



FY 2010 ANNUAL REPORT

Research, Intelligent Transportation Systems, and Technology Transfer Activities



**Research and
Technology Bureau**
A DRIVING FORCE OF INNOVATION
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**Iowa Department
of Transportation**

Executive Summary

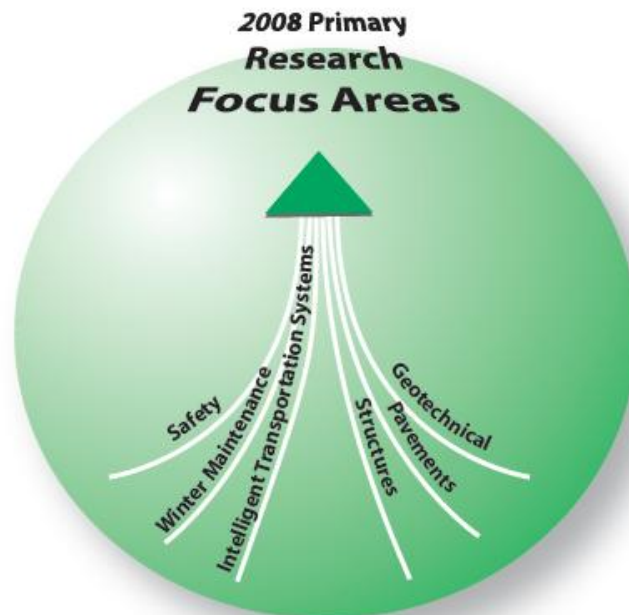
Transportation research makes a difference for Iowans and the nation. Implementation of cost-effective research projects contributes to a transportation network that is safer, more efficient, and longer lasting. Working in cooperation with our partners from universities, industry, other states, and FHWA, 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 2010, Iowa led fifteen active pooled fund studies, participated in twenty-two 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 20 continued, 9 new, and over a dozen reoccurring initiatives such as the technical transfer/training program. Additional research is managed and conducted by the Office of Traffic and Safety and other departments in the Iowa DOT.

In 2010, 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 three national pooled fund traffic safety projects and administers other widely varied safety projects such as a “GO Team” study of teen crash fatalities, evaluation of Iowa’s Driver Improvement Program, evaluation of dynamic warning signs at high crash curves, countermeasures to prevent lane departures, and tests of wet reflective pavement markings.
- **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 testing an automated deicer blending system, thermal mapping, and a combination snow fence/deer fence. 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 five 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.
- **Geotechnical** – The Partnership for Geotechnical Advancement (PGA) mission has been expanded into the new Earthworks Engineering Research Center (EERC) at Iowa State University. 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. The research portion of Iowa's SPR program has generally continued to grow (see *Attachment 1*) so that in FY 10 the total was \$2,745,092.

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 10 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.

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



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.

COMPLETED IN FY10

Portable Weather Station

In spring 2009 the Office of Maintenance requested proposals for a high-quality portable weather station that could be strategically relocated for summer projects and winter snow removal operations. The trailer-mounted portable weather station was received in December 2009. The station was equipped with four moveable solar panels, an electric 30-foot mast, an all-in-one wind, precipitation, air temperature, barometric pressure, and relative humidity sensor unit, a cabled soil/pavement temperature probe, and a non-contact infrared pavement temperature sensor. The sensors were removed for transport and were stored in a cabinet on the trailer. The mast folded for transport and telescoped for custom height adjustment. The trailer was equipped with jacks for leveling and stabilization. The station was tested for basic reliability and sensor performance for a month and a half in Ames before being moved to its operational assignment near Osceola, IA in early February 2010.

★ **Result:** The trailer-mounted station performed well and seemed to have successfully fulfilled a portion of its winter duties. Data from the station are available online through the North American RWIS website, Clarus (www.clarussystem.com) and via the Iowa State University Iowa Environmental Mesonet (<http://mesonet.agron.iastate.edu>). A written evaluation of the equipment and results was submitted.

Automated Liquid Deicer Blending System

The Office of Maintenance purchased an automated liquid deicing chemical blending system consisting of miscellaneous plumbing pieces, pumps, valves, tanks, electronic hydrometers, and other electronic components. The system was evaluated to automatically blend different ratios of liquid deicing chemicals to produce a customized liquid deicer blend with more melting ability. The contract was let in October of 2009 and the equipment was installed in November at the Mt. Pleasant Maintenance Garage. Several modifications were made during the winter season and the system was up and running.

★ **Result:** Operators used the system several times to mix calcium chloride and salt brine together while loading it on the truck versus mixing it in to a holding tank and waiting for the proper time to use the mixture. A testing protocol was established and more testing was completed in the 2010 – 2011 winter season. *A written evaluation of the equipment and results was submitted.*

Combination Snow/Deer Control Fence

On many roadways, maintenance forces attach lath or plastic snow fence to existing right-of-way fences to help control blowing and drifting snow. The porosity of the snow fence helps minimize blowing and drifting immediately downwind. The practice has proven to be an effective tool to control blowing and drifting snow problems if the right of way is sufficient to store the trapped snow. The addition of the lath or plastic fence was not very attractive resulted in a duplicated effort since two individual fences (Right of way fence and snow fence) had been installed for two needs. The existing fence was also not tall enough to deter deer from crossing the roadway. The snow fence erected along a stretch of Highway 20 near Williams was installed in October and November of 2009. 3000 feet of ROW fencing was removed and 4X4 posts were installed. Installed on the posts was a galvanized woven wire consisting of 1" X 2" squares. Attached to the fencing was black plastic snow fence at various heights above the ground. One section of 4' plastic fence was attached with a 1 foot gap at the bottom. The next section of 4' plastic fence was attached with a 2' gap at the bottom and yet another section was designed with two overlapping sections of 4' fence to obtain a 6 foot plastic fence attached leaving a 1' gap at the bottom. However winter moved in shortly after the fence was completed and measuring stakes did not get installed. The measuring stakes were installed summer 2010. This research was conducted by the Iowa DOT Maintenance staff. *The project was discontinued in 2010 and instead an Iowa Highway Research Board Project took its place. A summary document was submitted explaining the work done.*



★ **Result:** Improved safety for motorists from deer collisions and blowing snow.

Human Factors Focus Group (New)

Human error is a leading factor in the majority of transportation crashes whether by automobile, plane, train, or bicycle. This focus group brought 140 stakeholders and interested professionals together to identify and discuss human factor research needs and to establish priorities for future research. Results of the meeting were published at http://www.iowadot.gov/research/human_factors.htm.

★ **Result:** Clearer understanding and priority of human factors research needs.

Intelligent Compaction Pilot Project

Following on the success of the IC workshop in 2008, the Office of Construction began an evaluation of intelligent compaction on active construction projects in the 2009 and 2010 construction seasons. A preliminary data report was submitted to Iowa DOT on April 8, 2010 with results obtained from three demonstration projects held during summer-fall 2009. The Phase I report presented detailed findings from each project site including: empirical correlations between roller IC measurements and in-situ density, modulus, and shear strength measurements based on measurements obtained from various calibration and production test beds.



★ **Result:** A clearer understanding of changing technology and how to use it most effectively.

Performance of Embedded Galvanic Anodes

Four different corrosion protection systems were installed on bridge elements in Iowa. The corrosion protection systems included: Zinc sheet Cathodic Protection - Cedar Rapids; Galvashield XP anodes - Council Bluffs; Norcure Chloride Extraction - Council Bluffs; and Arc spray metalizing – Ottumwa. The intent of the studies was to determine a) if the systems were working properly and b) to compare the effectiveness of the different systems. Researchers performed site inspections that included visual inspection, system continuity checks, system diagnosis, depolarization testing, and sampling. Laboratory work included chloride testing of concrete samples (Norcure system) and microscopic examination of field samples of anode materials.

★ **Result:** Extended life of prestressed concrete beams and reduce maintenance cost.

LRFD Training

The Office of Bridges & Structures implemented LRFD specifications developed under a pooled fund study TPF-5(068). Manuals and design software were purchased and training presented.

★ **Result:** Ability to stay current with national LRFD standards of bridge design

Sign Management System Implementation (Phase 3)

The Sign Management System helped Iowa DOT develop a statewide inventory and management tool for roadway signs. Phase III was the Implementation & Operations Plan for the system.



★ **Result:** More effective road sign management

Mid Continent Transportation Symposium (New)

This was a biennial event that brought researchers and transportation professionals together to discuss implementable solutions for challenges experienced by federal and state departments of Transportation, cities, and counties.

2009 Research Peer Exchange (New)

Under SPR rules, each state department of Transportation was required to hold a research peer exchange once every three years. Iowa's 2010 peer exchange focused on promising research. Ten states and FHWA were invited to participate. The event was held August 19th through August 21st in conjunction with the Mid-Continent Transportation Symposium.

Maintenance Expo

The Maintenance Expo was attended by about 400 front-line DOT employees (mostly equipment operators) who learned about new equipment, technology and methods for improving their maintenance functions. This was the only structured opportunity where equipment operators got to learn about developments from pooled funds such as Aurora, RWIS, SICOP, MDSS, Clear Roads, and the Maintenance Concept Vehicle.

Research Implementation & Technology Transfer

Funds were used to learn about new research, technology and processes in other states that conducted small test or pilot projects based on research reports and shared the knowledge gained as a result. This was an ongoing item in the SP&R work program. An annual Research Implementation & Technology Transfer Plan detailing use of funds for this line item was submitted separately for FHWA approval.

Denver Bypass Structural Monitoring

Iowa DOT in cooperation with the FHWA successfully demonstrated the use of precast concrete panels in the construction of new bridge approaches. The next step in this endeavor was to demonstrate this accelerated construction technique on existing bridge approaches under live traffic condition with limited lane closures. A project on US 63 in Bremer County was identified and precast bridge approaches were installed. To evaluate the effectiveness of the repair, and to provide validation for similar potential remedial measures in the future, the goal of this study was to quantify the repair performance through instrumentation and monitoring. The test program would primarily seek to verify that the design details had sufficient strength and serviceability characteristics and to provide a mechanism for alerting interested parties should the behavior be unsatisfactory.

★ **Result:** If results of monitoring show this project is successful, approach replacements could be completed over night with 12 hour lane closure.

ONGOING ACTIVE PROJECTS

Basic Agreement with ISU/InTrans

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.

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

IOWA STATE UNIVERSITY
Institute for Transportation

Remote Sensing Coordinating Committee

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.

★ **Result:** Training and upgrading of existing infrastructure and promoting more efficient and effective use of the technology.

AASHTO Partnerships

Iowa DOT supports five AASHTO cooperative projects:



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

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

General Funds for Future IHRB and Other Projects

These funds are set aside for future projects in this plan including some approved by Iowa Highway Research Board. Projects supported by the Board that meet SPR criteria will be funded here. The plan will be amended as specific projects are designated.

Information Technology Development (Student Programmers)

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.

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.

Pavement Marking Management System

Phase 4 of this project was requested by the Offices of Traffic & Safety and Maintenance. This phase extends across several 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.

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 10, a total of 5 NHI and other technical courses were scheduled to be attended by more than 110 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.

Bridge Construction Web Management

Bridge construction projects are becoming increasingly complex as the demand for context sensitive solutions, aesthetic designs and accelerated bridge construction becomes more prevalent. In addition, the Iowa DOT is entering a phase of design and construction of large border bridges such as the I-80 (Let 2008 for \$56 Million) and U.S. 34 bridges over the Missouri River and I-74 over the Mississippi River. Researchers are investigating Iowa DOT requirements for a web-based construction project management and collaboration tool, reviewing industry "best-practices," reviewing commercially available software options, and making recommendations for implementation and/or development of software tools. This work is proposed to include a pilot project.

★ **Anticipated Result:** The successful implementation or development of software could speed construction submittal review time, reduce incidence of delay claims and free up DOT staff from project management administrative tasks.

Sign Management System (Phase IV)

The Iowa DOT has established an agency goal of developing 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. Phases I, II and III have been completed.

NEW ACTIVE PROJECTS

“GO Team” - Teen Driver Fatalities Study

Based on the crash investigation principles developed in 1967 by the National Transportation Safety Board (NTSB), this project will consist of an interdisciplinary team of crash safety experts to develop short case studies for each fatal teen crash in Iowa. At the core of NTSB investigations is the "Go-Team." The purpose of the NTSB Go-Team is simple and effective: begin the investigation of a crash with as much data as possibly available within a short timeframe, assembled from a team of experts proficient in examining the complex nature of a car crash. This team will consist of experts in driver behavior and performance, Iowa crash data,

traffic engineering, and logistics. In the first year, they will retrospectively examine at one year fatalities (2008) and plan for a 2009 prospective study.

★ **Anticipated Result:** Identify gaps in the Iowa crash data and appropriate priorities for Graduated Driver Licensing (GDL) enhancements.

Monitor Red Rock Mile Long Bridge

A data collection system similar to that installed on the Saylorville Reservoir bridge that will monitor wind speed and direction and provide notification to DOT personnel when preset thresholds (to be furnished by the DOT) have been reached. Following installation of the monitoring system, vibration data will be 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. Following installation of the monitoring system, the installed instrumentation system will notify interested parties, via cellular telephone, that preset thresholds have been reached. Also, when a threshold is breached, a limited amount of behavior data bursts will be 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.

Wind Loads on Dynamic Message Cabinets

Large Dynamic Message Signs (DMS) are used to provide timely information to motorists. There is increasing evidence 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.

Computational tasks are: 1) Study the influence of wind direction on the pressure distributions on DMS panels. 2) Study the behavior of typical trusses supporting DMS cabinets when subjected to wind forces computed using the CFD simulations. 3) Estimate the dynamic loads on DMS cabinets. 4) Perform detailed dynamic analysis of typical DMS structure using the above estimated dynamic loads. 5) Perform an integrated CFD-computational structural analysis to more fully account for aero-elastic phenomena like flutter and buffeting, with a particular focus on DMS structures. 6) Investigate the effect of damping on the dynamic response of DMS structures. 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

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.

★ **Anticipated Result:** Better understanding of the causes of winter weather crashes and possible preventive strategies.

Commercial Driver Fatigue

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.



Drilled Concrete 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.

★ **Anticipated Result:** The data base will be used to help in the implementation of LRFD and determine design parameters for future drilled shafts.

Reduce Speed on High Crash Curves (New in FY10 Plan)

The crash rate on horizontal curves is about three times that of normal straight highway sections. This research will evaluate the effectiveness of low cost dynamic speed signs and other low cost treatments on rural roadways in reducing speeds and crashes. Curve related crashes result from a number of causes, including driver workload, driver expectancy, and speeding. Reducing speed on curves can be done in the short term and at significantly lower costs than making geometric improvements. Dynamic curve warning signs are one method to be tried.

★ **Result:** Safer roads at lower cost than reconstruction

Lost License Resource Pilot (New in FY10 Plan)

It is not uncommon for drivers who have lost their license to continue driving, creating both law enforcement issues and possible safety hazards. For this pilot project, researchers will create a resource document with information on alternate means of transportation and will examine revoked drivers' responses. The pilot will be implemented in a rural area of the state. If results indicate the resource document is helpful in reducing continued driving incidents, similar documents may be developed for other areas of the state.

★ **Result:** Possible reduction in incidence of driving while suspended or revoked.

PROJECTS FUNDED BUT NOT BEGUN BEFORE FY11

Washing Weathering Steel Bridges

The objectives of this work are to determine if and at what locations chloride contamination above the critical threshold is occurring on weathering steel bridges. Information that indicates that salt plumes may be extending significant distances from the point of application. At the same time, weathering steel is being used more extensively and its performance is reliant upon the formation and maintenance of a protective patina which is negatively impacted by chlorides. The degree (including location, rate of accumulation, etc.) and location of contamination in existing bridges needs to be determined.

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. It is proposed to have the researchers from Rutgers University use the technology to assess the condition of nine bridge decks in Iowa starting the month of May 2009. This will be a true test of the effectiveness of this technology since the bridges being tested are scheduled for deck repairs shortly thereafter. This project may 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.

Investigate Defects in Existing Concrete Railing

The Illinois DOT has discovered large voids in the core of the slip formed bridge barrier rails that could significantly reduce the structural capacity and shorten the service life of the rail. While Iowa DOT is not aware of similar situations in barrier rails in Iowa, it may be that the problem has simply not yet been discovered. Traditional investigation techniques would require taking cores to inspect the subsurface conditions. Apart from the destructive nature of this testing, it is also hampered by the location of the tests. Without other indications of suspected defects, the investigators can only select random locations with the hope that a sufficient number of test locations will provide for an accurate determination of the overall conditions. If a non-destructive means could be used to evaluate the suspect rail, a large volume of rail could be examined more thoroughly with the destructive testing reserved to confirm suspect areas.



OWI Recidivism

This study will focus on OWI offenders and the sanctions that are used to deter additional offenses. Researchers will create a descriptive profile of first and second-time OWI offenders and seek to answer specific questions such as “What demographic variables, attitudes, and behaviors and sanctions are associated with Driving Under Suspension and second OWI offenses?”

Maintenance and Design of Steel Abutment Piles in Iowa Bridges

This is a two-year project funded with both SPR and Iowa Highway Research Board. Corrosion and resulting section loss in steel pilings has recently been observed on exposed piles immediately below bridge abutment footings and has raised the awareness within the Iowa DOT that additional research and investigation into the phenomenon is required. The findings of this

research will result in improved design and protection methodologies for existing and newly constructed bridges using driven steel pilings.

VOIDED PROJECTS

Evaluation of Iowa's Driver Improvement Program

This study was originally included for funding in the FY10 Plan and was later removed.

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. This permits purchase of equipment or software not normally used in day-to-day work of the department.

Hamburg Wheel Tracking Device

Iowa is among 39 highway agencies that utilize AASHTO T-283 as the primary measure of moisture susceptibility. This test, adopted in 1985, has been widely criticized for its marginal correlation to field performance. The Hamburg Wheel Tracking Device (HWTD) measures the combined effects of rutting potential and moisture-induced damage by rolling a steel wheel across the surface of an asphalt concrete specimen immersed in water.

The objectives of the study/ technology implementation were:

1. Purchase a Hamburg Wheel Tracking Device for evaluation.
2. Compare the unit's ability to identify moisture susceptibility to that of AASHTO T283.
3. Evaluate the rutting potential of asphalt mixtures and correlate to field surveys.
4. Evaluate the stripping potential of both HMA and WMA mixtures.
5. Use results to incorporate the HWTD into Quality Assurance measures.

Three projects were selected in the 2009 construction season to demonstrate different WMA technologies in accordance with ISU. Samples were collected daily from the plant produced mix and compacted such that the specimen best approximates the in-situ moisture content and compaction temperature. Additional specimens were stored for later testing. Once the HWTD was obtained, the stripping inflection point (SIP) was determined on the specimens and compared to AASHTO T283 tensile strength ratio (TSR) results. Changes to SIP and TSR over time were assessed to identify the long term effects of WMA additives/ processes as well as the HWTD's ability to measure these effects. The SIP and TSR were also compared for HMA control sections. Additional testing plans were made for the 2010 construction season.

★ **Result:** Recommendations and specification language for a Developmental Specification for use on future projects.

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. In FY 10 Iowa received the benefit of over \$2 million in research for its investment of \$312,000 in Iowa-led pooled fund studies, more than a six-fold return. See *Attachment 8* for details of the investment leverage.

Iowa currently leads 15 national pooled fund projects and is an active participant in 20 others. Each pooled fund study and its anticipated impact are described here.

Iowa-led Pooled Fund Projects

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 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:** Safe, efficient, convenient, and socially and environmentally sound movement of people and goods

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:** More efficient highway maintenance operations and safer winter road conditions

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:** More effective ice and snow removal and safer winter driving for motorists and for maintenance personnel.

REPORT (CARS) – SPR-3(079)



The CARS (Condition Acquisition and Reporting System) consortium was formed to promote the deployment of road condition reporting systems and road weather prediction systems. The resulting CARS program is used in Iowa as described in the next section under ITS Projects. A description of the various aspects of CARS used by Iowa and other states can be found at www.carsprogram.org.

★ **Result:** Motorists can make critical decisions such as postponing a trip when road conditions are deteriorating or rerouting if an incident has closed a roadway.

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:** Continued improvements in winter operations and safety.

Long-Term Maintenance of Load Resistance Factor Design (LRFD) Specifications – TPF-5(068)

LRFD incorporates state-of-the-art analysis and design methodologies for bridges with load and resistance factors based on the known variability of applied loads and material properties. The load and resistance factors are calibrated from actual bridge statistics to ensure a uniform level of safety. Forty-eight states are partners in the project. The project consultant assists the AASHTO Highway Subcommittee on



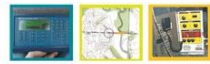
Bridges and Structures in interpreting, implementing, revising, and refining the AASHTO *LRFD Specifications*.

