for an accuracy assessment and determine what information can be extracted from the point cloud that meets survey accuracy.

Review of Breath Alcohol Ignition Interlock Devices: Policy and Implementation Implications

The goal of this proposal is to perform a systematic review of breath alcohol ignition interlock devices (BAIID or IID) to understand how other states have integrated such systems into administrative and judicial practice and to make recommendations for best practices in the state of Iowa. Towards this end, the University of Iowa and Iowa State University team proposes an analytical framework and plan that examines how such systems have been implemented and evaluated. Understanding the history of such devices will help the state of Iowa enhance their OWI programs.

IC HMA Lab Testing

Iowa DOT has collected loose mix samples from the Intelligent Compaction project on US 30. These samples were compacted at various void levels ranging from 2% up to 12% to simulate conditions for each roller pass. Then the samples were tested for dynamic modulus, the machine values per pass can be correlated with the known dynamic modulus for a given level of density.

Maintenance Asset Management, Phase-I

This project resulted in the development of a proof of concept for a features inventory process to be used by field staff. The resulting concept is adaptable for different asset classes (e.g. culverts, guardrail) and able to leverage existing DOT resources such as the videolog and LRS and our current technology platforms including Oracle and our GIS web infrastructure. The concept examined the feasibility of newly available technologies, such as mobile devices, while balancing ease of use in the field. Implementation and deployment costs were also important considerations in evaluating the success of the project. This project funds allowed the pilot to address the needs of two DOT districts. A report of findings was prepared, including recommendations for or against full deployment of the pilot solution.

Sign Management System

The Iowa DOT developed a sign management system which: 1) improves the quality of signage; 2) improves the ability to manage all aspects of signage from request to removal; 3) improves the ability to budget for these key assets on a statewide basis; and 4) provides a tool for decision makers to do signage related scenario planning. This additional phase will add the development of a GIS mapping component to show the location of the signs and the development of an inspection module for the management system.

2012 Work Program - Projects Funded in Earlier Programs, Not yet Completed

Investigation of Detection Methods of Defects in Existing Concrete Railing
The Illinois DOT has experienced problems with the construction of slip formed barrier rail for bridges. They discovered large voids in the core of the rails that were not visible from the surface. These voids could significantly reduce the structural capacity and shorten the service life of the rail. While we are not aware of a similar situation in barrier rails in Iowa, it may be that we have this problem and have not had the circumstances occur for it to be discovered. The consultant is reviewing methods for testing rebar corrosion at base of rail for finalizing scope of services. The methods they are reviewing are to find nondestructive methods to measure corrosion loss on embedded reinforcing at the construction joint between the deck and the barrier rail.

"GO Team" Teen Driver Fatalities Study
Researchers have put together a 'go team' to investigate and write a case study of each teen fatality crash in Iowa for a 12 month period. Using all public data from the local law enforcement's reconstruction and crash reports, they will produce a summary that would include methods that may have mitigated the crash – for instance, if it was a crash with multiple passengers, cell phone, night time, etc. They should be able to point to the exact causes of fatalities, providing data for future preventive measures.

Wind Loads on Dynamic Message Cabinets and Behavior of Supporting Trusses
Large Dynamic Message Signs (DMS) are used to provide timely information to motorists. There is increasing evident that the truss structures supporting these signs are subject to much more complex loadings than are typically accounted for. This study will include a wind tunnel and computational tasks as well as field observation. Field observation will include short-term (one or two days) monitoring of four DMS cabinet/trusses and long-term (three to six months) monitoring of one DMS cabinet/truss.

Midwest Transportation Symposium
This is a biennial event bringing researchers and transportation professionals together to discuss implementable solutions for challenges experienced by federal and state departments of transportation, cities, and counties. The 2011 Symposium included 114 papers, extended abstracts, and poster presentations and was attended by more than 328 people. Proceedings are at: http://www.intrans.iastate.edu/publications/posts/?publication=midcon-2011 .

Technology Transfer Peer SP&R Part II Exchange
Under SPR rules, each state department of transportation is required to hold a research peer exchange once every three years. Iowa's 2011 peer exchange focused on promising research. Ten states and FHWA were invited to participate. The event was held August 18-19, in conjunction with the Mid-Continent Transportation Symposium.

Safety and Mobility Impacts of Winter Weather

The primary objectives of Phase 1 of this project are to: 1) identify habitual, winter weather-related crash sites on state-maintained rural highways in Iowa, 2) investigate highway agency practices regarding integration of traffic safety- and mobility-related data in winter maintenance activities and performance measures, and 3) develop a preliminary work plan focusing on systematic use of safety- and mobility-related data in support of winter maintenance activities and collateral performance monitoring.

Phase 2 will investigate the effectiveness of existing roadway/roadside improvements, identify specific mitigation strategies (such as targeted/reprioritized maintenance activities, roadway/roadside improvements, and application of ITS technologies) for use in Iowa, and begin implementation of these strategies, particularly at problem areas identified in Phase 1.

RFID Rebar Corrosion Detection

This project will evaluate the use of low-cost RFID tags for detection of rebar corrosion at the interface between the bridge deck and the concrete barrier rail. Tiny radio transponders known as RFID tags will be embedded in the concrete barrier rail at the rebar during bridge construction. These tags are commercially available and cost in the range of 5 cents to 1 dollar (primary uses are asset tracking, logistics, contactless door locks, etc.). A tag embedded in concrete will fail once sufficient water and chloride ion have penetrated to corrode the tag's antenna connection. The bridge deck would be scanned by simply driving over it with an RFID scanner and GPS. As tags fail (can no longer be detected by the scanner), that would indicate deep chloride penetration to the layer of the tags.

Mass Concrete for Bridge Foundations

Iowa DOT has a Developmental Specification for Mass Concrete (Control of Heat of Hydration). The specification is based on national industry practices and experiences on the recent WB I-80 over Missouri River Bridge project. Mass concrete is defined as a concrete unit with a least dimension greater than three feet. If the mass concrete heat of hydration maximum temperature is not controlled the concrete can be susceptible to early deterioration through a mechanism called delayed ettringite formation cracking. Mass concrete temperature differentials between the core of the concrete unit and surface of the concrete can also cause immediate cracking when the strain due to the thermal differential exceeds the available tensile capacity of the curing concrete.

This research is an opportunity to tailor and refine Iowa's mass concrete specification for the conditions, materials and construction practices in Iowa. A considerable amount of data was collected on the WB I-80 over Missouri River Bridge. The research will involve analysis of the data collected, comparative modeling of the mass concrete placements and ultimately recommendations for the Iowa DOT mass concrete specifications. If the project is successful, the Iowa DOT will benefit from predictive models to better manage the risks associated with mass concrete. In turn project mass concrete controls can be better tailored to the location, materials and elements being constructed and potentially reduce the costs bid by contractors for the mass concrete controls.

Base Grouted Drilled Shafts Investigation
The purpose of this project is to perform field explorations at test shaft locations to better understand the behavior of base grouting in the sandy soil at the Broadway Viaduct drilled shaft location in Council Bluffs. Soil borings will be performed and possible geophysical testing near the test shafts will be investigated to evaluate possible grout migration away from the shaft base, including up along the sides of the drilled shafts. Data collected will be studied and analyzed to determine if the second phase of construction needs to be changed. Base grouting and improved drilled shaft design will be better understood. A report will be written.

Concrete Barrier NDE Program – Investigation of Detection Methods of Defects in Existing Concrete Railing (I-129 Missouri River Bridge Deck Condition Assessment Using Non-Destructive Testing Methods)
A consultant will be hired to perform comprehensive non-destructive field testing to evaluate the present condition of several bridge decks. The immediate work will be on an I29 bridge over the Missouri River. Five other bridges have also been identified for evaluation. Possible work could include:

- Visual and delamination surveys.
- Sampling of the existing concrete for purpose of determining chloride contents and obtaining samples for laboratory testing of concrete and reinforcing bars.
- Measurement of reinforcing bar covers.
- Electrical testing of the concrete and reinforcing to establish corrosion potential, corrosion activity, and electrical connectivity.

The consultant will report on results of evaluations and guide the Iowa DOT in the establishment of an in-house testing and evaluation program using the accumulated knowledge.

J Turn Simulation
At-grade intersection collisions on rural expressways reduce the safety benefits that should be achieved through conversion of undivided rural two-lane highways into expressways. Expressway intersections present challenges to crossing and left-turning minor road drivers attempting to select gaps in the far-side expressway traffic stream. One remedy is the J-turn intersection design. J-turn intersections reduce the potential for right-angle collisions (particularly far-side right-angle collisions) by replacing direct crossing and left-turn maneuvers from the minor roads with right-turns and downstream U-turns. For this project, two J-turn simulations will be developed and tested with the North American Driving Simulator (NADS) along with a Micro-station to NADS software converter.

2012 Work Program – Projects Continued from 2011, Funded in 2012

InTrans Support

Iowa DOT support for InTrans (formerly CTRE) ensures that research will be oriented toward real-world results and applications. A more detailed discussion of InTrans can be found in Section IV B of this report.

IOWA STATE UNIVERSITY
Institute for Transportation

★ ***Result:*** Continued support for InTrans provides technology transfer assistance to the Iowa DOT with technology transfer activities.

AASHTO Partnerships

Iowa DOT supports six AASHTO cooperative projects:

- Product Evaluation (NTPEP)
- Approved Product Evaluation List (APEL)
- Technology Implementation Group (TIG)
- Environmental Technical Assistance Program (ETAP)
- Transportation System Preservation Program (TSP2)
- LRFD Specification Maintenance

★ ***Result:*** Access to nationwide knowledge, expertise, and new technology

Remote Sensing Support

This is a long-term project for Iowa DOT. Funds are allocated for partnerships, training and upgrades of existing infrastructure and for promoting more efficient and effective use of the technology.

Geotechnical Support (formerly PGA) – Pavement performance issues sometimes relate to subgrade problems which can cause premature failure of the pavement system. Geotechnical research is performed by the new Earthworks Engineering Research Center (EERC) at Iowa State, which expands the mission of the Partnership for Geotechnical Advancement (PGA). For more information, see http://www.eerc.iastate.edu.

★ ***Result:*** Longer lasting pavement with lower life-cycle cost.

Information Technology Development
This is a multi-year pilot project that employs student programmers through InTrans to develop several management tools for use in DOT. The initial project was Resource Management System (RMS), Daily Log phase. RMS will be used by maintenance staff for managing both human and physical resources. A current application being developed is the Laboratory Information Management System (LIMS) for the Office of Materials.

★ ***Result:*** New systems developed at lower cost to meet existing needs

Pavement Marking Management System
Phase 4 of this project was requested by the Offices of Traffic & Safety and Maintenance. This phase extends across two years. Tasks include:

- Enhance pavement marking management tools
- Incorporate spring and fall assessment data into the marking tool
- Continue monitoring and analysis of existing demonstration sites statewide
- Complete an analysis of All Weather Pavement Markings (I-35)
- Provide support to the Pavement Marking Task Force (monthly meetings)
- Provide training to central and district staff on management tools
- Implementation and Operation

★ ***Result:*** More effective pavement marking management

Bridge Construction Web Management
This research project proposed to investigate DOT requirements for a web-based construction project management and collaboration tool, review industry "best-practices", review commercially available software options, make a recommendation for implementation of an available took, and conduct a pilot project.

★ ***Result:*** The pilot project is underway.

Technical Training and Conferences

The Iowa DOT has a high demand for technical training due to the nature of our work. Technology and best practices evolve constantly and require constant updating. Conferences attended using SPR funds are those at which the trainee will gain new technical knowledge directly applicable to his or her work. Employees who attend SPR-funded training and conferences must be working on a Federal-aid project, the cost must be reasonable and the training must be necessary to perform the federally funded work. Technical training is made available to DOT staff and to county and city staff when possible. In FY 12, a total of 18 NHI and other technical courses were scheduled to be attended by more than 264 employees of Iowa DOT, FHWA, and local agencies. A detailed list of courses planned can be found in *Attachment 7*. Not all the courses have been held yet.

★ ***Result:*** Better technically trained staff.

Research Implementation & Technology Transfer

Funds will be used to learn about new research, technology and processes in other states, conduct small test or pilot projects based on research reports and share the knowledge gained as a result. Funding may also be provided for DOT staff involved in SP&R or IHRB projects to present papers or participate on panels at technical conferences. This is an ongoing item in the SP&R work program. An annual Research Implementation & Technology Transfer Plan detailing use of funds for this line item will be submitted separately for FHWA approval. No funds were expended on this item in 12, but it will remain in the program for future use.

Investigation and Evaluation of Iowa Department of Transportation Bridge Deck Epoxy Injection Process

Bridge deck overlays typically last 15 to 20 years before delamination at the bond interface requires repairs to or replacement of the overlay. The delamination of the overlay is often repaired by Iowa DOT maintenance staff by injecting the deck overlay cracks and voids with epoxy.

Anecdotal observation by Iowa DOT field staff suggests that the epoxy injection process can delay repair of the overlays by 5 to 10 years, but there is currently not documentation to substantiate this. The process for epoxy injecting bridge deck cracks and delaminations is not well documented for DOT staff. There are wide variations in materials, equipment, and procedures used in the various Districts. There is a need to perform this treatment on 120-180 Iowa DOT structures annually.

The objectives of this project will cover three main focus areas; determination of the effectiveness, durability, and typical service life of epoxy injection of delaminated bridge decks, an evaluation of the current state of the practice in the epoxy injection industry, and development of procedures and specifications for epoxy injection.

Determining Entrance Loss Coefficients for Twin Pre-Cast and Triple RCB Culvert Designs

Currently the Iowa DOT uses Cast-in-Place (CIP) Twin and Triple RCB's with standard flared wing wall designs. There is increased interest in constructing Pre-Cast (PC) Twin and Triple RCB's. The difference in the geometry of the standard flared wing walls for Twin or Triple Cast-in-Place RCBs from the straight Pre-Cast culverts results in a difference in entrance losses. In the case of single wing wall configurations, wing walls conduct the flow directly into the barrel, reducing contraction losses at the entrance. For the same configuration with multiple barrels, there is minimal contraction loss for interior barrels so losses are much lower. Thus, a multiple barrel system should perform better than the same number of single barrels. Estimating this difference in entrance losses is critical to provide appropriate design for newly built pre-cast culverts.

This project will consist of a physical modeling study to determine entrance losses for Pre-Cast Twin and Triple RCB's designs. In addition, we would like to compare the velocities and shear stresses associated with a straight vs. flared wing wall. This could determine if a certain configuration provides better dissipation of the energy to mitigate potential erosion/scour at the inlet or outlet of a box culvert. In order to optimize the designs of both types of box culverts, the

effects of the span-to-rise ratio, skewed end condition, and optimum edge condition should also be determined.

LRFD Design of Drilled Shafts

The objective of this study is to examine and improve drilled shaft design in accordance with LRFD specifications, thereby increasing its cost effectiveness. Cast-in-place drilled shafts are an alternative to driven steel H-piles that are cost-competitive and relatively easy to construct. In order to make them truly competitive, regional resistance factors should be developed. An SPR project is already underway to build a drilled shaft database of completed static load tests from Iowa and other states. In this study, investigators will analyze the collected data, then calibrate and verify resistance factors.

Instrumentation and Monitoring of Accelerated Bridge Construction (Keg Creek Bridge)

The Iowa DOT and the FHWA, in coordination with the Strategic highway Research Program (SHRP2) project F04, Innovative Designs for Rapid Renewal, intend on demonstrating the latest advances in accelerated bridge construction methods. This accelerated project will limit the construction time to a maximum of two- week road closure. It is estimated that the construction time would have been six months under non-accelerated construction procedures.

The technologies incorporated into the proposed bridge project have been successfully used in constructed projects drawn from around the US. The fact that several diverse structural systems have been assembled and incorporated into a single project reinforces the concept that innovation does not necessarily mean creating something completely new, but rather facilitating incremental improvements in a number of specific bridge details to fully leverage previously successful work.

Iowa DOT construction project funds and SHRP II F04 funds will be used for the design and construction of the bridge. The funding for this project will be to instrument and monitor the bridge during and after construction, to determine the loading in various components due to construction forces and traffic.

Improving the Accuracy and Usability of Iowa Falling Weight Deflectometer Data, Phase-III

Evaluating structural condition of existing in-service pavements is a part of routine maintenance and rehabilitation activities by most DOTs. In the field the pavement deflection profiles (or basins) gathered from the nondestructive Falling Weight Deflectometer (FWD) test data are typically used to evaluate pavement structural condition. FWD testing is often preferred over destructive testing methods because it is faster and does not entail removal and replacement of pavement materials.

Phase II study of IA DOT Project (CTRE Project 04-177) focused on the development of a fully-automated software system for rapid processing of the FWD data. The software system can automatically read the FWD raw data collected by the JILS-20 type FWD machine that Iowa DOT owns, process, and analyze the collected data with the algorithms being developed during the Phase I study. This system smoothly integrates the FWD data analysis algorithms and the computer program being used to collect the pavement deflection data. With the implementation of the developed software system the FWD data can be filtered, processed and analyzed on-the-fly.

Phase III study continues prior research by InTrans by incorporating significant enhancements into the developed fully-automated software system for rapid processing of the FWD data base and improving the accuracy and usability of the collected FWD data. The objective of this study is to incorporate significant enhancements into the developed fully-automated software system for rapid processing of the FWD data based on the requirements by the proposed Technical Advisory Committee (TAC) members and engineers who will be using the program on a routine basis and to improve the accuracy and usability of collected FWD data. These enhancements are considered necessary by both the TAC and the research team to make the software readily usable by the Iowa DOT engineers on a day-to-day basis.

Assessment of Weathering Steel Bridge Performance (Need for Washing Weathering Steel Bridges)

The findings of this study will assist weathering steel bridge owners to formulate effective management policies on the frequency and location of washing. Proper bridge maintenance practices will increase the service life of weathering steel bridges and increase the confidence level of bridge owners in using non-painted weathering steel. Furthermore, preventing corrosion of steel will result in safer structures.

General Funds for Future Projects

These funds are set aside for future projects in this fiscal year. The plan will be amended as specific projects are designated.

Refer to the summary table in *Appendix 2* for the detailed 774 list of active and proposed research projects and proposed contributions.

2012 Work Program – New Items

AASHTO LRFD Support

This is the continuation of what was previously a pooled fund TPF-5(068). It qualifies for 100% federal share.

Salinity Sensors for Plows

The Office of Maintenance is researching the use of three vehicle-mounted salinity sensors on snow plows and/or Supervisor trucks in order to determine the effectiveness of the technology. Road salts, mostly chloride-based chemicals, play a key role in ensuring safe winter driving conditions, especially for highways that experience cold and snowy weather.

Maintenance Supervisors constantly strive to optimize the salt usage during winter while providing the highest possible level of service. The ability to monitor the residual salt concentrations on the road surface is of great importance to make educated decisions related to chemical reapplication. The end result may be significant cost savings and reduced environmental impacts.

Backing Warning Sensors for Tow Plows

DOT vehicles drive many miles each year and overall have a good record of accident avoidance. Although the majority of accidents occur while vehicles are going forward, approximately 30 percent of all accidents occur when vehicles are moving in reverse. Based on the high frequency of these accidents and the facts that all backing accidents are often preventable, emphasis must be placed on safe backing procedures or the use of some type of collision avoidance system. Since the Iowa DOT acquired three Tow Plows backing such a long trailer has become a problem. This research will determine if adding a back up warning system to the rear of the trailer would alert the driver to obstacles directly behind the trailer and out of view of the driver.

Heads-up Display for Snow Plow Limited Visibility

Iowa's winter weather conditions can produce some of the most hazardous driving conditions in America. This combination can reduce visibility to the point where the efficiency of snow removal operations is greatly affected and can result in collateral damage to infrastructure (i.e. guardrails, signs, milepost markers, equipment, etc.) as well as increase the likelihood of collision with other vehicles. As the efficiency of snow clearing operations declines there is a corresponding deterioration of driving conditions, which can ultimately result in the closure of highways. Highway closures affect the public's ability to access essential services, prevent public safety agencies from responding to emergencies, and result in substantial economic impact to the affected communities.

The heads up driver display should improve safety for the snow plow vehicle operator by providing the necessary cues for lane keeping and collision avoidance normally unavailable during poor visibility conditions. The heads up display, when placed in snow and ice control vehicles should improve safety by facilitating all-weather road services which keep roads open and passable for other emergency vehicles and the general motoring public.

Wireless Plow Blade Position Sensors

The Iowa DOT has recently deployed a GPS/AVL project in two garages. The limited deployment quickly identified that the snow plows are inundated with wiring and the GPS/AVL systems contributes to the excessive wires. The plow up/down sensor are at risk of excessive and premature corrosion, due to the high salt exposure. This project will investigate the use and effectiveness of a wireless plow blade position sensor.

IC HMA Lab Testing

Iowa DOT has collected loose mix samples from the Intelligent Compaction project on US 30. These samples were compacted at various void levels ranging from 2% up to 12% to simulate conditions for each roller pass. Then the samples were tested for dynamic modulus, the machine values per pass can be correlated with the known dynamic modulus for a given level of density.

Maintenance Asset Management, Phase-II

The first phase looked specifically at development of a culvert inventory and inspection system on a tablet PC, as well as a range of data collection options, and identified a risk matrix categorization for each option. Phase two will add additional features to the tablet based system and field test them with district staff. This work will evaluate how data might be checked in and out for field based data management. We will work with the Asset Management Team to

determine and prioritize field items for the purpose of this pilot. Existing DOT resources will be leveraged (e.g. the videolog, LRS) with current technology platforms including Oracle and our GIS web infrastructure. Expected benefits: Identify efficiencies for field staff to do inventory/inspections of assets we maintain in the field. Create a building block to a larger Asset Management System.

Feasibility Study for Detection and Quantification of Corrosion in Bridge Barrier Rails
Nondestructive evaluation methods are desired to detect and evaluate corrosion damage to rebar and U-bolts that anchor concrete bridge railings to bridge decks and roadway pavements. Moisture and chloride ions reach rebar and U-bolts anchors along the cold joint interface between the rail and road surface causing general corrosion. This work involves the Phase I feasibility study to compare the sensitivity and cost effectiveness of several nondestructive evaluation methods in a laboratory environment. Some initial field tests of eddy current and ground penetrating radar may be conducted pending laboratory results. The results of this study will be documented and discussed in a final report and methods that indicate the most promise will be proposed for field trial in a Phase II study.

Western Iowa Missouri River Flooding – Geo-Infrastructure Damage Assessment, Repair and Mitigation Strategies, and Solutions Manual
Recent flooding of the Missouri river has caused damage to many geo-infrastructure systems including pavement systems, culverts, unpaved roadways, and roadway embankment slopes — along the western Iowa Missouri river basin which includes Iowa counties: Woodbury, Monona, Harrison, Pottawattamie, Mills and Freemont. The flooding resulted in closures over 100 miles of secondary roads. There is great concern regarding access on Farm to Market routes and FEMA and the U.S. Army Corps of Engineer have expressed the need for emergency access to levees and other flood control elements often accessed by the County transportation system. Some roadways and embankments remain under water and/or saturated. Reportedly, the extent of damage is in some cases obvious, (i.e., where some segments of the roadway have been washed away); but in many cases, damage is undetermined, i.e., where pavement damage could result due to voids, saturation and other conditions below the pavement surface. The main objectives of this project are to assist the affected counties by: 1) deploying and using advanced technologies to rapidly assess the damage to geo-infrastructure, 2) developing effective repair and mitigation strategies, and 3) generating a detailed flood damage assessment and repair GUIDE to share evaluation and testing advice and lessons learned for use with future flood recoveries.

In-situ testing will be conducted to characterize roadway bearing capacities and voids underneath paved roads using technology such as falling weight deflectometer (FWD), ground penetrating radar (GPR), borehole shear tests (BST), penetration resistance tests, water-proof crawler camera imagery, and geo-spatially referenced imagery.

Highlighting Iowa DOT's Use and Implementation of Innovation
Several publications are desired to showcase Iowa DOT's research, innovation, and implementation efforts. Initially a two page publication was proposed to focus on how Iowa DOT is able to successfully implement NCHRP and other national research, address why implementing research is critical to Iowa, and how the state leverages its research investment through national programs. The target audience is transportation executives and managers as

well as state lawmakers and policymakers. This publication was presented at the January 2012 Transportation Research Board annual meeting.

One out of the four Asset Management showcase articles is completed. These articles will illustrate Iowa DOT's use of implementation and innovation in feature areas that may include winter maintenance, pavements, structures, and safety.

Evaluation of Flame Hardened Treatment of Ice Blades

Flame hardening is anticipated to improve blade wear edges. This study will investigate, through field application and use, the wearability of flame hardened ice blades compared to Iowa DOT standard steel ice blades. Blades are proposed to be mounted on plows with GPS capabilities to assist in tracking blade time, pavement type, and storm/roadway characteristics. Due to the nature of this research, 10 blades of each type (standard, flame hardened) are desired to obtain normalized results.

Standard blades will be purchased using DOT maintenance funds. This work will include purchase of 10 flame hardened blades, providing technical assistance in evaluation of research results, facilitating laboratory testing, providing technical research report documentation of wear results, and laboratory testing results. In addition to an expected increase in wear time, a benefit is anticipated in soft costs such as a reduction in injuries due to lifting and replacing blades, reduced down-time during snow storms, etc. A benefit/cost evaluation is proposed as part of this study.

Commercial Driver Fatigue, Phase II

The aim of this pilot project is to identify and evaluate a candidate set of diagnostic tools that can be deployed in the field by Iowa Motor Vehicle Enforcement Officers to provide objective evidence to identify drivers who are practicing sleep impaired driving. Countermeasures to the sleepy driver danger may seek to prevent the sleepy driver from ever getting on the road, through mandated duty cycles, driver logs, and other tools. Fair and accurate measures are also needed to identify at-risk drivers who have been identified as potentially driving in a sleep deprived state by the Iowa Motor Vehicle Enforcement Officers on the basis of erratic driving behavior. Phase 1 evaluated computerized tests of attention and memory to determine if drivers were sensitive to sleepiness effects and whether certain indices of sleepiness predicted cognitive performance. The findings indicated that sleepiness tests in the field have significant limitations. This next phase will attempt to refine the existing Fatigued Driving Evaluation Checklist. Indices will be evaluated for driver physiognomy (e.g. yawning, droopy eyelids, etc.) and driver behavioral/cognitive state (e.g. distracted driving) with respect to their sensitivity to objective and subjective measures of sleep deprivation.

Establishing Methods and Procedures for Measuring Water Clarity and Turbidity of Stormwater Runoff from Active Highway Construction Sites

This work will involve collection of stormwater runoff samples from active construction sites to measure and study turbidity and water transparency data. Monitoring protocols will be identified

and evaluated. Turbidimeter measurements will be compared to manual transparency measurements so that distribution curve numbers can be established based on a range of soil types. Instruction materials will be produced including materials on proper techniques, data management and basic analysis.

State Research Program

This funding will be used for research through the Iowa Highway Research Board, research support services, technology transfer, InTrans Core Research Program, and other approved projects and initiatives. A State Research Program Plan detailing use of funds for this line item will be submitted under a separate cover for FHWA approval.

School Bus Safety Study

The Department of Transportation, Department of Public Safety, and Department of Education are jointly proposing this study relating to school bus safety. The study will focus on the use of cameras mounted on school buses to enhance the safety of children riding the buses and to aid in enforcement of motor vehicle laws pertaining to school bus safety. The study will evaluate the feasibility of requiring school busses to pick-up and drop-off children on the side of the road on which their home is located. The study will evaluate school bus safety as part of the driver training program and other initiatives determined by the project team.

Deer Collision Website Update

Iowa DOT has been a partner in the Deer Crash pooled fund project TPF-5(120) led by others. The last quarterly report in March 2010 noted the funding was substantially spent at that time. The pooled fund project has been inactive since the spring of 2010. The information obtained in this project and the resulting website (www.deercrash.com) have proved to be very valuable to the Iowa DOT (and surrounding states). InTrans at Iowa State University is the website administrator. Iowa DOT proposes to contract directly with the web management organization to provide funding to update the website with data and information from FY 2010 through present.

Assessing Applicability of International Safety Countermeasures for Rural Roads

The United States has not had the same success rate as other countries in reducing fatal and injury crashes. The objective of this project is to identify and summarize international countermeasures that have proven successful in driving down fatal and injury crashes in other countries. This will include countermeasures that have not been utilized significantly in the US which show promise in reducing fatal and injury crashes in Iowa. The information gained will be summarized into outreach material which can be used by Iowa traffic safety professionals. The main benefit will be outreach materials for Iowa agencies. Another benefit is starting a dialog in Iowa about changes in practice and culture necessary to implement a program such as “Towards Zero Deaths.”

Research Support (775)

The objective of this section of the SPR program is to promote and provide support for essential priority research and data collection activities in support of further development of the highway engineering program. Work in this area involves purchase and evaluation of new and innovative testing equipment both for the Materials lab and for the field.

Accomplishments 2012

RapidAir 457 System

An adequate air void system is imperative to produce concrete with freeze-thaw durability in a wet freeze environment such as found in Iowa. Specifications rely on a percentage of air obtained in the plastic state by the pressure meter. Actual, in place air contents, of some concrete pavements in Iowa, have been found with reduced air content due to a number of factors such as excessive vibration and inadequate mixing. Determining hardened air void parameters is a time consuming process involving potential for human error. The RapidAir 457 air void analyzer is an automated device used to determine hardened air void parameters. The device is used in Europe and has been shown to quickly produce accurate and repeatable hardened air results. This research investigates how well the RapidAir 457 results correlate to plastic air content and the image analysis air technique. The repeatability and operator variation were also investigated, as well as, the impact of aggregate porosity and selection of threshold value on hardened air results.

Thermal imaging camera

Identifying areas of delaminated concrete on bridges is necessary for safety concerns and to identify maintenance needs. A handheld thermal imaging camera was acquired to evaluate the effectiveness of identifying delaminations compared with hand sounding techniques. Hand sounding, such as chain drag or hammer sounding, requires an inspector to be in close proximity to the concrete surface. This requires lane closures and aerial access equipment. The use of thermal imaging cameras has the potential to identify delaminations from ground level and out of traveled lanes.

★ ***Result:*** The Office of Bridges and Structures is evaluating the effectiveness and limitations of the camera.

Phased Array Ultrasonic Flaw Detector

Certain steel bridge components can develop internal defects that cannot be detected during a visual inspection. Traditional ultrasonic flaw detectors used to identify these defects provide limited information to the inspector. The phased array unit provides more information in a format that is easier for the inspector to interpret. This results in a higher quality inspection with false positive or false negative results.

★ ***Result:*** The equipment has been evaluated on bridge pin connections and light tower anchor bolts with positive results.

