Iowa Department of Transportation

ANNUAL REPORT
of
Iowa Highway Research Board
Research and Development Activities
FY 2011

Attachment to
FY 2011 Annual Report
Research, Intelligent Transportation Systems, and
Technology Transfer Activities

Iowa Department of Transportation
Research and Technology Bureau
A Driving Force of Innovation
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IHRB
IOWA HIGHWAY RESEARCH BOARD

DECEMBER 2011

ANNUAL REPORT
OF
IOWA HIGHWAY RESEARCH BOARD
RESEARCH AND DEVELOPMENT ACTIVITIES

FOR THE
FISCAL YEAR ENDING JUNE 30, 2011

RESEARCH AND TECHNOLOGY BUREAU
OPERATIONS RESEARCH
(515) 239-1447
www.iowadot.gov/operationsresearch

HIGHWAY DIVISION
IOWA DEPARTMENT OF TRANSPORTATION
AMES, IOWA 50010

DECEMBER 2011

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LIST OF ACRONYMS

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

RESEARCH AND DEVELOPMENT

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

This report, entitled ―Iowa Highway Research Board Research and Development Activities FY2011" 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, 2011. It is also a report on projects completed during the fiscal year beginning July 1, 2010 and ending June 30, 2011. 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

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

The Research Board consists of 15 regular members: seven Iowa county engineers, four Iowa DOT engineers, one representative from Iowa State University, one from The University of Iowa, and two engineers employed by Iowa municipalities. Each regular member may have an alternate who will serve at the request of the regular member. The regular members and their alternates are appointed for a three year term. The membership of the Research Board as of June 30, 2011, is listed in Table I.

The Research Board held seven regular meetings during the period from July 1, 2010, through June 30, 2011. Suggestions for research and development were reviewed at these meetings and recommendations were made by the Board.

IHRB
IOWA HIGHWAY RESEARCH BOARD

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

TABLE I

2011 IOWA HIGHWAY RESEARCH BOARD **July 1, 2011**

Member	Term Expires	Alternate
Ahmad Abu-Hawash Chief Structural Engineer Iowa DOT - Bridges and Structures 800 Lincoln Way Ames, IA 50010	12-31-12	Deanna Maifield Methods Engineer Iowa DOT – Office of Design 800 Lincoln Way Ames, IA 50010
Robert Younie Director Office of Maintenance 800 Lincoln Way Ames, IA 50010	12-31-11	Kent Nicholson Assistant Road Design Engineer Road Design 800 Lincoln Way Ames, IA 50010
James Alleman Dept. of CCE Engineering Iowa State University 390 Town Engineering Bldg. Ames, IA 50011	12-31-11	
Wade Weiss Greene County Engineer 114 N. Chestnut Jefferson, IA 50129	12-31-11 District 1	Robert Kieffer Boone County Engineers Office 201 State Street Boone, IA 50036-3988
Vicki Dumdei District Engineer Hwy Div- District 2 1420 Fourth St. S.E. Mason City, IA 50401-4438	12-31-13	David Little Assistant District Engineer Highway District 2 512000 - Hwy Div District 2 Office Mason City, IA 50401
Douglas Schnoebelen, Chair The University of Iowa – IIHR 323A SHL 300 South Riverside Drive Iowa City, Iowa 52242-1585	12-31-13	
J.D. King Fayette County Engineer 114 N. Vine St., PO Box 269 West Union, IA 52175	12-31-13 District 2	Doug Miller Kossuth County Secondary Road Department 114 W State Algona, IA, 50511

Member	Term Expires	Alternate
Jack Moellering Pocahontas County Engineer 99 Court Square – Ste. 4 Pocahontas, IA 50574-1629 712-335-3252 SS-076	12-31-12 District 3	Ron Haden Calhoun and Sac Counties' Engineer 416 4th Street Rockwell City, IA, 50579 (712) 297-8322 Calhoun SS-013 or SAC-081
James Berger Director of Materials Iowa DOT 800 Lincoln Way Ames, IA 50010	12-31-12	
John Joiner, Vice Chair Public Works Director 515 Clark Avenue P.O. Box 811 Ames, IA 50010	12-31-11	Jeff May Public Works Director 305 S. 3rd Knoxville, Iowa 50138
Ronald Knoche City Engineer 410 E. Washington Street Iowa City, IA 52240-1825	12-31-12	Bruce Braun Street Maintenance Administrator 216 SE 5th Street Des Moines, IA 50309
Mark Nahra Woodbury County Engineer 759 E. Frontage Road Movile, Iowa 51039	-	
Daniel Ahart Shelby County Engineer 1313 Industrial Parkway Harlan, IA 51537	12-31-11 District 4	Kevin Mayberry Mills County Engineers Office 403 Railroad Avenue Glenwood, IA, 51534
Ernie Steffensmeier Lee County Engineer 933 Avenue H Fort Madison, IA, 52627	12-31-13 District 5	Larry Roehl Louisa County Engineer 8313 K. Avenue Wapello, IA, 52653-9279
Clark Schloz Jackson County Engineer 201 W. Platt Maquoketa, IA 52060	12-31-12 District 6	Robert Fangmann Cedar County Engineer 400 Cedar Street Tipton, IA 52772

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, 2011. Total expenditure was $2,277,697.61.