★ **Result:** Uniform service levels and bridge reliability resulting from using LRFD should ensure superior serviceability and long-term maintainability for bridges.

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

SWZDI

Smart Work Zone Deployment Initiative



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:** Increased safety and efficiency of traffic operations and highway work

Performance Properties of Ternary Mixes – TPF-5(117)

DOT's have long used fly ash and ground granulated blast-furnace slag (slag cement) as a partial replacement for Portland cement in concrete production, but few attempts have been made to optimize the use of fly ash or slag cement to produce concrete mixtures that meet specific performance objectives. This project provides information needed to make sound engineering judgments pertaining to use of supplementary cementitious materials in conjunction with Portland or blended cement. Two phases have been completed and the third is underway. Project partners include six other states, FHWA and the Concrete Pavement Technology Center at InTrans (CP Tech Center).



★ **Result:** More effective utilization of supplementary materials and/or blended cements, enhancing the life-cycle performance and reducing the cost of transportation pavements and structures.

Surface Characteristics – TPF-5(139)



One pressing issue for the PCC paving industry is surface characteristics, the pavement properties that affect smoothness, friction, noise, drainage, splash and spray, rolling resistance, and reflectance. This study is the continuation of a comprehensive data collection and analysis program on new and existing pavements started in 2005. The research has produced a broader range of applicability and developed innovative texturing techniques with the potential to significantly reduce noise. Field sites consist of both conventional and innovative texturing techniques. Project partners include three other states, FHWA, industry and the CP Tech Center.

★ **Result:** Lower pavement noise and acceptable levels of smoothness, friction, and safety

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:** This project will help meet the challenge to design and build longer life concrete pavements that result in a higher level of user satisfaction for the public by using innovative materials and construction optimization technologies and practices.

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:** Established guidelines for the use of integral abutments with curved girder bridges



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.

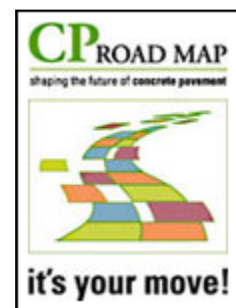
★ **Result:** Pavement foundations that are more durable, uniform, constructible, and economical

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:** Concrete pavements that are consistently long-lasting, constructible, and cost efficient



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:** Reduced crashes and related injuries among teen drivers by increasing driving skill and safe driving practices.

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:** Longer lasting pavements



Structural Health Monitoring – TPF-5(219)

Numerous damage detection algorithms exist to detect a change in the structure, but that information by itself is of little value to a state bridge engineer. What is needed is a structural health monitoring (SHM) system capable of evaluating the structural capacity and remaining service life of a bridge. The 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.

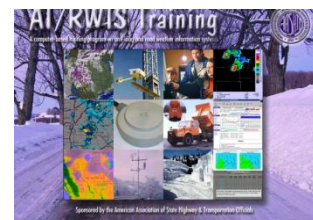
★ **Result:** A reliable means of predicting service life and capacity of bridges

Pooled Fund Projects with Iowa Participation

Pacific Northwest Snowfighters – TPF-5(036)



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. Corrosion inhibited Magnesium Chloride, Calcium Chloride, and Sodium Chloride (PNS Categories 1, 2, and 4, respectively) will be utilized for this research. Each product will be applied at varying rates, road conditions, temperatures, and humidity in order to establish their

performance.

Testing will also be performed on the materials stored in the covered and uncovered storage sites and the storage tanks to determine if there is separation of the deicer and inhibitor and whether the product breaks down during storage (i.e. how long can the product be stored and still be effective when applied to the roadway).

★ **Result:** Better stewardship of resources through improved understanding of chemical performance

Transportation Curriculum Coordinating Council: Training Management and Development (TCCC) – TPF-5(046)

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://www.nhi.fhwa.dot.gov/tccc/>.



★ **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.

Midwest States Accelerated Testing Program – TPF-5(048)



The Civil Infrastructure Systems Laboratory at Kansas State University evaluates various pavement components such as bases, AC and PCC using full scale accelerated pavement testing. The load testing can be conducted under a variety of environmental conditions in short time frames due to the ability to place more loading cycles on the pavement than can be achieved on a highway during the same time period.

★ **Result:** Conducting full-scale, accelerated testing of full-depth pavement section under realistic loading at a reduced operation cost

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

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:** Assessment of new tools and technologies

Transportation Library Connectivity
Pooled Fund Study – TPF-5(105)

Transportation Library Connectivity - TPF-5(105)

Transportation information services are developing at a rapid rate in the U.S. with significant advances almost every month. This pooled fund supports many of those initiatives and is dedicated to serving as a link to the future, when access to transportation information by practitioners and researchers will be rapid, reliable and institutionalized. Members also receive cost offsets and subscription management services to the Online Computer Library Center (OCLC). Progress can be tracked at www.libraryconnectivity.org.

★ **Result:** Shared knowledge and more cost efficient services

Investigation of Fatigue Life of Steel Base Plate to Pole Connections – TPF-5(116)

This project was conducted to investigate what improvements can be made to the base plate to pole connections for traffic structures, such as socket welds, to improve their fatigue life. Results will include a fatigue design guide which outlines how to quantitatively include improvements in the connection detail in the design process and a list of changes to the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals to recommend to the AASTHO T-12 Committee.

★ **Result:** Longer life of supports for highway signs and similar traffic structures.

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

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:** Longer lasting asphalt pavements.

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



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:** A test procedure that directly evaluates the permeability (transport properties) of concrete and relates these to anticipated performance with the use of exposure conditions.

CP Roadmap Administration – TPF-5(185)

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:** Concrete pavements that are consistently long-lasting and cost efficient.

Updating U.S. Precipitation Frequency Estimates for the Midwestern Region – TPF-5(187)



In some parts of the country, rainfall maps have not been updated for approximately 50 years. That means we are ignoring the last 50 years of rainfall data in our basic hydrologic estimates for drainage structures. 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 updates will be published

as subsequent Volumes of NOAA Atlas 14 "Precipitation-Frequency Atlas of the United States" on the web at www.nws.noaa.gov/ohd/hdsc.

★ **Result:** Better data for designing drainage structures.

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

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 represents 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:** Prevention of fatigue cracks and extended life of affected bridges.

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



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:** Safer roadsides and roadways

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

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:** The software improvements will make the program more versatile and provide additional analysis capabilities.

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

The use of recycled asphalt shingles (RAS) in hot-mix asphalt (HMA) applications has grown across the U.S. over the last 10 years. Although the majority of states are using manufacturers' RAS, there has been a rapidly growing interest in the use and applications of tear-off RAS in hot-mix asphalt. Many states share common concerns and questions in the use of tear-off shingles. Previous research has allowed for only limited laboratory testing and field surveys. Researchers and bituminous/material engineers still require additional research to study the effects of tear-off RAS on the performance of HMA applications and their economic value.



★ **Result:** Understanding the best practices for use of recycled asphalt shingles in hot-mix asphalt applications

Ultra-High Performance Concrete Connections between Precast Bridge Deck Elements – TPF-5(217)

Precast concrete bridge deck panels and precast concrete deck-bulb-tee girders both present solutions capable of facilitating accelerated construction/reconstruction/rehabilitation of highway bridges. However, the connections between these elements, which must be completed in the field, have proved to be a hurdle to successful implementation. In short, the connections between elements present long-term durability concerns and often result in less than desirable performance of the system as a whole.

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:** Better structural performance of UHPC connections in precast bridge decks.

Clear Roads – TPF-5(218)



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:** Improved winter maintenance techniques, safer winter driving conditions

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

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:** Better design of roundabouts.

ABC Decision Making and Modeling Tool – TPF-5(221)

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.



The final tool set will allow the user to specify key project characteristics (e.g. bridge length, complexity, road user characteristics, environmental requirements, traffic levels, existing levels of congestion, and construction site attributes) and to evaluate the economic impact of applying various ABC technologies and management approaches such as rapid, onsite construction, standardization, or PBES

to a particular project. This tool will incorporate not only construction costs (including traffic control costs) but also include estimates of soft costs including user delays resulting from congestion, rerouting, and/or closures associated with the project.

★ **Result:** Accurate early assessment of whether ABC will be an effective option for bridge construction.

Instrumentation to Aid in Steel Bridge Fabrication – TPF-5(226)

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.

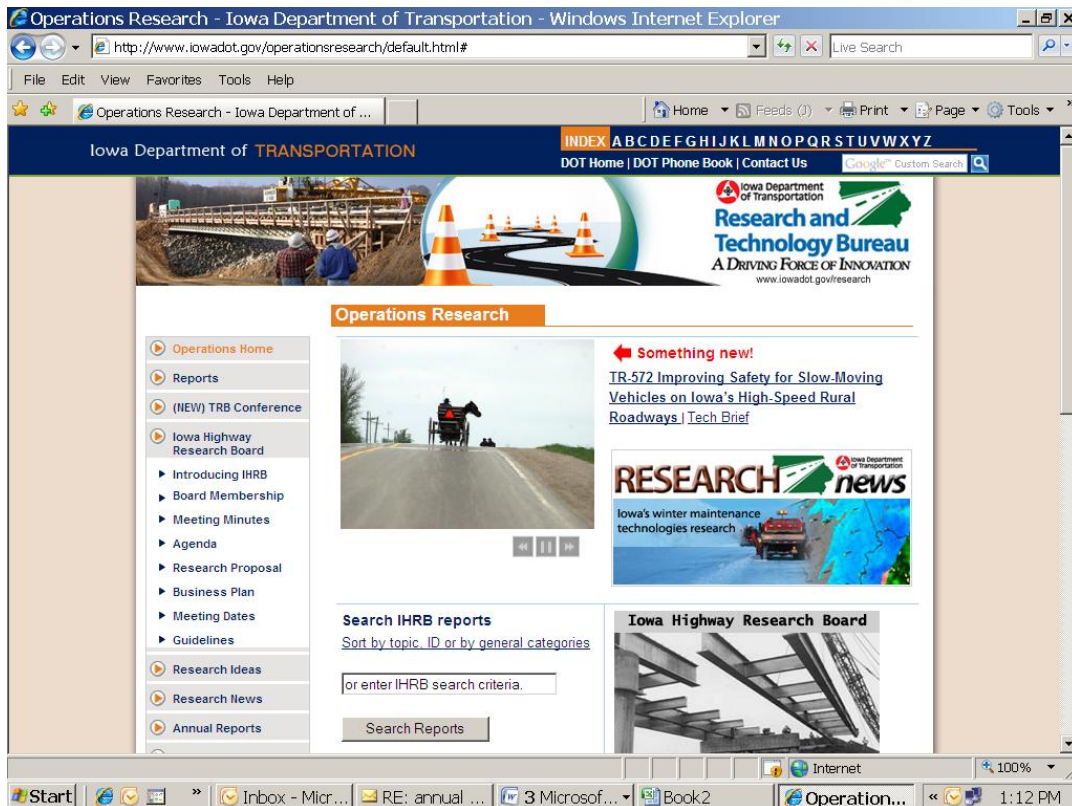
★ **Result:** Higher quality, lower cost bridge fabrication.

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 2010 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.

CARS/511 Implementation

CARS is a situation reporting system software that allows state agencies to input information regarding road incidents, weather conditions and roadway conditions that are reported to the public. CARS/511 information can be accessed from almost anywhere in Iowa by dialing 511, or from anywhere in the world at www.511ia.org.

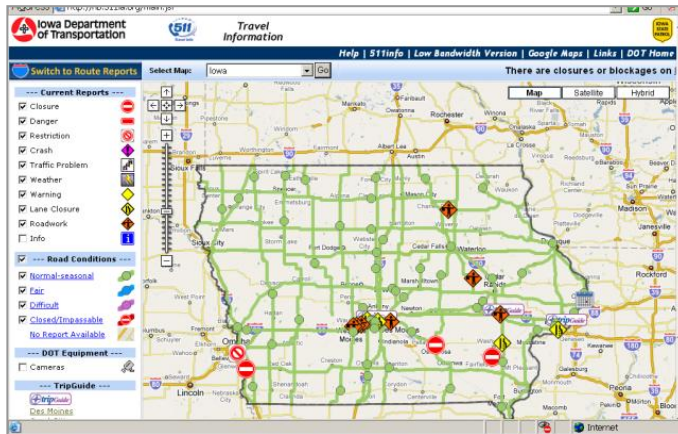


CARS/511 Usage				
Month	FY 10 Calls	FY 09 Calls	FY 10 Web Visits (high & low band)	FY 09 Web Visits (low band only)
July	10,091	21,932	19,439	28,040
August	10,704	10,647	20,869	12,222
September	7,694	10,410	15,500	13,158
October	9,663	8,885	19,075	9,590
November	8,325	17,770	15,165	37,323
December	242,007	154,311	424,006	267,121
January	134,706	112,435	1,902,303	154,714
February	96,886	30,106	1,548,586	61,831
March	15,024	22,324	146,019	31,116
April	7,537	22,943	unknown	28,031
May	8,410	10,101	34,802	17,886
June	14,634	12,186	45,655	19,964
Total	565,681	434,050	4,191,419	680,996

As expected, statistics on calls and web visits show much higher use of the 511 system during winter months, probably because winter weather and road conditions can change from hour to hour as well as from day to day.

The high-bandwidth 511 web site (below) was launched in 2008, but counters were not attached until 2009. This accounts for the significantly higher number of web visits registered in FY10 than the previous year. This site allows users to select and view various types of situations by clicking on the menu list at the left of the page. Users can pan across the state or zoom in on a

particular area. TripGuide cameras in Des Moines, Iowa City and Quad Cities can also be accessed from this site.



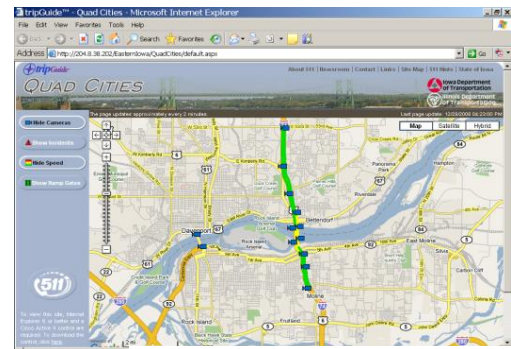
High Bandwidth 511 page

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.

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.



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

The Iowa City network of 22 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.

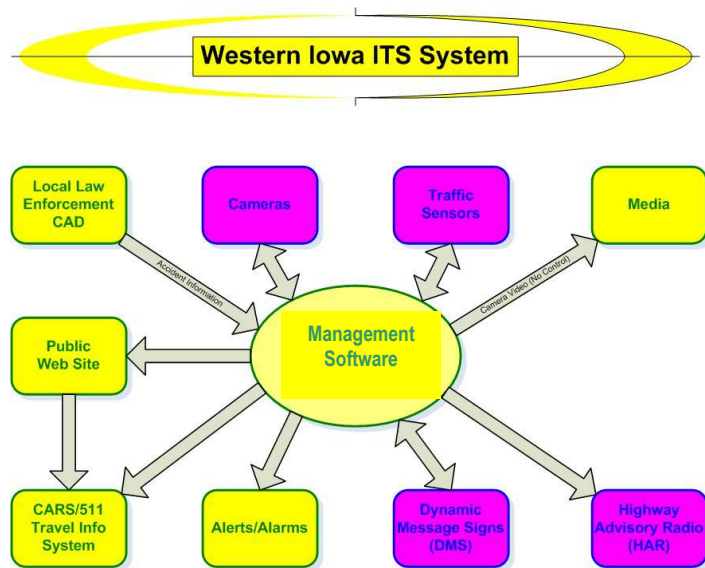


Both the Iowa City and Quad Cities projects have been developed in close coordination with local law enforcement, emergency responders, and traffic officials. The project was funded jointly by the Iowa and Illinois Departments of Transportation.

Western Iowa ITS

The Western Iowa ITS Project will encompass deployment of ITS technology and systems in both the Council Bluffs and Sioux City metropolitan areas.

The technology included 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 will include a series of 38 cameras and 49 sensors along I-29, I-80, U.S. 6 and U.S. 275. The Sioux City network will consist of 26 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 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 June 2010, Iowa DOT had 54 overhead and 14 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

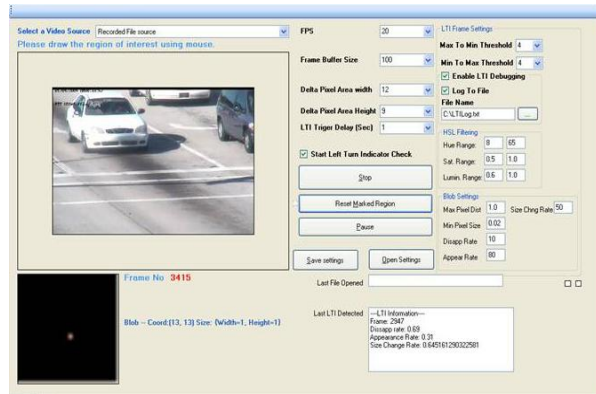


City area have been increasing. This increase of rail traffic has an effect on the downtown Sioux City street system. Some of these local street blockages then impact the operation of I- 29 mainline and ramps.

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 two 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.



Dyersville Traffic Warning System



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 2010 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/index.htm>

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:

- Non-Destructive Bridge Testing & Evaluation
- Intelligent Compaction Techniques
- Iowa DOT Implementation of LIDAR
- 2009 Mid-Continent Research Symposium Opening Session and Presentations
- Iowa's road weather information system at work
- Transportation Research Projects at Work – Making a Difference
- The U.S. 20 Iowa River Bridge: Providing for the future, preserving Iowa's past
- 2009 Human Factors and Roadway Safety Workshop

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. There are also links to the Operations Research Web site, a portal for the Iowa Highway Research Board (www.iowadot.gov/operationsresearch/default.html) and the Iowa DOT Transportation Library (www.iowadot.gov/research/lib_home.htm).

Research and Technology Bureau - Iowa Department of Transportation - Windows Internet Explorer

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

File Edit View Favorites Tools Help

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Iowa Department of **TRANSPORTATION** INDEX ABCDEFGHIJKLMNOPQRSTUVWXYZ
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Research and Technology Bureau

Research Home

- Research and Technology
- Research News
- State Planning and Research
- ITS
- (NEW) TRB Conference
- Operations Research
- DOT Library

2009 Conference Proceedings

RESEARCH news
 Iowa's winter maintenance technologies research

State Planning and Research

- Iowa-led pooled-fund studies
 Pooled-fund projects. [More](#)
- Iowa Highway Research Board
 Search IHRB Reports. [More](#)

VIDEO 1 (NEW) VIDEO 2 VIDEO 3 VIDEO 4

Kevin Mahoney
 14:08 IOWA DEPT. OF TRANSPORTATION

2009 Mid-Continent Transportation Research Symposium

Opening session
 Kevin Mahoney, highway division director and chief engineer, Iowa Department of Transportation, addresses participants during the opening session of 2009 Mid-Continent Transportation Research Symposium.

Internet 100%

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 8* 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 through 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 FY10 awarded research projects are listed in *Attachment 10*. Because proposals are received in August, projects often don't get underway until the next fiscal year. Some projects underway in FY10 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.

RWIS Improvements

Today, the Department maintains 62 RWIS sites throughout the state. Most sites are equipped with the traditional atmospheric and pavement sensors found on the majority of RWIS sites;



however, new sensors and upgrades are anticipated over the next 24 months for most sites. This will include installation of color cameras capable of taking still frame images (left) or video to provide more detailed information about actual roadway surface conditions in the area.

Also being added to the RWIS sites are new precipitation sensors called Weather Identifier and Visibility Sensors (WIVIS), which interpret the rate and kind of precipitation falling as well as the visibility distance at that particular tower's location. The WIVIS sensor will provide direct feedback to maintenance supervisors regarding potential problems in their areas and give motorists real-time roadway information that can proactively influence their travel plans. Information from RWIS sites will be available to the public and garage personnel online at the Iowa DOT's Weatherview Web site at www.dotweatherview.com.

Also new in 2009 is the Temperature Data Probe (TDP). This state-of-the-art probe measures road subsurface temperature every three inches for the first 18-inches and then every six inches down to six feet below the surface, providing precise information on temperatures at different levels under the road's surface. Maintenance personnel will be able to use information from these sensors to help determine what will happen at the road's surface when precipitation falls. Cold temperatures six inches below the surface may cause surface temperatures to be much colder than air temperatures on a warm day in early spring. The TDP probes may also contribute to a better understanding of conditions causing asphalt blow-ups during the summer months and stresses on roadways due to freeze-thaw cycles during the winter.



