Iowa Department of Transportation

ANNUAL REPORT
of
Iowa Highway Research Board
Research and Development Activities
FY 2009

Attachment to
FY 2009 Annual Report
Research, Intelligent Transportation Systems, and
Technology Transfer Activities

Iowa Department of Transportation
Research and Technology Bureau
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IHRB
IOWA HIGHWAY RESEARCH BOARD

DECEMBER 2009

ANNUAL REPORT
OF
IOWA HIGHWAY RESEARCH BOARD
RESEARCH AND DEVELOPMENT ACTIVITIES

FOR THE
FISCAL YEAR ENDING JUNE 30, 2009

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

HIGHWAY DIVISION
IOWA DEPARTMENT OF TRANSPORTATION
AMES, IOWA 50010

DECEMBER 2009

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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 FY2009" 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, 2009. It is also a report on projects completed during the fiscal year beginning July 1, 2008 and ending June 30, 2009. 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 Section 310.36 of the Code of Iowa and now denoted by 312.3A.

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, 2009, is listed in Table I.

The Research Board held eight regular meetings during the period from July 1, 2008, through June 30, 2009. 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

2009 IOWA HIGHWAY RESEARCH BOARD MEMBERS & ALTS **June 30, 2009**

Member	Term Expires	Alternate
Ahmad Abu-Hawash Chief Structural Engineer Iowa DOT - Bridges and Structures 800 Lincoln Way Ames, IA 50010 (515) 239-1393	12-31-09	Deanna Maifield Methods Engineer Iowa DOT – Office of Design 800 Lincoln Way Ames, IA 50010 (515) 239-1402
John Adam - Deputy Director Iowa DOT - Statewide Operations Bureau 800 Lincoln Way Ames, IA 50010 (515) 239-1333	12-31-11	Will Zitterich - Assistant Director Iowa DOT – Office of Maintenance 800 Lincoln Way Ames, IA 50010 (515) 239-1396
James Alleman Dept. of CCE Engineering Iowa State University 390 Town Engineering Bldg. Ames, IA 50011 (515) 294-3532	12/31/11	
Wade Weiss Green County Engineer 114 N. Chestnut Jefferson, IA 50129 (515) 386-3316 SS# 037	12-31-11 District 1	Robert Kieffer Boone County Engineer 201 State Street Boone, IA 50036-3988 (515) 433-0530 SS# 008
Vicki Dumdei - District Engineer Hwy Div - District 2 1420 Fourth St. S.E. Mason City, IA 50401-4438 (641) 422-9465	12-31-10	Robert Younie - Director Office of Maintenance 800 Lincoln Way Ames, IA 50010 (515) 239-1542
Keri Hornbuckle Dept. of Civil & Env. Engineering The University of Iowa 4138 Seamans Center Iowa City, IA 52242 (319) 384-0789	12-31-10	Douglas Schnoebelen The University of Iowa – IIHR 323A SHL 300 South Riverside Drive Iowa City, Iowa 52242-1585 319-335-6061
J. Jay Waddingham Franklin County Engineer 1341 Olive Avenue, PO Box 118 Hampton, IA 50441 (641) 456-4671 SS# 035	12-31-10 District 2	J.D. King Fayette County Engineer 114 N. Vine Street, PO Box 269 West Union, IA 52175 (563) 422-3552 SS# 033
Scott Rinehart Clay County Engineer 300 W. 4th Street #5 Spencer, IA 51301-2806 (712) 262-2825 SS# 021	12-31-09 District 3	Jack Moellering Pocahontas County Engineer 1 Ct Square, 99 Court Square – Ste. 4 Pocahontas, IA 50574-1629 (712) 335-3252 SS#076

Continued. . . . . 2009 IOWA HIGHWAY RESEARCH BOARD MEMBERS & ALTS

Jim Berger Director Iowa DOT – Office of Materials 800 Lincoln Way Ames, IA 50010 (515) 239-1843	12-31-09	Mark Kerper Assistant Director Iowa DOT - Office of Loc & Environment 800 Lincoln Way Ames, IA 50010 (515) 239-1591
John Joiner Public Works Director 515 Clark Avenue P.O. Box 811 Ames, IA 50010 (515) 239-5165	12-31-11	Ronald Knoche City Engineer 410 E. Washington Street Iowa City, IA 52240-1825 (319) 356-5138
Jeff Krist Public Works Project Manager 209 Pearl Street Council Bluffs, IA 51503 (712) 328-4635	12-31-09	Richard Fosse Director of Public Works 410 E. Washington Street Iowa City, IA 52240-1825 (319) 356-5141
Mark Nahra Woodbury County Engineer 620 Douglas Sioux City, Iowa 51101 (712) 279-6484 SS# 097		
Dan Ahart Shelby County Engineer 1313 Industrial Parkway Harlan, IA 51537 (712) 755-5954 SS# 083	12-31-11 District 4	Kevin Mayberry Mills County Engineer 403 Railroad Avenue Glenwood, IA, 51534 (712) 527-4873 SS# 065
Brian Moore Wapello County Engineer 536 Mill St. Ottumwa, Iowa 52501 (641) 684-5425 SS# 090	12-31-10 District 5	Ernie Steffensmeier Lee County Engineer 933 Avenue H Fort Madison, IA, 52627 (319) 372-2541 SS#056
Steve Gannon Linn County Engineer 1888 County Home Road Marion, IA 52302-9753 (319) 892-6400 SS# 057	12-31-09 District 6	Clark Schloz Jackson County Engineer 201 W. Platt Maquoketa, IA 52060 (563) 652-4782 SS#049

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 funds for research and development are 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, 2009. Total expenditure was $2,959,388.29.

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 percent of the federal aid allocated to the states for statewide planning and research (SPR). Iowa's obligation and actual expenditure for NCHRP varies and may be influenced by billing practices.

SECONDARY ROAD TRAFFIC COUNT PROGRAM

Secondary road traffic counts and road inventories are conducted annually and funded from the Secondary Road Research Fund as Non-Contract Engineering Studies. The Office of Transportation Data conducted traffic counts in 24 counties during fiscal year 2009 as part of the Annual Traffic Count Program. This activity consisted of 6100 portable recorder classification counts, 100 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 98 counties. This data provides county engineers, highway engineers, planners and administrators with essential information needed to determine design standards, to systematically classify highways, and to develop programs for improvement in maintenance of secondary roads.

SECONDARY ROAD RESEARCH FUND

Section 310.34 of the Iowa Code authorizes the Iowa Department of Transportation to set aside each year an amount not to exceed 1½ percent 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 2009 financial summary is:

Beginning Balance 7-1-08		$1,685,667.62
Receipts		
State Road Use Tax Fund		
(1½% of receipts)	$1,173,460.50	
Federal Aid Secondary		
(1½% of receipts)	0.00	
Research Income	0.00	
Sub-Total		$1,173,460.50
Total Funds Available		$2,859,128.12
Obligation for Expenditures		
Obligated for		
Contract Research	$1,705,000.99	
Non-Contract		
Engineering Studies	$99,474.79	
Total Expenditures		$1,804,475.78
Ending Balance 6-30-09		$1,054,652.34

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 2009 financial summary is:

Beginning Balance (7-1-08)	$ 29,841.00
Unobligated (Unused) Funds from Previous Projects	140,419.98
FY09 Street Research Funding	$200,000.00
Total Funds Available for Street Research	$370,260.98
Total Obligated for Expenditure FY09	$235,172.00
Ending Unobligated Balance 6-30-09	$135,088.98

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 FY09 was $928,659.81and the estimate for FY10 is $750,000.

PROJECTS INITIATED DURING FY 2009

HR-140 (140F) Special Flood Profiles

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

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

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-597 Wet Reflective Pavement Marking Demonstration Project

TR-598 Development of Updated Specifications for Roadway Rehabilitation Techniques

TR-599 Investigation of Warm Mix Asphalt Using Iowa Aggregates

TR-600 Improving Concrete Overlay Construction

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

TR-602 Updating Portions of the Three-Span Prestressed Concrete Beam Bridge Standards to LRFD Specifications – Part I

TR-603 Updating Portions of H-Standard Three Span Prestressed Beam Bridges, T-Pier and Pile Bent Pier Update to LRFD - Part II

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

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

TR-606 Leadership Academy (LTAP)

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

TR-608 Assessment of Iowa County Roadway Financing Needs

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

TR-611 Wireless Sensor Networks for Infrastructure Monitoring

19 Projects Initiated

PROJECTS COMPLETED DURING FY 2009

The following projects were completed during FY 2009 and project Final Reports were approved by the Iowa Highway Research Board:

TR Number	TITLE	REPORT
516	Measurement of Seasonal Changes and Spatial Variation in Pavement Subgrade Support Properties - A Link to Pavement Performance	7/25/08
545	Development of Self-Cleaning Box Culvert Designs	6/26/09
554	Performance & Evaluation of Concrete Pavement Granular Subbase	7/25/08
480	Investigation of the Long Term Effects of Concentrated Salt Solutions on Portland Cement Concrete	4/24/09
533	Evaluation of Design Flood Frequency Methods for Iowa Streams	6/26/09
525	Design Guide for Improved Quality of Roadway Subgrades and Subbases	9/26/08
541	The Effects of Headcut and Knickpoint Propagation on Bridges in Iowa	1/30/09
558	Use of Ultra-High Performance Concrete in Geotechnical and Substructure Applications	12/4/08
560	Clear Zone - A Synthesis of Practice and Benefits of Meeting the Ten-Foot Clear Zone Goal on Urban Streets	12/4/08
561	Laboratory, Field Testing and Evaluation of Precast Bridge Elements	3/27/09
569	Quantitative Mapping of Waterways Characteristics at Bridge Sites	12/4/08
571	GIS-Based Decision and Outreach Tools for Aggregate Source Management	9/26/08
572	Improving Safety for Slow Moving Vehicles on Iowa's High-Speed Rural Roadways	5/29/09
576	Investigation of Electromagnetic Gauges for Determination of In-Place Density of HMA Pavements - Phase II	5/29/09
587	Crack Development in Ternary Mix Concrete Utilizing Various Saw Depths	4/24/09
588	Statewide Consultant Services from Stanley Consultants, Update Bridge "J" Standards	12/1/08
590	Cold In-Place Recycling (TR-553) Phase II-Measuring Temperature, Moisture, Deflection and Distress for the Test Section	4/24/09
239	(HR-239) Load Ratings for Standard Bridges - Phase IV	6/26/09

