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# ANNUAL REPORT OF HIGHWAY DIVISION HIGHWAY RESEARCH AND DEVELOPMENT IN IOWA

DECEMBER 2005

Attachment 8 to

FY 2005 Annual Report -

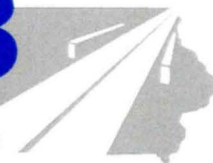
Research, Intelligent Transportation Systems, and  
Technology Transfer Activities



**Iowa Department  
of Transportation**

**IHRB**

**IOWA HIGHWAY  
RESEARCH BOARD**



**ANNUAL REPORT  
OF  
HIGHWAY DIVISION  
HIGHWAY RESEARCH AND DEVELOPMENT  
IN IOWA**

FOR THE  
FISCAL YEAR ENDING JUNE 30, 2005

RESEARCH AND TECHNOLOGY BUREAU  
(515) 239-1447  
[www.dot.state.ia.us/materials/research/research\\_home](http://www.dot.state.ia.us/materials/research/research_home)

HIGHWAY DIVISION  
IOWA DEPARTMENT OF TRANSPORTATION  
AMES, IOWA 50010

DECEMBER 2005



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### LIST OF ACRONYMS

AASHTO - American Association of State Highway and Transportation Officials	ISU - Iowa State University
AC - Asphalt Cement	LVR - Low Volume Road
ACC - Asphalt Cement Concrete	NCHRP - National Cooperative Highway Research Program
ACPA - American Concrete Paving Association	NDT - Non-Destructive Testing
APWA - American Public Works Association	PC - Prestressed Concrete
BMP - Best Management Practice	PCA - Portland Cement Association
BST - Borehole Shear Test	PCC - Portland Cement Concrete
CIPR - Cold In-Place Recycling	PI - Principal Investigator
CTRE - Center for Transportation Research and Education	QA - Quality Assurance
DOT - Department of Transportation	QC - Quality Control
FHWA - Federal Highway Administration	QM-E - Quality Management - Earthwork
FRP - Fiber Reinforced Polymer	RAP - Recycled Asphalt Pavements
FWD - Falling Weight Deflectometer	RC - Reinforced Concrete
GFRP - Glass Fiber Reinforced Polymer	SHRP - Strategic Highway Research Program
GIS - Geographic Information System	SUDAS - Statewide Urban Designs and Specifications
GPS - Global Positioning System	TAC - Technical Advisory Committee
HMA - Hot Mix Asphalt	TRB - Transportation Research Board
IHRB - Iowa Highway Research Board	U of I - The University of Iowa
ICPA - Iowa Concrete Paving Association	WIM - Weigh in Motion
ICEA - Iowa County Engineers Association	

## RESEARCH AND DEVELOPMENT

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

This report, entitled Highway Division Highway Research and Development in Iowa, 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, which were in progress on June 30, 2005; it is also a report on projects completed during the fiscal year beginning July 1, 2004, and ending June 30, 2005. Detailed information on each of the research and development projects mentioned in this report is available in the Research and Technology Bureau in the Highway Division of the Iowa Department of Transportation.

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### IOWA HIGHWAY RESEARCH BOARD

In developing a progressive, continuing and coordinated program of research and development, the Highway Division is assisted by the Iowa Highway Research Board. 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 is 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, 2005, is listed in Table I.

The Research Board held nine regular meetings during the period of July 1, 2004, to June 30, 2005. Suggestions for research and development were reviewed at these meetings and recommendations were made by the Board.



**TABLE I**  
2004-2005 IOWA HIGHWAY RESEARCH BOARD MEMBERS

<u>Member</u>	<u>Term Expires</u>	<u>Alternate</u>
John Adam Deputy Director Iowa DOT - Statewide Operations Bureau 800 Lincoln Way Ames, IA 50010 (515) 239-1333	12-31-05	James Berger Director of Materials Iowa DOT 800 Lincoln Way Ames, IA 50010 (515) 239-1843
James Alleman Dept. of CCE Engineering Iowa State University 390 Town Engineering Bldg. Ames, IA 50011 (515) 294-3532	-	-
Lyle Brehm Tama County Engineer 1002 E. 5 <sup>th</sup> Street Tama, IA 52339-2216 (641) 484-3341 SS#-086	12-31-05 District 1	Dennis Short Hamilton County Engineer 2300 Superior Street Webster City, IA 50595-3197 (515) 832-9520 SS# 040
Scott Dockstader District Engineer Iowa DOT - District 1 1020 S. Fourth Street Ames, IA 50010 (515) 239-1194	12-31-07	Robert Younie Construction Engineer Iowa DOT - District 1 1020 S. Fourth Street Ames, IA 50010 (515) 239-1542
Robert Ettema Dept. of Civil & Env. Engineering The University of Iowa 4105 Seamans Center Iowa City, IA 52242 (319) 384-0596	-	-
Todd Fonkert Bremer County Engineer 1995 Euclid Avenue Waverly, IA 50677 (319) 352-4302 SS# 009	12-31-07 District 2	Danny Waid Howard County Engineer 137 N. Elm Street Cresco, IA 52136 (563) 547-2620 SS# 045
Roger Gould Process Management Engineer Iowa DOT - Engineering Bureau 800 Lincoln Way Ames, IA 50010 (515) 239-1834	12-31-06	Ahmad Abu-Hawash Chief Structural Engineer Iowa DOT - Bridges and Structures 800 Lincoln Way Ames, IA 50010 (515) 239-1393

Jon Ites  
Buena Vista County Engineer  
215 E. 5<sup>th</sup> Street  
P.O. Box 368  
Storm Lake, IA 50588  
(712) 749-2540 SS# 011

12-31-06  
District 3

Steve Camp  
Pocahontas County Engineer  
99 Court Square, Suite 4  
Pocahontas, IA 50574-1629  
(712) 335-3252 SS #076

Larry Jesse  
Director of Local Systems  
Iowa DOT  
800 Lincoln Way  
Ames, IA 50010  
(515) 239-1291

12-31-06

Mark Kerper  
Assistant Director  
Office of Location and Environment  
Iowa DOT  
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

12-31-05

Ronald Knoche  
City Engineer  
410 E. Washington Street  
Iowa City, IA 52240-1825  
(319) 356-5138

Jeff Krist  
Project Manager  
Public Works Department  
209 Pearl Street  
Council Bluffs, IA 51503  
(712) 328-4635

12-31-06

Richard Fosse  
Director of Public Works  
410 E. Washington Street  
Iowa City, IA 52240-1825  
(319) 356-5141

Charles Marker  
Cass County Engineer  
5 W. 7th Street  
Atlantic, IA 50022  
(712) 243-2442 SS# 015

12-31-05  
District 4

John Rasmussen  
Pottawattamie County Engineer  
223 South 6<sup>th</sup> Street  
Council Bluffs, IA 51501  
(712) 328-5608 SS# 078

Mark Nahra  
Delaware County Engineer  
2139 Highway 38  
P.O. Box 68  
Delaware, IA 52036  
(563) 927-3505 SS# 028

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Roger Schletzbaum  
Marion County Engineer  
402 Willetts Drive  
Knoxville, IA 50138  
(641) 828-2225 SS# 063

12-31-07  
District 5

Jim Armstrong  
Appanoose County Engineer  
1200 Highway 2 W  
Centerville, IA 52544  
(641) 856-6193 SS# 004

Clark Schloz  
Jackson County Engineer  
201 W. Platt  
Maquoketa, IA 52060  
(563) 652-4782 SS# 049

12-31-06  
District 6

Steve Gannon  
Linn County Engineer  
1888 County Home Road  
Marion, IA 52302-9753  
(319) 892-6400 SS# 057



## **RESEARCH AND DEVELOPMENT PROJECTS**

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

These expenditures may be charged to the Primary Road Fund, Farm-to-Market Road 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 the benefits, the costs are shared.

Table II is a record of expenditures for research and development made during the fiscal year ending June 30, 2005. Total expenditure was \$2,411,362.45.

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## **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 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.

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## **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, 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 of the states in an amount equal to 0.055 percent of the federal aid allocated to the states for highways. Iowa's obligation and actual expenditure for NCHRP varies and may be influenced by billing practices.

## SECONDARY ROAD TRAFFIC COUNT PROGRAM

Secondary road traffic counts and road inventories are conducted annually and funded from the Secondary Road Research Fund as "Non-contract Engineering Studies." The Office of Transportation Data conducted traffic counts in 25 counties during fiscal year 2005 as part of the Annual Traffic Count Program. This activity consisted of 474 portable recorder classification counts, 5,200 portable recorder volume counts and 49 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 all 99 counties and were 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.

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## 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 use 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 2005 financial summary is:

Beginning Balance 7-1-04		\$2,604,292.90
Receipts		
State Road Use Tax Fund		
(1½% of receipts)	\$1,158,278.52	
Federal Aid Secondary		
(1½% of receipts)	0.00	
Research Income	0.00	
Sub-Total		<u>\$1,158,278.52</u>
Total Funds Available		\$3,762,571.42
Obligation for Expenditures		
Obligated for		
Contract Research	\$1,209,336.27	
Non-Contract		
Engineering Studies	0.00	
Total Expenditures		<u>\$1,209,336.27</u>
BALANCE 6-30-05		\$2,553,235.15



## STREET RESEARCH FUND

The Street Research Fund was established in 1989 under Section 312.3A of the Iowa Code. Each year \$200,000 are set aside from the street construction fund solely for the purpose of financing engineering studies and research projects, which have as their objective the 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 2005 financial summary is:

Beginning Balance (7-1-04)	\$ 21,812
FY05 Street Research Funding	<u>200,000</u>
Total Funds Available for Street Research	\$221,812
Total obligated for Expenditure	<u>\$220,855</u>
Ending Unobligated Balance 6-30-05	\$957

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## PRIMARY ROAD RESEARCH FUND

The Primary Road Research Fund is 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 FY05 was \$785,035.15 and the estimate for FY06 is \$750,000.

## PROJECTS INITIATED DURING FY 2005

The new projects initiated during FY 2005 were:

- TR-521 Field & Laboratory Investigation of Hydraulic Structures Facilitating Fish Abundance & Passage through Bridges in Western Iowa Streams
- TR-522 Investigation of Steel Stringer Bridges: Substructures and Superstructures
- TR-523 Appropriate Traffic Calming Techniques for Small Iowa Communities
- TR-524 Review of Inconsistencies Between SUDAS and Iowa DOT Specifications
- TR-525 Design Guide for Improved Quality of Roadway Subgrades and Subbases
- TR-526 Feasibility of Cooperative Development of Wetland Mitigation Projects
- TR-527 Guidelines for Removal of Traffic Control Devices in Rural Areas
- TR-528 Development of a New Process for Determining Design Year Traffic Demands
- TR-529 Construction and Evaluation of a Prestressed Concrete Bridge Constructed Using Ultra High-Performance Concrete
- TR-530 Development of an Improved Integral Bridge Abutment-to-Approach Slab Connection
- TR-531 Effective Shoulder Design and Maintenance
- TR-532 Evaluation of Transverse Joint Forming Methods in PCC Pavement
- TR-533 Evaluation of Design Flood Frequency Methods for Iowa Streams
- TR-534 Design Procedures and Field Monitoring of Submerged Barbs for Streambank Protection
- TR-535 Reuse of Lime Sludge from Water Softening and Coal Combustion Byproducts
- TR-536 Implementation of the Water Quality Control BMPs & Design & Specifications Manuals in the Iowa Stormwater Runoff Control Interactive Manual
- TR-537 Iowa Data Collection and Analysis for the 2005/2006 National Surface Characteristics Field Experiment Plan
- TR-538 Using Scanning Lasers for Real-Time Pavement Thickness Measurement
- TR-539 Instrumentation and Monitoring of Precast, Post-tensioned Bridge Approach Pavement
- TR-540 Developing Guidance for Use of Lighting on Rural and Urban Roadways in Iowa

20 projects



## PROJECTS COMPLETED DURING FY 2005

The following projects were completed during FY 2005 and the project final reports were approved by the Iowa Highway Research Board:

Project Number	Project Title	Completion Date
HR-399	Field Testing of Integral Abutments	June 2005
TR-414	Superpave Mix Designs for Low Volume Roads	October 2004
TR-422	Pretreatment for Reduction of Asphalt Absorption in Porous Aggregate	May 2005
TR-424	Steel Diaphragms in Prestressed Concrete Girder Bridges	September 2004
TR-432	Ultrathin Portland Cement Concrete Overlay Extended Evaluation	February 2005
TR-457	Development of a Manual Crack Quantification and an Automatic Crack Measurement System	January 2005
TR-459	Reuse of Lime Sludge From Water Softening	January 2005
TR-467	Investigation of the Modified Beam-in-Slab Bridge System	December 2004
TR-469	Reduction of Concrete Deterioration by Ettringite Using Crystal Growth Inhibition Techniques-Part II-Field Evaluation of Inhibitor Effectiveness	July 2004
TR-470	Development of a Method to Determine Pavement Damage Due to Detours and Haul Roads	April 2005
TR-481	Identification of the Best Practices for the Design, Construction, and Repair of Bridge Approach Sections	January 2005
TR-485	Erosion Control for Highway Applications - Phase II: Development and Implementation of a Web-Based Expert System for Erosion and Sediment Control Measures	January 2005
TR-486	Development of Abutment Design Standards for Local Bridge Designs	October 2004
TR-487	Development of Object Oriented Specifications for IADOT and Urban Standards	October 2004
TR-495	Field Evaluation of Compaction Monitoring Technology	September 2004
TR-496	Development of Standard Plans for the Design of Single Span Pretensioned, Prestressed Concrete Beam Bridges with Concrete Abutments	May 2005
TR-497	Manual of Iowa Drainage Law	February 2005
TR-499	Effectiveness of Electrochemical Chloride Extraction for the Iowa Avenue Pedestrian Bridge	January 2005
TR-500	Evaluation of the Compensatory Wetland Mitigation Program in Iowa	October 2004
TR-504	Extensions to the Iowa Culvert Hydraulics Software - The Design of Energy Dissipators	April 2005
TR-506	Determination and Evaluation of Alternate Methods for Managing and Controlling Highway-Related Dust, Phase II - Demonstration Project	June 2005
TR-509	AASHTO 2002 Pavement Design Guide Implementation Plan - Phases I and II	May 2005
TR-512	Measuring Pavement Profile at the Slipform Paver	April 2005