Date/Time: 03/21/2007 10:49

WB APPROACH

New Site Info

- Site info displays to incorporate road cameras, new visibility and traffic speed sensors

Available Images: WB Approach [View Forecast] [View History]

Current conditions Cedar Rapids Hwy 30 East		
Air temp: 34	Visibility: 1.2 mi.	Wind speed: 9 mph
Dew point: 32	Road condition: Wet	Wind direction: SE
Traffic Speed: 67 mph.	Pavement temp: 40	

Traffic sensors are currently being added to all interstate RWIS sites and will eventually be placed on most of the RWIS sites throughout the state. These sensors measure traffic speeds and count and classify traffic. Data collected from these systems may eventually be linked to the existing traffic counting and classification system used by the Department, providing information to supervisors about traffic speeds in their area. This information will also be available to the

traveling public through the Weatherview Web site. The Department plans to link information from these traffic sensors (in addition to weather information from RWIS and forecast information) to measure performance of winter maintenance operations. Monitoring traffic speeds during winter storms or the time required to return traffic speeds to normal may be used as performance measures for winter snow removal operations.

Ceramic Blades

Improvements in materials have provided new alternative materials (other than traditional carbide inserts) for cutting edges of plow blades. For decades the primary blade in snow and ice removal operations used a carbide insert—a very hard compound that withstands the rigors of winter maintenance. In recent years, however, the price of carbide has nearly tripled with resulting costs becoming a much larger portion of the snow and ice budget.



Developed in Germany, the Gummi-Kuper ceramic blades appear to have the same level of hardness as carbide blades but are reportedly lightweight, maintain a better cutting edge, and may eventually be cheaper than carbide blades when they become more widely available in the United States. Limited testing was done in 2008-2009 on the blades; however, the Iowa DOT will continue testing two sets of ceramic blades during the winter of 2009-2010 at several garages in District 2. Operators will continue measuring blade wear and provide feedback on other operational issues that impact snow removal operations such as noise and vibrations.

Joma 6000 Blades



First tested by the Iowa DOT in 2000, the cost of JOMA 6000 blades (JOMAs) was prohibitive—the price for a set these (ceramic) blades was nearly five times more expensive than traditional carbide ones. However, wear tests performed at the time indicate that they lasted approximately three times as long. Operators who tested the JOMAs thought they were quieter than traditional

blades, and because they include rubber cushioning, vibrations in the cab were reduced.

Wear tests done this year on the JOMAs at six different maintenance garages across District 2 are helping to determine if the blade's life expectancy can offset the higher price. Currently, the difference in cost between these and traditional blades is 2:1. With recent price increases for carbide blades, the JOMA 6000 blades appear to be a viable alternative. If testing verifies results from 2000, these blades may prove more even more cost effective in the future.

Flexible Edge Blades

A prototype, flexible edge blade developed at the central repair shop is divided into one-foot sections and attached to the front plow with bolts surrounded by rubber. The rubber around the bolt holes allows the one-foot sections to move both horizontally and vertically for adjustment with variations of the road's surface, keeping the blade's cutting edge in contact with the road along its entire length and providing more efficient removal of snow or ice.



Operators at the Hanlontown maintenance garage who tested this new blade report that the one-foot sections allow the plow to adjust to any contours in the road and that the rubber surrounding the bolts reduced noise and vibrations in the cab. In addition, operators observed less wear on blades and more uniform wear across their lengths. Traditional blades wear on the leading edge but the trailing edge wears very little; this means blades need to be discarded while they still contain carbide. The flexible edge blade wears evenly across its length so it can be used in its entirety until carbide is exhausted. Also, because they're in one-foot sections weighing about 15 lbs., changing any flexible edge blades that wear out is much easier than changing traditional ones which usually weigh 45-60 lbs.

Multiple Blade Plows

The triple-blade plow is showing promising results in clearing more snow and ice per pass. The lead blade is a typical carbide plow blade to remove most of the snow. Following that is a scarifying or scraping blade to break up packed ice. Finally, a trailing squeegee blade clears any remaining ice and snow.

To encourage participation from manufacturers in the multiple-edge plow project, the states of Ohio, Minnesota, Indiana and Wisconsin joined Iowa in a pooled fund to test prototypes developed by several plow manufacturers based on the Iowa design. After a competitive bidding process early in July, 2008, four manufacturers were selected to provide test models during the 2008-2009 winter season. One manufacturer prototype was tested in each state. Maintenance personnel at the Hanlontown garage tested the plow built by Flink and were very pleased with the results after the first year, reporting that it removed more snow and ice from the road and there was reduced noise and vibration in the cab. The Iowa DOT plans to work with manufacturers to develop a retrofit kit for adding a squeegee or scarifying blade to existing plows in the fleet.

Cameras with mobile recorders were sent to the testing locations to get video footage of all the snow plows operating in an actual winter storm. Video of the plow in operation is an excellent means of determining if the plow is actually cleaning the road surface in one pass and how much extra snow, slush, ice and water is being removed by the use of multiple blades versus the single bladed plow we use today. Additional testing of the multiple-blade plow will continue during the 2009-2010 winter season.



NaI/CaCl – Spicy Salt

This project was continued to determine if a blend of Calcium Chloride and salt brine can lower the eutectic temperature of salt brine and allow it to be more effective at lower temperatures. It is also designed to save on material versus the straight use of calcium chloride alone.



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 superload 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.

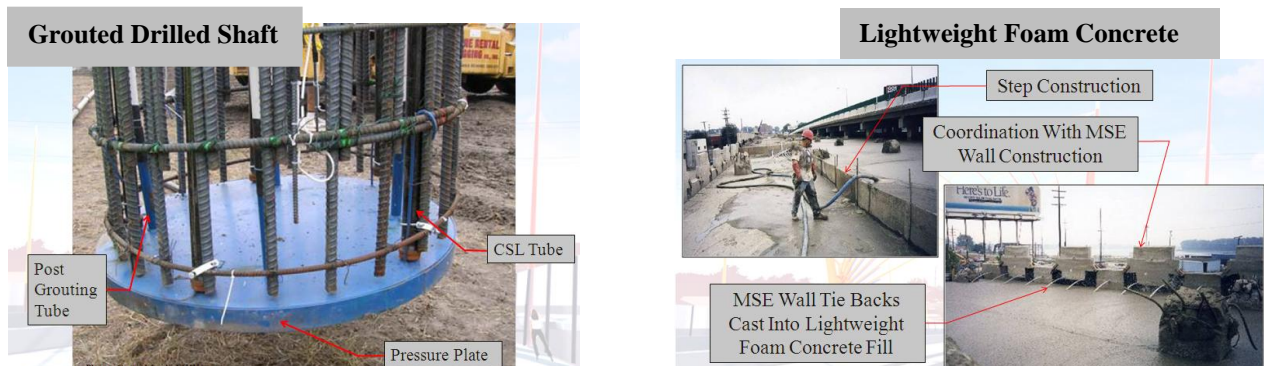
9th Street Bridge Monitor

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 2010 totaling \$106,657.

LRTF Grants Awarded FY 2010		
Researcher	Amount	Research Topic
Kirk Larsen, Luther College	\$ 9,253	Impact of roadside prairie plantings on plant and insect communities
Brian Wilsey & Lee Ann Martin, Iowa State University	\$ 10,675	Do fire and seed additions alter strong seed timing and priority effects on prairie establishment?
Daryl Smith, University of Northern Iowa	\$21,928	The effects of mycorrhizal inoculants and micronutrients on early plant establishment in prairie reconstruction
Daryl Smith, University of Northern Iowa	\$ 22,900	The effects of seeding time on emergence and growth of prairie grasses, sedges, legumes and forbs
Daryl Smith, University of Northern Iowa	\$ 30,712	Comparison of water interception and infiltration by selected grass dominated communities
Jennifer Hopwood, Iowa State University	\$ 11,189	Use of roadside prairie plantings by native bees

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:

- Committee on General Structures - Sandra Larson, member
- Portland Cement Concrete Pavement Construction - Sandra Larson, member
- Task Force on Surface Transportation Weather - Sandra Larson & Tina Greenfield, members
- NCHRP Project Panel on IDEA - Sandra Larson, member
- NCHRP Project Panel on Research for AASHTO Standing Committee on Planning: Support for Improved Transportation Planning and Project Development – Stu Anderson, member
- Alternative Transportation Fuels and Technologies – Ed Engle, member
- NCHRP Project Panel on Evaluation of Safety Strategies at Signalized Intersections – Troy Jerman, chair
- Properties of Concrete – Bob Younie, member
- NCHRP Project Panel on Improvement of Procedures for the Safety-Performance Evaluation of Roadside Features – Dave Little, member

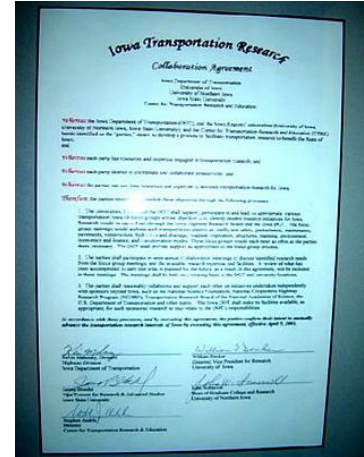
- SHRP 2 Expert Task Group on Freight Demand Modeling and Data Improvement Strategic Plan – Phil Mescher, member
- Transportation Planning Applications – Phil Mescher, member
- Urban Transportation Data and Information Systems – Phil Mescher, member
- Using National Household Travel Survey (NHTS) Data for Transportation Decision Making: A Workshop – Phil Mescher, member
- NCHRP 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 Administration of Highway and Transportation Agencies – Nancy Richardson, chair
- Application of Emerging Technologies to Design and Construction – Mark Dunn, member
- Construction of Bridges and Structures – Mark Dunn, member
- Roadside Maintenance Operations – Joy Williams, 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 Revision of the AASHTO Guide for the Development of Bicycle Facilities – Steve Bowman, member
- Statewide Transportation Data and Information Systems – Peggi Knight, member
- NCHRP Project Panel on Next Generation of Pooled Fund Web Site – Carol Culver, member
- NCHRP Panel on Performance of Warm Mix Asphalt (WMA) Technologies: Stage 1 – Moisture Susceptibility – Scott Schram, 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.

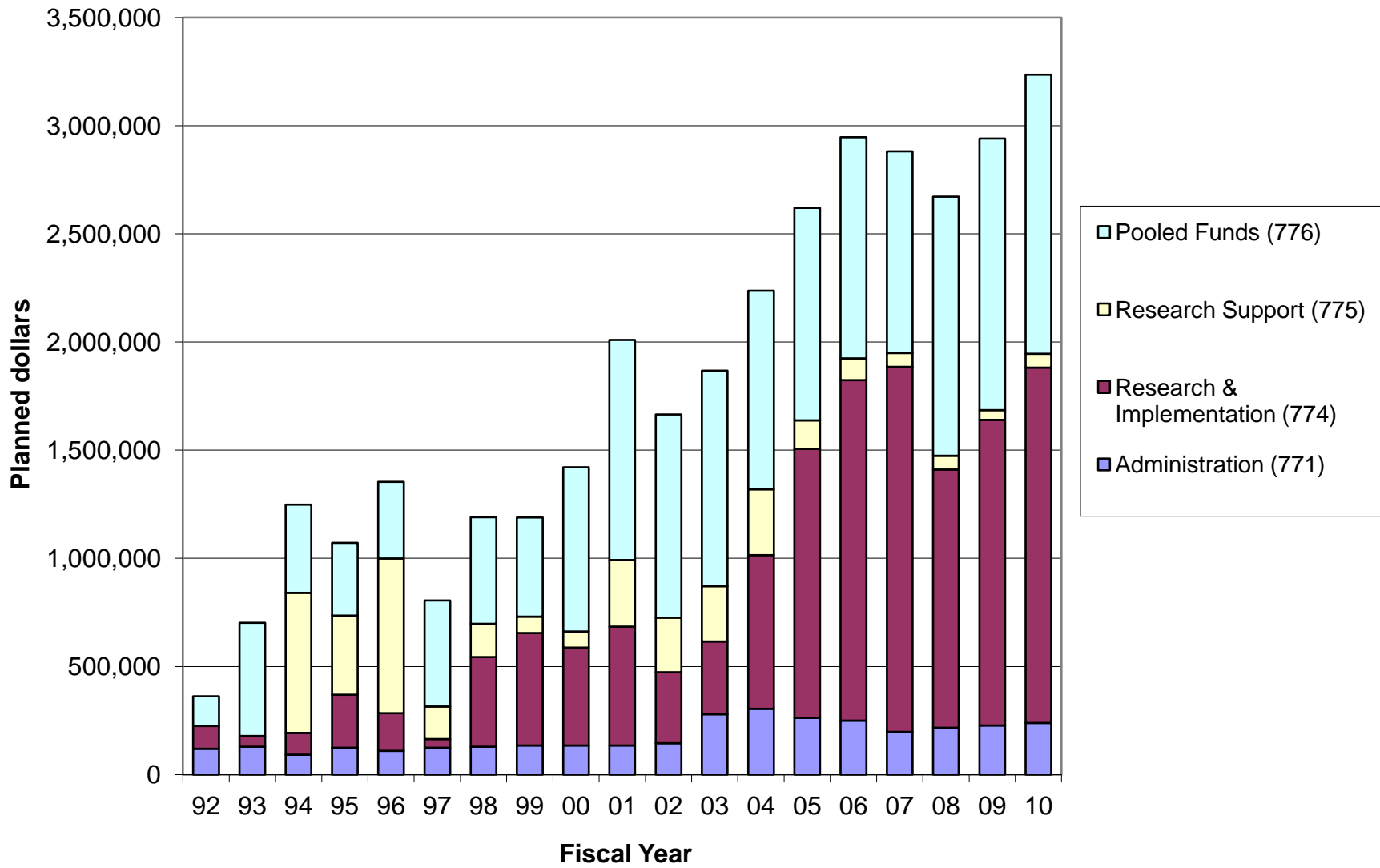


InTrans also supports the Iowa DOT through administration of the DOT Library. The librarian selects, catalogs and retains materials for the library, conducts literature searches for researchers, posts research activities to the Transportation Research Information System (TRIS) and Research in Progress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

V. Attachments

Annual SPR Plan - Distribution of Funds 1993-2010



FY 2010 Research Work Program Summary						
						Date: 7/01/10
771 - Administration & Support						
	Title	Est. \$ FY 10	Federal Funds	Iowa DOT Contact	FHWA Contact	# Yrs
	TRB Research Correlation Service	116,496	116,496	Larson	Grogg	
	Library	122,000	97,600	Larson	Grogg	
	General Funds for Future Needs	0	0	Larson	Grogg	
	Total w/ TRB	238,496	214,096			
776 - Pooled Fund Studies (100% Federal)						
Project #	Title (bold print = Iowa led)	Est. FY 10	Federal	Iowa DOT	FHWA	Yrs
HPR-4(201)	NCHRP	501,887	501,887	Larson	Grogg	Ongoing
SPR-3 (020)	Enterprise (IVHS Study)	30,000	30,000	Whited	Grogg	5+
SPR-3 (042)	Aurora Program	25,000	25,000	Greenfield	Roche	5+
SPR-3 (060)	Highway Maintenance Concept Vehicle	0	0	Greenfield	Grogg	5+
SPR-3 (079)	REPORT (CARS)	0	0	Whited	Grogg	Complete
TPF-5 (009)	SICOP: AI/RWIS Computer Based Training	6,000	6,000	Greenfield	Grogg	5+
TPF-5 (035)	Pacific Northwest Snowfighters	10,000	10,000	Greenfield	Grogg	2
TPF-5 (046)	TCCC	25,000	25,000	C. Anderson	Grogg	4
TPF-5 (065)	Traffic Control Device Consortium	20,000	20,000	Crouch	Roche	1
TPF-5 (068)	LRFD Specifications	10,000	10,000	Larson	Monk	4
TPF-5 (081)	Smart Work Zone Deployment Initiative	30,000	30,000	Sprengeler	Roche	5+
TPF-5 (099)	Evaluation of Low Cost Safety Improvements	30,000	30,000	Welch	Roche	1
TPF-5 (105)	Transportation Library Connectivity	5,000	5,000	Zaletel	Grogg	1
TPF-5(116)	Investigation of Fatigue Life of Steel Base Plate to Pole Connections	15,000	15,000	B Brakke	Monk	1
TPF-5 (117)	Performance Properties of Ternary Mixes	15,000	15,000	Berger	Grogg	1
TPF-5 (132)	Low Temp Cracking of Asphalt Pavement - Ph 2	5,000	5,000	Hinrichson	Grogg	3
TPF-5 (144)	Teen Driving Study	0	0	Snook	Roche	0
TPF-5(156)	Mississippi Valley Freight Coalition (Planning funds)	50,000	50,000	O'Riley	Grogg	2
TPF-5 (159)	TTCC	7,000	7,000	T Hanson	Grogg	2

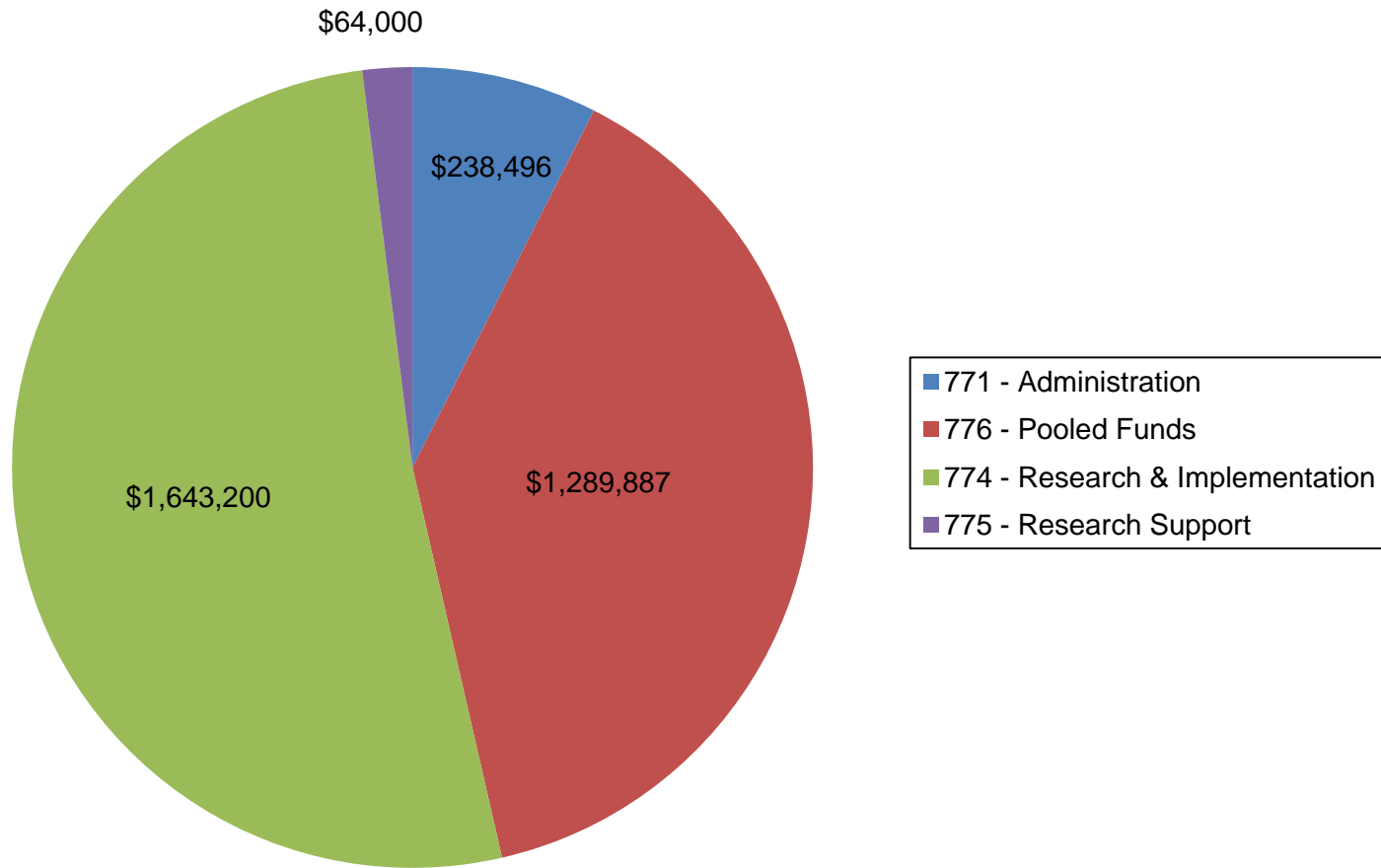
TPF-5 (169)	Investigation of Curved Girder Bridges with Integral Abutments	50,000	50,000	McDonald	Monk	2
TPF-5(179)	Evaluation of Test Methods for Permeability	25,000	25,000	Hanson	Grogg	2
TPF-5(183)	Foundations for Concrete Pavements	35,000	35,000	Larson	Grogg	2
TPF-5(185)	CP Roadmap Administration	25,000	25,000	Larson	Grogg	2
TPF-5(187)	Updating U.S. Precipitation Frequency Estimates for the Midwestern Region	20,000	20,000	Claman	Monk	1
TPF-5(189)	Enhancement of Welded Steel Bridge Girders	25,000	25,000	Abu Hawash	Monk	2
TPF-5(193)	Midwest States Pooled Fund Crash Test Program	55,000	55,000	Maifield	Roche	5+
TPF-5(202)	Hy-8 Culvert Analysis Program – Ph 3	10,000	10,000	McDonald	Monk	2
TPF-5(205)	Mix Design and Analysis	25,000	25,000	Hanson	Grogg	3
TPF-5(207)	Novice (School Age) Drivers	20,000	20,000	Falb	Roche	2
TPF-5(209)	Asset Management	0	0	Adam	Grogg	0
TPF-5(213)	Performance of Recycled Asphalt Shingles in Hot Mix Asphalt	45,000	45,000	Schram	Grogg	1
TPF-5(217)	UHPC Deck Joint Testing	25,000	25,000	Abu Hawash	Monk	1
TPF-5(218)	Clear Roads was TPF-5(092)	25,000	25,000	Greenfield	Grogg	5+
TPF-5(219)	Structural Health Monitoring	50,000	50,000	McDonald	Monk	2
TPF-5(220)	Accommodating Oversize/Overweight Vehicles at Roundabouts	15,000	15,000	Dillavou	Grogg	3
TPF-5(221)	Accelerated Bridge Construction Decision Tools	5,000	5,000	Abu Hawash	Monk	1
TPF-5(224)	Joint Deterioration in Concrete Pavements	15,000	15,000	Hanson	Grogg	3
Sol 1236	Instrumentation to Aid in Steel Bridge Fabrication	35,000	35,000	Abu Hawash	Monk	1
	General Funds for Future Projects	0	0	Larson	Grogg	
	Total w/ NCHRP	1,289,887	1,289,887			
774 - Research & Implementation (80% Federal)						
	Title	Est. FY 10	Federal	Iowa DOT	FHWA	Yrs
	Basic Agreement with InTrans	240,000	192,000	Larson	Grogg	5+
	Remote Sensing Coordinating Committee	10,000	8,000	Kadolph	Grogg	5+
	AASHTO - NTPEP	7,500	6,000	Berger	Grogg	5+
	AASHTO - APEL (Approved Product Eval List)	1,200	960	Dunn	Grogg	5+