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

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

SECONDARY ROAD TRAFFIC COUNT PROGRAM

Secondary road traffic counts 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 24 counties during fiscal year 2012 as part of the Annual Traffic Count Program. This activity consisted of 5600 portable recorder classification counts and 225 portable recorder volume counts. Traffic volumes from these counts are used to develop Motor Vehicle Traffic Flow Maps for each county showing the Annual Average Daily Traffic (AADT) on specific road sections within each county.

Secondary roads geometrics and current condition inventories were requested from and submitted by 98 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 2011 financial summary is:

Beginning Balance 7-1-10		$ 840,103.24
Receipts		
State Road Use Tax Fund (1½% of receipts)	$1,219,807.39	
Federal Aid Secondary (1½% of receipts)	0.00	
Research Income	0.00	
Sub-Total		$1,219,807.39
Total Funds Available		$2,059,910.62
Obligation for Expenditures		
Obligated for Contract Research	$1,021,450.86	
Non-Contract Engineering Studies	$87,977.00	
Total Expenditures		$1,109,427.86
Ending Balance 6-30-11		$950,482.76

STREET RESEARCH FUND

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

Beginning Balance (7-1-10)	$ 210,522.86
FY11 Street Research Funding	$200,000.00
Total Funds Available for Street Research	$410,522.86
Total Obligated for Expenditure FY11	$190,206.00
Ending Unobligated Balance 6-30-11	$220,316.86

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 FY11 was $784,352.23 and the estimate for FY12 is $750,000.

PROJECTS INITIATED DURING FY 2011

HR-140 (140H) Collection and Analysis of Streamflow Data

HR-296 Iowa State University Local Technical Assistance Program (LTAP)

TR-625 Improving Accuracy of Deflection & Camber Predictions for Pre-stressed Concrete Bridge Girders

TR-626 Optimization of Snow Drifting Mitigation & Control Methods for Iowa Conditions

TR-627 Risk Mitigation Strategies for Operations and Maintenance Activities

TR-628 Alkali Content in Fly Ash Measuring & Testing Strategies for Evaluating Compliance

TR-629 Revision to the SUDAS Traffic signal Standards Phase II

TR-630 Evaluation and Guidance on Effective Traffic Calming for Small Communities

TR-631 Automation of DEM Cutting for Hydrologic/Hydraulic Modeling

TR-632 Low Cost Rural Road Surface Alternatives

TR-633 Investigation into Shrinkage of High Performance Concrete Used for Iowa Bridge Decks and Overlays

TR-634 Pilot Construction for Granular Shoulder Stabilization

TR-635 Warm Mix Asphalt Phase II: Evaluation of WMA Quality Assurance Testing Protocols

13 Projects Initiated

PROJECTS COMPLETED DURING FY 2011

The following projects were completed during FY 2011 and project Final Reports were approved by the Iowa Highway Research Board:

TR-548 Investigation of the Impact of Rural Development on Secondary Road Systems

TR-551 Local Agency Pavement Marking Plan

TR-564 Adding Scour Estimation to the Iowa Bridge Backwater Software

TR-566 Investigation of Utility Cut Repair Techniques to Reduce Settlement in Repair Areas

TR-567 Development of Stage-Discharge Relations for Ungaged Bridge Waterways

TR-570 Identification of Practices, Design, Construction and Repair Using Trenchless Technology

TR-574 Structural Design Construction & Evaluation of a Pre-stressed Concrete Bridge Using Ultra High Performance Concrete Pi Girders

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

TR-580 Pavement Markings and Safety

TR-591 Stabilization Procedures to Mitigate Edge Rutting for Granular Shoulders

TR-594 Development of Non-Petroleum Based Binders for Use in Flexible Pavements

TR-598 Development of Updated Specifications for Roadway Rehabilitation Techniques

TR-599 Investigation of Warm Mix Asphalt Using Iowa Aggregates

TR-607 Review of Inconsistencies Between SUDAS & Iowa DOT Specifications

TR-610 On-The-Spot Damage Detection Methodology for Hwy Bridges During Natural Crisis