Moisture Induced Sensitivity Testing (MIST)

Several agencies specify AASHTO T283 as the primary test for field acceptance of moisture susceptibility in hot mix asphalt. When used in this application, logistical difficulties challenge its practicality, while repeatability is routinely scrutinized by contractors. An alternative test is needed which can effectively demonstrate the ability to screen mixtures based on expected performance. The ideal replacement can be validated with field performance, is repeatable, and allows for prompt reporting of results. Dynamic modulus, flow number, AASHTO T283, Hamburg wheel tracking device (HWTD), and the moisture induced sensitivity test (MIST) were performed on plant produced surface mixes in Iowa. Follow-up distress surveys were used to rank the mixes by their performance.

The rankings indicate both the quantity of swelling from MIST conditioning and submersed flow number matched the performance ranking of all but one mixture. Hamburg testing parameters also appear effective, namely the stripping inflection point and the ratio between stripping slope and the creep slope.

★ ***Result:*** Dynamic modulus testing was ineffective, followed by AASHTO T283 and ratios produced from flow number results of conditioned samples.

Hach 2100Q Portable Turbidimeter

This equipment measures turbidity of water. Use of this equipment may possibly improve the DOT's storm water permit compliance by measuring effectiveness of our sediment and erosion control measures. The transparency tube results were compared with the turbidimeter results from field measurements in the 2011 construction season. This equipment's evaluation on the effectiveness of the turbidimeter got extended and became the Iowa Highway Research Board project "Establishing Methods and Procedures for Measuring Water Clarity and Turbidity of Stormwater Runoff from Active Highway Construction Sites".

2012 Work Program

GeoGauge for Cold-in-Place Recycling

This equipment will be used to implement/validate the findings from a three-phase study on Cold-in-Place Recycling (CIR) in Iowa to evaluate and determine the expected gain in stiffness on current projects. Current specifications require the CIR layer to reach a maximum moisture content of 2% before the final HMA lift is placed. The "curing" criterion is difficult to determine with current procedures. This equipment will be used side-by-side with current moisture criteria on active projects. The results of the analysis will provide greater confidence in curing conditions, establish curing criteria that may reduce the period the CIR is left open to traffic and lend to expanded CIR use on high volume roads. The work is expected to result in improved specifications and practice.

Refer to the summary table in *Appendix 2* for the detailed 775 list of Highway Research Support and estimated contributions.

Pooled Fund Studies (776)

Transportation Pooled Fund (TPF) study means a planning, research, development, or technology transfer activity administered by the FHWA, a lead State DOT, or other organization that is supported by two or more participants and that addresses an issue of significant or widespread interest related to highway, public, or intermodal transportation. A transportation pooled fund study is intended to address a new area or provide information that will complement or advance previous investigations of the subject matter.

According to Code of Federal Regulations 23 §420.205, "To promote effective use of available resources, the State DOTs are encouraged to cooperate with other State DOTs, the FHWA, and other appropriate agencies to achieve RD&T objectives established at the national level and to develop a technology transfer program to promote and use those results. This includes contributing to cooperative RD&T programs such as the NCHRP, the TRB, and transportation pooled fund studies as a means of addressing national and regional issues and as a means of leveraging funds."

Pooled fund studies are a very effective means of leveraging precious research funds.

Iowa currently leads 15 national pooled fund projects and is an active participant in approximately 30 others. Each pooled fund study and its anticipated impact (i.e. ★ ***Result)*** are described below.

Iowa-led Inactive Pooled Fund Projects (776)

ITS Pooled Fund (ENTERPRISE) – SPR-3(020)
The purpose of this project is to develop, evaluate, and deploy Intelligent Transportation Systems. Participants include eight other U.S. states, one Canadian province, Transport Canada, and the Dutch Ministry of This project will involve the following tasks that establish the protocols for design and construction of non-fracture critical structures:

- Experimental study of fracture in I-girders to determine supplemental toughness requirements
    - Full scale fracture tests
    - Fracture Mechanics Tests
- Establish damage tolerant design concepts to utilize toughness and set in-service inspection requirements.
- Detailed, 3D Finite element modeling of a two girder bridge system to set detailing requirements for redundancy. Ideally this will include analysis of a two girder concept for an actual bridge project.
- Develop a guide specification for design and fabrication of non-fracture critical low redundancy structures. Transportation. ENTERPRISE provides a forum for member agencies to communicate and pursue ITS projects that might be difficult to initiate on

their own. Statewide projects and the establishment of a 511 travel information program are two examples of areas that are of interest to members. ENTERPRISE is an ongoing project started in 1991 and has a $250,000 annual budget. Its web site is www.enterprise.prog.org

★ ***Result:*** Project completed, objectives fulfilled, and financials being closed out. See following web site for progress reports –
http://www.pooledfund.org/Details/Study/159

Highway Maintenance Concept Vehicle – SPR-3(060)

Four phases of this project to apply new technology to a maintenance vehicle have been completed. In Phase 5, which is co-sponsored by the Clear Roads pooled fund, researchers have designed and built a prototype snowplow to remove snow more efficiently than plows in use today. The plow developed in this project has a contour-following blade, or alternative to a blade, capable of clearing a roadway in one pass, reducing snow residue behind the plow, and plowing at a speed that is within ten mph of traffic speed-about 40-45 mph.

★ ***Result:*** Project completed, objectives fulfilled, and financials being closed out. See following web site for progress reports –
http://www.pooledfund.org/Details/Study/206

Midwest States Work Zone Deployment – SPR-3(075)

Through this five state pooled-fund study which began in 1999; researchers investigate better ways of controlling traffic through work zones. Work is accomplished via a variety of projects carried out by researchers in the member states. During the first four years of the study, a total of 35 technologies were deployed and evaluated. A list of past and current projects can be found at www.ctre.iastate.edu/smartwz/index.cfm.

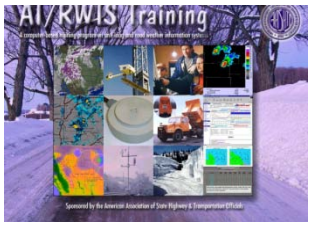
★ ***Result:*** Project completed, objectives fulfilled, and financials being closed out. See following web site for progress reports –
http://www.pooledfund.org/Details/Study/223

Long Term Maintenance of LRFD – TPF-5(068)

To provide timely assistance to the AASHTO Highway Subcommittee on Bridges and Structures in interpreting, implementing, revising, and refining the AASHTO load and resistance factor documents.

★ ***Result:*** Project completed, objectives fulfilled, and financials being closed out. See following web site for progress reports –
http://www.pooledfund.org/Details/Study/286

Iowa-led Active Pooled Fund Projects (776)



Snow and Ice Control (SICOP) – TPF-5(009)

SICOP is the Snow and Ice Pooled Fund Cooperative Program - developed by AASHTO. SICOP is under the oversight of the Winter Maintenance Technical Service Program. The goals of the winter maintenance program are to

1) Sustain or improve levels of winter maintenance service with significant benefit/cost improvements,
2) Provide an enhanced level of environmental protection, and
3) Place technology in service on operational maintenance sections within two winter seasons.

★ ***Result:*** See following web site for progress reports – http://www.pooledfund.org/Details/Study/4

Aurora – SPR-3(042)

The Aurora Program is a consortium of agencies focused on collaborative research, evaluation, and deployment of advanced technologies for detailed road weather monitoring and forecasting. Its projects result in technological advancement and improvement of existing Road Weather Information Systems (RWIS). Participants include eight other U.S. states, two Canadian provinces, and the Swedish National Road Administration. Aurora is an ongoing project started in 1995 and has an annual budget of about $200,000. The Aurora Work Plan can be found at the website, www.aurora-program.org

★ ***Result:*** See following web site for progress reports – http://www.pooledfund.org/Details/Study/128

Smart Work Zone Deployment Initiative – TPF-5(081)

Through this five state pooled-fund study which began in 1999; researchers investigate better ways of controlling traffic through work zones. Work is accomplished via a variety of projects carried out by researchers in the member states. During the first four years of the study, a total of 35 technologies were deployed and evaluated. A list of past and current projects can be found at www.ctre.iastate.edu/smartwz/index.cfm.

★ ***Result:*** See following web site for progress reports – http://www.pooledfund.org/Details/Study/303

Technology Transfer Concrete Consortium – TPF-5(159)

This project continues the collaborative effort begun in TPF-5(066) Materials and Construction Optimization. The TTCC will be open to any state desiring to be a part of new developments in

concrete paving leading to the implementation of new technologies which will lead to longer life pavements through the use of the innovative testing, construction optimization technologies and practices, and technology transfer. This partnership is also part of the Track Team for the CP Road Map Mix Design and Analysis Track. The Track Team will include state representatives along with FHWA representatives, industry representatives (from ACPA, ACPA chapters, and material suppliers), consultants, and academic representatives.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/390

Investigation of Curved Girder Bridges with Integral Abutments – TPF-5(169)

The purpose of the research is to investigate the use of integral abutments on curved girder bridges through a monitoring and evaluation program for in service bridges. The research will be conducted as a multiple phase study.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/396

Improving the Foundation Layers for Concrete Pavements – TPF-5(183)

The objective of this research is to improve the construction methods, economic analysis, and selection of materials, in-situ testing and evaluation, and development of performance-related specifications for the pavement foundation layers. Quality pavement foundation layers are essential to achieving excellent pavement performance. In recent years as truck traffic has greatly increased, the foundation layers have become even more critical to successful pavement performance. Although the focus of this research will be PCC concrete pavement foundations, the results will likely have applicability to ACC pavement foundations and, potentially, unpaved roads.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/408

Mix Design and Analysis – TPF-5(205)

The vision behind the work described in the Mix Design and Analysis (MDA) Track of the CP Road Map is to develop tools to help specify and make mixtures for concrete pavements that are consistently long-lasting, constructible, and cost efficient. The activities are intended to meet some of the needs identified by the track including

- Evaluation of emerging testing equipment,
- Modeling,
- Mixture testing and analysis guidelines (specifications), and
- Training and outreach.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/430

Novice Drivers, the Million Mile Study – TPF-5(207)

The million-mile study of 14½ year-old drivers is the first study of its type to provide parents and teens context-related information on their driving development using video feedback. Using the DriveCam event triggered video recorder, this study will provide a unique and sustained look into young driver skill development for state and federal policy makers, and the automotive and insurance industries.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/432

Joint Deterioration in Concrete Pavements – TPF-5(224)

The goal of this research project is to investigate the causes of this joint deterioration, estimate impacts based on an understanding of the problem and to develop repair, material, and construction strategies to minimize the sources. The objectives are:

- Determine the causes of anomalous concrete joint deterioration nationwide.
- Quantify any contributions to joint deterioration due to deicing chemicals and develop estimates of service reduction and life cycle costs.
- Develop recommendations based on research results for minimizing future joint deterioration on both existing pavements and new construction including possible repair methodologies and specification modifications.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/452

Impacts of Implements of Husbandry on Bridges – TPF-5(232)

The objective of this study is to determine how the implements of husbandry distribute their load within a bridge structural system and to provide recommendations for accurately analyzing bridges for these loading effects. To achieve this objective the distribution of live load and dynamic impact effects for different types of agricultural vehicles will be determined by load testing and evaluating two general types of bridges. The types of equipment studied will include but will not be limited to; grain wagons/grain carts, manure tank wagons, agriculture fertilizer applicators, and tractors. Once the effect of these vehicles has been determined, recommendations for the analysis of bridges for these non-traditional vehicles will be developed. Since Iowa DOT has already identified bridges needing evaluation, Iowa DOT is providing the funding sufficient for the completion of Phase I. Iowa State University (ISU) researchers associated with the Bridge Engineering Center will be performing the tasks associated with Phase I.

A proposed Phase II will provide the opportunity for other states to participate, including suggesting additional bridges/bridge types for evaluation or for the expansion of the Phase I plan to include a more comprehensive analytical component.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/460

Tech Transfer Intelligent Compaction Consortium (TTICC) – TPF-5(233)
The proposed project is for the establishment of a pooled fund for state representatives to continue this collaborative effort regarding intelligent compaction. The TTICC will be open to any state desiring to be a part of new developments in intelligent compaction leading to the implementation of new technologies which will lead to longer life pavements through the use of an integrated system of emerging innovative technologies. Two workshop meetings will be conducted each year. One of the meetings will be in person and is anticipated to occur during fall. The location of the in-person workshop meetings will be determined by the Executive Committee and moved regionally each year to participating states. The second meeting will be a webinar and occur in early spring hosted by the EERC. The objectives are:

- Identify and instigate needed research projects
- Develop pooled fund research projects for solutions to intelligent compaction issues
- Act as a technology exchange forum for the participating entities
- Be a forum for states and researchers to share their experience with IC technologies
- Identify and guide the development and funding of technology transfer materials such as tech brief summaries and training materials from research results
- Review the IC Road Map as updated annually and provide feedback to the FHWA, industry, states, and the EERC on those initiatives
- Provide research ideas to funding agencies
- Include current activities and deliverables of the pooled fund on the TTICC website
- Maintain pooled fund project website with current activities and deliverables
- Contribute to a technology transfer newsletter on intelligent compaction research activities every six months in cooperation with the EERC
- Post minutes to the website following web meetings
- Post a report following each in-person workshop to the website

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/461

Deicer Scaling Resistance of Concrete Pavements, Bridge Decks and Other Structures Containing Slag Cement – TPF-5(100)
The project is proposed to be accomplished in two phases:

Phase 1:

- Document the field performance of existing concrete pavements, bridge decks, and other structures made with slag cement that have been exposed to cyclical freeze-thaw cycles in the presence of deicing chemicals.
- Determine from the field study and construction/design records which mixtures and construction parameters have produced scale-resistant concrete containing slag.

Phase 2:

- Determine the effectiveness of ASTM C672 in predicting the deicer scaling behavior of field concrete. If discrepancies are noted, an attempt will be made to explain why the lab tests do not adequately mimic field performance and alternative procedures will be

recommended to improve the correlation between lab tests and field performance.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/333

Development of Performance Properties of Ternary Mixes – TPF-5(117)
The goal of this project is to provide the quantitative information needed to make sound engineering judgments pertaining to the selection and use of supplementary cementitious materials in conjunction with Portland or blended cement. This will lead to a more effective utilization of supplementary materials and/or blended cements enhancing the life-cycle performance and cost of transportation pavements and structures. The efforts of this project will be directed at producing test results that support the following specific goals:

- Provide quantitative guidance for ternary mixtures that can be used to enhance the performance of structural and pavement concrete
- Provide quantitative guidance for ternary mixtures that can be used to enhance the performance of structural and pavement concrete
- Provide a solution to the cold weather issues that are currently restricting the use of blended cements and/or supplementary cementitious materials
- Identify how to best use ternary mixes when rapid strength gain is needed Develop performance-based specifications for concrete used in transportation pavements and structures

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/349

PCC Surface Characteristics: Tire -Pavement Noise Program Part 3 - Innovative Solutions /Current Practices – TPF-5(139)
At the completion of this overall study, it is anticipated that it will be possible to specify the desirable surface characteristics of individual projects prior to construction to meet the site specific requirements for noise, skid, texture, and smoothness.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/368

Structural Health Monitoring System – TPF-5(219)
The ultimate objective of this project is to integrate a damage detection algorithm capable of evaluating a bridge's structural capacity and estimating remaining service life into a structural health monitoring system

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/447

Pooled Fund Projects with Iowa Participation (776)

Transportation Curriculum Coordinating Council: Training Management and Development (TCCC) – TPF-5(209) – FHWA led

A well-trained workforce is a more efficient and effective workforce. With that goal in mind, the Transportation Curriculum Coordination Council (TCCC), formed in the summer of 2000, has dedicated itself to improving training opportunities for transportation workers. The Council's goals also include developing a national core curriculum that can be used by any agency and building partnerships among State highway agencies and industry associations so as to save time and costs in developing training materials. For more information on TCCC, visit http://tccc.gov/

★ ***Result:*** Current needs identified for this region include developing field construction courses, basic materials courses for maintenance staff, and train-the-trainer courses for lab technicians.
See following web site for progress reports http://www.pooledfund.org/Details/Study/435

Traffic Control Device (TCD) Consortium – TPF-5(065) – FHWA led

The TCD Consortium is composed of regional, state, local entities, appropriate organizations and the FHWA. Its goals are to:

- Establish a systematic procedure to select, test, and evaluate approaches to novel TCD concepts as well as incorporation of results into the MUTCD;
- Select novel TCD approaches to test and evaluate.
- Determine methods of evaluation for novel TCD approaches.
- Initiate and monitor projects intended to address evaluation of the novel TCDs.
- Disseminate results.
- Assist MUTCD incorporation and implementation of results.

★ ***Result:*** See following web site for progress reports – http://www.pooledfund.org/Details/Study/281

Evaluation of Low Cost Safety Improvements – TPF-5(099) – FHWA led

This project will encompass safety-effectiveness evaluations of priority strategies from the NCHRP Report 500 Guidebooks, Guidance for Implementation of the AASHTO Strategic Highway Safety Plan.

The goal of this research is to develop reliable estimates of the effectiveness of the safety improvements that are identified as strategies in the National Cooperative Highway Research Program (NCHRP) Report 500 Guides. These estimates are determined by conducting scientifically rigorous before-after evaluations at sites in the U.S. where these strategies are being implemented

Additional information can be found at the URL: http://www.fhwa.dot.gov/research/

★ ***Result:*** See following web site for progress reports – http://www.pooledfund.org/Details/Study/332

Deer Vehicle Crash Information and Research (DVCIR) Center – TPF-5(120) – FHWA led
A significant amount of money has been spent on the implementation and study of deer-vehicle crash (DVC) countermeasures in the last several decades, but their expected crash reduction effectiveness is still largely unknown. The complexity and interdisciplinary requirements of implementation and long-term study of the correct potential DVC countermeasure(s) in the appropriate locations has limited the usefulness and transferability of past studies. A need exists to create a focal point for the definition and implementation of DVC-related research. This pooled fund would allow for the creation of a DVC Information and Research Center (DVCIR Center) to more properly address issues related to the DVC problem.

★ ***Result:*** See following web site for progress reports – http://www.pooledfund.org/Details/Study/352

Low Temperature Cracking of Asphalt Pavement, Phase 2 - TPF-5(132) – Minnesota led

The research proposed in this field study will build on all the previous research in the area of low temperature cracking performed in Minnesota and around the country. The next step is to validate the new models and laboratory test methods with field performance tests at MnROAD. The models being developed for top-down cracking and reflective cracking may be of some use for modeling thermal cracking. New asphalt materials, including modified PG binders, can be tested according to the principles developed in past research. Finally, upgrades to the AASHTO 2002 Design Guide could be proposed based on new innovations in modeling.

★ ***Result:*** See following web site for progress reports – http://www.pooledfund.org/Details/Study/395

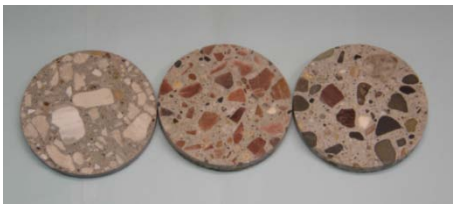
Mississippi Valley Freight Coalition – TPF-5(156) – Wisconsin led
The Coalition seeks to work closely with the ten states of the Mississippi Valley region to maximize the operational efficiency of the freight transportation system within our region. The objectives are:

- Share information between agencies that will improve the understanding of freight issues and the management of freight services and facilities
- Reach out to and share ideas with private sector shippers and carriers on approaches to making freight flow more smoothly through the region
- Gather, analyze and share information on the movement of freight throughout the region with sister agencies and with private sector interests
- Define a system of regionally significant freight highway, rail and water corridors and facilities and establish performance expectations for those facilities that will guide their management and operations

- Evaluate, implement and operate technologies and other roadway appurtenances from a regional perspective and in a manner that supports the reliable, efficient and safe movement of freight
- Evaluate, implement and enforce traffic and vehicle regulations that promote the reliable, efficient and safe movement of freight
- Identify corridors or bottlenecks that frustrate the movement of freight and then taking actions, individually or as a group, to improve those corridors or bottlenecks
- Define and support national transportation policies that will support and improve the movement of freight in the region

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/382

Evaluation of Test Methods for Permeability - TPF-5(179) – Indiana led



Historically, concrete has been specified and placed using prescriptive specifications. As a result DOT specifications for concrete pavements and bridge decks typically contain a specified compressive strength and prescriptive limitations on water-to-cement ratios, minimum cement contents, and supplementary cementitious addition rates. This project will investigate whether an alternative to these prescriptive limits can be developed.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/406

CP Roadmap Administration – TPF-5(185) – FHWA led

The CP Road Map is a strategic Long-Term Plan for Concrete Pavement Research and Technology that guides the investment of concrete pavement research dollars toward the development of specific technologies and systems identified by stakeholders as critical for accomplishing customer-driven goals. It is comprehensive in that it helps the concrete pavement community meet today's paving needs and tomorrow's pavement challenges.

Composed of integrated research tracks, with more than 250 research problem statements, it provides a collaborative management structure for existing local, state, and national concrete pavement research programs to focus their investments (about $300 million over 10 years) on stakeholder-identified priorities.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/409

Enhancement of Welded Steel Girders – TPF-5(189) – Kansas Led

Distortion-induced fatigue cracks constitute a serious national problem given the large number of steel girder bridges constructed before 1985 that are affected by this type of failure. It is estimated that 90% of all fatigue-related cracks in bridges have arisen due to out-of-plane distortion. Finding, repairing, and potentially preventing fatigue cracks at details susceptible to

out-of-plane distortion represent a significant expense to State DOTs.

The main objective of the proposed research is to explore the use of composite materials and hole treatments (ultrasonic impact treatment and bolt interference) to develop new retrofitting techniques aimed at extending the fatigue life of bridges with connection details susceptible to distortion-induced fatigue. The techniques that will be studied were selected because they are relatively inexpensive, easy to implement, and can be carried out without significant disruptions to traffic.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/413

Midwest States Crash Test Program – TPF-5(193) – Nebraska led

The purpose of this program, established in 1990, is to crash test highway roadside appurtenances (guardrails, bridge rails, signposts, barriers, etc.) to assure that they meet criteria established nationally. Full scale crash testing is performed at the Midwest Roadside Safety Facility, University of Nebraska.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/418

HY-8 Culvert Analysis Program – TPF-5(202) – FHWA led

The HY-8 is a computerized implementation of FHWA culvert hydraulic approaches and protocols. The objective of this research effort is to continue the phased development of HY-8. The anticipated scope of work consists of continued development efforts on the HY-8 software (beginning with phase three of the on-going development effort). The improvements would include hydrograph routing, analyzing hydraulic jumps, broken back culverts, and bottomless culverts.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/428

Clear Roads – TPF-5(218) – Minnesota led

Clear Roads is an open, cooperative research program aimed at funding highly relevant research to meet the needs of winter operations professionals around the world. This is an ongoing pooled fund project that proposes and funds new research projects or related activities on an annual basis. The Technical Advisory Committee proposes new research projects for funding every year. For more information see the web site at www.clearroads.org.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/446

Accommodating Oversize/Overweight Vehicles at Roundabouts – TPF-5(220) – Kansas led

Roundabouts are intentionally designed to operate at slower speeds by using narrow curb-to-curb widths and tight turning radii. However, if the design is too restrictive roundabout use by superloads may be difficult or impossible. Typical superloads are routed around restrictions such as bridges and narrow roads. With the growing popularity of roundabouts, such routing is becoming more difficult. Also, roundabouts can be damaged by too-wide loads which have difficulty making the narrow turns.

The objectives of this project are to: 1) compile current practice and research by various states and countries related to the effects that oversize/overweight vehicles (also called super loads) have on roundabout location, design and accommodation, and 2) fill in information gaps with respect to roundabout design and operations for these classes of vehicles.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/448

ITS Pooled Fund (ENTERPRISE) – TPF-5(231) was SPR-3(020) – Michigan led

The purpose of this project is to develop, evaluate, and deploy Intelligent Transportation Systems. Participants include eight other U.S. states, one Canadian province, Transport Canada, and the Dutch Ministry of This project will involve the following tasks that establish the protocols for design and construction of non-fracture critical structures:

- Experimental study of fracture in I-girders to determine supplemental toughness requirements
    - Full scale fracture tests
    - Fracture Mechanics Tests
- Establish damage tolerant design concepts to utilize toughness and set in-service inspection requirements.
- Detailed, 3D Finite element modeling of a two girder bridge system to set detailing requirements for redundancy. Ideally this will include analysis of a two girder concept for an actual bridge project.
- Develop a guide specification for design and fabrication of non-fracture critical low redundancy structures. Transportation. ENTERPRISE provides a forum for member agencies to communicate and pursue ITS projects that might be difficult to initiate on their own. Statewide projects and the establishment of a 511 travel information program are two examples of areas that are of interest to members. ENTERPRISE is an ongoing project started in 1991 and has a $250,000 annual budget. Its web site is www.enterprise.prog.org.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/459

Development of Design Guide for Thin and Ultrathin Concrete Overlays of Existing Asphalt Pavements – TPF-5(165) – Minnesota Led

The primary purpose of this project is to create a unified national design guide for thin and ultrathin concrete overlays of existing asphalt pavements. This consists of the following distinct objectives:

- Study and understand the field performance history of TCOAP and UTCOAP as demonstrated by various research test sections. These include current (and future) test sections at the MnROAD facility, accelerated loading facility test sections (FHWA), and other test sections installed and monitored by various local, national and international agencies.
- Develop a design guide for concrete overlays of existing asphalt pavements utilizing existing validated performance models, as well as new analytical models derived to address design aspects not currently considered in existing methods. The design guide will be based on mechanistic-empirical principles, including the effects of various concrete overlay and existing asphalt materials, panel thickness and geometry, joint opening and stiffness, traffic loads, and climates under which they must perform.
- Create a user-friendly design guide software program and user's manual. The program format should be such that it could become a module in the future national Mechanistic-Empirical Pavement Design Guide (MEPDG) for highway pavements.

★ ***Result:*** See following web site for progress reports – http://www.pooledfund.org/Details/Study/389

Transportation Engineering and Road Research Alliance – TPF-5(215) – Minnesota Led

TERRA is seeking organizations to join the alliance. Benefits of membership include:

- Sitting at the table collaboratively with industry, academia, and government agency representatives to define common road related research issues and establish joint research priorities, building on existing efforts such as FHWA's PC Roadmap and HMA Roadmap.
- Exploring research funding opportunities that leverage funds across organizations.
- Receiving timely results on TERRA research projects through communication products that focus on lessons learned and implementation.
- Assistance in putting research results into practice through technology transfer events such as the TERRA Innovation Series.
- Opportunities to feature news about your organization in a quarterly electronic newsletter. TERRA members serve on the board and supporting committees, meeting periodically throughout the year to determine priorities, develop strategies to address the priorities, and execute action plans. The current priority objectives of the organization are laid out in the following strategic directions, adopted in July 2008 by the current TERRA board.
- Define and launch a bold and synergistic research program. Create research priorities that expand beyond a MnROAD focus and leverage the power of the group. These priorities should utilize diverse funding sources, engage and benefit TERRA members, and be recognized nationally.
- Implement research results, implementation of transportation engineering and road

research applications should be successful, visible, and include innovations that are also put into practice outside of the alliance.

- Develop activities that enhance TERRA's role as a dynamic forum for research interchange Activities should provide continuous learning opportunities that enable members to educate each other, as well as adapt to a changing world through easily accessible information and ongoing exchange.
  TERRA committee members define specific annual action plans to help ensure these directions are implemented.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/443

Transportation Library Connectivity and Development – TPF-5(237) – Missouri Led
To support the coordinated development of transportation libraries, help implement TKNs and extend efforts beyond those of the TPF-5(105) Transportation Library Connectivity pooled fund, the following objectives have been adopted. These will be accomplished through member activities, partnerships with professional groups such as TRBs Library and Information Science for Transportation Committee, SLA's Transportation Division and the services of a qualified consultant:

- Provide technical guidance to eligible members, focused on smaller libraries that are served by only one librarian, while emphasizing an increased reliance on self-sustaining networks.
- Promote the value of transportation library and information services through the following activities:
  - Create key information products to demonstrate the value of, and further the contribution of, libraries to the field.
  - Deliver presentations to gatherings of DOT administrators, such as meetings of AASHTO and TRB Committees (Highways, Planning, Environment, etc...).
  - Share training materials and provide training sessions, with an added marketing component, for library users at member institutions.
- Conduct an annual meeting and workshop, in conjunction with other events, to help members demonstrate the value of library and information services to their customers.
- Develop an interactive content management system (CMS) based project website, including tracking and reporting information, as well as provide limited access to server space.
- Collaborate with the National Transportation Library, the AASHTO RAC Task Force on TKNs and other stakeholder groups to enhance communication between transportation librarians, specifically to support their projects as they help implement Transportation Knowledge Networks.
- Pay OCLC and TLCat subscriptions for eligible pooled fund members.
- Implement focused research and technology projects, as proposed by members, on an annual basis. Potential projects which have already been identified include:
  - Financial, technical, and logistical support for the creation of an NTKN portal website as envisioned in NCHRP Report 643.
  - The completion of a return-on-investment case study highlighting the tangible

contributions of libraries to research.

- A collaborative cataloging project to expand access to transportation resources, possibly done in conjunction with the National Transportation Knowledge Network, alleviating member time constraints.
- Pooled subscriptions for online databases to improve the accessibility of electronic information while reducing access costs to member libraries.
- Digitization support for institutions wishing to convert printed copies of older materials to digital formats.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/466

Design and Fabrication Standards to Eliminate Fracture Critical Concerns in Two Girder Bridge Systems – TPF-5(238) - Indiana Led

The FHWA currently has the authority to allow owners to forego fracture critical inspection for low redundancy bridge structures on a case by case basis, but this has rarely been done since no guidance is available for ensuring bridge safety. This project will establish guidance that provides a high level of bridge safety that can then form the basis for in-service inspection decisions.

When considering the estimated projects costs, it must be recognized that the results of this research will be transformative for the steel bridge industry. For the first time, material selection, design, and inspection will be rationally integrated to eliminate fracture concerns. This can result in significant cost savings for medium and long span bridges and facilitate introduction of modular concepts for short span bridges.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/467

Acceleration Maintenance innovation Implementation and Tech Transfer (No Boundaries Roadway Maintenance Practices) – TPF-5(239) – Missouri Led

Through this pooled fund project, the Missouri Department of Transportation plans to work with other State Departments of Transportation (DOTs) to establish a program in order to facilitate the implementation of promising innovations and technologies. This project will provide a forum for State DOTs to share their maintenance innovations with each other, support technology transfer activities and develop marketing and deployment plans for the implementation of selected innovations. Resources will be provided for implementing the innovations that includes travel, training and other technology transfer activities.

It is anticipated that this consortium would become the national forum for state involvement in the technical exchange needed for collaboration and new initiatives, and be a forum for advancing the application and benefit of research technologies. State participation in this process will be through the pooled fund. FHWA, industry and others will be invited to participate in the project discussions and activities.