23 Projects



**Table II**  
**FINANCIAL SUMMARY OF RESEARCH AND DEVELOPMENT PROJECT EXPENDITURES**

July 1, 2004 to June 30, 2005

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

Project	Total Funds Committed	Project Title	Primary Road	Secondary Road	Street	Total
			Research Fund Expenditures	Research Fund Expenditures	Research Fund Expenditures	
140	116,210	Collection and Analysis of Stream Flow Data		71,310.72	15,846.81	87,157.53
296	100,000/year	ISU Local Technical Assistance Program (LTAP)		74,125.16	69,912.21	144,037.37
375	22,400	TRB Education for County Engineers		1,876.75		1,876.75
428	294,760	Effective Structural Concrete Repair	5,481.32	26,044.46		31,525.78
432	183,903	Ultrathin PCC Overlay Extended Evaluation	43,842.64	64,917.47	4,649.79	113,409.90
457	73,997	Development of a Manual Crack Quantification and an Automatic Crack Measurement System	4,439.69	2,959.98		7,399.67
459	67,133	Reuse of Lime Sludge From Water Softening	1,826.17		15,779.41	17,605.58
460	87,924	Living Snow Fences	51.19	2,074.93		2,126.12
463	99,804	Field Performance Study of Past Iowa Pavement Research: A Look Back		142.25		142.25
468	10,000	Technology Transfer Program for the Iowa Highway Research Board (IHRB)		245.00		245.00
469	139,832	Reduction of Concrete Deterioration by Ettringite Using Crystal Growth Inhibition Techniques-Part II-Field Evaluation of Inhibitor Effectiveness	11,186.56	2,959.33	1,558.77	15,704.66
472	80,000	Investigation of Materials for the Reduction and Prevention of Corrosion on Highway Maintenance Equipment		7,406.39	2,532.96	9,939.35
473	178,197	Rehabilitation of Concrete Pavements Utilizing Rubblization and Crack and Seat Methods	4,755.10	16,075.76		20,830.86
474	270,513	Development of a Mix Design Process for Cold-In-Place Rehabilitation Using Foamed Asphalt	8,319.37	16,743.07		25,062.44
481	120,000	Identification of the Best Practices for the Design, Construction, and Repair of Bridge Approach Sections	5,985.97	19,800.48	6,000.00	31,786.45
483	145,775	Evaluation of Hot Mix Asphalt Moisture Sensitivity Using the Nottingham Asphalt Test Equipment		10,160.47	4,779.91	14,940.38
484	159,666	Materials & Mix Optimization Test Procedures for PCC Pavements	1,693.42	24,045.92	20,520.96	46,260.30
485	38,757	Erosion Control for Highway Applications, Phase II: Development & Implementation of a Web-Based Expert System for Erosion & Sediment Control Measures	3,520.21	4,428.53	1,739.69	9,688.43
486	99,265	Development of Abutment Design Standards for Local Bridge Designs		11,736.38		11,736.38
487	124,999	Development of Object Oriented Specifications for IADOT and Urban Standards	1,253.70	1,950.96	173.24	3,377.90
488	90,000	Economics of Using Calcium Chloride vs. Sodium Chloride for Deicing/Anti-icing		19,259.68	3,059.82	22,319.50
489	198,462	Innovative Solutions for Slope Stability Reinforcement and Characterization in Iowa Soils	4,148.10	60,895.53		65,043.63
491	100,000	Development of Winter Performance Measures for Highway Winter Maintenance Operations	22,476.08	7,405.75	5,924.34	35,806.17
492	169,067	Embankment Quality Phase IV - Application to Unsuitable Soils	13,329.39	5,629.36	5,953.12	24,911.87
493	196,421	Performance Evaluation of Steel Bridges: Phase II	24,293.39	1,759.44		26,052.83
495	75,000	Field Evaluation of Compaction Monitoring Technology	4,086.07	7,500.00	7,500.00	19,086.07
496	179,250	Development of Standard Plans for the Design of Single Span Pretensioned, Prestressed Concrete Beam Bridges with Concrete Abutments		111,530.12		111,530.12
497	59,965	Manual of Iowa Drainage Law		16,808.72	1,902.37	18,711.09
498	121,096	Field Testing of Railroad Flat Car Bridges		34,346.34		34,346.34
499	30,000	Effectiveness of Electrochemical Chloride Extraction for the Iowa Avenue Pedestrian Bridge	6,508.22	3,000.00	3,000.00	12,508.22
500	6,802	Evaluation of the Compensatory Wetland Mitigation Program in Iowa	4,802.00			4,802.00
503	119,412	Investigation of Improved Utility Cut Repair Techniques to Reduce Settlement in Repaired Areas	4,909.34	27,979.88	49,734.84	82,624.06
504	40,000	Extensions to the Iowa Culvert Hydraulics Software - The Design of Energy Dissipators	1,733.60	9,980.00		11,713.60
505	164,764	Improving PCC Mix Consistency & Production by Mixing Improvements	87,929.39	13,900.48	13,043.83	114,873.70



<u>Project</u>	<u>Total Funds Committed</u>	<u>Project Title</u>	<u>Primary Road Research Fund Expenditures</u>	<u>Secondary Road Research Fund Expenditures</u>	<u>Street Research Fund Expenditures</u>	<u>Total Expenditures</u>
506	107,070	Determination and Evaluation of Alternate Methods for Managing and Controlling Highway-Related Dust		62,128.83		62,128.83
507	86,373	Thin Maintenance Surfaces Phase III - Municipal Streets and Low-Volume Rural Roads			34,256.52	34,256.52
508	207,800	Design Guide and Construction Specifications for NPDES Site Runoff Control	41,754.80	39,792.48	33,401.04	114,948.32
509	75,003	AASHTO 2002 Pavement Design Guide Implementation	41,655.95	2,242.02	4,023.02	47,920.99
510	57,992	Lab Study Structural Behavior of Alternative Dowel Bars	2,183.69	206.86		2,390.55
511	101,578	Design and Construction Procedures for Concrete Overlay and Widening of Existing Pavements	24,652.02	18,866.58	1,446.04	44,964.64
512	75,000	Measuring Pavement Profile at the Slipform Paver	32,668.64	32,937.21	7,500.00	73,105.85
513	50,000	Decision Support Model for Assessing Archaeological Survey Needs for Bridge Replacement Projects in Iowa	20,250.00	21,595.51		41,845.51
514	64,991	Development of a Manual of Practice for Roadway Maintenance Workers		32,085.45		32,085.45
515	80,816	A Guide for Monitoring and Protecting Bridge Waterways Against Scour	15,047.09	15,270.67	1,952.89	32,270.65
516	40,000	Measurement of Seasonal Changes and Spatial Variation in Pavement Subgrade Support Properties	27,892.74	1,954.08	3,359.91	33,206.73
518	80,819	Monitoring Wind-Induced Vibrations/Stresses in a High Mast Lighting Tower	35,064.82			35,064.82
519	78,000	Developing Flood-Frequency Discharge Estimation Methods for Small Drainage Basins in Iowa	29,750.00	15,500.00		45,250.00
520	146,708	Evaluation of Dowel Bar Retrofits for Local Road Pavements		36,815.08	440.38	37,255.46
521	59,628	Field & Laboratory Investigation of Hydraulic Structures Facilitating Fish Abundance & Passage through Bridges in Western Iowa Streams	10,368.74	18,230.36	3,450.40	32,049.50
522	274,780	Investigation of Steel Stringer Bridges: Substructures and Superstructures		82,515.20	12,651.61	95,166.81
523	64,718	Appropriate Traffic Calming Techniques for Small Iowa Communities	1,369.24	15,569.62		16,938.86
524	147,174	Review of Inconsistencies Between SUDAS and Iowa DOT Specifications	20,412.20		10,590.81	31,003.01
525	153,212	Design Guide for Improved Quality of Roadway Subgrades and Subbases	21,790.93	39,097.81		60,888.74
526	59,925	Feasibility of Cooperative Development of Wetland Mitigation Projects	34,155.26			34,155.26
527	75,000	Guidelines for Removal of Traffic Control Devices in Rural Areas		31,065.94		31,065.94
528	125,000	Development of a New Process for Determining Design Year Traffic Demands	12,291.85	4,160.13	8,589.56	25,041.54
529	154,310	Construction & Evaluation of a Prestressed Concrete Bridge Using Ultra High-Performance Concrete	15,058.80	3,787.32		18,846.12
530	169,433	Development of an Improved Integral Bridge Abutment-to-Approach Slab Connection		3,523.61		3,523.61
531	103,323	Effective Shoulder Design and Maintenance	21,446.38			21,446.38
532	79,240	Eval of Transverse Joint Forming in PCC Pavement	5,156.13	4,041.07		9,197.20
533	99,544	Eval of Design Flood Frequency Methods for IA Streams	10,634.72			10,634.72
534	140,000	Design Procedures and Field Monitoring of Submerged Barbs for Streambank Protection	3,855.91	20,463.21		24,319.12
535	34,967	Reuse of Lime Sludge from Water Softening and Coal Combustion Byproducts	17,324.58			17,324.58
537	96,700	Iowa Data Collection and Analysis for the 2005/2006 National Surface Characteristics Field Experiment Plan	15,559.68		216.74	15,776.42
538	100,000	Using Scanning Lasers for Real-Time Pavement Thickness Measurement	1,114.87	12,220.49		13,335.36
1027		Secondary Road Research Coordinator		77,603.15		77,603.15
1081	25,000	Development of In-Situ Detection Methods for Material Related Distress (MRD) in Concrete	13,800.07			13,800.07
		Contract Research Subtotal	785,035.15	1,297,525.16	342,022.97	2,424,583.28



## HR-140

**Agency:**

United States  
Geological Survey

**Principal****Investigator:**

Rob Middlemis-Brown

**Research Period:**

July 1, 1967 to  
September 30, 2006  
Annual Renewal

**Research Board****Funding:**

\$218,413

**Funding Source:**

45% Federal funds,  
55% State - 40%  
Primary funds, 50%  
Secondary funds and  
10% Street funds

## Collection and Analysis of Stream Flow Data

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

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

**Reports:** Annual Report, Flood Event Reports

**Implementation:** Flood frequency and discharge data is used for sizing hydraulic structures across the state. Structure design agencies use this data for their designs.



## HR-296

**Agency:**

Iowa State University

**Principal Investigator:**

Duane Smith

**Research Period:**

October 1, 1986 to  
December 31, 2005

**Research Board Funding:**

\$100,000 per year

**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  
and 45% Street funds

*promote research -  
encourage implementation -  
distribute research data*

## Iowa State University Local Technical Assistance Program (LTAP)

**Objective:** The objective of this project is to help Iowa's local governments keep up with growing demands on local roads, streets, bridges, and public transportation. The center provides technical and management assistance to Iowa's local transportation officials through a variety of programs.

**Progress:** The major tasks are the following:

- publishing at least six *Technology News* newsletters per year,
- conducting at least 10 training courses/workshops per year,
- distribute publications,
- provide service and information to users, and
- 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.



## HR-375

**Agency:**

Iowa Department of  
Transportation, Highway  
Division

**Principal  
Investigator:**

Edward J. Engle

**Research Period:**

November 1, 1994,  
on-going

**Research Board  
Funding:**

\$37,400

**Funding Source:**

100% State -  
100% Secondary  
funds

## Transportation Research Board Education for County Engineers

**Objective:** The objective of the project is to send two county engineers annually to the TRB Annual Meeting in Washington, D.C., for research education. County engineers selected are generally those starting their term as regular members of the IHRB. The experience of 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 1995 to 2005, a total of 19 county engineers were sent to TRB.

**Reports:** None

**Implementation:** All county engineers who have attended the conference so far felt it was a very good educational experience. They believe the experience will allow them to better serve their counties and the IHRB.

## HR-399

**Agency:**

Iowa State University

**Principal Investigator:**

Robert Abendroth

**Research Period:**

February 1, 1997 to  
April 30, 2003

**Research Board Funding:**

\$299,932

**Funding Source:**

100% State -  
50% Primary funds,  
35% Secondary funds  
and 15% Street funds

## Field Testing of Integral Abutments

**Objective:** Previous research proposed extending the length limitations on some integral abutment bridges. The response of the abutment and pile system to longitudinal bridge movements has not been fully accepted for the extended length designs. This research proposes to do the following:

- Evaluate the state-of-the-art of integral abutment design.
- Validate the assumptions that are incorporated in the present pile design procedures for integral abutment bridges.

**Reports:** Final Report, June 2005

**Implementation:** The results of this research will be made available to bridge design engineers who have requested further verification of the pile design concepts that have been previously recommended for integral abutment bridges.



## TR-412

**Agency:**

The University of Iowa

**Principal Investigator:**

Wilfrid A. Nixon

**Research Period:**

August 1, 1997 to  
December 31, 2004

**Research Board Funding:**

\$65,000

**Funding Source:**

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

## Development of a Computer Controlled Underbody Plow

**Objective:** The objective of this proposed research is to develop a computer controlled underbody plow and then, through an expert system, capture and apply the experience of our best ice removal maintenance personnel.

**Reports:** Draft Final Report, October, 2005

**Implementation:** This project is proposed with the primary aim of developing a computer controlled underbody plow for snow and ice removal. The plow assembly will include an expert system utilizing fuzzy logic to obtain optimal response. Once the project is complete, the system will be available for deployment in field situations.



## TR-414

**Agency:**

Iowa Department of  
Transportation,  
Scott County,  
Mahaska County,  
Mills County,  
Cerro Gordo County,  
Dubuque County,  
Pocahontas County,  
Cass County,  
Linn County and  
Louisa County

**Principal  
Investigator:**

Edward J. Engle and  
respective County  
Engineers

**Research Period:**

July 1, 1997 to  
December 31, 2004

**Research Board  
Funding:**

\$50,000

**Funding Source:**

100% State -  
100% Secondary  
funds

*Gyratory mix  
design process*

## Superpave Mix Designs for Low Volume Roads

**Objective:** To determine what modifications to Superpave criteria will be needed to provide the benefits of this mix design process on low volume roads without significantly increasing paving costs.

**Reports:** Final Report, October 2004

**Implementation:** The Superpave mix design process shows excellent promise for improving paved road service life. If we can show this is applicable on low volume roads at little or no extra costs, it will be an attractive alternative for counties statewide. This is especially true as state ACC projects are shifted to 100% Superpave.



TR-414 Scott County. Coarse/Fine aggregate comparison.

Scott County Project. Coarse/Fine Aggregate Comparison



## TR-422

**Agency:**

Iowa Department of  
Transportation and  
Louisa County

**Principal  
Investigator:**

Edward J. Engle and  
John Hinrichsen

**Research Period:**

August 1998 to April  
2005

**Research Board  
Funding:**

\$14,000

**Funding Source:**

100% State -  
40% Primary funds,  
40% Secondary funds  
and 20% Street funds

## Pretreatment for Reduction of Asphalt Absorption in Porous Aggregate

**Objective:** The purpose of this research is to evaluate the effectiveness of an acrylic antistripping agent when used as an asphalt absorption inhibitor in ACC paving.

**Reports:** Final Report, April 2005

**Implementation:** Many of the aggregates in Iowa are highly absorptive. This results in ACC requiring high AC contents. If this additive can reduce the amount of AC absorption and hence the overall AC content in the ACC, then considerable cost savings to the county would be realized.



## TR-424

**Agency:**

Iowa State University

**Principal Investigator:**

Robert Abendroth and  
Fouad S. Fanous

**Research Period:**

January 1, 1999 to  
April 30, 2004

**Research Board Funding:**

\$178,358

**Funding Source:**

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

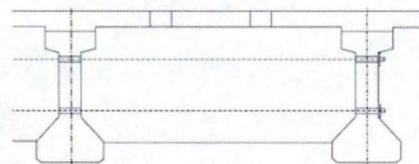
## Steel Diaphragms in Prestressed Concrete Girder Bridges

**Objective:** The objectives of the research are the following:

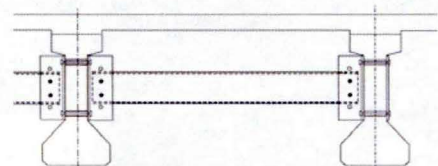
- Evaluate the state-of-the-art regarding the role of intermediate diaphragms in distributing lateral loads throughout PC girder bridge structures.
- Investigate the static and dynamic-load response characteristics of different types and configurations of intermediate diaphragms in PC girder bridges.
- Establish an economical and efficient intermediate structural steel diaphragm that can be used as an alternate for the intermediate RC diaphragm in Iowa PC girder bridges.

**Reports:** Final Report, September 2004

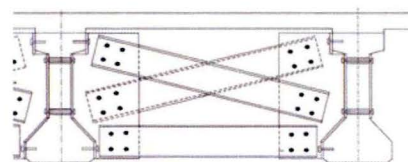
**Implementation:** The research results will provide bridge design engineers with a better understanding of the behavior of intermediate diaphragms in PC girder bridges that are subjected to lateral load impacts from over-height vehicles. The research will establish whether an intermediate structural steel diaphragm that has a simplified attachment assembly to a PC girder will essentially provide the same degree of PC girder damage protection than that which is currently being provided by the intermediate RC diaphragms used by the Iowa DOT.



Reinforced Concrete Diaphragm



Steel Channel Diaphragm



Steel X-Brace Diaphragm



## TR-427

**Agency:**

Iowa Department of  
Transportation and  
Buchanan County

**Principal  
Investigator:**

Brian Keierleber  
Edward Engle

**Research Period:**

December 21, 1998 to  
April 30, 2005

**Research Board  
Funding:**

\$26,200

**Funding Source:**

100% State -  
40% Primary funds,  
30% Secondary funds  
and 30% Street funds

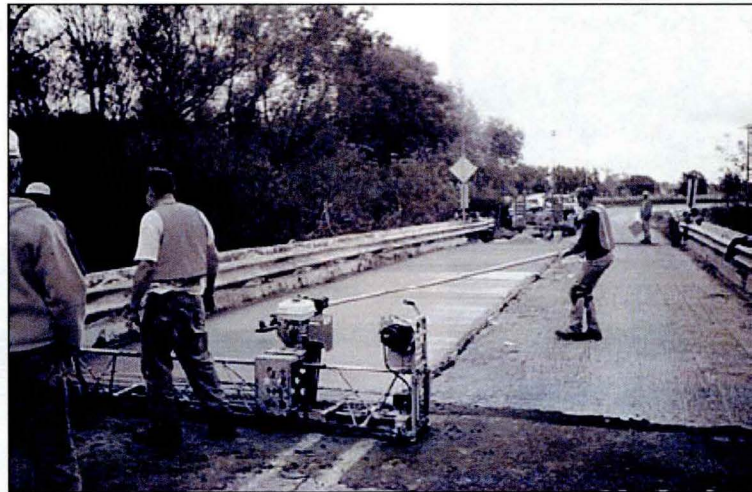
*The concrete could be  
delivered from local  
ready mix suppliers  
and placed in large  
quantities with  
standard equipment.*

## Evaluation of High-Slump Concrete for Bridge Deck Overlays

**Objective:** The objective of this research is to evaluate the feasibility of using high-slump concrete for bridge deck overlays and to develop effective mix designs and placement techniques for that concrete.