TR-611 Wireless Sensor Networks for Infrastructure Monitoring

16 Projects Completed and Approved

Table II

FINANCIAL SUMMARY OF RESEARCH AND DEVELOPMENT PROJECT EXPENDITURES

July 1, 2010 to June 30, 2011

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

Project	Project Title	Primary Road Research Fund Expenditures	Secondary Road Research Fund Expenditures	Street Research Fund Expenditures	Total Expenditures
140	Collection and Analysis of Stream Flow Data	168,824.50	124,825.00	23,943.00	317,592.50
296	ISU Local Technical Assistance Program (LTAP)	86,343.02	44,610.28	13,000.00	143,953.30
519	Developing Flood-Frequency Discharge Estimation Methods for Small Drainage Basins in Iowa		37,333.93		37,333.93
551	Local Agency Pavement Marking Plan	1,930.99			1,930.99
563	The Effects of Implements of Husbandry Farm Equipment on Pavement Performance	35,000.00			35,000.00
564	Scour Estimation for the Iowa Bridge Backwater Software	456.00			456.00
567	Stage-Discharge Relations for Ungaged Bridge Waterways	563.59			563.59
568	Modified Sheet Pile Abutments for Low Volume Bridges	7,231.23			7,231.23
573	Development of LRFD Design Procedures for Bridge Piles	47,666.83	8,247.48		55,914.31
574	Structural Design Construction & Evaluation of a Pre-stressed Concrete Bridge Using UHPC Pi Girders	23,177.41	15,318.94		38,496.35
575	Embedded (MEMS) Micro-Electromechanical Sensors & Systems for Infrastructure Management	31,930.76	35,952.40		67,883.16
579	Strategies to Reduce Speed and Crashes on Curves	8,908.10	21,015.83		29,923.93
580	Pavement Markings and Safety	10,029.95			10,029.95
581	Development of an Agricultural-Based Deicing Product	388.08			388.08
582	Ethanol By-Product Geo-Material Stabilization	7,812.19			7,812.19
583	Field Testing of Piles & Development of a Wave Equation Method for Pile Design in IA	81,959.32	28,209.36	4,810.59	114,979.27
584	Establishing a Dynamic Formula for Pile Design & Construction Control of Pile Driving	5,041.45			5,041.45
591	Stabilization to Mitigate Edge Rutting for Granular Shoulders	6,685.29			6,685.29
593	Infrastructure Impacts on Iowa's Changing Economy	2,827.75			2,827.75
594	Development of Non-Petroleum Based Binders for Use in Flexible Pavements	2,666.89			2,666.89
597	Wet Reflective Pavement Marking Demonstration Project	38,227.33	12,079.90		50,307.23
598	Development of Updated Specifications for Roadway Rehabilitation Techniques		1,423.79	131.04	1,554.83
599	Investigation of Warm Mix Asphalt Using Iowa Aggregates	30,557.35			30,557.35
600	Improving Concrete Overlay Construction	2,672.41			2,672.41
601	Roadway Lighting and Safety: Phase II (TR-540) Monitoring, Quality, Durability and Efficiency	2,824.48	19,601.58	2,135.56	24,561.62

Project	Project Title	Primary Road Research Fund Expenditures	Secondary Road Research Fund Expenditures	Street Research Fund Expenditures	Total Expenditures
604	Field Testing and Evaluation of a Demonstration Timber Bridge		11,739.08		11,739.08
605	Evaluation of the Buena Vista IBRD Bridge: A Furthering of Accelerated Bridge Construction in Iowa		29,539.09	1,622.98	31,162.07
606	Iowa Public Employees Leadership Academy (LTAP)		10,583.07	25,850.35	36,433.42
607	Inconsistencies Between SUDAS & Iowa DOT Specifications	5,760.29			5,760.29
608	Assessment of Iowa County Roadway Financing Needs	21,489.22	32,020.54		53,509.76
609	Curing Criteria for Cold In-Place Recycling Phase III	15,309.35	3,313.08	1,776.18	20,398.61
610	On-The-Spot Damage Detection Methodology for Hwy Bridges During Natural Crisis	23,497.15			23,497.15
611	Wireless Sensor Networks for Infrastructure Monitoring	29,936.00	27,761.09	3,062.59	60,759.68
613	Impacts of Implements of Husbandry on Iowa Bridges	20,133.73	70,317.26	6,849.12	97,300.11
614	Structural Characterization of a UHPC Waffle Bridge Deck and its Connections	9,425.26		355.28	9,780.54
615	Connection Details and Field Implementation of UHPC Piles	670.67	24,430.06	14,232.70	39,333.43
616	Timber Abutment Piling and Back Wall Rehabilitation and Repair		26,353.78		26,353.78
617	An Adaptive Field Detection Method for Bridge Scour Monitoring Using Motion-Sensing Radio Transponders (RFIDs)		13,489.43		13,489.43
618	Parallel Wing Headwalls for Single RCBs (LRFD)		85,339.24		85,339.24
619	Development of Self-Cleaning Box Culvert Design - Phase II - additional funding for field test approved 6/25/10 $9679	4,463.28	53,234.53	8,491.99	66,189.80
620	Update of RCB Culvert Standards to LRFD Specifications	47,486.94	159,141.42	30,185.69	236,814.05
621	Geo-synthetic Reinforced Soil for Low Volume Bridge Abutments	1,219.46	39,101.94	8,108.48	48,429.88
622	Maintenance and Design of Steel Abutment Piles in Bridges		12,241.73	19,953.22	32,194.95
623	Quality Control/Quality Assurance Testing for Joint Density and Segregation of Asphalt Mixtures		29,148.84	10,172.13	39,320.97
624	Development of Quality Standards for Inclusion of High Recycled Asphalt Pavement Content in Asphalt Mixtures		40,591.05	13,485.63	54,076.68
625	Improving Accuracy of Deflection & Camber Predictions for Prestressesd Concrete Bridge Girders	255.02	5,117.78		5,372.80
626	Optimization of Snow Drifting Mitigation & Control Methods for Iowa Conditions	160.56	43,616.59	7,617.22	51,394.37
627	Risk Mitigation Strategies for Operations and Maintenance Activities		24,177.65	2,383.01	26,560.66
629	Revision to the SUDAS Traffic signal Standards Phase II	820.38	2,879.80	2,526.28	6,226.46
630	Evaluation and Guidance on Effective Traffic Calming for Small Communities			213.72	213.72
635	Warm Mix Asphalt Phase II: Evaluation of WMA Quality Assurance Testing Protocols			1,210.75	1,210.75
1027	Secondary Road Research Coordinator		50,829.33		50,829.33
	Contract Research Subtotal	784,352.23	1,143,584.87	202,117.51	2,130,054.61
SPR-PL-1(47)	FY 2011 Transportation Inventory Engineering Studies		147,643.00		147,643.00
	Total of Expenditures	784,352.23	1,291,227.87	202,117.51	2,277,697.61

HR-140

Agency:
United States Geological Survey

Principal Investigator:
Rob Middlemis-Brown

Research Period:
July 1, 1967 to September 30, 2012 Annual Renewal

Research Board Funding:
$238,650

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 mi^2 of drainage area for selected floods and evaluate the flood characteristics and hydraulics at existing and proposed flow structures in basins of all sizes when requested.