Workshops could be provided for the states participating in the pooled fund project. This project will help DOTs to save time and money by not investing in the same research that has already been performed by other State DOTs. Hence rather than having each DOT identify and

implement research separately, DOTs can work collectively through this pooled fund project. The Missouri DOT will serve as the lead state for the execution of the pooled fund project described in this proposal. The Missouri DOT will handle all administrative duties associated with the project.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/468

Motorcycle Crash Causation Study – TPF-5(243) – FHWA led

The primary objective of the Motorcycle Crash Causation Study is to investigate the causes of motorcycle crashes and to enable the development of countermeasures that can be effective in reducing these crashes. Using the field tested methodology developed by the OECD, the study will focus on all relevant aspects of motorcycle crashes that could be susceptible to countermeasures that will either prevent motorcycle crashes from occurring or will lessen the harm resulting from them. The objective of this transportation pooled fund study is to provide additional funding to increase the number of crash investigations that will be used to expand the database.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/480

2012 Multi-State Asset Management Implementation Workshop – TPF-5(245) – FHWA Led

- To provide a conduit for enhancing the practical knowledge of member states concerning asset management implementation.
- To enhance the working knowledge of the asset management community.
- To provide for continued information sharing among member states beyond the 2012 Workshop.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/473

Field Testing Hand-held Thermo-graphic Inspection Technologies Phase II – TPF-5(247) – Missouri led

This research is focused on the development and application of practical Nondestructive Evaluation (NDE) tools for use in the routine inspection and maintenance of highway bridges to ensure safety. Thermal (infrared) imaging is used to detect and image subsurface damage (delaminations) in concrete.

The previous pooled fund study entitled TPF-5(152) "Development of Hand-held Thermographic Inspection Technologies" explored the application of thermal imaging technologies for the NDE of highway bridges. Phase I of the research included experimental testing and field testing by participating states. The outcome of phase I testing included a draft guideline for utilizing thermal imaging to detect deterioration in concrete bridges.

Phase II, of the research, consists of field testing and evaluation of thermal imaging to evaluate the reliability of the technology, validate previously developed guidelines for field use, and evaluate implementation barriers.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/475

Member-level Redundancy in Built-up Steel Members – TPF-5(253) – Indiana Led

The Federal Highway Administration currently has the authority to allow owners to forego fracture-critical inspection for low redundancy bridge structures on a case-by-case basis if supported by a rigorous damage analysis as per AASHTO LRFD. However, since there is limited experimental data specifically focused on this issue, using internal redundancy as the sole measure of redundancy cannot be approved by FHWA at this time. Hence, specific research is needed that can be used to evaluate the potential for a fracture propagating from one mechanically fastened element to another in a built-up member as well as the effects on the fatigue resistance of the faulted member. Furthermore, there is no known research that has quantified the energy release (and resulting loads on the remaining section) that is likely to occur during such a fracture event. This project will explore whether internally redundant members (either mechanically fastened built-up members, or those with parallel elements) do posses the internal arrest mechanisms to safely carry loads during and after a fracture event considering one of multiple elements are fractured. The project will be primarily based on full-scale specimens subjected to various fracture simulations for the purposes of gaining deeper understanding of the energy release, load redistribution, and subsequent fatigue resistance of damaged section. However, analytical studies will also be conducted to assist in the development of code-ready assessment methodologies. The project will also assess the role of inspection technique and frequency for internally redundant members considering the research may show they do not fit the AASHTO definition of fracture-critical. Obtaining experimental data in a controlled fashion will provide the needed evidence to establish if internal member redundancy is a reliable redundancy measure to use for collapse prevention in a fracture-critical assessment. This will improve the ability to properly allocate limited bridge inspection resources and improve overall safety of the nation's infrastructure.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/482

Bulb-T Beam as Alternate ABC to Side-By-Side Box-Beam – TPF-5(254) – Michigan led

To analyze and evaluate the decked bulb-T beam (or decked I- beam) as a viable replacement for the side-by-side box-beam bridge. The project's description uses the term bulb- T beam as a general description of an I- beam shape, with a wide top flange that can serve as a deck surface. For this type of beam to be a viable replacement to a box beam, it must have a very robust cross-section designed to have a shallow depth-to-span ratio; which makes it very different than the standard AASHTO section used by some states. The use of a bulb- T beam cross section would eliminate inherent problems associated with the ability to inspect and repair box-beam type structures. The Bulb-T beam cross-section will provide enough space at the section bottom for ease of periodical inspections and maintenance of critical elements; such as beam web and the

soffit of the bridge deck slab.

The purpose of this proposed study is to collaborate and share common interests with State DOTs in the Midwest area, and other research stakeholders, regarding alternative/innovative solution(s)to environmental and structural challenges in building and maintaining a sustainable transportation infrastructure. In correlation with analyzing the bulb- T beam this study includes comparing alternative non-corrosive materials, including, but not limited to carbon fiber, stainless steel and stainless clad reinforcement materials. The study's analysis and evaluation will include the evaluation of top flange connection details including the use of ultra-high performance concrete (UHPC) to fill the joint between the adjacent decked bulb-t beams (as used in New York).

The goal is to have a bridge structure with a service life exceeding 100 years, and have rapid construction applicability.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/483

Next-Generation Transportation Construction Management – TPF-5(260) – Colorado led
The Transportation Construction Management Group (TCM) is a coordinated effort between AASHTO, FHWA, ARTBA, AGC, and academia with representatives whose shared goal is the improvement of transportation construction management practices. This group was initiated to facilitate the sharing of best practices and to expedite the dissemination of information regarding new technology, procedures and programs. The TCM will accomplish this by:

- Sharing current practices through case studies, reports, evaluations, web pages, webinars, etc.;
- Developing and publishing sample guidelines, specifications and model procedures;
- Hosting meetings, conferences, webinars, and other means of exchanging information;
- Coordinating issues with industry associations representatives;
- Designating lead states for implementation efforts.

Those participating in this pooled fund will be involved with the creation of the annual work plan. The annual work plan will be created in June of each year for work from July 1 through June 30 of the following year. Prioritization of work items will depend on the amount of funding available and the consensus decisions of the participating agencies.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/489

Evaluation of Guide Sign Fonts – TPF-5(262) – Minnesota Led
The objective of this study is to conduct a field evaluation of new available highway fonts versus the Series E (Modified) and Clearview 5WR fonts for use on guide signs. This study will provide the analysis necessary for decision to be made on inclusion of fonts for older drivers in the MUTCD. In previous studies comparing Clearview fonts to previously used types, legibility distance, the distance at which a subject can read an unknown word, has been a robust measure of effectiveness. Researchers believe that in order to test the proposed font against the current

standard, nighttime data collection in which participants drive an instrumented vehicle along a closed course while researcher's record data would be most conducive.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/490

Development of an Improved Design Procedure for Unbonded Concrete Overlays – TPF-5(269) – Minnesota Led

The primary purpose of this project is to create a unified national design guide for unbonded concrete overlays of existing concrete and composite pavements. This consists of the following distinct objectives:

- Study and understand the field performance history of UCOCP as demonstrated by various test sections and in-service pavements.
- Determine suitable separator layer (interlayer) materials and properties to insure long term performance of UCOCP systems.
- Develop a design procedure for unbonded concrete overlays of existing concrete and composite pavements utilizing existing validated performance models, as well as new analytical models derived to address deficient or missing design parameters in existing methods. The design guide will be based on mechanistic-empirical principles, including the effects of various concrete overlay materials, separator layer (interlayer) types, panel thickness (4" to 10"?) and panel size, joint load transfer mechanisms, traffic loads, and climates (nation-wide) in which they must perform.

★ ***Result:*** See following web site for progress reports –
http://www.pooledfund.org/Details/Study/498

Transportation Library Connectivity and Development – TPF-5(237) - (was TPF-5(105)) – Missouri led

To support the coordinated development of transportation libraries, help implement TKNs and extend efforts beyond those of the TPF-5(105) Transportation Library Connectivity pooled fund, the following objectives have been adopted. These will be accomplished through member activities, partnerships with professional groups such as TRBs Library and Information Science for Transportation Committee, SLAs Transportation Division and the services of a qualified consultant:

1. Provide technical guidance to eligible members, focused on smaller libraries that are served by only one librarian, while emphasizing an increased reliance on self-sustaining networks.
2. Promote the value of transportation library and information services through the following activities:
    - **a.** Create key information products to demonstrate the value of, and further the contribution of, libraries to the field.
    - **b.** Deliver presentations to gatherings of DOT administrators, such as meetings of AASHTO and TRB Committees (Highways, Planning, Environment, etc...).
    - **c.** Share training materials and provide training sessions, with an added marketing component, for library users at member institutions.

3. Conduct an annual meeting and workshop, in conjunction with other events, to help members demonstrate the value of library and information services to their customers.
4. Develop an interactive content management system (CMS) based project website, including tracking and reporting information, as well as provide limited access to server space.
5. Collaborate with the National Transportation Library, the AASHTO RAC Task Force on TKNs and other stakeholder groups to enhance communication between transportation librarians, specifically to support their projects as they help implement Transportation Knowledge Networks.
6. Pay OCLC and TLCat subscriptions for eligible pooled fund members.
7. Implement focused research and technology projects, as proposed by members, on an annual basis. Potential projects which have already been identified include:
    - **a.** Financial, technical, and logistical support for the creation of an NTKN portal website as envisioned in NCHRP Report 643.
    - **b.** The completion of a return-on-investment case study highlighting the tangible contributions of libraries to research.
    - **c.** A collaborative cataloging project to expand access to transportation resources, possibly done in conjunction with the National Transportation Knowledge Network, alleviating member time constraints.
    - **d.** Pooled subscriptions for online databases to improve the accessibility of electronic information while reducing access costs to member libraries.
    - **e.** Digitization support for institutions wishing to convert printed copies of older materials to digital formats.

For further description of the solicitation go to :

http://www.pooledfund.org/Details/Solicitation/1271

Solicited Pooled Fund Projects with Iowa Participation (776)

Design and Fabrication Standards to Eliminate Fracture Critical Concerns in Two Girder Bridge Systems – Solicitation 1257 – Indiana led

The FHWA currently has the authority to allow owners to forego fracture critical inspection for low redundancy bridge structures on a case by case basis, but this has rarely been done since no guidance is available for ensuring bridge safety. This project will establish guidance that provides a high level of bridge safety that can then form the basis for in-service inspection decisions.

When considering the estimated projects costs, it must be recognized that the results of this research will be transformative for the steel bridge industry. For the first time, material selection, design, and inspection will be rationally integrated to eliminate fracture concerns. This can result in significant cost savings for medium and long span bridges and facilitate introduction of modular concepts for short span bridges.

This project will involve the following tasks that establish the protocols for design and construction of non-fracture critical structures:

- Experimental study of fracture in I-girders to determine supplemental toughness

requirements
    - Full scale fracture tests
    - Fracture Mechanics Tests
- Establish damage tolerant design concepts to utilize toughness and set in-service inspection requirements.
- Detailed, 3D Finite element modeling of a two girder bridge system to set detailing requirements for redundancy. Ideally this will include analysis of a two girder concept for an actual bridge project.
- Develop a guide specification for design and fabrication of non-fracture critical low redundancy structures.

For further description of the solicitation go to:

http://www.pooledfund.org/Details/Solicitation/1257

Accelerating Maintenance Innovation Implementation & Tech Transfer – Solicitation 1272 – Missouri led

Through this pooled fund project, the Missouri Department of Transportation plans to work with other State Departments of Transportation (DOTs) to establish a program in order to facilitate the implementation of promising innovations and technologies. This project will provide a forum for State DOTs to share their maintenance innovations with each other, support technology transfer activities and develop marketing and deployment plans for the implementation of selected innovations. Resources will be provided for implementing the innovations that includes travel, training and other technology transfer activities.

It is anticipated that this consortium would become the national forum for state involvement in the technical exchange needed for collaboration and new initiatives, and be a forum for advancing the application and benefit of research technologies. State participation in this process will be through the pooled fund. FHWA, industry and others will be invited to participate in the project discussions and activities.

Workshops could be provided for the states participating in the pooled fund project. This project will help DOTs to save time and money by not investing in the same research that has already been performed by other State DOTs. Hence rather than having each DOT identify and implement research separately, DOTs can work collectively through this pooled fund project. The Missouri DOT will serve as the lead state for the execution of the pooled fund project described in this proposal. The Missouri DOT will handle all administrative duties associated with the project.

1) Identify promising innovations and technologies ready for implementation within Maintenance activities, developed by the participating State DOTs;
2) Develop marketing plans for selected ready to deploy innovations and technologies;
3) Organize training classes about specific research topics for member State DOTs.

For further description of the solicitation go to:

http://www.pooledfund.org/Details/Solicitation/1272

Pooled Fund Projects still active with Iowa Past Participation (776)

North Central SuperPave Center – TPF-5(021) – Indiana led

This pooled fund project will provide for continued operation of the North Central Superpave Center to assist agencies and industry with Superpave implementation and hot mix asphalt issues. The NCSC will provide technical assistance, training, communication, and research and development work to meet the needs of the region

★ ***Result:*** See Following website for progress reports -
http://www.pooledfund.org/Details/Study/9

Pacific Northwest Snowfighters – TPF-5(035) – Washington led

Public agencies throughout the Northwest buy and use corrosion inhibited deicing chemicals in an attempt to reduce the effects of corrosion due to the deicers that they apply during winter. These inhibitors are organic (typically carbohydrates which are biodegradable) and add about $30-50 per ton to the cost of deicing chemicals. Laboratory test data indicates that we can reduce the corrosive effects of all deicers by 70% or more by the addition of inhibitors, but what we don't know is how long the inhibitors stay with the chlorides after application in a field environment. The deicing chemicals are stored in covered and uncovered facilities in the field and testing needs to be performed to determine if these inhibitors deteriorate and the limit to their effectiveness. Also, the actual field performance of these products needs to be documented to assist maintenance personnel.

Objectives:

Phase 1: Determine the longevity and cost effectiveness of corrosion inhibitors added to liquid and solid deicing chemicals

Phase 2: Evaluate the performance of liquid and solid deicing chemicals

★ ***Result:*** See Following website for progress reports -
http://www.pooledfund.org/Details/Study/302

Transportation Asset Management – TPF-5(036) – Wisconsin led

To enable participating states to leverage limited resources in an ongoing program of synthesis, research, and analysis to facilitate implementation of asset management. The intent is to supplement current national asset management research efforts of the MRUTC, prevent duplicity of existing efforts, and provide a means for regional state DOTs to share resources, technology and ideas in a coordinated environment. MRUTC Contact is Jason Bittner, (608) 262-7246.

★ ***Result:*** See Following website for progress reports -
http://www.pooledfund.org/Details/Study/31

KSU Accelerated Pavement Testing Laboratory – TPF-5(048) – Kansas led

This is an ongoing project that has an annual program determined by the TAC. Its objective is to evaluate various pavement components such as bases, ACP and ACCP using full scale

accelerated pavement testing as determined by the TAC.

★ ***Result:*** See Following website for progress reports -
http://www.pooledfund.org/Details/Study/236

Development of Maintenance Decision Support System – TPF-5(054) – South Dakota led
To provide safe transportation to motorists, state transportation agencies in northern states must apply effective highway maintenance treatments appropriate to a wide range of winter and year-round conditions. Maintenance personnel must decide what treatments to apply, and when to apply them, based on their knowledge of current pavement conditions, current and forecast weather conditions, and available maintenance techniques and resources. In large part, the decisions are based upon prior experience of maintenance personnel and supervisors.

Objectives:

1) To assess the need, potential benefit, and receptivity in participating state transportation departments for state and regional Maintenance Decision Support Systems.
2) To define functional and user requirements for an operational Maintenance Decision Support System that can assess current road and weather conditions, forecast weather that will affect transportation routes, predict how road conditions will change in response to candidate maintenance treatments, suggest optimal maintenance strategies to maintenance personnel, and evaluate the effectiveness of maintenance treatments that are applied.
3) To build and evaluate an operational Maintenance Decision Support System that will meet the defined functional requirements in the participating state transportation departments.
4) To improve the ability to forecast road conditions in response to changing weather and applied maintenance treatments.

★ ***Result:*** See Following website for progress reports -
http://www.pooledfund.org/Details/Study/240

Transportation Library Connectivity – TPF-5(105) – Wisconsin led
This pooled fund project on Transportation Library Connectivity focuses on making transportation information more readily available through better communication and coordination among state, federal, academic and private sector libraries. The study aims to institutionalize the best practices of individual transportation libraries and regional Transportation Knowledge Networks.

★ ***Result:*** See Following website for progress reports -
http://www.pooledfund.org/Details/Study/337

Impact of Implements of Husbandry on Bridges – TPF-5(148) – Minnesota led
The objectives of this study are to determine the pavement response under various types of agricultural equipment (including the impacts of different tires and additional axles) and to compare this response to that under a typical 5-axle semi tractor-trailer. This may be accomplished by constructing new instrumented test sections at MnROAD and/or to retrofit

instrumentation into the existing test sections. The final scope and work plan for the study will be developed by the participating agencies.

This pooled fund study, with contributions from Mn/DOT and other participating organizations, will fund both the possible construction of pavement test sections and the research on heavy farm equipment. This research will allow policy and design decisions to be driven by direct experimental results rather than by models that may not have been calibrated for the types of loadings and tire configurations of current and evolving agricultural equipment.

★ ***Result:*** See Following website for progress reports -
http://www.pooledfund.org/Details/Study/375

Updating US Precipitation Frequency Estimates for the Midwestern Region – TPF-5(187) – FHWA Led

The purpose of this study is to determine annual exceedance probabilities (AEP) and average recurrence intervals (ARI) for durations ranging from 5 minutes to 60 days and for ARIs from 1 to 1,000 years. The point estimates will be spatially interpolated to a spatial resolution of approximately 4km x 4 km. The study results will be published as volumes of NOAA Atlas 14, a wholly web based publication available at www.nws.noaa.gov/ohd/hdsc. The publication will include the artifacts provided in Volumes 1 and 2 including access through the Precipitation Frequency Data Server, base grids in standard formats, electronic copies of maps, results of trend analyses, charts of seasonal distributions and probabilistic temporal distributions, and detailed documentation. Updated areal reduction factors are being developed as a separate appendix to NOAA Atlas 14 for the entire U.S. including Alaska. The project will review and process all reasonably available rainfall data. It is recognized that the rainfall data archived by NOAA's National Climatic Data Center (NCDC) may not be sufficient to accomplish the objectives of this project. Therefore, other data available from sources such as State Climatologists and other Federal, State and local agencies will be examined and included if appropriate. The state of the art techniques and processes developed and applied for NOAA Atlas 14 Volumes 1 and 2 will be applied. They include regional frequency analysis based on L-moments including error estimates, a combination of PRISM based techniques and CRAB for spatial interpolation, techniques for the analysis of climatic trend, temporal distribution and seasonality, internal consistency checks and variety of automated processes designed to enhance productivity. Intermediate results in the form of hourly and daily estimates at several ARIs will be distributed for peer review as will the final documentation.

★ ***Result:*** See Following website for progress reports -
http://www.pooledfund.org/Details/Study/410

Performance of Recycled Asphalt Shingles in Hot Mix Asphalt – TPF-5(213) – Missouri led

The primary goal of this study is to address research needs of state DOT and environmental officials to determine the best practices for the use of recycled asphalt shingles in hot-mix asphalt applications. The study will address the following research objectives:

1. To address the concerns of quality assurance (QA)/ quality control (QC) in the sourcing, processing and incorporation of the RAS to achieve a final product that would

meet the requirements for use in state HMA applications. Create a specification that includes sufficient language to cover the QA/QC concerns.

2. To conduct demonstration projects to provide laboratory testing and field surveys to determine the behavior and performance of RAS in HMA at varying percentages, climates and traffic levels.

3. To create a comprehensive database on the performance of RAS in HMA applications.

★ ***Result:*** See Following website for progress reports –
http://www.pooledfund.org/Details/Study/441

Ultra-High Performance Concrete Deck Joint Testing – TPF-5(217) – FHWA led
The objective of this study is to investigate the structural performance of ultra-high performance concrete (UHPC) connection details developed for implementation in precast concrete bridge deck systems.

★ ***Result:*** See Following website for progress reports –
http://www.pooledfund.org/Details/Study/445

Accelerated Bridge Construction (ABC) Decision Making and Economic Modeling Tool – TPF-5(221) – Oregon Led
This pooled fund effort will develop a project-level tool for engineers and decision-makers to quantitatively assess the utility of ABC in the early project development stage and to determine whether or not ABC is more economically effective than conventional construction for a given bridge replacement or rehabilitation project.

★ ***Result:*** See Following website for progress reports –
http://www.pooledfund.org/Details/Study/449

Instrumentation to Aid in Steel Bridge Fabrication – TPF-5(226) – Virginia led
This research will deliver a laser based bridge measurement system that will greatly improve the quality and reduce the cost of complex bridge fabrication. This system will reduce or eliminate the need for shop fit-up and assembly by providing a virtual assembly capability using specialized solid modeling and analysis software specifically targeted at large-scale complex structures. This laser system will be specifically designed for steel bridge fabrication and will accurately and precisely measure all aspects of a bridge component, including splice hole locations, camber, sweep, and end-kick in a nearly full-automated manner. The completed system can be used as a quality control tool to document as-built conditions of girders and as a virtual fit-up tool to eliminate shop assembly. There is no existing laser-based measurement system that can measure very large and very complex girders with the accuracy, as rapidly, and with as little operator intervention as that being proposed.

The use of this laser system on just one complex bridge job could result in benefits that exceed the cost of this entire research project. The stakeholder group that can potentially benefit the most from the use of the proposed laser system are the State DOTs, who could save millions of

dollars on the cost of steel bridges and receive greater quality assurance on the end product. Elimination of shop assembly of complex structures could save millions of dollars. The proposed system can identify fabrication errors at the fabrication shop allowing repairs to be made prior to painting and shipment to a job site. Documentation from the proposed system is a permanent record that is certifiable and traceable. This documentation can be used to help reduce construction claims and could serve as evidence in legal disputes in cases where there are problems during bridge erection. Avoiding the legal expenses from one such dispute of this type could more than pay for the cost of this research.

Three phases are proposed for this research in order to proceed in an incremental and effectively managed fashion as well as to manage the risk of delivering an expensive system that is ready for full-scale implementation. Phase I will define measurement requirements on large-scale complex components and assess commercial software analysis tools. Phase II will extend this work to the development of virtual fit-up analysis tools for large-scale components, validated with testing in a fabrication plant. Phase III will incorporate the software tools developed in the previous phase and deliver a system at a fabricator. The Phase III project deliverable will be a dedicated laser-based bridge measurement system installed at a bridge fabricator or a group of fabricators. The final Phase III task will apply the laser measurement system to an actual complex structure bridge job, coordinated with a State DOT partner, where no shop assembly is employed.

★ ***Result:*** See Following website for progress reports –
http://www.pooledfund.org/Details/Study/454

B. Iowa Highway Research Board

The Iowa Highway Research Board (IHRB) has provided a distinctive partnership for the Iowa Highway community with a collaboration of city, county, state and university research expertise and oversight. Pooling a portion of funds for research from the Primary, Secondary, and Street Funds provides benefits to all levels of the Iowa highway community. Board membership includes representatives from Iowa's city and county government highway agencies, the Iowa DOT, and Iowa's public universities with civil engineering programs. Staff assistance is provided by the Iowa DOT.

The IHRB assists the Iowa DOT in the development and continuation of an effective program of research in highway transportation. Each year it oversees numerous projects on transportation issues in Iowa. Most of the projects are conducted by state universities. The Board supports engineering research studies and projects on topics ranging from soils and structures to pavements, markings, and winter maintenance. All are designed to find more efficient uses of funds and materials for the construction and maintenance of Iowa's highway system. Projects conducted under this program are summarized annually. The FY 2012 Annual Report is included as the final attachment to this document. For additional information, visit the board's web site at: http://www.iowadot.gov/operationsresearch/default.html#.

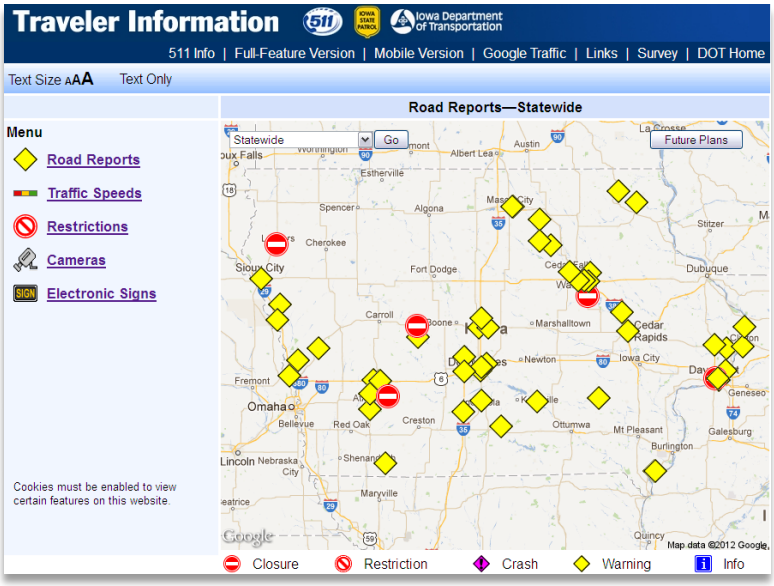
C. Intelligent Transportation System (ITS) Projects

Transportation problems have historically been solved by investing in infrastructure and services. Governments now also turn to innovative solutions collectively known as ITS, applications of information and technologies to improve the movement of people and goods. These applications typically rely on computer and communication technologies, potentially resulting in shorter travel times, increased traveler information, more travel options, increased safety, and a more efficient flow of people and goods. The Iowa DOT programs and coordinates ITS projects through the Research & Technology Bureau.

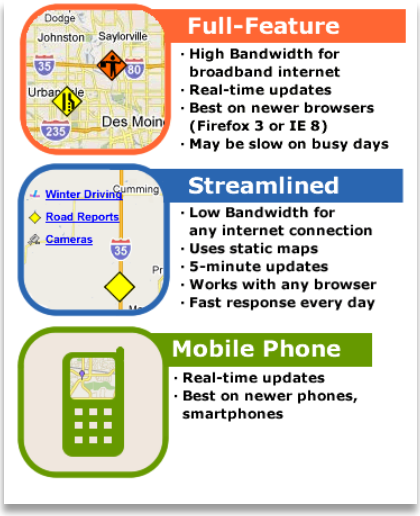
Iowa's Traveler Information Website *(511ia.org)*, Phone *(dial 511)*, & Highway Advisory Radio (HAR) System
June 2012
Iowa DOT - Research and Technology Bureau

Since 1998, Iowa has led an 11-agency pooled fund project called CARS (Condition Acquisition and Reporting System). This multi-state effort has allowed the Iowa DOT to share the development costs for the CARS system.

CARS is a software engine that works behind the scenes processing the information entered by the Iowa DOT or the Iowa State Patrol. Some of the types of events entered by the DOT are construction projects, maintenance activities, crashes, truck restrictions, and detours. The Iowa State Patrol (ISP) reports on the winter road conditions from October 15 to April 15.



Streamlined Website



Three different website formats for delivering our Traveler Information

The CARS software feeds our website (511ia.org), 511 phone system, and our Highway Advisory Radios (HAR) around Iowa. We have three different website formats for delivering our information - a high-bandwidth Google Map-based website (Full-Feature), a low-bandwidth website (Streamlined), and a mobile website. All of these can be accessed by going to 511ia.org. Our 511 phone system can be accessed by calling 511 (inside Iowa) or 1-800-288-1047 (nationwide) from a cell phone or landline. We have nine HAR sites around the state, which automatically receive information via CARS.

Over the last year, Iowa launched several new upgrades and enhancements. Some of the major additions were: traffic events via Twitter and Facebook, personalized routes with alerts via text message and/or email, streaming video and traffic speeds in six metro areas, and DMS messages on our website. Due to cost sharing with other states, we are able to continually improve our Traveler Information system at a lower cost.

One of the success stories of the system was during the February 2011 Groundhog Day Blizzard, our websites received over 334,122 hits in one day. During this blizzard, parts of Iowa saw up to 18.5 inches of snow. The heaviest snow fell in the eastern half of the state.

The approximate cost for Maintenance and Operations of our Traveler Information system is $210,000/year for the phone system and $135,000/year for the websites.

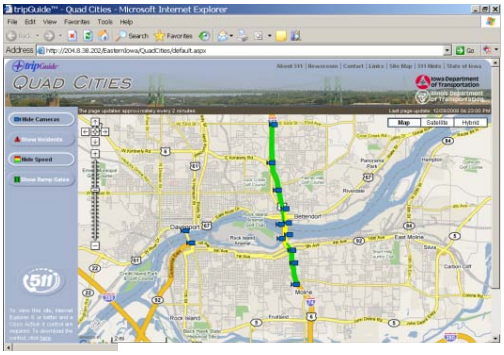
Annual 511 Web Usage Report					
	2012	**2011**	**2010**	**2009**	
	Total Visits	**Total Visits**	**Total Visits**	**Total Visits**	**Peak Day Visits**
January	725,444	1,287,260	1,902,303	421,515	21,557
February	606,826	1,056,012	1,548,586	122,082	16,332
March	148,019	191,386	146,019	59,460	4,933
Qtr 1 Total	**1,480,289**	**2,534,658**	**3,596,908**	**603,057**	
April	38,455	84,366	27,827	62,835	10,599
May	50,272	40,513	38,428	16,089	939
June	52,324	432,041	63,422	8,934	1,478
Qtr 2 Total	**141,051**	**556,920**	**129,677**	**87,858**	
July	48,874	224,160	75,913	17,063	775
August	43,419	136,336	216,930	23,876	972
September	33,558	104,504	43,171	15,986	711
Qtr 3 Total	**125,851**	**465,000**	**336,014**	**56,925**	
October	35,925	86,934	34,784	18,816	1,426
November	41,480	108,726	378,258	14,239	1,471
December	1,406,429	239,198	1,586,019	2,374,931	62,895
Qtr 4 Total	**1,483,834**	**434,858**	**1,999,061**	**2,407,986**	
Yr to Date	**3,231,025**	**3,991,436**	**6,061,660**	**3,155,826**	
Sources: 2010 - www.google.com/analytics, 2009 - www.webstat.com,					

Contact: Sinclair Stolle, Traveler Information Program Engineer
sinclair.stolle@dot.iowa.gov | 515.239.1933

Eastern Iowa ITS

The Eastern Iowa ITS Project entails deployment of ITS technology and systems in both the Iowa City and Quad Cities (Davenport-Bettendorf-Moline-Rock Island) metropolitan areas.