18 Projects Completed

Table II

FINANCIAL SUMMARY OF RESEARCH AND DEVELOPMENT PROJECT EXPENDITURES

July 1, 2008 to June 30, 2009

(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	184,056.00	181,295.00		365,351.00
239IV	Load Ratings for Standard Bridges - Phase IV		74,847.15		74,847.15
296	ISU Local Technical Assistance Program (LTAP)	75,713.58	59,632.45	13,000.00	148,346.03
375	TRB Education for County Engineers		2570.43		2,570.43
428	Effective Structural Concrete Repair	13,264.09	13,264.06	2,947.59	29,475.74
468	Technology Transfer Program for the Iowa Highway Research Board (IHRB)	334.96	1,093.40		1,428.36
519	Developing Flood-Frequency Discharge Estimation Methods for Small Drainage Basins in Iowa		64,892.50		64,892.50
520	Evaluation of Dowel Bar Retrofits for Local Road Pavements		14,480.29	764.65	15,244.94
529	Construction and Evaluation of a Prestressed Concrete Bridge Constructed Using Ultra High-Performance Concrete	4,284.20	7,933.91	1,918.49	14,136.60
530	Development of an Improved Integral Bridge Abutment-to-Approach Slab Connection	444.78			444.78
533	Design Flood Frequency Methods for Iowa Streams	14,982.62	11,407.80	1,279.02	27,669.44
539	Instrumentation and Monitoring of Precast, Post-tensioned Bridge Approach Pavement	743.25	1,362.97	393.94	2,500.16
545	Development of Self-Cleaning Box Culvert Designs	38,334.26	29,424.76	1,447.81	69,206.83
546	Revision to the SUDAS Traffic Signal Design Guide	2,446.91	1,308.90	20.92	3,776.73
550	Performance Evaluation of Rubblized Pavements in Iowa	8,394.56	4,724.99	65.41	13,184.96
551	Local Agency Pavement Marking Plan	13,132.42	10,229.83	4,038.23	27,400.48
553	Examination of Curing Criteria for Cold In-Place Recycling	3999.99	4,999.99	1,000.00	9,999.98
555	Evaluation of Hot Mix Asphalt Moisture Sensitivity using the Nottingham Asphalt Test Equipment	17,079.51	21,777.42	3,169.58	42,026.51
556	Feasibility Investigation of Segmentally Precast Bridge Piers for Accelerated Construction	138.51			138.51
558	Use of Ultra-High Performance Concrete in Geotechnical and Substructure Applications	320.61			320.61
559	Improved Method for Determining Wind Loads on Highway Sign and Traffic-Signal Structures	13,125.06	11,430.35	4,525.00	29,080.41
560	Clear Zone - A Synthesis of Practice and Benefits of Meeting the Ten-Foot Clear Zone Goal on Urban Streets	5,559.94			5,559.94
561	Precast Bridge Elements	6,571.38			6,571.38
564	Adding Scour Estimation to the Iowa Bridge Backwater Software		2,988.00	4,374.00	7,362.00
566	Investigation of Utility Cut Repair Techniques to Reduce Settlement in Repair Areas	37,673.85			37,673.85
567	Development of Stage-Discharge Relations for Ungaged Bridge Waterways	29,237.02	20,547.56	2,881.16	52,665.74
568	Modified Sheet Pile Abutments for Low Volume Bridges	41,181.38	85,524.34	8,760.61	135,466.33

Project	Project Title	Primary Road Research Fund Expenditures	Secondary Road Research Fund Expenditures	Street Research Fund Expenditures	Total Expenditures
569	Quantitative Mapping of Waterways at Bridge Sites		19,086.64	153.69	19,240.33
570	Identification of Practices, Design, Construction and Repair Using Trenchless Technology	37,866.60	20,155.20	4,870.55	62,892.35
571	GIS-Based Decision and Outreach Tools for Aggregate Source Management	34,544.00	43,178.00	8,635.00	86,357.00
572	Improving Safety for Slow Moving Vehicles on Iowa's High-Speed Rural Roadways	10,571.42	38,540.51		49,111.93
573	Development of LRFD Design Procedures for Bridge Piles	14,561.42	42,040.11		56,601.53
574	Structural Design Construction & Evaluation of a Pre-stressed Concrete Bridge Using UHPC Pi Girders	163.80	9,513.83	8,000.00	17,677.63
576	Investigation of Electromagnetic Gauges for Determination of In-Place Density of HMA Pavements - Phase II	6,822.57	3,588.59	251.33	10,662.49
577	Evaluation of Rumble Stripes on Rural Roads in Iowa	809.70	2,545.85	4,643.50	7,999.05
578	Development of Mix Design Process for Cold In-Place Recycling Using Emulsion - Phase 3	17,584.12	14,785.59	1,470.68	33,840.39
579	Strategies to Reduce Speed and Crashes on Curves	7,799.46	4,155.12	3,779.02	15,733.60
580	Pavement Markings and Safety	9,780.08	48,000.00	4,548.31	62,328.39
581	Development of an Improved Agricultural-Based Deicing Product	4,285.94	21,953.76	6,984.44	33,224.14
582	Ethanol By-Product Geo-Material Stabilization		22,212.06	3,679.60	25,891.66
583	Field Testing of Piles & Development of a Wave Equation Method for Pile Design in IA	55,056.86	31,107.67	21,454.92	107,619.45
584	Establishing a Dynamic Formula for Pile Design & Construction Control of Pile Driving	14,835.38	20,695.84	6,040.08	41,571.30
585	National Agriculture Image Program Participation	70,000.00	30,000.00		100,000.00
586	Pavement Thickness Design for Local Roads in Iowa	8,361.16	19,297.25	1,649.34	29,307.75
587	Impact of Low Shrinkage Mixes on Late-age Random Cracking in Pavements with Use of Early Entry Sawing	10,874.70	20,000.00	4,000.00	34,874.70
588	Statewide Consultant Services from Stanley Consultants, Update Bridge "J" Standards		116,805.24		116,805.24
590	Cold In-Place Recycling (TR-553) Phase II-Measuring Temperature, Moisture, Deflection and Distress for the Test Section	19,055.12	27,859.44	5,766.00	52,680.56
591	Stabilization to Mitigate Edge Rutting for Granular Shoulders	18,270.97	37,156.30	5,502.47	60,929.74
592	Bridge Rails and Approach Railing for Low-Volume Roads in Iowa	17,549.86	25,000.00	5,000.00	47,549.86
593	Infrastructure Impacts on Iowa's Changing Economy	9,359.73	36,060.56	12,000.00	57,420.29
594	Development of Non-Petroleum Based Binders for Use in Flexible Pavements	9,724.45	13,950.05	3,309.47	26,983.97
595	Autonomous Measurements of Bridge Pier and Abutment Scour Using Motion-Sensing Radio Transmitters	8,773.28	25,918.75	5,700.00	40,392.03
596	Insights into the Origin and Characteristics of the Sedimentation Process at Multi-Barrel Culverts in Iowa	29,101.00	17,140.61	5,031.01	51,272.62
597	Wet Reflective Pavement Marking Demonstration Project	1,889.31	931.14		2,820.45
598	Development of Updated Specifications for Roadway Rehabilitation Techniques		25,907.84	1,848.80	27,756.64
599	Investigation of Warm Mix Asphalt Using Iowa Aggregates		20,126.00	4,553.74	24,679.74

Project	Project Title	Primary Road Research Fund Expenditures	Secondary Road Research Fund Expenditures	Street Research Fund Expenditures	Total Expenditures
600	Improving Concrete Overlay Construction		88,884.70	16,914.99	105,799.69
601	Roadway Lighting and Safety: Phase II (TR-540) Monitoring, Quality, Durability and Efficiency		1,754.18		1,754.18
602	Part I - Updating Portions of the Three-Span Prestressed Concrete Beam Bridge Standards to LRFD Specifications		57,103.28		57,103.28
603	Part II - Updating Portions of H-Standard Three Span Prestressed Beam Bridges, T-Pier and Pile Bent Pier Update to LRFD		136,177.12		136,177.12
604	Field Testing and Evaluation of a Demonstration Timber Bridge		34,899.42		34,899.42
606	Leadership Academy (LTAP		13,190.36	5,105.07	18,295.43
607	Review of Inconsistencies Between SUDAS & Iowa DOT Specifications		3,645.15	8,545.90	12,191.05
1027	Secondary Road Research Coordinator		101,601.90		101,601.90
	Total of Expenditures	**928,659.81**	**1,820,704.16**	**210,024.32**	**2,959,388.29**

HR-140

Agency:
United States Geological Survey

Principal Investigator:
Rob Middlemis-Brown

Research Period:
July 1, 1967 to September 30, 2010
Annual Renewal

Research Board Funding:
$239,440

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

Collection and Analysis of Stream Flow Data

Objective: To 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; To 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. Extensive flooding in Iowa during June, 2008, resulted in a request to researchers for creation of several special Flood Event Reports.

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, 2008

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: To 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 at least five *Technology News* newsletters per year
- Conduct at least 10 training courses/workshops per year
- 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.

Participants at the 2007 Expo discover the latest technology and equipment
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: To 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). Attending 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: In the time period from 1995 - 2009, a total of 23 county engineers have been sent to TRB.

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.

New and Young Attendees Welcome Session held during the TRB 2009 Annual Meeting in Washington, D.C.
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: Objectives are to develop innovative repair methods and/or materials that result in cost effective repair of structural concrete elements.

Progress: A Final Report summarizing the work to date 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 has been created for use by maintenance personnel. The synopsis is included as an appendix to the Final Report. A revised Final Report will be prepared in 2009 to reflect the service life of the documented repairs.

Reports: Final 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 structural concrete bridges.

A transverse CFRP jacket being installed on a beam
Photo: Iowa State University/InTrans

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 June 30, 2007

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 level of friction
- Evaluate aggregate classifications and properties currently used to provide desirable friction levels for high traffic and possibly revise them based upon this research

Progress: Draft Final Report being written for delivery, January, 2010

Reports: None

Implementation: These research findings will identify blends of aggregates to be used in Iowa for maintaining the current baseline of friction. It is anticipated that increased macrotexture will diminish the need for high quality friction aggregates (to provide increased microtexture), resulting in more economical surface courses through reducing the need to import friction aggregates.