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

Reports: Annual Report, Flood Event Reports

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

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

HR-296

Agency:
Iowa State University

Principal Investigator:
Keith Knapp

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

Research Board Funding:
$145,000

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

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

promote research - encourage implementation - distribute research data

Iowa State University Local Technical Assistance Program (LTAP)

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

Progress:

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

Reports: Newsletters, Annual Report

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

HR-375

Agency:
Iowa Department of Transportation, Highway Division

Principal Investigator:
Mark Dunn

Research Period:
November 1, 1994 to on-going

Research Board Funding:
$37,400

Funding Source:
100% State - 100% Secondary funds

Transportation Research Board Education for County Engineers

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

Progress: Between 1995-2011, 25 county engineers have received funding through IHRB to attend the Annual TRB meeting in Washington, D.C.

Reports: None

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

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

TR-519
Phase II

Agency:
United States Geological Survey (USGS)

Principal Investigator:
David Eash

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

Research Board Funding:
$464,777

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

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

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

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

Progress: The skew study for Iowa was contracted to Cornell University. Cornell University was not able to start work on the Iowa skew study until about July 2010, about a nine-month delay. Then in September 2010, Cornell University found an error in the new EMA (expected moments algorithm) flood-frequency analysis program for low-outlier calculations and the EMA code was not revised by the USGS until April 2011, about a eight-month delay.

OSW recently reported that the skew study will be completed by November 1, 2011. The IA WSC has prioritized work for the remaining study tasks (update 517 streamgages with new skew values using EMA through the 2009 water year, perform regression analyses to develop new peak-flow estimation equations for both small- and large-sized drainage areas, prepare report, obtain USGS reviews for report and publish report, and implement GIS data and new regression equations into StreamStats). The IA WSC now estimates the study can be completed by March 2013.

Reports: None

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 SUDAS manual. Research findings will be shared through presentations at the County Engineer Conference, the ASCE Transportation Conference, the 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-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: The final testing occurred at the end of August 2011. 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

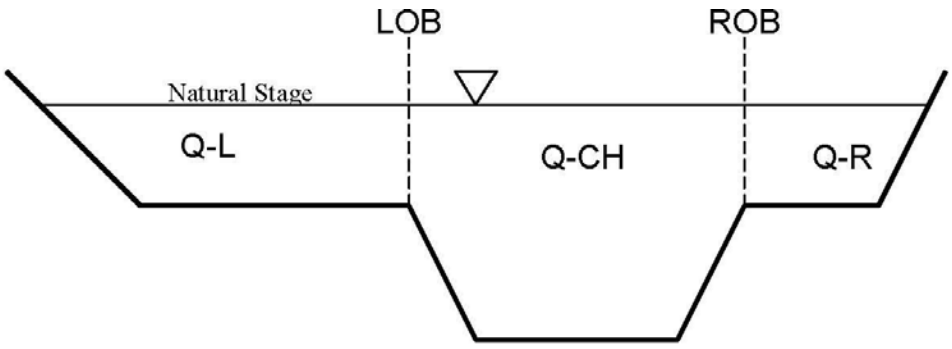
Objective: Add a new major component to the Iowa Bridge Backwater software (published in 2003), *The Estimation of Scour at Bridges*. Adding scour estimation will be the most significant portion of this project and provide a valuable time saving tool for city, county and state engineers.

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-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

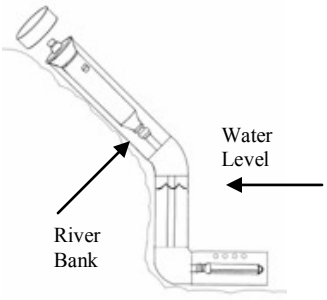
Development of Stage Discharge Relations for Ungaged Bridge Waterways in Western Iowa

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 December 31, 2011

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: Testing is complete and the final report is currently being written. The report will be presented at the January 2012 IHRB meeting.

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-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 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.

Reports: Final Report, February 2011

Implementation: The successful application of 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-579

Agency:
Iowa State University

Principal Investigator:
Shauna Hallmark

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

Research Board Funding:
$80,000

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

Low Cost Strategies to Reduce Speed and Crashes on Curves

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

Progress: 24-month data have been collected and reduced for all speed feedback signs. Before and after crash data were extracted for the curves where speed feedback signs were located. Low-cost reflective treatments were placed on IA 141 which was the last location to receive treatments. Data have been collected on schedule for the other sites. Lateral position and speed data have been collected.

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 ant-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.

TR-583

Agency:
Iowa State University

Principal Investigator:
Sri Sritharan

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

Research Board Funding:
$380,000

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

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

Objective:

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

Reports: Final Report, September 2011.

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

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

TR-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 2012.