**Reports:** Final Report, October 2005

**Implementation:** Current overlay technology uses a very dense concrete, which must be produced on-site and transported and placed with specialized equipment. With higher slump, the concrete could be delivered from local ready mix suppliers and placed in large quantities with standard equipment. Both operations would result in considerable cost savings to the county.



PCC Placement on the Independence Bridge



## TR-428

**Agency:**

Iowa State University

**Principal Investigator:**

F. Wayne Klaiber and  
Terry J. Wipf

**Research Period:**

February 1, 1999 to  
December 31, 2008

**Research Board Funding:**

\$294,760

**Funding Source:**

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

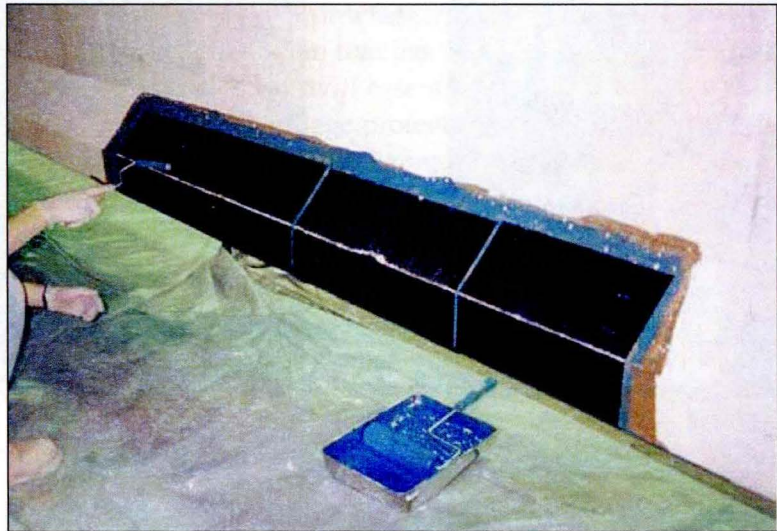
## Effective Structural Concrete Repair

**Objective:** The overall objective will be to develop innovative repair methods/materials that result in cost effective repair of structural concrete elements.

**Progress:** A final report summarizing the work to date was presented. Also, a synopsis of the installation procedures used for each of the 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 2008 to reflect the service life of the documented repairs.

**Reports:** Final Report, April 2004

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



Installation of transverse CFRP jacket on Beam



**TR-432**

**Agency:**  
Iowa State University

**Principal Investigator:**  
James K. Cable

**Research Period:**  
July 1, 1999 to  
December 31, 2004

**Research Board Funding:**  
\$183,903

**Funding Source:**  
100% State -  
50% Primary funds,  
45% Secondary funds  
and 5% Street funds

## **Ultrathin PCC Overlay Extended Evaluation**

**Objective:** The objectives of the project are as follows: 1) Evaluate conventional methods of slab removal and surface preparation for removal and replacement areas, 2) Evaluate the condition of the asphalt concrete surface under removal and replacement areas, 3) Evaluate the cost/benefit of polypropylene fiber addition to the concrete, 4) Evaluate the performance of the rehabilitated sections, and 5) Validate the existing ultrathin whitetopping design procedures of the PCA and ACPA for application in Iowa.

**Reports:** Final Report, January 2005

**Implementation:** The results of this study will be used to develop and validate design procedures for whitetopping and ultrathin whitetopping for the PCA and ACPA



## TR-438

**Agency:**

Iowa State University

**Principal Investigator:**

Robert Abendroth

**Research Period:**

July 1, 1999 to June 30, 2004

**Research Board Funding:**

\$142,903

**Funding Source:**

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

## An Integral Abutment Bridge With Precast Concrete Piles

**Objective:** The research objectives are the following:

- Determine the state departments of transportation that permit the use of PCC piles in integral-abutment bridges. For those states that use PCC piles in this type of a bridge, summarize the PCC pile design practices and investigate the abutment to pile connection details.
- Evaluate the performance of selected PCC piles in the bridge on County Route E43 over Otter Creek in Otter Creek Township of Tama County. This bridge will be referred to as the Tama County Bridge.
- Establish the longitudinal displacement versus temperature behavior for the abutments of the Tama County Bridge.

**Progress:** Final analysis is being performed on the data and a final report will be delivered in the fall of 2005.

**Reports:** None

**Implementation:** The results obtained from this research will provide bridge design engineers with a better understanding of the behavior of the PCC abutment piles in the Tama County integral-abutment bridge. Engineers with the Office of Bridges and Structures of the Iowa Department of Transportation have expressed concerns regarding the ductility of PCC piles in an integral-abutment bridge, since PCC piles exhibit non-ductile behavior. The experimental measurements of the lateral-displacement of the abutment pile caps, periodic visual inspections of the top portion of selected PCC abutment piles, and recorded longitudinal strains for these selected PCC piles in the Tama County Bridge will provide bridge design engineers with information regarding the performance characteristics of these PCC piles.



## TR-450

**Agency:**

Purdue University and 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 February 28, 2006

**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:** The main purpose of this research is to evaluate various blends of aggregates to optimize the combination of micro- and macro-texture to achieve a desired level of friction. Aggregate classifications and properties currently used to provide desirable friction levels for high traffic situations will be evaluated and possibly revised based upon this research.

**Progress:** Issues have created challenges with this project, such as identifying aggregates that would be of interest to the two sponsors of the project, the Indiana and Iowa Departments of Transportation. These issues have now been resolved, and work can be accelerated on this project.

A comparison of the test results from Dynamic Friction Tester (DFT) and Circular Texture Meter (CTM) was needed to take advantage of previously collected data. In Phase I of this project, the NCSC borrowed these devices from the National Center for Asphalt Technology as part of the evaluation of these devices for use in this project. Since the devices proved to be well-suited to the purposes of this research, the NCSC used funding from the Institute for Safe, Quiet and Durable Highways to purchase the equipment. In order to be able to use the previously collected data, it was necessary to compare the results of testing with NCAT's equipment and the new NCSC equipment. Comparison testing was performed on the NCAT test track in November.

**Reports:** None

**Implementation:** These research findings are expected to identify blends of aggregates that can be used in Iowa to maintain the current baseline of friction. It is anticipated that increase macrotexture will diminish the need for high quality friction aggregates to provide increased microtexture. This will lead to more economical surface courses for use in Iowa by reducing the need to import friction aggregates.



## TR-457

**Agency:**

The University of Iowa

**Principal Investigator:**

Hosin "David" Lee

**Research Period:**

April 1, 2001 to June 30, 2004

**Research Board Funding:**

\$73,997

**Funding Source:**

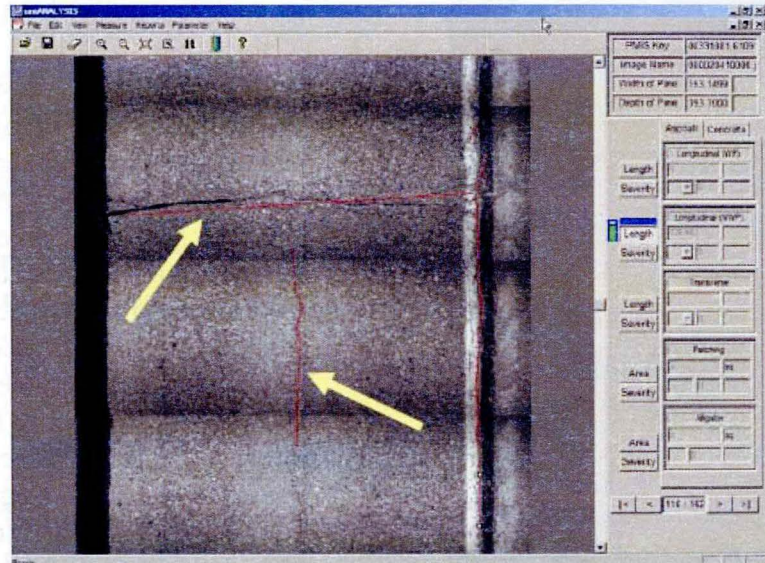
100% State -  
60% Primary funds  
and 40% Secondary  
funds

## Development of a Manual Crack Quantification and an Automated Crack Measurement System

**Objective:** To develop software to verify the outputs pavement management data against Iowa DOT procedures and to automatically process pavement crack data objectively and consistently.

**Reports:** Final, January, 2005

**Implementation:** The software package will offer improved accuracy and consistency over the current labor-intensive manual system at a lower cost. This system is available for use by the Iowa DOT and cities and counties.



Analysis of Longitudinal and Transverse Crack by Line



## TR-458

**Agency:**

The University of Iowa

**Principal Investigator:**

Wilfrid A. Nixon

**Research Period:**

May 1, 2001 to April 30, 2005

**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:** The objective of this project is 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 will be tested and compared with existing delivery methods, using a friction measuring device. It is expected that friction increases due to abrasives will diminish more slowly with the two delivery methods than with existing delivery methods.

**Progress:** The pieces for this project are all in place and functional now. The major challenge is coordinating the pieces so that after or during a storm it is possible for both truck and test vehicle to meet up and conduct their measurements in such a way as not to create a hazardous situation for the public. Last winter significant coordination difficulties were encountered but these have been addressed and it is hoped that good tests will be conducted this coming winter.

The project is at the point where a season of good field testing will provide definitive data to allow these questions to be answered. It is hoped that the 2005-06 winter season will provide such conditions. All equipment needs for the experiment are in place, and work at present is focused on ensuring that there are no logistical problems during the field season. Completion of the project together with the final report is anticipated in June 2006.

**Reports:** None

**Implementation:** Maintaining roads in winter in Iowa is difficult. The safety of the driving public is paramount. If one of these novel abrasive delivery methods proves more effective than conventional methods and is cost effective, then winter maintenance will be more easily performed and the driving public will be safer.



## TR-459

**Agency:**

Iowa State University

**Principal Investigator:**

J(Hans) van Leeuwen

**Research Period:**

August 15, 2001 to  
December 31, 2004

**Research Board Funding:**

\$67,133

**Funding Source:**

52% outside sources  
and 48% State -  
25% Primary funds  
and 75% Street funds

## Reuse of Lime Sludge from Water Softening in Road Construction

**Objective:** The objectives are as follows:

- Lime sludge in mixture with fly ash, soils and aggregate is to be tested for its suitability to prepare subbase for road construction.
- Evaluate the use of lime sludge for fill and embankments as an admixture with other fill materials and fly ash.
- Calcium Carbonate ( $\text{CaCO}_3$ ) is one of the feedstocks in cement manufacture and much larger quantities of this are required than produced in water treatment. The objective here is to determine if the sludge can be trucked economically to Mason City from Buffalo, Iowa to be used in cement production.
- Many power plants are already using calcium carbonate for sulfur dioxide removal. The present source of  $\text{CaCO}_3$  is limestone. Here the objective is to find means of preparing lime sludge to replace some of the limestone in power plants.
- Some waste water treatment plants need to add calcium hydroxide to compensate for reductions in alkalinity due to nitrification in the plant or due to the use of chemicals for phosphate removal. The objective of the research would be to find ways to substitute lime sludge for these purposes.

**Reports:** Final, December, 2004

**Implementation:** The potential value of the lime sludge in Iowa is around \$1 million, against present disposal costs of also around \$1 million, so this could mean some value adding and business opportunities. Iowa is not the only state with this problem and the technologies developed can be used more widely.



## TR-460

**Agency:**

The University of Iowa

**Principal Investigator:**

Wilfrid A. Nixon

**Research Period:**

September 1, 2001 to  
July 31, 2004

**Research Board Funding:**

\$87,924

**Funding Source:**

100% State -  
50% Primary funds  
and 50% Secondary  
funds

*12 rows of corn provide  
the best alternative to  
the traditional snow fence  
in terms of performance  
and cost effectiveness.*

## Living Snow Fences

**Objective:** The following are the main objectives:

- Determine the optimal configuration of corn rows and switch grass to “catch” drifting snow. Other living snow fences may also be studied during this part of the study, and direct comparison with artificial (i.e. wooden or plastic) snow fences will be made.
- Create a living snow fence design guide which parallels the snow fence guide developed under SHRP. This will indicate how to configure living snow fences for given levels of snow fall and wind fetch.
- Develop suitable marketing tools to “sell” living snow fences as a desirable option to landowners. This will include attempting to develop an appropriate cost tool to be used in providing compensation to landowners.

**Progress:** A series of field tests have been conducted successfully, and these, together with a detailed literature review, have led to the development of some straightforward guidelines that should be both easily implemented and provide effective protection under many winter conditions. At present, the final report of this project is being written, and is approximately 50% complete at this time.

**Reports:** None

**Implementation:** The results of this study will be presented at an appropriate meeting in Iowa after completion of the project. The report and the design guide will also be made available via e-mail to all subscribers to the snow and ice mailing list, and would be placed on the Snow and Ice Cooperative Program and Iowa DOT Web sites.



**TR-461**

**Agency:**

Iowa State University

**Principal Investigator:**

David J. White

**Research Period:**

July 1, 2001 to  
November 30, 2004

**Research Board**

**Funding:**

\$70,000

**Funding Source:**

61.1% outside sources  
and 38.9% State -  
60% Primary funds,  
35% Secondary funds  
and 5% Street funds

## **Soil Stabilization of Non-Uniform Subgrade Soils**

**Objective:** 1) Evaluate the influence of subgrade uniformity on pavement performance. 2) Determine how the addition of various raw fly ashes can bring about uniform subgrade support. 3) Develop an Ash Stabilization Guide as a resource for Iowa designers and contractors.

**Reports:** Final, April 2005

**Implementation:** The results of this research will allow highway agencies and contractors statewide to provide a more uniform subgrade for highways.



## TR-463

**Agency:**

The University of Iowa

**Principal Investigator:**

Hosin "David" Lee

**Research Period:**

August 24, 2001 to  
March 31, 2004

**Research Board Funding:**

\$99,804

**Funding Source:**

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

## Field Performance Study of Past Iowa Pavement Research: A Look Back

**Objective:** The objective of this project is to take a comprehensive look back at selected Iowa Highway Research Board projects to evaluate their performance over a period that is more representative of their expected service life.

**Reports:** Draft Final Report

**Implementation:** The results of this study will also provide a better understanding of pavement performance and the factors that influence performance. Validated findings of the past pavement research is being summarized. The new findings will provide a measure of the impact that the pavement research program has made on pavement design, construction and material selection.



## TR-466

**Agency:**

Iowa State University  
and City of Oskaloosa

**Principal Investigator:**

James K. Cable

**Research Period:**

July 1, 2001 to June  
30, 2006

**Research Board Funding:**

\$47,049 (Iowa State  
University - \$20,307;  
City of Oskaloosa -  
\$26,742)

**Funding Source:**

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

## Evaluation of Unbonded Ultrathin Whitetopping of Brick Streets

**Objective:** Demonstrate the ability to design and place an unbonded PCC overlay on an existing base of ACC and brick, and evaluate the performance of the 3" PCC overlay to that of the 3" ACC overlay in the short- and long-term.

**Progress:** The construction report was completed and presented to the IHRB. Monitoring of the site continues, including deflection and distress surveys.

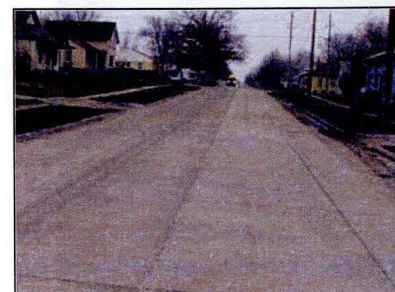
**Reports:** Construction Report, August 2002

**Implementation:** Information gathered from the three reporting periods will be distributed to city administrators and the highway industry through the following:

- Distribution of the project reports by the Iowa Highway Research Board to public entities and consultants.
- Use of the CTRE newsletters and Portland Cement Concrete Center publications.
- Presentations at the APWA Iowa Chapter annual meetings.
- Technology abstracts in the Midwest Concrete Consortium Web Page.