	AASHTO - TIG (Technology Implementation Group)	6,000	4,800	Larson	Grogg	5+
	AASHTO - Env Tech Assistance Program	8,000	6,400	Rost	Kennedy	5+
	AASHTO - TSP2	20,000	16,000	Todey	Grogg	5+
	Geotechnical Support	50,000	40,000	Larson	Grogg	5+
	Information Technology Development	160,000	128,000	Peperkorn	Grogg	2
	LRFD Training	10,000	8,000	McDonald	Monk	1
	Sign Management System	25,000	20,000	Crouch	Roche	5+
	Pavement Marking Management System	25,000	20,000	Crouch	Roche	5+
	Investigate Defects in Existing Concrete Railing	80,000	64,000	McDonald	Monk	1
	Bridge Construction Web Management	50,000	40,000	J Nelson	Monk	3
	Washing Weathering Steel Bridges	50,000	40,000	McDonald	Monk	1
	Drilled Shaft Testing Database	50,000	40,000	Abu Hawash	Monk	2
	Reduce Speed on High Crash Curves	40,000	32,000	Welch	Roche	1
	“GO Team” - Teen Driver Fatalities Study	50,000	40,000	Snook	Roche	1
	Evaluation of Iowa’s Driver Improvement Program	75,000	60,000	Snook	Roche	3
	OWI Recidivism Study	50,000	40,000	Falb	Roche	2
	Lost License Resource Pilot	25,000	20,000	Lowe	Roche	1
	Human Factors Focus Group	15,000	12,000	Larson	Grogg	1
	Maintenance And Design Of Steel Abutment Piles	31,500	25,200	Dunn	Grogg	1
	Wind Loads on Dynamic Message Cabinets	218,498	174,798	Dunn	Grogg	2
	Prototype Flex Edge Plow	0	0	Greenfield	Grogg	1
	Safety and Mobility Impacts of Winter Weather	20,000	16,000	Gent/Bradley	Roche	2
	Commercial Driver Fatigue	50,000	40,000	Lowe	Roche	2
	Intelligent Compaction Field Pilot Project	50,000	40,000	Smythe	Grogg	1
	Mid Continent Transportation Symposium	25,000	20,000	Larson	Grogg	1
	Research Peer Exchange*	20,000	20,000	Larson	Grogg	1
	Maintenance Expo	7,500	6,000	Greenfield	Grogg	1
	Technical Training & Conference Plan	80,000	64,000	Larson	Grogg	5+
	Research Implementation & Technology Transfer	10,000	8,000	Larson	Grogg	5+
	General Funds for Future IHRB and Other Projects	83,002	66,402	Larson	Grogg	1
	Total	1,643,200	1,318,560			
				*Peer Exchange eligible for 100% federal share		

775 - Research Support (80% Federal)						
	Title	Est. FY 10	Federal	Iowa DOT	FHWA	Yrs
	Hamburg Wheel Tracking Device	64,000	51,200	Jones	Hiatt	
	General Funds for Future Projects	0	0	Larson	Grogg	
	Total	64,000	51,200			
	Grand Total Research	3,235,583	2,873,743			
	Unobligated Funds from Previous Years		78,651			
	FY 09 SPR ½ % Apportionment		2,745,092			
	Part Planning Funds		50,000			
			2,873,743			

FY 2010 SPR Research Work Program by Category

Attachment 3

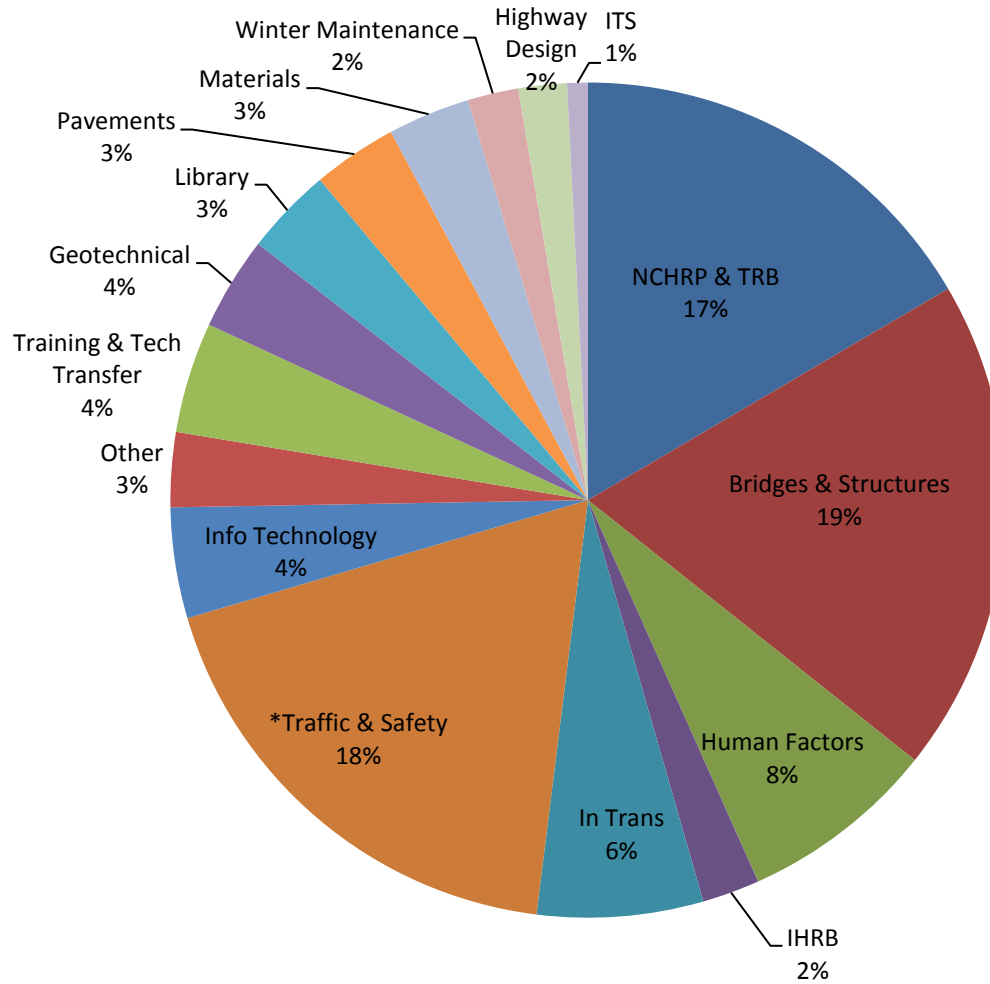


FY 2010 SPR Allocations by Type of Work

	FY 10 \$	% \$	#	% #	FY 09 \$
NCHRP & TRB	618,383	17	2	3	530,306
Bridges & Structures	714,998	19	15	22	609,000
Human Factors	285,000	8	7	10	170,000
IHRB	83,002	2	1	1	0
InTrans (CTRE)	240,000	6	1	1	233,000
*Traffic & Safety	690,000	18	5	7	390,000
Info Technology	160,000	4	1	1	160,000
Other	108,000	3	5	7	37,500
Training & Tech Transfer	160,000	4	5	7	187,500
Geotechnical	135,000	4	3	4	135,000
Library	127,000	3	2	3	126,000
Pavements	122,000	3	6	9	257,000
Materials	118,700	3	6	9	93,200
Winter Maintenance	73,500	2	6	9	211,500
Highway Design	70,000	2	2	3	20,000
ITS	30,000	1	1	1	50,000
	3,735,583	100	68	100	3,210,006

*Includes Traffic Safety Improvement Program Research Projects

FY 2010 SPR Allocations by Type of Work



*Includes Traffic Safety Improvement Program Research Projects

FY 2010 Traffic Safety Improvement Program Research Projects

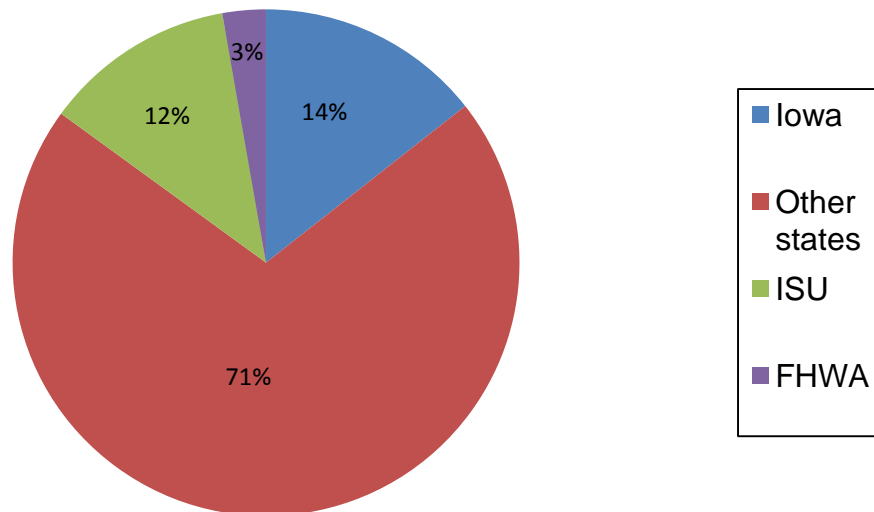
Title	Amount
Work Zone Safety – Public Awareness	50,000
Effectiveness of special deer management hunts on crash reduction	20,000
Implementation of the Older Driver Road & Pedestrian Safety Pilot Project - Iowa City	40,000
Moving beyond teen crash fatality statistics: the 'Go Team' study	40,000
Evaluation of Dynamic Warning Signs at High Crash Rural Curves, Phase II	40,000
Safety Analyst (FHWA)	20,000
Work Zone Safety Training	45,000
Traffic Safety Liaison Program	50,000
Iowa Traffic Safety Data Service (ITSDS)	20,000
Red Light Running Phase 3: "Rapid Intersection Evaluation Techniques Using Crash Surrogates"	5,000
Traffic and Safety Engineering Forum	50,000
Safety Circuit Rider	20,000
Development and Field Evaluation of a Prototype Tool to Detect and Identify Left Turning Vehicles	50,000
Evaluating the Effectiveness of the City of Des Moines LED Mid-Block Pedestrian Crossing Treatments on Multi-Lane Roadways	25,000
Summarizing Information on the Negative Impacts of Lane Departure Countermeasures –Phase I	25,000
Total	500,000

Attachment 7

FY 2010 SPR Approved Technical Training Requests							3/12/10
<i>Attachment to FY 10 State Planning & Research Plan</i>							
Requester	Course Name & NHI #	# Att	@ Cost	Class Cost	Room	Total	
NHI Courses							
<i>Gent/Huston</i>	<i>Application of Crash Reduction Factors #380093</i>	30	90	5,000	100	5,100	
<i>Ohman</i>	<i>Urban Drainage Design #135027</i>	30	520	15,600	450	16,050	
<i>Vortherms</i>	<i>Highway Capacity and Quality of Flow #133005C</i>	30	450	13,500	450	13,950	
<i>Dotzler</i>	<i>Highway Materials Engineering Academy #131023</i>	1	6,600	6,600	2,400	10,000	
<i>Todsen</i>	<i>Bridge Inspection Refresher Training #130053</i>	24	520	12,480	100	12,580	
				<i>Total NHI</i>		57,680	
Non – NHI Courses							
<i>Maifield</i>	<i>Roundabout Design</i>	30		15,000	1,500	16,500	
				<i>Total Non-NHI</i>		16,500	
Meetings & Conferences							
<i>Sorenson/Stolle</i>	<i>Heartland ITS Conference</i>	2	500	0	0	1,000	
<i>Sorenson</i>	<i>ITS America Conference</i>	1	1,500	0	0	1,500	
<i>Larson</i>	<i>AASHTO SCOR Meeting</i>	1	1,000	0	0	1,000	
<i>Lorenzen/Evans</i>	<i>Sleep Apnea and Trucking Conference</i>	2	1,000	300		2,300	
				<i>Total Conferences</i>		5,800	
						<i>Total cost of requested training</i>	\$79,980
						<i>Funds reserved for future use</i>	\$ 20
						\$80,000	

FY 2010 Research Funds Leveraged Through Iowa-Led Pooled Fund Projects

Pooled Fund	Iowa	Other states	ISU	FHWA	Total	% Iowa
Enterprise	30,000	175,000			205,000	15
Aurora	25,000	300,000			325,000	8
LRFD	10,000	190,000			200,000	5
Smart Work Zone	30,000	150,000			180,000	17
Ternary Mix	15,000	90,000			105,000	14
TTCC	7,000	103,000			110,000	6
Integral Abutments	50,000	72,500			122,500	41
Foundations	35,000	175,000			210,000	17
Mix Design & Analysis	25,000	90,000	265,000		380,000	7
Novice Drivers	20,000	25,000			45,000	44
SHM	50,000	70,000		60,000	180,000	28
Joint Deterioration	15,000	90,000			105,000	14
Total	312,000	1,530,500	265,000	60,000	2,167,500	14



**ANNUAL REPORT
OF
IOWA HIGHWAY RESEARCH BOARD
RESEARCH AND DEVELOPMENT ACTIVITIES**

**FOR THE
FISCAL YEAR ENDING JUNE 30, 2010**

RESEARCH AND TECHNOLOGY BUREAU
OPERATIONS RESEARCH
(515) 239-1447

www.iowadot.gov/operationsresearch

HIGHWAY DIVISION
IOWA DEPARTMENT OF TRANSPORTATION
AMES, IOWA 50010

DECEMBER 2010

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LIST OF ACRONYMS

<p>AASHTO - American Association of State Highway and Transportation Officials</p> <p>ACC - Asphalt Cement Concrete</p> <p>ADV - Acoustic Doppler Velocimeter</p> <p>APWA - American Public Works Association</p> <p>ASCE - American Society of Civil Engineers</p> <p>BMP - Best Management Practice</p> <p>CIPR - Cold In-Place Recycling</p> <p>CP - Concrete Pavement</p> <p>CPTP - Comprehensive Public Training Program</p> <p>CTRE - Center for Transportation Research and Education</p> <p>DOT - Department of Transportation</p> <p>DSM - Decision Support Model</p> <p>FHWA - Federal Highway Administration</p> <p>FRP - Fiber Reinforced Polymer</p> <p>FWD - Falling Weight Deflectometer</p> <p>GIS - Geographic Information System</p> <p>HMA - Hot Mix Asphalt</p> <p>IHRB - Iowa Highway Research Board</p> <p>ISRCIM - Iowa Stormwater Runoff Control Interactive Manual</p> <p>ISU - Iowa State University</p> <p>LRFD - Load and Resistance Factor Design</p> <p>LTAP - Iowa State University Local Technical Assistance Program</p>	<p>LVR - Low Volume Road</p> <p>MOVITE - Missouri Valley Section of the Institute of Transportation Engineers</p> <p>NAT - Nottingham Asphalt Tester</p> <p>NCHRP - National Cooperative Highway Research Program</p> <p>NDT - Non-Destructive Testing</p> <p>NPDES - National Pollution Discharge Elimination System</p> <p>NRCS - National Resource Conservation Service</p> <p>PCA - Portland Cement Association</p> <p>PCC - Portland Cement Concrete</p> <p>PI - Principal Investigator</p> <p>QA - Quality Assurance</p> <p>QC - Quality Control</p> <p>QM-E - Quality Management - Earthwork</p> <p>RC - Reinforced Concrete</p> <p>RRFC - Railroad Flat Car</p> <p>RSAP - Roadside Safety Analysis Program</p> <p>SHRP - Strategic Highway Research Program</p> <p>SUDAS - Statewide Urban Designs and Specifications</p> <p>TAC - Technical Advisory Committee</p> <p>TRB - Transportation Research Board</p> <p>USGS - United States Geological Survey</p>
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RESEARCH AND DEVELOPMENT

The Highway Division of the Iowa Department of Transportation (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 FY2010” 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, 2010. It is also a report on projects completed during the fiscal year beginning July 1, 2009 and ending June 30, 2010. Detailed information on each of the research and development projects mentioned in this report is available from the Research and Technology Bureau, Highway 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: *WORKING TO HELP IOWA*

In developing a progressive, continuing and coordinated program of research and development, the Highway Division is assisted by the Iowa Highway Research Board (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, 2010, is listed in Table I.

The Research Board held eight regular meetings during the period from July 1, 2009, through June 30, 2010. Suggestions for research and development were reviewed at these meetings and recommendations were made by the 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.**

www.iowadot.gov/operationsresearch/iowa_highway_research_board.asp

TABLE I**2010 IOWA HIGHWAY RESEARCH BOARD****June 30, 2010**

<u>Member</u>	<u>Term Expires</u>	<u>Alternate</u>
Ahmad Abu-Hawash 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
Robert Younie Director Office of Maintenance 800 Lincoln Way Ames, IA 50010 (515) 239-1589 Email: bob.younie@dot.iowa.gov	12-31-11	Kent Nicholson Assistant Road Design Engineer Road Design 800 Lincoln Way Ames, IA 50010 (515) 239-1586 Email: Kent.Nicholson@dot.iowa.gov
James Alleman Dept. of CCE Engineering Iowa State University 390 Town Engineering Bldg. Ames, IA 50011 (515) 294-3532 Email: jea@iastate.edu	12-31-11	
Wade Weiss Greene County Engineer 114 N. Chestnut Jefferson, IA 50129 (515) 386-3316 SS# 037 Email: wweiss@co.greene.ia.us	12-31-11 District 1	Robert Kieffer Boone County Engineers Office 201 State Street Boone, IA 50036-3988 (515) 433-0530 Email: engineer@co.boone.ia.us
Vicki Dumdei District Engineer 512000 - Hwy Div District 2 Office Mason City, IA 50401-4438 (641) 422-9465 Email: Victoria.Dumdei@dot.iowa.gov	12-31-10	David Little Assistant District Engineer 512000 - Hwy Div District 2 Office Mason City, IA 50401-4438 (641) 422-9464 Email: david.Little@dot.iowa.gov
Keri Hornbuckle Dept. of Civil & Env. Engineering The University of Iowa 4105 Seamans Center Iowa City, IA 52242 (319) 384-0789 Email: kchorn@engineering.uiowa.edu	12-31-10	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
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Kevin Mayberry
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Fort Madison, IA, 52627
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Email: ernies@leecounty.org

Robert Fangmann
Cedar County Engineer
400 Cedar Street
Tipton, IA 52772
(563) 886-6102
Email: engineer@cedarcounty.org

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 Highway 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, 2010. Total expenditure was \$2,211,950.81.