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-589

Agency:
National Weather Service

Principal Investigator:
National Weather Service

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

Research Board Funding:
$137,937

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

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: HDSC completed screening all 15-minute, 1-hour and 1-day stations for (1) duplicate records from different data sources, (2) duplicate records at co-located daily, hourly, and/or 15-minute stations, (3) extending records using data from co-located stations, (4) merging records of nearby stations, and (5) removing shorter, less reliable records in station dense areas. This was a significant accomplishment, since, for instance, 5,792 1-day stations required review. A total of 1,553 pairs of stations were merged or extended during this process.

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-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.

Reports: Final Report, February 2011

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-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.

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.

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-597

Agency:
Iowa State University

Principal Investigator:
Neal Hawkins

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

Research Board Funding:
$125,000

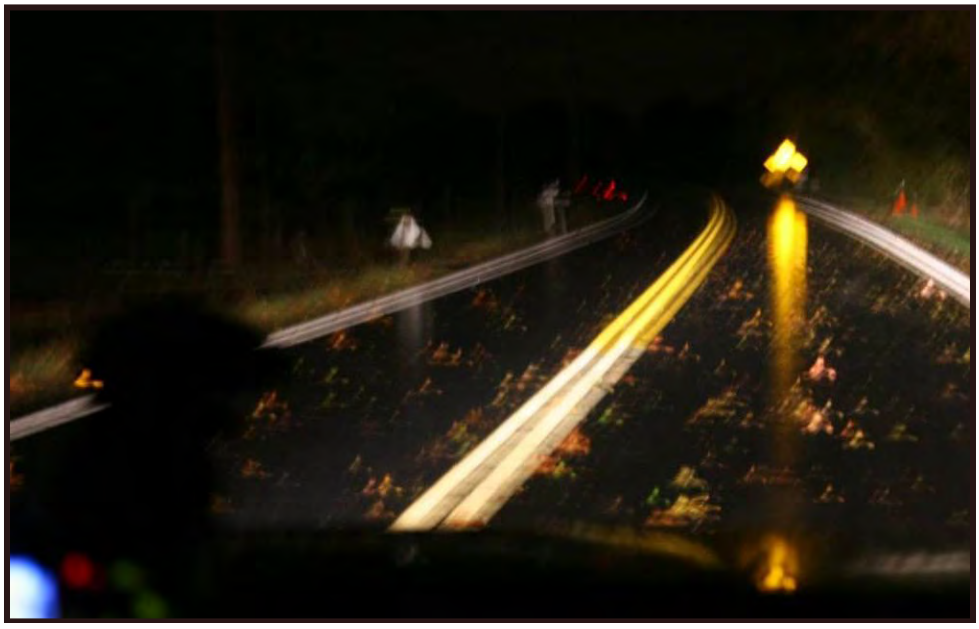
Funding Source:
100 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

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.

Reports: Final Report, December 2011

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



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

TR-598

Agency:
Iowa State University

Principal Investigator:
Charles Jahren

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

Research Board Funding:
$60,000

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

Development of Updated Specifications for Roadway Rehabilitation Techniques

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

Reports: Final Report, May 2011

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

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

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

TR-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

Reports: Final Report, April 2011

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 – September 30, 2011

Research Board Funding:
$100,000

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

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

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

Reports: Final Report, December 2011

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

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

TR-604

Agency:
Iowa State University

Principal Investigator:
Travis Hosteng

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

Research Board Funding:
$88,336

Funding Source:
100 % State - 100 % Secondary funds

Field Testing and Evaluation of a Demonstration Timber Bridge

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

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

Progress: The project team has completed all testing and is currently drafting the final report.

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: Testing is complete and the final report is currently being written.

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

Iowa Leadership Institute

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

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

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

Reports: Final Report, September 2011

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

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

TR-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

Reports: Final Report, December 2010

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 – December 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: Computation code has been reviewed and double-checked, so as to be ready to process in FY11 County Engineer Annual Report data as soon as it has been reviewed by the DOT. It is expected to quickly move on to completion of the dynamic modeling part of the project as soon as the new fiscal year is merged.

Reports: None

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

TR-609

Agency:
The University of Iowa

Principal Investigator:
Hosin –David" Lee

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

Research Board Funding:
$104,140

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

Curing Criteria for Cold In-Place Recycling – PHASE III

Objective: The Objectives of this project are to:

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

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

Progress: Moisture and stiffness data collection from the additional CIR-foam project sites were completed and they are currently being analyzed to develop a moisture loss index and stiffness gain model.

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

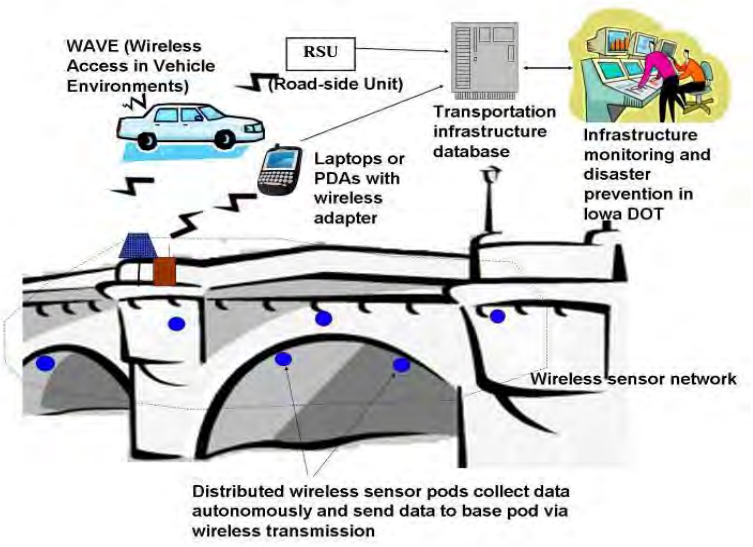
Wireless Sensor Networks for Infrastructure Monitoring

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

TR-613

Agency:
Iowa State University

Principal Investigator:
Terry J. Wipf

Research Period:
January 25, 2010 – June 30, 2011

Research Board Funding:
$153,590

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

Study of the Impacts of Implements of Husbandry on Iowa Bridges

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

Progress: Bridge load testing is complete for the Iowa bridges. The project team is currently analyzing the vast amounts of data.