Asphalt Surface with Exposed Brick



Completed Jointing Pattern



## TR-467

**Agency:**

Iowa State University

**Principal Investigator:**

F. Wayne Klaiber and  
Terry J. Wipf

**Research Period:**

December 1, 2001 to  
September 30, 2004

**Research Board Funding:**

\$190,890

**Funding Source:**

100% State -  
100% Secondary  
funds

*The value of the research is to provide strength and behavior information on the MBIS bridge system which can be used to replace deficient bridges in a cost effective manner.*

## Investigation of the Modified Beam-in-Slab (MBIS) Bridge System

**Objective:** The primary objective of this research is to do additional laboratory work on the alternate shear connector and to assist in designing and constructing two demonstration bridges which will use the MBIS system. Both bridges will be instrumented for measurement of strains and deflections at critical locations and load tested after construction is complete. Periodically they will be inspected and re-tested. The bridge design and construction will be documented (photographs, videotape, etc.) for use by other interested counties.

**Reports:** Final Report, November 2004

**Implementation:** The value of the research is to provide strength and behavior information on the MBIS bridge system which can be used to replace deficient bridges in a cost effective manner. The main advantages of the MBIS bridge system over the Benton County system are that less material is required, composite action is obtained, and longer spans are possible. In addition, the methodology developed will assist engineers with the design of this type of bridge. Construction of these bridges will be documented to assist others in the construction of additional MBIS bridge systems.



Transverse arches between the steel beams.



## TR-468

**Agency:**

Iowa Department of  
Transportation

**Principal  
Investigator:**

Mark J. Dunn

**Research Period:**

December 1, 2001,  
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:** The objective of this project is to provide improved research technology transfer and information distribution to the IHRB and to transportation professionals in Iowa.

This project also provides resources to cover 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 IHRB's annual traveling meeting at field sites in Iowa. No other technology transfer activities required funding for FY 04-05.

**Reports:** None



TR-469

**Agency:**  
Iowa State University

**Principal Investigator:**  
Paul G. Spry and Robert D. Cody

**Research Period:**  
March 1, 2002 to May 31, 2004

**Research Board Funding:**  
\$139,832

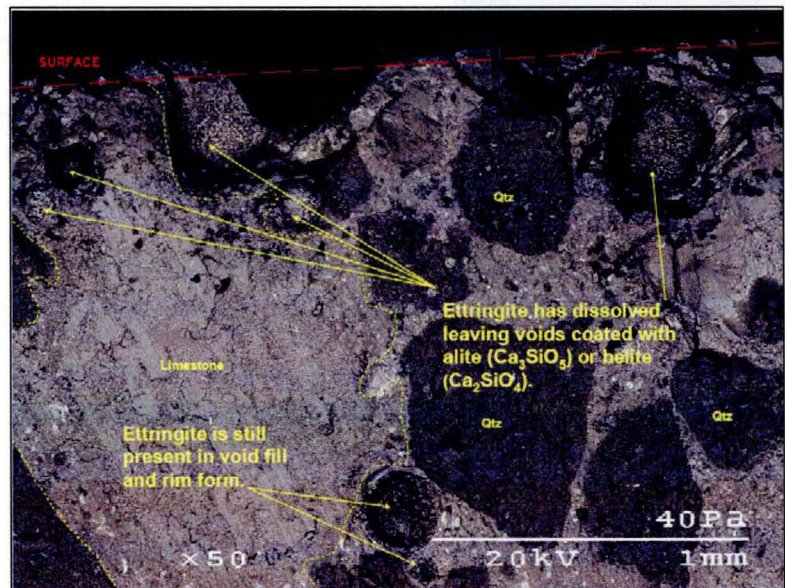
**Funding Source:**  
100% State -  
80% Primary funds,  
10% Secondary funds  
and 10% Street funds

## Reduction of Concrete Deterioration by Ettringite Using Crystal Growth Inhibition Techniques - Part II - Field Evaluation of Inhibitor Effectiveness

**Objective:** The proposed research project objective is to determine whether periodic application of inhibitor chemicals to highway concrete under field conditions will prevent or reduce ettringite formation.

**Reports:** Final Report, July 2004

**Implementation:** The result of this research will probably prove to be a highly cost-effective method of reducing secondary mineral crystal growth in existing highways. This will provide a specific guideline for application method of inhibitor chemicals to highways, including details of inhibitor concentration and rate of application.





## TR-470

**Agency:**

Iowa State University

**Principal Investigator:**

Omar Smadi

**Research Period:**

April 1, 2002 to  
September 30, 2004

**Research Board Funding:**

\$59,272

**Funding Source:**

100% State -  
50% Primary funds,  
45% Secondary funds  
and 5% Street funds

## Development of a Method to Determine Pavement Damage Due to Detours

**Objective:** The object of this project is to develop an objective method for determining pavement damage on secondary highways and municipal streets resulting from additional traffic loading on detours used temporarily by the Iowa DOT.

**Reports:** Final Report, April 2005

**Implementation:** A set of guidelines and procedures for a new process of developing detour compensation was presented. If approved, the Iowa DOT, cities, and counties involved in such activities will use the newly developed methodology to determine their compensation.



**TR-471**

**Agency:**

The University of Iowa and sub-contract with Iowa State University

**Principal Investigator:**

Wilfrid A. Nixon (The University of Iowa) and Kejin Wang (Iowa State University)

**Research Period:**

May 1, 2002 to April 30, 2004

**Research Board Funding:**

\$100,000 (The University of Iowa - \$92,000; Iowa State University - \$8,000)

**Funding Source:**

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

## **Evaluation of Using Non-Corrosive Deicing Materials and Corrosion Reducing Treatments for Deicing Salts**

**Objective:** To develop a series of tests that will allow the evaluation of existing and future deicing chemicals respective to their effectiveness at removing snow and ice, and their impact on the highway infrastructure and surrounding environment.

**Progress:** One of the main thrusts of the research has been the development of test procedures to determine performance of chemicals. The results obtained indicate that while many novel materials hold considerable promise, this promise must always be examined by means of standard tests to determine the efficacy of the novel material. At this time, the experiments have been conducted and many of them have been written up and fully documented. These results, in combination with others that are still being fully documented, will be combined into the final report.

**Reports:** None

**Implementation:** The results of this study will be presented at an appropriate meeting in Iowa after completion of the project. The report would also be made available via e-mail to subscribers on the snow and ice mailing list.



## 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:** The research project attempts to find methods that can effectively and economically reduce corrosion on maintenance vehicles, especially when liquid deicing chemicals are being used.

**Progress:** The challenge in this project was determining how to measure corrosion in a way that is simple, repeatable, and reliable, while ensuring that the method replicates, to the extent possible, the conditions equipment will experience on the highway. An extensive literature review indicates that this challenge is almost certainly impossible to meet. Field tests do provide useful field information, but do not necessarily provide information that is either replicable or fully representative of the range of conditions faced. Laboratory tests are often geared toward a single material type (for example, tests may be suitable for steels but not for aluminum alloys) and the replication of field conditions in the laboratory is an issue of ongoing contention in the field of corrosion.

Notwithstanding these challenges, the project has developed some methods whereby the efficacy of corrosion reduction and prevention additives can be evaluated. That said, the methods proposed should not be considered the last word in this area. The problem addressed herein is far from solved and is likely to remain a challenge for some time to come. At this time, the majority of the experiments conducted in this project have been written up, and the final report will be started once all experimental write-ups are complete.

**Reports:** None

**Implementation:** The result of this study will be presented at an appropriate meeting in Iowa after completion of the project. The report would also be made available via e-mail to all subscribers on the snow and ice mailing list.



**TR-473**

**Agency:**  
Iowa State University

**Principal Investigator:**  
Brian Coree

**Research Period:**  
January 1, 2002 to  
June 30, 2005

**Research Board Funding:**  
\$178,197

**Funding Source:**  
100% State -  
35% Primary funds  
and 65% Secondary  
funds

## **Rehabilitation of Concrete Pavements Utilizing Rubblization and Crack and Seat Methods**

**Objective:** The objective of this project is to study the effects of PCC rubblization and crack-and-seat operations of the HMA overlay thickness necessary to achieve the desired design life. To design HMA overlay on fractured slabs, it is necessary for the design to specifically avoid, or control, the primary distress, i.e. reflective cracking. This is the function of the slab fracturing process in combination with a sufficient thickness of HMA overlay to control the strains at the bottom of the HMA layer, which are a function of the constitution of the entire pavement structure, more especially the subgrade. In order to achieve this objective, four sub-objectives will need to be addressed: 1) to determine the structural value of PCC slabs fractured by either method, 2) to examine design, construction and performance records of existing overlaid fractured PCC pavements to estimate the effects of subgrade, fractured slab thickness and structural value, and overlay thickness on performance (or life), 3) to establish a structural and fatigue model, and 4) to validate/calibrate the model using in-service pavement performance histories and the instrumented pavements on IA 141. Ultimately, this project will provide a research report and implementable design guidelines to the Iowa DOT.

**Reports:** Final Report, September 2005

**Implementation:** The structural value of the fractured slabs will provide more accurate information for the design of overlays over rubblized and crack and seat pavements. The design guide may be used by pavement designers for improvement of the pavement designs.



## TR-474

**Agency:**

The University of Iowa

**Principal Investigator:**

Hosin "David" Lee

**Research Period:**

May 1, 2002 to  
September 30, 2005

**Research Board Funding:**

\$270,513

**Funding Source:**

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

## Development of a Mix Design Process for Cold In-Place Rehabilitation Using Foamed Asphalt- Phases I and II

**Objective:** The main objective is to develop a new mix design process for CIPR using foamed asphalt. The research will 1) review past research efforts on foamed asphalt, 2) evaluate the current practices of CIPR with emulsion, 3) determine mix design parameters for CIPR with foamed asphalt, and 4) develop a lab procedure.

**Progress:** A delay in the delivery of the simple performance tester and the collection and testing of additional samples required additional funding and an extension of time for this project. The final report is expected to be presented in the spring of 2006.

**Reports:** None

**Implementation:** The implementation outlook for the proposed project is very realistic, given a number of planned construction projects of CIPR pavements using foamed asphalt in Iowa. The results of this study will provide a better understanding of the CIPR process using foamed asphalt. A new design method for the CIPR using foamed asphalt is expected to come out of the study for implementation.



**TR-478**

**Agency:**  
Iowa State University

**Principal Investigator:**  
James K. Cable

**Research Period:**  
June 1, 2002 to June 30, 2006

**Research Board Funding:**  
\$49,520

**Funding Source:**  
80% Federal funds and 20% State -  
100% Primary funds -  
This funding is provided as the required state matching funds for the FHWA project.

## **Evaluation of Composite Pavement Unbonded Overlays**

**(Installation and Maintenance of Weigh in Motion (WIM) Detection System on Iowa Highway 13 in Delaware County)**

**Objective:** The IHRB is providing funding as a cost-share of \$50,000 (out of a total project cost of \$230,000). The purpose of this funding is to provide for placement and maintenance of a WIM system in support of the research project, Evaluation of Composite Pavement Unbonded Overlays.

**Progress:** The WIM system was installed in July 2002. The Iowa DOT continues to provide WIM data and maintain the system.

**Reports:** Construction Report, April 2003

**Implementation:** Information collected from the WIM site will be used to provide truck traffic data to Dr. Cable throughout the life of the research project.



## TR-480

**Agency:**

Michigan Technological University

**Principal Investigator:**

Lawrence L. Sutter

**Research Period:**

July 15, 2002 to  
March 14, 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:** The objectives of this project are:

- 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
- 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.

**Progress:** Primary initial focus of research has been shifted to laboratory mortar testing. Permeability, diffusion and sorptivity testing is being conducted on select specimens. A full factorial experimental design has been developed. Concrete testing will be based on the results from mortar testing. Mortar and concrete testing will include supplementary cementitious combinations (C ash, F ash, GGBFS) to determine potential benefits or problems. Profile grinding will be used to determine Cl<sup>-</sup> and Mg<sup>++</sup> distributions

**Reports:** Progress Report, December 2005

**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-481

**Agency:**

Iowa State University

**Principal Investigator:**

David J. White

**Research Period:**

August 15, 2002 to  
December 31, 2004

**Research Board Funding:**

\$120,000

**Funding Source:**

100% State -  
45% Primary funds,  
50% Secondary funds  
and 5% Street funds

## Identification of the Best Practices for the Design, Construction, and Repair of Bridge Approach Sections

**Objective:** 1) Identify state-of-the-art practices for design, construction, and maintenance of bridge approaches to reduce the bridge approach settlement problem. 2) Document several bridge approach sites where poor performance has been observed. 3) Develop practical threshold limits at the interface between the bridge approach and embankment to be used for determination of when corrective maintenance/repair is required. 4) Investigate and continue current monitoring of project case histories. 5) Conduct simple pilot tests for which more rigorous compaction specifications and the application of pre-cambering of the bridge approach is used. 6) Recommend design, construction and maintenance alternatives.

**Reports:** Final, January, 2005

**Implementation:** Because the proposed research is specific to Iowa conditions, results will be implemented by county, city, and state highway agencies and contractors statewide as follows: 1) It is expected that maintenance personnel will adopt the newly established threshold criteria indicating needed repair/maintenance of bridge approaches. 2) Bridge and earthwork contractors will improve quality construction to reduce the occurrence of the bump based on final recommendations. 3) Field personnel will implement QM-E end-result quality assurance testing to ensure proper compaction of bridge embankment fills. 4) Office of Soil Design will consider various ground improvement methods in areas where soft foundation conditions exist. 5) Office of Bridge Design and Office of Soil Design will consider alternative design approaches the design of new bridges.



## TR-483

**Agency:**

Iowa State University

**Principal Investigator:**

Brian J. Coree

**Research Period:**

August 1, 2002 to  
September 30, 2005

**Research Board Funding:**

\$145,775

**Funding Source:**

100% State -  
65% Primary funds,  
30% Secondary funds  
and 5% Street funds

## Evaluation of Hot Mix Asphalt Moisture Sensitivity Using the Nottingham Asphalt Test (NAT) Equipment

**Objective:** This research will develop one or more test protocols using the superpave gyratory compactor and the NAT with which more reliable, or robust, determinations may be obtained of the likelihood of moisture damage in hot mix asphalt mixtures. These protocols will include and specifically address sample preparation, sample conditioning and testing, and recommendations as to critical acceptance criteria. Field validation and implementation plans will be recommended.

**Reports:** Final Report, October 2005

**Implementation:** 1) DOT specification for each aggregate type and source that identifies the material as a stripper or a non-stripper; and 2) revised DOT specification substituting the recommended method/protocol in place of the current AASHTO T-283 procedure. Revision of the current specification to allow the use of 150 mm samples in the AASHTO T-283 procedure.



## TR-484

**Agency:**

Iowa State University

**Principal Investigator:**

Scott Schlorholtz

**Research Period:**

July 1, 2002 to  
December 31, 2005

**Research Board Funding:**

\$159,666

**Funding Source:**

49% Federal funds  
and 51% State -  
50% Primary funds,  
35% Secondary funds  
and 15% Street funds

## Materials and Mix Optimization Procedures for PCC Pavements

**Objective:** The ultimate goal of this research project is to provide contractors and engineers with a set of guidelines that simplify and specify the process of producing affordable and durable PCC pavements. The guidelines will provide details on optimization of concrete mixing procedures when supplementary cementitious materials and other admixtures are used to modify the properties of concrete. The scope of this project is limited to materials commonly used by the Iowa DOT.

The specific objectives of the project include:

- Define the characteristics of a “good” concrete mix while still in the plastic state.
- Investigate effects of the key parameters of concrete mixing on fresh concrete properties.
- Develop guidelines for proper optimization of materials and mixing method/time.

**Progress:**

- Laboratory and field projects are almost complete.
- A final report is expected to be ready for presentation to the IHRB at the January 2006 meeting.

**Reports:** None

**Implementation:** Implementation of the project results will be conducted through an implementation module structured for practicing engineers, technicians, quality assurance/quality control personnel, contractor superintendents, trade persons, and producers. Development of user guides and training sessions will be at the joint discretion of the Principal Investigator and PCC Center Advisory Board and Iowa Highway Research Board. In addition, the results will be incorporated for national distribution into the deliverables of the larger “Material and Construction Optimization for Concrete Pavements” program.



**TR-485**

**Agency:**

The University of Iowa

**Principal Investigator:**

Marian Muste

**Research Period:**

August 26, 2002 to  
September 30, 2003

**Research Board Funding:**

\$38,757

**Funding Source:**

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

## **Erosion Control for Highway Applications - Phase II: Development and Implementation of a Web-Based Expert System for Erosion and Sediment Control Measures**

**Objective:** The objectives of Phase II of this project are to substantially enhance the expert-system's (ES) knowledge database, transition the current PC version to a web-based platform, and disseminate the developed computer application to Iowa DOT users. Enhancement of the ES entails the following additions:

- The extensive in-house erosion and sedimentation control methods (ESCM) expertise developed by the Iowa DOT.
- Calculation engines for estimation of sediment yield or water runoff.
- The components related to the Storm Water Pollution Prevention Plan and other pertinent permitting requirements (e.g. state, local).