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 Research and Technology Bureau, 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 Research and Technology Bureau, Operations Research Section, wishes to express its appreciation to other offices for their assistance.

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

The National Cooperative Highway Research Program (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 Transportation Research Board (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 and road inventories 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 2010 as part of the Annual Traffic Count Program. This activity consisted of 6300 portable recorder classification counts, 150 portable recorder volume counts and 48 manual 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 and submitted by 99 counties. 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 2010 financial summary is:

Beginning Balance 7-1-09		\$1,054,655.34
Receipts		
State Road Use Tax Fund		
(1½% of receipts)	\$1,231,598.90	
Federal Aid Secondary		
(1½% of receipts)	0.00	
Research Income	<u>0.00</u>	
Sub-Total		<u>\$1,231,598.90</u>
Total Funds Available		\$2,286,254.24
Obligation for Expenditures		
Obligated for		
Contract Research	\$1,296,246.54	
Non-Contract		
Engineering Studies	<u>\$149,904.46</u>	
Total Expenditures		<u>\$1,446,151.00</u>
Ending Balance 6-30-10		\$840,103.24

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 2010 financial summary is:

Beginning Balance (7-1-09)	\$ 135,088.98
De-obligated (Unused) Funds from Previous Projects	21,233.88
FY10 Street Research Funding	<u>\$200,000.00</u>
Total Funds Available for Street Research	\$356,322.86
Total Obligated for Expenditure FY10	<u>\$145,800.00</u>
Ending Unobligated Balance 6-30-10	\$210,522.86

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 FY10 was \$549,403.92 and the estimate for FY11 is \$750,000.

PROJECTS INITIATED DURING FY 2010

- HR-140 (140H) Collection and Analysis of Streamflow Data
- HR-296 Iowa State University Local Technical Assistance Program (LTAP)
- TR-609 Curing Criteria for Cold In-Place Recycling Phase III
- TR-612 Wind Loads on Dynamic Message Cabinets and Behavior of Supporting Trusses
- TR-613 Study of the Impacts of Implements of Husbandry on Iowa Bridges
- TR-614 Structural Characterization of a UHPC Waffle Bridge Deck and its Connections
- TR-615 Connection Details and Field Implementation of UHPC Piles - Phase II: Use of Ultra-High Performance Concrete in Geotechnical and Substructure Applications
- TR-616 Timber Abutment Piling and Back Wall Rehabilitation and Repair
- TR-617 An Adaptive Field Detection Method for Bridge Scour Monitoring Using Motion-Sensing Radio Transponders (RFIDs)
- TR-618 Parallel Wing Headwalls for Single RCBs (LRFD)
- TR-619 Development of Self-Cleaning Box Culvert Design - Phase II
- TR-620 Update of RCB Culvert Standards to LRFD Specifications
- TR-621 Geo-synthetic Reinforced Soil for Low Volume Bridge Abutments
- TR-622 Maintenance and Design of Steel Abutment Piles in Iowa Bridges
- TR-623 Quality Control/Quality Assurance Testing for Joint Density and Segregation of Asphalt Mixtures
- TR-624 Development of Quality Standards for Inclusion of High Recycled Asphalt Pavement Content in Asphalt Mixtures

16 Projects Initiated

PROJECTS COMPLETED DURING FY 2010

The following projects were completed during FY 2010 and project Final Reports were approved by the Iowa Highway Research Board:

- TR-450 Identification of Laboratory Techniques to Optimize Superpave HMA Surface Friction Characteristics
- TR-458 Field Testing of Abrasive Deliver Systems in Winter Maintenance
- TR-472 Investigation of Materials for the Reduction and Prevention of Corrosion on Highway Maintenance Equipment
- TR-491 Development of Winter Performance Measures for Highway Winter Maintenance Operations
- TR-501 Optimization and Management of Materials in Earthwork Construction
- TR-517 Guidelines for Safety Treatment of Roadside Culverts
- TR-529 Ultra High Performance Concrete Bridge Wapello County
- TR-546 Revision to the SUDAS Traffic Signal Design Guide
- TR-555 Evaluation of Hot Mix Asphalt Moisture Sensitivity using the Nottingham Asphalt Test Equipment
- TR-573 Development of LRFD Design Procedures for Bridge Piles in Iowa
- TR-577 Evaluation of Rumble Stripes on Low Volume Rural Roads in Iowa
- TR-578 Development of Mix Design Process for Cold In-Place Recycling Using Emulsion - Phase III
- TR-582 Ethanol By-Product Geo-Material Stabilization
- TR-586 Pavement Thickness Design for Local Roads in Iowa
- TR-592 Bridge Rails and Approach Railing for Low-Volume Roads in Iowa
- TR-593 Infrastructure Impacts on Iowa's Changing Economy
- TR-595 Autonomous Measurements of Bridge Pier and Abutment Scour Using Motion-Sensing Radio Transmitters
- TR-596 Insights into the Origin and Characteristics of the Sedimentation Process at Multi-Barrel Culverts in Iowa
- TR-600 Improving Concrete Overlay Construction

19 Projects Completed and Approved

Table II
FINANCIAL SUMMARY OF RESEARCH AND DEVELOPMENT PROJECT EXPENDITURES
 July 1, 2009 to June 30, 2010
(Active projects with no current fiscal year expenditures are not included)

<u>Project</u>	<u>Project Title</u>	<u>Primary Road Research Fund Expenditures</u>	<u>Secondary Road Research Fund Expenditures</u>	<u>Street Research Fund Expenditures</u>	<u>Total Expenditures</u>
140	Collection and Analysis of Stream Flow Data	40,884.00	148,206.00	46,184.00	235,274.00
296	ISU Local Technical Assistance Program (LTAP)	41,714.05	82,496.83	14,686.00	138,896.88
450	Living Snow Fence	68,302.71			68,302.71
519	Developing Flood-Frequency Discharge Estimation Methods for Small Drainage Basins in Iowa		80,045.00		80,045.00
536	Implementation of the Water Quality Control BMPs & Design & Specifications Manuals	2,422.70	1,761.90	220.20	4,404.80
546	Revision to the SUDAS Traffic Signal Design Guide	45.11			45.11
551	Local Agency Pavement Marking Plan	5,402.50			5,402.50
555	Evaluation of Hot Mix Asphalt Moisture Sensitivity using the Nottingham Asphalt Test Equipment		1,300.22		1,300.22
563	The Effects of Implements of Husbandry Farm Equipment on Pavement Performance	7,000.00	52,500.00	10,500.00	70,000.00
564	Adding Scour Estimation to the Iowa Bridge Backwater Software		10,404.00		10,404.00
566	Investigation of Utility Cut Repair Techniques to Reduce Settlement in Repair Areas	5,922.31			5,922.31
567	Development of Stage-Discharge Relations for Ungaged Bridge Waterways	22,847.84	10,931.74	4,503.00	38,282.58
568	Modified Sheet Pile Abutments for Low Volume Bridges	2,510.39	66,314.39		68,824.78
570	Identification of Practices, Design, Construction and Repair Using Trenchless Technology	5,730.69			5,730.69
572	Improving Safety for Slow Moving Vehicles on Iowa's High-Speed Rural Roadways	11,152.38			11,152.38
573	Development of LRFD Design Procedures for Bridge Piles	10,453.54	21,267.56		31,721.10
574	Structural Design Construction & Evaluation of a Pre-stressed Concrete Bridge Using UHPC Pi Girders	5,875.82	4,770.71		10,646.53
575	Embedded (MEMS) Micro-Electromechanical Sensors & Systems for Monitoring Highway Structures & for Infrastructure Management	1,989.37	11,811.37	8,480.44	22,281.18
577	Evaluation of Rumble Stripes on Rural Roads in Iowa	370.44	502.74		873.18
578	Development of Mix Design Process for Cold In-Place Recycling Using Emulsion - Phase 3	6,184.94	8,110.51		14,295.45
579	Strategies to Reduce Speed and Crashes on Curves	1,760.60	12,068.62	564.90	14,394.12
580	Pavement Markings and Safety	13,139.58		3,568.10	16,707.68
581	Development of an Improved Agricultural-Based Deicing Product	4,804.53	20,221.05	1,196.88	26,222.46
582	Ethanol By-Product Geo-Material Stabilization	12,187.81	2,787.94	1,320.40	16,296.15
583	Field Testing of Piles & Development of a Wave Equation Method for Pile Design in IA		116,532.44	7,295.32	123,827.76
584	Establishing a Dynamic Formula for Pile Design & Construction Control of Pile Driving	8,123.17	14,304.16	959.92	23,387.25
586	Pavement Thickness Design for Local Roads in Iowa	11,636.82	5,702.75	3,350.66	20,690.23

Project	Project Title	Primary Road Research Fund	Secondary Road Research Fund	Street Research Fund	Total
		Expenditures	Expenditures	Expenditures	Expenditures
591	Stabilization to Mitigate Edge Rutting for Granular Shoulders	8,246.80	5,177.85	3,661.53	17,086.18
592	Bridge Rails and Approach Railing for Low-Volume Roads in Iowa	2,450.14			2,450.14
593	Infrastructure Impacts on Iowa's Changing Economy	35,812.18	23,939.44		59,751.62
594	Development of Non-Petroleum Based Binders for Use in Flexible Pavements	17,607.62	23,549.95	4,190.53	45,348.10
595	Autonomous Measurements of Bridge Pier and Abutment Scour Using Motion-Sensing Radio Transmitters	14,026.72	2,581.25		16,607.97
596	Insights into the Origin and Characteristics of the Sedimentation Process at Multi-Barrel Culverts in Iowa		19,235.39	2,243.99	21,479.38
597	Wet Reflective Pavement Marking Demonstration Project		49,292.13	12,351.64	61,643.77
598	Development of Updated Specifications for Roadway Rehabilitation Techniques	18,008.10	2,613.00	3,874.01	24,495.11
599	Investigation of Warm Mix Asphalt Using Iowa Aggregates	19,439.37	42,374.00	7,945.26	69,758.63
600	Improving Concrete Overlay Construction	97,326.66	36,115.30	8,085.01	141,526.97
601	Roadway Lighting and Safety: Phase II (TR-540) Monitoring, Quality, Durability and Efficiency		8,202.13	6,932.90	15,135.03
602	Part I - Updating Portions of the Three-Span Prestressed Concrete Beam Bridge Standards to LRFD Specifications		898.01		898.01
603	Part II - Updating Portions of H-Standard Three Span Prestressed Beam Bridges, T-Pier and Pile Bent Pier Update to LRFD		66,809.56		66,809.56
604	Field Testing and Evaluation of a Demonstration Timber Bridge		29,148.61		29,148.61
605	Evaluation of the Buena Vista IBRD Bridge: A Furthering of Accelerated Bridge Construction in Iowa	564.11	3,860.93	5,214.17	9,639.21
606	Iowa Public Employee Leadership Academy (LTAP)	12,500.00	13,415.06	6,543.77	32,458.83
607	Review of Inconsistencies Between SUDAS & Iowa DOT Specifications	28,822.07	52,081.85	2,600.10	83,504.02
608	Assessment of Iowa County Roadway Financing Needs, Phases 1-4		19,287.77	10,068.83	29,356.60
609	Curing Criteria for Cold In-Place Recycling Phase III		48,756.92	8,637.82	57,394.74
610	On-The-Spot Damage Detection Methodology for Hwy Bridges During Natural Crisis	4,138.85	34,546.00	6,910.00	45,594.85
611	Wireless Sensor Networks for Infrastructure Monitoring		8,844.97	3,267.56	12,112.53
613	Study of the Impacts of Implements of Husbandry on Iowa Bridges		486.75		486.75
614	Structural Characterization of a UHPC Waffle Bridge Deck and its Connections		22,192.02	4,170.12	26,362.14
615	Connection Details and Field Implementation of UHPC Piles - Phase II: Use of Ultra-High Performance Concrete in Geotechnical and Substructure Applications		22,673.30	2,323.12	24,996.42
616	Timber Abutment Piling and Back Wall Rehabilitation and Repair		5,003.68		5,003.68
618	Shuck-Britson Agreement for Parallel Wing Headwalls for Single RCBs (LRFD)		59,090.76		59,090.76
619	Development of Self-Cleaning Box Culvert Design – Phase II		183.29		183.29
1027	Secondary Road Research Coordinator		100,319.86		100,319.86
SPR-PL-1(46)	Contract Research Subtotal	549,403.92	1,372,719.71	201,850.18	2,123,973.81
	FY 2010 Transportation Inventory Engineering Studies		87,977.00		87,977.00
	Total of Expenditures	549,403.92	1,460,696.71	201,850.18	2,211,950.81

HR-140

Agency:
United States
Geological Survey

Principal Investigator:
Rob Middlemis-
Brown

Research Period:
July 1, 1967 to
September 30, 2011
Annual Renewal

Research Board Funding:
\$249,650

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 mi² 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:
Duane Smith

Research Period:
October 1, 1986 to
December 31, 2010

Research Board Funding:
\$130,000

Funding Source:
35.9% Federal funds,
15.4% 402 Safety funds,
14.4% ISU/Midwest Transportation Center funds,
8.7% Workshop income funds and
25.6% State –
10% Primary funds
45% Secondary funds
45% 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

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.



During the 2009 Snow Rodeo held at the Iowa State Fairgrounds in September, participants take part in defect testing, one of several required activities.

Photo: Iowa State University/InTrans

HR-375

Agency:

Iowa Department of
Transportation,
Highway Division

**Principal
Investigator:**

Edward J. Engle

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 two county engineers to the Transportation Research Board (TRB) Annual Meeting in Washington, D.C., for research education. County engineers selected are generally those starting their term as regular members of the Iowa Highway Research Board (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 1995-2010, 24 county engineers have received funding through IHRB to attend the Annual TRB meeting in Washington, D.C.

Reports: None

Implementation: County engineers who have attend 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-428

Agency:
Iowa State University

Principal Investigator:
F. Wayne Klaiber and
Terry J. Wipf

Research Period:
February 1, 1999 to
December 31, 2009

Research Board Funding:
\$294,760

Funding Source:
100% State -
45% Primary funds,
45% Secondary funds
and 10% Street funds

Effective Structural Concrete Repair

Objective: Develop innovative repair methods and/or materials that result in cost effective repair of structural concrete elements.

Progress: An Interim Report summarizing the construction work was presented at the April 2004 IHRB meeting. Also, a synopsis of the installation procedures used for each of the Fiber Reinforced Polymers (FRP) wraps was created for use by maintenance personnel. A synopsis was included as an appendix to the Interim Report. A Final Report will be prepared in 2010 to detail the long-term performance of the documented repairs and service lives of the bridges.

Reports: Interim Report April 2004

Implementation: Results from this investigation will provide technical information that bridge and other engineers can use to lengthen the useful life of concrete bridges.



Trucks in Lane 3 during the Altoona Bridge test

TR-450

Agency:

Purdue University,
sub-contract with
Iowa State University

Principal Investigator:

Rebecca S. McDaniel
(Purdue University)
and Brian Coree
(Iowa State
University)

Research Period:

June 1, 2001 to
April 30, 2010

Research Board Funding:

\$80,000 (Purdue
University - \$23,674;
Iowa State University
- \$56,326)

Funding Source:

Pooled funds
coordinated by North
Central Superpave
Center at Purdue
University –
50% Institute for
Safe, Quiet, and
Durable Highways
funds,
25% Indiana DOT
funds and
25% State -
100% Primary funds

Identification of Laboratory Techniques to Optimize Superpave HMA Surface Friction Characteristics

Objective:

- Evaluate various blends of aggregates
- Optimize the combination of micro- and macro-texture to achieve a desired friction values
- Evaluate aggregate classifications and properties currently used to provide desirable friction levels for high traffic and possibly revise them based upon this research

Reports: Final Report, April 2010

Implementation: These research findings will help to identify blends of aggregates to be used in Iowa for maintaining the current baseline of friction. It is anticipated that improved macro-texture will diminish the need for high quality friction aggregates (to provide increased micro-texture). This may result in more economical surface courses through reducing the need for imported high-friction aggregates.

TR-468

Agency:

Iowa Department of
Transportation

**Principal
Investigator:**

Mark J. Dunn

Research Period:

December 1, 2001 to
on-going

**Research Board
Funding:**

\$10,000

Funding Source:

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

Technology Transfer Program for the Iowa Highway Research Board

Objective: Provide improved research technology transfer and information distribution to the Iowa Highway Research Board (IHRB) and transportation professionals in Iowa, and provide resources for facility costs for small workshops related to IHRB research when it is beneficial to transfer technology.

Progress: This project covers small scale technology transfer costs for the Iowa Highway Research Board and other implementation related efforts.

Reports: None



The IHRB listens to a presentation during the Annual Travel Meeting held on July 30, 2010, at The University of Iowa's Lucille A. Carver Mississippi Riverside Environmental Research Station (LACRMERS) near Muscatine, Iowa.

Photo: Mark Dunn, IHRB Executive Secretary

TR-488

Agency:
The University of
Iowa

**Principal
Investigator:**
Wilfrid A. Nixon

Research Period:
February 1, 2003 to
July 31, 2005

**Research Board
Funding:**
\$90,000

Funding Source:
100% State -
70% Primary funds,
25% Secondary funds
and 5% Street funds

Economics of Using Calcium Chloride vs. Sodium Chloride for Deicing & Anti-icing

Objective: Determine what mixture of calcium chloride and sodium chloride when applied to the road surface under winter weather conditions provides the best possible level of service to the public in the most economical way possible; Examine economic factors as well as ice melting capabilities and operational impacts that are major factors of successful winter maintenance operations.

Progress: A draft final report has been submitted and is under review.

Reports: None

Implementation: The results of this study will be presented at various meetings in Iowa and made available via e-mail to subscribers listed on the *Snow and Ice* Mailing List.



←
Test chamber measures the freezing characteristics of Calcium Chloride brine.

Ice is treated with Calcium Chloride brine to determine melting rate. →



A low temperature cooling bath used to determine the very low temperature performance of Calcium Chloride brine.
←

Photos: Dr. Wilf Nixon,
The University of Iowa/IHR

TR-491

Agency:
The University of
Iowa

**Principal
Investigator:**
Wilfrid A. Nixon

Research Period:
July 1, 2003 to
September 29, 2009

**Research Board
Funding:**
\$100,000

Funding Source:
100% State -
80% Primary funds,
10% Secondary funds
and 10% Street funds

Development of Winter Performance Measures for Maintenance Operations

Objective: Create a method for measuring performance levels of winter maintenance operations during winter storms. The method must consider the severity of the storm and measure the outcomes of the winter maintenance actions in such a way as to cumulatively assess the performance of those actions.

Reports: Final Report, September 2009

Implementation: Performance in winter maintenance operations can be measured by the speed reduction observed on the road. For a specific road type and storm severity, a target speed reduction is given, and performance can be measured in relation to this speed reduction. The results of this study are available via e-mail to all subscribers to the *Snow and Ice* mailing list.



Iowa DOT Maintenance Operations snow removal during a winter storm
Photo: Iowa DOT

TR-501

Agency:
Iowa State University

Principal Investigator:
Vern Schaefer

Research Period:
January 1, 2004 to
May 21, 2010

Research Board Funding:
\$175,000

Funding Source:
100% State -
45% Primary funds,
45% Secondary funds
and 10% Street funds

Optimization and Management of Materials in Earthwork Construction

Objective:

- Identify the impact of not doing material management and optimization through a forensic study of recent geotechnical problems and failures in Iowa
- Determine appropriate parameter values to use in optimizing geotechnical system performance and material placement (i.e. shear strength, volumetric stability) in particular geotechnical applications, including subgrades, retaining structures, embankments, box culverts, and foundations
- Develop guidelines (i.e. flow chart) for selection, mixing, stabilization and/or ground improvement of materials that provide desired engineering properties to obtain optimal performance for the various applications
- Provide recommendations for Phase II pilot studies and development of design tools/software

Reports: Final Report, May 2010

Implementation: The observations and conclusions from this study provide recommendations for better management and optimization of on-site and select earth materials through the use of new ground improvement technologies. State, county, and local transportation agencies and contractors can implement the recommendations for improved geotechnical construction.