Reports: None

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

TR-614

Agency:
Iowa State University

Principal Investigator:
Sri Sritharan

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

Research Board Funding:
$50,000

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

Structural Characterization of a UHPC Waffle Bridge Deck and its Connections

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

Progress: The project team has developed a detailed finite element model (FEM) in ABAQUS, built full-scale test unit consisting of two waffle deck panels and UHPC infill joints and completed all tests outlined in the proposal. These tests included service load testing; fatigue testing consisted of more one million load cycles and ultimate load test on the joint between panels and on the center of a panel. The test results, which agreed with the finite element results, confirmed the designed UHPC panels can be used for field applications. Additionally, ultimate limit state tests and a punching failure test have been completed. Production of UHPC panels for the field implementation is complete and the construction of the bridge was completed in Fall 2011.

Reports: None

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

TR-615

Agency:
Iowa State University

Principal Investigator:
Sri Sritharan

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

Research Board Funding:
$210,000

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

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

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

Progress: A summary of the project progress is as follows: 1) Finalized the DOT drawings of the Test-Setup and of the production piles that will be monitored; 2) Completed a tension test on the proposed splice detail; 3) Completed a bending test on the proposed splice detail; 4) Completed a shear test on the proposed splice detail; 5) Calculated the amount of displacement in the lab needed to correspond to 1.0 inches of lateral displacement and 1.55 inches of lateral displacement; 6) Completed the pile-to-abutment connection test for the HP 10 x 57 test pile; 7) Devised an instrumentation plan for field testing and purchased the required instruments; 8) A SPT test was performed at the location of the test piles at the Sac County bridge site; 9) A CPT test was performed at the location of the test piles as well as at the west abutment of the westbound bridge; and 10) Completed the pile-to-abutment connection test for the UHPC test pile.

Reports: None

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

TR-616

Agency:
Iowa State University

Principal Investigator:
Brent Phares

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

Research Board Funding:
$150,846

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

Timber Abutment Piling and Back Wall Rehabilitation and Repair

Objective: The objectives of this investigation are to:

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

Progress: Flooding issues at the bridge sites has delayed progress, but significant effort was expended to catch up and proceed with testing in fall 2011.

Reports: None

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

TR-617

Agency:
The University of Iowa

Principal Investigator:
Thanos Papanicolaou

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

Research Board Funding:
$170,866

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

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

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

Progress: The project is continuing on pace. The PI held a conference call with the TAC on October 18, 2011 to discuss the progress of the study. Key results to date were discussed which included development of the automated RFID bridge scour monitoring system, the user friendly software to monitor the RFID tags, and development of the calibration curves for interpretation of the RFID signals. Movies were provided highlighting the RFID system.

Reports: None

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

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

TR-618

Agency:
Shuck Britson

Principal Investigator:
Steve Kunz

Research Period:
August 1, 2010 – December 31, 2010

Research Board Funding:
$130,248

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

Parallel Wing Headwalls for Single RCBs (LRFD)

Objective: The objective of this proposal is to the develop LRFD English standards for parallel wing headwalls for single box reinforced cast-in-place concrete box culverts.

Reports: Final Standards have been delivered to the Iowa DOT Office of Bridges and Structures and are undergoing final approval.

TR-619

Agency:
The University of Iowa

Principal Investigator:
Marian Muste

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

Research Board Funding:
$107,529

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

Development of Self-Cleaning Box Culvert Design - Phase II

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

Progress: Modeling of the culvert end treatment is complete. A demonstration site has been identified and the site has been cleaned for monitoring. Initial monitoring has taken place. Funding for constructing the demonstration retrofit is currently being sought by the Iowa DOT.

Reports: None

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

TR-620

Agency:
Foth Infrastructure

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

Research Board Funding:
$398,032

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

Update of RCB Culvert Standards to LRFD Specifications

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

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

Reports: None

TR-621

Agency:
Iowa State University

Principal Investigator:
David White

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

Research Board Funding:
$81,500

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

Geo-synthetic Reinforced Soil for Low Volume Bridge Abutments

Objective: The objectives of this project are to:

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

Progress: Field instrumentation data from the on-site data logger is being periodically downloaded at the office by the research team. A field visit was conducted on September 9, 2011 to monitor bridge elevations. An error occurred on the data logger during mid August and data was lost for a short period of time (about 25 days). This error was addressed during the September 9th visit and the data logger is now working again. Another site visit is being planned to conduct load test during early next quarter.

Significant progress has been made on data analysis during this quarter. Earth pressure cell and piezometer data have been plotted. Laboratory tests to determine shear strength properties of the GRS fill material are being conducted.

Research team will focus on completing the remaining laboratory tests and finish data analysis and the final report during the next quarter.