TR-458

Agency:
The University of Iowa

Principal Investigator:
Wilfrid A. Nixon

Research Period:
May 1, 2001 to April 30, 2006

Research Board Funding:
$151,920

Funding Source:
100% State - 30% Primary funds, 60% Secondary funds and 10% Street funds

Field Testing of Abrasive Delivery Systems in Winter Maintenance

Objective: To conduct a series of experiments aimed at improving the ability of abrasives to increase friction on snow and ice-covered roads. Two novel delivery methods were tested and compared with existing delivery methods, using a friction measuring device.

Reports: Final Report, September 2009

Implementation: Maintaining roads during winter in Iowa is difficult. The safety of the driving public is paramount.

A series of field experiments have been conducted to determine whether a standard or a chute based delivery system provides better friction when used to deliver abrasives to the road during winter storms. On the basis of these tests, no significant differences can be found between the two systems.

Reviews of other methods for material delivery have been made, together with an extensive report of a series of Iowa DOT tests on zero-velocity spreaders. On the basis of field testing and the reviews, a number of recommendations with respect to material delivery systems are available in printed and online pdf copies.

A sander chute in operation mode
Photo: The University of Iowa/IIHR

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

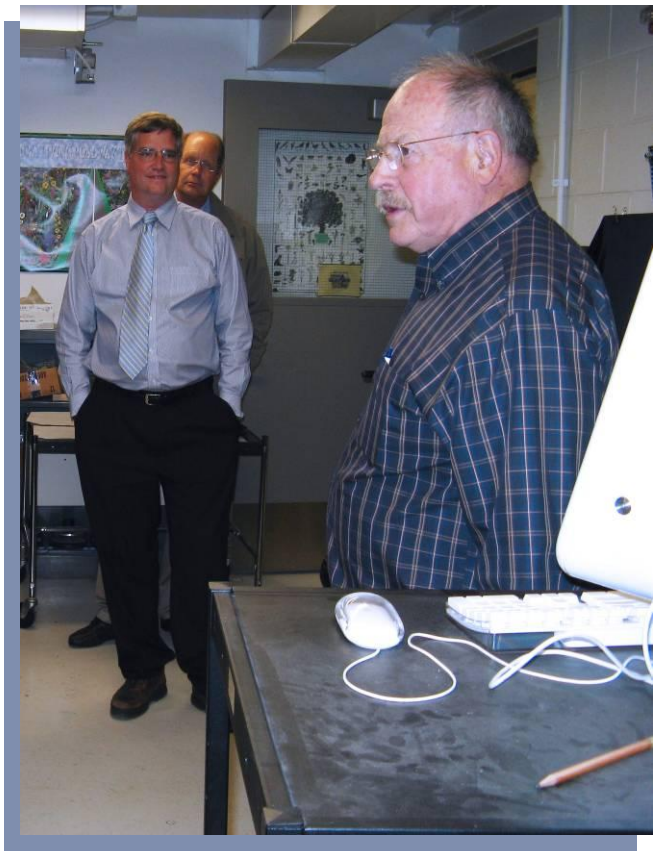
Funding Source:
100% State -
40% Primary funds,
50% Secondary funds
and 10% Street funds

Technology Transfer Program for the Iowa Highway Research Board

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

Progress: This project covers meeting costs for the Iowa Highway Research Board's Annual Travel Meeting at field sites in Iowa. Costs for the digital conversion of research report HR-29 "Drainage Areas for Iowa Streams" were also covered by this project.

Reports: None



Director of the Tallgrass Prairie Center at the University of Northern Iowa, Dr. Daryl Smith, discusses the Iowa Ecotype Project with the Iowa Highway Research Board during their Annual Travel Meeting on September 25, 2009. *Photo: Mary Starr, Iowa DOT, Research Bureau*

IHRB
IOWA HIGHWAY RESEARCH BOARD

TR-472

Agency:
The University of Iowa

Principal Investigator:
Wilfrid A. Nixon

Research Period:
May 1, 2002 to December 31, 2004

Research Board Funding:
$80,000

Funding Source:
100% State - 60% Primary funds, 35% Secondary funds and 5% Street funds

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

Objective: To find methods that can effectively and economically reduce corrosion on maintenance vehicles, especially when liquid deicing chemicals are being used.

Reports: Final Report, September 2009

Implementation: The recommendations and conclusions identified as having potential to minimize corrosion in winter maintenance equipment, thus reducing lifetime costs for vehicles, are presented in the report which is available via email to all subscribers on the snow and ice mailing list and online at the Iowa Department of Transportation Research Operations Web site.

Corrosion on snow plow blade

Corrosion Testing Apparatus

Photos: The University of Iowa/IIHR

TR-480
(SD2002-01)

Agency:
Michigan Technological University

Principal Investigator:
Lawrence L. Sutter

Research Period:
July 15, 2002 to June 30, 2007

Research Board Funding:
$80,000

Funding Source:
Multi-state pooled funds coordinated by South Dakota Department of Transportation - 86.7% other sources and 13.3% State - 45% Primary funds, 45% Secondary funds and 10% Street funds

Investigation of the Long Term Effects of Concentrated Salt Solutions on Portland Cement Concrete

Objective: To determine the long-term effects of concentrated solutions of magnesium, sodium and calcium chloride as well as calcium magnesium acetate or other alternative liquid deicers on durable Portland cement concrete; To estimate the potential for reduction in performance and service life for pavements (jointed plain, reinforced and continuously reinforced) and structures subjected to various concentrated deicing brines.

Reports: Final Report, April 2009

Implementation: The results of this research may be used to aid in the decision-making processes, with respect to the continued use of concentrated liquid deicers, while minimizing any potential damage to concrete pavements and structures.

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: To 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; To examine economic factors as well as ice melting capabilities and operational impacts that are major factors of successful winter maintenance operations.

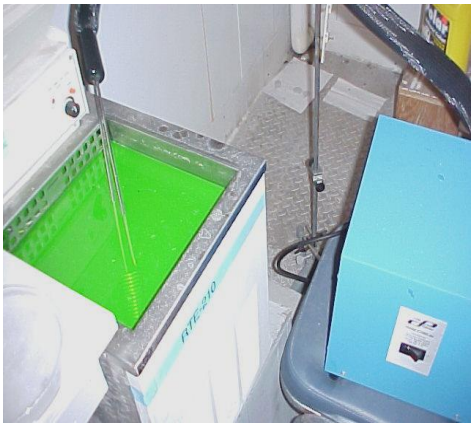
Progress: There have been numerous delays in the progress of this project; completion of the Final Report is anticipated in 2009.

Reports: None

Implementation: The result of this study will be presented at an appropriate meeting in Iowa after completion. The report will also be made available via e-mail to all subscribers listed on the Snow and Ice mailing list and will be placed on the Snow and Ice Cooperative Program Web site at **www.sicop.net** and the Iowa Department of Transportation Operations Research web site at **www.iowadot.gov/operationsresearch/reports.aspx**.

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 June 30, 2005

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: To create a method for measuring performance levels of winter maintenance operations during winter storms. The method must consider the severity of the storm, and be able to 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 given road type and a given 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. The Final Report is also available in PDF format on the Iowa Department of Transportation's Operations Research Web site.

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 February 29, 2008

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 completion expected January, 2010

Implementation: In addition to the written report, a summary sheet will be created, and presentations will be made at appropriate local and regional conferences. The observations and conclusions from this study will 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 December 31, 2005

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: To 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.

Progress: Draft Final Report under review, Final Report delivery expected December, 2009

Reports: None

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.

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: To develop a comprehensive flood-estimation method for unregulated, rural streams in Iowa. Specifically, to:

- 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-520

Agency:
Iowa State University

Principal Investigator:
James K. Cable

Research Period:
August 1, 2004 to July 31, 2008

Research Board Funding:
$146,708

Funding Source:
100% State - 95% Secondary funds and 5% Street funds

Evaluation of Dowel Bar Retrofits for Local Road Pavements

Objective:

- Evaluate the feasibility of using elliptical or round dowels to retrofit an eight-inch depth local road pavement as part of a retrofit/grind rehabilitation project
- Evaluate the impact of applying two, three or four dowels in the outer wheel path only on pavement performance
- Evaluate the impact of utilizing FRP or steel dowels in the retrofit of the test pavement, on long-term performance
- Determinate the relative cost of elliptical shaped dowels (FRP and steel) for the retrofit project

Reports: Final Report, February 2008

Implementation: The report provides guidance on the:

- Relative number of dowels per joint required to achieve a given level of performance
- Relative costs vs. performance of the various dowel material types
- Potential benefits of dowel bar retrofits versus overlay alternatives for this type of pavement rehabilitation

The results of this research are expected to provide guidance to local government officials in the use of dowel bar retrofits as a method of rehabilitation. This will provide local governments with an alternative to extensive overlays or reconstruction of such pavements.

Proper Slot Length
Photo: Dr. James Cable, Associate Professor Emeritus Iowa State University

TR-525

Agency:
Iowa State University

Principal Investigator:
Vernon R. Schaefer

Research Period:
November 1, 2004 to August 31, 2007

Research Board Funding:
$153,212

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

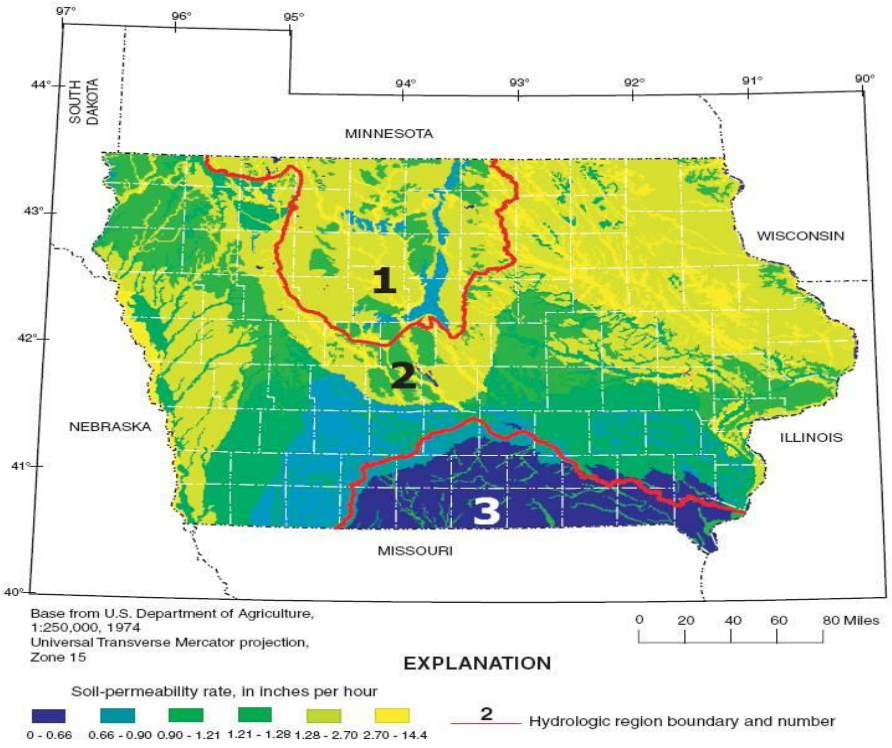
Design Guide for Improved Quality of Roadway Subgrades and Subbases

Objective: To analyze, synthesize, and present in a practical design guide, the findings of recent research relating to subbase and subgrade from Iowa and other states. The design guide will be incorporated into the Iowa DOT and SUDAS manuals.

