Iowa Department of Transportation

ANNUAL REPORT
of
Iowa Highway Research Board
Research and Development Activities
FY 2010

Attachment to
FY 2010 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 2010

ANNUAL REPORT
OF
IOWA HIGHWAY RESEARCH BOARD
RESEARCH AND DEVELOPMENT ACTIVITIES

FOR THE
FISCAL YEAR ENDING JUNE 30, 2010

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

HIGHWAY DIVISION
IOWA DEPARTMENT OF TRANSPORTATION
AMES, IOWA 50010

DECEMBER 2010

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LIST OF ACRONYMS

AASHTO - American Association of State Highway and Transportation Officials

ACC - Asphalt Cement Concrete
ADV - Acoustic Doppler Velocimeter
APWA - American Public Works Association
ASCE - American Society of Civil Engineers
BMP - Best Management Practice

CIPR - Cold In-Place Recycling
CP - Concrete Pavement
CPTP - Comprehensive Public Training Program
CTRE - Center for Transportation Research and Education
DOT - Department of Transportation
DSM - Decision Support Model
FHWA - Federal Highway Administration
FRP - Fiber Reinforced Polymer
FWD - Falling Weight Deflectometer
GIS - Geographic Information System
HMA - Hot Mix Asphalt
IHRB - Iowa Highway Research Board

ISRCIM - Iowa Stormwater Runoff Control Interactive Manual
ISU - Iowa State University
LRFD - Load and Resistance Factor Design
LTAP - Iowa State University Local Technical Assistance Program
LVR - Low Volume Road
MOVITE - Missouri Valley Section of the Institute of Transportation Engineers
NAT - Nottingham Asphalt Tester
NCHRP - National Cooperative Highway Research Program
NDT - Non-Destructive Testing
NPDES - National Pollution Discharge Elimination System
NRCS - National Resource Conservation Service
PCA - Portland Cement Association
PCC - Portland Cement Concrete
PI - Principal Investigator

QA - Quality Assurance
QC - Quality Control
QM-E - Quality Management - Earthwork
RC - Reinforced Concrete
RRFC - Railroad Flat Car
RSAP - Roadside Safety Analysis Program
SHRP - Strategic Highway Research Program
SUDAS - Statewide Urban Designs and Specifications
TAC - Technical Advisory Committee

TRB - Transportation Research Board
USGS - United States Geological Survey

RESEARCH AND DEVELOPMENT

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

This report, entitled ―Iowa Highway Research Board Research and Development Activities FY2010" is submitted in compliance with Sections 310.36 and 312.3A, Code of Iowa, which direct the submission of a report of the Secondary Road Research Fund and the Street Research Fund, respectively. It is a report of the status of research and development projects in progress on June 30, 2010. It is also a report on projects completed during the fiscal year beginning July 1, 2009 and ending June 30, 2010. Detailed information on each of the research and development projects mentioned in this report is available from the Research and Technology Bureau, Highway Division, Iowa Department of Transportation. All approved reports are also online for viewing at: **www.iowadot.gov/operationsresearch/reports.aspx**.

THE IOWA HIGHWAY RESEARCH BOARD: *WORKING* TO HELP IOWA

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

The Research Board consists of 15 regular members: seven Iowa county engineers, four Iowa DOT engineers, one representative from Iowa State University, one from The University of Iowa, and two engineers employed by Iowa municipalities. Each regular member may have an alternate who will serve at the request of the regular member. The regular members and their alternates are appointed for a three year term. The membership of the Research Board as of June 30, 2010, is listed in Table I.

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

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.**

www.iowadot.gov/operationsresearch/iowa_highway_research_board.asp

TABLE I

2010 IOWA HIGHWAY RESEARCH BOARD — June 30, 2010

Member	Term Expires	Alternate
Ahmad Abu-Hawash Chief Structural Engineer Iowa DOT - Bridges and Structures 800 Lincoln Way Ames, IA 50010 (515) 239-1393 Email: ahmad.abu-hawash@dot.iowa.gov	12-31-12	Deanna Maifield Methods Engineer Iowa DOT – Office of Design 800 Lincoln Way Ames, IA 50010 (515) 239-1402 Email: Deanna.Maifield@dot.iowa.gov
Robert Younie Director Office of Maintenance 800 Lincoln Way Ames, IA 50010 (515) 239-1589 Email: bob.younie@dot.iowa.gov	12-31-11	Kent Nicholson Assistant Road Design Engineer Road Design 800 Lincoln Way Ames, IA 50010 (515) 239-1586 Email: Kent.Nicholson@dot.iowa.gov
James Alleman Dept. of CCE Engineering Iowa State University 390 Town Engineering Bldg. Ames, IA 50011 (515) 294-3532 Email: jea@iastate.edu	12-31-11	
Wade Weiss Greene County Engineer 114 N. Chestnut Jefferson, IA 50129 (515) 386-3316 SS# 037 Email: wweiss@co.greene.ia.us	12-31-11 District 1	Robert Kieffer Boone County Engineers Office 201 State Street Boone, IA 50036-3988 (515) 433-0530 Email: engineer@co.boone.ia.us
Vicki Dumdei District Engineer 512000 - Hwy Div District 2 Office Mason City, IA 50401-4438 (641) 422-9465 Email: Victoria.Dumdei@dot.iowa.gov	12-31-10	David Little Assistant District Engineer 512000 - Hwy Div District 2 Office Mason City, IA 50401-4438 (641) 422-9464 Email: david.Little@dot.iowa.gov
Keri Hornbuckle Dept. of Civil & Env. Engineering The University of Iowa 4105 Seamans Center Iowa City, IA 52242 (319) 384-0789 Email: kchorn@engineering.uiowa.edu	12-31-10	Douglas Schnoebelen The University of Iowa – IIHR 323A SHL 300 South Riverside Drive Iowa City, Iowa 52242-1585 (319) 335-6061 Email: douglas-schnoebelen@uiowa.edu
J. Jay Waddingham Franklin County Engineer 1341 Olive Avenue, PO Box 118 Hampton, IA 50441 (641) 456-4671 SS#35 Email: jwaddingham@co.franklin.ia.us	12-31-10 District 2	J.D. King Fayette County Engineer 114 N. Vine St., PO Box 269 West Union, IA 52175 (563) 422-3552 SS# 033 Email: jamesdking@co.fayette.ia.us