**Reports:** Final Report, January 2005

**Implementation:** The ES is aimed at practically assisting state, city, and county engineers to select, design, construct, inspect, and maintain erosion and sediment control measures. The Web-version of the ES will enable additional user categories, (e.g. associate general contractors, design engineers, consultant engineers) to make use of the expertise assembled in the ES. Training sessions for various groups of users will be prepared by the developers of the ES aided by ESCM experts from Iowa DOT and elsewhere.



## TR-486

**Agency:**

Iowa State University

**Principal Investigator:**

F. Wayne Klaiber, David J. White and Terry J. Wipf

**Research Period:**

December 1, 2002 to August 31, 2004

**Research Board Funding:**

\$99,265

**Funding Source:**

100% State -  
100% Secondary funds

## Development of Abutment Design Standards for Local Bridge Designs

**Objective:** The objective of the proposed project is to prepare a series of abutment designs that complement previously developed replacement superstructures. Although various systems will be reviewed, as a minimum the following will be reviewed in detail (and where appropriate, designs and construction drawings developed): a simple concrete abutment, the sheet pile backwall, and a timber backwall design.

**Reports:** Final, August, 2004

**Implementation:** The bridge abutments used by many counties do not qualify as standard stub abutments according to the Bridge Design Manual. As a result, we do not have standards that county engineers can use to help design these abutments. This research will help develop those standards.



**TR-487**

**Agency:**

Iowa State University

**Principal Investigator:**

Edward J. Jaselskis

**Research Period:**

October 1, 2002 to  
October 31, 2004

**Research Board Funding:**

\$124,999

**Funding Source:**

100% State -  
45% Primary funds,  
50% Secondary funds  
and 5% Street funds

## **Development of Object-Oriented Specifications for Iowa DOT and Urban Standards**

**Objective:** The purpose of this research project is to perform a Phase I study to pilot test this idea and assess its impact on the design and construction of transportation projects. It is anticipated that some specifications (Iowa DOT and urban) will be included in an object-oriented format to demonstrate the concept. The research team plans to build off the current work related to the Electronic Reference Library (ERL) since this is already in a useable format for this pilot project. In a sense, the end product will be a graphical or visual front end system for the ERL. One possible acronym is the Visual Electronic Reference Library (VERL). Full-scale development and maintenance issues will be addressed as part of the project. Workshops will be provided to obtain information on the usefulness of this idea.

**Reports:** Final Report, October 2004

**Implementation:** It will be easier for designers, field personnel, contractors, suppliers, and manufacturers to find the specifications relevant for a specific portion of the design. This should improve the efficiency of preparing the design documents and interpreting them in the field. It will also help DOT in maintaining a cutting-edge presence in information technologies since this may be a new paradigm in which projects will be constructed in the future.



**TR-488**

**Agency:**

The University of Iowa

**Principal Investigator:**

Wilfrid A. Nixon

**Research Period:**

February 1, 2003 to  
July 31, 2004

**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:** The objective of this project is to determine what mixture of calcium chloride and sodium chloride is best applied to the road surface under winter weather conditions, to provide the best possible level of service to the public, in the most economical way possible. As part of this, economic factors, as well as ice melting capability, will be considered, and operational impacts will be a major factor of consideration.

**Progress:** The project has investigated the creation of these mixtures and has tested their efficacy with temperature. In addition, a financial model has been developed that allows the costs and benefits of these mixtures to be compared and thus indicates when mixtures make sense economically, and which are the most economical for given conditions. Further, the slurry issue has been investigated and found, for the most part, not to be of practical concern. The results of this study are in the process of being written into a final report.

**Reports:** None

**Implementation:** The result of this study will be presented at an appropriate meeting in Iowa after completion of the project. The report will also be made available via e-mail to all subscribers to the Snow and Ice mailing list, and will be placed on the Snow and Ice Cooperative Program Web site ([www.sicop.net](http://www.sicop.net)).



**TR-489**

**Agency:**

Iowa State University

**Principal Investigator:**

David J. White

**Research Period:**

March 1, 2003 to  
December 1, 2005

**Research Board Funding:**

\$198,462

**Funding Source:**

100% State -  
25% Primary funds  
and 75% Secondary  
funds

## **Innovative Solutions for Slope Stability Reinforcement and Characterization in Iowa Soils**

**Objective:** The objectives of this research are as follows:

- Identify state-of-the-art practices for design, construction and maintenance of earth slopes to reduce slope instability problems on new embankments and backslope cuts. Develop recommendations specific to Iowa site conditions.
- Document several failure sites (5-10) where failures have been observed in order to better understand conditions that lead to instability in Iowa.
- Show the validity of and develop appropriate test procedures (i.e. Instructional Memorandums) for determining shear strength parameters using the BST.
- Investigate and conduct simple pilot tests to evaluate various remediation techniques.
- Recommend design, construction and remediation alternatives for Iowa soil conditions to ensure slope stability of new embankment till and shallow backslopes.

**Progress:** Slope stability characterization focused on application of the in-situ technique of Borehole Shear Test (BST) for slope investigations. BST provides a fast means of determining effective shear strength parameter values of the soils. A total of 15 slopes involving clay shales and glacial tills in Iowa were investigated and analyzed using limit equilibrium methods and a probabilistic approach. To evaluate remediation of slopes with stabilizing piles, the soil-structure interaction for composite grouted piles with steel reinforcement subject to free-field lateral soil movement was investigated by conducting full-scale pile load tests.

**Reports:** None

**Implementation:** A summary sheet will be created and a PowerPoint presentation will be made at appropriate local/regional conferences to help in design, construction and maintenance operations.



**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:** The objective of this project is 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 must be able to measure the outcomes of the winter maintenance actions in such a way as to cumulatively assess the performance of those actions.

**Progress:** A winter storm index has been developed and rated by maintenance personnel. Thus, every storm that occurs in Iowa can now be assigned a score of between 1 (extremely difficult) and 0 (very easy).

The next step is to measure how much effort was expended addressing the problems caused by a storm. This expenditure may be considered the "output" of the agency that is charged with winter maintenance. This linkage is currently being explored.

The final step is to measure how well the efforts expended by the agency actually worked. In other words, the "outcomes" of the winter maintenance activities must be measured. Currently work is focused on establishing these levels and determining the best way to measure both safety and mobility in near real time, so that the outcomes of a given storm can be measured and discussed soon after the storm has occurred. This project is in the process of finishing research, and some of the final report (in the area of storm severity) has already been written.

**Reports:** None

**Implementation:** The results of this study will be presented at an appropriate meeting in Iowa after completion of the project. The report would also be made available via e-mail to all subscribers to the snow and ice mailing list. The final report will be made available in pdf format.



## TR-492

**Agency:**

Iowa State University

**Principal Investigator:**

David J. White

**Research Period:**

May 15, 2003 to  
November 15, 2005

**Research Board Funding:**

\$169,067

**Funding Source:**

100% State -  
70% Primary funds,  
15% Secondary funds  
and 15% Street funds

## Embankment Quality Phase IV - Application to Unsuitable Soils

**Objective:** Embankment Quality Phase IV research is to continue development and refinement of the QM-E program, but with effort focused specifically on “unsuitable” soils. This phase will provide additional *Grading Certification Level I* training of contractor and field personnel on two separate pilot projects - preferably one in western Iowa and one in southern Iowa. The outcomes of this phase will be 1) final recommendations for QM-E implementation; 2) a proposed Iowa DOT developmental specification; and 3) improved data management tools for contractor quality control (QC) and Iowa DOT quality assurance (QA).

**Progress:** The Phase IV pilot project has been selected – Jefferson county on US-34. The letting is scheduled for Fall of 2005. Because of the delays, a no-cost extension of this project is expected.

**Reports:** None

**Implementation:** The results of this research and pilot studies will be used as a basis for developing statewide specification changes for improved roadway embankments.



## TR-493

**Agency:**

Iowa State University

**Principal Investigator:**

Terry J. Wipf

**Research Period:**

May 1, 2003 to April 30, 2006

**Research Board Funding:**

\$196,421

**Funding Source:**

100% State -  
75% Primary funds,  
20% Secondary funds  
and 5% Street funds

## Performance Evaluation of Steel Bridges - Phase II

**Objective:** There are two primary objectives to the proposed research: first, to study the performance of bridges with suspect or untested design details; and second, to develop a low-cost system for use by secondary road bridge owners to easily monitor the conditions of infrastructure.

**Progress:** A detailed data processing scheme and instrumentation plan have been developed and deployed. Monitoring schemes and system development continues. Significant progress has been made in both hardware integration and in the preparation of data collection and analysis software.

**Reports:** None

**Implementation:** The product of this research will be a better understanding of two types of primary road bridges and the development of a low-cost monitoring system for secondary road bridges. With the behavior information for the primary road bridge, the bridge owner will likely gain confidence in the performance of two bridge types. Also, secondary road bridge owners will have a low-cost system for monitoring bridges for specific behaviors or events.



## TR-495

### Agency:

Iowa State University

### Principal Investigator:

E. Thomas Cackler,  
David J. White and  
Edward J. Jaselskis

### Research Period:

May 15, 2003 to  
August 31, 2004

### Research Board Funding:

\$75,000

### Funding Source:

40% other sources  
and 60% State -  
80% Primary funds,  
10% Secondary funds  
and 10% Street funds

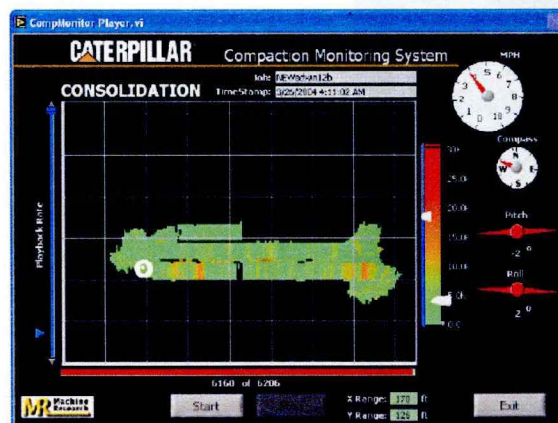
## Field Evaluation of Compaction Monitoring Technology

**Objective:** The project's objectives are as follows:

- Evaluate compaction-monitoring technology under actual field conditions for a wide range of soil, aggregate, and asphaltic concrete materials available in Iowa.
- Identify needed refinements to the technology and communication systems and make appropriate modifications.
- Develop model QC/QA guidelines using this technology.
- Identify the technology's potential benefit to contractors and project owners.

**Reports:** Final Report, September 2004

**Implementation:** The project will result in advances in real-time compaction monitoring technology, which will provide contractors and project owners improved job site safety, faster construction, and greater cost savings. The motoring public will also benefit from reductions in travel delays and disruption. The project will contribute significantly to the AASHTO Subcommittee on Construction's priorities of research into rapid, real-time testing.



Monitor output for machine energy



**TR-496**

**Agency:**  
Stanley Consultants, Inc.

**Principal Investigator:**  
Larry Badtram

**Research Period:**  
April 1, 2004 to  
January 31, 2005

**Research Board Funding:**  
\$179,250

**Funding Source:**  
100% State -  
100% Secondary  
funds

## **Development of Standard Plans for the Design of Single Span Pretensioned, Prestressed Concrete Beam Bridges with Concrete Abutments**

**Objective:** The objective of this project is to perform an engineering study to update the existing H24S and H30S bridge standards and to create a new standard (H24IS and H30IS) utilizing concrete abutments.

**Reports:** Bridge Standards, May 2005.

**Implementation:** All drawing files were included in Microstation format for the final submittal for both standard series. The detail sheets will be made available in PDF and Microstation format on the Iowa DOT Web page.

Counties are currently paying approximately \$5,000 to \$8,000 per bridge for consultant designs of concrete abutments. The cost of developing these standards will be recouped after being used approximately 23-36 times. Cost savings would then be available for use in other parts of the roadway network.



## TR-497

**Agency:**

Iowa State University

**Principal Investigator:**

Stephen J. Andrie

**Research Period:**

July 1, 2003 to  
February 28, 2005

**Research Board****Funding:**

\$59,965

**Funding Source:**

100% State -  
20% Primary funds,  
75% Secondary funds  
and 5% Street funds

## Manual of Iowa Drainage Law

**Objective:** The objective of this project is to develop a manual that clearly and completely describes drainage laws that are applicable to the entire state of Iowa and those specific to Iowa's drainage districts. The manual will provide a comprehensive reference for Iowa engineers, landowners, drainage district commissioners, county drainage clerks, county supervisors and other officials, contractors, and other interested people of drainage laws and general legal principles of drainage as well as potential impacts on construction and maintenance of drainage improvements.

**Reports:** Final Report, February 2005

**Implementation:** Iowa counties, cities, and the Iowa DOT will be able to apply the research results and products to improve efficiency, procedures, and communications. Affected landowners and others who are interested will also benefit from having access to the information in the manual. The manual will serve to answer questions, reduce confusion, and facilitate mutually beneficial, rather than adversarial, relationships between parties affected by drainage issues and transportation projects.



## TR-498

**Agency:**

Iowa State University

**Principal Investigator:**

F. Wayne Klaiber and  
Terry J. Wipf

**Research Period:**

June 1, 2003 to July  
31, 2006

**Research Board Funding:**

\$192,958

**Funding Source:**

100% State -  
100% Secondary  
funds

## Field Testing of Railroad Flat Car (RRFC) Bridges

**Objective:** The primary objective of this research was to obtain more data on the structural behavior of additional RRFC bridges. When this project was initially proposed, only two RRFC demonstration bridges had been constructed and tested. Numerous other variables needed to be investigated. Refinement of the design methodology presented in TR-444 was needed, as well as the development of a load rating process for these types of bridges.

In June, 2005, the need to investigate continuous span RRFC bridges became apparent and thus an extension to the current project to include the testing of three continuous span bridges was proposed and approved by the IHRB.

**Progress:** The five simple span bridges have been tested and data from these tests have been incorporated into the design methodology developed in TR-444. A rating procedure has also been developed for simple span RRFC bridges. One of the continuous span bridges will be tested in fall, 2005 and two others in spring and summer, 2006.

**Reports:** None

**Implementation:** The primary value of the proposed research is to provide counties with a bridge superstructure alternative that is relatively inexpensive and easy to install. Results of this investigation will improve the design methodology previously developed in TR-444. The rating methodology developed in this investigation will make it possible for county engineers and consultants to rate these types of bridges.



Finished Buchanan County RRFC Bridge



## TR-499

**Agency:**

NNW, Inc. and sub-contract with The University of Iowa

**Principal Investigator:**

Steven Jacobsen (NNW, Inc.) and Hosin "David" Lee (The University of Iowa)

**Research Period:**

July 15, 2003 to July 31, 2004

**Research Board Funding:**

\$30,000 (NNW, Inc. - \$20,000; The University of Iowa - \$10,000)

**Funding Source:**

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

## Effectiveness of Electrochemical Chloride Extraction (ECE) for the Iowa Avenue Pedestrian Bridge

**Objective:** This research effort is expected to provide local engineers and contractors with a better understanding of the ECE process as it applies to bridge decks. It is hoped that research will show that the ECE process is an effective method to prolong the useful life of bridge decks and thus provide a replacement cost savings to the people of Iowa.

**Reports:** Final, March, 2005

**Implementation:** The research findings are expected to determine the short-term and long-term effectiveness and justification for the ECE process for various depths or thicknesses of slabs. If the ECE proves effective, it would extend the life of bridges, thereby reducing the costs for bridge replacement.

Construction specifications would be written to include testing of the deck concrete and extraction when required.



## TR-500

**Agency:**

Iowa Department of  
Transportation

**Principal  
Investigator:**

Kelly Poole and Scott  
Marler

**Research Period:**

July 24, 2003 to  
August 31, 2004

**Research Board  
Funding:**

\$6,802

**Funding Source:**

100% State -  
100% Primary funds

## Evaluation of the Compensatory Wetland Mitigation Program in Iowa

**Objective:** This research will focus on characterizing wetland mitigation projects at a minimum of 24 randomly selected sites. The research objectives are to do the following:

- Determine if project areas meet the definition of a jurisdictional wetland, and
- Determine degree of compliance with requirements specified in Clean Water Act Section 404 permits.