Reports: None

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

TR-622

Agency:
Wiss, Janey, Elstner and Associates

Principal Investigator:
Wade Clarke

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

Research Board Funding:
$123,426

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

Maintenance and Design of Steel Abutment Piles in Iowa Bridges

Objective: The desired outcome of this research will yield

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

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

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

Progress: WJE has constructed the laboratory test setups, prepared the test specimens, and is currently performing the laboratory testing phase of this project. Preliminary results from these laboratory tests will be used to select several coatings for field tests on existing piles and to develop system requirements for a trial cathodic protection system field test. The field testing phase of this project is anticipated to begin in May of 2012.

Reports: None

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

TR-623

Agency:
Iowa State University

Principal Investigator:
Chris Williams

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

Research Board Funding:
$150,742

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

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

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

Progress: Field testing and subsequent coring were done on three projects: 1. 12.5mm nominal maximum aggregate size (NMAS) that utilized a butt joint, 12.5mm NMAS that used a joint heater, 12.5mm NMAS that consisted on a non-traditional joint construction method.

The non-traditional method involved milling the driving lane and placement of the new mix to the adjoining old mix in the passing lane and then milling the passing lane and placing new mix next to the previously place new mix in the driving lane- thus always maintaining a confined joint. Field testing consisted on using a non-nuclear gauge to record "density", followed by permeability testing and subsequent coring.

Reports: None

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

TR-624

Agency:
The University of Iowa

Principal Investigator:
David Lee

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

Research Board Funding:
$150,000

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

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

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

Progress: Mix design was performed on the mixtures with varying RAP contents. Typical, fractionated and optimum gradation has been evaluated. Test sections with High RAP will be constructed during the spring of 2012.

Reports: None

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

TR-625

Agency:
Iowa State University

Principal Investigator:
Sri Sritharan

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

Research Board Funding:
$250,000

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

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

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

A set of prestressed beams will be identified and monitored from fabrication through final erection. Samples of the concrete used in these beams from different precast plants will be tested for strength gain, progressive change of modulus of elasticity, creep and shrinkage behavior in the laboratory. Through this systematic evaluation and measurement of camber immediately after fabrication and continuing through construction, recommendations will be made in a final

Progress: A review of literature has focused on creep and shrinkage of concrete and prediction of camber using methods recommended for design practice. Gathering of data has focused on historical information collected by precast plants and district engineers. several camber measurements techniques have been studied and it has been decided that a tape measure, a digital level, and a string potentiometer measurement system will be deployed to accurately capture the camber at precast plants. It has also been decided to collect data from three precast plants (i.e., Andrews Precast, Coreslab-Omaha and IPC Precast) and initial interviews have been completed at two of the three precast plants.

Reports: None

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

TR-626

Agency:
The University of Iowa

Principal Investigator:
George Constantinescu

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

Research Board Funding:
$151,430

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

Optimization of Snow Drifting Mitigation & Control Methods for Iowa Conditions

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

Progress: Two main sites were chosen (Anamosa and Williams). A meeting with TAC focused on results of the field study during the winter of 2010 and proof of concept of the numerical tool that will be used to develop recommendations in terms of optimum design of snow fences. It was also decided to focus on the Williams site where three different designs can be tested at the same time under similar wind conditions. This is critical for development and calibration of numerical methodology.

Based on 23 design modifications considered in the parametric study of classical snow fences, two new designs were selected for testing in the field. After consultation with the TAC, some of the parameters for these two new designs were adjusted. These new fences are being installed in the field.

Reports: None

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

TR-627

Agency:
Iowa State University

Principal Investigator:
Kelly Strong

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

Research Board Funding:
$79,826

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

Risk Mitigation Strategies for Operations and Maintenance Activities

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

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

Progress: Draft final report is written and is being finalized by publications staff at InTrans.

Reports: None

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

TR-629

Agency:
Iowa State University

Principal Investigator:
Neal Hawkins

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

Research Board Funding:
$75,000

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

Revision to the SUDAS Traffic signal Standards Phase II

Objective: The objectives of this project are:

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

Progress: A Traffic Signal Committee meeting was held in November to discuss these revised figures. The subcontractor conducted structural review of footing depth, reinforcing steel, and concrete capacities in contrast to existing design standards in Iowa. A table will be added to the SUDAS Design Manual to help designers determine the type of footing to specify for a mast arm pole based on loading and mast arm length. Non-proprietary fiber optic cable, modem, and related communications hardware specifications were developed to be used for traffic signal communications. These draft specs were reviewed by the TAC and revisions were made accordingly. The final drafts will be reviewed by the Traffic Signal Committee in November.

Reports: None

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

TR-630

Agency:
Iowa State University

Principal Investigator:
Shauna Hallmark

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

Research Board Funding:
$55,000

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

Evaluation and Guidance on Effective Traffic Calming for Small Communities

Objective: The objectives of this study are:

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

Progress: A total of 16 sites were received and reviewed. The team worked with two counties and obtained 10 sites in 5 communities which will be included in the analysis. The team requested and just received approval from the MUTCD experimentation group for several of the treatments.

The treatments were ordered after obtaining permission from the MUTCD group. The treatments are here and installation was scheduled for Late Oct. After several group discussions, the team decided to wait on installation until spring 2012 and subsequently will need a project extension. Although they could have been installed this fall it was decided that it did not make sense to lay down new pavement marking treatments which would then be subjected to snowplows and winter conditions.