Jack Moellering
Pocahontas County Engineer
1 Court Square
99 Court Square – Ste. 4
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12-31-12
District 3

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12-31-12

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12-31-11

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12-31-12

Tracy Warner
Municipal Engineer
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Woodbury County Engineer
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Daniel Ahart
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12-31-11
District 4

Kevin Mayberry
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12-31-10
District 5

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Email: ernies@leecounty.org

Clark Schloz
Jackson County Engineer
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Maquoketa, IA 52060
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12-31-12
District 6

Robert Fangmann
Cedar County Engineer
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(563) 886-6102
Email: engineer@cedarcounty.org

RESEARCH AND DEVELOPMENT PROJECTS

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

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

Table II is a record of expenditures for research and development made during the fiscal year ending June 30, 2010. Total expenditure was $2,211,950.81.

IN-HOUSE RESEARCH AND DEVELOPMENT

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

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

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

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

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

SECONDARY ROAD TRAFFIC COUNT PROGRAM

Secondary road traffic counts and road inventories are conducted annually and funded from the Secondary Road Research Fund as Non-Contract Engineering Studies. The Office of Transportation Data conducted traffic counts in 25 counties during fiscal year 2010 as part of the Annual Traffic Count Program. This activity consisted of 6300 portable recorder classification counts, 150 portable recorder volume counts and 48 manual counts. Traffic volumes from these counts are used to develop Motor Vehicle Traffic Flow Maps for each county showing the Annual Average Daily Traffic (AADT) on specific road sections within each county.

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

SECONDARY ROAD RESEARCH FUND

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

The fiscal year 2010 financial summary is:

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

STREET RESEARCH FUND

The Street Research Fund was established in 1989 under Section 312.3A of the Iowa Code. Each year $200,000 is set aside from the street construction fund for the sole purpose of financing engineering studies and research projects. The objective of these projects is more efficient use of funds and materials available for construction and maintenance of city streets. The Iowa Department of Transportation accounting procedure for the Street Research Fund is based on obligations for expenditures on research projects and not the actual expenditures. The fiscal year 2010 financial summary is:

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

PRIMARY ROAD RESEARCH FUND

The Primary Road Research Fund is sourced from non-obligated funds of the Primary Road Fund. These funds can only be expended on Iowa DOT projects for which the funds were reserved, such as contracted research and project-specific research supplies or equipment. An estimate of Primary Road Research Fund expenditures is made prior to the beginning of each fiscal year. The amount expended for contract research from the Primary Road Research Fund for FY10 was $549,403.92 and the estimate for FY11 is $750,000.

PROJECTS INITIATED DURING FY 2010

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

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

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

TR-612 Wind Loads on Dynamic Message Cabinets and Behavior of Supporting Trusses

TR-613 Study of the Impacts of Implements of Husbandry on Iowa Bridges

TR-614 Structural Characterization of a UHPC Waffle Bridge Deck and its Connections

TR-615 Connection Details and Field Implementation of UHPC Piles - Phase II: Use of Ultra-High Performance Concrete in Geotechnical and Substructure Applications

TR-616 Timber Abutment Piling and Back Wall Rehabilitation and Repair

TR-617 An Adaptive Field Detection Method for Bridge Scour Monitoring Using Motion-Sensing Radio Transponders (RFIDs)

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

TR-619 Development of Self-Cleaning Box Culvert Design - Phase II

TR-620 Update of RCB Culvert Standards to LRFD Specifications

TR-621 Geo-synthetic Reinforced Soil for Low Volume Bridge Abutments

TR-622 Maintenance and Design of Steel Abutment Piles in Iowa Bridges

TR-623 Quality Control/Quality Assurance Testing for Joint Density and Segregation of Asphalt Mixtures

TR-624 Development of Quality Standards for Inclusion of High Recycled Asphalt Pavement Content in Asphalt Mixtures

16 Projects Initiated

PROJECTS COMPLETED DURING FY 2010

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

TR-450 Identification of Laboratory Techniques to Optimize Superpave HMA Surface Friction Characteristics

TR-458 Field Testing of Abrasive Deliver Systems in Winter Maintenance

TR-472 Investigation of Materials for the Reduction and Prevention of Corrosion on Highway Maintenance Equipment