Soil mixing operation through layered soils, Des Moines, Iowa
Photo: Vern Schaefer, Iowa State University/CCEE

TR-517

Agency:
University of
Nebraska - Lincoln

**Principal
Investigator:**
Dean L. Sicking and
Ronald K. Faller

Research Period:
April 1, 2004 to
February 26, 2010

**Research Board
Funding:**
\$24,995

Funding Source:
100% State -
45% Primary funds,
45% Secondary funds
and 10% Street funds

Guidelines for Safety Treatment of Roadside Culverts

Objective: Develop general guidelines for safety treatment alternatives for cross-drainage culverts. Cost-effective analysis procedures will be utilized to determine traffic characteristics and roadside geometries for which each of the above safety treatments are most cost-beneficial.

Reports: Final Report, February 2010

Implementation: Generalized guidelines for safety treatment of cross-drainage culverts will greatly simplify development of plans for reconstruction, rehabilitation & resurfacing (3R) projects. These guidelines will provide reasonably accurate and consistent safety treatment designs for roadside cross-drainage culverts. Further, the simplified design guidelines will significantly reduce the effort required to develop safety treatment plans for roadside cross-drainage culverts.

It is anticipated that the Iowa DOT will be able to immediately implement the simplified design guidelines developed under the study proposed herein. A short seminar will be presented at the end of this study in order to train Iowa highway designers in the application of the guidelines.



Safety treatment for cross-section drainage culverts
*Photo: Midwest Roadside Safety Facility (MwRSF)
University of Nebraska-Lincoln*

TR-519 Phase II

Agency:

United States
Geological Survey
(USGS)

Principal Investigator:

David Eash

Research Period:

June 1, 2004 to
December 31, 2011

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 objectives for Phase I have been achieved. Additional Phase II funding for the implementation of StreamStats was approved and work has begun.

Reports: None

Implementation: This study will provide a flood estimation method that will enable engineers, managers, and planners to estimate flood-frequency discharges for small drainage basins with great predictive accuracy.

Regional regression equations developed will only include basin characteristics that are considered easy for users to apply. The probabilistic rational method of flood estimation developed in this study will present runoff coefficient and rainfall frequency maps of the state from which users will determine runoff and rainfall values for small drainage basins.

The study will produce a standard USGS Scientific Investigation Report that will describe the study and present example applications of flood-estimation methods.

TR-529

Agency:
Iowa State University

Principal Investigator:
Brent Phares

Research Period:
February 1, 2005 to
June 25, 2010

Research Board Funding:
\$154,310

Funding Source:
45 % FHWA,
31 % Wapello
County,
24 % State (IHRB) -
49 % Primary funds,
49 % Secondary
funds and
2 % Street funds

Construction and Evaluation of a Prestressed Concrete Bridge Using Ultra-High Performance Concrete

Objective:

- Advance state-of-the-art concrete bridge construction technology by constructing the first bridge in the United States to use a novel concrete mix
- Develop experience in the State of Iowa in design and construction of bridges using advanced materials
- Develop recommended design procedures for shear design of ultra-high performance concrete beams

Reports: Final Report, June 2010

Implementation: These advances will be useful to all jurisdictions within Iowa by ultimately reducing costs and utilizing a higher strength material with almost zero permeability. This could essentially eliminate deterioration of bridge decks.

The results of this research will be compiled in design recommendations and specifications that may potentially be adopted by the American Association of State Highway and Transportation Officials (AASHTO).



A UHPC prestressed bridge constructed on Little Soap Road in Wapello County, Iowa

Photo: Dr. Brent Phares, Iowa State University/CCEE

TR-536

Agency:

The University of
Iowa

**Principal
Investigator:**

Marian Muste

Research Period:

April 1, 2005 to
December 31, 2008

**Research Board
Funding:**

\$44,048

Funding Source:

100 % State -
55 % Primary funds,
40 % Secondary
funds and
5 % Street funds

Implementation of the Water Quality Control BMPs and Design and Specifications Manuals

Objective: Incorporate the content of the latest best management practices and design and specification manuals for erosion and sediment control measures (currently under development through project TR-508, “Design Guide and Construction Specifications for NPDES Site Runoff Control”) in the existing web-based erosion control expert system.

Progress: Manuals to be incorporated into the interactive Web site are:

- *Iowa Construction Site Erosion Control Manual*
- Statewide Urban Standard Design and Specification Manuals for Erosion and Sedimentation Control
- *Design of Guidelines and Specifications for Improving Stormwater Water Quality*

Guidelines for *The Best Management Practices and Design and Specification Guidelines for Erosion and Sedimentation Control* have been incorporated into the interactive manual. The Water Quality section is still under development.

The software is operationally robust and works well.

Reports: None

Implementation: Once finalized, the *Iowa Stormwater Runoff Control Interactive Manual* (ISRCIM) will be transferred onto one of the Iowa DOT existing Web servers. Strong outreach, testing and upgrading activities are envisioned during the dissemination of the ISRCIM to a wide category of users; the training programs incorporated in Part III of research project TR-508, “Design Guide and Construction Specifications for NPDES Site Runoff Control” presents a major portion of this implementation.

Additionally, training sessions on ISRCIM will be organized according to requests formulated by IHRB, Iowa cities and counties, and other specialized state offices with responsibilities in the area of sediment, sedimentation and water quality control.

TR-545

Agency:

The University of Iowa

Principal Investigator:

Marian Muste
Peter Haug

Research Period:

March 15, 2005 to
June 26, 2009

Research Board Funding:

\$144,785

Funding Source:

80 % State -
40 % Primary funds,
50 % Secondary
funds and
10 % Street funds

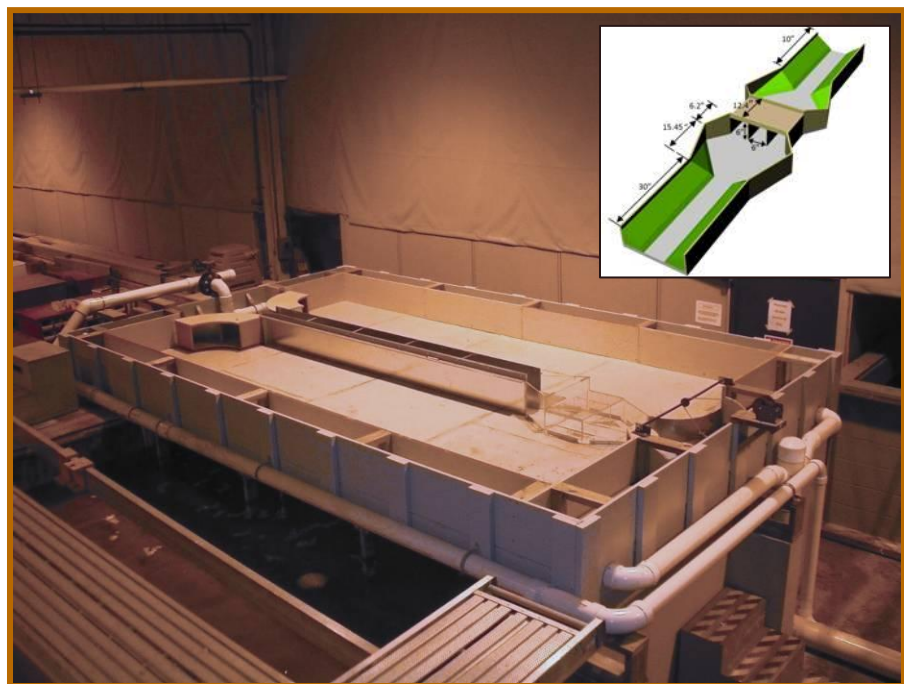
Development of Self-Cleaning Box Culvert Designs

Objective: 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 barrels and keep the structure performing well with little or no maintenance.

This research involved laboratory evaluation using several potential inlet geometries to maintain flow and minimize sediment clogging using scaled flumes, and Phase II will test the best of those geometries using actual culverts in the field.

Reports: Final Report, June 2009

Implementation: Results include one or more inlet designs that can be built into new culverts and retro-fitted to existing culverts, which will be beneficial to all levels of government in Iowa – cities, counties and the state.



Laboratory hydraulic model and schematic of channel (insert) with three-barrel culvert geometry

Photo: Dr. Marian Muste, The University of Iowa/IIHR

TR-546

Agency:
Iowa State University

Principal Investigator:
Neal Hawkins

Research Period:
December 1, 2005 to
June 30, 2009

Research Board Funding:
\$80,000

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

Revision to the SUDAS Traffic Signal Design Guide

Objective: Update and publish new Chapter 13 (Traffic Signal Design) and Division 8 (Traffic Signal Specification) documents for the SUDAS manual. This effort will require a significant amount of collaboration with numerous groups including a project advisory group, the SUDAS Traffic Signal Sub-Committee, consultants, contractors, Iowa DOT and municipal agency staff, the signal industry as well as professionals from fields such as electrical, geotechnical and soils engineering.

Reports: Final Report, July 2009

Implementation: Research findings will be shared through incorporation into the SUDAS manual as well as through presentations at the county engineer conference, the MOVITE traffic engineering conference, the ASCE transportation conference, the APWA conference, and through a variety of other professional, municipal, and national group presentations.



SUDAS specifications are updated to stay current with new traffic signal technologies and methods

Photo: Neal Hawkins, Iowa State University/InTrans

TR-548

Agency:
Iowa State University

Principal Investigator:
Chris Albrecht

Research Period:
December 1, 2005 to
April 30, 2007

Research Board Funding:
\$80,000

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

Investigation of the Impact of Rural Development on Secondary Road Systems

Objective: Quantify traffic and fiscal impacts of two common types of rural development on the secondary road system in Iowa:

- Rural residential subdivisions which are commonly found 30 minutes or less from centers of employment
- Livestock production facilities which are typically located in remote areas

Reports: Final Report, September 2010

Implementation: The research team worked with planning and extension groups such as the Iowa Association of Counties and its affiliated groups, LTAP, Iowa State Extension (ISE), Iowa Chapter of the American Planning Association and others to disseminate the research and with ISE and LTAP to develop a series of informational workshops on the topic of rural development impacts on transportation networks.



A rural residential subdivision
Photo: Susan Deblicek, Iowa State University

TR-551

Agency:
Iowa State University

Principal Investigator:
Neal Hawkins

Research Period:
January 1, 2006 to
July 30, 2010

Research Board Funding:
\$157,081

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

Local Agency Pavement Marking Plan

Objective: Produce a Reflectivity Guideline to assist local agencies in identifying application of pavement marking needs due to wear or marking damage over the winter and in developing marking needs and priorities each spring. This research will also:

- Develop a county and city pavement marking application matrix which will provide guidance on the selection of marking materials based on roadway type, pavement service life, user needs, and other factors specific to local agency conditions
- Address quality control issues for cities and counties to improve efficiency and effectiveness of pavement markings on all marked public roadways

Reports: Final Report, July 2010

Implementation: These guidelines will be incorporated into a pavement marking design section within the Iowa Statewide Urban Designs and Specifications (SUDAS) manual. Research findings will be shared through presentations at the County Engineer Conference, the American Society of Civil Engineers (ASCE) Transportation Conference, the American Public Works Association (APWA) Conference, and through a variety of other professional, municipal, and national group presentations.



One goal of this project was to find new products and methods for improving both durability and retro-reflectivity of centerline markings.

Photo: Neal Hawkins, Iowa State University/CCEE

TR-555

Agency:
Iowa State University

Principal Investigator:
Chris Williams

Research Period:
April 1, 2006 to
April 30, 2010

Research Board Funding:
\$75,000

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

Evaluation of Hot-Mix Asphalt Moisture Sensitivity Using the Nottingham Test Equipment

Objective: Evaluate moisture susceptibility of individual components of HMA through an experimental plan to isolate different variables. Dynamic Modulus and Flow Number testing were used to evaluate the moisture susceptibility of the HMA, including:

- Compare test results for select materials in both a moisture-saturated and dry environment; integrate a range of Iowa DOT asphalt mixtures.
- Develop new test protocol for determining moisture susceptibility using results obtained from Dynamic Modulus and Flow Number Tests.

Reports: Final Report, April 2010

Implementation: The research team delivered recommendations on acceptable test protocol conditions and limitations along with appropriate user variability.

The implementation plan provides recommendations for integrating moisture testing and evaluates different anti-stripping agents and their success in mitigating moisture damage. Technology developments will be dispersed through electronic, web-based and paper formats.



Indirect tensile strength test setup

TR-562

Agency:
Robert Connor &
Assoc

Principal Investigator:
Robert Connor &
Bruce Brakke (Iowa
DOT)

Research Period:
July 14, 2006 to
September 30, 2008

Research Board Funding:
\$36,755

Funding Source:
100 % State -
100 % Primary funds

Field Instrumentation and Testing of High-Mast Lighting Towers in the State of Iowa

Objective: The Iowa DOT owns 233 high-mast lighting towers ranging from 100-feet to 180-feet tall. In 2003, a 140-foot tower collapsed due to a fracture at the welded connection at the base plate. Subsequently, cracks were found in twenty other towers. In addition to cracks at the base plate, a crack was also found at the welded access opening detail on one tower; cracked towers were removed from service.

The main objective is to determine how a reinforcing jacket affects the tower's response to wind induced vibrations and determine the magnitude of stresses in both the jacket and the original tower, including the anchor rods.

Progress: The field work for the research project to Monitoring Wind-Induced Vibrations/Stresses in a High-Mast Lighting Tower was started in the summer of 2006, with the goal of collecting data for a least one year. Instrumentation has provided information as intended from the original tower shell, the bolted reinforcing jacket and the anchor rods. Additional data will be collected in order to better understand the tower's long-term response to wind.

Reports: A Draft Final Report is complete.

Implementation: The research will likely provide a more cost effective repair to cracked high-mast towers and a more efficient retrofit for un-cracked towers with fatigue susceptible details. The Iowa DOT would be able to expeditiously address the problems associated with these towers at a large cost savings.



Bolted Reinforcing Jacket



A bolted reinforcing jacket was placed on a tower in the I-35 & US 18 Interchange near Clear Lake

TR-563 (TPF-5, 148)

Agency:
Minnesota
Department of
Transportation

Principal Investigator:
Tim Clyne
(Minnesota
Department of
Transportation)

Research Period:
July 2006 to
September 30, 2011

Research Board Funding:
\$105,000

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

The Effects of Implements of Husbandry Farm Equipment on Pavement Performance (MnROAD Study)

Objective: Determine pavement response under various types of agricultural equipment (including impacts of different tires and additional axles) and compare this response to the impact of a typical five-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.

Progress: Four iterations of testing have been completed. These tests have included a wide range of vehicles and configurations. The final testing occurred at the end of August 2010. The Final Report is expected to be complete in December 2011.

Reports: None

Implementation: This research will help with policy and design decision making, providing direct experimental results to support those decisions rather than using just models. When models are used they cannot be calibrated for the types of loadings and tire configurations for a variety of agricultural equipment.



Large manure hauling tank on the MnROAD test track; fully loaded it weighs more than 134,000 lbs (distributed over four axles - not including the tractor).

Photo: Shongtao Dai, Research Operations Engineer, Minnesota DOT

TR-564

Agency:
Digital Control, Inc.

Principal Investigator:
LaDon Jones

Research Period:
September 1, 2006 to
September 24, 2010

Research Board Funding:
\$52,000

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

Adding Scour Estimation to the Iowa Bridge Backwater Software

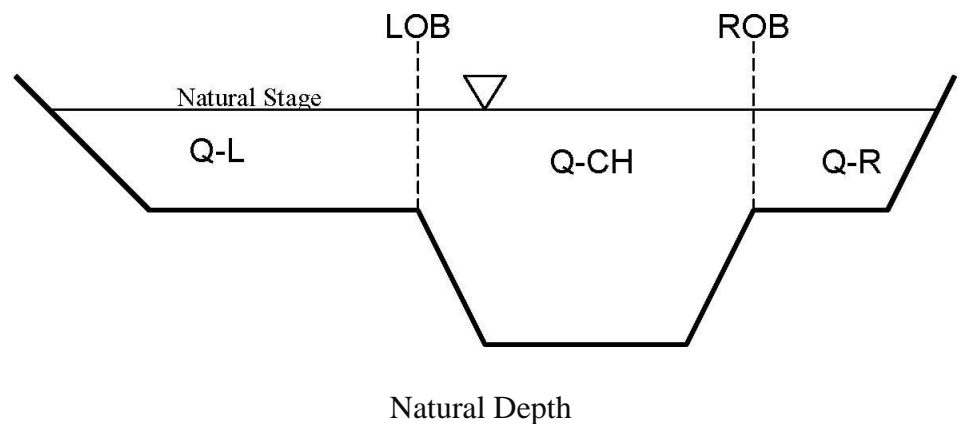
Objective: Add a new major component to the Iowa Bridge Backwater software (published in 2003), *The Estimation of Scour at Bridges*. Adding scour estimation will be the most significant portion of this project and provide a valuable time saving tool for city, county and state engineers.

In addition to scour, the following items will also be completed as part of Version II of the software as suggested by users of the current software:

- Improved convergence and iteration on backwater with overtopping
- Improved label scaling on plots and graphs
- Design flow rate copying
- Updated User Manual
- Online Help

Reports: Final Report, September 2010

Implementation: The Iowa Bridge Backwater Version 2 software will be utilized by city and county engineers, Iowa DOT staff and consultants for the design of bridges along the State's primary and secondary road system. One copy of the program will be provided to each county engineering office in Iowa.



Natural Depth
The depth of the natural stage above the lowest elevation of a sample valley cross-section.

TR-566

Agency:
Iowa State University

Principal Investigator:
Larry Stevens

Research Period:
December 1, 2006 to
May 31, 2009

Research Board Funding:
\$165,316

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

Utility Cut Repair Techniques – Investigation of Improved Utility Cut Repair Techniques to Reduce Settlement in Repaired Areas: Phase II

Objective: Based on the results of Phase I (IHRB TR-503), the research team will monitor the constructed utility cuts for two more years, construct new trenches using the three methods suggested by the research team in Phase I and instrument utility trenches to further understand the mechanisms of trench backfill settlement and load distribution.

This research examines utility cut construction practices using continued monitoring of restored cuts to improve understanding of trench settlement and load transfer through the instrumentation of utility trenches. The goal of increasing the pavement patch life and reducing the maintenance of the repaired areas is priority.

Progress: Final Report, December 2010

Reports: None

Implementation: Observations and conclusions from this study will provide recommendations on effective utility cut repairs. State, county and city transportation agencies and jurisdictions can implement the recommendations for utility cut repairs. It is anticipated that the best practices manual will be incorporated as a chapter into the Statewide Urban Design and Specifications (SUDAS) Design Manual, and that specification recommendations will be included in the SUDAS Specifications Manual.



Large lift thickness used in utility cut trench backfilling
Photo: Iowa State University/InTrans

TR-567

Agency:

The University of Iowa

Principal Investigator:

Thanos Papanicolaou

Research Period:

August 1, 2006 to September 30, 2010

Research Board Funding:

\$157,030

Hungry Canyons Alliance Funding:

\$105,000

Funding Source:

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

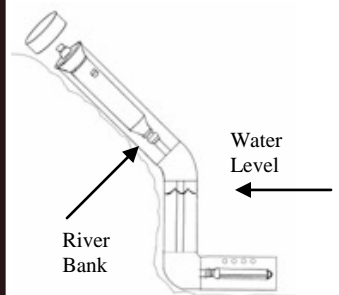
Development of Stage Discharge Relations for Ungaged Bridge Waterways in Western Iowa

Objective: Establish stage-discharge relationships for ten ungaged streams in western Iowa through implementation of a semi-automatic sensor network. This project seeks to describe and document knickpoint propagation and identify and prioritize at-risk sites, thereby avoiding potential safety and asset risks due to knickpoint propagation and channel vertical shift.

Reports: Final Report, October 2010

Implementation: This research will provide stage-discharge relations for small-to-medium size ungaged streams in western Iowa and comparisons with other ongoing studies; a tool for predicting river response based on discharge data; explain scour and erosion processes at bridge waterways while indicating how past, present, and possible future changes in river or stream dynamics may affect bridge waterway stability as a function of discharge.

Description and documentation of knickpoint propagation in the Hungry Canyons Alliance (HCA) region will aid in identifying and prioritizing at-risk sites, thereby avoiding or lessening potential safety and asset risks. Results will be presented at conferences and information made available to interested agencies.