Construction practices for subgrades and subbases will be reviewed and analyzed so as to identify typical problems that can occur due to poor construction practices. An assessment of stabilization and treatment techniques in relation to construction of subgrades and subbases will be conducted with the goal of selecting reliable geotechnical and foundation treatments. The purpose and expected outcome of best practices for different subgrade and subbase types and treatments will be outlined.

Reports: Final Report, September 2008

Implementation: The conclusions and design guide from this study will provide recommendations on roadway subgrade and subbase design. The design guide and integrated best practices will be incorporated as a chapter in the Statewide Urban Design Manual and the specification recommendations will be included in the Statewide Urban Specifications Manual.



Shaded soil-permeability rates and hydrologic regions in Iowa
Image: Iowa State University/InTrans

TR-529

Agency:
Iowa State University

Principal Investigator:
Brent Phares

Research Period:
February 1, 2005 to October 31, 2008

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 the state-of-the-art in 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 the design and construction of bridges using advanced materials
- Develop recommended design procedures for the shear design of ultra-high performance concrete beams

Reports: Final Report, October 2008

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 potentially may 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-530

Agency:
Iowa State University

Principal Investigator:
Brent Phares

Research Period:
March 1, 2005 to April 30, 2008

Research Board Funding:
$169,433

Funding Source:
100 % State -
48 % Primary funds,
48 % Secondary funds and
4 % Street funds

Development of an Improved Integral Bridge Abutment-to-Approach Slab Connection

Objective:

- Develop an effective approach slab-to-integral abutment connection detail for use on Iowa bridges
- Install a structural monitoring system to document and assess the performance of the connection detail and its effects on overall bridge performance

Reports: Final Report (combined with TR-539), June 2008

Implementation: The successful development of an integral abutment-to-approach slab connection will be useful to all jurisdictions within Iowa. This improved connection detail will be incorporated into the Iowa DOT standard bridge plans and utilized for state, city and county bridge projects statewide.

Installation of an improved bridge-to-pavement connection detail
Photo: Dr. Brent Phares, Iowa State University/CCEE

TR-533

Agency:
The University of Iowa

Principal Investigator:
Allen Bradley

Research Period:
March 1, 2005 to May 31, 2008

Research Board Funding:
$99,544

Funding Source:
100 % State -
51 % Primary funds,
45 % Secondary funds and
4 % Street funds

Evaluation of Design Flood Frequency Methods for Iowa Streams

Objective: The objective of this project is to assess the predictive accuracy of two standard design flood methods, the Rational Method and the National Resource Conservation Service/NRCS (or SCS) method, for flood frequency estimation on Iowa streams. The evaluation will be based on comparisons of flood frequency estimates at sites with sufficiently long stream gage records.

Reports: Final Report, June 2009

Implementation: The results of this project will be most relevant to city and county engineers, who are frequently engaged in design and planning of stormwater management facilities for changing land use conditions. Research findings will be presented to the Iowa Stormwater Comprehensive Workgroup, which plays an advisory role in SUDAS. The evaluation may result in specific recommendations for changes in the current SUDAS procedures.

A stream in southern Iowa overflows its banks closing a road, August 2007
Photo: The University of Iowa

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

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

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

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

  The software is operationally robust and works well.

Reports: None

Implementation: Once Finalized, the *Iowa Stormwater Runoff Control Interactive Manual* (ISRCIM) will be transferred onto one of the Iowa DOT existing Web servers. Strong outreach, testing and upgrading activities are envisioned during the dissemination of the ISRCIM to a wide category of users; the training programs incorporated in Part 3 of research project TR-508, "Design Guide and Construction Specifications for NPDES Site Runoff Control" presents a major portion of this implementation.

Additionally, training sessions on ISRCIM use 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-539

Agency:
Iowa State University

Principal Investigator:
Brent Phares

Research Period:
July 1, 2005 to April 30, 2008

Research Board Funding:
$149,126

Funding Source:
100 % State -
49 % Primary funds,
49 % Secondary funds and
2 % Street funds

Instrumentation and Monitoring of Precast, Post-tensioned Bridge Approach Pavement

Objective: A structural health monitoring system was installed to document and evaluate the performance of a precast, post-tensioned approach pavement and its effects on overall bridge performance. The research team installed a monitoring system to collect overall bridge movement and bridge component strain.

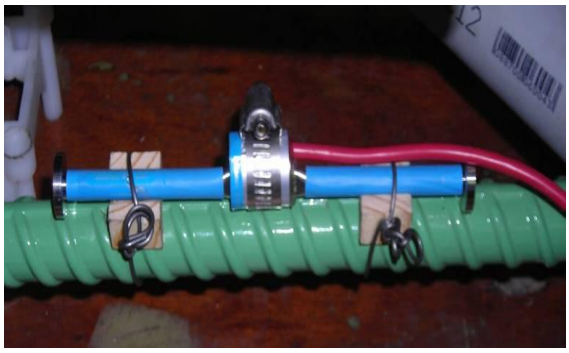
Performance evaluation was formulated through comparisons with recognized codes and standards including the AASHTO specifications.

Demonstrating the benefits of a precast, post-tensioned approach pavement through this pilot project may provide an opportunity for the Iowa DOT to successfully pursue CPTP funding for accelerated construction of other precast concrete pavement projects under the FHWA Highways for Life program.

Reports: Final Report, June 2008

Implementation: The successful development of a precast, post-tensioned bridge approach pavement system will be a useful extension to the proposed integral abutment-approach slab connection that is currently being studied by the research team under IHRB project TR-530. An improved approach pavement system may be incorporated into the Iowa DOT standard bridge plans and utilized for bridge projects throughout the state.

These results will be distributed to the engineering community through the publication of technical papers in the engineering press and presentations at bridge and transportation conferences, and through posting of pertinent information on the Web site of Iowa DOT's Office of Bridges and Structures and Iowa State University's Bridge Engineering Center Web site.



Installed embedded strain gauge
Photo: Iowa State University

TR-541

Agency:
The University of Iowa

Principal Investigator:
Thanos Papanicolaou

Research Period:
Sept 1, 2005 to September 30, 2008

Research Board Funding:
$63,749

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

The Effects of Headcut and Knickpoint Propagation on Bridges in Iowa

Objective: Research suggests that where headcuts and knickpoints form and migrate, more than 60% of bed erosion occurs in susceptible streams. The objectives of this research are:

- Understand the processes causing formation and migration of headcuts and knickpoints in the field
- Develop a sound but practical model that predicts the formation and migration of headcuts and knickpoints, and associated scour

Reports: Final Report, January 2009

Implementation: Knowledge of the initiation of knickpoint formation will allow the design and construction of grade-stabilization structures at an early stage before sizeable knickpoints have developed.

The specific products of the project will be 1) A practical manual what will aid engineers in monitoring knickpoints, and 2) The development of a model that will predict migration rate and scour depth of knickpoints.

Students conduct bi-annual surveys of channel morphology at knickpoint study site, Mug Creek
Photo: Dr. Thanos Papanicolaou, The University of Iowa/IIHR

TR-545

Agency:
The University of Iowa

Principal Investigator:
Marian Muste
Peter Haug

Research Period:
March 15, 2005 to December 31, 2008

Research Board Funding:
$144,785

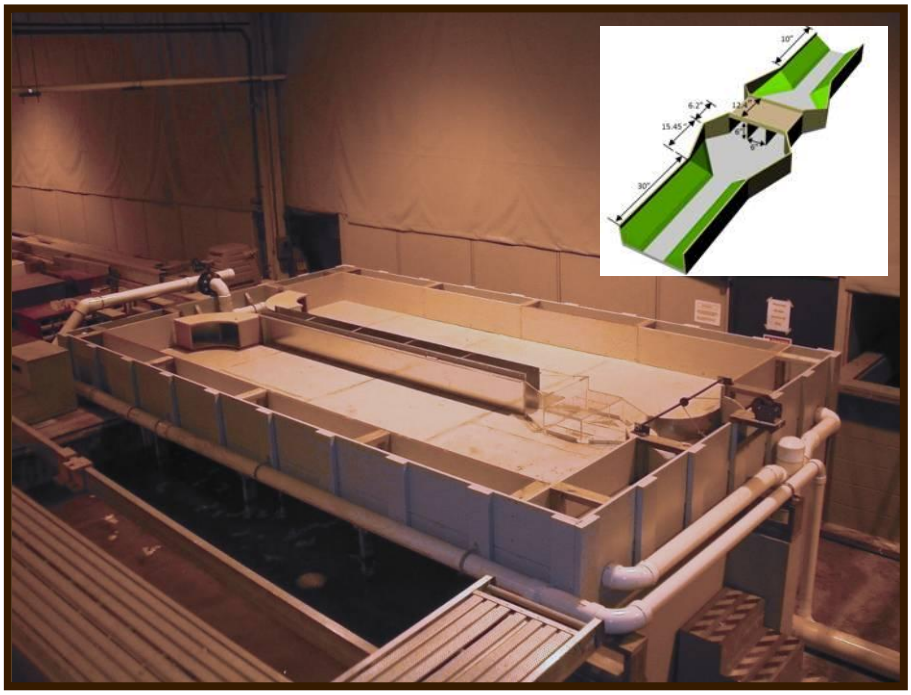
Funding Source:
80 % State -
40 % Primary funds,
50 % Secondary funds and
10 % Street funds

Development of Self-Cleaning Box Culvert Designs

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

Reports: Final Report, June 2009

Implementation: The methods identified will be limited to those that can be contained within the right-of-way of the roadway under which the culvert passes. It is anticipated that the results of the project will be applicable to culverts in general.