TR-491 Development of Winter Performance Measures for Highway Winter Maintenance Operations

TR-501 Optimization and Management of Materials in Earthwork Construction

TR-517 Guidelines for Safety Treatment of Roadside Culverts

TR-529 Ultra High Performance Concrete Bridge Wapello County

TR-546 Revision to the SUDAS Traffic Signal Design Guide

TR-555 Evaluation of Hot Mix Asphalt Moisture Sensitivity using the Nottingham Asphalt Test Equipment

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

TR-577 Evaluation of Rumble Stripes on Low Volume Rural Roads in Iowa

TR-578 Development of Mix Design Process for Cold In-Place Recycling Using Emulsion - Phase III

TR-582 Ethanol By-Product Geo-Material Stabilization

TR-586 Pavement Thickness Design for Local Roads in Iowa

TR-592 Bridge Rails and Approach Railing for Low-Volume Roads in Iowa

TR-593 Infrastructure Impacts on Iowa's Changing Economy

TR-595 Autonomous Measurements of Bridge Pier and Abutment Scour Using Motion-Sensing Radio Transmitters

TR-596 Insights into the Origin and Characteristics of the Sedimentation Process at Multi-Barrel Culverts in Iowa

TR-600 Improving Concrete Overlay Construction

19 Projects Completed and Approved

Table II

FINANCIAL SUMMARY OF RESEARCH AND DEVELOPMENT PROJECT EXPENDITURES

July 1, 2009 to June 30, 2010

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

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

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

HR-140

Agency:
United States Geological Survey

Principal Investigator:
Rob Middlemis-Brown

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

Research Board Funding:
$249,650

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

Collection and Analysis of Stream Flow Data

Objective: Collect the data necessary for analytical studies (including flood-frequency discharge estimation) and to define, for any location, the statistical properties and trends in discharge or elevation of streams, lakes, and reservoirs; Define the water-surface-elevation profiles and corresponding discharges along streams in basins with at least 100 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:
Duane Smith

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

Research Board Funding:
$130,000

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

promote research - encourage implementation - distribute research data

Iowa State University Local Technical Assistance Program (LTAP)

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

Progress:

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

Reports: Newsletters

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

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

HR-375

Agency:
Iowa Department of Transportation, Highway Division

Principal Investigator:
Edward J. Engle

Research Period:
November 1, 1994 to on-going

Research Board Funding:
$37,400

Funding Source:
100% State - 100% Secondary funds

Transportation Research Board Education for County Engineers

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

Progress: Between 1995-2010, 24 county engineers have received funding through IHRB to attend the Annual TRB meeting in Washington, D.C.

Reports: None

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

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

TR-428

Agency:
Iowa State University

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

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

Research Board Funding:
$294,760

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

Effective Structural Concrete Repair

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

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

Reports: Interim Report April 2004

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

Trucks in Lane 3 during the Altoona Bridge test

TR-450

Agency:
Purdue University, sub-contract with Iowa State University

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

Research Period:
June 1, 2001 to April 30, 2010

Research Board Funding:
$80,000 (Purdue University - $23,674; Iowa State University - $56,326)

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

Identification of Laboratory Techniques to Optimize Superpave HMA Surface Friction Characteristics

Objective:

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

Reports: Final Report, April 2010

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

TR-468

Agency:
Iowa Department of Transportation

Principal Investigator:
Mark J. Dunn

Research Period:
December 1, 2001 to on-going

Research Board Funding:
$10,000

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

Technology Transfer Program for the Iowa Highway Research Board

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

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

Reports: None

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

TR-488

Agency:
The University of Iowa

Principal Investigator:
Wilfrid A. Nixon

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

Research Board Funding:
$90,000

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

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

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

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

Reports: None

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

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

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

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

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

TR-491

Agency:
The University of Iowa

Principal Investigator:
Wilfrid A. Nixon

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

Research Board Funding:
$100,000

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

Development of Winter Performance Measures for Maintenance Operations

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

Reports: Final Report, September 2009

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

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

TR-501

Agency:
Iowa State University

Principal Investigator:
Vern Schaefer

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

Research Board Funding:
$175,000

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

Optimization and Management of Materials in Earthwork Construction

Objective:

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

Reports: Final Report, May 2010

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

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

TR-517

Agency:
University of Nebraska - Lincoln

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

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

Research Board Funding:
$24,995

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

Guidelines for Safety Treatment of Roadside Culverts

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

Reports: Final Report, February 2010

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

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

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

TR-519
Phase II

Agency:
United States Geological Survey (USGS)

Principal Investigator:
David Eash

Research Period:
June 1, 2004 to December 31, 2011

Research Board Funding:
$464,777

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

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

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

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

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

Reports: None

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

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

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

TR-529

Agency:
Iowa State University

Principal Investigator:
Brent Phares

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

Research Board Funding:
$154,310

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

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

Objective:

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

Reports: Final Report, June 2010

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

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

A UHPC prestressed bridge constructed on Little Soap Road in Wapello County, Iowa
Photo: Dr. Brent Phares, Iowa State University/CCEE

TR-536

Agency:
The University of Iowa

Principal Investigator:
Marian Muste

Research Period:
April 1, 2005 to December 31, 2008

Research Board Funding:
$44,048

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

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

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

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

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

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

  The software is operationally robust and works well.

