ANNUAL REPORT
OF
HIGHWAY DIVISION
HIGHWAY RESEARCH AND DEVELOPMENT
IN IOWA

OCTOBER 2001

Iowa Department of Transportation

ANNUAL REPORT
OF
HIGHWAY DIVISION
HIGHWAY RESEARCH AND DEVELOPMENT IN IOWA

FOR THE
FISCAL YEAR ENDING JUNE 30, 2001

OFFICE OF MATERIALS
(515) 239-1447

HIGHWAY DIVISION
IOWA DEPARTMENT OF TRANSPORTATION
AMES, IOWA 50010

OCTOBER 2001

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, 2001; it is also a report on projects completed during the fiscal year beginning July 1, 2000, and ending June 30, 2001. Detailed information on each of the research and development projects mentioned in this report is available in the Office of Materials in the Highway Division of the Iowa Department of Transportation.

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 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 by the Iowa Department of Transportation Highway Division Director for a three-year term. The membership of the Research Board as of June 30, 2001 is listed in Table I.

The Research Board held nine regular meetings during the period of July 1, 2000 to June 30, 2001. Suggestions for research and development were reviewed at these meetings and recommendations were made by the Board.

TABLE I
2000-2001 IOWA HIGHWAY RESEARCH BOARD MEMBERS

Member	Term Expires	Alternate
John Adam Director of Materials Iowa DOT - Highway Division 800 Lincoln Way Ames, IA 50010 (515) 239-1130	12-31-02	Robert Younie Construction Engineer Iowa DOT - Dist. 1 1020 S. 4th Street Ames, Iowa 50010 (515) 239-1542
Jim George Dallas County Engineer 415 River Street Adel, IA 50003 (515) 993-4289 SS#-025	12-31-02	Charles Marker Cass County Engineer 5 W. 7th Street Atlantic, IA 50022 (712) 243-2442 SS#-015
Lowell Greimann Dept of Civil & Const. Engr. Iowa State University 390 Town Engineering Bld. Ames, IA 50011 (515) 294-5586	12-31-03	Steve Andrle Center for Transp. Res. & Educ. ISU Research Park 2901 South Loop Drive, Suite 3100 Ames, IA 50010-8632 (515) 294-8103
Douglas Julius Sioux County Engineer 207 Central Avenue SE P.O. Box 17 Orange City, IA 51041 (712) 737-2248 SS# 084	12-31-03	Jon Ites Buena Vista County Engineer 215 E. 5th Street P.O. Box 368 Storm Lake, IA 50588 (712) 749-2540 SS# 011
Brian Keierleber Buchanan County Engineer 1511 1st Street East Independence, IA 50644-3123 (319) 334-6031 SS# 010	12-31-03	Clark Schloz Jackson County Engineer 201 W. Platt Maquoketa, IA 52060 (319) 652-4782 SS# 049
Randall Krauel Director of Public Works 112 East 5th Carroll, IA 51401 (712) 792-1000	12-31-02	Scott Peppler Street Director 1201 6th Street SW Cedar Rapids, IA 52404 (319) 286-5828
Sandra Larson Director of Engineering Bureau Iowa DOT - Highway Division 800 Lincoln Way Ames, IA 50010 (515) 239-1205	12-31-03	Roger Gould Process Management Engineer Engineering Bureau Iowa DOT - Highway Division 800 Lincoln Way Ames, IA 50010 (515) 239-1834
Kevin Mahoney Deputy Director of Statewide Oper. Bureau Iowa DOT - Highway Division 800 Lincoln Way Ames, IA 50010 (515) 239-1333	12-31-03	Lee Wilkinson Director of Maintenance Iowa DOT - Highway Division 800 Lincoln Way Ames, IA 50010 (515) 239-1589

Member	Term Expires	Alternate
Thomas Myers Director of Public Works 116 West Adams Street P.O. Box 449 Creston, IA 50801-0449 (641) 782-5410	12-31-03	Frank Farmer Director of Public Works 819 1st Avenue S. Ft. Dodge, IA 50501-4739 (515) 576-3601
Mark Nahra Delaware County Engineer 2139 Highway 38 P.O. Box 68 Delaware, IA 52036 (319) 927-3505		
Jacob Odgaard Associate Dean of Engr. The University of Iowa 3100 Seamans Center Iowa City, IA 52242 (319) 335-5191	12-31-01	Wilfrid Nixon IA Inst of Hydraulic Res The University of Iowa 300 S Riverside Drive Iowa City, IA 52242 (319) 335-5166
Dennis Osipowicz Lee County Engineer 933 Avenue H P.O. Box 158 Fort Madison, IA 52627 (319) 372-2541 SS#-056	12-31-01	Christy Van Buskirk Keokuk County Engineer 101 S. Main Sigourney, IA 52591 (641) 622-2610 SS#-054
John Selmer District Engineer Iowa Department of Transportation District 4 63200 White Pole Rd. P.O. Box 406 Atlantic, IA 50022 (712) 243-3355	12-31-03	Glen Miller Construction Engineer Iowa Department of Transportation District 4 63200 White Pole Rd. P.O. Box 406 Atlantic, IA 50022 (712) 243-3355
Wade Weiss Greene County Engineer 114 N Chestnut Jefferson IA 50129 (515) 386-3316 SS#-037	12-31-02	Lyle Brehm Tama County Engineer 1002 E. 5th Street Tama IA 52339-2216 (641) 484-3341 SS#-086
Jim Witt Cerro Gordo County Engineer 2716 S. Federal Avenue Mason City, IA 50401 (641) 424-9037 SS#-017	12-31-01	Jerry Weber Clayton County Engineer 429 High Street N.E. P.O. Box 456 Elkader, IA 52043-0456 (319) 245-1782 SS#-022

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 and the Director 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, 2001. Total expenditure was $1,984,192.43.

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 Office of Materials, Research Section. In many instances, personnel from other offices are designated as principal investigators, 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 Office of Materials, Research Section, wishes to express its appreciation to other offices for their assistance.

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

The National Cooperative Highway Research Program (NCHRP) was organized by the American Association of State Highway Officials (now the American Association of State Highway and Transportation Officials--AASHTO). The program is administered by the Transportation Research Board, 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 0.0675 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. The secondary obligations to NCHRP are paid from the Secondary Road Research Fund.

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 twenty-five counties during fiscal year 2001 as part of the Annual Traffic Count Program. This activity consisted of 356 portable recorder classification counts, 6,270 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 were physically inventoried for geometrics and current condition in ninety counties. This data provides county engineers, highway engineers, planners and administrators with essential information needed to determine design standards, to systematically classify highways, and to develop programs for improvement in maintenance of secondary roads.

SECONDARY ROAD RESEARCH FUND

Section 310.34 of the Iowa Code authorizes the Iowa Department of Transportation to set aside each year an amount not to exceed 1½ percent of the receipts to the Farm-to-Market Fund in a fund to be known as the Secondary Road Research Fund. This authorization was first made in 1949; it was repealed in 1963 and reinstated in 1965. When the fund was reinstated, the 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 2001 financial summary is:

Beginning Balance 7-1-00		$1,690,242.62
Receipts		
State Road Use Tax Fund (1½% of receipts)...	$1,077,416.66	
Federal Aid Secondary (1½% of receipts)...	0.00	
Research Income	0.00	
Sub-Total		$1,077,416.66
Total Funds Available		$2,767,659.28
Obligation for Expenditures		
Obligated for Contract Research...	585,540.00	
Non-Contract Engineering Studies...	25,032.96	
Total Expenditures		610,572.96
BALANCE 6-30-01		$2,157,086.32

STREET RESEARCH FUND

The Street Research Fund was established in 1989 under Section 312.3A of the Iowa Code. Each year two hundred thousand dollars 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 2001 financial summary is:

Beginning Balance (7-1-00)	$ 19,815
FY01 Street Research Funding	200,000
Total Funds Available for Street Research	$219,815

Obligated for Expenditure

HR-296	$ 40,950
HR-394	3,080
TR-448	5,000
TR-451	7,072
TR-453	6,266
TR-454	10,910
TR-455	7,480
TR-458	15,192
TR-459	20,575
TR-461	3,500
TR-462	12,312
TR-463	10,000
TR-464	3,000
TR-465	7,410
TR-466	30,582

Total obligated for Expenditure $183,329

Ending Unobligated Balance 6-30-01 $ 36,486

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. There is no balance carried forward to the next fiscal year and uncommitted funds remain in the Primary Road Fund. The amount expended for contract research from the Primary Road Research Fund for FY01 was $771,104.02 and the estimate for FY02 is $750,000.

PROJECTS INITIATED DURING FY 2001

The new projects initiated during FY 2001 were:

TR-448, "Foamed Asphalt Technology Workshop & Demonstration"
TR-449, "Determination and Evaluation of Alternative Methods for Managing and Controlling Highway Related Dust"
TR-450, "Identification of Laboratory Techniques to Optimize Superpave HMA Surface Friction Characteristics"
TR-451, "Investigation Into Improved Pavement Curing Materials and Techniques"
TR-452, "Alternative Solutions to Meet the Service Needs of Low Volume Bridges in Iowa (7.03)"
TR-453, "Low Water Stream Crossings in Iowa"
TR-454, "Durable, Cost Effective Pavement Marking Materials - Phase 1"
TR-455, "Handbook of Simplified Practice for Traffic Studies"
TR-456, "Measuring Main-Channel Slopes for Major Rivers in Iowa"
TR-457, "Development of a Manual Crack Quantification and an Automated Crack Measurement System"
TR-458, "Field Testing of Abrasive Delivery Systems in Winter Maintenance"
TR-459, "Reuse of Lime Sludge From Water Softening"
TR-460, "Living Snow Fences"
TR-461, "Soil Stabilization of Non-Uniform Subgrade Soils"
TR-462, "Manual for Roadside Control of Trees and Brush"
TR-463, "Field Performance Study of Past Iowa Pavement Research: A Look Back"
TR-464, "Erosion Control for Highway Applications"
TR-465, "Transportation Information System for Road Users (Phase 1)"
TR-466, "Evaluation of Unbonded Ultrathin Whitetopping of Brick Streets"

19 projects

Table II
FINANCIAL SUMMARY OF RESEARCH AND DEVELOPMENT PROJECT EXPENDITURES

July 1, 2000 to June 30, 2001

(Active projects with no current fiscal year expenditures are included)

Project	Total Funds Committed	Project Title	Primary Road Research Fund Expenditures	Secondary Road Research Fund Expenditures	Street Research Fund Expenditures	Total Expenditures
198	125,000	Preliminary Archaeological Investigation Along Proposed Highway Right-of-Way		15,294.36		15,294.36
296	91,000	ISU Technology Transfer		41,884.25	72,495.28	114,379.53
360	30,290	Field Evaluation of Various Engineering Fabrics				
370	10,000	Pipe Rehabilitation With Polyethylene Pipe Liners				
375	22,400	Transportation Research Board Education for County Engineers		2,860.70		2,860.70
379	77,000	Recycled Asphalt Shingles for Slurry Leveling & Crack Filling	4,361.53			4,361.53
388	67,838	Road Network Model Spreadsheet for Service Level Decision Making				
391	163,741	Optimal Usage of De-Icing Chemicals When Scraping Ice				
394	672,152	Transportation Program Management System	42,609.60	163,566.01	5,107.71	211,283.32
395A	131,000	Phase II, "Estimating the Magnitude and Frequency of Floods in Iowa 1997"	8,950.00	3,950.00	13,100.00	26,000.00
397	179,880	Field Laboratory Testing of Damaged Prestressted Concrete (P/C) Girder Bridges	15,914.40			15,914.40
398	33,832	Hydraulics of Slope-Tapered Concrete Pipe Culverts				
399	299,932	Field Testing of Integral Abutments	9,697.43	7,162.14	4,684.75	21,544.32
401	337,135	Embankment Quality	44,944.76		7,165.83	52,110.59
405	190,131	Impact of Deck Cracking on Durability	4,342.86	1,828.47	3,525.29	9,696.62
406	141,762	Determine Initial Cause for Current Premature PCC Pavement Deterioration		7,095.89	2,373.12	9,469.01
408	220,595	Glass Fiber Composite Dowel Bars for Highway Pavement	39,937.17			39,937.17
410	246,660	Investigation of Two Bridge Alternatives for Low Volume Roads - Phase II				
411	47,993	An Improved Computer Program for River Valley Rating Curves				
412	65,000	Development of a Computer Controlled Underbody Plow				
414	50,000	Superpave Mix Designs for Low Volume Roads		10,000.00		10,000.00
415	152,664	Aggregate-Related Factors of Critical VMA in Asphalt Paving		1,085.90		1,085.90
416	11,674	Development of Materials Training Course for Technicians	18.86			18.86
417	300,000	ICEA Service Bureau		29,999.90		29,999.90
419	30,000	Education on Urban Corridor Issues				
420	98,478	Field Evaluation of Alternative Load Transfer Device Locations in Low Traffic Volume		529.87	826.02	1,355.89
422	14,000	Pretreatment for Reduction of Asphalt Absorption in Porous Aggregate	5,600.00	5,600.00	2,800.00	14,000.00
424	178,358	Steel Diaphragms in Prestressed Concrete Girder Bridges	19,837.34	5,222.45	11,822.30	36,882.09
426	106,358	Mobility and Safety Impacts of Winter Storm Events in a Freeway Environment			893.01	893.01
427	26,200	Evaluation of High-Slump Concrete for Bridge Deck Overlays	9,243.61	6,932.70	6,932.70	23,109.01
428	294,760	Effective Structural Concrete Repair		46,703.37		46,703.37
429	195,060	Evaluation of Appropriate Maintenance Repair and Rehabilitation Methods for Iowa	54,132.63	59,865.36	16,052.50	130,050.49
430	179,801	Regional Approach to Landslide	5,338.98		61,684.35	67,023.33
431	139,236	Reduction of Concrete Deterioration by Ettringite Using Crystal Growth Inhibition	31,060.71	11,646.12		42,706.83