**Reports:** Final, August, 2004

**Implementation:** The results of this study will form the basis of more detailed biological, chemical and physical investigations of selected mitigation sites. In addition, the results of this work will provide a means for evaluating restoration and construction techniques and provide valuable information toward improving the DOT's compensatory wetland mitigation efforts as we respond to an increasing number of non-compliance inquiries. The results of this work will be integrated with the results of additional studies which will be submitted for publication in a peer-reviewed journal.



## TR-501

**Agency:**

Iowa State University

**Principal****Investigator:**

Radhey S. Sharma

**Research Period:**

January 1, 2004 to  
December 31, 2005

**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:** The following are the objectives for this project:

- Through a forensic study of recent geotechnical problems and failures in Iowa, identify the impact of not doing material management and optimization.
- 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.

**Progress:** The project has been focused on three problems, namely: optimization of earthwork materials by mixing and proportioning, shoulder disintegration, and distress in the vicinity of highway drainage pipes. Data analysis and soil sampling are underway. Profiles of distress over drainage pipes have begun and will be compared to with numerical results.

**Reports:** None

**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.



## TR-502

**Agency:**

Iowa State University  
and The University of  
Iowa

**Principal  
Investigator:**

Charles Jahren and  
Hosin "David" Lee

**Research Period:**

November 1, 2003 to  
February 28, 2006

**Research Board  
Funding:**

\$145,216 (Iowa State  
University - \$97,941;  
The University of  
Iowa - \$47,275)

**Funding Source:**

100% State -  
50% Primary funds  
and 50% Secondary  
funds

## Evaluation of Long Term Field Performance of Cold In-Place Recycled Roads

**Objective:** The objectives of this research project are to develop an understanding of the following:

- How the engineering properties of CIPR material, the environment, traffic and subgrade conditions influence the performance of the CIPR pavement.
- How the engineering properties of CIPR material change over time.
- How the mix design and the construction methods influence the engineering properties of CIPR materials.
- A rational mix design method and construction quality control system that is generally accepted in Iowa.

**Progress:** An inventory of CIPR projects across the state of Iowa has been completed as have pavement distress surveys. Sampling for field and laboratory testing is being completed.

**Reports:** None

**Implementation:** The result of this study will allow transportation officials to make decisions with regard to cold in-place asphalt recycling with more confidence that those decisions will result in actual improvements in road performance. As road performance improves, road users will have more satisfaction with pavement condition and tax payers will obtain more cost effectiveness from transportation network investments.



## TR-503

**Agency:**

Iowa State University

**Principal Investigator:**

Vernon R. Schaefer

**Research Period:**

October 1, 2003 to  
December 31, 2004

**Research Board Funding:**

\$119,412

**Funding Source:**

100% State -  
25% Primary funds,  
25% Secondary funds  
and 50% Street funds

## Utility Cut Repair Techniques - Investigation of Improved Utility Cut Repair Techniques to Reduce Settlement in Repaired Areas

**Objective:**

- To identify pavement patching techniques that are cost effective and durable. Pavement patch techniques will be examined on existing urban streets and rural highways. Good and poor pavement utility repair techniques will be identified.
- Research and identify trench subsurface principles that minimize utility trench settlement or bridging of the trench in cold weather.
- Develop a best practices utility repair techniques manual for state and local jurisdictions, which is a synthesis of known field practices and/or documented research. A section of the manual will contain recommended requirements that can be used by jurisdictions in their utility permit process.

**Progress:** The research team is drafting the final report.

**Reports:** None

**Implementation:** The observations and conclusions from this study will provide recommendations on effective utility cut repairs. State, county, and city transportation agencies/jurisdictions can implement the recommendations for utility cut repairs. It is anticipated that the best practices manual 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.



## TR-504

**Agency:**

Digital Control, Inc.

**Principal Investigator:**

LaDon Jones

**Research Period:**

November 1, 2003 to  
December 31, 2004

**Research Board Funding:**

\$40,000

**Funding Source:**

100% State -  
50% Primary funds  
and 50% Secondary  
funds

## Extensions to the Iowa Culvert Hydraulics Software - The Design of Energy Dissipators

**Objective:** The main objective is the addition of energy dissipator design to the Iowa Culvert Hydraulics software. The updated software will be known as the Iowa Culvert Hydraulics Software, Version 2.0. The updated version will be completely backward compatible with the current version. That is, the user can access files created from the current version in the new version without any loss of information.

In addition, while the software is being upgraded, we propose to also add an additional design discharge estimation method, update the user manual, and add an on-line version of the user manual.

**Reports:** Software package, April, 2005

**Implementation:** The Iowa DOT and counties can use the updated software to assist in the design of energy dissipators for culvert outlets. The Iowa DOT handled the copying and distribution of the current version of the Iowa Culvert Hydraulics Software, and we propose to continue with this arrangement.



## TR-505

**Agency:**

Iowa State University

**Principal Investigator:**

Vernon R. Schaefer

**Research Period:**

October 1, 2003 to  
September 30, 2005

**Research Board Funding:**

\$164,764

**Funding Source:**

50% Federal funds  
and 50% State -  
70% Primary funds,  
15% Secondary funds  
and 15% Street funds

## Improving PCC Mix Consistency and Production by Mixing Improvements

**Objective:** To find optimal mixing procedures for production of a homogeneous and workable mixture and quality concrete using a two-stage mixing operation.

**Specific Objectives:**

- To achieve optimal mixing energy and time for a homogeneous cementitious material.
- To characterize the homogeneity and flow property of the pastes.
- To investigate effective methods for coating aggregate particles with cement slurry.
- To study the effect of the two-stage mixing procedure on concrete properties.
- To improve production rates.

**Progress:** Laboratory concrete testing is complete. Analysis of the field data obtained is being undertaken. Report preparation has begun to document the laboratory and field results. There has been difficulty in identifying and developing a full scale field test section. A full scale field test will be delayed until spring 2006.

**Reports:** None

**Implementation:** The Iowa DOT will use this two-stage mixing operation in demonstration projects. This is intended to lead to development of a new specification for the process.



TR-506

**Agency:**  
Iowa State University

**Principal Investigator:**  
Vernon R. Schaefer and  
Robert A. Lohnes

**Research Period:**  
October 1, 2003 to  
March 31, 2005

**Research Board Funding:**  
\$107,070

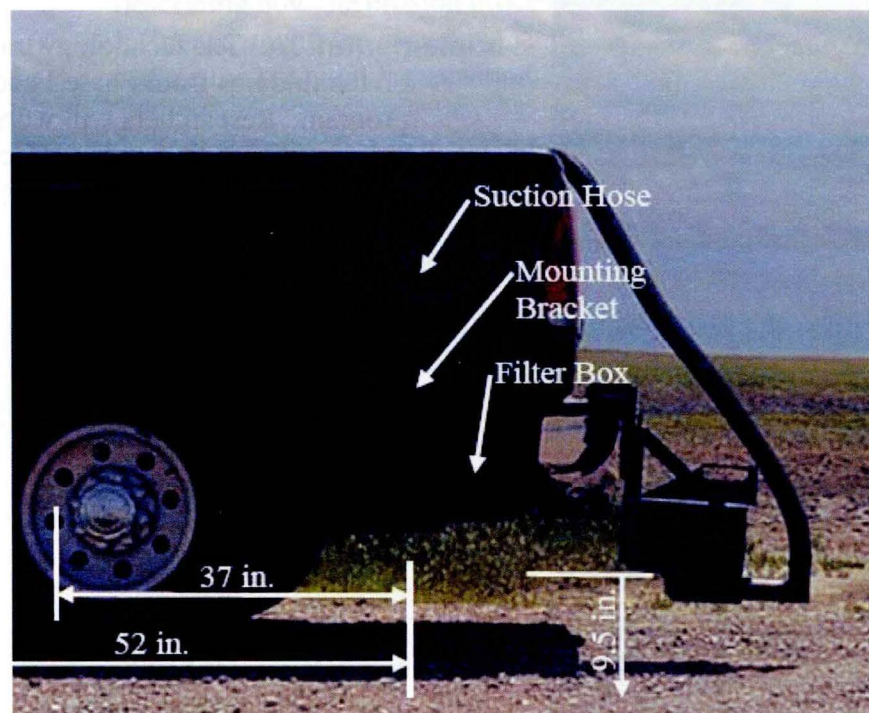
**Funding Source:**  
100% State -  
100% Secondary  
funds

## Determination and Evaluation of Alternate Methods for Managing and Controlling Highway-Related Dust, Phase II - Demonstration Project

**Objective:** The objective of the proposed study is to evaluate the effectiveness of two dust control additives that have been used but subjected to limited systematic studies. The two suppressants are: ground asphalt shingles and soap stock (a soybean oil by-product). These materials will be compared with untreated sections, as well as lignin and calcium chloride that are currently widely used as dust palliatives.

**Reports:** Final, June, 2005

**Implementation:** The observations and conclusions from this study will provide recommendations on most effective dust control methods and materials. State, county, and city transportation agencies can implement the recommendations for maintenance of unpaved roads.



Mounted Dustometer



**TR-507**

**Agency:**

Iowa State University

**Principal Investigator:**

Charles Jahren

**Research Period:**

November 1, 2003 to  
December 31, 2005

**Research Board Funding:**

\$86,373

**Funding Source:**

100% State -  
20% Primary funds,  
20% Secondary funds  
and 60% Street funds

## **Thin Maintenance Surfaces - Phase III - Municipal Streets and Low Volume Rural Roads**

**Objective:** The objective of the proposed project is to fully develop a thin maintenance surface technology transfer program specifically for municipal and secondary road personnel. The program will be developed to fit the specific needs of the following groups:

- Municipal and county engineers
- Consulting engineers and contractors involved in secondary road and street maintenance
- Secondary road and street superintendents
- Officials involved in street maintenance for small municipalities

**Progress:** Demonstration sections construction is complete. Post construction monitoring is ongoing. A final report is expected to be presented to the IHRB in January, 2006.

**Reports:** None

**Implementation:** The technology transfer program will be based on the findings from Phase I and II of this research program. Researchers will work with a focus group of the target audience to develop effective material.



## TR-508

**Agency:**  
Iowa State University

**Principal Investigator:**  
Dale Harrington

**Research Period:**  
December 1, 2003 to  
November 30, 2005

**Research Board Funding:**  
\$207,800

**Funding Source:**  
100% State -  
33.3% Primary funds,  
33.4% Secondary  
funds and 33.3%  
Street funds

## Design Guide and Construction Specifications for NPDES Site Runoff Control

**Objective:** Update and publish a revised erosion control section in the SUDAS Urban Design Standards and Urban Standard Specifications in order to provide additional tools for designers and contractors to meet the requirements of National Pollution Discharge Elimination System (NPDES) Phase II Stormwater Regulations. Issue addenda to the two SUDAS manuals and place the contents of the erosion and sedimentation control on the Web. Assist Iowa DOT to upgrade its design standards and specifications for Iowa DOT's and counties' rural projects.

**Progress:** Work on the draft version of the design chapter for SUDAS Erosion and Sediment Control Design Manual is nearing completion. Design criteria have been developed and written for twenty-seven different erosion and sediment control measures. Supporting information to accompany the measures has also been developed. A design section describing how the erosion process occurs, the factors that influence it, and the methods that can be implemented to reduce the potential for erosion has been developed.

A section in the design manual on the regulatory requirements that apply to erosion control is also complete. This section provides a description of the NPDES system of regulations and the steps necessary to comply with the regulations.

**Reports:** None

**Implementation:** This project will provide Iowa Municipal Separate Storm Sewer Systems entities and design engineers a reference and design handbook for selection and implementation of water quality based BMP for stormwater management. The design procedures and specifications should facilitate the adoption of water quality based stormwater management by Iowa communities.



## TR-509

**Agency:**

Iowa State University

**Principal Investigator:**

Brian J. Coree

**Research Period:**

November 1, 2003 to  
January 31, 2005

**Research Board Funding:**

\$75,003

**Funding Source:**

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

## AASHTO 2002 Pavement Guide Implementation Plan - Phases I and II

**Objective:** The objective is to formalize a process leading to an approved implementation plan by July 2004.

**Reports:** Final Report, May 2005

**Implementation:** The benefits that may accrue from this project include the following:

- A detailed analysis of the Design Guide by knowledgeable faculty and Iowa DOT staff.
- An examination of the data-readiness of Iowa DOT for implementation.
- A sensitivity study to identify those factors of specific importance to implementation in Iowa.
- A phased approach to implementation over four years, with which the background, the basics, the testing and use of the new guide can be developed in an orderly fashion.
- A training schedule for DOT and non-DOT users.



## TR-510

**Agency:**

Iowa State University

**Principal Investigator:**

Max Porter

**Research Period:**

February 1, 2004 to  
October 31, 2005

**Research Board Funding:**

\$57,992

**Funding Source:**

56.2% Federal funds,  
11.2% other sources  
and 32.6% State -  
80% Primary funds  
and 20% Secondary  
funds

## Laboratory Study of Structural Behavior of Alternative Dowel Bars

**Objective:** The objective of this research is to determine an improved test procedure to replace the AASHTO T253 procedure and the corresponding analysis to incorporate the modulus of dowel support based upon structural laboratory tests.

**Progress:** A full series of 36 concrete specimens were completed for their testing. An additional 18 test specimens are being constructed with concrete casting scheduled for October 2005. Two graduate students are no longer employed on the project. The departure of these individuals has caused delays and an extension will be requested.

**Reports:** None

**Implementation:** Implementation is to be done via recommendations to the following:

- State DOTs for improved dowel bar design
- AASHTO for an improved test procedure to replace the current T253
- FHWA for improved dowel bar design.



## TR-511

**Agency:**

Iowa State University

**Principal****Investigator:**

James K. Cable

**Research Period:**

February 1, 2004 to  
September 30, 2005

**Research Board  
Funding:**

\$101,578

**Funding Source:**

52.8% Federal funds,  
2.6% State In-kind  
and 44.6% State -  
45% Primary funds,  
50% Secondary funds  
and 5% Street funds

## Design and Construction Procedures for Concrete Overlay and Widening of Existing Pavements

**Objective:** The objectives of this research are as follows:

- Conduct a structural analysis of the overlay and widening unit contributions to stress reductions and extended pavement life of the composite pavement.
- Develop construction guidelines for construction of thin concrete overlays and widening units and a catalog of designs employed.
- Develop overlay design procedures for the thin PCC overlays and widening units.
- Validate the structural and design procedure with field load tests and strain measures for the various pavement layers of the existing pavements.

**Reports:** Final Report, October 2005

**Implementation:** The results will be implemented in several ways:

- Presentation of the design manual with city, county, state, and national groups during their annual meetings or through special workshops.
- Development of demonstration projects with specific county, city and state engineers in selected Iowa highway districts to illustrate the process.



## TR-512

**Agency:**  
Iowa State University

**Principal Investigator:**  
James K. Cable

**Research Period:**  
February 1, 2004 to  
December 31, 2004

**Research Board Funding:**  
\$75,000

**Funding Source:**  
20% Federal funds,  
46.5% other sources  
and 33.5% State -  
45% Primary funds,  
45% Secondary funds  
and 10% Street funds

## Measuring Pavement Profile at the Slipform Paver

**Objective:** This research is directed at evaluation of equipment and methods to measure profile being produced at the slipform paver and by each of the various pieces of paving equipment and processes used from the deposit of the pavement concrete to the completion of the curing operation.

**Reports:** Final Report, April 2005

**Implementation:** The results of this research (guidelines and draft specifications) relating to smoothness will first be introduced at national, state and local pavement meetings to discuss the proposed specifications, equipment and goals of proposed changes in paving processes.

Secondly, a series of demonstration projects using different paving train equipment models and makes with the profiling equipment to compare the results to conventional measurements and processes would be developed for state and local projects.



Real Time Profiler Beams Attached in Each Wheel Track



## TR-513

**Agency:**

The University of Iowa -  
Office of the State  
Archaeologist

**Principal  
Investigator:**

Joe Alan Artz

**Research Period:**

April 1, 2004 to  
December 30, 2005

**Research Board  
Funding:**

\$50,000

**Funding Source:**

100% State -  
45% Primary funds  
and 55% Secondary  
funds

## Decision Support Model for Assessing Archaeological Survey Needs for Bridge Replacement Projects in Iowa

**Objective:** The Decision Support Model will leverage Iowa DOT's 30-year investment in archaeological survey to create a tool for evaluating the archaeological potential of bridge replacement projects. The following objectives will be achieved:

- Evaluate data from previous archaeological surveys of bridge replacements with regard to their ability to detect buried archaeological sites.
- Identify critical variables that influence the presence, preservation, and relative age of cultural deposits in a proposed bridge replacement's Area of Potential Effect.
- Develop a Decision Support Model that allows project planners and their archaeological consultants to apply the critical variables in evaluating the archaeological potential of proposed bridge replacement projects.
- Develop a handbook in pdf format containing guidance and best practices for using the Decision Support Model
- Develop recommendations for further research to improve, test, and extend the Decision Support Model.