Installation of Water Level Loggers (left) and drawing (right) of Logger Placement

Photo and Illustration: Dr. Thanos Papanicolaou, The University of Iowa/IIHR

TR-568

Agency:
Iowa State University

Principal Investigator:
David J. White

Research Period:
January 1, 2007 to
August 31, 2010

Research Board Funding:
\$365,912

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

Modified Sheet Pile Abutments for Low Volume Bridges

Objective: Develop a design approach for sheet pile bridge abutments for short span, low-volume bridges, including calculation of lateral stresses from retained soil and bearing support for superstructures; formulate an instrumentation and monitoring plan to evaluate performance of sheet pile abutment systems including evaluation of lateral structural forces and bending stresses in sheet pile sections.

Also, evaluate and understand the costs and construction efforts associated with building a sheet pile bridge abutment demonstration project and materials; provide recommendations for use and potential limitations of sheet pile bridge abutment systems.

Progress:

- Black Hawk County - Construction of the project has been completed and load tested. Data collected from the testing is currently being analyzed.
- Boone County - Construction of the project has been completed and a load test scheduled. The monitoring system has been installed and is ready for load testing.
- Tama County – Construction of the project was delayed until March, 2010 due to weather and site conditions. Construction underway and expected to be complete by the end of August 2010. Changes to the design were required due to existing conditions and were implemented through change order.

Reports: None

Implementation: The Final Report will provide recommendations for site investigation and design of sheet pile bridge abutments for LVRs. A summary sheet will be made available at appropriate local and regional conferences.

The observations and conclusions from this study provide recommendations for use of sheet pile abutments in bridges on low volume roads and in-situ soil testing. County engineers (responsible for 80% of Iowa's low volume roads) can implement recommendations for use of an alternative abutment system.

TR-570

Agency:

Iowa State University

Principal Investigator:

Muhammad Suleiman

Research Period:

March 1, 2007 to
July 31, 2009

Research Board Funding:

\$174,980

Funding Source:

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

Identification of Practices, Design, Construction, and Repair Using Trenchless Technology

Objective: Collect and analyze information recommending practices for design, construction and repair utilizing trenchless technology by state and local jurisdictions; these recommendations will be a synthesis of known field practices and/or documented research from studies conducted as part of this research, which can be used by jurisdictions in their utility and restoration permit process.

These recommendations will be proposed for incorporation into the Statewide Urban Design and Specifications (SUDAS) Design Manual Chapter 14.

Progress: Final Report, October 2010

Reports: None

Implementation: This study will provide recommendations on effective utility installation and repair. State, county and city transportation agencies/ jurisdictions can implement the recommendations for utility construction or repair.

It is anticipated that the best practices recommendations will be incorporated in the SUDAS Design Manual and the specification recommendations will be included in the SUDAS Specifications Manual.

In addition to the written report, a summary sheet will be created and presentations will be made at appropriate local and regional conferences and the research team will publish the results in refereed journals.

TR-572

Agency:
Iowa State University

Principal Investigator:
Neal Hawkins

Research Period:
June 1, 2007 to
November 30, 2008

Research Board Funding:
\$99,881

Funding Source:
100 % State -
40 % Primary funds,
60 % Secondary
funds

Improving Safety for Slow Moving Vehicles on Iowa's High Speed Rural Roadways

Objective: Focus on improving transportation safety for drivers of slow-moving vehicles and other drivers in the proximity of these vehicles on the public roadway system; this work will include the guidance of an advisory panel made up of IHRB members, city and county engineers, city and Iowa DOT planners, industry representatives and other relevant stakeholders.

A matrix of recommended strategies in dealing with agricultural and non-motorized user groups based upon roadway conditions such as speed, shoulder treatment, volume, and frequency of use by these groups and seasonal variations will be made.

Reports: Final Report, June 2009

Implementation: This research seeks to improve safety for both motorists and operators of slow moving vehicles on Iowa's roadways. The work focused on design and technology improvement strategies to systematically address crash experience and exposure to assist technical and nontechnical staff in assessing what can be done to improve safety for slow moving vehicles while providing links to other resources and best practices. This project was designed to improve transportation safety for SMVs on Iowa's public roadway system. The report includes a literature review showing various SMV statistics and laws across the United States, a crash study based on three years of Iowa SMV crash data, and recommendations from the SMV community.



An Amish buggy travels along one of Iowa's high speed rural roads
Photo: Iowa DOT

TR-573

Agency:
Iowa State University

Principal Investigator:
Sri Sritharan

Research Period:
July 1, 2007 to
June 25, 2010

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 Load and Resistance Factor Design (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-574

Agency:

Iowa State University

Principal Investigator:

Terry Wipf

Research Period:

April 1, 2007 to
September 30, 2010

Research Board Funding:

\$79,933

Funding Source:

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

Structural Design, Construction and Evaluation of a Pre-stressed Concrete Bridge Using Ultra High-Performance Concrete Pi Girders

Objective: Optimize the design and use of Pi girders while advancing the state-of-the-art in bridge concrete construction technology. In addition, this research continues to foster an important partnership with FHWA and industry that is contributing to the standardization and use of the next generation of high performance materials.

Progress: Analysis of the data has been completed and the Final Report is in preparation.

Reports: Final Report expected January 2011

Implementation: The successful application of ultra high performance concrete (UHPC) will further advance development of cost-effective use for implementation by all jurisdictions within Iowa as ultimately costs are reduced through:

- Taking advantage of a higher strength material
- Taking advantage of a material with almost zero permeability which could essentially eliminate deterioration of bridge decks
- The optimization, validation, and acceptance of the proposed girder cross section represent a significant step in more widespread adoption

Benefits associated with this work will be a reduction in costs associated with bridge construction and, more significantly, in costs associated with bridge maintenance.

Further advances with UHPC may yield bridge designs in which the deck and super-structure last for the same duration, thus eliminating the need for intermittent and costly deck replacement.

These benefits will be easily quantified at that time by a significant reduction in life-cycle costs associated with bridge ownership.

TR-576

Agency:
Iowa State University

Principal Investigator:
Chris Williams

Research Period:
August 1, 2007 –
December 31, 2008

Research Board Funding:
\$39,795

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

Investigation of ElectroMagnetic Gauges for Determination of In-Place Density of Hot Mix Asphalt (HMA) Pavements – Phase II

Objective: The first phase of this research project found that the electronic gauge technology was promising for use in determining the density of intermediate and surface course mixtures. However, there was indicated a need to understand whether the correction factor obtained in the first day of paving operations for a specific mix and paving conditions is applicable for the ensuing paving days under those same conditions. Objectives are to:

- Determine the consistency of gauge correction factors for multiple paving days
- Determine the number of gauge readings that need to be made for representative quality assurance testing

Reports: Final Report, May 2009

Implementation: The research team will work with the Technical Advisory Committee to develop recommendations for electromagnetic use in quality assurance testing. This will include gauge calibration and/or obtaining gauge correction factors, and determining how they are applied to gauge readings.

TR-577

Agency:
Iowa State University

Principal Investigator:
Shauna Hallmark

Research Period:
November 1, 2007 –
September 30, 2011

Research Board Funding:
\$53,807

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

Evaluation of Rumble Stripes on Low-Volume Rural Roads in Iowa

Objective: Investigate the economic and physical feasibility of installing narrow rumble stripes along the edge of selected paved secondary roads in Iowa.

A painted edge line will be placed directly over the rumble strips, thus providing anticipated improved longevity and wet weather visibility of the paint. Evaluation of reduced run-off and drift-off crashes will be undertaken as well as enhanced performance of the painted edge lines.

Reports: Final Report, October 2009

Implementation: Iowa counties (and others) will benefit from this research by obtaining another tool for improving rural roads safety and extending the effective life and wet weather visibility of painted edge lines. With expanded use of this technique, installation costs should be reduced and more common use of rumble stripes may occur. Narrow width installation may also provide more options to the Iowa DOT for future rumble stripe installation on the primary road system.

A test section of rumble stripes and reflective paint.
*Photo: Dr. Shauna Hallmark,
Iowa State University/CCEE*



TR-578

Agency:

The University of Iowa

Principal Investigator:

Hosin "David" Lee

Research Period:

December 1, 2007 – February 26, 2010

Research Board Funding:

\$65,646

Funding Source:

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

Development of Mix Design Process for Cold In-Place Recycling Using Emulsion - Phase III

Objective: The first two phases of the research developed and validated the mix design procedure for cold-in-place recycling using foamed asphalt (CIR-foam). They also demonstrated that the field performance of various CIR-foam mixtures could be predicted based on the test results from newly purchased performance testing equipment. The objective of the phase III study is to develop a new mix design process for cold-in-place recycling using an emulsion (CIR-emulsion) by applying the knowledge gained and using the equipment purchased during the previous two phases.

Reports: Final Report, February 2010

Implementation: Cold in-place recycling is increasingly being used as the prices of virgin raw materials for paving continue to rise. The results of this Phase III study will provide a mix design process for CIR-emulsion which can be implemented as part of Iowa DOT specifications.



CIR-emulsion mixtures tested using an Interlaken Gyratory Compactor
Photo: Dr. Hosin "David" Lee, The University of Iowa/IIHR

TR-579

Agency:
Iowa State University

Principal Investigator:
Shauna Hallmark

Research Period:
November 1, 2007 –
March 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.

Progress: The team has selected sites for the low-cost treatments. They are waiting through the approval process to continue at those sites. Speed data collection was obtained from the sites with dynamic speed feedback signs for 6 to 12 months. All speed data has been reduced.

Reports: None

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-580

Agency:
Iowa State University

Principal Investigator:
Omar Smadi

Research Period:
January 1, 2008 –
July 30, 2010

Research Board Funding:
\$96,113

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

Pavement Markings and Safety

Objective: Use Iowa DOT data under nighttime conditions to achieve the following:

- Capitalize on current research efforts and develop a systematic method to compare pavement marking and crash data for a given roadway segment
- Investigate the impact that varying levels of pavement marking retroreflectivity have on crash performance
- Use findings to develop strategies for agencies in determining the level of investment needed for pavement markings

Reports: Final Report, December 2010

Implementation: This research will assist technical and non-technical staff in assessing pavement marking needs and the impact on safety. These results will be incorporated into the ongoing efforts of the Iowa DOT Pavement Marking Task Force, and will also benefit the Iowa Highway Research Board Local Agency Pavement Marking Plan research efforts and technology outreach.



A pavement marking test deck in Dallas County, evaluating experimental centerline markings placed within a groove.

Photo: Neal Hawkins, Iowa State University/CCEE

TR-581

Agency:
Iowa State University

Principal Investigator:
John Verkade &
Peter Taylor

Research Period:
November 15, 2007 –
February 14, 2010

Research Board Funding:
\$100,000

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

Development of an Improved Agricultural-Based Deicing Product

Objective: Seek agricultural based products suitable for use as deicing materials that are suitably cost effective, environmentally acceptable and technically functional.

Reports: A draft final report has been submitted and is currently being reviewed.

Implementation: If a suitable compound can be found the Iowa DOT will be able to reduce costs associated with deicing and anti-icing, either by the use of a cheaper material, more efficient use of materials, reduced maintenance costs, reduced environmental impact, or some combination of these benefits.

TR-582

Agency:
Iowa State University

Principal Investigator:
Halil Ceylan

Research Period:
March 1, 2008 –
April 30, 2010

Research Board Funding:
\$50,000

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

Ethanol By-Product Geo-Material Stabilization

Objective: Investigate the utilization of processed corn stover or corn grain fermentation by-product in pavement base/subbase soil stabilization. Specifically:

- Demonstrates the ability of lignin as an effective soil stabilizing agent for lignins that are currently available or are anticipated to become available in the future in abundant supply.
- Evaluates the effect of lignin on the engineering properties of soil-lignin mixtures for Iowa conditions. It is anticipated that this research will lead to extended and rigorous evaluation of this concept both in the lab and in terms of field performance.

Reports: Final Report, April 2010

Implementation: The usefulness of industrial lignins has been demonstrated by profitability of the lignin chemicals industry operated worldwide. Lignin is also a by-product of ethanol plant production. With the increase in soy/corn based ethanol plant production, new uses of lignin are being developed to provide additional revenue streams to improve the economics of the biorefineries.

Modified lignins have already been successfully used as concrete admixtures and as dust suppressants in unpaved roads. Currently, they are being evaluated as anti-oxidants in asphalt. Considering the wide range of pavement-related applications in which agricultural derived lignin could be used, this research could result in substantial economic savings for Iowa.

Corn stover
Photo: NREL, 2007



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

Progress: Project progress:

The draft final report is complete and training materials are currently being developed for submittal in February 2011.

Reports: None

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-584

Agency:

Iowa State University

Principal Investigator:

Sri Sritharan

Research Period:

January 1, 2008 –
August 31, 2010

Research Board Funding:

\$70,000

Funding Source:

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

Establishing a Dynamic Formula for Pile Design and Construction Control of Pile Driving

Objective: Consistent with LRFD specifications, develop dynamic formulas to design piles and control their installation in the field, focusing on methods suitable for Iowa soil conditions.

Progress: The draft final report is complete and training materials are currently being developed for submittal in February 2011.

Reports: None

Implementation: A training course to supplement the Final Report and expedite implementation of results into design and practice in the field will be developed. Designed for engineers 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. The training course will largely be delivered by the project team members. 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-586

Agency:

The University of
Iowa

Principal**Investigator:**

Hosin "David" Lee

Research Period:

April 1, 2008 –
February 26, 2010

**Research Board
Funding:**

\$50,000

Funding Source:

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

Pavement Thickness Design for Local Roads in Iowa

Objective:

- Identify the most critical input parameters by performing a sensitivity analysis
- Determine the minimum pavement thickness by performing a mechanistic analysis of pavement structure
- Develop a new SUDAS pavement design procedure which can provide more appropriate design thicknesses for a broad range of pavement conditions

Reports: Final Report, February 2010

Implementation: Institutions and individuals taking leadership to implement the new SUDAS pavement design procedure and software will be identified, and probably be engineers from the SUDAS board of directors, six SUDAS districts and personnel from the Iowa DOT, who will use the procedures and then publicize the benefits to other cities and counties in Iowa.

At the project's initiation, the research team will recruit leaders to guide the development process as potential users. They will be invited to serve on the Technical Advisory Committee (TAC), who will guide the PI and his project team following established specific objectives.

Through guidance by the SUDAS board of directors and six districts, the research team can periodically adjust the development of new pavement design procedure and software interfaces to meet the demands from users.

The most critical input parameters were identified and their typical values for local roads in Iowa were used to run three existing pavement design software packages. A prototype PD&SA software package was developed to store pavement design values in the database so users can determine the optimum pavement thickness by retrieving the pavement design values from the database without running the actual pavement design programs.

The prototype PD&SA software can be used to make comparisons from the pavement design catalog developed for the database.

TR-589

Agency:
National Weather
Service

**Principal
Investigator:**
National Weather
Service

Research Period:
April 1, 2008 –
March 31, 2011

**Research Board
Funding:**
\$137,937

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

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: Stations that are reporting data at the same time interval within 5 miles distance and maximum 300ft elevation difference are being considered for merging to increase record lengths. Time series plots of the annual maximum series for station pairs that were considered for merging were reviewed, and merge candidates were identified. T-test and double-mass curve analysis will be used to ensure that the annual maximum series of stations considered for merging are from the same population. This work is underway for the 15-minute, 1-hour and 1- day datasets.

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-590

Agency:

The University of
Iowa

Principal Investigator:

Hosin "David" Lee

Research Period:

April 1, 2008 –
April 24, 2009

Research Board Funding:

\$57,666

Funding Source:

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

Examination of Curing Criteria for Cold In-Place Recycling (CIR) – Measuring Temperature, Moisture, Deflection and Distress for the Test Section

Objective: During phase I, research efforts focused on laboratory experimentation. However, it is suspected that moisture conditions measured in the laboratory may not be equivalent to moisture conditions in the field. Objectives of phase II:

- Measure the moisture levels throughout a CIR layer
- Develop a relationship between field moisture measurements and laboratory moisture measurements
- Develop a curing index to determine the optimum curing time for a CIR layer before overlay

Reports: Final Report, April 2009

Implementation: The research findings were compiled as a set of curing indices based on experimentation to measure moisture and temperature conditions throughout a CIR layer in the field.

This curing index will be useful for pavement engineers to accurately determine the optimum timing for an overlay to prevent premature failure of the CIR layer and HMA overlay.



Installation of weather station

Photo: Public Policy Center, The University of Iowa

TR-591

Agency:

Iowa State University

Principal Investigator:
Charles Jahren

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

Research Board Funding:
\$91,638

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

Stabilization Procedures to Mitigate Edge Rutting for Granular Shoulders – Phase II

Objective:

- Determine the relative importance of localized, chronic edge rut issues compared to longer reaches of roadway with more general shoulder edge rut maintenance issues.
- Develop strategies for mitigating edge rut problems using various mixtures and gradations of granular materials and stabilization agents.
- Rate the performance of a subset of the above mentioned strategies.
- Recommend strategies based on the results of test section performance, cost and likely future maintenance procedures.
- Assist the Iowa DOT in implementing use of the recommended strategies.

Progress: The testing and data analysis for all test sections has been completed. A final report is expected before the end of 2010.

Reports: None

Implementation: Results of this study are intended to allow maintenance personnel to improve the performance of granular shoulders with regard to edge ruts with the existing complement of maintenance personnel. If methods can be devised to lessen the number of times that crews must be redirected in order to address acute edge rut problems in localized chronic areas, greater overall maintenance efficiency will be achieved.

It is anticipated that the results of this project will reduce life cycle costs for granular shoulders, increase safety, and improve the procedures currently in use to maintain granular shoulders in Iowa.



An example of granular shoulder edge rutting
Photo: Dr. David White, Iowa State University/InTrans

TR-592

Agency:
Iowa State University

Principal Investigator:
Brent Phares

Research Period:
August 1, 2008 –
April 30, 2010

Research Board Funding:
\$50,000

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

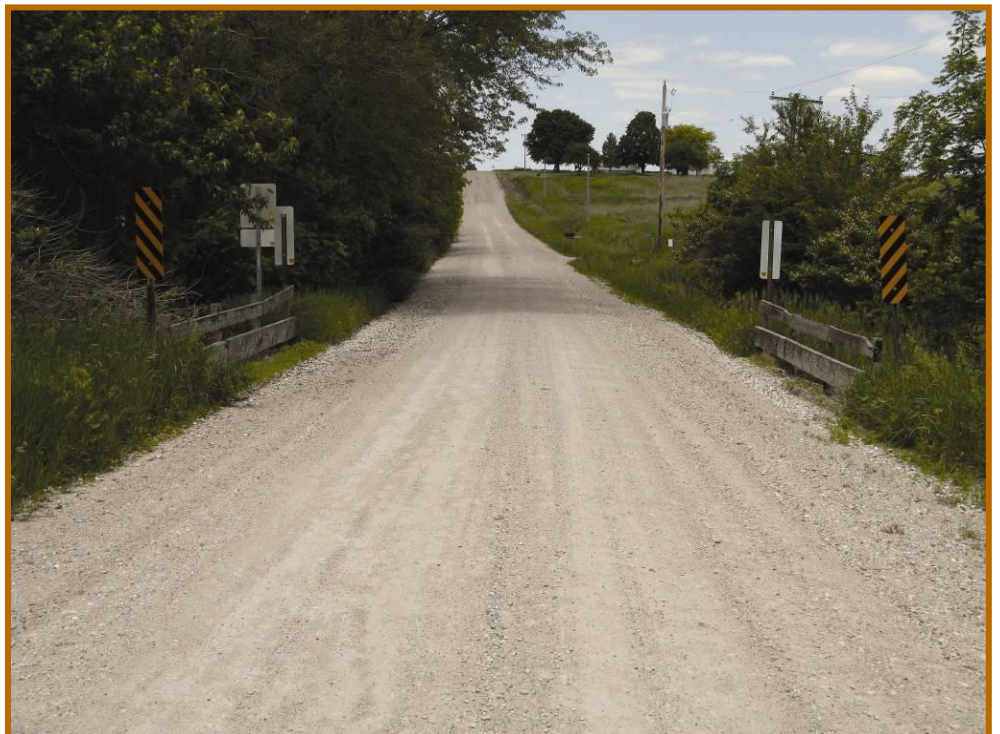
Bridge Rails and Approach Railing for Low-Volume Roads in Iowa

Objective: Provide guidance to county engineers for replacing or upgrading bridge and bridge approach guard railing.