The technology included in these projects includes pan-tilt-zoom cameras, side-firing, radar-type traffic sensors, dynamic message signs (DMS), highway advisory radio (HAR) transmitters and, in the Quad Cities, ramp gates to control access to the I-74 Mississippi River Bridge. The public can view live streaming video via www.511ia.org.



Quad Cities tripGuide (above)
Iowa City camera view (below)

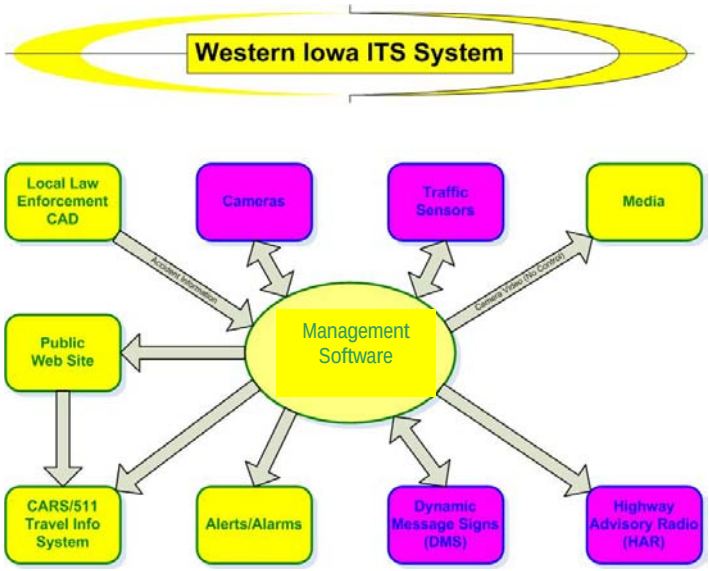
The Quad Cities *tripGuide* system (right) is focused on the I-74 corridor across the Mississippi River. This corridor from Bettendorf to Moline experiences significant delay frequently due to traffic incidents on the high volume, narrow twin suspension bridges.

The Iowa City network of 25 cameras and 27 sensors (right) will help address traffic needs anticipated during the reconstruction of Interstate 80, existing daily congestion on I-80 and I-380 and special event needs generated by University of Iowa athletic events.

Both the Iowa City and Quad Cities projects have been developed in close coordination with local law enforcement, emergency responders, and traffic officials. The project was funded jointly by the Iowa and Illinois Departments of Transportation.

A new project that is underway will be in the Cedar Rapids area. There is a current plan for the installation of 50 cameras in the next upcoming year.

Western Iowa ITS



The Western Iowa ITS Project has deployed ITS technology and systems in both the Council Bluffs and Sioux City metropolitan areas.

The technology deployed in these projects includes pan-tilt-zoom cameras, side-firing radar-type traffic sensors, dynamic message signs (DMS), and highway advisory radio (HAR) transmitters. The public will be able to view live streaming video via *511ia.org*.

The Council Bluffs system includes a series of 40 cameras and 52 sensors along I-29, I-80, U.S. 6 and U.S. 275. The Sioux City network consists of 27 cameras and 26 sensors on I-29, U.S. 20, Lewis Blvd and Gordon Drive. Each system also includes one HAR transmitter. As with similar systems, these projects have been developed in close coordination with local law enforcement, emergency responders, and traffic officials. The Quad Cities also have deployed 13 cameras and 18 sensors along I-74 and U.S. 67.

The goals of the systems are:

- Provide accurate and timely traffic information to the public.
- Provide traffic management tools to aid public officials in addressing traffic needs resulting from construction activities, incidents, special events, congestion, etc.

Statewide Dynamic Message Signs (DMS)

A statewide system of DMS has been developed to provide on-site just-in-time information to the traveling public. The system is designed for traffic management (primarily congestion mitigation) and for public safety (emergency operations, homeland security, amber alert, weather emergencies, etc.). DMS communications and messages will be coordinated with other states as well as with local governments and agencies. In actual practice, it functions as more than merely a statewide system. Operations are integrated with bordering cities and states such as Nebraska, South Dakota, and Illinois as well as metropolitan areas such as Omaha, Rock Island/ Moline, etc.

By 2012, Iowa DOT had 64 overhead and 51 side-mount DMS installed statewide. The signs are located primarily in urban areas on or near the interstate system. A DMS plan is prepared and reviewed annually and amended to maintain a five year outlook.

In addition to overhead and roadside DMS, Iowa DOT also maintains a system of small DMS in each of 37 highway rest areas.

Highway Advisory Radio

Highway Advisory Radio (HAR) provides traffic information to motorists along our highway system. Four low-power FM (LPFM) HAR sites in Iowa have been licensed and are operating on I-80 at DeSoto and Adair, on the I-29 corridor at Sloan, and on I-380 near Urbana. Information supplied to travelers includes information that is available through the CARS/511 system as well as local incidents and alerts.

Due to FCC restrictions on available frequencies, use of LPFM is not feasible in metropolitan areas. In Des Moines, the Iowa DOT is using the new generation of AM radio (SuperHAR) technology to reach greater numbers of motorists with real-time traffic information. The AM SuperHAR uses the same CARS/511 voice recognition technology and programming utilized in automating the LPFM HAR stations. Other SuperHAR locations are Quad Cities and Iowa City. HAR transmissions can be monitored at http://www.iowadot.gov/research/har_listen.htm.

Two portable HAR units can be placed anywhere in the state within a few hours to assist with disaster recovery, special events, major road closures, or construction projects.

Ia RTN SmartNet - Statewide Real Time Kinematic Global Positioning System Network

Ia RTN SmartNet is a statewide high precision global positioning referencing network. Activated in February 2009, the network consists of eighty Iowa DOT-owned and vendor-managed base stations that provides real-time positioning with instantaneous centimeter-level accuracy to support applications of survey, construction and mapping. The goal is to provide a system that will improve the efficiency and accuracy for all GPS users and meet or exceed the Iowa DOT's requirements relating to accuracy, precision, reliability, and scalability. Any authorized user, public or private sector, using a late-model, survey-grade, single- or dual-frequency rover equipped with a cellular modem or data-capable cell phone will receive near-instantaneous GPS satellite corrections anywhere in Iowa. The system uses DOT facilities for base stations, DOT communications network, and DOT servers and is accessible without charge to public and private users. For more information, see http://www.iowadot.gov/rtn/index.html.

Statewide ITS Management Software (SIMS)

Statewide ITS Management Software (SIMS) will provide an integrated software package enabling DOT personnel and partner agency(s) staff to control and configure existing and future deployments of ITS (Intelligent Transportation System) devices statewide. SIMS will interface with CARS, the Iowa DOT's 511 Traveler Information Service, to enable the delivery of real time traffic information to the general public. The SIMS project also involves the replacement of cameras in the Des Moines metro area.

Prior to the SIMS project, the Iowa DOT had installed three deployments of ITS networks across the state; Des Moines, Iowa City and the Quad Cities. The Western Iowa ITS project is also currently in the process of installing a fiber optic communications system to support the deployment of ITS devices (e.g., PTZ cameras, traffic sensors, wireless communications) in the Council Bluffs/Omaha and Sioux City metropolitan areas.

These ITS deployments have utilized stand-alone software packages, which require users to exit out of one deployment's software in order to control the devices in another metropolitan area. In 2009 the Iowa DOT opened a Statewide Emergency Operations Support Center (SEOP Center) in Ames. The Center had a need to utilize ITS devices throughout the state, highlighting the cumbersome nature of moving from one metro area to another. The Center was a driving force behind the development of the SIMS project.

Electronic Speed Limit Signs

Two electronic school zone speed limit signs were installed at United Community Elementary School near Boone, Iowa, to test for speed reduction impacts. The school is situated along U.S. 30, a rural four-lane divided expressway. Due to concerns about high speeds in the area, Iowa DOT replaced the original static school zone speed limit signs, which had flashing beacons during school start and dismissal times, with electronic speed signs that only display the school speed limit of 55 mph during school arrival and dismissal.

A speed evaluation of the area was conducted one week before, one month after, and seven months after the new signs were installed. Overall, the new school zone speed limit signs were more effective in reducing speeds than the original signs at both one month after as well as seven months after. The signs were effective for both directions of traffic and for both the school's start and dismissal periods. While an increase in speeds was seen when the signs were active for the eastbound direction seven months after the signs were installed, this increase was less than the increase in speeds seen in the overall (24 hour) period. The results of

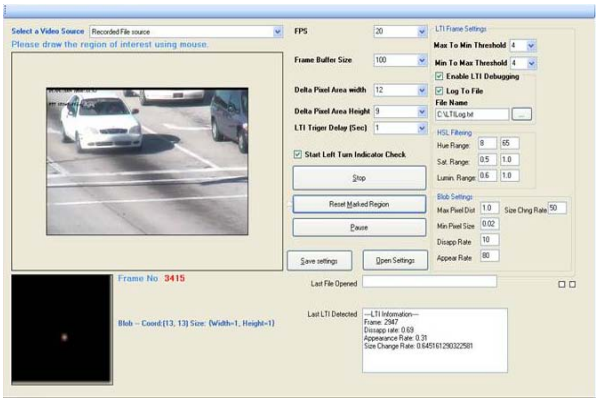
the data analysis showed that the signs seemed to have a more significant effect for westbound traffic than for eastbound. This difference may be due to the fact that the school is visible to westbound traffic when those vehicles encounter the sign, while the school is not similarly visible for eastbound traffic.

Sioux City Railroad Warning System

This system senses when a train is present and is blocking streets into downtown Sioux City, then relays information to a pair of Dynamic Message Signs on I-29 in advance of the affected interchanges. Both the frequency and length of trains in the Sioux City area have been increasing. This increase of rail traffic has an effect on the downtown Sioux City street system. Some of these local street blockages then impact the operation of I-29 mainline and ramps.

I-29 currently has four interchanges serving downtown Sioux City. The routes from two of these interchanges into downtown have at-grade railroad crossings (Hamilton Blvd. and Nebraska Street). The other two interchanges (Wesley Parkway and Floyd Blvd.) do not have at-grade crossing issues and can be used as alternate routes when trains are present.

Prototype Tool to Detect and Identify Left Turning Vehicles



Researchers are currently working with industry to use video detection to help detect left turning vehicles where no left turn lane exists. This could benefit safety in that cities could modify signal operations to give exclusive left turn indications when needed. The proposed device would take an analog video feed input, analyze a specified region to identify a vehicle with an activated left-turn signal and provide that information through a contact closure interface. In order to gauge accuracy, video could be recorded and compared to the vehicle log created by the detector.

Portable Closed Circuit TV (CCTV)

During the summer of 2008, Iowa DOT rented a portable CCTV unit in order to monitor the highway flooding in Eastern Iowa (see photo). This was so successful that DOT has now acquired six trailer-mounted solar powered video camera systems for monitoring traffic conditions on construction projects, special events, major road closures, disasters, and traffic studies.

Interstate Gate Closures

For better access and control of closing the Interstate system, DOT is conducting a pilot project using gates with remote controls to create hard closures. Three locations have been selected for gates, each of which has a history of closures. They are: Southbound I-35 at US 18, Northbound I-35 at US 30, and Northbound I-29 at US 30. Cameras will be used at each gate to monitor the closing period, give visual confirmation that the gates are down and not broken, and monitor traffic backups.

Intersection Warning Systems

A first of its kind in Iowa traffic-activated warning system was installed in Dyersville on US 20 and 7th Street on June 10th. There have been 6 fatalities in the last 9 years at this at-grade intersection. The system detects approaching traffic on US 20 and alerts drivers on the side-road by use of a sign with yellow flashers. These signs are designed to aid side road motorists by providing a warning when U.S. 20 traffic is approaching the intersection.

Many younger and older drivers have a difficult time identifying an approaching vehicle and its approaching speed when attempting to cross a four lane highway.

These new signs inform the motorists that a vehicle is approaching the intersection. Signs only assist motorists in making their driving decisions.

D. Primary Road Research

The Primary Road Research Fund receives $750,000 annually for contracted research, training, and project-specific research supplies or equipment. Primary Road Research projects in 2012 included the following.

InTrans Administration and Shared Faculty Support
Four shared research faculty positions are funded along with support for InTrans administration. These include Bridge Engineer, Materials Engineer, PCC Engineer, and Safety Engineer. For more information about InTrans and these positions, see Section IV of this report.

Nondestructive Bridge Deck Evaluation
Iowa DOT, like many other State DOTs, is faced with the need to identify and deploy means for rapid, nondestructive, and accurate condition assessment and performance monitoring of bridge decks. A series of bridge decks along I-80 in western Iowa were examined. All the decks are PC concrete decks with or without dense low-slump concrete overlay. The work concentrated on bridge deck evaluation by technologies such as ground penetrating radar (GPR) and impact echo (IE).

The data collected from nondestructive testing (NDT) of bridge decks should complement other information in understanding of its lifecycle costs, deterioration mechanisms, and the effectiveness of preservation techniques at various stages of the aging process, and most important, prevent premature and unexpected failure.

E. Technology Transfer

Newsletters http://www.iowadot.gov/operationsresearch/researchnews.aspx

The Bureau's newsletter contains current and timely research articles published quarterly to highlight recent transportation achievements for those looking for a bit more detail, description, and analysis of projects. Articles are written by Principal Investigators, collaborating researchers and key Iowa DOT personnel. Packed with photos and project information, notifications are emailed to an ever-growing recipient list when newsletters are

posted online. To have your name added to the notification list, e-mail your request to mary.starr@dot.iowa.gov .

Video http://www.iowadot.gov/research/video/videogallery.html

Users can now enjoy the convenience of watching to-the-point research videos online or on media-ready cell phones. A developing avenue for technical transfer, the Research Bureau's collection of informative videos is growing steadily, with a variety of new short films in production to educate and assist engineers and other transportation personnel on the latest developments.

Videos currently online:

- Teen Driver Studies
  - Use of Video in Teen Driving
  - Go Team Project
  - Implementing Breath Alcohol Interlock Devices
- Projects at Work
  - The Aurora Program
  - The Iowa River Bridge
  - One Design – 10,000 Bridges
  - Pavement markings and Safety Research
  - 2009 Transportation Research Projects at Work Making a Difference
  - Soil Stabilization Using Bio-Ethanol Byproducts
  - Development and Testing of Flexible (Multi-Blade) Snow Plows
  - Self-Cleaning Box Culvert
  - Non-Destructive Bridge Deck Evaluation
  - Intelligent Compaction (IC) Techniques for Quality Permanent Foundations
- Workshops and Conferences

Web site http://www.iowadot.gov/research/index.htm

Feedback on the Bureau's Web site indicates it has become a highly regarded centralized hub for transportation-related research information and news shared by Iowa with others throughout the United States and abroad. Implementing advanced applications found on the site can help accelerate construction time, save energy, resources, and lower repair and lifetime maintenance costs for many transportation projects and help contribute to lower injury and fatality rates.
The link to the Operations Research Web site and for the Iowa Highway Research Board is: (www.iowadot.gov/operationsresearch/default.html).

II. Other Research, Development, and Technology Transfer Activities

Additional research, development, and technology transfer activities are carried out in several other divisions and offices of the Department. *Attachment 4* shows the distribution of research funds throughout the Department.

A. Traffic & Safety Research

Shared Faculty Research Projects

The Traffic Safety Engineer (TSE) program associated with the Institute for Transportation (InTrans) at Iowa State University (ISU) provides traffic engineering support and research expertise. This includes support of the Office of Traffic and Safety in the development of project level and detailed work plans, support in professional and agency associations, conduct of research, support of special projects, and support in training. Sample duties include:

- Support DOT staff in developing policies and practices regarding deployment of centerline rumble strips
- Lead efforts on lane departure aspect of comprehensive Highway Safety Plan
- Develop standards and guidelines for interchange lighting
- Improving traffic flow though improved signal operations
- Support efforts to improve work zone safety

Traffic Safety Improvement Program (TSIP)

The Office of Traffic & Safety sponsors a variety of highway safety related research and demonstration projects each year. Although some safety projects are funded by IHRB or the SPR program, the primary funding source is the Iowa Traffic Safety Improvement Program (TSIP), which provides about $500,000 annually. TSIP projects can be safety studies, research, or public information initiatives. The Traffic Safety Fund, which funds the TSIP, is ½% of annual Iowa gas tax receipts. The FY12 awarded research projects are listed in *Attachment 6*. Because proposals are received in August, projects often don't get underway until the next fiscal year. Some projects underway in FY12 are described below.

Lane Departure Safety Countermeasures
Lane departure crashes are a significant percentage of the total number of crashes each year. Possible outcomes of lane departures are sideswipe or head-on crash. Objectives of this study are to identify strategies, policies, and practices adopted by other states to reduce lane departure crashes and update Iowa's Lane Departure Strategic Action Plan.

Wet Reflective Pavement Marking Demo
One of the leading complaints from drivers is the inability to see pavement markings under wet night conditions. Driving under such conditions is stressful and fatiguing for all drivers, but

particularly for elderly drivers. This project provides the opportunity to test the performance of wet reflective pavement marking materials and treatments and assess where these types of markings may be most effective in improving visibility and overall safety.

B. Maintenance Research

The Office of Maintenance conducts a variety of research projects, mostly around the topic of winter road management. The following testing and evaluation projects were conducted in the winter. These are internal efforts, managed and conducted by Department field maintenance personnel, generally without additional funding. Maintenance is also active in implementing new technology, particularly for road weather information.

Salt Use Management Dashboard

A new service under development in the Office of Maintenance might not quite qualify as a crystal ball, but the goal is to give highway maintenance supervisors a glimpse into what they can expect for salt use in the upcoming 48 hours. This tool is very similar to the salt dashboard supervisors are using this season, except that it is driven by forecast data, so it predicts how much salt can be expected to be used over the next 48 hours. While the salt dashboard is a performance measurement tool, the predictive dashboard gives crews an idea of what can be expected given the weather forecast over the next two days. The data driving dashboard is an hourly forecast for each county. The DOT wants the supervisors to have more flexibility, while the Iowa DOT will provide the information on what is coming and the supervisors can use that to plan accordingly.

The system is currently being tested and may be rolled out to the field later this winter. It is hoped that by the end of the season to include predictions for active hour and crew hours in this dashboard.

Winter Crash Analysis and Mitigation Project

Since 2006, the Iowa DOT has been working with the Institute for Transportation at Iowa State University to study the circumstances surrounding reportable crashes occurring in winter driving conditions on every mile of Iowa's interstate system. In the past few years, the data was expanded to all state-maintained highways. When the geometry or topography issues that cause blowing snow are identified, the job becomes finding mitigation strategies to reduce crashes in those areas. Last year three sites were chosen for further study, I-35 in the Williams/Dows area, I-29 near Sloan and I-80 east of Iowa City. This year the study has been expanded to include more than 10 sites to see if the causes of crashes can be pinpointed during the winter weather. Other mitigation strategies may be considered in this study depending on the crash characteristics of the sites. Modifications to snow fence, snow plow routes, road design, signage and others may be some of the options to resolve some of the issues.

C. Bridges & Structures Research

Shared Faculty Research Projects

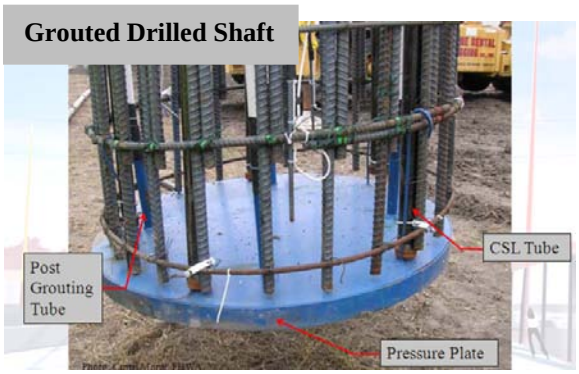
The Bridge Engineer (BE) program associated with the Institute for Transportation (InTrans) at Iowa State University (ISU) provides bridge engineering support and research expertise. This includes support of the Office of Bridges and Structures in the development and conduct of research, support of special projects and support in training. Current research projects conducted by the BE program include the following.

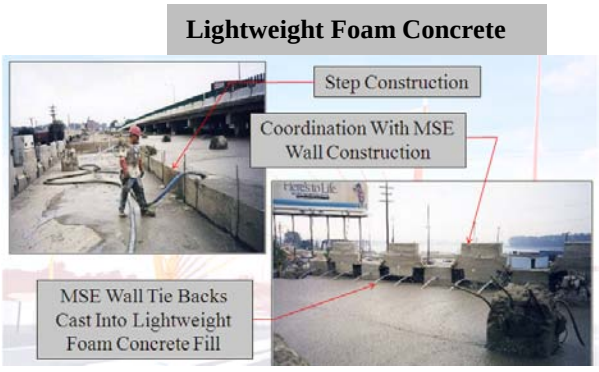
Load rating tests on bridges
The Office of Bridges and Structures at the Iowa Department of Transportation (Iowa DOT) is charged with evaluating and maintaining the primary bridge system. Conventional bridge rating processes are typically used for this process, but on occasion the Office uses diagnostic load testing procedures for the load rating, including super load permit vehicles. The Bridge Engineer program at Iowa State University provides the personnel to perform these tests and works directly with the Iowa DOT Rating Engineer. In addition, the load testing program provides support to other Office research associated with the structural performance of bridges constructed with advanced materials and for determining the effectiveness of strengthened bridges.

9th Street Bridge Monitor
This project involved monitoring and evaluation of a drilled shaft and integral abutment bridge on 9th Street in Des Moines. It includes instrumentation on several drilled shafts at both the north and south abutments.

Innovative Bridge Research and Deployment Program

Broadway/U.S. 6 Viaduct in Council Bluffs
The proposed innovations for this project will be the use of special foamed concrete as a lightweight fill material and base grouted drill shafts. Base grouting is used to develop/increase end bearing capacity as an economical alternative to bedrock supported drilled shafts.





D. Living Roadway Trust Fund Research

The Iowa Living Roadway Trust Fund (LRTF) is administered by the Office of Road Design. Recognizing the value of native plants in our roadsides, the Iowa Legislature established the LRTF program in 1988. Appropriations for the LRTF are allocated from the road use tax fund, the Resource Enhancement and Protection (REAP) fund, and other sources. This annual competitive grant program provides funding for integrated roadside vegetation management (IRVM) activities, including the preservation, establishment, and maintenance of native vegetation along Iowa's roadsides. Information about the program can be found at www.iowalivingroadway.com.

LRTF projects directly benefit Iowans in many ways, including the beautification of roadsides, the enhancement of children's education through the establishment of outdoor classrooms, and the improvement of water and air quality through the use of plant communities best adapted to, and sustainable along, our living roadways. The LRTF encourages the submission of proposals for research addressing aspects of integrated roadside vegetation management. The statewide research projects listed below were accepted for LRTF funding in 2012 totaling $11,186.

III. Transportation Research Board

The mission of the Transportation Research Board (TRB) is to promote innovation and progress in transportation through research. TRB is one of six major divisions of the National Research Council, a private institution administered by the National Academy of Science and National Academy of Engineering. Payment of TRB and NCHRP fees enables Iowa to participate in the selection of more than $30 million of transportation research each year, addressing every business area of the agency.

TRB provides an extensive range of services, including:

- Opportunities for information exchange on current transportation research and practice
- Management of cooperative research and other research programs
- Analyses of national transportation policy issues and guidance on federal and other research programs, and
- Publication and access to research information from around the world

Information exchange opportunities are provided through the annual TRB meeting, field visits by technical staff, conferences and workshops, and standing committees and task forces. There are over 200 committees composed of engineers, administrators, researchers and educators who identify research needs, review papers for presentation and publication, and encourage implementation of research findings.

TRB administers both the National Cooperative Highway Research Program (NCHRP) and the Strategic Highway Research Program (SHRP II). All state highway departments contribute annually to NCHRP research activities. Research priorities are set by AASHTO's Standing Committee on Research. Another program administered by TRB is Innovations Deserving Exploratory Analysis (IDEA) which encourages exploration of untested concepts with potential technological breakthroughs.

TRB committees with Iowa DOT participation:

- Concrete Bridges – Ahmad Abu-Hawash, member
- General Structures – Ahmad Abu-Hawash, member
- NCHRP Project Panel on Development of Rational Loading, Analysis, and Inspection Criteria for High Mast Lighting Towers, Ahmad Abu-Hawash, member
- NCHRP Project Panel on Precast Full Depth Deck Panel Concept – Possible Next Generation Solution – Ahmad Abu-Hawash, chair
- Committee on the Long-Term Stewardship of Safety Data from the Second Strategic Highway Research Program – John Adam, member
- NCHRP Project Panel on Research for AASHTO Standing Committee on Planning: Support for Improved Transportation Planning and Project Development – Stuart Anderson, member

- NCHRP Project Panel on Design Guidance for Interchange Loop Ramps – Kelly Christine Bell, member
- NCHRP Project Panel on Revision of the AASHTO Guide for the Development of Bicycle Facilities – Steven Bowman, member
- NCHRP Project Panel on Use of Bicycle Lanes for Various Roadway Characteristics – Steven Bowman, member
- Application of Emerging Technologies to Design and Construction – Mark Dunn, member
- Construction of Bridges and Structures – Mark Dunn, member
- Alternative Transportation Fuels and Technologies – Edward Engle, member
- Fabrication and Inspection of Metal Structures – Vanessa Goetz, member
- Low-Volume Roads – Vanessa Goetz, member
- Surface Transportation Weather – Tina Greenfield
- Winter Maintenance – Tina Greenfield, member
- Committee for the Tenth National Conference on Transportation Asset Management – Matthew Haubrich, member
- NCHRP Project Panel on Use of Cross Asset Optimization Results and the Impact on Performance Measures – Matthew Haubrich, member
- NCHRP Project Panel on Evaluation of Safety Strategies at Signalized Intersections – Troy Jerman, chair
- NCHRP Project Panel on Safety Evaluation for the 13 Controlling Criteria for Design – Troy Jerman, member
- NCHRP Project Panel on Developing a Methodology for Designing Low and Intermediate Speed Roadways that serve All Users – Yanxiao Jia
- Geographic Information Science and Applications – Peggi Knight, member
- Statewide Transportation Data and Information Systems – Peggi Knight, member
- General Structures – Sandra Larson, member
- Long-Term Bridge Performance (LTBP) Committee – Sandra Larson, member
- NCHRP Project Panel on IDEA (Innovations deserving Exploratory Analysis) – Sandra Larson, chair
- NCHRP Project Panel on Participation in European Road Association (ERA) ERA-NET Road Research Program – Sandra Larson, member
- Portland Cement Concrete Pavement Construction – Sandra Larson, member
- SHRP 2 Technical Expert Task Group for the Project on Nondestructive Testing to Identify Bridge Deck Deterioration (Project R06-A) – Sandra Larson, chair
- NCHRP Project Panel on Criteria for Restoration of Longitudinal Barriers: Phase II – David Little, member
- NCHRP Project Panel on Improvement of Procedures for the Safety-Performance Evaluation of Roadside Features – David Little, member
- NCHRP Project Panel on An Assessment of Geometric Design Policies and Processes – Deanna Lynn Mainfield, member
- NCHRP Project Panel on Bridge System Reliability for Redundancy – Norman McDonald, member
- Task Force on Understanding New Directions for the National Household Travel Survey – Phillip Mescher, member

- Census Transportation Planning Products Oversight Board – Phil Mescher, chair
- Urban Transportation Data and Information Systems – Phillip Mescher, member
- Hydrology, Hydraulics and Water Quality – Linda Narigon, member
- NCHRP Project Panel on Preconstruction Services Cost Estimating Guide – James Nelson, member
- Freight Rail Transportation – Tamara Nicholson, member
- NCHRP Project Panel on Structural Testing and Design Methodology for Single Column-Single Shaft Foundation Considering the Flexural Capacity of Steel Casing – Michael Nop, member
- NCHRP Project Panel on Development of Cost-Effective Treatments of Roadside Ditches to Reduce the Number and Severity of Roadside Crashes – Chris Poole, chair
- NCHRP Project Panel on Identification of Factors Related to Serious Injuries in Crashes of Motorcyclists into Traffic Barriers – Chris Poole, member
- NCHRP Project Panel on Performance of Longitudinal Barriers on Curves and Super-Elevated Roadway Sections – Chris Poole, member
- NCHRP Project Panel on Performance of Warm Mix Asphalt (WMA) Technologies – Scott Schram, member
- NCHRP Project Panel on Short-Term Laboratory Conditioning of Asphalt Mixtures – Scott Schram, member
- Committee for Intelligent Construction Systems and Technologies: Program Review – Melissa Serio, member
- ACRP Project Panel on Evaluating Methods for Counting Aircraft Operations at Non-Towered Airports – Kay Thede, member
- Committee on Implementing the Research Results from the Second Strategic Highway Research Program – Paul Trombino III, member
- Oversight Committee for the Strategic Highway Research Program 2 – Paul Trombino III, member
- Roadside Maintenance Operations – Joy Williams, member
- Mineral Aggregates – Robert Younie, member
- NCHRP Project Panel on Managing Rights-of-Way for Biomass Generation and/or Carbon Sequestration, Robert Younie, member
- Properties of Concrete – Robert Younie, member
- Surface Transportation Weather – Robert Younie, member
- NCHRP Best Practices in Privatization of Maintenance Functions – Bob Younie, member
- NCHRP Alternative Delivery Methods for Winter Operations – Bob Younie, member

IV. University Research Collaboration

A. Iowa Transportation Research Collaboration

The Iowa DOT has a collaboration agreement with The University of Iowa, Iowa State University, the University of Northern Iowa, and InTrans. The purpose of the collaboration is to facilitate transportation research to benefit the state of Iowa.

Semi-annual collaboration meetings are held to order priorities among groups, bring new ideas to the table, review needs, expertise, and facilities available. The group also collaborates on independent transportation research, looking for new ways to serve the state through regional and national research interests. Meeting sites rotate among member agencies, enabling participants to get to know each other's capabilities.

Many research projects come about as a result of focus groups comprised of DOT staff, city and county engineers, consultants, industry and university representatives. Focus groups are initiated by the DOT, based on types of work as outlined in the Iowa Transportation Research Collaboration Agreement. Focus group topics include pavement, construction, hydraulics, drainage, environment, geotechnical issues, and planning.

A page for information about the collaboration is included in the R&T Bureau's web pages (http://www.dot.state.ia.us/research/collaboration.htm). Researchers can visit the site to find the business plan, focus group information and a contact list developed to facilitate collaboration among researchers at different universities.

B. Institute for Transportation (InTrans)

The Institute for Transportation (InTrans) coordinates transportation research activities for Iowa State University. InTrans's mission is to develop and implement innovative methods, materials, and technologies for improving transportation efficiency, safety, and reliability while improving the learning environment of students, faculty, and staff in transportation-related fields.