Laboratory hydraulic model and (insert) schematic of channel 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: To 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, MOVITE traffic engineering conference, ASCE transportation conference, 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: To 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

Progress: The Draft Final Report is being prepared at this time. The Draft will be reviewed by the TAC and then a presentation scheduled with the Iowa Highway Research Board.

Reports: None

Implementation: The research team will work with the Iowa Association of Counties and its affiliated groups, LTAP, Iowa State Extension (ISE), Iowa Chapter of the American Planning Association and other associations and agencies who serve to disseminate the research and knowledge of how to use the impact tool. The research team will work 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 located in prime farmland
Photo: Susan Deblieck, Iowa State University

TR-550
Phase II

Agency:
Iowa State University

Principal Investigator:
Halil Ceylan

Research Period:
December 1, 2005 to August 31, 2007

Research Board Funding:
$46,212

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

Performance Evaluation of Rubblized Pavements in Iowa

Objective: Based on IHRB TR-473, the primary objective of this study is to evaluate the structural condition of existing rubblized concrete pavements across Iowa through Falling Weight Deflectometer (FWD) tests, Dynamic Cone Penetrometer (DCP) tests, visual pavement distress surveys, etc. Through back-calculation of FWD deflection data, the rubblized layer modulus values will be determined for various projects and compared with each other for correlating with long term pavement performance.

The results will be useful in establishing design modulus and for providing AASHTO layer coefficient recommendations for rubblized PCC layers.

Reports: Final Report, April 2008

Implementation: The results of this study show that rubblization is a valid option to use in Iowa in the rehabilitation of PCC provided the foundation is strong enough to support construction operations during the rubblization process. The M-E structural design methodology developed during Phase I can estimate the HMA overlay thickness reasonably well to achieve long-lasting performance of HMA pavements. The rehabilitation strategy is recommended for continued use in Iowa under those conditions conducive for rubblization.

Layer condition underneath HMA after coring:

PCC layer without rubblization on IA-139 in Winneshiek County, Iowa

Rubblized PCC layer on IA-3 in Delaware County, Iowa

Photos: Dr. Halil Ceylan, Iowa State University/CCEE

TR-551

Agency:
Iowa State University

Principal Investigator:
Neal Hawkins

Research Period:
January 1, 2006 to June 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: To 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 development of marking needs and priorities each spring. This research will also:

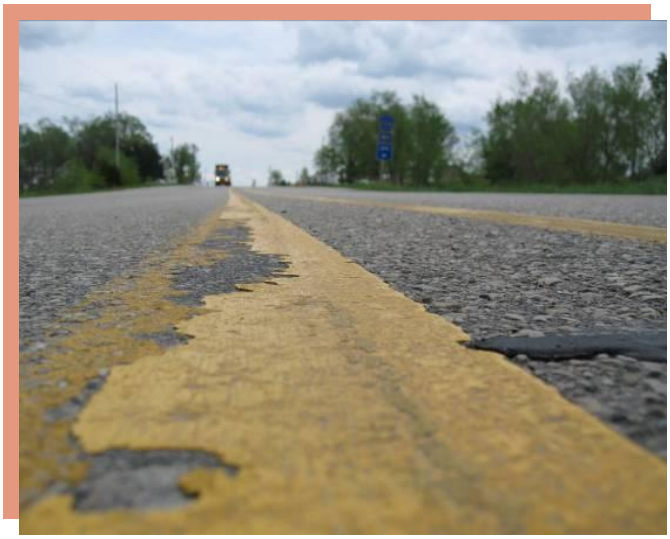
- Develop a county and city pavement marking application matrix which will provide guidance on the selection of marking materials based on roadway type, pavement service life, user needs, and other factors specific to local agency conditions

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

Progress: Work continues on case study data collection for counties and cities; monitor test decks in West Des Moines and Dallas County.

Reports: None

Implementation: 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. These guidelines could eventually be incorporated into a pavement marking design section within the Iowa Statewide Urban Designs and Specifications (SUDAS) manual.



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

TR-553

Agency:
The University of Iowa

Principal Investigator:
Hosin "David" Lee

Research Period:
April 1, 2006 to March 31, 2008

Research Board Funding:
$100,000

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

Examination for Curing Criteria for Cold In-Place Recycling

Objective: To advance Iowa's development of asphalt recycling technology using technically sound and more effective ways to identify minimum in-place CIR properties necessary to permit placement of the HMA overlay or chip seal.

Reports: Final Report, February 2008

Implementation: Research efforts focused on procedures that will minimize the CIR exposure time while retaining the potential for the owner agency's investment to succeed; this includes minimizing the risk of CIR layer and HMA damages.

One of the procedures researched was a maturity curve for CIR layer under various curing conditions. The research developed a better analysis tool that the industry and owner agencies can apply to monitor the CIR layer in preparation for a timely placement of the wearing surface.

Simple Performance Testing Equipment at The University of Iowa
Photo: Dr. Hosin "David" Lee, The University of Iowa/IIHR

TR-555

Agency:
Iowa State University

Principal Investigator:
Chris Williams

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

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: This project evaluates the moisture susceptibility of the individual components of HMA through an experimental plan which will isolate different variables. Dynamic Modulus and Flow Number testing will be used to evaluate the moisture susceptibility of the HMA. Research objectives include:

- Comparison of test results for materials tested in a moisture-saturated environment and a dry environment - the research plan will integrate a range of Iowa DOT asphalt mixtures.

- Using results obtained from Dynamic Modulus and Flow Number Tests, develop a new test protocol for determining moisture susceptibility.

Progress: A Draft Report was submitted and review comments received. The review comments are being addressed. A revised Final Report should be delivered in the autumn of 2009 for approval.

Reports: None

Implementation: Several products will be developed from this project. The research team will deliver concise recommendations on acceptable test protocol conditions and limitations along with appropriate user variability in the Draft and Final reports. The Final Report will include an executive summary. The research team will also provide quarterly progress reports to the Technical Advisory Committee (TAC). The research team will also evaluate different anti-stripping agents.

The implementation plan will include recommendations for integrating moisture testing. This research will also evaluate different anti-stripping agents and their success in mitigating moisture damage; technology developments will be dispersed through electronic, web-based and paper formats.

TR-556

Agency:
Iowa State University

Principal Investigator:
Matt Rouse

Research Period:
May 1, 20065 to December 31, 2007

Research Board Funding:
$89,623

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

Feasibility Investigation of Segmentally Precast Bridge Piers for Accelerated Construction

Objective: To simulate, evaluate and test several component materials, connection details, and component configurations to identify the most cost-effective and structurally advantageous means of constructing a radically different design approach of segmentally precast bridge piers for accelerated construction. The basic proposed pier assembly features steel belts at the ends of segments, external reinforcement of segment joints which have bolted connections, and bearing pads between segments to avoid labor-intensive grouting procedures.

This steel belt assembly serves three purposes:

- Reinforcement of fragile concrete corners
- Confinement of the concrete at the ends of the segments to provide additional concrete strength and ductility
- Convenient and aesthetically pleasing means for the connection of the exterior reinforcement plates

Progress: Experiments and simulations are complete. A Final Report is being prepared.

Reports: Final Report, July 2008

Implementation: Results of the research will include cost-benefit analyses of varying materials and component configurations, calibrated analytical models for future designs, and recommendations for full-scale field prototype demonstrations.

Segmented column joint and foundation prior to testing
Photo: Dr. Matt Rouse, Iowa State University/CCEE

TR-558

Agency:
Iowa State University

Principal Investigator:
Muhannad Suleiman

Research Period:
July 1, 2006 to November 30, 2007

Research Board Funding:
$80,266

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

Use of Ultra-High Performance Concrete in Geotechnical and Substructure Applications

Objective: One quarter of our nation's 590,000 bridges, including their substructures, are currently classified as structurally deficient or functionally obsolete, primarily due to material deterioration. This is driving the engineering community to design durable bridges and infrastructures that can last for a minimum of 75 years with minimal maintenance.

To achieve longer life of bridges, new and innovative materials must be used. Ultra-High Performance Concrete (UHPC) provides a unique combination of durability, strength, ductility and aesthetic flexibility, which not only improves longevity of bridges but can produce long-term cost-effective solutions. Iowa is one of the pioneering states in the use of UHPC in bridge superstructure applications.

The unique engineering properties of UHPC show great potential for producing durable foundation elements, which in turn lead to longer lasting substructures and soil stabilization remedies in different conditions. This research aims to investigate and evaluate the use of UHPC for geotechnical applications related to transportation structures.

Reports: Final Report, December 2008

Implementation: Conclusions from this study provide recommendations on the use of UHPC in geotechnical applications related to transportation facilities for Iowa engineers. Using precast, prestressed pile foundations made of UHPC may help achieve the targeted service life, avoid drivability problems, and ensure durability in future bridges.

TR-559

Agency:
The University of Iowa

Principal Investigator:
George Constantinescu

Research Period:
August 28, 2006 to September 28, 2007

Research Board Funding:
$45,253

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

Improved Method for Determining Wind Loads on Highway Sign and Traffic-Signal Structures

Objective:

- Obtain information on airflow around highway sign and traffic signal structures and then estimate the unsteady forces and moments acting on them using state-of-the-art Computational Fluid Dynamics (CFD) tools [including Large Eddy Simulation (LES)].

- Perform structural analysis of the highway sign and traffic structures subjected to these loads, and study new design ideas for panels that will include a certain number of holes to reduce the pressure forces acting on them under strong wind conditions.

Additionally, there is a need to determine how best to minimize wind loads on structure supporting signs and lights. Several options are available for doing this, including:

- Development of improved shape and dimensions of signs and their support structures

- Development of air-flow panels (panels with holes disposed on a certain pattern) to reduce wind loadings (especially drag form) and addition of flow-modifying fixtures

Reports: Final Report, January 2008

Implementation: The report will present the methodology (e.g., description of CFD and structural analysis codes, parameters, boundary conditions, assumptions, etc.), definition of test cases and presentation of simulation results, comparison among the numerical methods, design recommendations and relevance to other problems of interest to DOT in a clear manner that is easy to understand for engineers.

Main benefits from this research include a better understanding of the effects of wind on highway sign and traffic signal structures, including a dynamic analysis of aeroelastic effects and the degree to which the presence of holes disposed in a certain pattern over the main plate of these structures can reduce wind loads.