- Determine criteria and guidelines used by other states for bridge and approach guardrail implementation low-volume roads
- Perform benefit/cost analysis for using bridge and approach guardrails based on traffic levels and road classifications
- Investigate the use of non-standard and innovative bridge and approach guardrails for low-volume roads

Reports: Final Report, April 2010

Implementation: This project provides useful technical information on the future feasibility of using bridge and approach guardrails on low-volume roads for the State of Iowa.



Example of a non-standard timber bridge rail located on a very low-volume road in Central Iowa, June 2009

Photo by: Zach Hans, Iowa State University/InTrans

TR-593

Agency:
Iowa State University

Principal Investigator:
Nadia Gkritza

Research Period:
August 15, 2008 –
April 30, 2010

Research Board Funding:
\$120,000

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

Infrastructure Impacts on Iowa's Changing Economy

Objective: Develop traffic and fiscal assessment tools to understand the impacts of biofuels and wind industries on Iowa's highway transport infrastructure, particularly the secondary road system. Also, to document the current physical and fiscal impacts of Iowa's existing bio-fuels and wind industries; Assess the likely physical and fiscal impacts (and infrastructure needs) of further development of biofuels and wind power industries in Iowa in the next 15-20 years using a multi-county, case study approach; and quantify and visualize the impacts to the extent possible.

Progress: The research team interviewed county engineers from Des Moines and Lee counties to better understand county roadway maintenance expense and traffic and pavement condition fluctuations over the analysis period.

The findings from the local agency survey were included in Chapter 3, while results of the traffic impact analysis and associated pavement deterioration were included in Chapter 4. The results of pavement analysis (recommended pavement design thickness based on ESALs) as well as the results of the fiscal impact analysis will be included in Chapter 5.

Reports: Final Report, April 2010

Implementation: Develop a set of public policy recommendations to support the biofuels and wind industries in Iowa during the next 15-20 years and a Road Map for technology transfer for this issue.



A typical wind turbine blade transport vehicle, often seen traveling on Iowa roads
Photo: Iowa Energy Center

TR-594

Agency:
Iowa State University

Principal Investigator:
Chris Williams

Research Period:
August 15, 2008 –
May 31, 2010

Research Board Funding:
\$75,000

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

Development of Non-Petroleum Based Binders for Use in Flexible Pavements

Objective: Optimize a bio-oil product (production and post-production) for use as a non-petroleum binder. Various bio-oils will be produced and pyrolytic lignins derived for modifying asphalt binders. Liter quantities of bio-oil from five different sources will be obtained and analyzed for their properties such as acidity, char content, and stability.

Progress: Lab work and analysis have been complete. The final report is written and undergoing editing. Publication and presentation of the final report will be delayed by patent issues, but are expected by the end of 2010.

Reports: Final Report, October 2010

Implementation: The benefits of this research are potentially very substantial. A lower cost binder that performs as well as asphalt binders currently used could be developed.

Further, the bio binder will likely lower hot mix asphalt plant production temperatures, thus reducing plant emissions. Lastly, the bio binder represents the development of renewable green materials/technology, reducing reliance on crude oil.

TR-595

Agency:

The University of Iowa

Principal Investigator:

Thanos Papanicolaou

Research Period:

August 1, 2008 –
January 29, 2010

Research Board Funding:

\$57,000

Funding Source:

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

Autonomous Measurements of Bridge Pier & Abutment Scour Using Motion-Sensing Radio Transmitters

Objective:

- Evaluate the Radio Frequency Identification systems (RFID) performance and if necessary make adjustments for facilitating direct and autonomous measurements of scour holes using RFIDs
- Examine the performance of different transponder types and geometric shapes at critical scour bridges found in eastern and western Iowa, and provide a QA/QC protocol as a way of testing the performance of the RFIDs relationships statewide
- Train users in the application, maintenance, collection and analysis of the data obtained from the RFID dataloggers and provide the software developed to the Iowa DOT

Reports: Final Report, January 2010

Implementation: An RFID system fitted with data telemetry equipment can collect and transmit data to a maintenance office. Remote monitoring could mitigate inefficiencies and dangers in current practices and provide early warning of impending bridge failure and tracking of long-term degradation as a result of scouring.



The water/sediment re-circulating flume for the RFID tests (antenna is at the center of the flume).

Photo: Dr. Thanos Papanicolaou, The University of Iowa/IIHR

TR-596

Agency:

The University of
Iowa

**Principal
Investigator:**

Marian Muste

Research Period:

August 1, 2008 –
February 28, 2010

**Research Board
Funding:**

\$72,752

Funding Source:

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

Insights into the Origin and Characteristics of the Sedimentation Process at Multi-Barrel Culverts in Iowa

Objective: Initiate a comprehensive study to determine specific conditions leading to culvert sedimentation in Iowa, including field inspection and measurement, physical modeling in a laboratory, and numerical simulations. The sedimentation process will be investigated using: culvert geometry, soil characteristics at the culvert site, hydrologic characteristics, and sedimentation cumulative effects.

Reports: Final Report, June 2010

Implementation: Results of this research provide fundamental insights in the sedimentation process at multi-barrel culverts and a general understanding of processes currently not documented by analytical, experimental or numerical simulation means.

Of particular interest is implementing a realistic flow and sediment hydrograph in the model that can lead to reliable sediment deposition patterns and spatial and temporal variability induced by the unsteady flows.

Practical recommendations will be shared through workshops with county engineers. Research findings will also be presented during the annual meeting of the Iowa County Engineers.

Phase II of this research will involve performing field tests using designs developed through laboratory testing. Culverts with a history of sedimentation problems will be retrofitted with new inlet geometries and monitored for performance.

Sedimentation at a Buena Vista
County culvert
*Photo: Dr. Marian Muste,
The University of Iowa/IIHR*



TR-597

Agency:
Iowa State University

Principal Investigator:
Neal Hawkins

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

Research Board Funding:
\$125,000

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

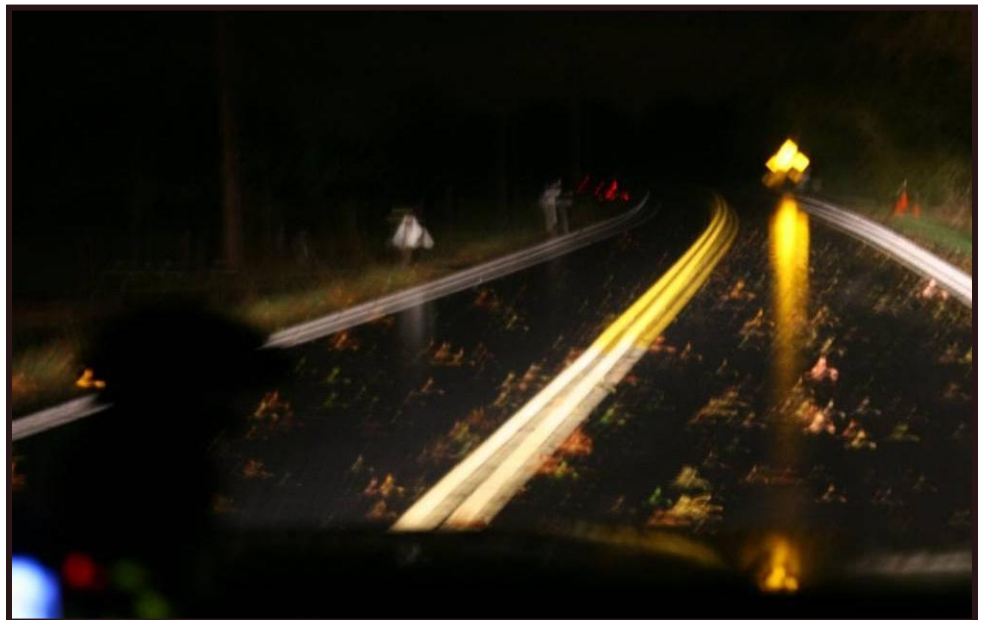
Wet Reflective Pavement Marking Demonstration Project

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.

Progress: All products have been installed. Dry and wet retro-reflectivity measurements will continue for a period of two years to determine durability and performance for each product.

Reports: None

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.

Progress: Specification revision recommendations are complete. Review of recommendations is complete. The Final Report is expected by the end of 2010.

Reports: None

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-599

Agency:
Iowa State University

Principal Investigator:
Chris Williams

Research Period:
January 26, 2009 –
December 31, 2010

Research Board Funding:
\$124,997

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

Investigation of Warm Mix Asphalt Using Iowa Aggregates

Objective: Identify technologies for producing Warm Mix Asphalt (WMA) and recommend up to three with the greatest potential for success using Iowa aggregates:

- Develop and test selected WMAs in the laboratory for performance (permanent deformation, fatigue and moisture susceptibility), aging characteristics, and laboratory compaction effort
- Document a Draft set of procedures for field implementation
- Construct and monitor field trials and laboratory performance testing
- Compare performance of field produced mixtures with laboratory produced mixtures and standard HMA control mixtures

Progress: The scope of the project has changed from a laboratory study to a field study.

During the quarter, two field research projects were done including ones using Evotherm 3G/Revix and Sasobit. The warm mix asphalt (WMA) sampled last year (and the control mix) have undergone substantial mix testing (dynamic modulus) as well as viscosity testing and binder grading. Preliminary results illustrate the WMA mixture increases in stiffness when reheated as compared to the field compacted specimens. Also, the Evotherm 3G appears to have some anti-stripping potential.

All of the aggregate was sampled for the laboratory portion of the research project and the aggregate sieved. Control mix designs have been completed too.

Reports: None

Implementation: This project will provide guidance on the implementation of WMA technology in Iowa. The research team will assist in implementing WMA technology beyond obligations of this research, including evaluation and integration of WMA technology into Iowa.

An additional phase for this project will likely be needed to address the developing technical issues, namely how to integrate warm mix asphalt into Iowa DOT QC/QA specifications.

TR-600

Agency:
Iowa State University

Principal Investigator:
Paul Wiegand

Research Period:
November 3, 2008 –
September 30, 2010

Research Board Funding:
\$250,000

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

Improving Concrete Overlay Construction

Objective: Reduce quantity overrun concerns using project GPS mapping and reduce construction survey time. Evaluate GPS and 3-D construction equipment control (milling machine, slipform paver, cure cart) and develop ways to establish the profile grades and machine control before or immediately after the contract letting by the highway agency so construction is not impacted.

Reports: Final Report, June 2010

Implementation: Findings of the project provide guidance on the implementation of WMA technology in Iowa. The research team continues to assist in WMA technology implementation beyond the obligations of this research.



On County Road V-18 in Poweshiek County, a six-inch concrete overlay is constructed without the use of strings to control the paver. A fabric bond breaker between the new overlay and underlying pavement was used instead of the usual asphalt layer.

Photo: Paul Wiegand, Iowa State University/InTrans

TR-601

Agency:
Iowa State University

Principal Investigator:
Omar Smadi

Research Period:
January 1, 2009 –
December 31, 2010

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. Iowa State University (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.

Progress: The project team is coordinating with VTTI to collect lighting data for close to 20 intersections that were used in the Phase I of the project. The database of the location and characteristics of each intersection was sent to VTTI for testing and evaluation. The data collection work is complete. The data has been submitted so that the analysis of lighting and impact on safety can be completed for the study intersections.

Reports: None

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-602

Agency:
WHKS & Company

Principal Investigator:
Fouad Daoud

Research Period:
November 26, 2008 –
August 31, 2009

Research Board Funding:
\$66,476

Funding Source:
100 % State -
100 % Secondary funds

Updating Portions of the Three-Span Prestressed Concrete Beam Bridge Standards to LRFD Specifications – Part I

Objective: Update county "H" standard prestressed beam bridge plans and abutment details of current three-span prestressed beam bridge secondary road standards (H-24, H-30, H-40 and H-44) to conform with AASHTO LRFD Specifications and update other various superstructure details.

Update specifications for abutment piling to conform with LRFD Specifications, modify abutment wings section, revise F and Open Railing end sections, and make other miscellaneous revisions.

Reports: Completed Standard Plans March 2010

Implementation: Using contributions from structural, geotechnical and LRFD specialists, this project will provide updated portions of the Three Span Prestressed Concrete Beam Bridge Standards (H24, H30, H40 and H44 Standards). This involves updating the abutment piling to conform to the LRFD Specifications, modifying the abutment wings, revising the F and Open railing end sections, and making other miscellaneous revisions.



Three-span bridge on US 169 over the Des Moines River, Algona, IA
Photo: WHKS & Company

TR-603

Agency:

Foth Infrastructure &
Environmental, LLC

**Principal
Investigator:**

J. Scott Ingersoll

Research Period:

November 26, 2008 –
January 4, 2010

**Research Board
Funding:**

\$274,111

Funding Source:

100 % State -
100 % Secondary
funds

Updating Portions of H-Standard Three-Span Prestressed Beam Bridges, T-Pier and Pile Bent Pier Update to LRFD Specifications – Part II

Objective: Update and revise the following specifications to LRFD Specification:

- H-Standard T-Pier and Pile Bent Pier
- T-pier cantilever to conform to strut and tie model
- T-pier stems
- T-pier footings
- T-pier pile supported footings for SRL-2 pile capacities
- Pile bent Bridge Design Specifications

Progress: Final standard plans November, 2010.

Reports: None

Implementation: Plans will be delivered in electronic format to the Iowa DOT. The Bentley MicroStation V8 design files will adhere to the Iowa DOT Office of Bridges and Structures CAD standards for color, leveling, line weight and naming convention. One CAD file will be provided for each roadway width.

The pier sheets will be assembled into a single PDF file for each roadway width. MicroStation design files will also be provided. All files will be sent to the Iowa DOT via electronic mail or the Iowa DOT FTP site. All design computations will be provided in PDF format and submitted to the Iowa DOT. One file for each roadway width will be provided.

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 Iowa State University (ISU), the United States Department of Agriculture (USDA) Forest Products Laboratory (FPL) and Delaware County Engineering staff.

Progress: A follow-up load test was conducted to study more localized behaviors which may be cause of the asphalt wearing surface cracking to identify the source of deterioration.

Reports: None

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

Progress: Bridge construction is complete and documented using both point-in-time photographs and time-lapse photography. Initial testing of the bridge was conducted. Investigators are currently in the process of analyzing the collected data.

Reports: None

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

Leadership Academy (LTAP)

Objective: The Iowa Local Technical Assistance Program (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
- Fundamentals of Government
- Resource Management Skills
- 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.

Progress: All modules will be complete and available online by December 2010.

Reports: None

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-607

Agency:
Snyder and
Associates

**Principal
Investigator:**
Steve Klocke

Research Period:
March 9, 2009 –
December 31, 2010

**Research Board
Funding:**
\$111,455

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

Review of Inconsistencies Between SUDAS and Iowa DOT Specifications – PHASE III

Objective: Revise sections of SUDAS specifications consistent with the format utilized during the Phase II project and other work completed by SUDAS staff. Sections to be revised:

- **Division 7: Streets and Related Work**
Specifications for Section 7040, Pavement Repair and Rehabilitation specifications
- **Division 9: Site Work and Landscaping**
Specifications for Sections 9020, Sodding; 9030, Plant Material and Planting; 9050, Gabions and Rip Rap; 9060, Fencing; 9070, Retaining Walls; and 9080, Concrete Steps and Handrails
- **Standard Drawings:** SUDAS figures for sections 7010, PCC Pavement; 7020, Hot Mix Asphalt; 7040, Pavement Repair and Rehabilitation; 9030, Plant Material and Planting; 9050, Gabions and Rip Rap; 9060, Fencing; 9070, Retaining Walls; and 9080, Concrete Steps and Handrail

Progress: Final Report, December 2010

Reports: None

Implementation: Revised specifications and figures developed as part of this project will be adopted by SUDAS for inclusion in the SUDAS Specification manual and utilized by agencies and contractors across the State of Iowa. In addition, the Iowa DOT may adopt any portion of the revised specifications.

TR-608

Agency:

Iowa County
Engineer Association
Service Bureau

**Principal
Investigator:**

Steve DeVries

Research Period:

August 1, 2009 –
July 31, 2011

**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: We have finalized our methods for calculation of traffic based on land use, obtained accident data from InTrans, devised a way to estimate truck traffic and resulting ESALS, and worked out the step by step sequence of processing to be used in modeling annual cycles.

Cost per mile per year data on earth, granular, hard surface and paved roads was distributed to all counties for review and comment in May. The feedback received suggests that the amounts being spent today fall several percentage points below sustainable. Bridges seem to be doing better than pavement. Data on pavement condition trends has been requested from the IPMAP program at InTrans.

In August, we'll meet with both the Agri-business representatives group and the Technical Advisory Committee again to get a review of the analysis engine plan. Actual development will commence in October.

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, 2010

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 – PHASE III

Objective:

- 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.

Progress: Moisture data from two project sites were analyzed. Moisture sensors were calibrated in the laboratory using the laboratory samples. Four more project sites were identified. One site was monitored and three additional project sites will be monitored.

Reports: None

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-610

Agency:

The University of
Iowa

**Principal
Investigator:**

Salam Rahmatalla

Research Period:

August 1, 2009 –
July 31, 2010

**Research Board
Funding:**

\$69,092

Funding Source:

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

On-the-Spot Damage Detection Methodology for Highway Bridges During Natural Crises

Objective: Develop and assess effectiveness of an experimental approach to a damage-detection methodology that can be applied to highway bridges in Iowa during natural disasters such as flooding and assist bridge inspectors in assessments. The research will:

- Verify and validate the proposed methodology using structural models in the lab
- Apply the methodology on one of Iowa highway bridges in rural areas, such as Iowa Highway 22
- Visually validate the finding

Reports: Final Report, July 2010

Implementation: This research provides a proof-of-concept report supplemented with a Matlab vibration analysis module based on test results to analyze the effectiveness of experimental damage detection methodologies for bridges during natural crises.



On-the Spot damage detection field testing on County IA-1, South of Iowa City, Iowa, near Gingerich Road

Photo: Dr. Salam Rahmatalla, The University of Iowa

TR-611

Agency:

The University of
Northern Iowa

**Principal
Investigator:**

M.D. Salam

Research Period:

August 1, 2009 –
October 31, 2010

**Research Board
Funding:**

\$74,842

Funding Source:

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

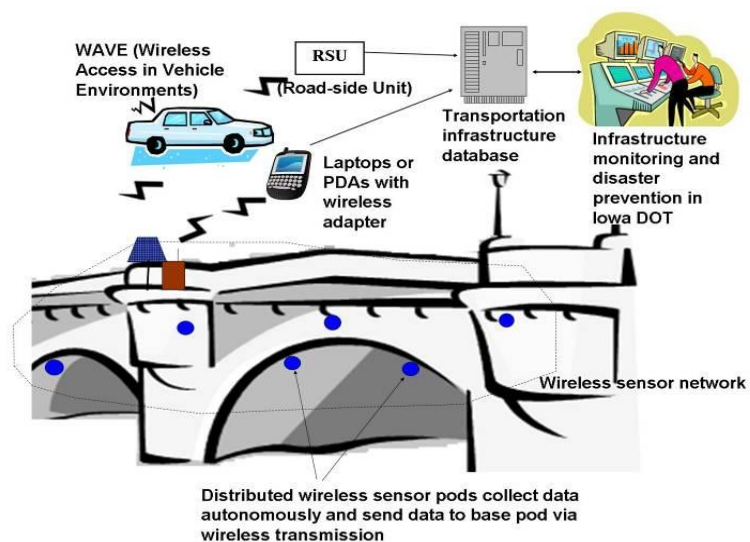
Wireless Sensor Networks for Infrastructure Monitoring

Objective: Evaluate the use of distributed wireless sensor networks instead of PC-based systems for transportation infrastructure monitoring, specifically:

- Establish a list of physical quantities to be monitored and their requirements from the practical, technical and financial aspects
- Investigate sensor and data acquisition technologies salient to these quantities and select likely technologies for field implementation
- Establish the characteristics of mobile computers and wireless communication adapters
- Test available technologies and select the best fit
- Deploy a prototype test-bed unit in the field
- Acquire data under a variety of climatological conditions
- Investigate the feasibility of integrating existing infrastructure monitoring system into the Intelligent Transportation System using WAVE interfaces
- Evaluate the suitability and scalability of these technologies for practical deployment in other bridges and further investigation based on data and observation analysis and direct testing by Iowa transportation professionals

Reports: Final Report, December 2010

Implementation: This project will lead to a working design for application in Iowa. For testing, this project will adopt the technologies most recently commercially available.



Graphic: Dr. M.D. Salim, University of Northern Iowa/IT

HR-1027

Agency:

Iowa Department of
Transportation

**Principal
Investigator:**

Edward J. Engle

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: Ed Engle 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.