Reports: None

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

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

TR-545

Agency:
The University of Iowa

Principal Investigator:
Marian Muste
Peter Haug

Research Period:
March 15, 2005 to June 26, 2009

Research Board Funding:
$144,785

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

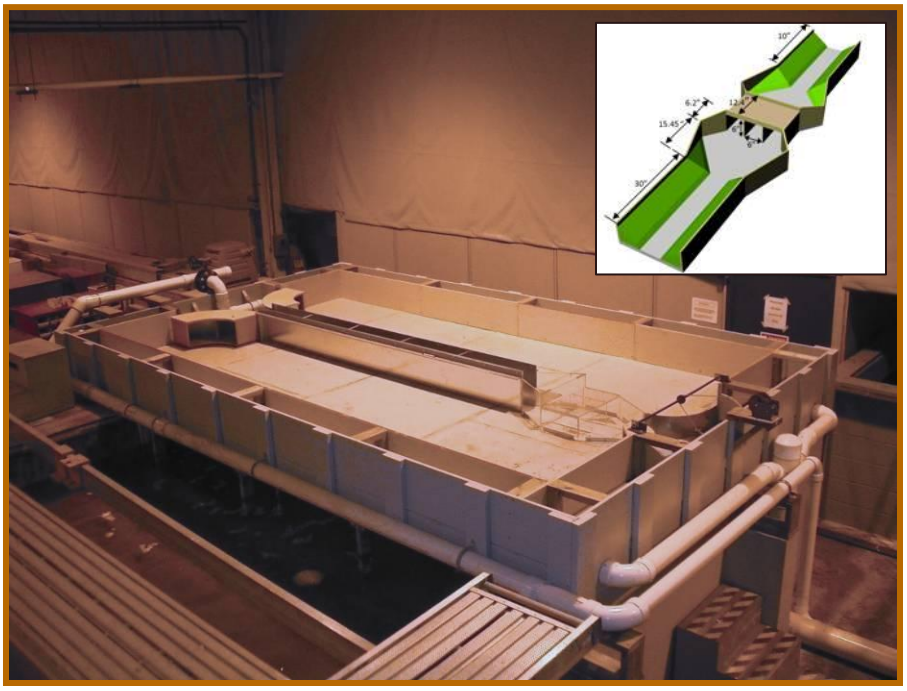
Development of Self-Cleaning Box Culvert Designs

Objective: Identify and/or develop methods for constructing or retro-fitting box culverts so that the typical flow through a culvert will clean the culvert's barrels and keep the structure performing well with little or no maintenance.

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

Reports: Final Report, June 2009

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



Laboratory hydraulic model and schematic of channel (insert) with three-barrel culvert geometry
Photo: Dr. Marian Muste, The University of Iowa/IIHR

TR-546

Agency:
Iowa State University

Principal Investigator:
Neal Hawkins

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

Research Board Funding:
$80,000

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

Revision to the SUDAS Traffic Signal Design Guide

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

Reports: Final Report, July 2009

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

SUDAS specifications are updated to stay current with new traffic signal technologies and methods
Photo: Neal Hawkins, Iowa State University/InTrans

TR-548

Agency:
Iowa State University

Principal Investigator:
Chris Albrecht

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

Research Board Funding:
$80,000

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

Investigation of the Impact of Rural Development on Secondary Road Systems

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

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

Reports: Final Report, September 2010

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

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

TR-551

Agency:
Iowa State University

Principal Investigator:
Neal Hawkins

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

Research Board Funding:
$157,081

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

Local Agency Pavement Marking Plan

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

- Develop a county and city pavement marking application matrix which will provide guidance on the selection of marking materials based on roadway type, pavement service life, user needs, and other factors specific to local agency conditions

- Address quality control issues for cities and counties to improve efficiency and effectiveness of pavement markings on all marked public roadways

Reports: Final Report, July 2010

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

One goal of this project was to find new products and methods for improving both durability and retro-reflectivity of centerline markings.
Photo: Neal Hawkins, Iowa State University/CCEE

TR-555

Agency:
Iowa State University

Principal Investigator:
Chris Williams

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

Research Board Funding:
$75,000

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

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

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

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

Reports: Final Report, April 2010

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

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

Indirect tensile strength test setup

TR-562

Agency:
Robert Connor & Assoc

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

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

Research Board Funding:
$36,755

Funding Source:
100 % State -
100 % Primary funds

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

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

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

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

Reports: A Draft Final Report is complete.

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

Bolted Reinforcing Jacket

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

TR-563
(TPF-5, 148)

Agency:
Minnesota Department of Transportation

Principal Investigator:
Tim Clyne (Minnesota Department of Transportation)

Research Period:
July 2006 to September 30, 2011

Research Board Funding:
$105,000

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

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

Objective: Determine pavement response under various types of agricultural equipment (including impacts of different tires and additional axles) and compare this response to the impact of a typical five-axle semi tractor-trailer. This may be accomplished by constructing new instrumented test sections at MnROAD and/or to retrofit instrumentation into the existing test sections. The final scope and work plan for the study will be developed by the participating agencies.

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

Reports: None

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

Large manure hauling tank on the MnROAD test track; fully loaded it weighs more than 134,000 lbs (distributed over four axles - not including the tractor).
Photo: Shongtao Dai, Research Operations Engineer, Minnesota DOT

TR-564

Agency:
Digital Control, Inc.