Reports: None

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

TR-631

Agency:
Iowa State University

Principal Investigator:
Brian Gelder

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

Research Board Funding:
$73,873

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

Automation of DEM Cutting for Hydrologic/Hydraulic Modeling

Objective: The primary objectives for this project are:

- Develop and program algorithms to enforce fine scale drainage on LiDAR DEMs for the state
- Accurately enforce drainage on catchments larger than 24 acres in conjunction with the Iowa DNR and IIHR

Progress: The IHRB portion of this project has just begun although completion of the Iowa DNR portion of the project, enforcement of channelized streams, is not entirely complete. The DNR portion of the project is within one month of completion at this time.

Reports: None

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

TR-632

Agency:
Iowa State University

Principal Investigator:
David White

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

Research Board Funding:
$50,000

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

Low Cost Rural Road Surface Alternatives

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

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

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

Progress: The research team met with Hamilton County Engineer on June 6, 2011 to discuss their local practices on stabilization of gravel roads. A 3.5 mile segment of gravel road on Vail Avenue (North of Hwy 175) was identified as a candidate demonstration site for further evaluation and long-term monitoring.

The research team also met with Pottawattamie County engineer to discuss their local practices on stabilization of gravel roads. Pottawattamie County has some segments of gravel roads that are stabilized with emulsified asphalt stabilized bases (~ 6 inches) surfaced with chip seal coat and desires a better understanding of the seasonal performance of these type roads using a DCP to measure strength capacities so to make better decisions about roadway management.

Buchanan and Hamilton county engineers have expressed interest in further evaluation of some mechanical and chemical stabilization techniques as part of future demonstrations.

Reports: None

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

TR-633

Agency:
Iowa State University

Principal Investigator:
Kejin Wang

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

Research Board Funding:
$124,996

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

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

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

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

Progress: The literature review was focused on the test methods for different types of shrinkage. The factors that affect concrete shrinkage have also been studied. The material collection for this project started in July 2011. With help from IADOT/TAC, all cementitious materials needed for this project were collected. All aggregates were purchased, and chemical admixtures were collected from the suppliers.

Aggregate properties (specific gravity, absorption, and gradation) were measured and the dosages of chemical admixtures (e. g. air entraining agent) were determined. Chemical shrinkage tests – Paste samples for all proposed 11 mixes were cast, and their chemical shrinkage measurements are in progress.

Setting times of mortar samples made with all 11 mixes were determined. Mortar samples made with mixes 1, 5, 7, 10, and 11 were cast for the AutoShrink measurement. Concrete samples made with mixes 1, 2, and 4 were cast for ASTM C157 tests. The shrinkage measurements are in progress.

Reports: None

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

TR-634

Agency:
Iowa State University

Principal Investigator:
Chuck Jahren

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

Research Board Funding:
$85,820

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

Pilot Construction for Granular Shoulder Stabilization

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

Progress: The project team received price quotes for the use of DUSTLOCK in the summer of 2011and conducted a literature review. Soy soapstock was applied at various locations at Algona, Garner, Allison, Waverly, Elkader and West Union Garages. Preconstruction observations and one set of post construction observations were taken. Analysis of results of testing will continue during the winter.

Reports: None

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

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

TR-635

Agency:
Iowa State University

Principal Investigator:
Chris Williams

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

Research Board Funding:
$174,991

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

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

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

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

Progress: The research team has developed a proposed experimental plan. Field condition surveys of the pavement sections have been done as well as coring of the all but one of the project locations. Personnel have undergone lab safety training and are being trained on performing extractions utilizing a blend of toluene and ethanol and the recoveries purging nitrogen over the chemical-asphalt binder blend to minimize oxidation aging during the recovery process.

Phase I E* data was used in the M-EPDG to assess the effects of WMA on pavement life with subsequent analysis and development of a draft paper that will be available for the TAC to review. Samples were procured for subsequent moisture sensitivity testing using two varieties of Evotherm with 0%, 0.5%, and 1.0% by weight of the binder as well as samples for testing by Meadwesvaco for compactibility. Frequency sweep testing of binders using Evotherm and Sasobit with polymer modified asphalt was done to evaluate the effects of the polymer-warm mix technology interaction.

Reports: None

HR-1027

Agency:
Iowa Department of Transportation

Principal Investigator:
Vanessa A. Goetz

Research Period:
March 1980 – on-going

Research Board Funding:
$85,000/year (covers salary and state share of costs for FICA, IPERS, health insurance, vehicle costs and expenses)

Funding Source:
100% State - 100% Secondary funds

Secondary Road Research Coordinator

Objective: This is a full-time position at the Iowa DOT. The coordinator's jobs are to act as a research liaison with all of the county engineers and solicit new, innovative and progressive ideas. He or she also actively promotes research for solutions to problems and ideas that will improve quality and reduce costs on the secondary road system.

Progress: Vanessa Goetz continues communications with county engineers to discuss problems encountered by secondary road departments and to discuss current research projects throughout the year.

At any one time as much as 50 percent of IHRB projects involve the secondary road system, including secondary projects with consultants. The coordinator assists these counties with special testing, evaluation and writing of reports necessary to the research and keeps county engineers updated on the latest important research results.

Reports: None

Implementation: There are many problems that are unique to the secondary road system in Iowa. These problems are often common to several counties. Coordination between counties is necessary for understanding the problems and formulating solutions. Proper documentation and dissemination of research results allows for timely technology transfer to and between the counties.