TR-560

Agency:
Iowa State University

Principal Investigator:
Tom Maze

Research Period:
July 1, 2006 to December 31, 2008

Research Board Funding:
$54,814

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

Clear Zone – Synthesis of Practice and Benefits of Meeting the Ten-Foot Clear Zone Goal on Urban Streets

Objective: To determine the status for practice of clear zone design guidance (standards) and the experiences other jurisdictions have had with applied clear zone guidance; to identify experience in other jurisdictions with clear zone guidance with respect to application of traffic calming designs and/or context sensitive solutions, and to observe the benefits or drawbacks in Iowa that have resulted from providing ten feet of clear zone or from providing less than the ten foot goal.

Reports: Final Report, December 2008

Implementation: The project will produce a Final Report and technology transfer brief. The investigators anticipate making presentations at the Iowa American Society of Civil Engineers (ASCE) transportation engineering conference, the Iowa American Public Works Association (APWA) Chapter conference, and the Missouri Valley Section of the Institute of Transportation Engineers (MOVITE) chapter of Institute of Transportation Engineers (ITE) biannual conference.

The main benefit of this project is enhanced understanding of the benefits in meeting the ten foot clear zone goal and the costs of providing something less than ten feet. The result should also help the Iowa DOT clarify their policy on clear zone width so that there is less uncertainty in the process.

Utility poles along a Des Moines, Iowa, street are within a few feet of the roadway. *Photo: Iowa State University/InTrans*

TR-561

Agency:
Iowa State University

Principal Investigator:
Terry Wipf

Research Period:
May 1, 2006 to November 30, 2008

Research Board Funding:
$341,089

Funding Source:
100 % State -
25 % Primary funds,
65 % Secondary funds and
10 % Street funds

Laboratory and Field Testing and Evaluation of Precast Bridge Elements

Objective: To test and evaluate precast components for three separate bridge projects in order to assess overall design, construction, and bridge structural performance, and to design and install monitoring systems; perform laboratory structural tests on bridge specimens that represent structural details for use on the three projects.

Reports: Final Report, March 2009

Implementation: Demonstrating benefits of precast, post-tensioned bridge components through this project may provide an opportunity for the Iowa DOT and Iowa County Engineers to design and construct more cost-effective and durable bridges. The benefits derived from developing accelerated construction concepts may also be significant.

Concrete being placed in the first series of abutment specimen

Boone County bridge substructure (West abutment) being placed
Photos: Dr. Terry Wipf, Iowa State University/BEC

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 goal is to determine how the reinforcing jacket affects the tower's response to wind induced vibrations and to also 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. The instrumentation is providing information as intended from the original tower shell, the bolted reinforcing jacket and the anchor rods. It has been decided to continue to collect additional data in order to better understand the tower's long-term response to wind.

Reports: A Draft Final Report is complete. The Final Report is expected in late 2009.

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 July 2009

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: To determine the pavement response under various types of agricultural equipment (including the impacts of different tires and additional axles) and to compare this response to that under a typical 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. Two testing seasons remain: autumn, 2009 and spring, 2010.

Reports: None

Implementation: This research will allow policy and design decision-making to be driven by direct experimental results rather than by models that may not have been calibrated for the types of loadings and tire configurations of current and evolving agricultural equipment.

Agricultural equipment traveling on a rural roadway
Photo: Iowa DOT

TR-564

Agency:
Digital Control, Inc.

Principal Investigator:
LaDon Jones

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

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: To 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 2 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 flowrate copying
- Updated User Manual
- Online Help

Progress: The calculation sections are being completed and the scour information in the user manual is being updated. Estimation of scour at bridges is approximately 95% complete.

Reports: None

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 engineer's office in Iowa.

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 in progress

Reports: None

Implementation: The 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

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

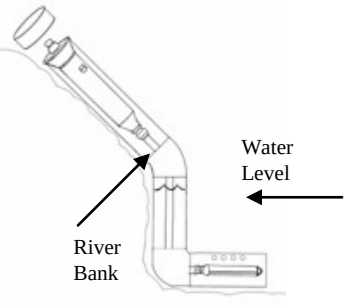
Objective: To establish stage-discharge relationships for ten ungaged streams in western Iowa through implementation of a semi-automatic sensor network. This project seeks to describe and document knickpoint propagation and identify and prioritize at-risk sites, thereby avoiding potential safety and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

Progress: Water levels, velocity and stream discharge measurements are ongoing.

Reports: None

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 potential safety and asset risks due to knickpoint propagation and channel vertical shift. Main findings would presented at conferences and information made available to those interested agencies.



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

TR-568

Agency:
Iowa State University

Principal Investigator:
David J. White

Research Period:
January 1, 2007 to December 31, 2009

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: To 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, to evaluate and understand the cost and construction effort associated with building the sheet pile bridge abutment demonstration project and materials that 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 - Bridge design is complete, flatcars for the superstructure are on site, and demolition of the existing bridge is expected to begin within two weeks. The structural monitoring system for the Tama project has been acquired.

[Soil borings and CPT's have been obtained for all sites and subsequent laboratory analysis has been completed.]

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 will provide recommendations for use of sheet pile abutments in LVRs and in-situ soil testing. County engineers (responsible for 80% of Iowa's LVRs) can implement recommendations for use of an alternative abutment system.

TR-569

Agency:
The University of Iowa

Principal Investigator:
Marian Muste

Research Period:
January 15, 2007 to August 15, 2008

Research Board Funding:
$85,891

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

Quantitative Mapping of Waterways Characteristics at Bridge Sites

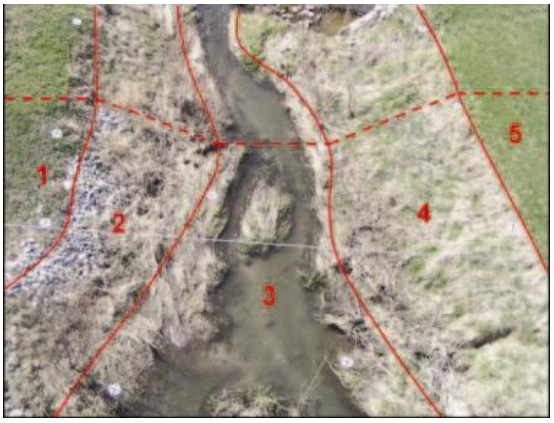
Objective: To dramatically improve current capabilities for quantifying and monitoring bridge scour. Eventually this methodology can be refined to include long term development of bridge monitoring platforms to be comprised of multiple non-intrusive instruments (image, acoustic- and laser-based principles proven through this research), allowing cost effective, informative, comprehensive measurements with improved accuracy and information detail at minimal effort and expense; especially well suited for monitoring small bridges typical in Iowa and surrounding states.

Reports: Final Report, December 2008

Implementation: A software package that calculates quantitative mapping of bridge waterways will be developed and be a modular structure so equipment interchange and addition of hardware can be easily accommodated. The code developed will be an open source to all interested parties. Companion user manuals will be provided instructing users on methodology background and implementation.

The details of the Mobile Large-Scale Particle Image Velocimetry (MLSPIV) truck-based prototype will be available for users willing to construct such observational platforms with demonstrations for various interested user groups to illustrate the prototype's developed capabilities. The Final Report was delivered in both electronic and hard copy formats.

MLSPIV unit with mast deployed and ancillary equipment



River reach plan decomposition; numbers indicate the quasi-planar surfaces: One and five are floodplains; two and four are sloping banks; three is the river water surface.

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

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: To 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 in progress

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-571

Agency:
Iowa Department of Natural Resources - Geological Survey

Principal Investigator:
Robert D. Libra

Research Period:
May 1, 2007 to April 30, 2008

Research Board Funding:
$86,357

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

GIS - Based Decision and Outreach Tools for Aggregate Source Management

Objective: To create useful statewide mapping tools for Iowa DOT and local entities with a focus on initial investigations, including locations and descriptions of aggregate resource and factors with implications for extraction; consultation with county planning and zoning officials (Iowa State Association of Counties - County Zoning Affiliate), Iowa DOT Office of Materials and the Iowa Limestone Producers Association (ILPA) will assure development of tools that best address aggregate resources and the barriers to aggregate access.

Reports: Final Report, September 2008

Implementation: The Final product will be delivered in two mediums for two specific audiences: shapefiles created of historical and current quarry operations for the State, with data linked as specified by Iowa DOT for staff use and the Internet Map Service (IMS) created for use by Iowa DOT, planning groups and the public.

This data will be used in planning aggregate source access prior to planning and development of residential/business subdivisions. Internet Map Service with GIS layers relevant to aggregate access planning and education with National standard GIS metadata will accompany all layers/coverages.

Development occurring around Crawford and Morgan Creek quarries in Linn County, outside the western city limits of Cedar Rapids, Iowa
Photo: Iowa Department of Natural Resources, Geological Survey

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: To 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, May 2009

Implementation: This research seeks to improve safety for both motorists and operators of slow moving vehicles on Iowa's roadways. This 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 December 31, 2009

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: To 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.

Progress:

- Reformatting of the database providing a user-friendly interface and improved relational model uploading of all steel H, wood, concrete, and steel monotube/pipe pile data and addition of data from ongoing field tests in project TR-583
- Continuation of literature review of current LRFD practice, static analysis methods, construction control aspects, and other relevant topics
- Calibration of resistance factors for all data available in PILOT for steel H-piles in three different soil types using static analysis methods and comparing the values with those recommended by AASHTO and other DOTs
- Completion of static analysis for all piles tested in project TR-583 and evaluation of the test and predicted capacity differences using an advanced analysis methods for three different piles

Reports: None

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 Prestressed Concrete Bridge Using Ultra High-Performance Concrete Pi Girders

Objective: To 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: The bridge was constructed in the autumn of 2008. A second load test was conducted on the bridge. Unlike the first test, dynamic data were collected that will allow investigation of these behaviors.

Reports: None

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: The objectives of this project are to 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, in particular 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 completed in June 2008
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 – December 31, 2009

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.

Progress: A Draft Final Report is under review. It is anticipated the report will be presented for approval in December, 2009.

Reports: None

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 Interlaken Performance Testing Equipment
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: The main goal is to 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 reviewed additional sites in Iowa which may be potential test or control sites. A list of potential sites was available from the initial study to where sites were determined for speed feedback signs. An additional 21 sites were identified and site visits were made. Site visits consisted of taking pictures and collected speeds for 20 - 30 vehicles using a radar gun.

Sites where the mean or average speed was not more than 5 mph over the posted or advisory speed were removed from further analysis. A total of 20 sites were determined to be suitable for either a test or control site. Several treatments were selected based on consultation with a FHWA pooled fund study on low cost curve treatments. The team is currently working on preparing documents to receive approval from MUTCD for several of the treatments.