Project	Total Funds Committed	Project Title	Primary Road Research Fund Expenditures	Secondary Road Research Fund Expenditures	Street Research Fund Expenditures	Total Expenditures
432	183,903	Ultrathin Portland Cement Concrete Overlay Extended Evaluation	9,823.59		2,815.15	12,638.74
433	89,265	HWYNEEDS-Methodology, Analysis and Evaluation		22,230.20		22,230.20
434	30,420	Use of Abrasives in Winter Maintenance		3,893.20		3,893.20
435	117,030	Thin Maintenance Surfaces – Phase II	17,004.16	23,795.51		40,799.67
436	158,028	Retrofit Methods for Distortion Cracking Problems in Plate Girder Bridges	48,648.14	10,185.09	1,288.78	60,122.01
437	43,334	Performance of Strip Seals in Iowa Bridges, Pilot Study	9,012.76	5,400.71	4,400.46	18,813.93
438	142,903	Integral Abutment Bridge With Precast Concrete Piles	2,668.36	29,372.73	1,954.86	33,995.95
440	137,580	Field & Laboratory Evaluation of Precast Concrete Bridges		77,617.46	14,459.56	92,077.02
441	70,669	Iowa Reference Manual for Traffic Control Devices & pavement Markings	7,844.94	29,035.00	3,077.15	39,957.09
442	126,235	Systematic Identification of High Crash Locations	57,675.19	27,772.00	3,787.00	89,234.19
443	148,938	Evaluation of Rammed Aggregate Piers for Highway Applications in Iowa Soils	33,272.70	67,022.00	7,447.00	107,741.70
444	187,620	Demonstration Project Using Railroad Flatcars for Low Volume Road Bridges		42,203.48		42,203.48
445	176,876	Development of Bridge Load Testing Process for Load Evaluation	94,083.89	22,153.24		116,237.13
446	214,150	Technology Transfer of "As Built Preliminary Surveys" by Total Station GPS, Video Logging & Laser	89,364.39	4,955.57		94,319.96
447	68,200	A Computer Program for the Hydraulic Design of Culverts	30,918.00	24,549.75	6,138.00	61,605.75
448	25,000	Foamed Asphalt Technology Workshop & Demonstration		20,000.00	5,000.00	25,000.00
449	58,135	Determination and Evaluation of Alternative Methods for Managing and Controlling Highway Related Dust		20,067.03		20,067.03
450	80,000	Identification of Laboratory Techniques to Optimize Superpave HMA Surface Friction Characteristics				
451	70,718	Investigation Into Improved Pavement Curing Materials and Techniques	3,954.89			3,954.89
452	48,865	Alternative Solutions to Meet the Service Needs of Low Volume Bridges in Iowa (7.03)		642.33		642.33
453	62,664	Low Water Stream Crossings in Iowa	79.32	11,166.27		11,245.59
454	43,640	Durable, Cost Effective Pavement Marking Materials – Phase I	17,290.18	7,862.34		25,152.52
455	37,400	Handbook of Simplified Practice for Traffic Studies				
456	107,800	Measuring Main-Channel Slopes for Major Rivers in Iowa				
457	73,997	Development of a Manual Crack Quantification and an Automatic Crack Measurement System				
458	151,920	Field Testing of Abrasive Delivery Systems in Winter Maintenance	2,183.79			2,183.79
1027	60,000/yr	Secondary Road Research Coordinator		57,073.23		57,073.23
1075	90,341	Response of Iowa Pavements to Heavy Agricultural Loads	51,289.84			51,289.84
			=========	=========	=========	==========
		Contract Research Subtotal	771,104.02	928,224.63	259,830.82	1,959,159.47
SPR-PR-PL-1(33)		FY2001 Planning & Research Program (Transportation Inventory Engineering Studies)		25,032.96		25,032.96
			=========	=========	=========	==========
		Noncontract Engineering Studies Subtotal		25,032.96		25,032.96
		Grand Total of Expenditures	771,104.02	953,257.59	259,830.82	1,984,192.43

Project Number: HR-198

Project Title: Preliminary Archaeological Investigation Along Proposed Highway Right-of-Way

Agency: State Archaeologist (The University of Iowa)

Principal Investigator: State Archaeologist

Research Period: July 1, 1977 to June 30, 2001

Research Board Funding: $125,000

Funding Source: 100 percent State – 100 percent Secondary funds

Objective: To determine well in advance of highway construction if proposed planning corridors contain known or probable sites of archaeological value; to locate such sites and describe their limits as accurately as possible without resorting to excavation or other detailed examinations.

Progress: Due to reduced participation in the project, it was terminated effective June 30, 2001. Counties will now work directly through the State Archaeologist Office as many are doing already.

Reports: Annual reports are completed, giving a county-by-county summary of archaeological survey activities.

Implementation: The project is beneficial because counties know what projects should be reviewed and the reviews can be conducted in a more timely manner.

Project Number: HR-296

Project Title: Iowa State University Technology Transfer Center

Agency: Iowa State University

Principal Investigator: Tom Maze

Research Period: October 1, 1986 to December 31, 2001

Research Board Funding: $91,000 per year

Funding Source: 100 percent State – 10 percent Primary funds, 45 percent Secondary funds and 45 percent Street funds

Objective: To promote research, encourage implementation and distribute research data.

Progress: The major tasks are:

1. publishing at least four newsletters per year
2. conducting at least 10 training courses per year
3. distribute publications
4. provide service and information to users
5. 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.

Project Number: HR-360

Project Title: Field Evaluation of Various Engineering Fabrics - Audubon Co.

Agency: Audubon County and Iowa Department of Transportation, Highway Division

Principal Investigator: Donald Torney and Ed Engle

Research Period: May 4, 1993 to June 1, 2001

Research Board Funding: $30,290

Funding Source: 100 percent State – 100 percent Secondary funds

Objective: To evaluate the Pro-Guard and Paveprep engineering fabrics as reflective crack retarders when used in conjunction with an ACC overlay on a low volume secondary road.

Reports: Final Report, June 1, 2001

Implementation: Reports were distributed to the cities and counties of Iowa disseminating the results.

Project Number: HR-370

Project Title: Pipe Rehabilitation With Polyethylene Pipe Liners

Agency: Dallas County, Jefferson County, Jones County, Mahaska County, Taylor County, and the Iowa Department of Transportation, Highway Division

Principal Investigator: Brad Skinner, Gary Bishop, Dan Waid, Raymond Blessum, James Delozier and Ed Engle

Research Period: June 1, 1994 to December 31, 2001

Research Board Funding: $10,000

Funding Source: 100 percent State – 100 percent Secondary funds

Objective: The objective of the research is to demonstrate and evaluate the applicability of pipe rehabilitation with polyethylene pipe liners.

Progress: Six locations were selected for the installation of polyethylene liners. Culverts rehabilitated included corrugated metal pipe, concrete roadway pipe, and a wooden box culvert. The polyethylene liners used for this research were Culvert-Renew® and Snap-Tite®. Installations were completed in October 1994. The research is also evaluating several additional pipes that were rehabilitated with polyethylene liners. Field visits have shown that several of the liners have moved or show signs of creeping. Movement measurements range from 1-3/8" to 2-5/8." Evaluation and final report development is in progress.

Reports: Construction Report, March 1995

Implementation: If the use of polyethylene liners is successful, it may give engineers an economical alternative to the removal and replacement of deteriorated culverts.

Project Number: HR-375

Project Title: Transportation Research Board Education for County Engineers

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: Ed Engle

Research Period: November 1, 1994 to December 31, 2004

Research Board Funding: $22,400

Funding Source: 100 percent State – 100 percent Secondary funds

Objective: The objective of the project is to annually send two county engineers to the Transportation Research Board (TRB) Annual Meeting in Washington, D.C. for research education. The two county engineers to attend the TRB Annual Meeting are generally the county engineers starting their term as regular members of the Iowa Highway Research Board (IHRB). The experience of attending the TRB Annual Meeting will give 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 2001, a total of 14 county engineers were sent to TRB.

Reports: None

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

Project Number: HR-379

Project Title: Recycled Asphalt Shingles for Slurry Leveling and Crack Filling

Agency: City of Spencer

Principal Investigator: Charles L. Fisher

Research Period: April 6, 1995 to October 31, 1999

Research Board Funding: $77,000

Funding Source: 100 percent State – 20 percent Primary funds, 40 percent Secondary funds and 40 percent Street funds

Objective: The research is to determine the feasibility of using recycled asphalt shingles to develop a low cost slurry leveling and crack filling material and to evaluate the performance of the recycled asphalt shingle slurry leveling and crack filling material.

Reports: The principal investigator for the project passed away in 1998. Due to lack of documentation and difficulties processing the materials, the project has been terminated.

Project Number: HR-388

Project Title: Road Network Model Spreadsheet for Service Level Decision Making

Agency: Mills County and the Iowa Department of Transportation, Highway Division

Principal Investigator: Steve DeVries

Research Period: May 29, 1996 to February 28, 2002

Research Board Funding: $67,838

Funding Source: 100 percent State – 100 percent Secondary Funds

Objective: To develop and test a new method for making highway service level decisions by modeling a road network, finding the best service levels for given traffic volumes and using the results to make road system management decisions.

Progress: The basic theories of this project have been developed and a prototype system for implementing them is being built using Microsoft Access and Excel. All road and bridge data has been loaded into the files and current efforts are directed at gathering and entering cost data. It is expected that this project will be completed by January 2002.

Reports: None.

Implementation: Operating, improving and maintaining a ready system is difficult and funds are scarce. This research will develop and test a new method for making the decisions required to manage a road system with all of the inherent tradeoffs to deploy scarce funds for maximum public benefit.

Project Number: HR-391

Project Title: Optimal Usage of De-Icing Chemicals When Scraping Ice

Agency: The University of Iowa

Principal Investigator: Wilfrid Nixon

Research Period: May 21, 1996 to December 31, 2001

Research Board Funding: $163,741

Funding Source: 100 percent State – 70 percent Primary funds, 10 percent Secondary funds and 20 percent Street funds

Objective: The objective of the work proposed in this study is to determine the best combination of chemical application and scraping for removing the various types of ice from the road.

Progress: Preliminary testing has resulted in the development of test protocols, which allow for very good repeatability of test results (which is a necessary part of this project, since some effects may be small). Testing since the spring has concentrated on salt (sodium chloride) as a deicer, and has tested various quantities of salt, applied for varying length of time and in various forms (coarse granules, fine powder, etc.).

Reports: None

Implementation: A field guide would be developed which would contain for each chemical tested, the optimal application rate and delay time for that chemical for each ice type. This will improve winter ice removal, thereby, improving safety of the motoring public.

Project Number: HR-394

Project Title: Transportation Program Management System, Phases II - IV

Agency: Iowa County Engineers Association Service Bureau

Principal Investigator: Steve DeVries

Research Period: March 1, 1999 to July 31, 2002

Research Board Funding: $672,152

Funding Source: 100 percent State – 25% Primary funds, 72% Secondary funds, and 3% Street funds

Objective: The objective of this project is to create a centralized, automated system to support project programming and development tracking to:

a) reduce the potential for errors and conflicts.
b) speed up the process and deliver road improvements to the public more expeditiously.
c) decrease the total labor cost required to get programming and development work accomplished.
d) make the status of any project or action available to all parties who need to know on a "real-time" basis.
e) Improve communications and provide an on-line transcript of each projects' history.

Progress: The Beta version has been deployed and is being tested. User instruction and training will continue through the summer of 2001. The software and database will be improved to optimize performance and refine the system.

Reports: None

Implementation: The results of this project will be a system that will both improve and expedite the current Transportation Program Management process. It will enable local agencies to reduce project errors, conflicts, and delays. All interested parties will be able to get a "real-time" project status at any time.

Project Number: HR-395A

Project Title: Phase II, Estimating the Magnitude and Frequency of Floods in Iowa

Agency: United States Geological Survey

Principal Investigator: David Eash

Research Period: January 15, 1998 to September 30, 2000

Research Board Funding: $131,000

Funding Source: 100 percent State – 45 percent Primary funds, 45 percent Secondary funds and 10 percent Street - USGS matches

Objective: The proposed study objectives include:

1. Determine whether generalized skew coefficients for Iowa should be revised.
2. Compile 3 data sets for basin characteristics using different techniques. Develop flood-frequency equations for each data set using statewide, regional, drainage area, and region of-influence regression methods.
3. Develop one or two sets of flood-frequency equations for Iowa that:
   a) provide most accuracy.
   b) are simple for users to apply and provide greatest predictive accuracy obtainable.