InTrans's work with the Iowa DOT is structured with a three-year rolling Basic Agreement and Management Agreement, Annual Work Plans and individual research project addenda.
InTrans supports the work of Iowa DOT through a variety of activities, including:

- Conducting research
- Administering the Local Technical Assistance Program (LTAP)
- Continued development of a technician training program

- Support for pavement management and geographic information systems (GIS) development
- Statewide Urban Design & Specifications program (SUDAS)
- Support for remote sensing activities as part of the GIS program
- Statewide traffic safety database system.
- Conducting training, technology transfer workshops and conferences
- Leading focus groups

Each year the Iowa DOT and InTrans develop work plans for shared faculty in four major transportation research areas: structures, materials, PCC pavements, and traffic safety. These shared faculty provide the DOT with expertise in specialized technical areas. The bridge engineer conducts research projects and assists the Office of Bridges & Structures as needed. The materials engineer conducts research, provides training, and assists with special investigations, particularly with regard to hot mix asphalt. The PCC engineers conduct research projects, develop and execute the research program for the CP Tech Center and help the Center develop and execute training and technology transfer programs. The CP Tech Center develops concrete research in its testing and teaching laboratory and administers several Iowa-led pooled fund projects. The Traffic Safety Engineer provides traffic engineering support and research expertise for the Office of Traffic and Safety.

InTrans also supports the Iowa DOT through administration of the DOT Library. The librarian selects, catalogs and retains materials for the library, conducts literature searches for researchers, posts research activities to the Transportation Research Information System (TRIS) and Research in Progress (RIP) databases and represents Iowa in the Midwest Transportation Knowledge Network (MTKN).

Other ongoing research includes traffic and safety, winter operations, remote sensing and long-term transportation planning. More than 100 individual research contracts are structured as Addenda to the Management Agreement.

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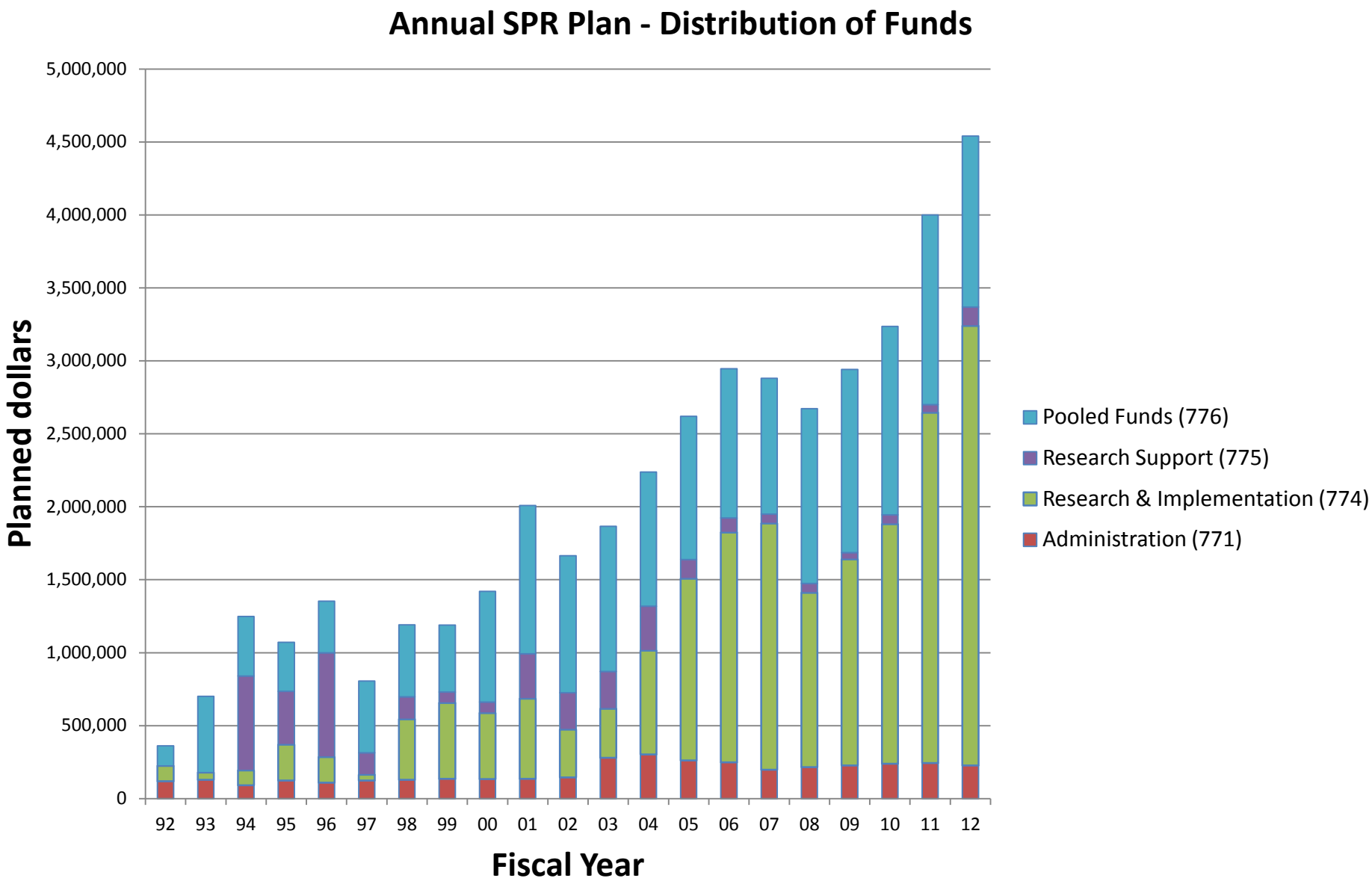
Annual SPR Plan - Distribution of Funds
Planned dollars
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4,000,000
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12
Fiscal Year
Pooled Funds (776)
Research Support (775)
Research & Implementation (774)
Administration (771)

Attachment 2

FY 2012 Research Work Program Summary				Rev #6- 02/18/13	
Administration - 771					
Project No.	**Project Title**	**FY 2012**	**Federal Funds**	**Iowa DOT Contact**	**No. Years**
	*Transportation Research Board	$105,905	$105,905	Larson	Annual
	DOT Library Support	$122,000	$97,600	Larson	Annual
	General Funds for Future Needs	$0	$0	Larson	Annual
Research Monitoring and Technical Support Total		**$227,905**	**$203,505**	--	--
Pooled Fund Studies - 776					
Project No.	**Project Title (Bold = Iowa Led)**	**FY 2012**	**Federal Funds**	**Iowa DOT Contact**	**No. Years**
TPF-5(412)	NCHRP	$532,602	$532,602	Larson	Annual
SPR-3(042)	**Aurora Program**	$25,000	$25,000	Greenfield	5+
SPR-3(079)	**Report (CARS)**	$0	$0	Stolle	Annual
TPF-5(009)	**SICOP (Computer-Based Training System on AI/RWIS)**	$4,000	$4,000	A. Dunn	Annual
TPF-5(021)	Base Funding for the North Central Superpave Center	$0	$0	Schram	
TPF-5(035)	Pacific Northwest Snowfighters	$0	$0	A. Dunn	
TPF-5(036)	Transportation Asset Management Research Program	$0	$0	Narigon	
TPF-5(048)	Midwest States Accelerated Testing	$0	$0	M. Dunn	
TPF-5(054)	Development of Maintenance Decision Support System	$0	$0	A. Dunn	
TPF-5(065)	Traffic Control Device Consortium	$20,000	$20,000	Crouch	Annual
TPF-5(081)	**Smart Work Zone Deployment Initiative**	$45,000	$45,000	Sprengeler	5+
TPF-5(099)	Evaluation of Low Cost Safety Improvements	$30,000	$30,000	Vortherms	Annual
TPF-5(100)	**Deicer Scaling Resistance of Concrete Pavements, Bridge Decks and Other Structures Containing Slag Cement**	$25,000	$25,000	Hanson	2
TPF-5(117)	**Development of Performance Properties of Ternary Mixes**	$0	$0	Hanson	5+
TPF-5(120)	Deer Vehicle Crash Information and Research (DVCIR) Center	$0	$0	Vortherms	
TPF-5(132)	Low Temp Cracking of Asphalt Pavement - Phase 2	$5,000	$5,000	Schram	1
TPF-5(139)	**PCC Surface Characteristics - Part 3**	$0	$0	Hanson	5
TPF-5(148)	The Effects of Implements of Husbandry "Farm Equipment" on Pavement Performance	$0	$0	Goetz	
TPF-5(156)	Mississippi Valley Freight Coalition (Pd w/Part 1 funds)	$0	$0	O'Riley	Annual
TPF-5(159)	**Technology Transfer Concrete Consortium (TTCC)**	$7,000	$7,000	Merryman	1

TPF-5(165)	Development of Design Guide for Thin and Ultrathin Concrete Overlays of Existing Asphalt Pavements	$12,500	$12,500	Brakke	1
TPF-5(169)	**Integral Abutments on Moderately Curved Girder Bridges**	$0	$0	Abu-Hawash	2
TPF-5(179)	Evaluation of Test Methods for Permeability (Transport) and Development of Performance Guidelines for Durability	$0	$0	Hanson	
TPF-5(183)	**Improving the Foundation Layers for Concrete Pavements**	$35,000	$35,000	Larson	1
TPF-5(185)	CP Road Map Operations Support	$0	$0	Hanson	
TPF-5(187)	Updating U.S. Precipitation Frequency Estimates for the Midwestern Region	$0	$0	Claman	
TPF-5(189)	Enhancement of Welded Steel Bridge Girders Susceptible to Distortion-Induced Fatigue	$0	$0	Abu-Hawash	
TPF-5(193)	Midwest States Crash Test Program was SPR-3(017)	$65,000	$65,000	Maifield	Annual
TPF-5(202)	HY-8 Culvert Analysis Program - Phase Three of Development Efforts	$0	$0	Claman	
TPF-5(205)	**Mix and Design Analysis**	$0	$0	Hanson	1
TPF-5(207)	**Novice (School Age) Drivers - Million Mile Study**	$20,000	$20,000	Snook	1
TPF-5(209)	Transportation Curriculum Coordination Council (TCCC) was TPF-5(046)	$25,000	$25,000	C. Anderson	Annual
TPF-5(213)	Performance of Recycled Asphalt Shingles in Hot Mix Asphalt	$0	$0	Schram	
TPF-5(215)	Transportation Engineering and Road Research Alliance (TERRA)	$7,500	$7,500	M. Dunn	1
TPF-5(217)	Ultra-High Performance Concrete Deck Joint Testing	$0	$0	Abu-Hawash	
TPF-5(218)	Clear Roads was TPF-5(092)	$25,000	$25,000	Greenfield	Annual
TPF-5(219)	**Structural Health Monitoring**	$50,000	$50,000	Abu Hawash	4
TPF-5(220)	Accommodating Oversize/Overweight Vehicles at Roundabouts	$0	$0	Vortherms	
TPF-5(221)	Accelerated Bridge Construction (ABC) Decision Making and Economic Modeling Tool	$0	$0	Abu-Hawash	
TPF-5(224)	**Joint Deterioration in Concrete Pavements**	$15,000	$15,000	Hanson	1
TPF-5(226)	Instrumentation to Aid in Steel Bridge Fabrication	$0	$0	Abu-Hawash	
TPF-5(231)	Enterprise (IVHS Study) was SPR-3(020)	$30,000	$30,000	Stolle	Annual
TPF-5(232)	**Impacts of Implements of Husbandry on Bridges**	$0	$0	M. Dunn	5
TPF-5(233)	**Tech Transfer Intelligent Compaction Consortium (TTICC)**	$9,000	$9,000	M. Dunn	4
TPF-5(237)	Transportation Library Connectivity & Development was TPF -5(105)	$5,000	$5,000	Zalatel	Annual
TPF-5(238) Solicitation 1257	Design and Fabrication Standards to Eliminate Fracture Critical Concerns in Two Girder Bridge Systems	$20,000	$20,000	McDonald	2
TPF-5(239)	Acceleration Maintenance Innovation Implementation and Tech Transfer (No Boundaries Roadway Maintenance Practices)	$12,000	$12,000	M. Dunn	2
TPF-5(243) Solicitation 1300	Motorcycle Crash Causation Study	$15,000	$15,000	Vortherms	3

TPF-5(245)	2012 Multi-State Asset Management Implementation Workshop	$10,000	$10,000	Haubrich	1
TPF-5(247) Solicitation 1291	Field Testing Hand-held Thermo-graphic Inspection Technologies Phase II	$30,000	$30,000	Port	2
TPF-5(253) Solicitation 1290	Member-Level Redundancy in Built-Up Steel Members	$25,000	$25,000	Abu-Hawash	3
TPF-5(254) Solicitation 1264	Bulb-T Beam as Alternate ABC to Side-By-Side Box-Beam	$15,000	$15,000	Abu-Hawash	4
TPF-5(260), was sol.1280	Next-Generation Transportation Construction Management	$25,000	$25,000	Smythe	3
TPF-5(262) Solicitation 1293	Evaluation of Sign Guide Fonts	$15,000	$15,000	Crouch	2
TPF-5(269) Solicitation 1309	Development of an Improved Design Guide for Unbonded Concrete Overlays	$20,000	$20,000	C. Brakke	3
TPF-5(266) Solicitation 1316	Surface-Water Model System (SMS)	$10,000	$10,000	Claman	1
	General Funds for Future Pooled Fund Projects	$0	$0	Larson	
Pooled Fund Studies Total		**$1,189,602**	**$1,189,602**	--	--
Technology Transfer - 774					
Project No.	**Project Title**	**FY 2012**	**Federal Funds**	**Iowa DOT Contact**	**No. Years**
	Basic Agreement with InTrans	$240,000	$192,000	Larson	Annual
	*AASHTO - NTPEP (Product Evaluation)	$7,500	$7,500	Berger	Annual
	*AASHTO - APEL (Approved Product Evaluation List)	$1,200	$1,200	Dunn	Annual
	*AASHTO - Technology Implementation Group	$6,000	$6,000	Larson	Annual
	*AASHTO - TSP2	$20,000	$20,000	Todey	Annual
	*AASHTO - LRFD Specification Maintenance	$10,000	$10,000	McDonald	Annual
	*AASHTO - Environmental Technical Assistance Program	$8,000	$8,000	Rost	Annual
	Remote Sensing Support	$10,000	$8,000	Samson	Annual
	Geotechnical Support	$50,000	$40,000	M. Dunn	Annual
	Information Technology Development	$170,000	$136,000	Peperkorn	2
	Pavement Marking Management System	$25,000	$20,000	Crouch	5+
	Bridge Construction Web Management	$20,000	$16,000	Nelson	1
	Intelligent Compaction Field Pilot	$50,000	$40,000	M. Dunn	1
	Bridge Deck Epoxy Injection Process	$40,000	$32,000	M. Dunn	7
	Mass Concrete for Bridge Foundations	$50,000	$40,000	Nelson	1
	Entrance Loss Coefficients for Culvert Designs	$130,439	$104,351	Claman	1

	LRFD Design of Drilled Shafts	$50,000	$40,000	Abu-Hawash	2
	Instrumentation and Monitoring of Accelerated Bridge Construction	$50,000	$40,000	Abu-Hawash	1
	Improving the Accuracy and Usability of Iowa Falling Weight Deflectometer Data	$109,991	$87,993	Omundson	1
	Need for Washing Weathering Steel Bridges	$20,000	$16,000	Abu-Hawash	1
	New Items this Fiscal Year				
	Salinity Sensors for Plows	$15,000	$12,000	A. Dunn	1
	Backing Warning Sensors for Tow Plows	$10,000	$8,000	A. Dunn	1
	Limited Visibility Heads-Up Display for Blizzard Conditions	$50,000	$40,000	A. Dunn	1
	Wireless Plow Blade Position Sensors	$7,000	$5,600	A. Dunn	1
	[1] Multiple Blade Under Body Snow Plow	$75,000	$60,000	A. Dunn	1
	Sign Management Systems	$15,000	$12,000	Crouch	1
	IC HMA Lab Testing	$15,000	$12,000	Schram	1
	Maintenance Asset Management Phase-II	$50,000	$40,000	Blaesing	1
	Precast Concrete Box Culvert Survey and Recommendations	$0	$0	Abu-Hawash	1
	[2]Statewide ABC Constructability Review	$70,000	$56,000	Abu-Hawash	1
	[1]Alternative Bridge Deck Overlay Options for Iowa	$80,000	$64,000	Abu-Hawash	1
	Feasibility Study for Detection and Quantification of Corrosion in Bridge Barrier Rails	$89,416	$71,533	Abu-Hawash	1
	Western Iowa Missouri River Flooding - Geo-Infrastructure Damage Assessment, Repair and Mitigation Strategies, and Solutions Manual	$50,000	$40,000	M. Dunn	1
	Highlighting Iowa DOT's Use and Implementation of Innovation	$16,000	$12,800	L. Narigon	1
	Evaluation of Flame Hardened Treatment of Ice Blades	$11,000	$8,800	J. Dowd	1
	Diagnostic Tools for Identifying sleepy Drivers - Phase 2	$53,646	$42,917	D. Lorenzen	1
	Establishing Methods and Procedures for Measuring Water Clarity and Turbidity of Stormwater Runoff from Active Highway Construction Sites	$50,000	$40,000	Serio	2
	School Bus Safety Study	$60,000	$48,000	Gent	1
	State Research Program - IHRB	$1,000,000	$800,000	Larson	2
	Deer Collision Website Update	$15,000	$12,000	Gent	1
	Assessing Applicability of International Safety Countermeasures for Rural Road	$30,000	$24,000	V. Goetz	1
	Reoccurring Items				
	Technical Training & Conference Plan	$180,000	$144,000	Larson	5+
	Research Implementation	$0	$0	Larson	5+
	General Funds for Future Projects	$1,133	$906	Larson	
Technology Transfer Total		**$3,011,325**	**$2,419,600**	--	--

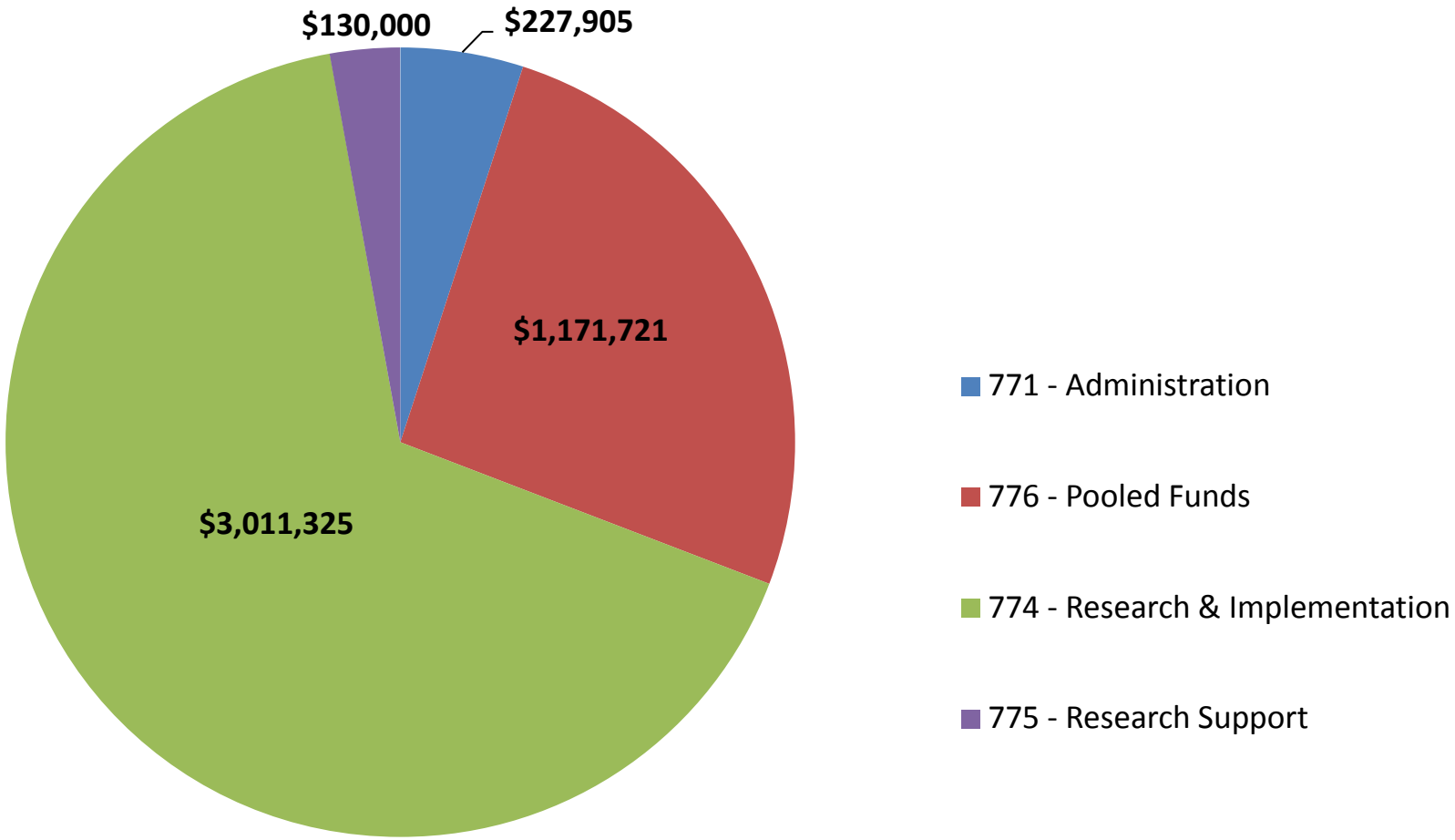
	* Items with 100% Federal Share				
Highway Research Support - 775					
	RapidAir 457 System	$55,000	$44,000	Jones/Hanson	1
	Thermal Imaging Camera	$25,000	$20,000	Todsen	1
	Phased Array Ultrasonic Flaw Detector	$40,000	$32,000	Todsen	1
	GeoGauge for Cold-in-Place Recycling	$10,000	$8,000	Schram	1
	General Funds for Future Projects	$0	$0	Larson	
Highway Research Support Total		**$130,000**	**$104,000**	--	--
RD&TT Grand Total		**$4,558,832**	**$3,916,707**	--	--
FY12 SPR ½ % Apportionment			$2,420,917		
75% of TRB and NCHRP (From Part I Planning Funds)			$478,880		
State Research Program (From Part I Planning Funds)			$800,000		
	SUBTOTAL FY12 SPR Funds for Research		**$3,699,797**		
Unobligated Funds from Prior Years*			$216,910		
Total Research SPR Funds*			**$3,916,707**		

*The unobligated fund estimate is a preliminary determination, we expect to discover and document additional unobligated funds as we continue to evaluate and close out projects.

[1]This was later voided in FY13 prior to this report being finalized. Funds reclaimed in FY 2012

[2]This was later voided in FY13 prior to this report being finalized. Funds reclaimed in FY 2013 revision plan 2

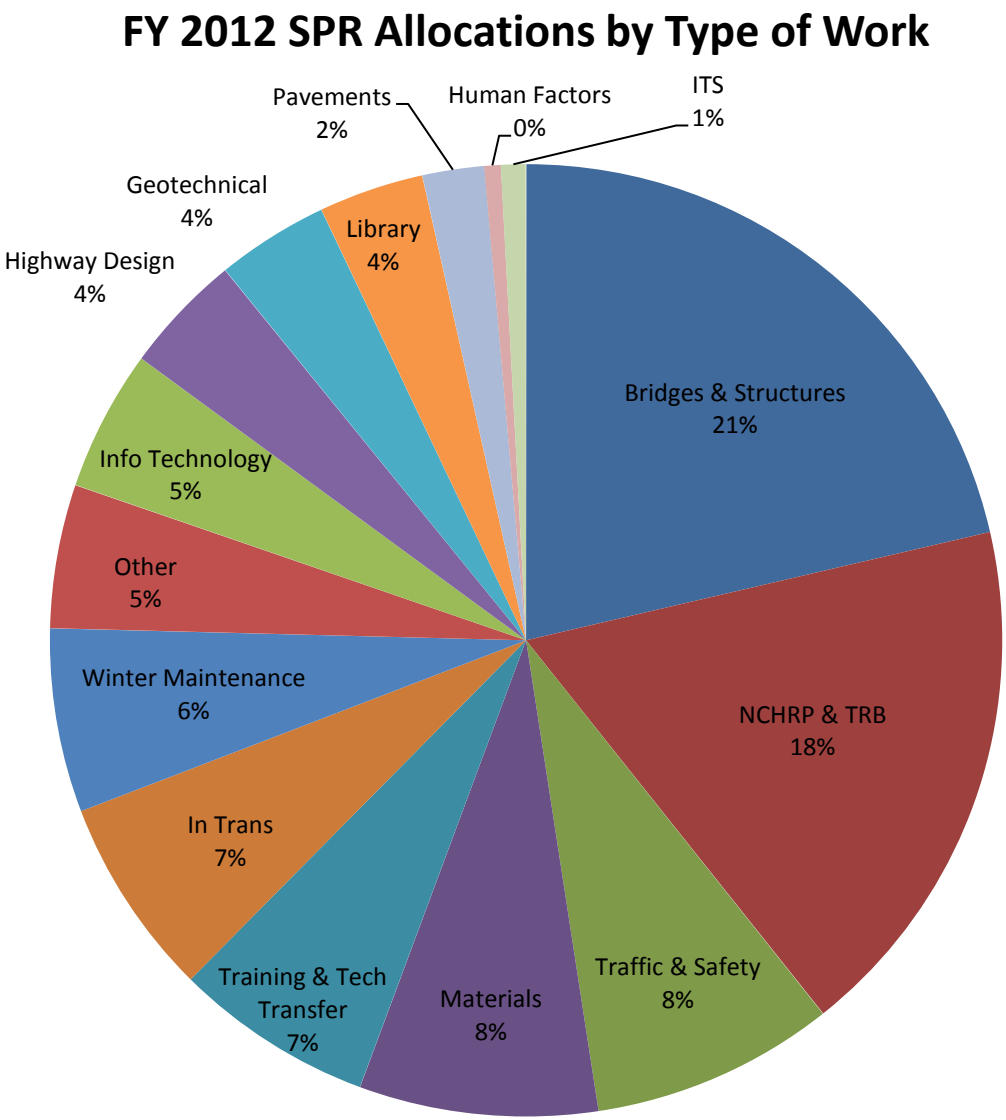
FY 2012 SPR Work Program by Category



Attachment 4

FY 2012 SPR Allocations by Type of Work

	FY 12 $	% $	Project #	% #	FY 11 $
IHRB	$ 1,001,133	22	2	3	$ 3,900
Bridges & Structures	$ 759,855	17	17	21	$ 1,040,000
NCHRP & TRB	$ 638,507	14	2	3	$ 654,098
Traffic & Safety	$ 293,646	6	10	13	$ 383,533
Materials	$ 288,691	6	10	13	$ 90,300
Training & Tech Transfer	$ 240,000	5	4	5	$ 285,000
In Trans	$ 240,000	5	1	1	$ 240,000
Winter Maintenance	$ 222,000	5	9	11	$ 385,067
Other	$ 173,500	4	8	10	$ 138,999
Info Technology	$ 170,000	4	1	1	$ 170,000
Highway Design	$ 145,000	3	3	4	$ 168,275
Geotechnical	$ 135,000	3	3	4	$ 135,000
Library	$ 127,000	3	2	3	$ 127,000
Pavements	$ 74,500	2	6	8	$ 64,000
Human Factors	$ 20,000	0	1	1	$ 85,000
ITS	$ 30,000	1	1	1	$ 30,000
	$ 4,558,832	**100**	**80**	**100**	**$ 4,000,172**


FY 2012 SPR Allocations by Type of Work
Pavements 2%
Human Factors 0%
ITS 1%
Geotechnical 4%
Library 4%
Highway Design 4%
Bridges & Structures 21%
Info Technology 5%
Other 5%
Winter Maintenance 6%
NCHRP & TRB 18%
In Trans 7%
Training & Tech Transfer 7%
Materials 8%
Traffic & Safety 8%

FY 2012 Traffic Safety Improvement Program
Research Projects

Title	Amount
Traffic Safety Liaison Program	55,000
Safety Circuit Rider Support	20,000
Comprehensive Highway Safety Plan Implementation	70,000
Traffic and Safety Engineering Forum, Training and Peer Exchange	20,000
NADS Motorcycle Conspicity	50,000
Low-Cost Treatment on Curves - Phase II	20,000
Iowa Traffic Safety Alliance "Changing the Culture" Younger Drivers	30,000
Intersection Magic/Diagram Magic Statewide License Renewal	15,000
Iowa Traffic Safety Data Service (ITSDS)	15,000
Training Materials for Work Zone Traffic Control	45,000
Purchase 2009 MUTCD for DOT, Cities & Counties	92,000
Visualization of Innovative Traffic Safety Applications using InTrans Minisim Driver Simulator	35,000
The Impact of Roadway Characteristics on Safety Improvement Prioitization	25,000
Oversize Loads & Roundabouts	25,000
Total	**517,000**

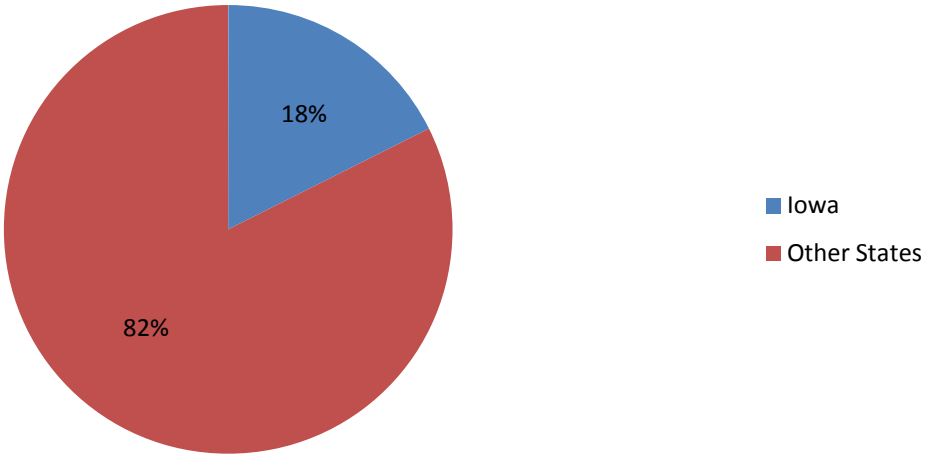
2012 In-State Technical Training Requests Rev #8 6/2013 Attachment to FY 12 State Planning & Research Plan						
Requester	**Course Name**	**# Att**	**@ Cost**	**Class Cost**	**Room**	**Total**
NHI Courses						
Todsen	Fracture Critical Inspection Techniques for Steel Bridges #130078	6	880	5,280	0	5,280
Todsen	Safety inspection of in-service bridges #130055	5	1,800	9,000	0	9,000
Todsen	Engineering Concepts for Bridge Inspectors #130054	4	0	No Cost	0	0
Neubauer	Bridge Inspection Refresher Training #130053	2	775	1,550	0	1,550
Maifield	Value Engineering #134005B (two 4-day classes)	26	600	15,600	0	15,600
Vortherms	Highway Safety Manual (Assume 3 of the 5 modules; up to 4 days)	0	1,000	0	0	0
Mescher	Transportation Asset Management #131106A	34	350	11,900	665	12,565
V.Goetz	Leap not Creep #134073 (Highways for Life funded the course. Meals only)	25	0	0	1,135	1,135
Purcell	LTAP: Transportation Asset Management #131106A	34	LS	5,921	0	5,921
				Total NHI		**51,051**
Non – NHI Courses						
Schram	Advanced Mix Design of HMA 3 days	4	545	2,180	0	2,180
Schram	Intermediate Mix Design of HMA (Jan 8, 2013)	1	545	545	0	545
Maifield	Geometric Design Workshop	30	LS	14,800	7,556	22,356
Simodynes	Roundabout Design 1 (2 trainers for 2 days)	12		1,384	0	1,384
Samson	Quick Terrain Modeler	30		1,995	0	1,995
Todsen	40 hr Ultrasonic Testing (UT) Level 1 Course	5	LS	6,577	0	6,577
Todsen	40 hr Ultrasonic Testing (UT) Level 2 Course	3	LS	6,577	0	6,577
				Total Non-NHI		**41,613**