Reports: None

Implementation: Iowa counties in particular will benefit from this research 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.

TR-580

Agency:
Iowa State University

Principal Investigator:
Omar Smadi

Research Period:
January 1, 2008 – December 31, 2009

Research Board Funding:
$96,113

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

Pavement Markings and Safety

Objective: Using Iowa DOT data under nighttime conditions, this research effort is focused on achieving the following objectives:

- 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

Progress: All data collection and analysis are completed. A Final Report is being written. A set of conclusions addressing impacts of pavement marking retroreflectivity on safety is being prepared.

A presentation was prepared for DOT staff to be presented at the annual state DOT research meeting during the Midwest Transportation Symposium.

Reports: None

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

Progress: Lab tests are completed. A report is being written.

Reports: None

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 – February 28, 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: The objective of this research is to investigate the utilization of processed corn stover or corn grain fermentation by-product in pavement base/subbase soil stabilization. Specifically, it will:

- Demonstrate 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.

- Evaluate the effect of lignin on the engineering properties of soil-lignin mixtures for Iowa conditions. It is anticipated that the successful completion of the proposed research will lead to extended and rigorous evaluation of this concept both in the lab and in terms of field performance.

Progress: Research efforts have focused on the analysis of secondary experimental test results. The research team also carried out experimental test program to compare the moisture susceptibility property of bio-fuels co-products treated soils with untreated and traditional stabilizer (fly ash) treated soil samples. Combined additive combinations (bio-oil and fly ash, bio-oil and E310) on soil stabilization were also evaluated. The laboratory tests for moisture susceptibility evaluation consisted of two types of tests; the unconfined compression strength (UCS) tests after "dry" and "wet" conditioning procedure and the visual observations of soaked specimens (so-called soaking tests).

Reports: None

Implementation: The usefulness of industrial lignins has been demonstrated by the profitability of the lignin chemicals business 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. Recently 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, the results of this research could result in substantial economic savings for Iowa.

TR-583

Agency:
Iowa State University

Principal Investigator:
Sri Sritharan

Research Period:
January 1, 2008 – December 31, 2009

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:

- Completion of static and dynamic pile tests in Mills, Mahaska Polk, Jasper, Clark, Buchanan 1 and Buchanan 2, and Poweshiek counties, conducting in-situ and laboratory soil tests (CPT, SPT, Borehole Shear Test, sieve analysis, Atterburg Limits, and soil classification) for all test sites
- Conducting PDA and CAPWAP analyses for records collected from Mills, Mahaska and Clark counties
- Conducting GRLWEAP analysis on usable data from electronic database PILOT-IA established in TR-573 and determining resistance factors using four different soil input options
- Examining the use of WEAP for construction control purposes using a probability based approach
- Investigating the influence of setup on pile capacity using recently collected test data in Clay and Drafting of a conference paper based on this outcome

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 office of Construction at the Iowa DOT, the course will be delivered over a period of one to three days and will 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 – December 31, 2009

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:

- Completion of an on-line survey of Iowa counties in the following topic areas: foundation practice, usage of timber piles, pile analysis and design, as well as drivability and construction control
- Completion of analysis of usable steel H-pile and timber pile data from the database using eight different dynamic pile driving formulas
- Examination of dynamic formulas in construction control using a probability based approach
- Analyzed the capacity prediction capabilities of various dynamic pile driving formulas with regard to the type of hammer utilized for driving the pile
- Analyzed the relationship between the predicted pile capacity of various dynamic pile driving formulas and capacity dependent parameters such as pile length and blow count

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 will 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 be largely 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-585

Agency:
United States Geological Survey

Principal Investigator:
Jim Giglierano

Research Period:
April 15, 2008–September 30, 2009

Research Board Funding:
$100,000

Funding Source:
100 % State -
70 % Primary funds,
30 % Secondary funds

National Agriculture Image Program Participation

Objective: To participate in funding the acquisition of high resolution quality aerial imagery on an annual basis and make it publically available free of charge. Duplication of aerial imagery acquisition will be eliminated by providing a product that meets the needs of state, county and local officials in a majority of cases. It is imperative ways are found to combine limited resources that best meet the needs of those utilizing this imagery frequently.

Reports: Final Report, December 2008

Implementation: The USDA Farm Service Agency (FSA) uses this imagery to keep farm records current, verify crop reporting and commodity compliance. Many departments of city, county, and state government use the imagery for integral government business such as property appraisal, law enforcement, emergency management, road and bridge maintenance, water resource management, etc. An annual imagery program also allows change detection of photo-identifiable features.

Iowa state government uses this imagery in multiple ways. In many cases availability of quality, yearly imagery has become a substitute for field visits, saving staff time and mileage. Aerial imagery also enhances field visits, making staff more efficient by locating features more quickly or identifying potential problems before they become acute.

2008 NAIP imagery of an intersection on US 18 and I-35 in Cerro Gordo County *Photo: United States Geological Survey*

TR-586

Agency:
The University of Iowa

Principal Investigator:
Hosin "David" Lee

Research Period:
April 1, 2008 – September 30, 2009

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

Progress: Draft Final Report is under review

Reports: None

Implementation: Institutions and individuals who will take leadership in applying the new SUDAS pavement design procedure and software will be identified. These leaders will probably be engineers from the SUDAS board of directors, six SUDAS districts and 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 proper 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.

TR-587

Agency:
Iowa State University

Principal Investigator:
Kejin Wang

Research Period:
March 1, 2008 – February 28, 2009

Research Board Funding:
$40,000

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

Impact of Low Shrinkage Mixes on Late-Age Random Cracking in Pavements with Use of Early Entry Sawing

Objective: The objective of this project is to investigate whether or not there is an increased risk of delayed random cracking in early-entry sawed pavements. Since cracking is related to the stress development in concrete, the specific objective of this study is to examine the levels of stresses developed at early entry sawed joints of pavements in comparison to conventional depth joints.

Reports: Final Report, April 2009

Implementation: The results of the study can be used by the Iowa DOT and the paving industry to identify potential late-age random cracking problems in the pavement constructed with early-entry sawing operations. The results may also provide insights into any modifications of the current early entry operations, such as sawing depth and joint spacing.

Strain gages installed at joints just before paving monitor stress resulting from concrete shrinkage (US 34 Fairfield bypass)
Photo: Dr. Kejin Wang, Iowa State University/CCEE

TR-588

Agency:
Stanley Consultants

Principal Investigator:
Larry Badtram

Research Period:
March 1, 2008 – June 30, 2008

Research Board Funding:
$113,239

Funding Source:
100 % State -
100 % Secondary funds

Update of the Continuous Concrete Bridge Standards (J Standards)

Objective: The Iowa Highway Research Board (IHRB) has recently released updated Three Span, Continuous Concrete Slab Bridge Standards (J Standards). The standards were updated to bring the superstructure design up to current LRFD design standards.

At the time of the update, the AASHTO LRFD substructure design standards were not ready for use. Recent changes in Iowa DOT design standards for abutment wings, barrier rail end sections and paving notches have also been completed but were not included in the J standard update.

This project will update the J standards to LRFD substructure design, the barrier rail end section, paving notch and wing design sections.

Reports: Standards Complete, December 2008

Implementation: Detail sheets are available to all local jurisdictions in Iowa as well as the Iowa DOT (in Microstation and PDF format) at: **www.dot.state.ia.us/bridge/index.htm**.

Cost savings from using these standards instead of individual consultant designs for each bridge will be available for use in other parts of the roadway network.

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: To 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: Recent focus has been on data acquisition, evaluation, and reformatting. A total of 39 potential data sources were identified. Seventeen datasets were downloaded from the internet or received after contacting the data sources. Two datasets (NCDC and USGS data) were reformatted into the HDSC standard format. After preliminary evaluation, it was decided not to use data from nine sources, either because they had no stations with more than ten years of data or because data was duplicated from another source.

The main focus for the next period will be data reformatting, evaluation, extraction of annual maximum series, and quality control, as well as a review of related literature.

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.

TR-590

Agency:
The University of Iowa

Principal Investigator:
Hosin "David" Lee

Research Period:
April 1, 2008 – March 31, 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 the phase I study, research efforts focused on the laboratory experimentation. However, it is suspected that the moisture conditions measured in the laboratory may not be equivalent to the moisture conditions in the field. The main objectives of this phase II study are to:

- 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 results of the research were presented 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 because it can accurately determine an optimum timing for an overlay to prevent premature failure of the CIR layer and HMA overlay.

TR-591

Agency:
Iowa State University

Principal Investigator:
Charles Jahren

Research Period:
April 1, 2008 – February 28, 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 first set of test sections were completed on US 20 just east of Jesup, Iowa. Stabilizers included Sodium Silicate, Magnesium Chloride and Calcium Chloride.

A second set of test sections was constructed on US 75 north of Sioux Center and US 20 WB lanes near Jessup. Post construction observations for the second test sections are currently being conducted. A Final Report is expected in early 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.

TR-592

Agency:
Iowa State University

Principal Investigator:
Brent Phares

Research Period:
August 1, 2008 – January 31, 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: To provide guidance to county engineers for replacing or upgrading bridge and bridge approach guard railing by:

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

Progress: Most project tasks are completed and the Final Report is being written. However, due to the low number of crashes occurring, few statistically justifiable results can be extracted.

Reports: None

Implementation: The successful completion of this project will provide 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 – January 15, 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: To 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; To 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; To 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 the results of the traffic impact analysis (traffic growth in truck traffic in 5-, 10- and 20-mile radii around the plants) 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: None

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 traveling along Iowa roads.
Photo: Iowa Energy Center

TR-594

Agency:
Iowa State University

Principal Investigator:
Chris Williams

Research Period:
August 15, 2008 – February 28, 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: To optimize a bio-oil product (production and post-production) for use as a bio binder. Varying bio-oils will be produced and pyrolytic lignins derived for modifying asphalt binders. Liter quantities of bio-oil from five different fractions will be obtained and analyzed for their properties such as acidity, char content, and stability.

Progress: The bio-oil production facilities have been dismantled and the Bio-Economy Institute (BEI) & Center for Sustainable Environmental Technologies (CSET) encountered issues associated with purchasing components for the new pilot plant that is under construction. The BEI/CSET had the new pilot plant operational in late March, but is encountering production inconsistency.

Analysis of data collected (with some additional data) was used to develop reaction curves. The research team has exhausted the supply of bio-oil fractions provided by CSET and are waiting for additional bio-oil fractions to complete the experimental plan.