Reports: Final Report, January 2001

Implementation: Results from this study will be two sets of regression equations, which will be published. These equations will: 1) provide the greatest predictive accuracy obtainable; 2) provide the simplest application and great predictive accuracy obtainable.

Project Number: HR-397

Project Title: Field Laboratory Testing of Damaged Prestressed Concrete (P/C) Girder Bridges

Agency: Iowa State University

Principal Investigator: F. Wayne Klaiber

Research Period: November 26, 1996 to December 31, 1999

Research Board Funding: $179,880

Funding Source: 100 percent State – 70 percent Primary funds, 10 percent Secondary funds and 20 percent Street funds

Objective: The objective of this project is to develop guidelines that an engineer can use to determine the effect a damaged member(s) would have on the redundancy and reliability of a given bridge.

Reports: Final Report, December 1999

Implementation: Results from this study will provide guidance to maintenance management for determining if a bridge with a damaged member(s) should be closed, limited to one lane, continue to be used at reduced speeds, etc.

Project Number: HR-398

Project Title: Hydraulics of Slope-Tapered Concrete Pipe Culverts

Agency: FHWA Office of Engineering Research and Development and GKY and Associate

Principal Investigator: J. Sterling Jones

Research Period: January 17, 1997 to May 1, 1997

Research Board Funding: $33,832

Funding Source: 100 percent State – 100 percent Primary funds

Objective: The objective of this research project is to verify the hydraulic design details of slope tapered pipe culverts.

Progress: FHWA and their contractor have completed all laboratory work and submitted a draft final report in January 1998. Final review comments to this draft report need to be submitted by the Office of Bridges and Structures to FHWA so the report can be finalized.

The results of the research show that both the slope tapered inlet configuration and the typical precast concrete pipe apron (Iowa DOT Standard Road Plan RF-3) are more hydraulically efficient than assumed. Also, in the slope taper section, the number of reducer sections required in Iowa DOT's design guidelines could be decreased by one reducer without adversely affecting hydraulic efficiency of the inlet. In general, the research verified assumptions in Iowa DOT's design guidelines for slope tapered concrete culverts.

Reports: None

Implementation: Iowa DOT intends to use the new hydraulic design coefficient for a standard concrete pipe apron which results in a slightly improved hydraulic performance for all concrete pipe culverts, not only slope tapered inlets. Also, IDOT's design procedures for the slope tapered pipe culvert will be finalized and distributed.

Project Number: HR-399

Project Title: Field Testing of Integral Abutments

Agency: Iowa State University

Principal Investigator: Robert Abendroth

Research Period: February 1, 1997 to October 31, 2001

Research Board Funding: $299,932

Funding Source: 100 percent State – 50 percent Primary funds, 35 percent Secondary funds and 15 percent Street funds

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:

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

Progress: Long-term monitoring of strains, displacements, and temperatures continuing at both integral abutment bridges selected. Lab tests were conducted to determine the coefficient of thermal expansion and contraction of core samples taken from the decks. Analysis of these tests has been completed. The finite-element model for both bridges is complete. A calibration procedure that involves the comparison of analytically predicted and experimentally measured bridge displacement has been completed. Disassembly and removal of data collecting instrumentation from the 2 bridges is under way.

The final report is being prepared.

Reports: Quarterly Report, April 2001

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.

Project Number: TR-401

Project Title: Embankment Quality, Phase I, Phase II and Phase III

Agency: Iowa State University

Principal Investigator: Kenneth Bergeson

Research Period: May 1, 1997 to December 31, 2001

Research Board Funding: $337,135

Funding Source: 100 percent State – 70 percent Primary funds, 15 percent Secondary funds and 15 percent Street funds

Objective: The primary objectives of this study are as follows:

Phase I - Evaluate the current compaction method and acceptance and to provide suggestions for new compaction procedures and to recommend methods of testing and acceptance.

Phase II - Field testing of alternative embankment acceptance procedures and methods for rapid field identification of the range of soil types in Iowa.

Phase III - Design and construct a project using the recommended design specifications.

Progress: Phase I has been completed with a cost to the Iowa DOT of $100,892 and has indicated that the Iowa DOT is not consistently obtaining a quality embankment constructed under the current Iowa DOT specifications.

Phase II project selection, test sections, and field testing is completed at a cost of $147,018.

Phase III, at a cost of $89,225, was authorized in February 2000. A project has been designed based on the proposed soil classification method developed from Phase I and II.

Reports: Quarterly Report, April 2001

Implementation: Iowa State University will prepare recommended embankment construction acceptance procedure and field testing procedures for Iowa DOT and grading contractors to use.

Project Number: TR-405

Project Title: Impact of Deck Cracking on Durability - Phase I and II

Agency: Iowa State University and a subcontract to the University of Northern Iowa

Principal Investigator: Fouad Fanous, Edward Jaselskis (Phase I only) and M. Salim (Phase I only)

Research Period: April 15, 1997 to September 30, 2000

Research Board Funding: $190,131

Funding Source: 100 percent State – 65 percent Primary funds, 25 percent Secondary and 10 percent Street funds

Objective: The objective of the research is to determine the impact of deck cracking on the durability of a bridge deck.

Reports: Final Report, March 2000

Implementation: This research will guide bridge engineers to determine when to conduct Class A or Class B repairs

Project Number: TR-406

Project Title: Determine Initial Cause for Current Premature Portland Cement Concrete (PCC) Pavement Deterioration

Agency: Iowa State University

Principal Investigator: Scott Schlorholtz

Research Period: May 1, 1997 to November 30, 2000

Research Board Funding: $141,762

Funding Source: 100 percent State – 50 percent Primary funds, 25 percent Secondary funds and 25 percent Street funds

Objective: The objective of this research is to determine the initial cause for premature deterioration of some PCC pavements constructed mainly since 1983. A specific objective is to determine the impact to deterioration from alkali silica reactivity (ASR) and/or from ettringite expansion.

Reports: Final Report, October 2000

Implementation: The proposed research should identify the initiating cause of the pavement deterioration. Once the cause is known, specifications can be changed to ensure longevity of our PCC pavements.

Project Number: TR-408

Project Title: Glass Fiber Composite Dowel Bars for Highway Pavement

Agency: Iowa State University

Principal Investigator: Max Porter

Research Period: June 2, 1997 to May 31, 2001

Research Board Funding: $220,595

Funding Source: 100 percent State – 80 percent Primary funds, 10 percent Secondary funds and 10 percent Street funds

Objective: The objective of this research project is to investigate the long-term performance and fatigue behavior of glass fiber composite dowels.

Progress: An extensive literature review was conducted. The information gathered was used to develop a test matrix for the project.

Specimens were constructed and tested for both the unaged and aged elemental static direct shear tests. The elemental fatigue specimens for both the unaged and aged specimens have been constructed. The testing apparatus for the fatigue specimens is currently under construction.

A modified AASHTO T253 testing method was used to evaluate round dowels of different sizes and materials. The testing materials included three different concrete strengths and eight different sizes and types of dowels.

Preparations are underway for testing of aged Glass Fiber Composite (GFC) dowels, which will be done in accordance with the American Society for Testing and Materials (ASTM) D4476-85 and D4475-85. The results of the aged flexural and interlaminar strengths will be compared to previously unaged GFC dowels.

Two full-scale slabs have been tested utilizing 1.5" diameter GFC dowels spaced at six and twelve inches. The data is currently being analyzed.

Reports: Draft Final Report, June 2001

Implementation: This research will provide designers with a new set of preliminary design criteria for using the GFC dowels in highway pavement joints as an alternative to epoxy coated steel dowels.

Project Number: TR-410

Project Title: Investigation of Two Bridge Alternatives for Low Volume Roads - Phase II

Agency: Iowa State University

Principal Investigator: F. W. Klaiber, T. J. Wipf

Research Period: June 16, 1997 to November 30, 2000

Research Board Funding: $246,660

Funding Source: 100 percent State – 100 percent Secondary funds
The participating county will contribute an additional $25,000

Objective: The objective of this research (Phase II) is to construct a demonstration bridge using Concept 1 in the field, subjecting it to periodic field testing and perform additional laboratory testing of the Concept 2 bridge.

Reports: Final Report, October 2000

Implementation: HR-365, "Evaluation of Bridge Replacement Alternatives for the County Bridge System" was recently completed to evaluate several replacement bridges currently being used on low volume roads in Iowa. This study also concluded that many counties in Iowa have the ability and are interested in using their own forces to design and construct short span bridges. The current research should provide viable bridge designs for such efforts.

Project Number: TR-411

Project Title: An Improved Computer Program for River Valley Rating Curves

Agency: Iowa State University

Principal Investigator: T. Al Austin

Research Period: July 23, 1997 to December 31, 2001

Research Board Funding: $47,993

Funding Source: 100 percent State – 40 percent Primary funds, 40 percent Secondary funds and 20 percent Street funds

Objective: The objective of this research project is to rewrite the computer program, PCVAL, in a user-friendly format, Visual Basic 5.0, and develop a user's manual to enhance its use.

Progress: A new version of PCVAL has been written in Visual Basic and includes interactive graphics and much improved user flexibility. The PCVAL 2.2 was Beta tested by a committee of eight (8) county engineers and Iowa Department of Transportation engineers. Comments were received through June 1 and final corrections and extensions have been made. PCVAL 2.2 is nearly ready for distribution.

The project received additional funds in July 1998 to include the computation of bridge backwater.

Reports: None

Implementation: The new PCVAL code will be fully Windows capable and will operate under Windows 3.0 or higher and Windows 95 and Windows NT. The computer code and user manual will be presented to the Iowa DOT. One copy of the program and user manual will be provided to every county engineer's office in Iowa for use in the development of river valley rating curves.

Project Number: TR-412

Project Title: Development of a Computer Controlled Underbody Plow

Agency: The University of Iowa

Principal Investigator: Wilfrid A. Nixon

Research Period: August 1, 1997 to December 31, 2001

Research Board Funding: $65,000

Funding Source: 100 percent State – 80 percent Primary funds, 10 percent Secondary funds and 10 percent Street funds

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.

Progress: The MATLAB software package has allowed a base level program for fuzzy control of a snowplow to be developed. This has the capability of providing fuzzy control over a closed feedback loop, in which the force between underbody plow and the road surface (the scraping force) is the primary feedback signal. It also incorporates a number of secondary feedback signals (such as plow angle) into the control loop and a simple weighted algorithm has been used for this.

Reports: Annual Progress Report, July 1999

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.

Project Number: TR-414

Project Title: Superpave Mix Designs for Low Volume Roads

Agency: Iowa DOT, Scott County, Mahaska County, Mills County, Cerro Gordo County, Dubuque County, Pocahontas County, Cass County, Linn County, and Louisa County

Principal Investigator: Ed Engle and the respective County Engineer

Research Period: July 1, 1997 to December 31, 2003

Research Board Funding: $50,000

Funding Source: 100 percent State – 100 percent Secondary funds

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

Progress: All of the eight final projects are completed. Annual distress and performance surveys commenced in 1999. A report will be presented to the IHRB at their September 2001 meeting.

Reports: None

Implementation: The Superpave mix design 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 naturally be an attractive alternative for counties statewide. This is especially true as state ACC projects are shifted to 100% Superpave.

Project Number: TR-415

Project Title: Effects of Aggregate-Related Factors of Critical VMA in Asphalt Paving

Agency: Iowa State University

Principal Investigator: Brian Coree

Research Period: January 1, 1998 to August 31, 2000

Research Board Funding: $152,664

Funding Source: 100 percent State – 45 percent Primary funds, 40 percent Secondary funds and 15 percent Street funds

Objective:
1. Establish a laboratory method by which the transition of an asphalt paving mixture from sound to unsound behavior may be credibly identified and measured.
2. Use that method to identify and evaluate statistically the effect of aggregate related factors on the critical state of such mixtures.
3. Derive a predictive relationship relating critical state (e.g., critical VMA) to aggregate-related properties such as nominal maximum aggregate size, gradation, shape, and texture.

Reports: Final Report, June 2000

Implementation: The resulting relationships will provide Iowa DOT with an improved means of identifying the magnitude of the critical volumetric parameters. This will allow the Iowa DOT and the contractor to target volumetric design close to the critical threshold with greater confidence than is now possible, and to identify situations in which conventional analysis might fail to identify potentially unsound mixtures. It is further anticipated that some of the effects of the SUPERPAVE consensus aggregate properties will be better defined.

Project Number: TR-416

Project Title: Development of Materials Training Course for Technicians

Agency: Iowa State University

Principal Investigator: Brian Coree

Research Period: January 1, 1998 to November 30, 2000

Research Board Funding: $11,674

Funding Source: 100 percent State – 70 percent Primary funds, 20 percent Secondary funds and 10 percent Street funds

Objective: The objectives of the proposed research are: 1) develop a "Highway Materials Training Course for Technicians," comprised of a series of stand-alone modules of one and two-day classes covering the major material types relevant to highway works; 2) to develop both the instructor and participant packages; 3) to undertake pilot classroom instruction and to refine the developed instructional materials based upon participant feedback.