Total Cost of In-State Training	**92,665**

Total Cost of Requested Training & Conferences	**99,312**

FY 2012 Committed Research Funds Leveraged Through Iowa-Led Pooled Fund Projects

Project #	Pooled Fund	Iowa	Other States	Total	% Iowa
SPR-3(042)	Aurora	$ 25,000	$ 326,064	$ 351,064	7
TPF-5(009)	SICOP (Computer-Based Training System on AI/RWIS)	$ 4,000	$ 40,000	$ 44,000	9
TPF-5(081)	Smart Work Zone	$ 45,000	$ 100,000	$ 145,000	31
TPF-5(100)	Deicer Scaling of Slag Cement Products	$ 25,000	$ -	$ -	100
TPF-5(159)	TTCC	$ 7,000	$ 124,500	$ 131,500	5
TPF-5(183)	Foundations for Concrete Pvmt	$ 35,000	$ 105,000	$ 140,000	25
TPF-5(207)	Novice Drivers	$ 20,000	$ 25,000	$ 45,000	44
TPF-5(219)	Structural Health Monitoring	$ 50,000	$ 220,000	$ 270,000	19
TPF-5(224)	Joint Deterioration	$ 15,000	$ 90,309	$ 105,309	14
TPF-5(233)	Tech Transfer Intelligent Compaction	$ 9,000	$ 69,000	$ 78,000	12
	Total	$235,000	$1,099,873	$1,309,873	18



Iowa Department of Transportation

ANNUAL REPORT
of
Iowa Highway Research Board
Research and Development Activities
FY 2012

Attachment to
FY 2012 Annual Report
Research, Intelligent Transportation Systems, and
Technology Transfer Activities

IHRB
IOWA HIGHWAY
RESEARCH BOARD

DECEMBER 2012

ANNUAL REPORT
OF
IOWA HIGHWAY RESEARCH BOARD
RESEARCH AND DEVELOPMENT ACTIVITIES

FOR THE
FISCAL YEAR ENDING JUNE 30, 2012

OFFICE OF RESEARCH AND ANALYTICS
OPERATIONS RESEARCH
(515) 239-1447
www.iowadot.gov/operationsresearch

PERFORMANCE AND TECHNOLOGY DIVISION
IOWA DEPARTMENT OF TRANSPORTATION
AMES, IOWA 50010

DECEMBER 2012

TABLE OF CONTENTS

LIST OF ACRONYMS

AASHTO - American Association of State Highway and
APWA - American Public Works Association
ASCE - American Society of Civil Engineers
DOT - Department of Transportation
FHWA - Federal Highway Administration
GIS - Geographic Information System
HMA - Hot Mix Asphalt
HPC – High Performance Concrete
IHRB - Iowa Highway Research Board
ISU - Iowa State University
LiDAR – Light Detection and Ranging
LRFD - Load and Resistance Factor Design
LTAP - Local Technical Assistance Program
LVR - Low Volume Road
MOVITE - Missouri Valley Section of the Institute of Transportation Engineers
NCHRP - National Cooperative Highway Research Program
SUDAS - Statewide Urban Designs and Specifications
TAC - Technical Advisory Committee
TRB - Transportation Research Board
UHPC - Ultra High Performance Concrete
USGS - United States Geological Survey
WMA – Warm Mix Asphalt

RESEARCH AND DEVELOPMENT

The Iowa DOT engages in research and development for two reasons: first, to find workable solutions to the many problems that require more than ordinary, routine investigation; and second, to identify and implement improved engineering and management practices.

This report, entitled "Iowa Highway Research Board Research and Development Activities FY2012" is submitted in compliance with Sections 310.36 and 312.3A, Code of Iowa, which direct the submission of a report of the Secondary Road Research Fund and the Street Research Fund, respectively. It is a report of the status of research and development projects in progress on June 30, 2012. It is also a report on projects completed during the fiscal year beginning July 1, 2011 and ending June 30, 2012. Detailed information on each of the research and development projects mentioned in this report is available from the Office of Research and Analytics, Performance and Technology Division, Iowa Department of Transportation. All approved reports are also online for viewing at: **www.iowadot.gov/operationsresearch/reports.aspx**.

THE IOWA HIGHWAY RESEARCH BOARD

In developing a progressive, continuing and coordinated program of research and development, the Iowa DOT is assisted by the IHRB. This advisory group was established in 1949 by the Iowa State Highway Commission to respond to the research denoted in Sections 310.36 and 312.3A of the Code of Iowa.

The Research Board consists of 15 regular members: seven Iowa county engineers, four Iowa DOT engineers, one representative from Iowa State University, one from The University of Iowa, and two engineers employed by Iowa municipalities. Each regular member may have an alternate who will serve at the request of the regular member. The regular members and their alternates are appointed for a three year term. The membership of the Research Board as of June 30, 2012, is listed in Table I.

The Research Board held eight regular meetings during the period from July 1, 2011, through June 30, 2012. Suggestions for research and development were reviewed at these meetings and recommendations were made by the Board.

IHRB
IOWA HIGHWAY
RESEARCH BOARD

Members of the IHRB are serious about the future of transportation. Understanding that every research project has the potential to strengthen the infrastructure, save lives, time and precious resources, they work hard to make sure new methods, technologies and materials are developed efficiently and economically for application in the real world. **The IHRB has received national attention as a leader in transportation research implementation.**

2012 IOWA HIGHWAY RESEARCH BOARD

Member	Term Expires	Alternate
Ahmad Abu-Hawash, Vice Chair Chief Structural Engineer Iowa DOT - Bridges and Structures 800 Lincoln Way Ames, IA 50010 (515) 239-1393 Email: ahmad.abu-hawash@dot.iowa.gov	12-31-12	Deanna Maifield Methods Engineer Iowa DOT – Office of Design 800 Lincoln Way Ames, IA 50010 (515) 239-1402 Email: Deanna.Maifield@dot.iowa.gov
James Berger Director of Materials Iowa DOT 800 Lincoln Way Ames, IA 50010 (515) 239-1843 Email: james.berger@dot.iowa.gov	12-31-12	Kevin Jones Materials Testing Engineer Iowa DOT 800 Lincoln Way Ames, IA 50010 (515) 239-1237 Email: Kevin.Jones@dot.iowa.gov
Vicki Dumdei District 2 Engineer Iowa DOT 1420 Fourth St. S.E. Mason City, IA 50401-4438 (641) 422-9465 Email:Victoria.Dumdei@dot.iowa.gov	12-31-13	David Little Assistant District 2 Engineer Iowa DOT 1420 Fourth St. S.E. Mason City, IA 50401-4438 (641) 422-9464 Email: david.Little@dot.iowa.gov
Robert Younie Director of Maintenance Iowa DOT 800 Lincoln Way Ames, IA 50010 (515) 239-1589 Email: bob.younie@dot.iowa.gov	12-31-14	Tim Simodynes ITS Engineer Iowa DOT - Research & Technology 800 Lincoln Way Ames, IA 50010 (515) 239-1606 Email: Tim.Simodynes@dot.iowa.gov
Jeff May Public Works Director 305 S. 3rd Knoxville, Iowa 50138 (641) 828-0550 Email: knoxvillepwd@cityofknoxville.us	12-31-14	Dan Whitlow City Engineer 1225 6th Avenue – Suite 200 Marion, Iowa 52302 (319) 713-6340 Email: dwhitlow@cityofmarion.org
Ronald Knoche, Chair City Engineer 410 E. Washington Street Iowa City, IA 52240-1825 (319) 356-5138 Email: ron-knoche@iowa-city.org	12-31-12	Bruce Braun Street Maintenance Administrator 216 SE 5th Street Des Moines, IA 50309 (515) 237-1371 Email: babraun@dmgov.org
Douglas Schnoebelen The University of Iowa – IIHR 323A SHL 300 South Riverside Drive Iowa City, Iowa 52242-1585 (319) 335-6061 Email: douglas-schnoebelen@uiowa.edu	----------	

Wade Weiss
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Boone County Engineers Office
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12-31-13
District 2

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12-31-14
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12-31-13
District 5

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Louisa County Engineer
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12-31-12
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Iowa State University
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RESEARCH AND DEVELOPMENT PROJECTS

Proposals for research and development are reviewed by the Iowa Highway Research Board. The Board's recommendations are transmitted to the director of the Performance and Technology Division of the Iowa Department of Transportation. Expenditure of research and development funds is then authorized on an individual project basis.

These expenditures may be charged to the Primary Road Research Fund, Secondary Road Research Fund or the Street Research Fund, depending on which road system will benefit from the project. If more than one jurisdiction's roads share in benefits, the costs are shared.

Table II is a record of expenditures for research and development made during the fiscal year ending June 30, 2012. Total expenditure was $2,088,802.08.

IN-HOUSE RESEARCH AND DEVELOPMENT

Research and development projects performed by Iowa DOT personnel are termed "in-house" projects. These projects may involve other departmental and field personnel in addition to personnel from The Office of Research and Analytics, Operations Research Section. In many instances, personnel from other offices are designated as a project principal investigator, which means that they have a major role in the planning, performance and analysis of the research.

Contract research funds may be used for material and equipment costs for in-house research, but cannot be used for salary or personal expenses of the participating personnel. Consequently, the contract amounts for in-house projects are relatively small. The Office of Research and Analytics, Operations Research Section, wishes to express its appreciation to other offices for their assistance.

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

The NCHRP was organized by the American Association of State Highway Officials (now the American Association of State Highway and Transportation Officials—AASHTO). The program is administered by the TRB, a branch of the National Academy of Sciences.

The purpose of NCHRP is to provide the funds and direction for research in highway matters of national concern. The program is funded annually by all fifty states in an amount equal to 5.5% of the federal aid allocated to the states for statewide planning and research (SPR). Iowa's obligation and actual expenditure for NCHRP varies and may be influenced by billing practices.

SECONDARY ROAD TRAFFIC COUNT PROGRAM

Secondary road traffic counts are conducted annually and funded from the Secondary Road Research Fund as Non Contract Engineering Studies. The Office of Transportation Data conducted traffic counts in 25 counties during fiscal year 2012 as part of the Annual Traffic Count Program. This activity consisted of 5400 portable recorder classification counts and 100 portable recorder volume counts. Traffic volumes from these counts are used to develop Motor Vehicle Traffic Flow Maps for each county showing the Annual Average Daily Traffic (AADT) on specific road sections within each county.

Secondary roads geometrics and current condition inventories were requested from all 99 counties and 92 of those submitted information. This data provides county engineers, highway engineers, planners and administrators with essential information needed to determine design standards, to systematically classify highways, and to develop programs for improvement in maintenance of secondary roads.

SECONDARY ROAD RESEARCH FUND

Section 310.34 of the Iowa Code authorizes the Iowa Department of Transportation to set aside each year an amount not to exceed 1½% of the receipts to the Farm-to-Market Fund in a fund to be known as the Secondary Road Research Fund. This authorization was first made in 1949; it was repealed in 1963, and reinstated in 1965. When the fund was reinstated, the fund was designated to finance engineering studies and research projects. The Iowa Department of Transportation accounting procedure for the Secondary Road Research Fund is based on obligations for expenditures on research projects and not the actual expenditures.

The fiscal year 2012 financial summary is:

Beginning Balance 7-1-11		$ 850,482.76
Receipts		
State Road Use Tax Fund (1½% of receipts)	$1,270,172.68	
Federal Aid Secondary (1½% of receipts)	0.00	
Research Income	0.00	
Sub-Total		$1,270,172.68
Total Funds Available		$2,120,655.45
Obligation for Expenditures		
Obligated for Contract Research	$1,206,236.54	
Non-Contract Engineering Studies	$57,316.46	
Total Expenditures		$1,263,553.00
Ending Balance 6-30-12		$857,102.45

STREET RESEARCH FUND

The Street Research Fund was established in 1989 under Section 312.3A of the Iowa Code. Each year $200,000 is set aside from the street construction fund for the sole purpose of financing engineering studies and research projects. The objective of these projects is more efficient use of funds and materials available for construction and maintenance of city streets. The Iowa Department of Transportation accounting procedure for the Street Research Fund is based on obligations for expenditures on research projects and not the actual expenditures. The fiscal year 2011 financial summary is:

Beginning Balance (7-1-11)	$220,316.86
De-obligated (Unused) Funds from Previous Projects	$7,446.17
FY11 Street Research Funding	$200,000.00
Total Funds Available for Street Research	$427,763.03
Total Obligated for Expenditure FY12	$208,716.00
Ending Unobligated Balance 6-30-12	$219,047.03

PRIMARY ROAD RESEARCH FUND

The Primary Road Research Fund is sourced from non-obligated funds of the Primary Road Fund. These funds can only be expended on Iowa DOT projects for which the funds were reserved, such as contracted research and project-specific research supplies or equipment. An estimate of Primary Road Research Fund expenditures is made prior to the beginning of each fiscal year. The amount expended for contract research from the Primary Road Research Fund for FY12 was $667,751.18 and the estimate for FY13 is $750,000.

PROJECTS INITIATED DURING FY 2012

HR-140	(140H) Collection and Analysis of Streamflow Data
HR-296	Iowa State University Local Technical Assistance Program (LTAP)
TR-636	Optimization of Snow Drifting Mitigation & Control Methods for Iowa Conditions
TR-637	Risk Mitigation Strategies for Operations and Maintenance Activities
TR-638	Alkali Content in Fly Ash Measuring & Testing Strategies for Evaluating Compliance
TR-639	Revision to the SUDAS Traffic signal Standards Phase II
TR-640	Evaluation and Guidance on Effective Traffic Calming for Small Communities
TR-641	Automation of DEM Cutting for Hydrologic/Hydraulic Modeling
TR-642	Low Cost Rural Road Surface Alternatives
TR-643	Investigation into Shrinkage of High Performance Concrete Used for Iowa Bridge Decks and Overlays
TR-644	Pilot Construction for Granular Shoulder Stabilization
TR-645	Warm Mix Asphalt Phase II: Evaluation of WMA Quality Assurance Testing Protocols
TR-646	Development of Bridge Inspection, Load Rating & Maintenance Manuals
TR-647	Methods for Removing Concrete Decks from Bridge Girders
TR-648	Evaluation and Testing of a Light-Weight Fine Aggregate Concrete Bridge Deck in Buchanan County, Iowa

15 Projects Initiated

PROJECTS COMPLETED DURING FY 2012

The following projects were completed during FY 2012 and project Final Reports were approved by the Iowa Highway Research Board:

TR-568 Modified Sheet Pile Abutments for Low Volume Bridges

TR-573 Development of LRFD Design Procedures for Bridge Piles in Iowa

TR-575 Embedded (MEMS) Micro-Electromechanical Sensors & Systems for Monitoring Highway Structures & for Infrastructure Management

TR-583 Field Testing of Piles & Development of a Wave Equation Method for Pile Design in IA

TR-584 Establishing a Dynamic Formula for Pile Design & Construction Control of Pile Driving

TR-597 Wet Reflective Pavement Marking Demonstration Project

TR-601 Roadway Lighting and Safety: Phase II (TR-540) Monitoring, Quality, Durability and Efficiency

TR-604 Field Testing and Evaluation of a Demonstration Timber Bridge

TR-605 Evaluation of the Buena Vista IBRD Bridge: A Furthering of Accelerated Bridge Construction in Iowa

TR-606 Iowa Public Employees Leadership Academy (LTAP)

TR-609 Curing Criteria for Cold In-Place Recycling Phase III

TR-618 Parallel Wing Headwalls for Single RCBs (LRFD)

TR-620 Update of RCB Culvert Standards to LRFD Specifications

TR-621 Geosynthetic Reinforced Soil for Low Volume Bridge Abutments

TR-627 Risk Mitigation Strategies for Operations and Maintenance Activities

15 Projects Completed and Approved

Table II

FINANCIAL SUMMARY OF RESEARCH AND DEVELOPMENT PROJECT EXPENDITURES

July 1, 2011 to June 30, 2012

(Active projects with no current fiscal year expenditures are not included)

Project #	Project Title	Primary Road Research Fund Expenditures	Secondary Road Research Fund Expenditures	Street Research Fund Expenditures	Total Expenditures
HR375	Transportation Research Board Education for County Engineers		1,777.64		1,777.64
HR140	Collection & Analysis of Streamflow Data	62,412.50	95,460.00	23,865.00	181,737.50
HR296	ISU Local Technical Assistance Program (LTAP)	54,006.70	95,351.14	18,773.04	168,130.88
HR1027	Secondary Road Research Coordinator (Annual Funds)		57,316.46		57,316.46
TR519	Developing Flood-Frequency Discharge Estimation Methods for Small Drainage Basins in Iowa			12,720.00	12,720.00
TR573	Development of LRFD Design Procedures for Bridge Piles in Iowa	33,036.15			33,036.15
TR575	Embedded (MEMS) Micro-Electromechanical Sensors & Systems for Monitoring Highway Structures & for Infrastructure Management	6,079.51	2,236.23	1,519.56	9,835.30
TR579	Low Cost Strategies to Reduce Speed and Crashes on Curves	1,100.31	849.72	96.72	2,046.75
TR583	Field Testing of Piles & Development of a Wave Equation Method for Pile Design in IA	156.09			156.09
TR597	Wet Reflective Pavement Marking Demonstration Project	3,169.53			3,169.53
TR598	Development of Updated Specifications for Roadway Rehabilitation Techniques	5,991.90	55.37	146.15	6,193.42
TR601	Roadway Lighting and Safety: Phase II (TR-540) Monitoring, Quality, Durability and Efficiency	14,326.08	8,226.70	931.54	23,484.32
TR604	Field Testing and Evaluation of a Demonstration Timber Bridge		12,315.39		12,315.39
TR605	Evaluation of the Buena Vista IBRD Bridge: A Furthering of Accelerated Bridge Construction in Iowa	27,285.08	1,621.98	166.85	29,073.91
TR606	Iowa Public Employees Leadership Academy (LTAP)		23,604.05	12,500.81	36,104.86
TR608	Assessment of Iowa County Roadway Financing Needs, Phases 1-4	9,919.15	23,742.52	5,362.17	39,023.84
TR609	Curing Criteria for Cold In-Place Recycling Phase III	26,346.65			26,346.65
TR613	Study of the Impacts of Implements of Husbandry on Iowa Bridges	36,624.97	5,990.99	8,509.88	51,125.84
TR614	Structural Characterization of a UHPC Waffle Bridge Deck and its Connections		1,553.02	474.60	2,027.62
TR615	Connection Details and Field Implementation of UHPC Piles - Phase II: Use of Ultra-High Performance Concrete in Geotechnical and Substructure Applications	37,827.84	57,896.64	4,444.18	100,168.66
TR616	Timber Abutment Piling and Back Wall Rehabilitation and Repair		96,108.39		96,108.39
TR617	An Adaptive Field Detection Method for Bridge Scour Monitoring Using Motion-Sensing Radio Transponders (RFIDs)		34,759.76	4,125.63	38,885.39
TR619	Development of Self-Cleaning Box Culvert Design - Phase II - additional funding for field test approved 6/25/10 $9679	28,852.72	346.18	6,984.93	36,183.83
TR620	Update of RCB Culvert Standards to LRFD Specifications	81,073.14	10,593.58	3,761.31	95,428.03

Project #	Project Title	Primary Road Research Fund Expenditures	Secondary Road Research Fund Expenditures	Street Research Fund Expenditures	Total Expenditures
TR621	Geosynthetic Reinforced Soil for Low Volume Bridge Abutments	31,305.44	1,648.06	41.52	32,995.02
TR622	Maintenance and Design of Steel Abutment Piles in Iowa Bridges		22,113.56		22,113.56
TR623	Quality Control/Quality Assurance Testing for Joint Density and Segregation of Asphalt Mixtures	17,494.39	39,623.23	4,901.87	62,019.49
TR624	Development of Quality Standards for Inclusion of High Recycled Asphalt Pavement Content in Asphalt Mixtures	33,026.32	41,201.59	1,514.37	75,742.28
TR625	Improving Accuracy of Deflection & Camber Predictions for Prestressed Concrete Bridge Girders		49,000.48	25,000.00	74,000.48
TR626	Optimization of Snow Drifting Mitigation & Control Methods for Iowa Conditions	52,784.30	32,098.41	7,525.78	92,408.49
TR627	Risk Mitigation Strategies for Operations and Maintenance Activities	31,931.00	15,735.35	5,598.99	53,265.34
TR628	Alkali Content in Fly Ash Measuring & Testing Strategies for Evaluating Compliance		18,220.75	14,979.00	33,199.75
TR629	Revision to the SUDAS Traffic signal Standards Phase II	29,179.62	34,620.20	4,973.72	68,773.54
TR630	Evaluation and Guidance on Effective Traffic Calming for Small Communities	292.55	10,786.63	5,286.28	16,365.46
TR631	Automation of DEM Cutting for Hydrologic/Hydraulic Modeling	6,055.81	33,666.17	7,387.00	47,108.98
TR632	Low Cost Rural Road Surface Alternatives		27,659.43		27,659.43
TR633	Investigation into Shrinkage of High Performance Concrete Used for Iowa Bridge Decks and Overlays	5,293.33	41,937.46	12,500.00	59,730.79
TR634	Pilot Construction for Granular Shoulder Stabilization	20,519.82	42,960.00	8,592.00	72,071.82
TR635	Warm Mix Asphalt Phase II: Evaluation of WMA Quality Assurance Testing Protocols	11,660.28	44,744.77	16,288.25	72,693.30
TR636	Bridge Damage Detection: Integration of Structural Health Monitoring System Concepts and Components – A Statewide Collaboration		54,457.87	30,343.00	84,800.87
TR638	Western Iowa Missouri River Flooding — Geo-Infrastructure Damage Assessment, Repair and Mitigation Strategies		15,628.21	8,275.50	23,903.71
TR639	Development of Bio-Based Polymers for Use in Asphalt		39,693.12	14,996.00	54,689.12
TR640	Optimizing Pavement Base, Subbase, and Subgrade Layers for Cost and Performance on Local Roads		11,508.31		11,508.31
TR641	Reflective Crack Mitigation Guide for Flexible Pavements			9,877.45	9,877.45
TR643	Evaluating Roadway Subsurface Drainage Practices		12,017.76	11,997.00	24,014.76
TR646	Development of Bridge Inspection, Load Rating & Maintenance Manuals		7,463.68		7,463.68
	Project Totals	667,751.18	1,126,590.80	294,460.10	2,088,802.08

HR-140

Agency:
United States Geological Survey

Principal Investigator:
Rob Middlemis-Brown

Research Period:
July 1, 1967 to September 30, 2013
Annual Renewal

Research Board Funding:
$260,340

Funding Source:
45% Federal funds,
55% State –
40% Primary funds
50% Secondary funds
10% Street funds

Collection and Analysis of Stream Flow Data

Objective: Collect the data necessary for analytical studies (including flood-frequency discharge estimation) and to define, for any location, the statistical properties and trends in discharge or elevation of streams, lakes, and reservoirs; Define the water-surface-elevation profiles and corresponding discharges along streams in basins with at least 100 mi^2 of drainage area for selected floods and evaluate the flood characteristics and hydraulics at existing and proposed flow structures in basins of all sizes when requested.

Progress: Data collection and annual reporting of stream flow data is ongoing annually.

Reports: Annual Report, Flood Event Reports

Implementation: Flood frequency and discharge data is used for sizing hydraulic structures in Iowa. Structure design agencies use this data for their designs.

U.S. Geological Survey measures the high water mark on the Cedar River at the Janesville stream gage on June 10, 2008. The record discharge for this site was set that day with streamflow measured at 53,400 cfs.
Photo: U.S. Geological Survey

HR-296

Agency:
Iowa State University

Principal Investigator:
Keith Knapp

Research Period:
October 1, 1986 to December 31, 2012

Research Board Funding:
$145,000

Funding Source:
Federal funds, 15.4% Safety funds, State Funds, Workshop income funds

State –
40% Primary funds
50% Secondary funds
10% Street funds

promote research - encourage implementation - distribute research data

Iowa State University Local Technical Assistance Program (LTAP)

Objective: Assist Iowa's local governments with growing demands on local roads, streets, bridges, and public transportation. The center provides technical and managerial assistance to Iowa's local transportation officials through a variety of programs.

Progress:

- Publish *Technology News* newsletters
- Conduct training courses and workshops
- Distribute publications
- Provide service and information to users
- Present transportation safety information to rural communities by employing a Transportation Safety Circuit Rider

Reports: Newsletters, Annual Report

Implementation: Implementation of research findings and the proper training of state and county employees will improve the quality and reduce the cost of road construction and maintenance.

HR-375

Agency:
Iowa Department of Transportation, Performance and Technology Division

Principal Investigator:
Mark Dunn

Research Period:
November 1, 1994 to on-going

Research Board Funding:
$37,400

Funding Source:
100% State - 100% Secondary funds

Transportation Research Board Education for County Engineers

Objective: Annually send county engineers to the TRB Annual Meeting in Washington, D.C., for research education. County engineers selected are generally those starting their term as regular members of the IHRB. Attendance at the TRB Annual Meeting gives county engineers serving on the IHRB a better understanding of research at a national and international level. Additional benefits may be gained as the county engineers begin to develop ideas for research from their experience at the TRB meeting.

Progress: Between 1995-2012, 26 county engineers have received funding through IHRB to attend the Annual TRB meeting in Washington, D.C.

Reports: None

Implementation: County engineers who have attended the conference say it was a very good educational experience and that it educates and encourages them to better serve their counties and the IHRB.

Dr. Martin Wachs, Director, Transportation, Space and Technology Program, Rand Corporation, delivers the Thomas B. Deen Distinguished Lecture during TRBs 88th Annual meeting in Washington, D.C. on January 11, 2010.
Photo: Cable Risdon, Transportation Research Board

TR-519
Phase II

Agency:
United States Geological Survey (USGS)

Principal Investigator:
David Eash

Research Period:
June 1, 2004 to March 31, 2013

Research Board Funding:
$464,777

Funding Source:
44.3% Federal funds and 55.7% State - 45% Primary funds, 45% Secondary funds and 10% Street funds

Implementing a StreamStats Web Site for Iowa and Developing Flood-Estimation Equations for Small and Large Drainage Basins

Objective: Develop a comprehensive flood-estimation method for unregulated, rural streams in Iowa. Specifically:

- Implement an interactive StreamStats Web site for all of Iowa that allows users to easily select stream sites and estimate flood-frequency discharges by automating the measurement of basin characteristics and calculation of regression estimates
- Develop two sets of regional regression equations to estimate 2-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-year flood-frequency discharges
- Develop the smallest drainage-area range for a transition zone as possible for Iowa to prevent the possibility of small-basin regression estimates exceeding large-basin regression estimates

Progress: The first draft of the final report was completed in early October 2012 and the report is receiving USGS peer review. Final review will be complete by mid-January 2013.

GIS data layers from the study were sent to the National StreamStats Team who will start implementing the data from the study after the report is approved.
Publication of the report and implementation of StreamStats will be complete by the end of March 2013.

Reports: Draft Final Report

TR-573

Agency:
Iowa State University

Principal Investigator:
Sri Sritharan

Research Period:
July 1, 2007 to March 31, 2012

Research Board Funding:
$250,000

Funding Source:
100 % State -
45 % Primary funds,
55 % Secondary funds

Development of LRFD Design Procedures for Bridge Piles in Iowa

Objective: Examine current pile design and construction procedures used by the Iowa DOT and recommend changes and improvements to those that are consistent with available pile load test data, soils information and bridge design practice recommended by LRFD. It is a priority to work towards recommended changes that do not significantly increase design and construction costs.

Reports: Final Report, June 2010

Implementation: This research will provide direct benefits to bridge infrastructure in Iowa, including the development and implementation of LRFD design procedures for bridge piles in Iowa to ensure the uniform reliability of bridges while providing cost-effective solutions to foundation designs in accordance with the LRFD specifications and local soil conditions.

A training course will be designed for engineers at the Iowa DOT, emphasizing the importance of collaboration between structural, geotechnical and construction engineers. Other participants from transportation agencies will also be attending.

TR-579

Agency:
Iowa State University

Principal Investigator:
Shauna Hallmark

Research Period:
November 1, 2007 – December 31, 2011

Research Board Funding:
$80,000

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Low Cost Strategies to Reduce Speed and Crashes on Curves

Objective: Evaluate the effectiveness of dynamic speed feedback signs and other low-cost strategies to reduce speeds and crashes on curves. Research results will provide traffic safety and county engineers and other professionals with additional tools to more effectively manage speeds and decrease crashes on horizontal curves on rural roadways.

Reports: Final Report, June 29, 2012

Implementation: Iowa counties will benefit from this research (among others) by obtaining another tool for improving safety on rural curves. A number of treatments have been used but their effectiveness is not known. Additionally, use of the project as matching funds to the FHWA project allows us to leverage federal funding to evaluate treatments in Iowa and to be able to compare those results to other sites nationally.

Two strategies being evaluated in this research:

A dynamic sign triggered by speeds above a safe threshold. ←

A static, painted warning sign. ↓

TR-583

Agency:
Iowa State University

Principal Investigator:
Sri Sritharan

Research Period:
January 1, 2008 – February 28, 2011

Research Board Funding:
$380,000

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Field Testing of Piles and Development of a Wave Equation Method for Pile Design in Iowa

Objective:

- Install and load test piles in the field
- Collect complete data including driving data
- Improve design of piles in accordance with LRFD specifications
- Develop a suitable dynamic analysis method for pile design
- Disseminate research outcomes to bridge designers in Iowa and elsewhere

Reports: Final Report, September 2011.