**Progress:** As a framework for evaluating survey data and modeling archaeological potential, a GIS has been developed. Researchers have created a web site that provides planners and archaeologists with a means of evaluating archaeological site potential from soil survey data. The Decision Support Model and final report should be ready for presenting to the IHRB by winter, 2005.

**Reports:** None

**Implementation:** The Decision Support Model will be used at the local level by city, county, and district engineers, at the state level by State Historical Preservation Office and Iowa DOT, and by archaeological and engineering/environmental consultants at the individual project level. Self-training will be provided to some extent by the User's Manual, but some amount of hands-on, instructor-led training may also be needed.



**TR-514**

**Agency:**  
Iowa State University

**Principal Investigator:**  
Duane Smith

**Research Period:**  
May 1, 2004 to  
December 31, 2005

**Research Board Funding:**  
\$64,991

**Funding Source:**  
100% State -  
100% Secondary  
funds

## **Development of a Manual of Practice for Roadway Maintenance Workers**

**Objective:** The objective of this project is to prepare a maintenance practices manual for county road workers and supervisors for use as a training and reference tool. The manual will be topical with each maintenance activity covered in a short chapter that will offer concise information targeted to equipment operators (backhoe operators and truck drivers) and other workers who actually perform the maintenance work. Ideally, the chapters would form the backbone for a "tool box talk" safety and training program.

**Progress:** The chapter format and outlines have been established. Graphics and illustrations are in the process of being developed. Several chapters are currently being written.

**Reports:** None

**Implementation:** Presentations to introduce and explain the handbook will be made to county engineers and transportation professionals at conferences and workshops. The manual will be highlighted in Iowa's Local Technical Assistance Program (LTAP) publication, *Tech News*, and technical articles will be developed incorporating the research findings. It is anticipated a one-day workshop on the manual will most likely be developed, and will be provided for maintenance workers at many locations around the state over the next several years through the Iowa LTAP.



## TR-515

**Agency:**

The University of Iowa

**Principal Investigator:**

Robert Ettema and  
Thanos Papanicolaou

**Research Period:**

April 1, 2004 to  
December 31, 2005

**Research Board Funding:**

\$80,816

**Funding Source:**

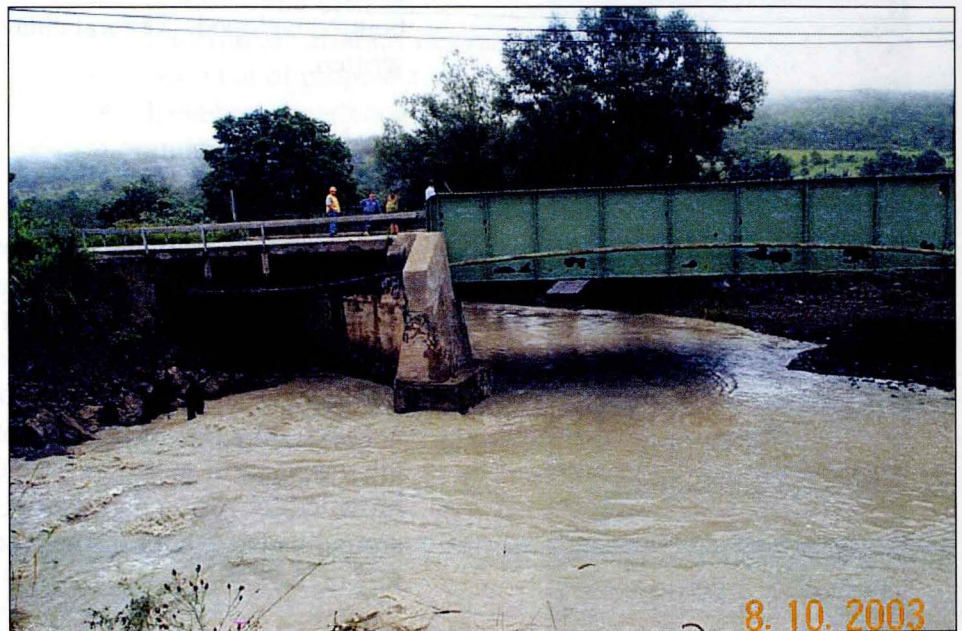
100% State -  
40% Primary funds,  
55% Secondary funds  
and 5% Street funds

# A Guide for Monitoring and Protecting Bridge Waterways Against Scour

**Objective:** The objective of this project is to prepare a comprehensive, well-illustrated, and practical manual that will substantially help engineers in monitoring, maintaining, and protecting bridge waterways so as to mitigate or manage scour occurring at the bridge structures.

**Reports:** Draft Final Report, October 2005

**Implementation:** The primary product of this project will be a practical manual that will aid engineers to monitor bridge waterways. If deemed necessary, the manual could be introduced and explained in a workshop setting.



Waterway scour threatens bridge abutment and embankment.



## TR-516

**Agency:**

Iowa State University

**Principal Investigator:**

David J. White

**Research Period:**

May 1, 2004 to April 30, 2008

**Research Board Funding:**

\$40,000

**Funding Source:**

100% State -  
75% Primary funds,  
15% Secondary funds  
and 10% Street funds

## Measurement of Seasonal Changes and Spatial Variation in Pavement Subgrade Support Properties - A Link to Pavement Performance

**Objective:**

- Conduct field tests on newly compacted subgrade (after construction and prior to paving) to document spatial variation in stiffness parameters,
- Monitor changes in subgrade stiffness due to seasonal variation in moisture and temperature, and
- Measure the influence of matric suction (difference of pore air pressure and pore water pressure) and the water content of the soil in the laboratory to establish a database for Iowa soil types.

**Progress:** Test instrumentation was installed on US-20 in Webster county, Iowa. Before the test section was paved, spatial variation of density, moisture content, and strength in the subgrade was determined. Similar testing was completed after the aggregate base layer was placed and trimmed. The layout of instruments installed in the test section closely follows the Seasonal Monitoring Program Guidelines. The instruments monitor and record site conditions including soil and limited weather data. Data have been collected since mid May, 2005. Soil samples were taken from before and after paving for laboratory testing.

**Reports:** None

**Implementation:** The resulting technology transfer will be incorporated into the final report of the Embankment Quality Phase IV TR-492 project. It is envisioned that the conclusions will be used as a basis for developing proposed statewide specification changes.

The research findings and conclusions will be disseminated through electronic distribution of the final report, the Iowa DOT and CTRE's Websites, and through local/regional presentation. It is also expected that the final recommendations will be implemented at the national level through publication of technical papers and presentation at TRB in Washington, D.C.



## TR-517

**Agency:**

University of Nebraska -  
Lincoln

**Principal  
Investigator:**

Dean L. Sicking and  
Ronald K. Faller

**Research Period:**

April 1, 2004 to  
January 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:** General guidelines will be developed 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:** Analysis procedures are being developed. There has been difficulty isolating the culvert extension costs from the total project costs. There is also limited cost history for constructing safety grates. It is anticipated that the project may shift to one which produces only the benefit, in terms of cost, for each alternative. The cost analysis would be shifted to the designer, given the benefit identified in this study.

**Reports:** None

**Implementation:** Generalized guidelines for safety treatment of cross-drainage culverts will greatly simplify development of plans for 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-518**

**Agency:**

Iowa State University  
and Robert J. Dexter

**Principal Investigator:**

Terry J. Wipf and Robert  
J. Dexter

**Research Period:**

July 1, 2004 to  
December 31, 2005

**Research Board Funding:**

\$80,819 (Iowa State  
University - \$59,519;  
Robert J. Dexter -  
\$21,300)

**Funding Source:**

100% State -  
100% Primary funds

## **Monitoring Wind-Induced Vibrations/Stresses in a High-Mast Lighting Tower**

**Objective:** A high-mast tower in the I-35/U.S. 18 interchange near Clear Lake needs to be instrumented and monitored for at least one year to determine the type of vibrations and stress ranges that are being induced at various wind velocities. The natural frequencies and damping characteristics of a number of towers also need to be determined.

The objective of this research is to collect long-term behavior information on the performance of one of the eight high-mast lighting towers in the I-35/U.S. 18 interchange near Clear Lake, IA, for the purpose of validating assumptions made by others in an analytical investigation of these and similar towers.

The natural frequencies and damping characteristics of a number of towers need to be determined because they are very important in the investigation/evaluation of towers.

**Progress:** This project has been delayed due to changes in the investigative staff under subcontract. Data collection for analysis continues. A final report is anticipated in December, 2005.

**Reports:** None

**Implementation:** The research will likely provide information to revise/improve the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals. This, in turn, would improve the design of future new towers and the retrofit of existing towers not only in Iowa but nationwide.

The research has the potential to result in considerable savings for the Iowa DOT in inspection manpower and tower retrofit/replacement costs.



## TR-519

**Agency:**

United States Geological Survey (USGS)

**Principal Investigator:**

David Eash

**Research Period:**

June 1, 2004 to  
September 30, 2006

**Research Board Funding:**

\$78,000

**Funding Source:**

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

## Developing Flood-Frequency Discharge Estimation Methods for Small Basins in Iowa

**Objective:** The objectives of this study were to develop and evaluate flood-frequency discharge estimation methods for rural, ungaged streams in Iowa with drainage areas less than 50 square miles. Specific objectives were to:

- Develop regional regression equations, which only include basin characteristics that are considered easy for users to apply, to estimate 2-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-year flood-frequency discharges.
- Develop a probabilistic rational method, from a base runoff coefficient map developed for Iowa, to estimate 2-, 5-, 10-, 25-, 50-, and 100-year flood-frequency discharges.
- Evaluate the predictive accuracy of flood-frequency discharge estimates calculated using the newly developed regional regression equations, the probabilistic rational method, the 2001 regional regression equations, and the Iowa Runoff Chart by comparing estimates computed using these four methods to estimates computed using Bulletin 17B flood-frequency analyses.

**Progress:** The objectives above have been accomplished. A report is in preparation and should be ready early in 2006.

**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 in this study 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:** This research seeks to provide the following:

- Evaluate the feasibility of using elliptical or round dowels to retrofit an 8-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.
- Determine the relative cost of elliptical shaped dowels (FRP and steel) for the retrofit project.

**Progress:** This project has been constructed and is performing well to-date. All testing scheduled for the first year of work has been completed. A construction report is being prepared.

**Reports:** None

**Implementation:** The report will provide guidance to counties and cities on the following:

- Relative number of dowels per joint required to achieve a given level of performance.
- Relative costs versus 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.



## TR-521

**Agency:**

The University of Iowa

**Principal Investigator:**

Thanos Papanicolaou

**Research Period:**

September 1, 2004 to  
December 31, 2005

**Research Board Funding:**

\$59,628

**Funding Source:**

25 % Hungry  
Canyons Alliance,  
25 % Iowa DNR,  
50 % State (IHRB) -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

*Hungry Canyons  
Alliance*

## Field and Laboratory Investigation of Hydraulic Structures Facilitating Fish Abundance and Passage Through Bridges in Western Iowa Streams

**Objective:** The objective of the research is to evaluate the hydraulic performance of fish passage structures located in close proximity to bridges in western Iowa.

**Progress:** The major tasks are:

1. Specify the sites for conducting flow measurements.
2. Define measurements and procedures used for the field study.
3. Evaluate the performance of different structure types and relate their performance to bridge-waterway performance.
4. Perform laboratory experiments based on the results of task 3 to establish permissible flow criteria.

As of 30 June, 2005 the tasks had been completed with the exception of additional data readings for task 3 which are expected to continue through the fall of 2005.

**Reports:** None

**Implementation:** This research will result in specifications and design criteria for constructing control structures which meet the needs of protecting bridges and facilitating fish passage.



A plan/side panoramic view of a fish ladder



## TR-522

**Agency:**

Iowa State University

**Principal Investigator:**

F. Wayne Klaiber

**Research Period:**

November 1, 2004 to  
December 31, 2006

**Research Board Funding:**

\$274,780

**Funding Source:**

100 % State -  
95 % Secondary  
funds and 5 % Street  
funds

## Investigation of Steel Stringer Bridges: Substructures and Superstructures

**Objective:** The objective of this proposed investigation is twofold:

- Development of procedures for assessing, rehabilitating, strengthening, and replacing inadequate substructure components or entire substructures.
- Develop methods to more accurately evaluate and rate non-composite, steel stringer, concrete deck bridges

**Progress:** Several bridges have been tested with the planning and data reduction and analysis of other continuing. Additional testing will take place in the fall, weather permitting.

**Reports:** None

**Implementation:** By employing the substructure evaluation procedure, bridge owners will be able to evaluate the strength of the elements in various types of substructure. Procedures for replacing deficient substructure elements or in some cases the entire substructure will be developed. Prior to full scale implementing these on several bridges, they need to be evaluated in demonstration projects.

By using the rating factor developed in this part of the investigation, it will be possible to more accurately evaluate existing non-composite-steel stringer concrete deck bridges. In some cases it should be possible to remove posting and obtain several more years of service from a particular bridge.



## TR-523

**Agency:**

Iowa State University

**Principal Investigator:**

Shauna Hallmark  
Neal Hawkins  
David Plazak

**Research Period:**

December 1, 2004 to  
May 31, 2006

**Research Board Funding:**

\$64,718

**Funding Source:**

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

## Appropriate Traffic Calming Techniques for Small Iowa Communities

**Objective:** The purpose of this research is to evaluate and provide guidance on the use of different traffic calming techniques that can be used by both engineers and communities to select economically feasible alternatives for conditions typical of Iowa's county roads and other major roads within small rural communities.

**Progress:** 20 possible project sites have been identified and field visits have been completed. A draft document describing all of the potential traffic calming measures appropriate for small communities has been written. Initial speed studies have been completed in 8 communities.

**Reports:** None

**Implementation:** The information from this research will be combined with other traffic studies literature into a practical workshop which could be administered by LTAP.



## TR-524

**Agency:**

Snyder and Associates

**Principal Investigator:**

Wade Greiman  
David Moeller  
Mark Land

**Research Period:**

December 1, 2004 to  
April 1, 2006

**Research Board Funding:**

\$154,481

**Funding Source:**

100 % State -  
50 % Primary funds,  
25 % Secondary  
funds and 25 % Street  
funds

## Review of Inconsistencies Between SUDAS and Iowa DOT Specifications

**Objective:** The objective of this research is to review the Iowa DOT specifications and SUDAS specification section by section and develop recommendations for possible changes that will allow the SUDAS specifications to be incorporated into or by reference without any conflicts with the Iowa DOT specifications.

**Progress:** The team of three SUDAS representatives, four Snyder & Associates representatives and four Iowa DOT representatives has been meeting approximately bi-weekly. SUDAS and the Iowa DOT are in agreement on all of the proposed changes to-date. The Iowa DOT and SUDAS will take proposed changes to their respective committees for review and approval during the next year.

**Reports:** None

**Implementation:** Having uniformity of specifications and bidding processes across jurisdictional boundaries helps both the contractors and funding agencies work efficiently. Implementation of this project will involve the modification of both sets of specifications. Thereafter, any new changes will need to be made to both.



## TR-525

**Agency:**

Iowa State University

**Principal Investigator:**

Vernon R. Schaefer

**Research Period:**

November 1, 2004 to  
April 30, 2006

**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:** The objective of this investigation is 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.

**Progress:** The outline and contents of the design manual have been developed. Several of the eight sections have been drafted. All of the draft sections will be submitted to the TAC for input in the fall of 2005.

**Reports:** None

**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.

In addition to the written report, a summary sheet and a PowerPoint presentation will be created for dissemination through SUDAS and the Iowa DOT. The study's findings and conclusions will be disseminated through electronic distribution of the final report, CTRE's website, and through presentations made at appropriate local/regional/national conferences.



**TR-526**

**Agency:**

Iowa State University

**Principal Investigator:**

Timothy Ellis  
Stephen J. Andrie

**Research Period:**

December 1, 2004 to  
September 30, 2005

**Research Board Funding:**

\$59,925

**Funding Source:**

100 % State -  
75% Primary funds,  
25 % Secondary  
funds

## **Feasibility of Cooperative Development of Wetland Mitigation Projects**

**Objective:** The objectives of this project are to:

1. Determine the need for cooperative wetland mitigation projects.
2. Identify resources
3. Develop a conceptual framework to facilitate more centralized wetlands mitigation strategies that would reduce costs and improve effectiveness.