Progress: The materials are complete and shall be presented to the IHRB for approval in the Fall 2001.

Reports: None

Implementation: It is anticipated that technicians will benefit from exposure to a more general materials background, and perhaps feel empowered with a degree of ownership with a greater understanding of the importance and relevance of the tests that they routinely perform in the course of their work, and to avoid testing and evaluation errors due to lack of experience. It is anticipated that this program be offered annually by the DOT and that newly hired technicians will be expected to participate. The benefits of this project are largely intangible.

Project Number: TR-417

Project Title: Iowa County Engineers Association Service Bureau

Agency: Iowa County Engineers Association

Principal Investigator: Steve DeVries

Research Period: June 4, 1998 to June 30, 2000

Research Board Funding: $300,000

Funding Source: 100 percent State – 100 percent Secondary funds

Objective: To enhance county engineer's service to the public by helping them save time, do their jobs more efficiently, increase the quality of their work, and improving the intercommunications between them and the Iowa DOT. Functions are to include data distribution and conversion, TPMS operation, user support and training, and collective purchasing ability.

Reports: Final Report, October 2000

Implementation: By the end of the research period, the counties should have a self-supporting organization to provide support for information management and transfer. This service bureau will provide benefits to all of the counties in Iowa.

Project Number: TR-419

Project Title: Education on Urban Corridor Issues Through Computer Animation

Agency: Snyder and Associates

Principal Investigator: Brad Skinner

Research Period: May 21, 1998 to January 31, 2002

Research Board Funding: $30,000

Funding Source: 100 percent State – 45 percent Primary funds, 5 percent Secondary funds and 50 percent Street funds

Objective: The objective of this research is to develop a method of using a combination of photo-imaging and computer animation at much less expense to provide a visual aid to gain public acceptance of an urban safety upgrade project.

Progress: The script, video and citizen evaluation of the video has been completed and an interim report was presented to the Iowa Highway Research Board in October 1998. Overall, 97% of the project is completed.

A final report will be submitted, following the construction project completion, including a video comparison of the constructed project. The "After Construction" video will be presented for comparison to the animated improvements developed in the interim submittal. The roadway construction is currently underway in 2001and should be complete in the spring of 2002.

Reports: Interim Report, October 1998

Implementation: Implementation of this research will be through an evaluation of how photo-imaging and computer animation can be used in combination to cost-effectively give the average citizen an understanding of how a constructed design will compare to the current conditions. A before and after comparison of a corridor will also show how well the post-construction appearance can be represented by integration of imaging and animation into a video prior to actual construction.

Project Number: TR-420

Project Title: Field Evaluation of Alternative Load Transfer Device Locations in Low Traffic Volume Pavements

Agency: Iowa State University

Principal Investigator: James K. Cable and Curtis Greenfield

Research Period: July 30, 1998 to December 31, 2003

Research Board Funding: $98,478

Funding Source: 100 percent State – 80 percent Secondary funds and 20 percent Street funds

Objective: The objective of this research is to evaluate the placement of load transfer dowels in PCC pavements on low volume roads. The intention is to find strategic dowel placements that would decrease the number of dowels needed and make placement easier.

Progress: Paving was completed in Union County during the summer of 1998. Evaluations, including traffic counts and pavement performance indicators, have been performed for the two paving projects. These evaluations will be performed annually through 2003.

Reports: None

Implementation: If an optimized dowel placement regimen can be demonstrated, counties will be able to save significantly on paving projects - both from the cost of dowels and reduced labor in placement.

Project Number: TR-422

Project Title: Pretreatment for Reduction of Asphalt Absorption in Porous Aggregate

Agency: Louisa County

Principal Investigator: Ed Engle, John Hinrichsen and Robert Simmering

Research Period: August 1998 to December 2003

Research Board Funding: $14,000

Funding Source: 100 percent State – 40 percent Primary funds, 40 percent Secondary funds and 20 percent Street funds

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

Progress: The paving project was completed in the summer of 1998. Evaluations of the pavement are being performed in conjunction with another research project (HR-414) on an annual basis. The additive does not appear to have provided significant reduction in asphalt absorption into the aggregate. A final report is in preparation.

Reports: None

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.

Project Number: TR-424

Project Title: Steel Diaphragms in Prestressed Concrete Girder Bridges

Agency: Iowa State University

Principal Investigator: Robert Abendroth and Fouad Fanous

Research Period: January 1, 1999 to December 31, 2001

Research Board Funding: $178,358

Funding Source: 100 Percent State – 65 percent Primary funds, 25 percent Secondary funds, and 10 percent Street funds

Objective: The objectives of the research are:

1. Evaluate the state-of-the-art regarding the role of intermediate diaphragms in distributing lateral loads throughout PC girder bridge structures.
2. Investigate the static and dynamic-load response characteristics of different types and configurations of intermediate diaphragms in PC girder bridges.
3. 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.

Progress: Five members have been selected for the Project Advisory Committee. After an extended, difficult search, a graduate student has finally been assigned to work on this project. He will begin in July 1999. A survey has been prepared for distribution to state bridge engineers and it will be mailed soon. Work on a mathematical model for bridge analysis is progressing. Due mainly to the delay in obtaining the research assistant (graduate student), the project required a no-cost time extension.

Reports: Quarterly Report, April 2001

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 proposed 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. If economical and sufficiently stiff intermediate steel diaphragms can be used to replace the conventional intermediate RC diaphragms, bridge construction time and costs should be reduced.

Project Number: TR-426

Project Title: Mobility of Safety Impacts of Winter Storm Events in a Freeway Environment

Agency: Iowa State University

Principal Investigator: Keith Knapp

Research Period: November 1, 1998 to May 31, 2000

Research Board Funding: $106,358

Funding Source: 100 percent State – 80 percent Primary funds, 10 percent Secondary funds and 10 percent Street funds

Objective: The purpose of this research is to better understand the relationships between freeway traffic flow and safety characteristics and the quantifiable and measurable characteristics of a freeway environment during a winter storm event.

Reports: Final Report, March 2000

Implementation: The information produced by this research will provide city, county, and state transportation agencies with a better understanding of the operational and safety impacts of winter storm events. The research results should identify the most important factors to be considered in the development of maintenance policies and standards, operations, and resource allocation. More specifically, this research should allow the quantification and inclusion of winter storm roadway user impacts within these activities.

The results of this research will also provide city, county, and state transportation agencies with the ability to alert travelers to more specific operational and safety impacts of winter storm events.

Project Number: TR-427

Project Title: Evaluation of High-Slump Concrete for Bridge Deck Overlays

Agency: Buchanan County

Principal Investigator: Brian Keierleber

Research Period: December 21, 1998 to December 31, 2004

Research Board Funding: $26,200

Funding Source: 100 percent State – 40 percent Primary funds, 30 percent Secondary funds and 30 percent Street funds

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.

Progress: Construction of two bridge deck overlays was completed in Fall 2000. A Construction report will be submitted to the IHRB at their September 2001 meeting.

Reports: None

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.

Project Number: TR-428

Project Title: Effective Structural Concrete Repair

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 percent State – 45 percent Primary funds, 45 percent Secondary funds, and 10 percent Street funds

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

Progress: A draft report was prepared related to the laboratory testing of small test beams using different repair materials. The test beams had simulated damage by loss of concrete section by forming void areas into them when they were cast. Different repair materials were used. The beams were tested in flexure.

A draft report was prepared for the laboratory testing of three new P/C beams that were damaged (concrete removed from the tension flange and strands severed) and repaired. A fourth similar damaged beam has been tested, repaired and retested in the laboratory and the result data are being evaluated.

Two field demonstration repair projects have been completed to date. Both projects had damaged prestressed girders from over height vehicles. They are on IA 65 in Altoona and IA 34 over I-35 near Osceola. Both were load tested prior to repair, then repaired with FRP. The first was retested and the second will be retested.

A meeting was held with the DOT Office of Bridges and Structures to determine suitable candidates for additional field demonstration projects.

Reports: Progress Report, June 2001

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.

Project Number: TR-429

Project Title: Evaluation of Appropriate Maintenance Repair and Rehabilitation (MR&R) Methods for Iowa Bridges

Agency: Iowa State University

Principal Investigator: Terry J. Wipf, Fouad S. Fanous and F. Wayne Klaiber

Research Period: February 1, 1999 to December 31, 2001

Research Board Funding: $195,060

Funding Source: 100 percent State – 45 percent Primary funds, 45 percent Secondary funds and 10 percent Street funds

Objective: The primary objective of the proposed research is to compile current information on MR&R techniques and implementation guidelines. The proposed research will provide guidance for designers as well as field personnel.

Progress: A summary of the literature search results (including results from the Iowa County survey) related to MR&R procedures has been prepared. This information will be a part of the draft final report that is currently in preparation. The MR&R procedures determined to be most useful for addressing the county bridge needs have been compiled. This information is being prepared into a format that will constitute a design manual. In addition, design procedures associated with some of the MR&R procedures have been developed for incorporation into the design manual. Work is proceeding on the development of the design manual and final report.

Reports: Progress Report, June 2001

Implementation: The result of this research project will provide MR&R procedures that are systematic and will serve as guidelines to engineers and field personnel.

Project Number: TR-430

Project Title: Regional Approach to Landslide Interpretation and Repair

Agency: Iowa State University

Principal Investigator: Robert Lohnes and Bruce Kjartanson

Research Period: February 1, 1999 to March 31, 2001

Research Board Funding: $179,801

Funding Source: 100 percent State – 35 percent Primary funds and 65 percent Secondary funds

Objective: The objective of the proposed research is to provide Iowa county engineers and highway maintenance personnel with procedures that will allow them to efficiently and effectively interpret and repair or avoid landslides.

The proposed research will provide methods to distinguish areas of potential slope instability, identify incipient failure conditions and recognize the cause or causes of a landslide at a particular location. Based upon those interpretations, the most appropriate methods to restore stability to the site will be apparent.

Reports: Final Report

Implementation: Iowa county engineers and highway maintenance personnel for both the counties and the Iowa DOT will use the products of this research. The products are:

- Landslide susceptibility map. This will provide a guide for preliminary evaluation of landslide potential.
- Report on landslide assessment. This report (or manual) will provide a procedure for assessing the landslide potential of a given site and in situations where landslides have occurred, provide a method to determine the cause or causes of the slide. Recommendations for repairs will be included.
- Workshops on how to use report and map. These workshops will provide "hands-on experience" on how the information included in the other two products can be utilized.

Project Number: TR-431

Project Title: Reduction of Concrete Deterioration by Ettringite Using Crystal Growth Inhibition Techniques

Agency: Iowa State University

Principal Investigator: Robert Cody

Research Period: February 1, 1999 to February 28, 2001

Research Board Funding: $139,236

Funding Source: 100 percent State – 90 percent Primary funds and 10 percent Secondary funds

Objective: The objective of the proposed research is to experimentally determine whether commercial crystallization inhibitor chemicals will prevent or reduce ettringite formation in highway concrete, with the ultimate goal of reducing premature deterioration of highways. The proposed research has the potential to significantly reduce expensive highway repairs that are required because of premature concrete deterioration.

Reports: Final Report, February 2001

Implementation: If experiments prove successful, then applications of crystallization inhibitor solutions mixed with deicing brines, or powered inhibitor chemicals added to rock salt or CMA, might prove to be a highly cost-effective method of reducing secondary mineral damage to existing highways. After application of inhibitor-enhanced brines or solid deicers, solutions containing inhibitor molecules will infiltrate downward into the highly porous and permeable concrete slabs. Concrete slab pore fluids containing the inhibitors potentially will be modified so that ettringite precipitation will be reduced or prevented.

Mixing solid or liquid inhibitor chemicals deicers/anti-icers will require no modifications to existing equipment. Commercial inhibitors are effective in small concentrations (ppm) and the chemicals are not expensive. For example, Dequest 2060, a widely used boiler scale inhibitor costs $1.20/lb in large quantities. Costs of implementing such a program should be low compared to the costs of repairs to highways damaged by secondary mineral growth.

Project Number: TR-432

Project Title: Ultrathin PCC Overlay Extended Evaluation

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 percent State – 50 percent Primary funds, 45 percent Secondary funds and 5 percent Street funds

Objective: Evaluation of the following: 1.) conventional methods of slab removal and surface preparation for removal and replacement areas, 2.) the condition of the asphaltic concrete surface under removal and replacement areas, 3.) the cost/benefit of polypropylene fiber addition to the concrete, 4.) the performance of the rehabilitated sections, and 5.) the validation of the design methods of PCA and ACPA.

Progress: The first rehabilitation was completed and with good success in traditional full depth patching of the overlay depth. Monitoring has continued and a second rehabilitation and spot overlays is scheduled for the fall of 2001.

Reports: Construction Report, July 2000

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

Project Number: TR-433

Project Title: HWYNEEDS - Methodology, Analysis and Evaluation

Agency: Iowa State University

Principal Investigator: Tom Maze and Omar Smadi

Research Period: May 1, 1999 to April 30, 2001

Research Board Funding: $89,265

Funding Source: 100 percent State – 20 percent Primary funds and 80 percent Secondary funds

Objective: This project covers the HWYNEEDS computer program and its use in the Quadrennial Needs Study. The HWYNEEDS program methodology will be analyzed and evaluated to investigate its appropriateness for use in the Quadrennial Needs Study.