Principal Investigator:
LaDon Jones

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

Research Board Funding:
$52,000

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

Adding Scour Estimation to the Iowa Bridge Backwater Software

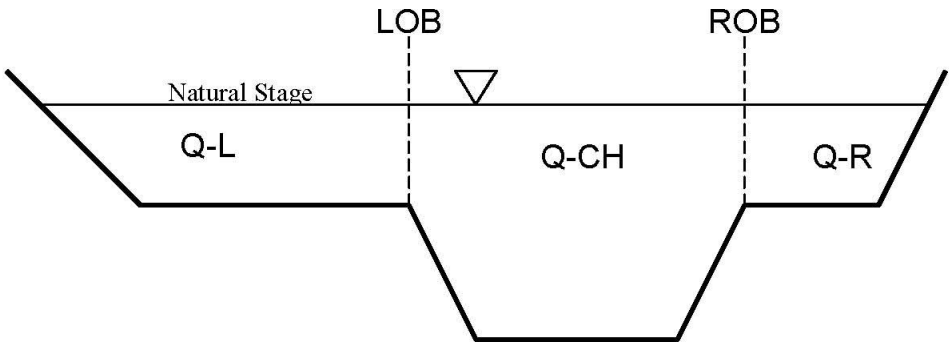
Objective: Add a new major component to the Iowa Bridge Backwater software (published in 2003), *The Estimation of Scour at Bridges*. Adding scour estimation will be the most significant portion of this project and provide a valuable time saving tool for city, county and state engineers.

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

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

Reports: Final Report, September 2010

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



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

TR-566

Agency:
Iowa State University

Principal Investigator:
Larry Stevens

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

Research Board Funding:
$165,316

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

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

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

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

Progress: Final Report, December 2010

Reports: None

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

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

TR-567

Agency:
The University of Iowa

Principal Investigator:
Thanos Papanicolaou

Research Period:
August 1, 2006 to September 30, 2010

Research Board Funding:
$157,030

Hungry Canyons Alliance Funding:
$105,000

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

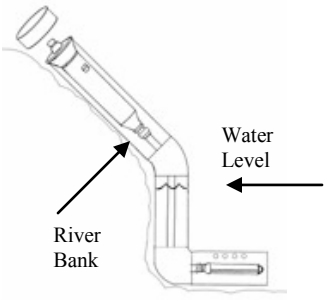
Development of Stage Discharge Relations for Ungaged Bridge Waterways in Western Iowa

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

Reports: Final Report, October 2010

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

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



Installation of Water Level Loggers (left) and drawing (right) of Logger Placement
Photo and Illustration: Dr. Thanos Papanicolaou, The University of Iowa/IIHR

TR-568

Agency:
Iowa State University

Principal Investigator:
David J. White

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

Research Board Funding:
$365,912

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

Modified Sheet Pile Abutments for Low Volume Bridges

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

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

Progress:

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

Reports: None

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

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

TR-570

Agency:
Iowa State University

Principal Investigator:
Muhannad Suleiman

Research Period:
March 1, 2007 to July 31, 2009

Research Board Funding:
$174,980

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

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

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

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

Progress: Final Report, October 2010

Reports: None

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

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

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

TR-572

Agency:
Iowa State University

Principal Investigator:
Neal Hawkins

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

Research Board Funding:
$99,881

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

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

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

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

Reports: Final Report, June 2009

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

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

TR-573

Agency:
Iowa State University

Principal Investigator:
Sri Sritharan

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

Research Board Funding:
$250,000

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

Development of LRFD Design Procedures for Bridge Piles in Iowa

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

Reports: Final Report, June 2010

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

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

TR-574

Agency:
Iowa State University

Principal Investigator:
Terry Wipf

Research Period:
April 1, 2007 to September 30, 2010

Research Board Funding:
$79,933

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

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

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

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

Reports: Final Report expected January 2011

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

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

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

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

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

TR-576

Agency:
Iowa State University

Principal Investigator:
Chris Williams

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

Research Board Funding:
$39,795

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

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

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

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

Reports: Final Report, May 2009

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

TR-577

Agency:
Iowa State University

Principal Investigator:
Shauna Hallmark

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

Research Board Funding:
$53,807

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

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

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

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

Reports: Final Report, October 2009

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

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

TR-578

Agency:
The University of Iowa

Principal Investigator:
Hosin –David" Lee

Research Period:
December 1, 2007 – February 26, 2010

Research Board Funding:
$65,646

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

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

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

Reports: Final Report, February 2010

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

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

TR-579

Agency:
Iowa State University

Principal Investigator:
Shauna Hallmark

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

Research Board Funding:
$80,000

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

Low Cost Strategies to Reduce Speed and Crashes on Curves

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

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

Reports: None

Implementation: Iowa counties will benefit from this research (among others) by obtaining another tool for improving safety on rural curves. A number of treatments have been used but their effectiveness is not known.

Additionally, use of the project as matching funds to the FHWA project allows us to leverage federal funding to evaluate treatments in Iowa and to be able to compare those results to other sites nationally.