Implementation: The project team will organize and deliver a training course to supplement the Final Report and expedite implementation of project results into actual design and field practice. Designed for engineers in the office of Bridges and Structures, Soils Design Section, and the Construction Office at the Iowa DOT, the course will be delivered over a period of one to three days and clearly emphasize the importance of collaboration between structural, geotechnical, and construction engineers.

Other interested participants from county and city transportation agencies will also be invited. Depending on need, FHWA experts on LRFD may contribute to the course by providing an overall perspective on the implementation of project outcomes based on their experience with other bridge design agencies.

TR-589

Agency:
National Weather Service

Principal Investigator:
National Weather Service

Research Period:
April 1, 2008 – September 30, 2012

Research Board Funding:
$137,937

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

FHWA Pooled Fund project TPF-5(187)

Updating U.S. Precipitation Frequency Estimates for the Midwestern Region

Objective: Determine annual exceedance probabilities and average recurrence intervals for rainfall durations ranging from five minutes to 60 days and frequencies from 1-500 years. The study results will be a web based publication.

Progress: In the next reporting period, the peer review of precipitation frequency estimates at base durations (1-hour, 1-day and 10-day) will occur. Hydrometeorological Design Studies Center will review and begin to address any comments received. Additionally, the following tasks will be completed: temporal distribution analysis, seasonality analysis and rainfall frequency analysis. Web publication for precipitation frequency estimates will be complete by March 2013. Area reduction factors will be published by the end of 2013.

Reports: None

Implementation: The National Weather Service (NWS) rainfall maps have not been updated for approximately 50 years. This means that the designs of storm sewers, culverts, dams, detention basins, etc. have been performed by engineers using outdated data. This project is part of a national effort to update the rainfall/frequency relationships for the entire United States.

Contour maps and high resolution grids will be available for each combination of rainfall frequency and duration. Charts of seasonal distribution of annual rainfall will be developed and documented.

Implementing updated precipitation frequency estimates as a design tool for future projects will help engineers design bridges, culverts, detention basins, storm sewers and other transportation projects more efficiently.
Photo: NOAA

TR-597

Agency:
Iowa State University

Principal Investigator:
Neal Hawkins

Research Period:
August 1, 2008 – July 31, 2011

Research Board Funding:
$124,989

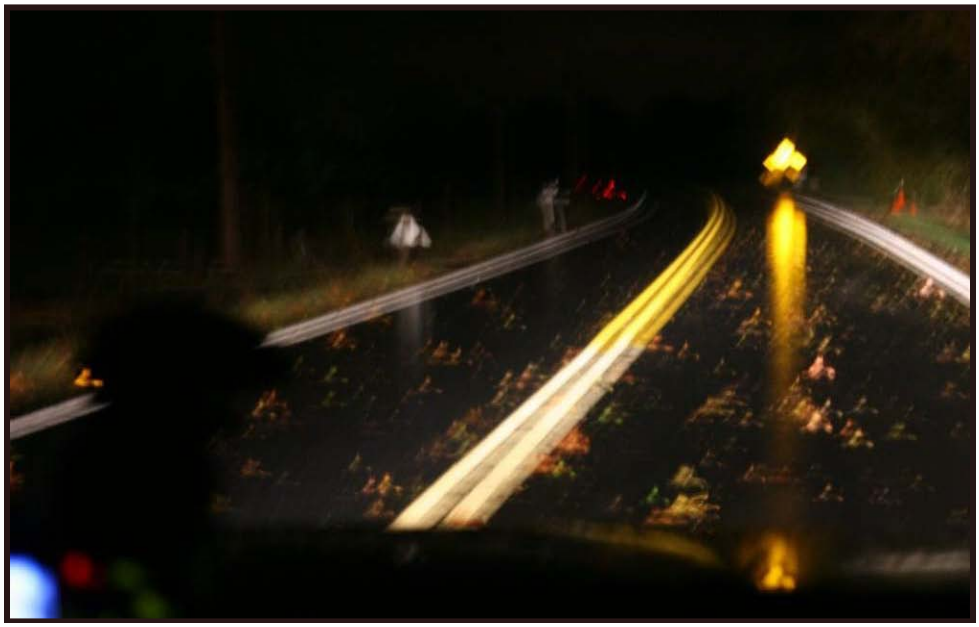
Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Wet Reflective Pavement Marking Demonstration Project

Objective: Develop a two year line-test deck allowing the evaluation and demonstration of a variety of wet reflective pavement marking materials and treatments under wet night conditions.

Reports: Final Report, December 2011

Implementation: Documenting the performance of these various products and treatments will assist the Iowa DOT and local agencies in determining when and where their use might be most effective. Performance parameters will include durability, presence, retro-reflectivity, and wet night visibility.



Wet, dark conditions present special challenges to drivers, such as color variations (shown here between two different centerline pavement marking products used on a rural two-lane roadway). In dry conditions, both products are yellow. However, under wet conditions the nearer product appears white in color (like edge line markings) which is an obvious safety concern.
Photo: Neal Hawkins, Iowa State University/InTrans

TR-598

Agency:
Iowa State University

Principal Investigator:
Charles Jahren

Research Period:
December 1, 2008 – September 30, 2010

Research Board Funding:
$60,000

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Development of Updated Specifications for Roadway Rehabilitation Techniques

Objective: Create recommendations to improve the SUDAS and Iowa DOT standard specifications, incorporating results of recent research on seal coat, slurry seal, micro-surfacing, and fog sealing; To assess cold in-place recycling and stabilization in the SUDAS manuals and based on input, recommend appropriate additions for cold in-place recycling and modifications to the sections on stabilization.

Reports: Final Report, May 2011

Implementation: The research findings will be reported as Draft and Final documents for inclusion in the SUDAS Standard Specifications, the SUDAS Design Manual, the Iowa DOT Standard Specifications, the Iowa DOT Materials Instructional Memoranda, and other similar documents.

It is expected that the results of this research can be fully implemented within current SUDAS and Iowa DOT staffing, budgets, and procedures.

A chip spreader applies cover aggregate during a seal coat or "chip seal" operation on 74th Street in Cedar Rapids, Iowa, during a road maintenance effort
Photo: Dr. Charles Jahren, Iowa State University/CCEE

TR-601

Agency:
Iowa State University

Principal Investigator:
Omar Smadi

Research Period:
January 1, 2009 – September 30, 2011

Research Board Funding:
$100,000

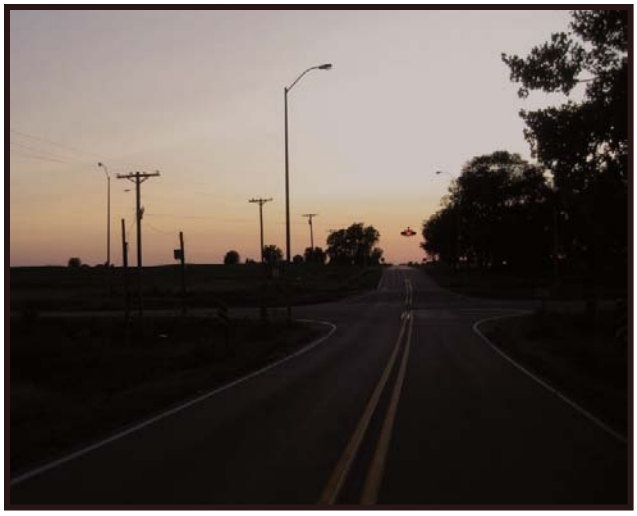
Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Roadway Lighting and Safety: PHASE II – Monitoring, Quality, Durability and Efficiency

Objective: Address the quality of lighting rather than just the presence of light with respect to safety. ISU staff are teamed with Virginia Tech Transportation Institute (VTTI) through funding from the National Safety Center. VTTI will replicate Phase I, develop roadway illumination monitoring equipment, and work with ISU to complete objectives to analyze data and establish a relationship between crash performance and illumination at rural, unsignalized intersections. Recommendations to address lighting design and maintenance will be developed.

Reports: Final Report, December 2011

Implementation: Findings can be incorporated into Chapter 11 of the SUDAS Roadway Lighting Design Manual and will be included in the SUDAS manuals. Presentations will be given at the County Engineer Conference, ASCE Transportation Conference, APWA conference, and through a variety of other professional, municipal, and national group presentations.



Intersection infrastructure and geometry influence lighting levels and corresponding crash rates. Safety recommendations will be established based specifically on lighting levels and related crash data.
Photo: Dr. Omar Smadi, Iowa State University/ InTrans

TR-604

Agency:
Iowa State University

Principal Investigator:
Travis Hosteng

Research Period:
November 15, 2008 – December 31, 2011

Research Board Funding:
$88,336

Funding Source:
100 % State -
100 % Secondary funds

Field Testing and Evaluation of a Demonstration Timber Bridge

Objective: Perform field testing and evaluation of a glued-laminated timber girder bridge with transverse deck panels and an asphalt wearing surface to assess overall design, construction, and bridge and wearing surface performance. Monitoring systems will be designed and installed on the demonstration field timber bridge to collect overall bridge construction and in-service performance over a period of approximately two years.

Evaluation of performance will be formulated through comparisons with design assumptions, previous research, and existing bridge performance records. The research will be performed through a cooperative effort of researchers at ISU, the United States Department of Agriculture (USDA) Forest Products Laboratory (FPL) and Delaware County Engineering staff.

Reports: Final Report February 24, 2012

Implementation: The successful development and implantation of deck panel joint details for transverse glued-laminated decks will be useful nationwide for management of timber bridges with asphalt wearing surfaces. The systems may be incorporated into typical standard bridge plans and utilized nationwide for bridge projects.

A demonstration timber bridge was completed in the spring of 2009 in Delaware County, Iowa. It features an innovative deck treatment system.
Photo: Iowa State University/InTrans, Bridge Engineering Center

TR-605

Agency:
Iowa State University

Principal Investigator:
Terry Wipf

Research Period:
November 15, 2008 – December 31, 2011

Research Board Funding:
$70,044

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Evaluation of the Buena Vista IBRD Bridge: A Furthering of Accelerated Bridge Construction in Iowa

Objective:

- Assist the Iowa DOT and Iowa County Engineers to fully leverage FHWA Innovative Bridge Research Construction Program funding
- Demonstrate benefits of precast post-tensioned bridge components
- Perform testing and evaluation of precast components for the bridge project in Buena Vista County and assess design, construction, and structural performance
- Design and install monitoring systems and perform structural tests over approximately two years
- Formulate evaluation of performance through comparisons with design assumptions, recognized codes and standards

Reports: Final Report February 24, 2012

Implementation: The development of precast (and in some cases post-tensioned) bridge components offers the potential to significantly reduce traffic delays and inconvenience to the travelling public, improve safety during construction, resulting in more durable bridges, particularly for low volume roads.

Beam placement during accelerated construction of Buena Vista IBRD bridge
Photo: Dr. F. Wayne Klaiber, Iowa State University/CCEE

TR-606

Agency:
Iowa State University

Principal Investigator:
Duane Smith

Research Period:
February 21, 2009 – February 29, 2011

Research Board Funding:
$125,000

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Iowa Leadership Institute

Objective: The Iowa LTAP, in conjunction with Iowa's public agency representatives, continues developing a training program to create better (or new) leaders and supervisors for Iowa's public agencies. Modules are offered for a fee to support future development and administration of the Academy through the Iowa LTAP. The curriculum and course content for ten core modules includes:

- Supervisory Techniques
- Effective Communication
- Community Service Skills
- Resource Management Skills
- Fundamentals of Government
- Basic Management Skills
- Leadership Skills
- Legal Understanding
- Finance
- Operations and Maintenance

Tasks: Coordinate Planning and Development Activities; Develop Academy Identity or Theme (Branding); Establish A Marketing Plan; Sequence and Schedule Academy Development; Create Module Content; Present Academy Modules; Integrate the Academy into Conferences and Workshops; Identify Measures of Success and Suggest Peer Exchange Format.

Reports: Final Report, September 2011

Implementation: The modules are accessible to anyone with an internet connection at www.ctre.iastate.edu/LTAP. Publicity about the program is being handled through the LTAP program.

Leadership Academy Program Coordinator Bob Sperry records an instructional video with Marion County Engineer Roger Schletzbaum and Lorri Jahner, Marion Deputy County Auditor. *Photo: Iowa State University*

TR-608

Agency:
Iowa County Engineer Association Service Bureau

Principal Investigator:
Steve DeVries

Research Period:
August 1, 2009 – December 31, 2012

Research Board Funding:
$154,316

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Assessment of Iowa County Roadway Financing Needs

Objective: Develop a conceptual model to facilitate accurate forecasting simple enough for presentation to the public, also:

- After the conceptual model is defined, physical and financial data will be gathered from public and private sectors and reviewed to identify and quantify interrelationships between the road network, vehicles that operate on it, and land parcels that adjoin it.

- Define a data structure and processing engine that represent road, traffic and land use entities' relationships and affects on each other.

Progress: The analysis engine was first completed in July, but substantial test and refinement proved necessary. As a result, it was not finished until 9/30/2012. It is now operational and being used to explore various 'what-if" outcomes. The last remaining tasks are a) direct generation of usable graphics for counties and b) a final report.

Reports: None

Implementation: The model will assist agencies with estimating the cost of a service level, find what service level fits a particular revenue stream, and project what improvements are needed to meet traffic levels. It will also facilitate study and discussion of tradeoffs between road costs, vehicle costs and land use costs, and identify the value of commerce supported by secondary roads.

TR-609

Agency:
The University of Iowa

Principal Investigator:
Hosin David Lee

Research Period:
July 16, 2009 – December 31, 2011

Research Board Funding:
$104,140

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Curing Criteria for Cold In-Place Recycling (CIR) – PHASE III

Objective: The Objectives of this project are to:

- Measure moisture contents and temperature throughout a CIR layer at six CIR project sites
- Calibrate developed moisture loss indices using field measurements from six CIR project sites
- Develop stiffness/density gain model to supplement (or possibly replace) the moisture criteria

The moisture loss indices will provide data when rationalizing how the quality of CIR layer is inspected for optimum timing of an HMA overlay, and significantly enhance the long-term performance of CIR pavements. In addition, the stiffness of CIR layer measured by the Geo-gage can be used to supplement (or possibly replace) the moisture measurement during a curing period.

Reports: Final Report, January 27, 2012

Implementation: This research will provide a moisture loss index and/or a stiffness/density gain model to monitor the CIR layer for a timely placement of the wearing surface. A set of curing indices and/or a stiffness/density gain model that can determine an optimum timing of an overlay are expected.

Curing process on Iowa county road before overlay
Photo: Dr. Hosin "David" Lee, IIHR, The University of Iowa

TR-613

Agency:
Iowa State University

Principal Investigator:
Terry J. Wipf

Research Period:
January 25, 2010 – June 30, 2015

Research Board Funding:
$153,590

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Study of the Impacts of Implements of Husbandry on Iowa Bridges

Objective: The objective of this study is to determine how the implements of husbandry distribute their load within a bridge structural system and to provide recommendations for accurately analyzing bridges for their loading effects. To achieve this objective the distribution of live load and dynamic impact effects for different types of agricultural vehicles will be determined by load testing and evaluating two general types of bridges. The types of equipment studied will include but is not limited to; grain wagons/grain carts, manure tank wagons, agriculture fertilizer applicators, and tractors. Once the effect of these vehicles has been determined, recommendations for the analysis of bridges for these non-traditional vehicles will be developed.

Progress: Several calibrated bridge models have been formalized that will be used in the determination of the rating factors. The project team has completed analyzing the field collected data, creating analytical models for those field tested bridges and computing experimental and analytical distribution factors for those bridges and have also started collecting information on a large number of bridges which will be investigated analytically. Most participating states have provided information.

Reports: None

Implementation: Engineers involved in the rating/evaluation of bridges for live load performance of bridges will be able to immediately be able to use the resulting information as the results will be given in a format commonly used by practicing engineers. The results of this study will most likely supplement existing standards by providing information/guidance not previously available.

TR-614

Agency:
Iowa State University

Principal Investigator:
Sri Sritharan

Research Period:
November 20, 2009 – December 31, 2011

Research Board Funding:
$50,000

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Structural Characterization of a UHPC Waffle Bridge Deck and its Connections

Objective: The objectives of this proposed research is to perform structural characterization of the UHPC waffle bridge deck panel designed for the bridge in Wapello County and its critical connections, and evaluate the system performance and ride ability of the panel top surface.

Progress: The Phase 1 Report, which is on the laboratory testing of the UHPC waffle deck, has been completed. The feedback received on the report from TAC and representatives of FHWA's Highway for LIFE program have been incorporated. FHWA has approved the final version of the Phase 1 report, thereby giving authorization for the production of UHPC panels for the field implementation which will take place in the next phase. The final report to IHRB will combine both Phase I and Phase II studies.

Construction of the prototype bridge was delayed, but was completed in Fall 2011. Field testing of the Wapello County Bridge was completed in March 2012. The draft of the Phase-II report presenting the analysis and results from the field testing data was submitted to the Coreslab Structures Inc. for review comments. Following analysis of field data, the draft version of the Final report to IHRB has been completed. The final report is anticipated to be completed by end of December 2012.

Reports: None

Implementation: The research findings of the project will be disseminated to designers and practitioners in the fields of structural and construction engineering.

TR-615

Agency:
Iowa State University

Principal Investigator:
Sri Sritharan

Research Period:
December 17, 2009 – December 31, 2012

Research Board Funding:
$210,000

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Connection Details and Field Implementation of UHPC Piles - Phase II: Use of Ultra-High Performance Concrete in Geotechnical and Substructure Applications

Objective: The objectives chosen for the next phase of the project are to: 1) establish and test connection details to extend the length of UHPC piles in the field; 2) develop and test suitable details that can be used to connect the UHPC pile to concrete pile cap as well as to bridge abutment; 3) study a UHPC pile behavior as part of a bridge foundation in the field and compare its behavior to that of a steel H pile, and 4) develop a preliminary geotechnical design methodology.

Progress: The instrumented steel HP 10 x 57 piles have been driven. The first UHPC production pile was broken after falling from the crane and deemed unusable for the bridge. A new pick-up point was devised for the UHPC pile using a threaded rod, washers and nuts. The second production pile was instrumented and driven. All piles in the field and all the pile-to-cap connections in the laboratory have been completed. Data reduction from the tests is currently underway. Field monitoring of the piles are currently underway

Reports: None

Implementation: This research will contribute to establishing a cost-effective, durable pile for bridge infrastructure. The proposed laboratory tests will allow UHPC piles to be effectively extended without causing any construction delays, while the connection tests will establish details for anchoring the pile into pile caps and abutments, which may also be used for steel piles. The planned field tests will not only confirm the expected behavior of the UHPC piles under real-world loading conditions, but will also create unique data that will enable preliminary evaluations to be completed on LRFD design of UHPC piles, examination of the effects of setup and understanding the potential benefits of construction control for this pile type.

TR-616

Agency:
Iowa State University

Principal Investigator:
Brent Phares

Research Period:
August 7, 2010 – January 31, 2012

Research Board Funding:
$150,843

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Timber Abutment Piling and Back Wall Rehabilitation and Repair

Objective: The objectives of this investigation are to:

- review existing products for timber preservation and repair and to document their effectiveness in extending the life expectancy of various bridge components.
- determine techniques used by county engineers and other engineers to repair and restore load carrying capacity of piling damaged by deterioration and cracking.
- review methods used to repair failed piling.
- determine/develop effective methods for transferring bridge loads through the failed portion of the pile.
- determine that safe load capacity is restored by the repair methods (existing or new) determined to be structurally efficient.

Reports: Final Report, September 2012

Implementation: The identification of effective existing systems and new systems for the strengthening/rehabilitating timber substructure elements offers significant benefits to the State of Iowa. Close to 25% of the bridges on LVRs are structurally deficient. Many of these have sound superstructure elements and deficient timber substructure elements. By rehabilitating or strengthening the deficient timber substructure elements, one creates a significant cost savings by extending the life of the bridge.

TR-617

Agency:
The University of Iowa

Principal Investigator:
Thanos Papanicolaou

Research Period:
June 1, 2010 – December 31, 2012

Research Board Funding:
$170,866

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

An Adaptive Field Detection Method for Bridge Scour Monitoring Using Motion-Sensing Radio Transponders (RFIDs)

Objective: The objective is to utilize Motion-Sensing Radio Transponders (RFIDS) on fully adaptive bridge monitoring and residual life prediction to minimize the problems inherent in human inspections of bridges. This will include an integrated condition-based maintenance (CBM) framework integrating RFID sensors and sensing architecture, for in-situ scour monitoring of critically scoured bridge structures. This will provide real-time state awareness datasets that can be used in making decisions on down time, repair cost, and functionality.

Progress: The project was extended until December 31, 2012. There is a modification of the reader software to improve data recording by adding some new features such as options to record sequential readings and perform plots of the signal intensity. The new software provides the ID of the transponder; its location and signal reader strength; records sequential readings and performs plots of the signal intensity. The final report is currently being written.

Reports: None

Implementation: The need for maintenance personnel to be present at a bridge site could be removed by automating the collection and transmission of scour data, thereby making the scour-monitoring process safer and more efficient. An RFID system fitted with data telemetry equipment can provide the ability to collect and transmit data to a maintenance office. Remote monitoring could mitigate the inefficiencies and dangers inherent in the current practices, as well as provide early warning of impending bridge failure and the ability to track long-term degradation as a result of scouring.

Additional benefits of remote monitoring include the potential reduction in the labor required to perform monitoring, and the acquisition of real-time data for calibrating scour prediction equations and enhancing the state of knowledge about the scour-monitoring process.

TR-619

Agency:
The University of Iowa

Principal Investigator:
Marian Muste

Research Period:
April 1, 2010 – January 31, 2012

Research Board Funding:
$156,159

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Development of Self-Cleaning Box Culvert Design - Phase II

Objective: The overall objective of this project is to identify and/or develop methods for constructing, or retro-fitting, box culverts so that the typical flow through a culvert will clean the culvert's entrance area and the barrels and keep the structure performing well with little or no maintenance. The new phase of the study will include, but not be limited to, preparing the implementation phase for the self-cleaning design at selected sites in Iowa and continue the multi-prong research on self-cleaning designs for other types of culverts, besides the 3-box culvert investigated in TR 545.

Progress: The routine monitoring at the Hwy 1 three-box culvert has been continued as planned. A real-time web camera is in place for continuous monitoring of the sedimentation development and real-time stream-gage sensor is also operating continuously for flow monitoring.

The research team presented a progress report to TAC on August 28, 2012. The meeting reviewed the monitoring progress. The low flow situation during the spring and summer seasons has not developed major changes in the sediment deposits. However, vegetation growth produced some morphology changes that are expected to further trigger sedimentation with the first rain events.

The drawings for construction of the fillets were executed by Iowa DOT and Iowa City. They were reviewed by our team and brought as much as possible to the modeled configuration. Currently the bidding for the construction of the fillets is in progress.

Reports: None

Implementation: The primary products of the project would be a practical report that provides design layouts and guidance for self-cleansing methods for use for new culverts and for retrofitting to existing culverts known to have a sedimentation problem. The report prepared will be formatted in a comprehensive and well-illustrated manner that directly helps engineers to select the self-cleansing method best suited for a culvert site.

TR-620

Agency:
Foth Infrastructure

Research Period:
July 26, 2010 – August 31, 2011

Research Board Funding:
$339,471

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Update of Reinforced Concrete Box (RCB) Culvert Standards to LRFD Specifications

Objective: The objectives of the project involve developing software that will design the RCB culvert barrel sections. Using the software, the consultant will design and develop RCB culvert standards to LRFD specifications for single, twin and triple box culverts.

Progress: Barrel Standards are complete and have been submitted to the Iowa DOT Office of Bridges and Structures for approval. Headwall standards are currently being designed and detailed. Additional funding has been approved for the addition of a rating component to be added to the design software.

Reports: Final Report, June 29, 2012

Implementation: Updated standards are available at: http://www.iowadot.gov/bridge/v8elrfdculstd.html

TR-621

Agency:
Iowa State University

Principal Investigator:
David White

Research Period:
July 9, 2010 – December 31, 2011

Research Board Funding:
$81,500

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Geo-synthetic Reinforced Soil (GRS) for Low Volume Bridge Abutments

Objective: The objectives of this project are to:

1. Develop an instrumentation and monitoring plan to evaluate performance of newly constructed GRS bridge abutment systems.
2. Develop a design approach and construction guidelines for GRS bridge abutment systems with shallow spread footings on LVR bridges.
3. Document and evaluate the cost and construction aspects associated with construction of GRS bridge abutment systems from detailed field observations on project sites.
4. Produce a research report and technology transfer materials that provide recommendations for use and potential limitations of GRS bridge abutment systems.

Reports: Final Report, January 27, 2012

Implementation: The observations and conclusions from this study will provide recommendations for use of sheet pile abutments in LVRs and in-situ soil testing. County engineers can implement the recommendations for use of an alternative abutment system.

TR-622

Agency:
Wiss, Janey, Elstner and Associates (WJE)

Principal Investigator:
Wade Clarke

Research Period:
August 1, 2010 – July 31, 2012

Research Board Funding:
$134,442

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Maintenance and Design of Steel Abutment Piles in Iowa Bridges

Objective: The desired outcome of this research will yield

1. Methods for addressing the problem of pile corrosion in existing bridges, and

2. A cost effective design methodology to prevent steel pile corrosion from occurring in new bridges in the future.

In addressing cost effective methods to prevent steel pile corrosion in new bridges, corrosion protection strategies will be developed that can be readily incorporated into contract specifications. These methods can be used and evaluated on upcoming bridge construction projects where steel pile corrosion is a concern.

Progress: WJE has completed the laboratory testing for this project and selected coatings for field application. Coatings have been ordered for field application. WJE has also selected a controlled low-strength material mix and admixture for use in conjunction with the cathodic protection (CP) system. Field work for both the field CP and field coating tests may be completed this fall if the contractor is able to schedule the work before the weather gets too cold. The final report will be completed approximately six to eight weeks after the field work is complete.

Reports: None

Implementation: The project recommendations can be immediately implemented as changes to bridge construction specifications and specifications in maintenance contracts for existing structure repairs or preventive maintenance. Further, the work will provide a basis to develop recommendations to Iowa DOT maintenance staff to assist with optimizing the maintenance of bridge foundations.

TR-623

Agency:
Iowa State University

Principal Investigator:
Chris Williams

Research Period:
August 1, 2010 – July 31, 2012

Research Board Funding:
$150,742

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Quality Control/Quality Assurance Testing for Joint Density and Segregation of Asphalt Mixtures

Objective: The objectives for this project are to identify best practices for joint geometry, joint construction, and for minimizing segregation. Field testing of asphalt pavements during construction as well as existing pavement sections exhibiting open longitudinal joints will be investigated. The project will concurrently compare and evaluate destructive and non-destructive testing methods for identifying segregation and quality control/quality assurance of centerline joints. Testing criteria will then be developed for the most suitable method." Additionally, a test method that can be used to evaluate the permeability of mixtures during the mix design phase will be included.

Progress: The research team has continued with the analysis of the data collected on the 2011 construction projects. Additional projects from 2012 continue to support the data from the 2011 construction season. Lab testing of the materials is nearly complete and a substantial amount of the analysis has been completed too.

The research from the 2011 construction season data shows premature longitudinal joint failures are a result of a combination of low density, high permeability, segregation and lack of joint adhesion.

Reports: None

Implementation: The implementation and technology transfer aspects of the project will include the specific items stated in the products above and in particular: (1) The development of draft test methods for laboratory and field permeability testing. (2) Development of draft permeability quality assurance criteria for inclusion in percent within limit specifications.

TR-624

Agency:
The University of Iowa

Principal Investigator:
Hosin David Lee

Research Period:
August 1, 2010 – July 31, 2012

Research Board Funding:
$150,000

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Development of Quality Standards for Inclusion of High Recycled Asphalt Pavement Content in Asphalt Mixtures

Objective: The objective of this project is to develop quality standards for inclusion of high RAP content in asphalt mixtures. Performance testing and asphalt binder testing will be performed at all temperature regimes to characterize the binder contained in RAP and whether or not results are source dependent. Both laboratory and plant produced mixtures will be examined, which would help answer the question that how much blending occurs between the binder in RAP and virgin binder. In addition, this study will explore the possible role that fractionation may take in increasing RAP usage.

Progress: Due to the difficulty in identifying the test section, test sections were not be constructed with varying RAP/FRAP contents as originally proposed. The project duration was extended to December 31, 2012. Laboratory samples were prepared for testing dynamic modulus and flow number. The Laboratory testing will replace the anticipated field testing.

Reports: None

Implementation: The implementation outlook for this research effort is very realistic given an increasing number of construction projects of asphalt pavements with RAP in Iowa. The results of this study shall provide a new mix design process with high RAP/Fractionated RAP contents.

TR-625

Agency:
Iowa State University

Principal Investigator:
Sri Sritharan

Research Period:
November 1, 2010 – December 31, 2012

Research Board Funding:
$250,000

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Improving Accuracy of Deflection & Camber Predictions for Pre-stressed Concrete Bridge Girders

Objective: The primary objective of the proposed research is to provide accurate methods for predicting short-term and time dependent camber during design and, if desired, means of increasing camber for prestressed beams fabricated for Iowa bridges. The approach will be to evaluate existing data and models as well as to systematically understand instantaneous and time dependent components of camber from casting of the PPCBs to construction of the actual bridge and beyond by quantifying the most significant parameters affecting camber of beams used in Iowa.

Progress: A summary of the project progress is as follows: 1) review of literature has focused on creep and shrinkage of concrete, prediction of camber using methods recommended for design practice and finite element modeling of prestressed beams; 2) Gathering of data has focused on historical information collected by precast plants and district engineers; 3) several camber measurements techniques have been studied and decided that a tape measure, a digital level, and a string potentiometer measurement system will be deployed to accurately capture the camber at precast plants; 4) several camber measurements have been taken from precast beams from Andrews Precast, Coreslab Precast, and IPC Precast; 5) detailed analysis of beams are currently underway to evaluate the cause of discrepancy between measured and expected camber using the design equations; 6) measuring and monitoring of four state bridge projects is being pursued. Three bridge projects are complete and long-term camber is currently being monitored on each of these along with the girders from the fourth project; and 8) work on the final report is started.

Reports: None

Implementation: Better understanding of camber behavior and improved predictive tools will facilitate smooth construction, avoid difficult field problems for which there may be no good solution, ensure better service performance, and ultimately reduce life-cycle costs for Iowa's prestressed bridge inventory.

TR-626

Agency:
The University of Iowa

Principal Investigator:
George Constantinescu

Research Period:
October 15, 2010 – June 30, 2012

Research Board Funding:
$151,430

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Optimization of Snow Drifting Mitigation & Control Methods for Iowa Conditions

Objective: The overarching goal of the present proposal is to optimize the design of passive snow-control measures for Iowa roadways such that the impact of drifting on the roads is minimized or eliminated. The focus of the research will be on providing optimized solutions for limited-area right of ways and topographies which are favoring snow drifting on roadways. This design optimization should result in cost-effective solutions to the snow drift problem that can be tailored for weather and road conditions that are the most common for the Iowa environment.