Reports: Final Report, April 2001

Implementation: This HWYNEEDS - Methodology, Analysis and Evaluation will be evaluated against the counties needs and conditions.

Project Number: TR-434

Project Title: Use of Abrasives in Winter Maintenance

Agency: The University of Iowa

Principal Investigator: Wilfrid Nixon

Research Period: May 1, 1999 to July 31, 2000

Research Board Funding: $30,420

Funding Source: 100 percent State – 10 percent Primary funds, 80 percent Secondary funds and 10 percent Street funds

Objective: The objective of this project is twofold. First, by surveying the literature and the current practice to develop reference guidelines for best practice in abrasive application as a part of winter maintenance activities in Iowa. Second, the project will develop an outline of an experimental program to improve understanding of how abrasives work, and thus improve the guidelines for best practice based on the results of those experiments.

Progress: A contract has been signed to conduct this research with the University of Iowa. The literature review has been conducted and most of the needed reports and papers have been obtained. The current phase of the work examines the "grey" literature, and efforts are underway to obtain as much of this as is possible.

Reports: Final Report, December 2000

Implementation: This research will develop a comprehensive set of recommendations for abrasive use by state, county and city agencies.

Project Number: TR-435

Project Title: Thin Maintenance Surfaces - Phase II and Guidelines for Winter Maintenance on Thin Maintenance Surfaces

Agency: Iowa State University and The University of Iowa

Principal Investigator: Charles Jahren and Wilfrid Nixon

Research Period: July 1, 1999 to October 31, 2001

Research Board Funding: $117,030

Funding Source: 100 percent State – 55 percent Primary funds and 45 percent Secondary funds

Objective: There are five principal objectives for this research.

1. Continue monitoring of the performance of previously placed test sections;
2. Investigate possible improvements in the use of seal coat aggregates;
3. Select a seal coat design process to recommend for use by the State of Iowa;
4. Develop a micro-surfacing mix using local limestone; and
5. Develop guidelines for winter maintenance on thin maintenance surfaces.

Progress: Performance monitoring at existing test locations has been on-going. Placement of seal-coat test sections was finished by fall of 1999. The winter maintenance portion of the research is also complete. Additional test sections are being placed during summer 2000.

Reports: None

Implementation: The results from this research should provide engineers and transportation decision makers with guidelines for the selection of materials, techniques and maintenance practices for thin maintenance surfaces.

Project Number: TR-436

Project Title: Retrofit Methods for Distortion Cracking Problems in Plate Girder Bridges

Agency: Iowa State University

Principal Investigator: Terry Wipf

Research Period: July 1, 1999 to August 31, 2002

Research Board Funding: $158,028

Funding Source: 100 percent State – 75 percent Primary funds, 20 percent Secondary funds and 5 percent Street funds

Objective: The objectives of this proposal are to: 1) verify the effects of the bolt loosening on one of the first retrofitted bridges, including long-term continuous monitoring of a retrofitted bridge, 2) investigate the retrofit method's applicability for bridges with I-beam diaphragms, and 3) study the cause and possible remedies for the failure of the retrofitted bolted connection in the two-beam bridges.

Progress: The identification and inspection of bridges to be field tested was completed. Six field load bridge tests have been done. Evaluation of data is in progress. Some problems with the data acquisition system occurred. This problem caused a significant delay in progress and required a time extension to the contract. A new data acquisition system was purchased. Field data from continuous monitoring has been reduced. A PowerPoint presentation of the progress of bridge tests was presented to the committee and a draft on 2 bridge tests has been written.

Reports: Quarterly, January 2001

Implementation: The results of the proposed research study should provide guidance in maintaining steel girder bridges to the Office of Bridge Maintenance and Inspection of the Iowa DOT.

Specifically, the effectiveness of potential retrofit methods to be used by the Iowa DOT will be determined.

Project Number: TR-437

Project Title: Performance of Strip Seals in Iowa Bridges, Pilot Study

Agency: Iowa State University

Principal Investigator: Lowell Greimann and James Bolluyt

Research Period: August 16, 1999 to December 31, 2000

Research Board Funding: $43,334

Funding Source: 100 percent State – 60 percent Primary funds, 20 percent Secondary funds and 20 percent Street funds

Objective: The objectives of this research are to determine the causes of failures of strip seals in Iowa bridges and to identify possible solutions.

Reports: Final Report, April 2001

Implementation: Once the primary causes of the strip seal failures are identified, the solution to failure prevention would be apparent. If the solution is not apparent, further laboratory testing and field evaluation of seals may be appropriate.

Project Number: TR-438

Project Title: An Integral Abutment Bridge With Precast Concrete Piles

Agency: Iowa State University

Principal Investigator: Robert Abendroth

Research Period: July 1, 1999 to June 30, 2002

Research Board Funding: $142,903

Funding Source: 100 percent State – 60 percent Primary funds, 35 percent Secondary funds and 5 percent Street funds

Objective: The research objectives are:

1. 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.
2. 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.
3. Establish the longitudinal displacement verses temperature behavior for the abutments of the Tama County bridge.

Progress: Data has been recorded for the instrumentation devices that were installed at the Tama County Bridge since about April of 2000. Transducer instrumentation devices are monitoring horizontal displacements of the abutments along the longitudinal and transverse directions of the bridge, and strain gages are monitoring longitudinal strains in selected PC piles. The field data are being screened by a data reduction procedure to evaluate the accuracy of measured responses. Graphical presentations are being generated for displacement and strain responses verses time.

Reports: Quarterly reports are prepared in January, April, July and October of each year.

Implementation: The results obtained from this research will provide bridge design engineers for the Iowa DOT with a better understanding of the behavior of the PCC abutment piles in the Tama County integral-abutment bridge. Engineers with the Bridge Design Section 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.

Project Number: TR-440

Project Title: Field and Laboratory Evaluation of Precast Concrete Bridges

Agency: Iowa State University

Principal Investigator: F. Wayne Klaiber, Terry Wipf and Mark Nahra

Research Period: November 1, 1999 to October 31, 2001

Research Board Funding: $137,580

Funding Source: 100 percent State – 85 percent Secondary funds and 15 percent Street funds

Objective: The primary objective of this research is to determine the strength of deteriorated precast concrete deck bridges (PCDBs). This will be accomplished through the field and laboratory testing of this type of bridge and the individual precast units.

Progress: The major portion of the project is completed. Four different precast concrete bridges have been field tested. One of the bridges was removed from service and several of the elements from it have been tested to failure in the structures laboratory to determine their actual strength.

Mark Nahra is removing a precast concrete bridge this fall. Plan is to obtain two of the precast units from this bridge and test them in the laboratory, analyze the data from the test and complete the writing of the final report.

Reports: Progress Report

Implementation: Results from this research make it possible to more accurately rate similar PCDBs. This information will be valuable for county engineers with such bridges and consultants who work with the various counties.

Project Number: TR-441

Project Title: Reference Manual for Traffic Control Devices

Agency: Iowa State University

Principal Investigator: Keith Knapp, Tom McDonald and Duane Smith

Research Period: November 1, 1999 to April 30, 2001

Research Board Funding: $70,669

Funding Source: 100 percent State – 35 percent Primary funds, 50 percent Secondary funds and 15 percent Street funds

Objective: The objective for this research project is to identify specific areas in traffic control device and pavement marking programs where references and guidelines will be most beneficial for local government staff.

Reports: Final Report, April 2001

Implementation: The operating statement and manual resulting from this project may be adapted by individual transportation agencies in Iowa. The manual will be sufficiently flexible to permit local modification and field use.

Project Number: TR-442

Project Title: Systematic Identification of High Crash Location

Agency: Iowa State University

Principal Investigator: Reginald Souleyrette and Ali Kamyab

Research Period: January 15, 2000 to April 30, 2001

Research Board Funding: $126,235

Funding Source: 100 percent State – 75 percent Primary funds, 22 percent Secondary funds and 3 percent Street funds

Objective: This research project seeks to develop a tool and a process by which Iowa engineers can identify potentially hazardous roadway locations and design.

Reports: Final Report, June 2001

Implementation: This research will establish a database for high crash locations.

Project Number: TR-443

Project Title: Evaluation of Rammed Aggregate Piers for Highway Application in Iowa Soils

Agency: Iowa State University

Principal Investigator: John Pitt and David White

Research Period: January 1, 2000 to December 31, 2001

Research Board Funding: $148,938

Funding Source: 100 percent State – 50 percent Primary funds, 45 percent Secondary funds and 5 percent Street funds

Objective: The primary objective of this project is to evaluate a new method for soil reinforcement called Geopiers with Iowa soils, with particular emphasis on two problem areas.

1. Reinforcement of soft soils prior to construction of highway embankments in order to minimize settlement.
2. Reinforcement of embankment or cut toe slopes in order to prevent slope failures.

Progress: Task 1 - 100 percent completed.
Task 2 - Conduct site evaluation prior to installation to determine in site engineering properties of soil with Pressuremeter, Dilatometer and Ko-Stepped Blade is 75 percent completed.
Task 3 - Geopiers have been installed and monitoring is in progress. Soil tests are in progress and 90 percent are completed.
Task 4 - Observe and document Geopier installations and develop construction guidelines for future use is 50 percent completed.
Task 5 - Conduct in situfield-testing after construction to determine changes in soil strength and settlement parameters is 50 percent completed.
Task 6 - 0 percent completed.
Task 7 - Monitor the performance of reinforced test section and carry out yearly performance is 20 percent completed.

Reports: Quarterly Report, January 2001

Implementation: Results of the evaluation will be prepared in a summary report and made available to state, county and city agencies, which will provide a practical option to improve soft soils, reduce bridge approach settlement, and reinforce slopes and retaining structures.

Project Number: TR-444

Project Title: Demonstration Project Using Railroad Flat Cars for Low Volume Road Bridges

Agency: Iowa State University

Principal Investigator: F. Wayne Klaiber

Research Period: June 25, 2000 to August 31, 2002

Research Board Funding: $187,620

Funding Source: 100 percent State – 100 percent Secondary funds

Objective: The objective of this research is to design and construct two bridges using railroad flatcars. The bridges will be instrumented and field load tested at the end of construction, and inspected and load tested periodically thereafter.

Progress: The project involves the construction and testing of two Rail Road Flat Car (RRFC) demonstration bridges. Progress on the demonstration bridges is described in the following paragraphs.

The RRFC bridge in Buchanan County was completed in June 2001. This bridge, which consists of 3 RRFC side-by-side, is 60 ft. long. A unique concrete beam system was used to connect the 3 cars together longitudinally. This bridge was instrumented and tested twice during the summer. Test 1 involved loading one of the RRFC before the cars were connected; Test 2 involved load testing the completed bridge prior to installation of the guardrails. Theoretical and experimental results indicated the bridge can carry Iowa legal loads. This bridge will be retested in Summer 2002.

The RRFC bridge in Winnebago County is under construction. As of June 30, 2001, piles were being driven and fabrication was completed on the RRFCs. This bridge will consist of 3 RRFCs, each 89 ft. in length. Due to the edge members being different on these cars, a different structural connection between adjacent cars will be used. Similar to the first demonstration bridge, an individual car will be instrumented and tested prior to connecting the adjacent cars. The bridge will be tested a second time in Fall 2001, after the timber plank surface is installed, and again in Summer 2002.

Reports: None

Implementation: The primary value of the research is to provide strength behavior information for these bridges, so that they can be used to replace deficient bridges in a cost effective manner. In addition, design and construction guidelines will be developed to assist engineers with this type of bridge. Construction of these bridges will be documented to assist others in the construction of additional railroad flatcar bridges.

Project Number: TR-445

Project Title: Development of Bridge Load Testing for Load Evaluation

Agency: Iowa State University

Principal Investigator: Terry Wipf, F. Wayne Klaiber and Douglas Wood

Research Period: May 22, 2000 to November 30, 2001

Research Board Funding: $176,876

Funding Source: 100 percent State – 65 percent Primary funds, 30 percent Secondary funds and 5 percent Street funds

Objective: The primary objective of this research is to investigate and develop a load testing process for evaluating and rating bridges on the highway system in Iowa. This is an initial step in the process of establishing an objectively tested bridge rating system.

Progress: Task 1 – Survey of other states – 90 percent complete.

Task 2 – Validation of load testing process – 50 percent complete

- Diagnostic load test evaluation of previously tested bridges
- Comparison of load rating methods
- Proof load test

Task 3 – Assessment of the analytical process – 50 percent complete

Task 4 – Load rating of posted bridges – 60 percent complete

Reports: Quarterly Report – July 2001

Implementation: The results from this investigation will provide technical information and recommendations that engineers can use to more accurately evaluate existing bridges. In addition, the information will provide useful guidelines regarding actual bridge behavior that can be beneficial to engineers responsible for bridge design.