Two strategies being evaluated in this research:

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

A static, painted warning sign. ↓

TR-580

Agency:
Iowa State University

Principal Investigator:
Omar Smadi

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

Research Board Funding:
$96,113

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

Pavement Markings and Safety

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

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

Reports: Final Report, December 2010

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

A pavement marking test deck in Dallas County, evaluating experimental centerline markings placed within a groove.
Photo: Neal Hawkins, Iowa State University/CCEE

TR-581

Agency:
Iowa State University

Principal Investigator:
John Verkade &
Peter Taylor

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

Research Board Funding:
$100,000

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

Development of an Improved Agricultural-Based Deicing Product

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

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

Implementation: If a suitable compound can be found the Iowa DOT will be able to reduce costs associated with deicing and 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.

Corn stover
Photo: NREL, 2007

TR-583

Agency:
Iowa State University

Principal Investigator:
Sri Sritharan

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

Research Board Funding:
$380,000

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

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

Objective:

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

Progress: Project progress:

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

Reports: None

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

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

TR-584

Agency:
Iowa State University

Principal Investigator:
Sri Sritharan

Research Period:
January 1, 2008 – August 31, 2010

Research Board Funding:
$70,000

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

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

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

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

Reports: None

Implementation: A training course to supplement the Final Report and expedite implementation of results into design and practice in the field will be developed. Designed for engineers at the Iowa DOT, the course will be delivered over a period of one to three days and clearly emphasize the importance of collaboration between structural, geotechnical, and construction engineers.

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

TR-586

Agency:
The University of Iowa

Principal Investigator:
Hosin –David" Lee

Research Period:
April 1, 2008 – February 26, 2010

Research Board Funding:
$50,000

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

Pavement Thickness Design for Local Roads in Iowa

Objective:

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

Reports: Final Report, February 2010

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

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

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

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

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

TR-589

Agency:
National Weather Service

Principal Investigator:
National Weather Service

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

Research Board Funding:
$137,937

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

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

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

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

Reports: None

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

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

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

TR-590

Agency:
The University of Iowa

Principal Investigator:
Hosin –David" Lee

Research Period:
April 1, 2008 – April 24, 2009

Research Board Funding:
$57.666

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

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

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

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

Reports: Final Report, April 2009

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

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

Installation of weather station
Photo: Public Policy Center, The University of Iowa

TR-591

Agency:
Iowa State University

Principal Investigator:
Charles Jahren

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

Research Board Funding:
$91,638

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

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

Objective:

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

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

Reports: None

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

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

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

TR-592

Agency:
Iowa State University

Principal Investigator:
Brent Phares

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

Research Board Funding:
$50,000

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

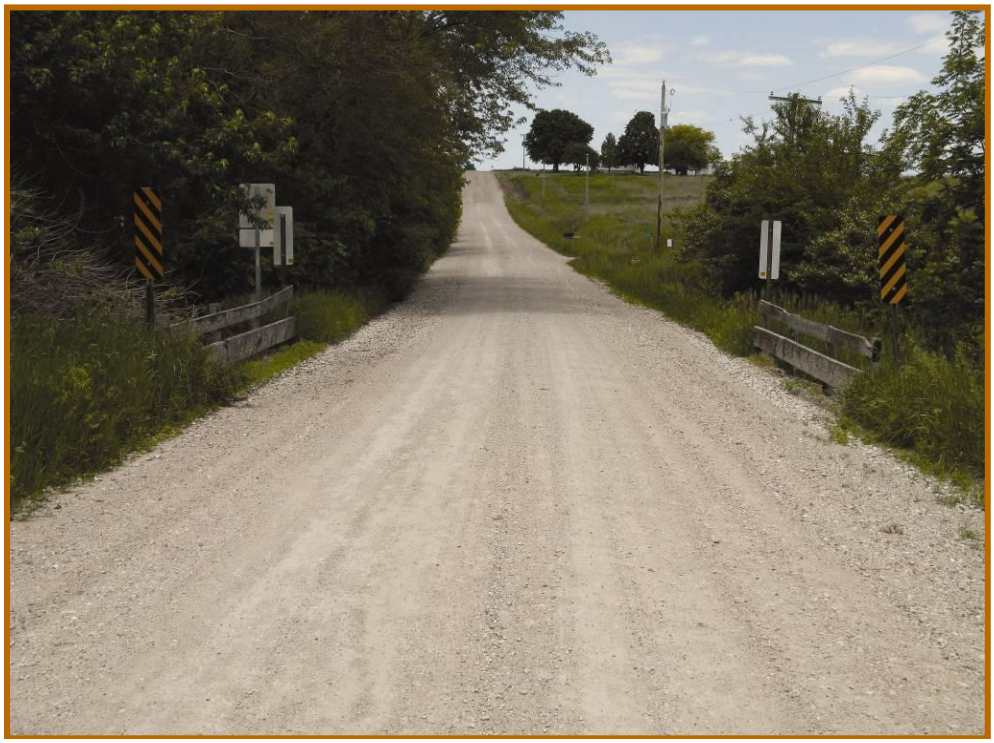
Bridge Rails and Approach Railing for Low-Volume Roads in Iowa

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

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

Reports: Final Report, April 2010

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



Example of a non-standard timber bridge rail located on a very low-volume road in Central Iowa, June 2009
Photo by: Zach Hans, Iowa State University/InTrans