Progress: The snow events for 2011/2012 did not result in significant snow deposition. Given the lack of validation data during the winter of 2012, the study was extended to another winter and it was expanded to included living snow fences.

As the continuation of the work performed as part of the present project (Part I), it was decided after consultation with the Iowa DOT project manager to submit a final report at the conclusion of the second part of the project. Presently, the project team is working with the TAC committee to identify sites where monitoring of living snow fences will be done. The monitoring of structural snow fences at the Williams site will be continued. A major development in terms of field monitoring of deposits will be to obtain quantitative information of snow deposit in time. The project team is in the process of deciding what software to acquire for this purpose.

Reports: None

Implementation: A series of practical recommendations will be compiled by the project team to include the findings of the study in the Iowa snow fence design guidelines and illustrate the lifecycle cost benefits resulting from the new design implementation. The test cases and set up of the numerical model will be made available to IDOT for future use in new situations where the space constraints and local topography are of concern for the design of snow fences.

TR-627

Agency:
Iowa State University

Principal Investigator:
Kelly Strong

Research Period:
November 1, 2011 – May 31, 2012

Research Board Funding:
$79,826

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Risk Mitigation Strategies for Operations and Maintenance Activities

Objective: The objective of this research is to investigate the application of integrated risk modeling to Operations/Maintenance activities, specifically moving operations such as pavement testing, pavement marking, painting, snow removal, shoulder work, mowing, etc. The ultimate goal is to reduce frequency and intensity of loss events (property damage, personal injury, and fatality) during operations and maintenance activities.

After potential risk factors have been identified and loss severity has been evaluated, the research team will identify risk mitigation strategies that can be used within integrated teams to reduce the frequency and/or severity of losses during Operations/Maintenance activities.

Reports: Final Report, April 27, 2012

Implementation: The general form of the research findings will be a process map or guidebook for use by the Iowa DOT, Iowa County Engineers, and municipal transportation agencies to assess the risk potential of various operations and maintenance activities and develop team-based risk mitigation strategies.

TR-629

Agency:
Iowa State University

Principal Investigator:
Neal Hawkins

Research Period:
March 1, 2011 – August 31, 2012

Research Board Funding:
$75,000

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Revision to the SUDAS Traffic signal Standards Phase II

Objective: The objectives of this project are:

1. Update all of the existing SUDAS traffic signal specifications figures
2. Conduct a structural review of footing steel and concrete capacities and standards and incorporate this information into the SUDAS Design Manual
3. Develop and include non-proprietary, performance based NEMA and Type 170 controller and cabinet specifications
4. Develop and include non-proprietary fiber optic cable, modem, and communications specifications
5. Develop and include non-proprietary video monitoring/camera specifications

Reports: Final Report June 1, 2012

Implementation: The findings of this research will be shared through incorporation into the SUDAS manuals as well as through presentations at the Iowa county engineer's conference, MOVITE Traffic Engineering Conference, ASCE Transportation Conference, Iowa Chapter APWA conference, and through a variety of other professional, municipal, and national group presentations. This information will be disseminated and available for use by all agencies that use the SUDAS manuals.

TR-630

Agency:
Iowa State University

Principal Investigator:
Shauna Hallmark

Research Period:
January 15, 2011 – December 31, 2012

Research Board Funding:
$55,000

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Evaluation and Guidance on Effective Traffic Calming for Small Communities

Objective: The objectives of this study are:

- Summarize information about effective transition zone planning and design practice
- Identify and summarize techniques used to manage speeds in transition zones
- Demonstrate the effectiveness of techniques that are practical for high- to low-speed transition zones
- Acquire additional information about techniques that may show promise but lack sufficient evidence of effectiveness
- Develop an application toolbox to assist small communities in selecting appropriate transition zones and selecting effective techniques for transitioning from high-speed to low-speed roadways

Progress: Treatments were installed in St. Charles at all 4 community entrances. Temporary curbing was installed at the north, south, and west community entrances and an LED speed sign was installed at the east entrance. The Buchanan county engineer was planning to install a speed sign in Rowley, Iowa. The team worked with Buchanan County to investigate the site. This location will now be included in the study. The team conducted a before speed study and assisted with the installation of the sign.

Before data was collected St. Charles and Rowley. 1-month after data was collected in all communities. Most of the speed data have been reduced. A draft toolbox has been developed. The project team is currently looking for additional treatments to include.

Reports: None

Implementation: The findings from this research will enable practitioners to better design speed transition areas from high- to low-speed roadways, determine when speed management is necessary, and then select and monitor appropriate techniques. This capability is expected to have an impact at the national, state, and local level.

TR-631

Agency:
Iowa State University

Principal Investigator:
Brian Gelder

Research Period:
April 1, 2011 – January 31, 2014

Research Board Funding:
$73,873

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Automation of Digital Element Model (DEM) Cutting for Hydrologic/Hydraulic Modeling

Objective: The primary objectives for this project are:

- Develop and program algorithms to enforce fine scale drainage on LiDAR DEMs for the state
- Accurately enforce drainage on catchments larger than 24 acres in conjunction with the Iowa Department of Natural Resources (DNR) and Iowa Institute for Hydraulic Research

Progress: Most of the tasks are nearly complete and are waiting upon completion of the IA DNR project. The IA DNR portion of the project, enforcement of channelized streams, is nearly complete and a final version will be complete within the coming month, allowing the DOT project to proceed to completion. The project investigator plans to arrange another TAC meeting for early 2013 to discuss the current status of the project and determine where to best focus remaining work. With the current status of the project, no extension requests are expected. However, additional work to derive additional watershed characteristics may be requested and will be discussed with the TAC at the next meeting.

Reports: None

Implementation: These DEMs will be used by bridge and culvert engineers during initial design as well as by city and county engineers to correctly contributing area and the hydrologic characteristics of the contributing area as they design water conveyance structures. The actual algorithms for DEM enforcement are not likely to be used by the practicing engineer or administrator but will likely be used by DOT GIS professionals to support LiDAR database maintenance.

TR-632

Agency:
Iowa State University

Principal Investigator:
David White

Research Period:
July 1, 2011 –
June 30, 2012

Research Board Funding:
$50,000

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Low Cost Rural Road Surface Alternatives

Objective: The proposed objectives of this research project are to:

(a) Conduct a comprehensive literature survey of the state of practice for granular surface road construction with respect to freeze/thaw damage resistance

(b) Develop recommendations with respect to conducting a phase 2 study to demonstrate various technologies.

Progress: A database of literature pertaining to the stabilization of low-volume roads and granular surfaced roads with an emphasis on increasing freeze-thaw durability has been compiled. Each individual document within the database is currently being assessed and rated for its applicability to the project objective. Results from the assessment will be used to populate the literature summary table and annotated bibliography.

The research team continued the literature review process. The reference management tools initiated during the previous quarter were further explored to assist with the annotation and automatic referencing of documents. The final report is being prepared and is about 50% completed.

Reports: None

Implementation: The benefits from this project will be to provide improved knowledge in the state-of-the practice for granular surface stabilization. The project will result in improved decision making and investment.

TR-633

Agency:
Iowa State University

Principal Investigator:
Kejin Wang

Research Period:
August 1, 2011 – January 31, 2013

Research Board Funding:
$125,000

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Investigation into Shrinkage of High Performance Concrete Used for Iowa Bridge Decks and Overlays

Objective: The main objective of the proposed study is to investigate the shrinkage behavior of HPC used for Iowa bridge decks and bridge deck overlays. The specific objectives of this investigation include:

(1) To identify major components of shrinkages (chemical, autogenous, and drying shrinkages) in Iowa concretes;
(2) To evaluate the influence of various constituent materials, such as types and contents of cementitious material and aggregate, and admixtures, on these shrinkages; and
(3) To provide recommendations for improving Iowa HPC mix design and construction practice so as to reduce the concrete shrinkage cracking potential.

Progress: The progress of activities is as follows:

• Completed all ring shrinkage tests and data plots. It was found that Mixes 2 and 5 had one sample broken during the tests because of the sample handling and one sample had no change in strain gage readings with time. Therefore, the project team will re-do the ring tests for these two mixes.

• Completed casting of all samples for elastic modulus, compressive and splitting strength tests. The measurements of these tests are in progress

• Completed preliminary analysis of the shrinkage test data. It was found that among the 11 mixes studied, two mixes cracked, which had the highest cementitious material contents but not the highest shrinkage values. Further analysis of the data is still continuing.

• Drafted the project report (70% done)

Reports: None

Implementation: Early age cracking in concrete due to excessive shrinkage is often reported by state DOTs, and the problem is a special concern for HPC used for bridge deck and bridge deck overlays. The most effective way to solve this problem is to select proper concrete materials and mix proportions so that the concrete will have a low tendency to shrink and/or to crack. The observations and conclusions from this proposed study will lead to valuable recommendations on HPC material selection and mix design to reduce the concrete shrinkage cracking potential.

TR-634

Agency:
Iowa State University

Principal Investigator:
Charles Jahren

Research Period:
July 1, 2011 –
June 30, 2012

Research Board Funding:
$85,920

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Pilot Construction for Granular Shoulder Stabilization

Objective: The objective of the proposed research project is to assist Iowa DOT in cost effectively mitigating edge ruts on granular shoulders by pilot testing the use of DUSTLOCK in a full scale maintenance setting and continuing to explore other alternatives such as developing standard specifications for a class of products that might have similar effectiveness and using other stabilizing strategies or paving short sections of shoulders.

Progress: The project is complete and the final report is being written. A final project meeting is scheduled for December 2012.

Reports: None

Implementation: The observations and conclusions from this study will provide recommendations on products and procedures available to mitigate edge rut problems for granular shoulders. In particular the use of DUSTLOCK will be investigated as a pilot construction project. State, county, and city transportation agencies/ jurisdictions can implement these recommendations. The results of this research could improve the behavior of granular shoulders, and reduce its maintenance cost.

Full implementation of possible recommendations may require the purchase of new equipment in order to perform the stabilization process. Alternatively, it may be possible to rent equipment or contract out certain operations. Changes for stabilization agent purchasing processes may be necessary to properly specify stabilization agents or to purchase proprietary materials. It is expected that researchers will be able to assist the Iowa DOT with these issues within the scope of this proposal.

TR-635

Agency:
Iowa State University

Principal Investigator:
Chris Williams

Research Period:
June 1, 2011 –
May 31, 2013

Research Board Funding:
$174,991

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Warm Mix Asphalt Phase II: Evaluation of WMA Quality Assurance Testing Protocols

Objective: Phase II of this study will evaluate the performance of plant-produced WMA mixtures as compared to HMA using NCHRP 9-43 recommendations. Other objectives involving curing behavior, quality assurance testing, and hybrid technologies are outlined as follows:

1. Compare the predicted and observed field performance of existing WMA trials produced in the previous Phase I study to that of HMA control sections to determine if Phase I conclusions are translating to the field.
2. Identify any curing effect (and timing of the effect) of WMA mixtures and binders in the field. Determine how the field compacted mixture properties and recovered binder properties of WMA compares to those of HMA over time for technologies common to Iowa.
3. Identify protocols for WMA sample preparation for volumetric and performance testing which best simulate field conditions.

Progress: All field sections were surveyed for the 2012 season and additional field analysis is currently in progress. Additional samples were produced in the laboratory from mix previously collected in the field during prior construction seasons. The samples are produced from mixes representing various regions within the state of Iowa and they incorporate various types of commonly used warm mix technologies, varying amounts of recycled asphalt pavement and a mix which contains multiple levels of shingles used in conjunction with WMA.

The sample density was evaluated. This allows for the density of the entire core to be measured as well as the density within just the top layers of the roadway. AASHTO T-283 testing for all core samples has been completed.

Reports: None

Implementation: WMA technology may have benefits in providing longer haul distances and or longer construction seasons as well as the ability to place thicker lifts. Lastly, it may also be possible to incorporate higher percentages of RAP although this will need to be carefully examined as to the effect on binder grade selection via reduced aging in production/construction of the virgin binder.

TR-636

Agency:
Iowa State University, the University of Iowa, the University of Northern Iowa

Principal Investigator:
Brent Phares

Research Period:
September 1, 2011 – August 31, 2013

Research Board Funding:
$303,433

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Bridge Damage Detection: Integration of Structural Health Monitoring System Concepts and Components – A Statewide Collaboration

Objective: The objectives are:

1: Final development of the overall SHM system hardware and software
2: Integration of vibration-based measurements into current damage detection algorithm
3: Evaluation and development of energy harvesting techniques

Progress: There has been significant communication between all the universities with the bulk of the effort/communication driven by the field implementation. The project team finalized the installation of the hardware components necessary of the system. Additionally, the team induced artificial damage into the first sacrificial specimen. Work has continued on the energy harvesting system. It is anticipated that, in the upcoming quarter, additional damage will be induced and the system will be installed.

Reports: None

Implementation: The area of Structural Health Monitoring has been of significant interest to the Iowa DOT and several Iowa Counties for many years. This is especially true as the DOT moves toward collecting and using more real-time data on the state of the transportation system. This interest and the representation of various DOT offices on the project TAC will ensure a successful completion of the project and implementation of its findings.

Since this topic also has implications to other nearby states, it is anticipated that many other states and counties will be interested in the results of the project. These results will be distributed to the engineering community through the publication of technical papers in the engineering press, and presentations at bridge and transportation conferences and workshops. Posting of pertinent information on the websites of the participating organizations will be made.

TR-638

Agency:
Iowa State University

Principal Investigator:
David White

Research Period:
June 1, 2011 –
May 31, 2013

Research Board Funding:
$100,000

Funding Source:
50% Federal – SPR
50 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Western Iowa Missouri River Flooding — Geo-Infrastructure Damage Assessment, Repair and Mitigation Strategies

Objective: The objectives of this research project are:

1. Field Reconnaissance — Review the geotechnical problems and challenges in the affected counties and cities, and prioritize areas for detailed in-situ testing and evaluation.

2. In-Situ Testing and Evaluation — Conduct in-situ testing to conduct a geotechnical assessment of the flood affected areas. The in-situ testing will focus on:
    a. Evaluating roadway support capacities (both paved and unpaved roads)
    b. Evaluating embankment conditions (slope failures)
    c. Identifying settlement problems along roadway segments, and around bridge abutments and culverts.

3. Field Data Report, Repair and Mitigation Strategies, and Recommendations — Develop a field data report, provide repair and mitigation strategies depending on the assessment of the level and extent of the damage, and recommendations for geo-infrastructure monitoring.

4. Guide for Geo-Infrastructure Flood Damage Assessment and Repair Solutions — Develop the emergency response criteria and guidelines for evaluating geo-infrastructure and recommending repair solutions following a flood event.

Progress: Results from Pottawattamie and Fremont county sites were analyzed. The research team also worked on the final report with detailed results, findings, and recommendations. The report is about 70% finished.

Reports: None

Implementation: The guide's intent is to be used by the County and City Engineers to prepare emergency response plans for future flood events. It will highlight important geo-infrastructure criteria and technologies for damage assessment, emergency response, and repair options. The details of the manual will be developed as an outcome from the research. A detailed data report with lessons learned, repair solutions, and recommendations for geo-infrastructure continuous monitoring will also be provided.

TR-639

Agency:
Iowa State University

Principal Investigator:
Chris Williams

Research Period:
November 22, 2011 – April 30, 2013

Research Board Funding:
$149,958

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Development of Bio-Based Polymers for Use in Asphalt

Objective: The objectives of this project are to:

- Identify the most promising polymerization chemistries for forming linear-chain polymers from vegetable oils.
- Identify the triglycerides most amenable to such polymerization and collaborate with plant scientists to identify/develop agricultural feedstock best suited to express these.
- Develop the structure-property relationships crucial to the use of soybean-oil based thermoplastics in applications currently dominated by petrochemcially-derived polymers.

Progress: The research team has synthesized multiple biopolymers using atom transfer radical polymerization (ATRP) and characterized them rheologically. The research team has blended two Kraton polymers (1101 and 1118) with asphalt binder supplied by Flint Hills (PG52-34). The blending has included multiple percentages of the two Kraton polymers and included full binder characterization. Blending of ATRP polymers with the asphalt and subsequent rheological characterization has been done too.

All asphalt-polymer blends were prepared with a base asphalt modified with 3% polymer. Rheology test results show the ability of the biopolymer to widen the grade range of asphalt almost identically as the commercially available SBS polymers, with the exception of increasing the low critical temperature 1.4°C higher than the D1118 SBS polymer. The Multiple Stress Creep Recovery (MSCR) test results also show the biopolymer can lower the Jnr value as low as the two commercially available SBS polymers can.

Reports: None

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

TR-640

Agency:
Iowa State University

Principal Investigator:
Tom Cackler

Research Period:
November 22, 2011 – November 30, 2013

Research Board Funding:
$150,000

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Optimizing Pavement Base, Subbase, and Subgrade Layers for Cost and Performance on Local Roads

Objective: The objectives of this study include the following:

1. Determine the level of increased performance on local roads when PCC is placed on granular subbase or treated subgrade and quantify the performance and cost effectiveness.

2. Develop a user guide for various traffic, soils and pavement factors for optimized performance and financial benefits.

Progress: The research team is working on design calculations to determine the in-situ coefficient of drainage and reliability percentage based on field conditions of the test sites. These variables will be utilized with the 1993 AASHTO pavement design formula to evaluate the benefit of pavement support materials. Fifteen sites were tested across the State with various subbase and subgrade conditions. The results are anticipated to be complete by the end of October 2012. Each of the pavements will be compared using the pavement distress and the field test results for the underlying subbase or subgrade condition.

Reports: None

Implementation: The guide will be published and circulated statewide by incorporating the findings into Chapter 6 of the SUDAS Design Manual. The guide will also be published on the IHRB and CP Tech Center Website. Upon completion of the study, SUDAS, County Engineers and Municipal Engineers would be responsible for applying the research results. Specific standards or practices that may be affected include SUDAS and the Iowa DOT design manual and specifications.

TR-641

Agency:
Iowa State University

Principal Investigator:
Chris Williams

Research Period:
November 22, 2011 – October 31, 2013

Research Board Funding:
$99,966

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Reflective Crack Mitigation Guide for Flexible Pavements

Objective: The objectives of the study are:

1. Develop guidelines for project selection including but not limited to design considerations such as existing pavement type, thickness, and distress, patching needs, traffic, and minimum subgrade support required.
2. Review preferred practice of rubblization and crack & seat techniques and the selection of proper fracture size and how it relates to performance. Develop quantitative quality acceptance criteria for these projects and recommendations for the use of leveling course material.
3. Develop a mechanistic, performance-based life cycle cost analysis with the MEPDG to further aid in project selection using these crack mitigation techniques based on previously completed studies on reflective crack mitigation techniques.

Progress: The literature review was completed and field locations for the various types of methods for mitigating reflective cracking have been identified. For the rock interlayer approach, local agency sites have been identified with challenges in accrued field performance being an issue. The research team has contacted the Special Investigations group and others at the Iowa DOT for data mining the various pavement sections using alternative crack mitigation techniques.

All of the pavement selections for the various types of reflective crack mitigation techniques have been identified. The pavement structure for some of the pavement sections has been determined. Preliminary pavement design analysis for some sections has been done.

Reports: None

Implementation: The benefits of this research will be improved pavement performance for Iowa jurisdictional agencies and the Iowa DOT. The project will provide guidelines for assisting engineers in selecting cost effective strategies for mitigating reflective cracking. Further construction guidelines for the strategies for mitigating reflective cracking will also be provided-currently there are no guidelines for crack & seat and rubblization in Iowa.

TR-642

Agency:
The University of Iowa

Principal Investigator:
Witold F. Krajewski

Research Period:
February 1, 2012 – January 31, 2014

Research Board Funding:
$172,721

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Pilot Project for a Hybrid Road-Flooding Forecasting System on Squaw Creek

Objective: This project is a 2-year plan for the design, implementation and evaluation of a hybrid flood forecasting system that combines real-time stream level observations with a state-of-the-art distributed hydrologic models called CUENCAS. The system will, over time, provide accurate predictions of flooding potential for each and every road/stream intersection in a river basin. The observation component of the system is accomplished with a stream-level sensing device, which uses ultrasound technology to measure the distance from the bridge deck to the stream water surface.

The device is designed for installation under the deck of a bridge. The hydrologic model provides a faithful representation of the waterways in a river basin and does not rely on calibrated parameters. However, it depends on the accurate description of travel times along the channels of the river networks.

Progress: The project investigators have constructed all 25 sensors but deployed only 17 of them to date. The remaining 8 require building customized mounting brackets and will be deployed by the end of the year. The seventeen deployed sensors work well and provide data in near real time (every15 minutes) to the database located at the Iowa Flood Center. Project investigators have developed a rainfall-runoff model for the Squaw Creek basin but are unable to test it due to the continuing drought. Overall the project is progressing on schedule and without major technical difficulties.

Reports: None

Implementation: A distributed flood-forecasting mathematical model capable of highly accurate predictions (i.e. with errors on the order of 1%) could replace the need for a network of observations by making predictions of flooding in all the intersections of roads and streams in a river network. However, the level of accuracy of current hydrologic models is much lower (~ 50% error) precluding their use as a sole forecasting tool of road conditions. In addition, the architecture of standard hydrologic models precludes the ability of forecasting flood levels on small tributaries. As an example, the National Weather Service provides routine stream level forecasts for about 100 locations in the state of Iowa. These forecasting locations usually correspond to large cities or highly populated regions, but provide no information on small creeks or the multiple intersections of roads and streams.

TR-643

Agency:
Iowa State University

Principal Investigator:
Halil Ceylan,

Research Period:
January 15, 2012 – July 31, 2013

Research Board Funding:
$119,975

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Evaluating Roadway Subsurface Drainage Practices

Objective: The objectives of this project are as follows:

- Conduct a comprehensive performance review of pavement subdrains in Iowa.
- Include the condition of the drains and a determination of whether they are functioning as designed
- Evaluate a corresponding pavement to determine if pavement deterioration is occurring at the drain locations.
- Determine the cause of the problem if there are drains that are not functioning properly.
- Make recommendations for improvements to the pavement drainage system, when appropriate.

Progress: The research team contacted and consulted Iowa District Maintenance Engineers on site selection in pursuit of field investigation for Task 3 (Forensic Testing and Evaluation). The input from district maintenance engineers have been incorporated into a list of candidate sites and a forensic test plan. About 80 sites have been identified from this task.

The subsurface drainage forensic testing and evaluation program was also initiated. Five sites in I-35 and US-30 have been visited and investigated so far. The preliminary findings from these sites are: (1) Tufa was observed but it did not always make drainage outlet non-functional (caused more than 50% blockage) and (2) little pavement cracking was observed on surface nearby drainage outlet but several mid-panel cracks were observed on pavement surface nearby culverts.

Reports: None

Implementation: Based on the outcome of this study, the research findings will be directly used by Iowa city, county, and DOT engineers to assess the performance of their pavement subdrains and improve their drainage practices.

TR-644

Agency:
Iowa State University

Principal Investigator:
Brent Phares

Research Period:
August 27, 2012 – December 31, 2015

Research Board Funding:
$90,000

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

This project is jointly funded with the Minnesota Local Roads Research Board.

Development of Cost-Effective Timber Bridge Repair Techniques

Objective: Currently no sources of guidance for the repair of timber bridges exist. At the same time county engineers have recognized several types of timber bridges that are in need of repair and maintenance; this represents a major concern. This project is to identify the state-of-the-practice of timber bridge repair through national and international search and to marry those repair techniques with the needs of county engineers. The efficacy of those techniques will then be evaluated from both engineering and fiscal perspectives. Through a multi-pronged approach, the most viable techniques will be communicated to engineers through a coordinated outreach effort.

Progress: A contract for services is currently being executed. No work has begun on the project.

Reports: None

Implementation: The principal benefit of the work proposed here will be that local system engineers will have formal guidance for repairing timber bridge components. Currently county and city engineers have little to no State or national sources to which they can turn for guidance on the repair of timber bridges. This represents a significant problem as they strive to ensure the safety of the travelling public. The benefit of having such a resource will be measured by improving the overall condition of the transportation system and reducing system failures through implementation by local officials.

TR-645

Agency:
University of Minnesota - Duluth

Principal Investigator:
Brian K. Brashaw

Research Period:
August 13, 2012 – December 31, 2014

Research Board Funding:
$60,000

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

This project is jointly funded with the Minnesota Local Roads Research Board.

Development and Integration of Advanced Timber Bridge Inspection Techniques for NBIS

Objective: Inspections for timber bridges have been mostly limited to visual inspection, hammer sounding and probing. These techniques have proven appropriate for advanced decay detection, but are inadequate for early stage or internal deterioration. It is critical that efforts be conducted to develop and implement advanced timber inspection techniques into routine bridge inspections in accordance with National Bridge Inspection Standards (NBIS) requirements.

This project will result in improved assessment information that can be used to improve the safety and reliability of bridges. An experienced research team will identify and help implement an inspection protocol for timber bridges (with an emphasis on timber substructure) that can accurately assess structural condition and support the load rating process. Key milestones include the development of standard inspection protocols, integration of the results into bridge data management software, development of a customized inspection manual, outreach training for districts, recommendation of equipment purchases, and completion of an economic assessment on the use of advanced inspection techniques.

Progress: A contract for services is currently being executed. No work has begun on the project.

Reports: None

Implementation: This project will provide clear implementation strategies that can be used to accurately identify deteriorated structural timber members and provide key information that can be used to adjust load ratings, develop repair strategies and improve maintenance. One outcome from the project will be a recommendation for the purchase of timber inspection equipment for sharing within the State. Training and outreach will be conducted for inspectors and engineers for each District. By providing training and access to advanced timber inspection equipment, the project will improve the safety and reliability of timber bridges.

TR-646

Agency:
HDR Engineering

Principal Investigator:
Phil Rossbach

Research Period:
May 10, 2012 – June 30, 2013

Research Board Funding:
$289,494

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Development of Bridge Inspection, Load Rating & Maintenance Manuals

Objective: Under a project funded by the Iowa Highway Research Board, HDR will provide services to the Iowa Department of Transportation to develop Bridge Inspection, Load Rating and Maintenance manuals with the intent of capturing existing Office of Bridges and Structures (OBS) policies and procedures, and summarizing current and past knowledge of DOT staff in these areas. The manuals would utilize a .pdf format in order to have sections or pages that may be linked to Iowa DOT's Structure Inventory and Inspection Management System (SliMS) software.

Progress: The first phase of the effort included development of topic outlines for separate Inspection, Load Rating and Maintenance Manuals. Phase I was completed in August 2012. This second phase of the development of the manuals incorporates the actual writing, development of figures and incorporation of figures and photographs into the individual manuals. The second phase, begun in September 2012, will also assign links to the SliMS program, although actual programming of the links would be performed by InpectTech, the developers of the SliMS software.

Reports: None

Implementation: The manuals will provide the required technical information and guidance to allow DOT Bridge staff and District maintenance personnel to consistently inspect, evaluate and maintain on-system bridges. A secondary benefit will be to provide a framework for policy guidance to local municipal and county bridge owners and employees as well as to independent bridge consulting firms working for the State or local entities.

TR-647

Agency:
Iowa State University

Principal Investigator:
Brent Phares

Research Period:
July 1, 2012 – December 31, 2013

Research Board Funding:
$143,391

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Methods for Removing Concrete Decks from Bridge Girders

Objective: The objective of this work is to determine the most, and/or develop new, cost-effective and efficient deck removal techniques for steel and prestressed concrete superstructure bridges. Further, the work proposed herein will include guidance on assessing and repairing steel girders that are damaged during removal of a deck. The following criteria will be considered as part of the evaluation: Impact on the future performance of the superstructure, Cost, Time, Safety, and Noise

Progress: This project has just begun. The investigator has initiated a state DOT questionnaire to begin collecting information that will be helpful in subsequent phases. Additionally, they have been organizing the meetings with contractors.

Reports: None

Implementation: At the conclusion of this project, a suite of tools will exist that will allow bridge owners to make informed decisions regarding the removal of concrete decks from bridges. The outcomes of this work will be immediately implementable as standards of practice will be developed.

TR-648

Agency:
Iowa State University

Principal Investigator:
Peter Taylor

Research Period:
July 1, 2012 –
June 30, 2016

Research Board Funding:
$83,049

Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Evaluation and Testing of a Light-Weight Fine Aggregate (LWA) Concrete Bridge Deck

Objective: The objective of this project is to perform laboratory and field testing and evaluation of a concrete bridge deck constructed with LWA concrete. The CP Tech Center will conduct material tests on the LWA and concrete mixtures used in the bridge deck, both in the lab and during construction. In addition, the Bridge Engineering Center (BEC) will conduct live load field tests to evaluate the performance and condition of the LWA deck and the control deck both at the time of placement and approximately 1 year after construction. Evaluation of performance will be made through comparisons with design assumptions, previous research, and the performance of the LWA deck compared to the control.

Progress: Samples of lightweight materials have been received and a laboratory test plan is being finalized. Communications have been started with the County Engineer to coordinate field activities.

Reports: None

Implementation: The benefits of this research include collected field data and information regarding the structural performance of LWA in concrete bridge decks compared to a similar bridge deck constructed of normal weight concrete. By providing internal moisture to the concrete, the LWA facilitates internal curing of the concrete, in turn, reducing the short and long term shrinkage cracking that often results during concrete curing. With no reduction in strength, concrete with reduced shrinkage cracking has a potential advantage over typical concrete mixtures in our Midwest climates and the subsequent use of deicing salts in the winter months. In addition, there is the potential for improved durability, as well as economic benefits as well.

HR-1027

Agency:
Iowa Department of Transportation

Principal Investigator:
Vanessa A. Goetz

Research Period:
March 1980 – on-going

Research Board Funding:
$85,000/year (covers salary and state share of costs for FICA, IPERS, health insurance, vehicle costs and expenses)

Funding Source:
100% State - 100% Secondary funds

Secondary Road Research Coordinator

Objective: This is a full-time position at the Iowa DOT. The coordinator's jobs are to act as a research liaison with all of the county engineers and solicit new, innovative and progressive ideas. He or she also actively promotes research for solutions to problems and ideas that will improve quality and reduce costs on the secondary road system.

Progress: Vanessa Goetz continues communications with county engineers to discuss problems encountered by secondary road departments and to discuss current research projects throughout the year.

At any one time as much as 50 percent of IHRB projects involve the secondary road system, including secondary projects with consultants. The coordinator assists these counties with special testing, evaluation and writing of reports necessary to the research and keeps county engineers updated on the latest important research results.

Reports: None

Implementation: There are many problems that are unique to the secondary road system in Iowa. These problems are often common to several counties. Coordination between counties is necessary for understanding the problems and formulating solutions. Proper documentation and dissemination of research results allows for timely technology transfer to and between the counties.