Project Number: TR-446

Project Title: Technology Transfer of "As Built Preliminary Surveys" by Total Station GPS, Video Logging and Laser Scanning

Agency: Iowa State University

Principal Investigator: Kandiah Jeyapalan

Research Period: June 1, 2000 to May 31, 2002

Research Board Funding: $214,150

Funding Source: 100 percent State – 65 percent Primary funds, 30 percent Secondary funds and 5 percent Street funds

Objective: The objectives of this project are to develop a user friendly positioning system using video logging and soft photogrammetry for the purpose of constructing "AS Built" surveys of bridges and culverts and to demonstrate the development and use of local geoid in preliminary and photogrammetric control surveys for Iowa engineers and surveyors.

Progress: Three sites have been selected for the "AS Built" Survey Study. Data collection has been started as well as development of a local geoid.

Reports: Quarterly Progress Report, April 2001

Implementation: The research should prove the feasibility of using soft photogrammetry and video logging for constructing "AS Built" surveys more efficiently. It will also provide methods for creating a local geoid for preliminary and control surveys.

Project Number: TR-447

Project Title: A Computer Program for the Hydraulic Design of Culverts

Agency: Digital Control, Inc.

Principal Investigator: LaDon Jones

Research Period: July 1, 2000 to June 30, 2001

Research Board Funding: $68,200

Funding Source: 100 percent State – 50 percent Primary funds, 40 percent Secondary funds and 10 percent Street funds

Objective: A computer program is needed that combines the data, methods and tasks required for Iowa DOT culvert design into a single, integrated, user-friendly, software package. The program should incorporate into one package the information and tools needed to perform the hydraulic culvert design from start to finish. Such a program will be developed for the Iowa DOT Preliminary Bridge Section, under the guidance of Mr. Dave Claman, with input from the primary users of the program, county, city and consulting engineers.

The culvert program will provide a quick and efficient way of calculating a range of various culvert sizes and types based on drainage area. The program will make it easier for Iowa DOT staff to determine the required size of structures along our highways and will facilitate staff review of consultant submittals of Iowa DOT projects. The program will enable the designer to evaluate various culvert sizes and design discharges quickly and efficiently.

Reports: Final Report, June 2001

Implementation: The computer program will be used by the Iowa DOT and Iowa's cities and counties as a quick, efficient tool for properly sizing and designing various culverts for Iowa roadways.

Project Number: TR-448

Project Title: Foamed Asphalt Technology Workshop Demonstration

Agency: Iowa Department of Transportation

Principal Investigator: Mike Heitzman

Research Period: October 3 – 4, 2000

Research Board Funding: $25,000

Funding Source: 100 percent State – 80 percent Secondary funds and 20 percent Street funds

Objective: The Foamed Asphalt Technology Workshop and Demonstration will give engineers, technicians and project development managers rehabilitation strategies for our pavement system.

Progress: This workshop was held on October 3 – 4, 2000 in the Materials Lab of the Iowa Department of Transportation. One hundred-two people from different organizations attended this workshop and demonstration and learned first hand about Foamed Asphalt.

Reports: Workshop and Demonstration completed.

Implementation: The project will be monitored for the next five years for performance. The findings will be used in other Foamed Asphalt projects.

Project Number: TR-449

Project Title: Determination and Evaluation of Alternative Methods for Managing and Controlling Highway Related Dust

Agency: Iowa State University

Principal Investigator: Robert Lohnes

Research Period: March 1, 2001 to June 30, 2002

Research Board Funding: $58,135

Funding Source: 100 percent state – 100 percent Secondary funds

Objective: The objective of the research is to evaluate currently used and potential technology and products for dust control and to identify new alternative methods for controlling dust.

Progress: A contract for this research was executed in February 2001.

Reports: None

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

Project Number: TR-451

Project Title: Investigation Into Improved Pavement Curing Materials and Techniques – Phases I & II

Agency: Iowa State University

Principal Investigator: K. Wang and James K. Cable

Research Period: December 1, 2000 to September 30, 2002

Research Board Funding: $70,718

Funding Source: 100 percent state – 60 percent Primary funds, 30 percent Secondary funds, and 10 percent Street funds

Objective: To identify and evaluate alternate curing materials and techniques to improve moisture retention in newly placed PCCP, and to develop a method for measuring effectiveness of the compound placed on the pavement at construction time.

Progress:
1. Finished seven designed tests for all reference specimens,
2. Finished Case I study as designed (3 types of curing compounds, sprayed at 3 different times, cured at room temperature); Two hours spraying was also tried for selected curing compound,
3. Started tests of specimens with curing compound 1 (Iowa currently used curing compound) and cured at 100° F (in oven) before and after spraying.

Reports: None

Implementation: The results of this research can be used to provide an alternative set of materials for curing of pavements to enhance performance.

Project Number: TR-452

Project Title: Alternative Solutions to Meet the Service Needs of Low Volume Bridges in Iowa

Agency: Iowa State University

Principal Investigator: F. Wayne Klaiber

Research Period: March 1, 2001 to March 31, 2002

Research Board Funding: $48,865

Funding Source: 100 percent State – 100 percent Secondary funds

Objective: The object of this phase of the project is to develop a reference document to address common problems in low-volume road (LVR) bridges. This reference document will not only summarize previous IHRB sponsored research, but will also present pertinent information from other sources. Iowa county engineers need to be surveyed to determine problems they are having with LVR bridges. Also, their solutions to some of the bridge problems they have encountered need to be determined and summarized. A review of the collected data will reveal where inadequate information is available and enable the research team to develop a work plan to address areas where there is inadequate information.

Progress: A contract for this research was executed in February 2001.

Reports: None

Implementation: Local agencies in Iowa and elsewhere are beset by a combination of bridge deficiencies and the lack of funding to address the deficiencies. This research will provide a summary of approaches to this problem and evaluations to show which approaches worked best.

A product of the research will be a reference document that county and city engineers can use to help them decide how best to solve their LVR bridge problems.

Project Number: TR-453

Project Title: Low Water Stream Crossings in Iowa

Agency: Iowa State University

Principal Investigator: Robert Lohnes

Research Period: January 1, 2001 to December 31, 2001

Research Board Funding: $62,664

Funding Source: 100 percent State – 10 percent Primary funds, 80 percent Secondary funds and 10 percent Street funds

Objective: This research will identify possible guidelines for use of low water stream crossings, update previously developed design criteria, and recommend traffic control procedures to adequately advise road users of the existence and proper travel over low water crossings. A manual will be developed to offer clear, easily understood guidelines and accepted standards in an abbreviated format.

Progress: A contract for this research was executed in February 2001.

Reports: None

Implementation: The Low Water Stream Crossings Design Guide Manual for Iowa can be used by local agencies when considering low cost options for replacing deficient structures on low volume roads. This will be particularly beneficial with very low volume and minimum maintenance roads where structure replacement funding is unavailable and continuous, all-weather access is not necessary.

Project Number: TR-454

Project Title: Durable, Cost Effective Pavement Marking Materials – Phase I

Agency: Iowa State University

Principal Investigator: Gary B. Thomas

Research Period: January 1, 2001 to June 30, 2001

Research Board Funding: $43,640

Funding Source: 100 percent State – 50 percent Primary funds, 25 percent Secondary funds and 25 percent Street funds

Objective: The objective of this research is to evaluate the durability, performance, and placement procedure of pavement marking materials.

Progress: Phase I for this research is complete and the final report will be presented to the Research Board at its September meeting for approval.

Reports: Final Report, June 2001

Implementation: The result of this phase of the project will be used to develop an appropriate method of getting durable and cost effective Pavement Marking Materials.

Project Number: TR-455

Project Title: Handbook of Simplified Practice for Traffic Studies

Agency: Iowa State University

Principal Investigator: Stephen J. Andrle

Research Period: March 1, 2001 to March 31, 2002

Research Board Funding: $37,400

Funding Source: 100 percent State – 20 percent Primary funds, 60 percent Secondary funds and 20 percent Street funds

Objective: There are two primary objectives for this project. The first objective is to develop a manual of traffic studies that is convenient for Iowa jurisdictions to use in assessing traffic issues. The second objective of the project is to develop a series of boilerplate scopes of work that local jurisdictions can use to hire outside consulting firms to perform traffic studies.

Progress: The project was approved by the Iowa Highway Research Board at it January 26, 2001 meeting. A contract has been signed by Iowa State University to conduct this research.

Reports: None

Implementation: One of the main objectives of this project is to make the task of performing traffic studies less cumbersome for local jurisdictions. By providing boilerplate scopes of work, simplified procedures, and a manual that includes only the most commonly used studies, it is anticipated that local jurisdictions can and will be better prepared to perform the needed studies.

Project Number: TR-456

Project Title: Measuring Main-Channel Slopes for Major Rivers in Iowa

Agency: United States Geological Survey

Principal Investigator: David Eash

Research Period: April 18, 2001 to September 30, 2003

Research Board Funding: $107,800

Funding Source: 50 percent Federal and 50 percent State – 50 percent Primary funds and 50 percent Secondary funds

Objective: To measure Main Channel Slope (MCS) using GIS along major rivers in Iowa, plot graphs of those measurements, and compare them to manual measurements to determine if adjustments are necessary.

Progress: The contract has been signed.

Reports: None

Implementation: The results of this project will enable engineers, managers, and planners to estimate flood-frequency discharges with greater efficiency and predictive accuracy.

Project Number: TR-457

Project Title: Development of a Manual Crack Quantification and an Automated Crack Measurement System

Agency: The University of Iowa

Principal Investigator: Hosin "David" Lee

Research Period: April 1, 2001 to March 31, 2002

Research Board Funding: $73,997

Funding Source: 100 percent State – 60 percent Primary funds and 40 percent Secondary funds

Objective: To develop two software packages: one to verify the outputs of Roadware Inc. against Iowa DOT procedures; and the second to automatically process pavement crack data objectively and consistently.

Progress: A set of digital images was obtained from Roadware Inc. Each 1548 by 972 pixel image is made of six pictures, which covers pavement of 4.91 m long and 3.79 m wide (3.17 mm/pixel by 3.9 mm/pixel). A significant effort was made to relate each image to Iowa DOT's highway segment. Following the existing manual crack survey procedure of Iowa DOT, a beta version of the manual crack quantification software package was developed. This software package was designed in consultation with Iowa DOT personnel that would allow them to process digital images interactively through a computer screen in the most efficient manner.

Reports: None

Implementation: The software packages will offer improved accuracy and consistency over the current labor-intensive manual system at a lower cost. This system will be implemented in Iowa DOT and selected cities and counties.

Project Number: TR-458

Project Title: Field Testing of Abrasive Delivery Systems in Winter Maintenance

Agency: The University of Iowa

Principal Investigator: Wilfrid Nixon

Research Period: May 1, 2001 to April 30, 2003

Research Board Funding: $151,920

Funding Source: 100 percent State – 30 percent Primary funds, 60 percent Secondary funds, and 10 percent Street funds

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: A contract for this research was executed in May 2001.

Reports: None

Implementation: Maintaining roads in winter, in Iowa is difficult. The safely 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.

Project Number: HR-1027

Project Title: Secondary Road Research Coordinator

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: Ed Engle

Research Period: March 1980 to present

Research Board Funding: $60,000.00/yr. (covers salary and state share of costs for FICA, IPERS, health insurance, vehicle costs and expenses)

Funding Source: 100 percent State – 100 percent Secondary funds

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 fifteen (15) 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 Iowa Highway Research Board (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.

Project Number: HR-1075

Project Title: Response of Iowa Pavements to Heavy Agricultural Loads

Agency: Iowa State University

Principal Investigator: Fouad Fanous, Brian Corree, and Doug Wood

Research Period: July 1, 1999 to February 28, 2001

Research Board Funding: $90,341

Funding Source: 100 percent Primary funds

Objective: The objective of this project is to study the effects of large grain carts and tank wagons on pavement in comparison to a legal tractor - semi trailer and the benefits of using flotation tires or tracks on the implements.

Reports: Final Report, December 2000

Implementation: The information developed from this study will be used to determine reasonable legal axle load restrictions for tank wagons and grain carts.

ANNUAL REPORT
OF
HIGHWAY DIVISION
HIGHWAY RESEARCH AND DEVELOPMENT
IN IOWA

NOVEMBER 2002

Iowa Department of Transportation

ANNUAL REPORT
OF
HIGHWAY DIVISION
HIGHWAY RESEARCH AND DEVELOPMENT IN IOWA

FOR THE
FISCAL YEAR ENDING JUNE 30, 2002

OFFICE OF MATERIALS
(515) 239-1447

HIGHWAY DIVISION
IOWA DEPARTMENT OF TRANSPORTATION
AMES, IOWA 50010

NOVEMBER 2002

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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, 2002; it is also a report on projects completed during the fiscal year beginning July 1, 2001, and ending June 30, 2002. Detailed information on each of the research and development projects mentioned in this report is available in the Office of Materials in the Highway Division of the Iowa Department of Transportation.

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 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 by the Iowa Department of Transportation Highway Division Director for a three-year term. The membership of the Research Board as of June 30, 2002 is listed in Table I.

The Research Board held nine regular meetings during the period of July 1, 2001 to June 30, 2002. Suggestions for research and development were reviewed at these meetings and recommendations were made by the Board.