TR-593

Agency:
Iowa State University

Principal Investigator:
Nadia Gkritza

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

Research Board Funding:
$120,000

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

Infrastructure Impacts on Iowa's Changing Economy

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

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

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

Reports: Final Report, April 2010

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

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

TR-594

Agency:
Iowa State University

Principal Investigator:
Chris Williams

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

Research Board Funding:
$75,000

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

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

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

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

Reports: Final Report, October 2010

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

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

TR-595

Agency:
The University of Iowa

Principal Investigator:
Thanos Papanicolaou

Research Period:
August 1, 2008 – January 29, 2010

Research Board Funding:
$57,000

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

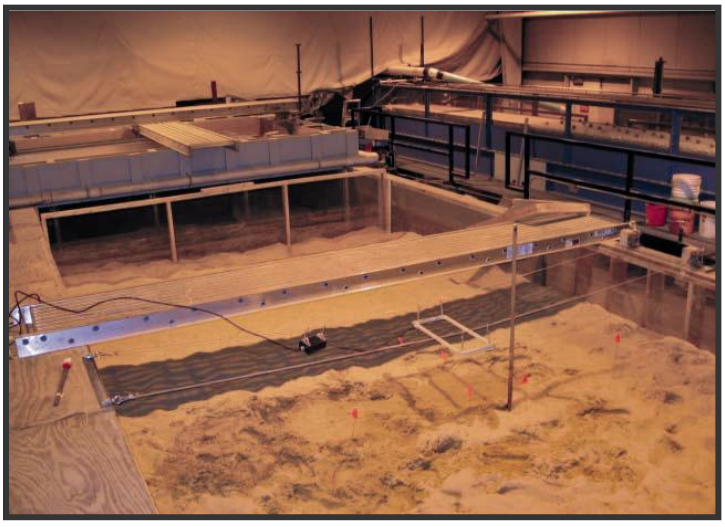
Autonomous Measurements of Bridge Pier & Abutment Scour Using Motion-Sensing Radio Transmitters

Objective:

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

Reports: Final Report, January 2010

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



The water/sediment re-circulating flume for the RFID tests (antenna is at the center of the flume).
Photo: Dr. Thanos Papanicolaou, The University of Iowa/IIHR

TR-596

Agency:
The University of Iowa

Principal Investigator:
Marian Muste

Research Period:
August 1, 2008 – February 28, 2010

Research Board Funding:
$72,752

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

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

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

Reports: Final Report, June 2010

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

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

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

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

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

TR-597

Agency:
Iowa State University

Principal Investigator:
Neal Hawkins

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

Research Board Funding:
$125,000

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

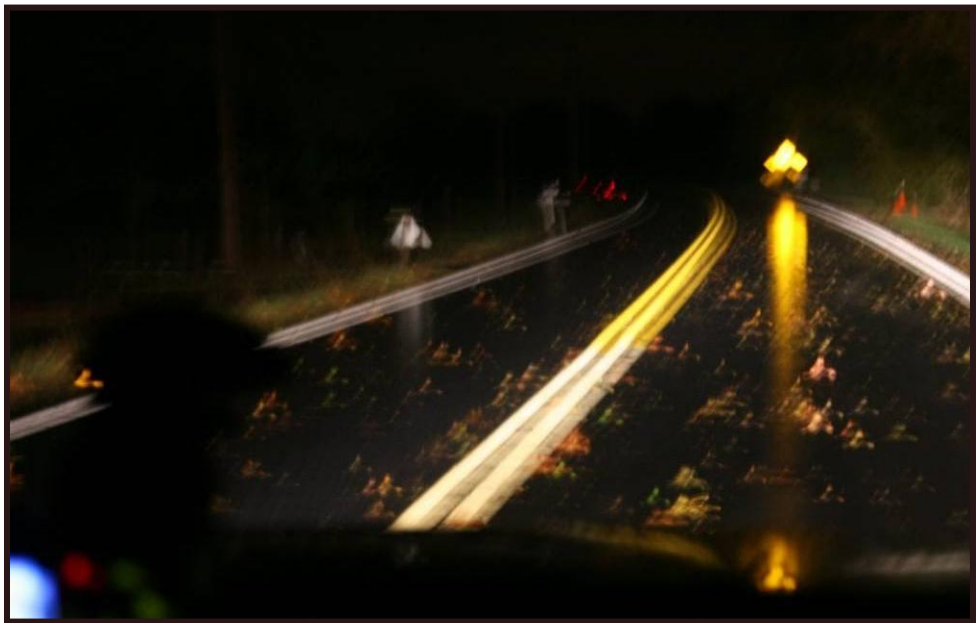
Wet Reflective Pavement Marking Demonstration Project

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

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

Reports: None

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



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

TR-598

Agency:
Iowa State University

Principal Investigator:
Charles Jahren

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

Research Board Funding:
$60,000

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

Development of Updated Specifications for Roadway Rehabilitation Techniques

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

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

Reports: None

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

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

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

TR-599

Agency:
Iowa State University

Principal Investigator:
Chris Williams

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

Research Board Funding:
$124,997

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

Investigation of Warm Mix Asphalt Using Iowa Aggregates

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

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

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

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

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

Reports: None

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

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

TR-600

Agency:
Iowa State University

Principal Investigator:
Paul Wiegand

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

Research Board Funding:
$250,000

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

Improving Concrete Overlay Construction

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

Reports: Final Report, June 2010

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

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

TR-601

Agency:
Iowa State University

Principal Investigator:
Omar Smadi

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

Research Board Funding:
$100,000

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

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

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

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

Reports: None

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

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

TR-602

Agency:
WHKS & Company

Principal Investigator:
Fouad Daoud

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

Research Board Funding:
$66,476

Funding Source:
100 % State -
100 % Secondary funds

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

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

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

Reports: Completed Standard Plans March 2010

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

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

TR-603

Agency:
Foth Infrastructure & Environmental, LLC

Principal Investigator:
J. Scott Ingersoll

Research Period:
November 26, 2008 – January 4, 2010

Research Board Funding:
$274,111

Funding Source:
100 % State -
100 % Secondary funds

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

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

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

Progress: Final standard plans November, 2010.