Physio-chemical analysis of the various fractions was done and is showing the various components that are influencing the behavior of the developed binders.

Reports: None

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 foreign crude oil.

TR-595

Agency:
The University of Iowa

Principal Investigator:
Thanos Papanicolaou

Research Period:
August 1, 2008 – December 31, 2009

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

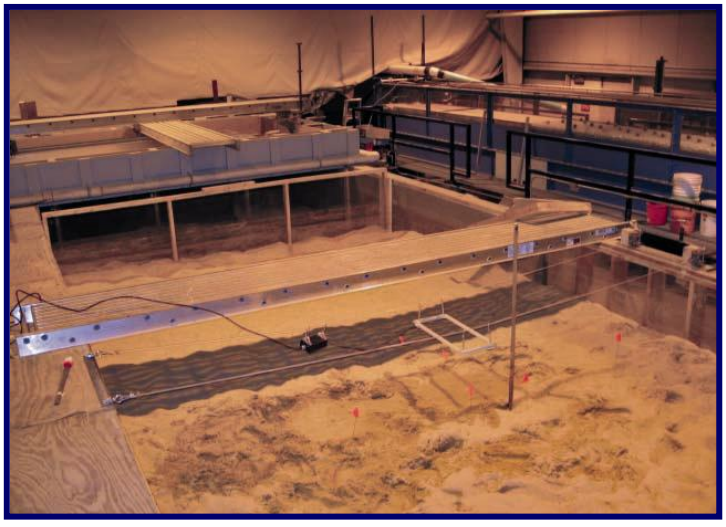
Objective:

- 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 use, maintenance, collection and analysis of the data obtained from the RFID dataloggers and provide the software developed to the Iowa DOT

Progress: Work on this project is essentially complete. A Final Report is being written and will be delivered in December, 2009.

Reports: None

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 isat 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: To initiate a comprehensive study for determination of specific conditions leading to culvert sedimentation in Iowa, engaging field inspection and measurement, physical modeling in a laboratory, and numerical simulations. The sedimentation process will be investigated in terms of: Culvert geometry; Soil characteristics at the culvert site; Hydrologic characteristics; and Sedimentation cumulative effects.

Progress: Supplemental field information, literature review, numerical modeling and experimental work are done. The simulation using HEC RAS were focused on establishing the stage/discharge relationship in the culvert responsible for the creation of the settling pools in the expansion leading to the culvert. Progressive simulations with rectangular, trapezoidal and unsteady flow conditions were tested to identify the factors responsible for sedimentation. Of special interest was capturing the hysteresis in the stage - discharge relationship.

The experiments in the flume modeled the newly synthesized information from literature and field surveys, as well as from numerical simulations. Of particular interest was 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.

Reports: None

Implementation: This research will provide fundamental insights in the sedimentation process at multi-barrel culverts and general understanding of processes that are currently not documented by analytical, experimental or numerical simulation means. Practical recommendations will be shared during workshops with county engineers. Research findings will be presented during the annual meeting of the Iowa County Engineers.

Sedimentation at culvert Buena Vista County
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: To develop a two year line-test deck that allows the evaluation and demonstration of a variety of wet reflective pavement marking materials and treatments under wet night conditions.

Progress: The research team worked with the vendors to install the different pavement marking materials selected for the wet reflective test deck. So far, 12 out of 16 different products have been installed.

Dry and wet retroreflectivity measurements will be collected next quarter and for a period of two years to determine durability and performance for each product.

Reports: None

Implementation: Having the opportunity to document the performance of these various products and treatments will assist the Iowa DOT and local agencies in determining when and where use of these products might be most effective. Performance parameters will include durability, presence, retroreflectivity, 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/CCEE

TR-598

Agency:
Iowa State University

Principal Investigator:
Charles Jahren

Research Period:
December 1, 2008 – February 28, 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: To 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 underway. Input on the specification changes will be provided during the early winter season. The Final Report is expected in spring 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 – August 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: To identify technologies for producing Warm Mix Asphalt (WMA) and recommend up to three with the greatest potential for success using Iowa aggregates. These three technologies will be:

- Developed and tested in the laboratory for performance (permanent deformation, fatigue and moisture susceptibility), aging characteristics, and laboratory compaction effort

- Documented in a Draft set of procedures for field implementation; Field trials constructed and monitored and laboratory performance tested; Performance of field produced mixtures compared to laboratory produced mixtures and standard HMA control mixtures

Progress: The scope of the project is changing from the intended laboratory study to a field study. 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.

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 the obligations of this research including evaluation and integration of WMA technology into Iowa.

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: To reduce quantity overrun concerns with GPS mapping of the project and reduce construction survey time with GPS mapping; To evaluate GPS and 3-D construction equipment control (milling machine, slipform paver and 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 that construction is not impacted.

Progress: An open house focusing on stringless paving was held September 2, 2009. Over 100 people representing five states visited the US 65 project. Grades were finalized on the US 65 project using GPS survey and total stations. All construction is completed or near completion on the Iowa 9 Osceola County, V-18 Poweshiek County and US 65 Worth County, sites. Construction work will be completed on this project in the upcoming quarter.

The Final Report outline and some background and discussion of the construction process used on each project are completed.

Reports: None

Implementation: It is anticipated the findings of the project will provide guidance on the implementation of WMA technology in Iowa. The research team will assist in the implementation of WMA technology 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: This Phase II study addresses the quality of lighting rather than just the presence of light with respect to safety. Iowa State University (ISU) staff have 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, un-signalized intersections. Recommendations to address lighting design and maintenance will be developed.

Progress: Project staff are working and coordinating with VTTI to collect lighting data for close to 145 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. Testing is to take place in November 2009.

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

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

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

This project involves updating specifications for abutment piling to conform to the LRFD Specifications, modifying the abutment wings section, revising the F and Open railing end sections, and making other miscellaneous revisions.

Progress: Completed Standard Plans have been delivered to the Iowa DOT for review. Final plans should be available in autumn, 2009.

Reports: None

Implementation: Using a combination of structural, geotechnical and LRFD specialists, this project will update 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

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

Objective: To 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: The project is currently 90% complete. Final submittals are expected by the end of December, 2009.

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: To 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: Bridge construction was completed this quarter and a field test was immediately performed. The performance of the asphalt wearing surface and how its design may be impacting the overall bridge performance is being examined.

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.

Demonstration timber bridge completed in spring 2009, Delaware County, Iowa, 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 in fully leveraging the FHWA Innovative Bridge Research Construction Program funding made available
- 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: The construction of the bridge is complete and documented using both point-in-time photographs and time-lapse photography. Field load testing of the completed bridge will be conducted early in the 4th quarter of 2009.

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 will be 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

Research Tasks for this Project:

- 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
- Suggest Peer Exchange Format

Progress: The first three modules have been developed. Future modules are being tested and taped at a rate of about three per year.

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.

Dr. Duane Smith teaches a module of the LTAP Leadership Academy in October, 2009, at Iowa State University
Photo: Mina Shin, Iowa State University

TR-607

Agency:
Snyder and Associates

Principal Investigator:
Steve Klocke

Research Period:
March 9, 2009 – March 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: To 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: The first regular review meeting was held in July 2009 to review the patching specifications and associated figures which have been completed and reviewed by the SUDAS District committees. It is anticipated that the SUDAS Board of Directors will approve the patching specifications in March. This would make the revised patching specifications available as a possible supplemental specification.

Work has begun on establishing a landscaping subcommittee to review those specifications and provide recommended changes over the winter 2009 – 2010. Remaining specification sections will be revised for incorporation into the 2011 Edition of SUDAS.

Reports: None

Implementation: The revised specifications and figures developed as a 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: To develop a conceptual model that facilitates accurate forecasting, yet simple enough to be presented and explained in public presentations. In addition:

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

- A data structure and data processing engine will be defined to represent the road, traffic and land use entities relationship to and affect on each other.

Progress:

- Gathered data on roads, bridges, land use and costs and a joint GIS/SQL database built to contain and relate the information

- Developed a correlation between acres of land and miles of roadway

- Developed a model for associating rural land use attributes, (population, acres of crop ground, total grain harvest quantities, number of farmsteads and animal counts), with overall VMT in each county

  This information will be used in agri-business contact sessions to frame questions on how farming is evolving, and as a tool for predicting future traffic levels based upon likely trends in rural land use. All process variables and tables needed to assemble the 'analysis engine' proposed in this project have been identified.

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: 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. Objectives are to:

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

Progress: Contract signed June 2009

Reports: None

Implementation: This study 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.

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 Crisis

Objective: To develop and assess the 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 assisting bridge inspectors in their endeavors.

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

Progress: Contract signed July 2009

Reports: None

Implementation: This research will provide 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 – July 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

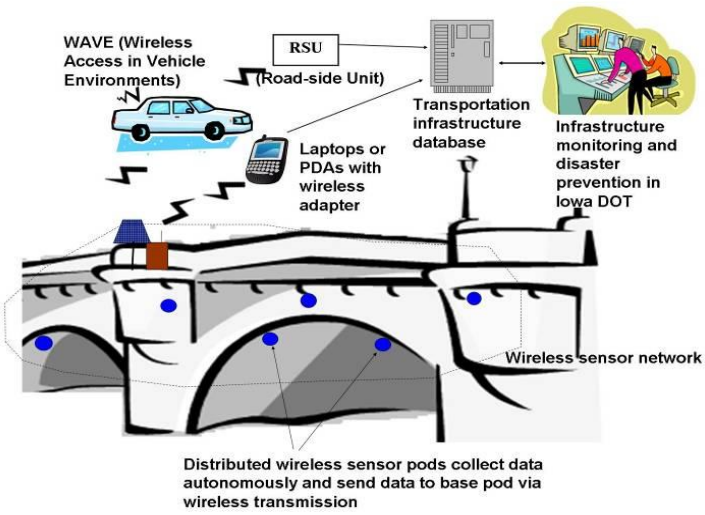
Objective: To evaluate the use of distributed wireless sensor networks instead of PC-based systems for transportation infrastructure monitoring. This research will:

- 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 a 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

Progress: Contract signed July 2009

Reports: None

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: To maintain research liaison with all county engineers and solicit new, innovative and progressive ideas; To actively promote secondary research for solutions to problems and ideas that will improve quality and reduce costs.

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

At present, there are approximately 40 active research projects involving counties, including secondary projects with consultants. The coordinator assists these counties with special testing, evaluation and writing of construction and final reports necessary to the research and keeps county engineers updated on the changes in the IHRB operating procedures.

Reports: None

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