TABLE I
2001-2002 IOWA HIGHWAY RESEARCH BOARD MEMBERS

Member	Term Expires	Alternate
John Adam Deputy Director Iowa DOT - Statewide Operations Bureau 800 Lincoln Way Ames, IA 50010 (515) 239-1333	12-31-02	Robert Younie Construction Engineer Iowa DOT - Dist. 1 1020 S. 4th Street Ames, IA 50010 (515) 239-1542
Jerald Byg Ames City Engineer 515 Clark Street Ames, Iowa 50010 (515) 239-5163	12-31-03	Richard Fosse City Engineer 410 E. Washington Iowa City, Iowa 52246-5717 (319) 356-5143
Robert Ettema Chair, Dept. of Civil & Env. Engineering The University of Iowa 4105 Seamans Center Iowa City, IA 52242 (319) 384-0596		
Jim George Dallas County Engineer 415 River Street Adel, IA 50003 (515) 993-4289 SS#-025	12-31-02	Charles Marker Cass County Engineer 5 W. 7th Street Atlantic, IA 50022 (712) 243-2442 SS#-015
Roger Gould Process Management Engineer Engineering Bureau Iowa DOT - Highway Division 800 Lincoln Way Ames, IA 50010 (515) 239-1834	12-31-03	James Berger Director of Materials Iowa DOT - Highway Division 800 Lincoln Way Ames, IA 50010 (515) 239-1843
Lowell Greimann Dept of Civil & Const. Engr. Iowa State University 390 Town Engineering Bld. Ames, IA 50011 (515) 294-5586		
Douglas Julius Sioux County Engineer 207 Central Avenue SE P.O. Box 17 Orange City, IA 51041 (712) 737-2248 SS# 084	12-31-03	Jon Ites Buena Vista County Engineer 215 E. 5th Street P.O. Box 368 Storm Lake, IA 50588 (712) 749-2540 SS# 011

Brian Keierleber
Buchanan County Engineer
1511 1st Street East
Independence, IA 50644-3123
(319) 334-6031 SS# 010

12-31-03

Clark Schloz
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Randall Krauel
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12-31-02

Kevin Mahoney
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12-31-03

Larry Jesse
Director of Local Systems
Iowa DOT - Highway Division
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Mark Nahra
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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 and the Director 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, 2002. Total expenditure was $1,493,599.85.

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 Office of Materials, Research Section. In many instances, personnel from other offices are designated as principal investigators, 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 Office of Materials, Research Section, wishes to express its appreciation to other offices for their assistance.

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

The National Cooperative Highway Research Program (NCHRP) was organized by the American Association of State Highway Officials (now the American Association of State Highway and Transportation Officials--AASHTO). The program is administered by the Transportation Research Board, 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 0.0675 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. The secondary obligations to NCHRP are paid from the Secondary Road Research Fund.

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 twenty-five counties during fiscal year 2002 as part of the Annual Traffic Count Program. This activity consisted of 310 portable recorder classification counts, 4,700 portable recorder volume counts and 50 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 were physically inventoried for geometrics and current condition in ninety counties. This data provides county engineers, highway engineers, planners and administrators with essential information needed to determine design standards, to systematically classify highways, and to develop programs for improvement in maintenance of secondary roads.

SECONDARY ROAD RESEARCH FUND

Section 310.34 of the Iowa Code authorizes the Iowa Department of Transportation to set aside each year an amount not to exceed 1½ percent of the receipts to the Farm-to-Market Fund in a fund to be known as the Secondary Road Research Fund. This authorization was first made in 1949; it was repealed in 1963 and reinstated in 1965. When the fund was reinstated, the 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 2002 financial summary is:

Beginning Balance 7-1-01		$2,157,086.32
Receipts		
State Road Use Tax Fund (1½% of receipts)...	$1,113,492.46	
Federal Aid Secondary (1½% of receipts)...	0.00	
Research Income	0.00	
Sub-Total		$1,113,492.46
Total Funds Available		$3,270,578.78
Obligation for Expenditures		
Obligated for Contract Research...	872,593.15	
Non-Contract Engineering Studies...	94,127.00	
Total Expenditures		966,720.15
BALANCE 6-30-02		$2,303,858.63

STREET RESEARCH FUND

The Street Research Fund was established in 1989 under Section 312.3A of the Iowa Code. Each year two hundred thousand dollars 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 2002 financial summary is:

Beginning Balance (7-1-01)	$ 36,486
FY02 Street Research Funding	200,000
Total Funds Available for Street Research	$236,486

Obligated for Expenditure

HR-296	$ 36,900
TR-465	-7,410 (cancelled)
TR-468	1,000
TR-469	13,983
TR-470	3,000
TR-471	4,600
TR-472	4,000
TR-474	4,984
TR-475	5,000
TR-476	13,875
TR-479	9,683

Total obligated for Expenditure $89,615

Ending Unobligated Balance 6-30-02 $146,871

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. There is no balance carried forward to the next fiscal year and uncommitted funds remain in the Primary Road Fund. The amount expended for contract research from the Primary Road Research Fund for FY02 was $624,494.32 and the estimate for FY03 is $750,000.

PROJECTS INITIATED DURING FY 2002

The new projects initiated during FY 2002 were:

TR-467, "Investigation of the Modified Beam-in-Slab Bridge System"
TR-468, "Technology Transfer Program for the Iowa Highway Research Board (IHRB)"
TR-469, "Reduction of Concrete Deterioration by Ettringite Using Crystal Growth Inhibition Techniques - Part II - Field Evaluation of Inhibitor Effectiveness"
TR-470, "Development of a Method to Determine Pavement Damage Due to Detours and Haul Roads"
TR-471, "Evaluation of Using Non-Corrosive Deicing Materials and Corrosion Reducing Treatments for Deicing Salts"
TR-472, "Investigation of Materials for the Reduction and Prevention of Corrosion on Highway Maintenance Equipment"
TR-473, "Rehabilitation of Concrete Pavements Utilizing Rubblization and Crack and Seat Methods"
TR-474, "Development of a Mix Design Process for Cold-In-Place Rehabilitation Using Foamed Asphalt"
TR-475, "Synthesis of Best Practices for Increasing Protection and Visibility of Highway Maintenance Vehicles"
TR-476, "PCVAL: A Computer Program for Valley Stage-Discharge Curves and Bridge Backwater Calculations"
TR-477, "Total Cost of Transportation Analysis - Phase II"
TR-478, "Evaluation of Composite Pavement Unbonded Overlays"
(Installation and Maintenance of Weigh In Motion Detection System on Iowa Highway 13 in Delaware County)
TR-479, "Investigation Into Improved Pavement Curing Materials and Techniques: Part II (Phase III)"

13 projects

Table II
FINANCIAL SUMMARY OF RESEARCH AND DEVELOPMENT PROJECT EXPENDITURES

July 1, 2001 to June 30, 2002

(Active projects with no current fiscal year expenditures are included)

Project	Total Funds Committed	Project Title	Primary Road Research Fund Expenditures	Secondary Road Research Fund Expenditures	Street Research Fund Expenditures	Total Expenditures
296	82,000	ISU Local Technical Assistance Program (LTAP)	8,200.00	15,312.49	3,974.34	27,486.83
370	10,000	Pipe Rehabilitation With Polyethylene Pipe Liners				
375	22,400	Transportation Research Board Education for County Engineers		3,107.45		3,107.45
388	67,838	Road Network Model Spreadsheet for Service Level Decision Making		17,980.29		17,980.29
391	163,741	Optimal Usage of De-Icing Chemicals When Scraping Ice				
394	672,152	Transportation Program Management System	13,550.96	66,564.01	4,136.29	84,251.26
398	33,832	Hydraulics of Slope-Tapered Concrete Pipe Culverts				
399	299,932	Field Testing of Integral Abutments		1,755.14	2,729.38	4,484.52
401	337,135	Embankment Quality	7,628.33	2,646.56	522.97	10,797.86
408	220,595	Glass Fiber Composite Dowel Bars for Highway Pavement	10,874.29	4,882.28	4,249.99	20,006.56
411	47,993	An Improved Computer Program for River Valley Rating Curves				
412	65,000	Development of a Computer Controlled Underbody Plow				
414	50,000	Superpave Mix Designs for Low Volume Roads				
416	11,674	Development of Materials Training Course for Technicians				
419	30,000	Education on Urban Corridor Issues				
420	98,478	Field Evaluation of Alternative Load Transfer Device Locations in Low Traffic Volume		26,074.11	1,844.67	27,918.78
422	14,000	Pretreatment for Reduction of Asphalt Absorption in Porous Aggregate				
424	178,358	Steel Diaphragms in Prestressed Concrete Girder Bridges	59,542.69			59,542.69
427	26,200	Evaluation of High-Slump Concrete for Bridge Deck Overlays				
428	294,760	Effective Structural Concrete Repair	12,812.47	14,150.26		26,962.73
429	195,060	Evaluation of Appropriate Maintenance Repair and Rehabilitation Methods for Iowa	5,370.14	15,338.92	821.01	21,530.07
430	179,801	Regional Approach to Landslide	6,292.96	11,687.03		17,979.99
431	139,236	Reduction of Concrete Deterioration by Ettringite Using Crystal Growth Inhibition	12,531.10	1,392.38		13,923.48
432	183,903	Ultrathin Portland Cement Concrete Overlay Extended Evaluation	7,776.40	674.11	587.42	9,037.93
433	89,265	HWYNEEDS-Methodology, Analysis and Evaluation		535.53		535.53
434	30,420	Use of Abrasives in Winter Maintenance				
435	117,030	Thin Maintenance Surfaces - Phase II		3,464.55		3,464.55
436	158,028	Retrofit Methods for Distortion Cracking Problems in Plate Girder Bridges	28,740.36	9,874.35		38,614.71
437	43,334	Performance of Strip Seals in Iowa Bridges, Pilot Study	21,599.95	866.70	866.70	23,333.35
438	142,903	Integral Abutment Bridge With Precast Concrete Piles	16,371.71		111.89	16,483.60
440	137,580	Field & Laboratory Evaluation of Precast Concrete Bridges		37,373.97	4,569.38	41,943.35
443	148,938	Evaluation of Rammed Aggregate Piers for Highway Applications in Iowa Soils	13,279.68			13,279.68
444	187,620	Demonstration Project Using Railroad Flatcars for Low Volume Road Bridges		110,306.20		110,306.20
445	176,876	Development of Bridge Load Testing Process for Load Evaluation	38,108.03	12,236.19	4,587.99	54,932.21
446	214,150	Technology Transfer of "As Built Preliminary Surveys" by Total Station GPS, Video Logging & Laser	37,504.94	10,238.52	5,563.38	53,306.84
447	68,200	A Computer Program for the Hydraulic Design of Culverts	3,638.00	2,727.75	682.00	7,047.75
449	58,135	Determination and Evaluation of Alternative Methods for Managing and Controlling Highway Related Dust		31,257.25		31,257.25
450	80,000	Identification of Laboratory Techniques to Optimize Superpave HMA Surface Friction Characteristics				
451	70,718	Investigation Into Improved Pavement Curing Materials and Techniques	38,475.11	7,942.67	7,072.00	53,489.78
452	48,65	Alternative Solutions to Meet the Service Needs of Low Volume Bridges in Iowa (7.03)		31,568.70		31,568.70
453	62,664	Low Water Stream Crossings in Iowa	5,074.74	33,012.77	2,306.18	40,393.69
454	43,640	Durable, Cost Effective Pavement Marking Materials – Phase I				