Reports: None

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

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

TR-604

Agency:
Iowa State University

Principal Investigator:
Travis Hosteng

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

Research Board Funding:
$88,336

Funding Source:
100 % State -
100 % Secondary funds

Field Testing and Evaluation of a Demonstration Timber Bridge

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

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

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

Reports: None

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

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

TR-605

Agency:
Iowa State University

Principal Investigator:
Terry Wipf

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

Research Board Funding:
$70,044

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

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

Objective:

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

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

Reports: None

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

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

TR-606

Agency:
Iowa State University

Principal Investigator:
Duane Smith

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

Research Board Funding:
$125,000

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

Leadership Academy (LTAP)

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

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

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

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

Reports: None

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

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

TR-607

Agency:
Snyder and Associates

Principal Investigator:
Steve Klocke

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

Research Board Funding:
$111,455

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

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

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

- **Division 7:** Streets and Related Work
  Specifications for Section 7040, Pavement Repair and Rehabilitation specifications

- **Division 9:** Site Work and Landscaping
  Specifications for Sections 9020, Sodding; 9030, Plant Material and Planting; 9050, Gabions and Rip Rap; 9060, Fencing; 9070, Retaining Walls; and 9080, Concrete Steps and Handrails

- **Standard Drawings:** SUDAS figures for sections 7010, PCC Pavement; 7020, Hot Mix Asphalt; 7040, Pavement Repair and Rehabilitation; 9030, Plant Material and Planting; 9050, Gabions and Rip Rap; 9060, Fencing; 9070, Retaining Walls; and 9080, Concrete Steps and Handrail

Progress: Final Report, December 2010

Reports: None

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

TR-608

Agency:
Iowa County Engineer Association Service Bureau

Principal Investigator:
Steve DeVries

Research Period:
August 1, 2009 – July 31, 2011

Research Board Funding:
$154,316

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

Assessment of Iowa County Roadway Financing Needs

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

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

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

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

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

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

Reports: None

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

TR-609

Agency:
The University of Iowa

Principal Investigator:
Hosin ―David" Lee

Research Period:
July 16, 2009 – December 31, 2010

Research Board Funding:
$104,140

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

Curing Criteria for Cold In-Place Recycling – PHASE III

Objective:

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

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

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

Reports: None

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

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

TR-610

Agency:
The University of Iowa

Principal Investigator:
Salam Rahmatalla

Research Period:
August 1, 2009 – July 31, 2010

Research Board Funding:
$69,092

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

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

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

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

Reports: Final Report, July 2010

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

On-the Spot damage detection field testing on County IA-1, South of Iowa City, Iowa, near Gingerich Road
Photo: Dr. Salam Rahmatalla, The University of Iowa

TR-611

Agency:
The University of Northern Iowa

Principal Investigator:
M.D. Salam

Research Period:
August 1, 2009 – October 31, 2010

Research Board Funding:
$74,842

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

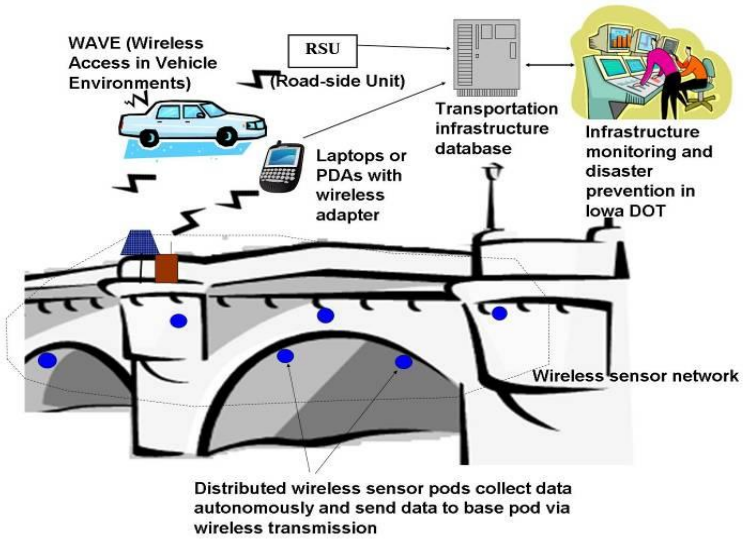
Wireless Sensor Networks for Infrastructure Monitoring

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

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

Reports: Final Report, December 2010

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



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

HR-1027

Agency:
Iowa Department of Transportation

Principal Investigator:
Edward J. Engle

Research Period:
March 1980 – on-going

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

Funding Source:
100% State - 100% Secondary funds

Secondary Road Research Coordinator

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

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

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

Reports: None

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