**Progress:** Literature reviews and background research has been completed. A focus group was held at ISU in March, 2005 and was well attended. The researchers have developed and conducted a survey of state, county and city agencies. A final report is being prepared for presentation to the IHRB at the January, 2006 meeting.

**Reports:** None

**Implementation:** A workshop will be held with the assistance of LTAP on cooperative development of wetland mitigation projects for the purpose of publicizing the recommended framework and beginning the process of creating a working procedure for cooperative development of wetland mitigation projects.



## TR-527

**Agency:**

Iowa State University

**Principal Investigator:**

Reg Souleyrette  
Tom Maze

**Research Period:**

December 1, 2004 to  
October 31, 2005

**Research Board Funding:**

\$75,000

**Funding Source:**

100 % State -  
100 % Secondary  
funds

## Guidelines for Removal of Traffic Control Devices in Rural Areas

**Objective:** The objective of this research is to study the effectiveness of rural stop control with a goal of developing warrants that can be used to support engineering decisions made by county and rural city staff to reduce or eliminate unnecessary control.

**Reports:** Final Report, December 2005

**Implementation:** As much as possible, technology transfer will be leveraged by making it part of other ongoing efforts by state and local technical organizations. The final report will be available to all interested parties. The FHWA may be interested in investigating the recommended criteria for inclusion in the MUTCD.



## TR-528

**Agency:**

Iowa State University

**Principal Investigator:**

Neal Hawkins  
Reg Souleyrette

**Research Period:**

December 31, 2004 to  
May 31, 2006

**Research Board Funding:**

\$125,000

**Funding Source:**

100 % State -  
33 % Primary funds,  
34 % Secondary  
funds and 33 % Street  
funds

## Development of a New Process for Determining Design Year Traffic

**Objective:** The objective of this research is to improve civil engineering design in terms of more consistent roadway performance over the life of the project. This will be accomplished through developing an alternative and more detailed method to develop traffic projections, to create tools which allow for scenario planning, to embrace the traditional planning process and evaluate alternative methods to using existing long range models, and to improve the overall relationship between planning and civil transportation design.

**Progress:** The TAC has been established and met to discuss the project. A literature review is in process.

**Reports:** None

**Implementation:** These research findings will result in an example methodology along with the actual tools needed to conduct scenario planning and development of traffic forecasts. The results have the potential to change the way traffic impact studies are conducted in allowing for the review of impacts much further away from a new site than the adjacent intersections.



**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:** The overall objectives of the work are to:

- 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.

**Progress:** Research conducted has included three full-scale laboratory design verification tests, 21 scale model laboratory tests, finalization of the completed bridge design, and construction of the nation's first UHPC bridge. During the full-scale laboratory tests, a 75' long UHPC beam, that was constructed in the same geometrical configuration as those to be used in the completed field bridge, was tested. In all cases, data were collected that allowed the original design assumptions to be verified. Construction of the nation's first UHPC bridge was also completed with delivery and setting of the UHPC girders being completed in late fall. Testing and evaluation of the completed bridge will be conducted over the duration of the project.

**Reports:** None

**Implementation:** These new advances will be of use to all jurisdictions within Iowa as they will ultimately reduce costs by (1) taking advantage of a higher strength material and (2) taking advantage of a material with almost zero permeability which could essentially eliminate deterioration of bridge decks. The result of these advances will ultimately be in the form of design recommendations and specifications that would likely be adopted by the American Association of State Highway and Transportation Officials.



## TR-530

**Agency:**

Iowa State University

**Principal Investigator:**

Brent Phares

**Research Period:**

March 1, 2005 to  
April 30, 2007

**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:** The objectives of this project are as follows:

- 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

**Progress:** Only minor work has been complete. Investigators are awaiting development of the final bridge details, bridge location, and specifications.

**Reports:** None

**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 throughout the state.



## TR-531

**Agency:**

Iowa State University

**Principal Investigator:**

David J. White

**Research Period:**

March 1, 2005 to  
September 30, 2006

**Research Board Funding:**

\$103,323

**Funding Source:**

100 % State -  
45 % Primary funds,  
55 % Secondary  
funds

## Effective Shoulder Design and Maintenance

**Objectives:**

- Identify practices for design, construction and maintenance of granular shoulders that result in reduced rutting and drop-off, improved safety, reduced maintenance costs, and extended performance life with recommendations specific to Iowa materials and conditions.
- Document several granular shoulder sites where poor and good performance has been observed in order to better understand the factors contributing to shoulder problems.
- On a pilot basis, evaluate and compare the performance of several test sections using chemical stabilization and mechanical reinforcement techniques including application of waste and recycled materials in construction.
- Perform a cost/benefit analysis to investigate owner costs of alternative systems.

**Progress:** A foamed asphalt stabilized shoulder section on I-35 was inspected and tested during and after construction. Samples were retrieved for further laboratory testing. Another shoulder experiencing severe rutting due to soft subgrade on US-34 near Batavia was inspected and tested. Samples were obtained from the subgrade and shoulder material for laboratory analysis. A laboratory study is ongoing in an attempt to stabilize the soft subgrade using fly ash.

**Reports:** None

**Implementation:** The observations and conclusions from this study will provide recommendations on best practices and maintenance procedures used on granular shoulders. State, county and city transportation agencies/jurisdictions can implement these recommendations. The results of this project will be implemented when (1) specifications and Materials Instructional Memoranda are updated to reflect the findings, and (2) transportation officials make improved project selection decisions by selection of more effective construction materials.



## TR-532

**Agency:**

Iowa State University

**Principal Investigator:**

James K. Cable

**Research Period:**

March 1, 2005 to  
February 28, 2006

**Research Board****Funding:**

\$79,240

**Funding Source:**

100 % State -  
50 % Primary funds,  
50 % Secondary  
funds

## Evaluation of Transverse Joint Forming Methods in PCC Pavement

**Objective:** The objective of this research is to evaluate currently available and conceptual joint forming equipment and methods for transverse joints. The goal is to find a method that can be efficiently and cost effectively employed at the time of pavement construction to form transverse joints (or induce the vertical crack that acts as a joint) in a dowelled or plane concrete pavement.

**Progress:** The project was constructed in May of 2005 on U.S. 20 near Fort Dodge, Iowa. The project field evaluation was terminated by direction to the Iowa DOT Construction staff in June of 2005 when they sawed the joints. Field observations will continue into the fall of 2005. A final report is in preparation.

**Reports:** None

**Implementation:** The results of this research will be in the form of diagrams with dimensions of local or commercial materials and methods.

If a new process is developed that meets the objectives, the materials/methods can be specified by all levels of government in Iowa for use in road construction projects. The results will require changes in mindset of pavement owners to accept the crack configuration that will result from use of the devices/methods. This will involve a review and possible changes in the expectations of the Iowa DOT and SUDAS specifications regarding transverse joint development.



## TR-533

**Agency:**

The University of Iowa

**Principal Investigator:**

Allen Bradley

**Research Period:**

March 1, 2005 to  
February 28, 2007

**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 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.

**Progress:** A contract has been initiated between the Iowa DOT and the University of Iowa to conduct the research.

**Reports:** None

**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.



## TR-534

**Agency:**

The University of Iowa

**Principal Investigator:**

Thanos Papanicolaou

**Research Period:**

May 1, 2005 to  
October 31, 2006

**Research Board****Funding:**

\$140,000

**Funding Source:**

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

## Design Procedures and Field Monitoring of Submerged Barbs for Streambank Protection

**Objectives:** (1) Model hydraulically the performance of a proposed submerged barb design for the US-169 bridge site. (2) Perform a comprehensive field study involving the design, installation and monitoring of submerged barbs at the same site.

**Progress:** A contract has been initiated between the Iowa DOT and the University of Iowa to conduct the research.

**Reports:** None

**Implementation:** The results of this research will provide:  
(1) Specifications on the range of flow conditions that are detrimental for bank erosion and scour around barb structures. (2) A classification of barbs based on their hydraulic performance under various flow conditions. (3) Criteria regarding the stability of the structures for future design recommendations. (4) A detailed technical report describing the performance of the recommended structures, as well as summarizing the performances of alternative structures.



Partially submerged barb



## TR-535

**Agency:**

Iowa State University

**Principal Investigator:**

J(Hans) van Leeuwen

**Research Period:**

March 1, 2005 to  
July 31, 2005

**Research Board Funding:**

\$34,967

**Funding Source:**

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

## Reuse of Lime Sludge from Water Softening and Coal Combustion Byproducts

**Objective:** The objectives of this project are as follows:

- Obtain evidence that shows that using lime sludge stabilized with fly ash and mixed with bottom ash will not harm the environment if used as a fill material.
- Obtain additional data for direct shear testing and California Bearing Ratio (CBR) so that a conclusive analysis can be completed.
- Continue testing for strength, density, moisture, and temperature variation on the test embankment built in July 2004. Without the measurements in the spring, a comparison of data before and after a full season of freezing and thawing cannot be made.

**Reports:** Final Report, September 2005

**Implementation:** The final report contains the information needed for highway design engineers and professionals to use for project design. These designers will use the results to design structural fills for highway projects where lime sludge is available at a reasonable transportation expense. Designers will have the ability to determine necessary material amounts using the research information.



## TR-536

**Agency:**

The University of Iowa

**Principal Investigator:**

Marian Muste

**Research Period:**

April 1, 2005 to  
December 31, 2006

**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:** The objective of this project is 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:** The manuals to be incorporated in the interactive website are:

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

At this time, the ISRC project provided parts a) and b) in a temporary form. The TR-536 project team has initiated the work with these partial components and it is preparing the structure for part c).

**Reports:** None

**Implementation:** Once finalized, the Iowa Stormwater Runoff Control Interactive Manual (ISRCIM) will be transferred on one of the IDOT existing web servers. Strong outreach, testing and upgrading activities are envisioned during the dissemination of the ISRCIM to a wide category of users. Major role in this regard will play the training programs incorporated in Part 3 of research project TR-508, "Design Guide and Construction Specifications for NPDES Site Runoff Control". 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-537

**Agency:**

Iowa State University

**Principal Investigator:**

Tom Cackler

**Research Period:**

April 1, 2005 to  
March 31, 2006

**Research Board Funding:**

\$96,700

**Funding Source:**

87 % Other Sources,  
13 % State (IHRB) -  
49 % Primary funds,  
49 % Secondary  
funds and 2 % Street  
funds

## Iowa Data Collection and Analysis for the 2005/2006 National Surface Characteristics Field Experiment Plan

**Objective:** The objectives of this research are as follows:

1. To design, procure, build, test, and evaluate various concrete pavement texture patterns that address noise reduction in relationship to friction, smoothness, and texture, as well as their time rates of change in service.
2. To analyze data from over 35 existing sites in the U.S., benchmarking Iowa values.
3. To develop best practice guidance to Iowa for optimizing texturing, balancing noise considerations with friction and smoothness.

**Progress:** A contract has been initiated between the Iowa DOT and Iowa State University to conduct the research.

**Reports:** None

**Implementation:** The outcome of the project will include a set of best practices that can be used to improve the means of texturing concrete pavements in the State of Iowa. It is anticipated that these best practices will work within the bounds of the new FHWA Technical Advisory on "Surface Texture for Asphalt and Concrete Pavements". The best practices are anticipated to identify pavement surfaces that are not only quieter, but do not compromise safety, smoothness, or performance.

Implementation of these best practices will be accomplished with a cooperative effort between industry, the PCC Center and the Iowa DOT. Their application can be the subject of stand-alone workshops and/or a component of existing technology transfer activities already underway.



## TR-538

**Agency:**

Iowa State University

**Principal Investigator:**

Ed Jaselskis

**Research Period:**

May 1, 2005 to  
April 30, 2006

**Research Board****Funding:**

\$100,000

**Funding Source:**

20 % Other Sources,  
80 % State (IHRB) -  
49 % Primary funds,  
49 % Secondary  
funds and 2 % Street  
funds

## Using Scanning Lasers for Real-Time Pavement Thickness Measurement

**Objective:** The principal objective of the research is to develop the algorithms that can process real time laser scanning data to create an accurate 3D model of the pavement that can then be used to determine pavement thickness at any point. Such a device may potentially greatly reduce the need for state DOTs to take cores in order to assess this aspect of quality. A device such as this can also be considered for in process control of the paver since real time concrete depths will be calculated. This method may eliminate the need for the owner and contractor to take depth measurements during the paving process.

**Progress:** A contract has been initiated between the Iowa DOT and Iowa State University to conduct the research.

**Reports:** None

**Implementation:** A non-destructive system will greatly reduce the need to take core samples after the paving process is complete. Also, this system will provide a much denser sampling of thickness measurements, which will increase accuracy of the quality control program. Having real time feedback on actual pavement thickness means that the contractor does not need to pave at a higher than specified thickness to assure that the contractor meets the specifications.

Other direct benefits will be the cost savings from not needing to do pavement depth checks during the paving operation (both contractor and owner). This sensor will be able to provide real time depth measurements as a profile of the concrete will be generated. Volume of concrete in place will be easily determined using this approach. The system would fit on any paver that can provide position coordinates and may be retrofitted onto a paver by using relative position control. It is also possible that if the point cloud is sufficiently dense, pavement smoothness can also be determined using this approach.



## TR-539

**Agency:**

Iowa State University

**Principal Investigator:**

Brent Phares

**Research Period:**

July 1, 2005 to  
December 31, 2007

**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 will be installed to document and evaluate the performance of a precast, post-tensioned approach pavement and its effects on overall bridge performance. The research team will install a monitoring system to collect overall bridge movement and bridge component strain data over an extended period of time of more than two years. Evaluation of performance will be 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.

**Progress:** A contract has been initiated between the Iowa DOT and Iowa State University to conduct the research.

**Reports:** None

**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 website of the Office of Bridges and Structures and the website of the Bridge Engineering Center.



## TR-540

**Agency:**

Iowa State University

**Principal Investigator:**

Stephen J. Andrie

**Research Period:**

June 1, 2005 to March 31, 2007

**Research Board Funding:**

\$124,842

**Funding Source:**

46 % Other Sources,  
54 % State (IHRB) -  
40 % Primary funds,  
58 % Secondary  
funds and 2 % Street  
funds

## Developing Guidance for Use of Lighting on Rural and Urban Roadways in Iowa

**Objective:** The main goal of the proposed project is to provide agencies in Iowa with information and guidance on the use of lighting so that agencies are able to make cost-effective decision about the use of lighting. In order to accomplish this goal the following objectives are proposed:

- Summarize existing lighting guidelines
- Document good lighting practice
- Quantify the effectiveness of roadway lighting in reducing the number and severity of night-time crashes
- Compare roadway lighting to other safety measures, such as pavement markings, rumble strips, etc. and provide information to decision-makers to select strategies to reduce night-time crashes from among a range of alternatives.
- Develop recommendations for the use of roadway lighting

**Progress:** A contract has been initiated between the Iowa DOT and Iowa State University to conduct the research.

**Reports:** None

**Implementation:** The project will result in a lighting guidance document that will be incorporated into SUDAS. The guidance document will provide a rural and urban application matrix which recommends where roadway lighting should be prioritized based upon roadway, land use, safety, and traffic conditions.



## HR-1027

**Agency:**

Iowa Department of Transportation

**Principal Investigator:**

Edward J. Engle

**Research Period:**

March 1980, on-going

**Research Board****Funding:**

\$70,000/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 to visit with many county engineers to discuss problems being encountered by the secondary road departments and to discuss present research projects during the year. At present, there are approximately 40 active research projects that involve 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. He has also been keeping 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.



**HR-1081**

**Agency:**

Iowa State University

**Principal Investigator:**

Scott Schlorholtz

**Research Period:**

January 1, 2003 to  
December 31, 2004

**Research Board Funding:**

\$25,000

**Funding Source:**

100% State -  
100% Primary funds

## **Development of In-Situ Detection Methods for Material Related Distress (MRD) in Concrete Pavements, Phase II Extension**

**Objective:** The research is designed to evaluate and develop methods to detect and quantify material-related distress in PCC pavements by completing the following: 1) Identify current techniques (preferably nondestructive) that can be used to identify the condition of the aggregates and the cement paste throughout the depth of the Portland cement pavement at any given time in the life of the pavement. 2) Identify the gaps in the current NDT methods for identification of MRD. 3) Evaluate the most promising MRD methods identified in the Phase I effort.

**Reports:** Draft Final Report, September 2005

**Implementation:** The results of the previous Iowa research and development efforts and the evaluation of the MRD methods should be communicated to the general highway industry through newsletters, electronic media and workshops for the ICPA, ICEA, and APWA members.

The method developed for distress identification should be demonstrated through workshops in various parts of the state for consultants, state and local government persons to view.



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