Project	Total Funds Committed	Project Title	Primary Road Research Fund Expenditures	Secondary Road Research Fund Expenditures	Street Research Fund Expenditures	Total Expenditures
455	37,400	Handbook of Simplified Practice for Traffic Studies	7,480.00	22,440.00	7,480.00	37,400.00
456	107,800	Measuring Main-Channel Slopes for Major Rivers in Iowa	43,000.00			43,000.00
457	73,997	Development of a Manual Crack Quantification and an Automatic Crack Measurement System	39,957.31	26,640.02		66,597.33
458	151,920	Field Testing of Abrasive Delivery Systems in Winter Maintenance	25,964.04	22,433.78		48,397.82
459	27,433	Reuse of Lime Sludge From Water Softening	6,172.23		11,719.46	17,891.69
460	87,924	Living Snow Fences	22,214.22			22,214.22
461	70,000	Soil Stabilization of Non-Uniform Subgrade Soils	25,051.41			25,051.41
462	61,560	Manual for Roadside Control of Trees and Brush	15,730.41	14,030.61	3,741.43	33,502.45
463	99,804	Field Performance Study of Past Iowa Pavement Research: A Look Back	23,022.86			23,022.86
464	30,000	Erosion Control for Highway Applications - A Critical Review of Published Literature	7,990.11		130.14	8,120.25
466	47,049	Evaluation of Unbonded Ultrathin Whitetopping of Brick Streets	6,515.08	2,406.60	15,807.61	24,729.29
467	190,890	Investigation of the Modified Beam-in-Slab Bridge System		29,453.55		29,453.55
468	10,000	Technology Transfer Program for the Iowa Highway Research Board (IHRB)	56.60	50.00		106.60
469	139,832	Reduction of Concrete Deterioration by Ettringite Using Crystal Growth Inhibition Techniques-Part II-Field Evaluation of Inhibitor Effectiveness	2,394.90			2,394.90
470	60,000	Development of a Method to Determine Pavement Damage Due to Detours and Haul Roads	8,282.97			8,282.97
471	100,000	Evaluation of Using Non-Corrosive Deicing Materials and Corrosion Reducing Treatments for Deicing Salts	4,468.16			4,468.16
472	80,000	Investigation of Materials for the Reduction and Prevention of Corrosion on Highway Maintenance Equipment	4,378.86			4,378.86
473	178,197	Rehabilitation of Concrete Pavements Utilizing Rubblization and Crack and Seat Methods	1,160.56			1,160.56
474	99,683	Development of a Mix Design Process for Cold-In-Place Rehabilitation Using Foamed Asphalt	700.70			700.70
475	25,000	Synthesis of Best Practices for Increasing Protection and Visibility of Highway Maintenance Vehicles	10,000.00	4,348.76	5,000.00	19,348.76
476	69,375	PCVAL: A Computer Program for Valley Stage-Discharge Curves and Bridge Backwater Calculations				
477	29,635	Total Cost of Transportation Analysis - Phase II (HR-388 - Phase I)				
478	49,520	Evaluation of Composite Pavement Unbonded Overlays (Installation and Maintenance of Weigh In Motion Detection System on Iowa Hwy 13 in Delaware Co.)				
479	96,828	Investigation Into Improved Pavement Curing Materials and Techniques: Part II (Phase III)				
1027	70,000	Secondary Road Research Coordinator		91,700.80		91,700.80
1080	29,997	Synthesis of Dowel Bar Research	22,582.04			22,582.04
		Contract Research Subtotal	624,494.32	686,474.30	88,504.23	1,399,472.85
SPR-PR-PL-1(33)		FY2002 Planning & Research Program (Transportation Inventory Engineering Studies)		94,127.00		94,127.00
		Noncontract Engineering Studies Subtotal		94,127.00		94,127.00
		Grand Total of Expenditures	624,494.32	780,601.30	88,504.23	1,493,599.85

Project Number: HR-296

Project Title: Iowa State University Local Technical Assistance Program (LTAP)

Agency: Iowa State University

Principal Investigator: Stephen J. Andrle

Research Period: October 1, 1986 to December 31, 2002

Research Board Funding: $82,000 per year

Funding Source: 54 percent Federal, 15 percent State Safety, and 31 percent State IHRB (10 percent Primary funds, 45 percent Secondary funds and 45 percent Street funds)

Objective: To promote research, encourage implementation and distribute research data.

Progress: The major tasks are:

1. publishing at least four newsletters per year
2. conducting at least 10 training courses per year
3. distribute publications
4. provide service and information to users
5. 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.

Project Number: HR-370

Project Title: Pipe Rehabilitation With Polyethylene Pipe Liners

Agency: Dallas County, Jefferson County, Jones County, Mahaska County, Taylor County, and the Iowa Department of Transportation, Highway Division

Principal Investigator: Brad Skinner, Gary Bishop, Dan Waid, Raymond Blessum, James Delozier and Ed Engle

Research Period: June 1, 1994 to December 31, 2001

Research Board Funding: $10,000

Funding Source: 100 percent State – 100 percent Secondary funds

Objective: The objective of the research is to demonstrate and evaluate the applicability of pipe rehabilitation with polyethylene pipe liners.

Progress: Six locations were selected for the installation of polyethylene liners. Culverts rehabilitated included corrugated metal pipe, concrete roadway pipe, and a wooden box culvert. The polyethylene liners used for this research were Culvert-Renew® and Snap-Tite®. Installations were completed in October 1994. The research is also evaluating several additional pipes that were rehabilitated with polyethylene liners (but were not funded). Field visits have shown that several of the liners have moved or show signs of creeping. Movement measurements range from 1-3/8" to 2-5/8." Evaluation and final report development are in progress.

Reports: Construction Report, March 1995

Implementation: If the use of polyethylene liners is successful, it will give engineers an economical alternative to the removal and replacement of deteriorated culverts.

Project Number: HR-375

Project Title: Transportation Research Board Education for County Engineers

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: Ed Engle

Research Period: November 1, 1994 to December 31, 2004

Research Board Funding: $22,400

Funding Source: 100 percent State – 100 percent Secondary funds

Objective: The objective of the project is to send two county engineers annually to the Transportation Research Board (TRB) Annual Meeting in Washington, D.C. for research education. The two county engineers selected are generally those starting their term as regular members of the Iowa Highway Research Board (IHRB). The experience of attending the TRB Annual Meeting will give 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 2002, a total of 16 county engineers were sent to TRB.

Reports: None

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

Project Number: HR-388

Project Title: Road Network Model Spreadsheet for Service Level Decision Making

Agency: Mills County and the Iowa Department of Transportation, Highway Division

Principal Investigator: Steve DeVries

Research Period: May 29, 1996 to May 31, 2002

Research Board Funding: $67,838

Funding Source: 100 percent State – 100 percent Secondary Funds

Objective: To develop and test a new method for making highway service level decisions by modeling a road network, finding the best service levels for given traffic volumes and using the results to make road system management decisions.

Progress: This project is complete and a final report with software was presented to the Board on May 31, 2002. Copies of the software and manual will be distributed to all 99 counties in Iowa by September 2002.

Reports: Final Report, May 31, 2002.

Implementation: Operating, improving and maintaining a ready system is difficult and funds are scarce. This research will develop and test a new method for making the decisions required to manage a road system with all of the inherent tradeoffs to deploy scarce funds for maximum public benefit.

Project Number: HR-391

Project Title: Optimal Usage of De-Icing Chemicals When Scraping Ice

Agency: The University of Iowa

Principal Investigator: Wilfrid A. Nixon

Research Period: May 21, 1996 to December 31, 2003

Research Board Funding: $163,741

Funding Source: 100 percent State – 70 percent Primary funds, 10 percent Secondary funds and 20 percent Street funds

Objective: The objective of the work proposed in this study is to determine the best combination of chemical application and scraping for removing the various types of ice from the road.

Progress: Preliminary testing has resulted in the development of test protocols, which allow for very good repeatability of test results (which is a necessary part of this project, since some effects may be small). Testing since the spring has concentrated on salt (sodium chloride) as a deicer, and has tested various quantities of salt, applied for varying length of time and in various forms (coarse granules, fine powder, etc.).

Reports: None

Implementation: A field guide would be developed which would contain for each chemical tested, the optimal application rate and delay time for that chemical for each ice type. This will improve winter ice removal, thereby, improving safety of the motoring public.

Project Number: HR-394

Project Title: Transportation Program Management System, Phases II - IV

Agency: Iowa County Engineers Association Service Bureau

Principal Investigator: Steve DeVries

Research Period: March 1, 1999 to February 28, 2003

Research Board Funding: $672,152

Funding Source: 100 percent State – 25% Primary funds, 72% Secondary funds, and 3% Street funds

Objective: The objective of this project is to create a centralized, automated system to support project programming and development tracking to:

a) reduce the potential for errors and conflicts.
b) speed up the process and deliver road improvements to the public more expeditiously.
c) decrease the total labor cost required to get programming and development work accomplished.
d) make the status of any project or action available to all parties who need to know on a "real-time" basis.
e) Improve communications and provide an on-line transcript of each projects' history.

Progress: The system facilitates preparation and submission by the counties, review by DOT district planners, and final approval by the Office of Local Systems. TPMS' programming data has been synchronized with the DOT's mainframe STIP, so that the two systems exactly match regarding federal aid projects. The user interface has been refined and improved and will be able to open the system for FY 2004 program edits by mid-November.

On the project development tracking side, the system has been made current with the DOT's list of future lettings and counties are in the process of activating development records for all relevant FY 2003 projects that haven't yet shown up in the DOT's system. Efforts to set up an automatic, daily exchange of project information between TPMS and the DOT's Project Scheduling System, PSS, are nearly complete. This part of the system should be able to go live in October.

Reports: None

Implementation: The results of this project will be a system that will both improve and expedite the current Transportation Program Management process. It will enable local agencies to reduce project errors, conflicts, and delays. All interested parties will be able to get a "real-time" project status at any time.

Project Number: HR-398

Project Title: Hydraulics of Slope-Tapered Concrete Pipe Culverts

Agency: FHWA Office of Engineering Research and Development and GKY and Associate

Principal Investigator: J. Sterling Jones

Research Period: January 17, 1997 to May 1, 1997

Research Board Funding: $33,832

Funding Source: 100 percent State – 100 percent Primary funds

Objective: The objective of this research project is to verify the hydraulic design details of slope tapered pipe culverts.

Progress: FHWA and their contractor have completed all laboratory work and submitted a draft final report in January 1998. Final review comments to this draft report have been submitted by the Office of Bridges and Structures to FHWA so the report can be finalized.

The results of the research show that both the slope tapered inlet configuration and the typical precast concrete pipe apron (Iowa DOT Standard Road Plan RF-3) are more hydraulically efficient than assumed. Also, in the slope taper section, the number of reducer sections required in Iowa DOT's design guidelines could be decreased by one reducer without adversely affecting hydraulic efficiency of the inlet. In general, the research verified assumptions in Iowa DOT's design guidelines for slope tapered concrete culverts.

Reports: Final Report, June 2001

Implementation: Iowa DOT intends to use the new hydraulic design coefficient for a standard concrete pipe apron which results in a slightly improved hydraulic performance for all concrete pipe culverts, not only slope tapered inlets. Also, IDOT's design procedures for the slope tapered pipe culvert will be finalized and distributed.

Project Number: HR-399

Project Title: Field Testing of Integral Abutments

Agency: Iowa State University

Principal Investigator: Robert Abendroth

Research Period: February 1, 1997 to October 31, 2002

Research Board Funding: $299,932

Funding Source: 100 percent State – 50 percent Primary funds, 35 percent Secondary funds and 15 percent Street funds

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:

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

Progress: Long-term monitoring of strains, displacements, and temperatures has been completed at both integral abutment bridges selected. Lab tests were conducted to determine the coefficient of thermal expansion and contraction of core samples taken from the decks. Analysis of these tests has been completed. The finite-element model for both bridges is complete. A calibration procedure that involves the comparison of analytically predicted and experimentally measured bridge displacement has been completed. Disassembly and removal of data collecting instrumentation from the 2 bridges is under way. Design methodology and examples are taking more time than expected.

The final report is being prepared.

Reports: Interim Report, June 1998

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.

Project Number: TR-401

Project Title: Embankment Quality, Phase I, Phase II and Phase III

Agency: Iowa State University

Principal Investigator: Kenneth Bergeson and David J. White

Research Period: May 1, 1997 to March 31, 2002

Research Board Funding: $337,135

Funding Source: 100 percent State – 70 percent Primary funds, 15 percent Secondary funds and 15 percent Street funds

Objective: The primary objectives of this study are as follows:

Phase I - Evaluate the current compaction method and acceptance and to provide suggestions for new compaction procedures and to recommend methods of testing and acceptance.

Phase II - Field testing of alternative embankment acceptance procedures and methods for rapid field identification of the range of soil types in Iowa.

Phase III - Design and construct a project using the recommended design specifications.

Reports: Final Report, June 2002

Implementation: Iowa State University will prepare recommended embankment construction acceptance procedure and field testing procedures for Iowa DOT and grading contractors to use.

Project Number: TR-408

Project Title: Glass Fiber Composite Dowel Bars for Highway Pavement

Agency: Iowa State University

Principal Investigator: Max Porter

Research Period: June 2, 1997 to May 31, 2001

Research Board Funding: $220,595

Funding Source: 100 percent State – 80 percent Primary funds, 10 percent Secondary funds and 10 percent Street funds

Objective: The objective of this research project is to investigate the long-term performance and fatigue behavior of glass fiber composite dowels.

Reports: Final Report, September 2001

Implementation: This research will provide designers with a new set of preliminary design criteria for using the GFC dowels in highway pavement joints as an alternative to epoxy coated steel dowels.

Project Number: TR-411

Project Title: An Improved Computer Program for River Valley Rating Curves

Agency: Iowa State University

Principal Investigator: T. Al Austin

Research Period: July 23, 1997 to December 31, 2001

Research Board Funding: $47,993

Funding Source: 100 percent State – 40 percent Primary funds, 40 percent Secondary funds and 20 percent Street funds

Objective: The objective of this research project is to rewrite the computer program, PCVAL, in a user-friendly format, Visual Basic 5.0, and develop a user's manual to enhance its use.

Progress: This project was terminated by the IHRB at its March 2002 meeting due to staffing issues and extensive delays in satisfactory completion of the project.

Reports: None

Project Number: TR-412

Project Title: Development of a Computer Controlled Underbody Plow

Agency: The University of Iowa

Principal Investigator: Wilfrid A. Nixon

Research Period: August 1, 1997 to December 31, 2002

Research Board Funding: $65,000

Funding Source: 100 percent State – 80 percent Primary funds, 10 percent Secondary funds and 10 percent Street funds

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.

Progress: The MATLAB software package has allowed a base level program for fuzzy control of a snowplow to be developed. This has the capability of providing fuzzy control over a closed feedback loop, in which the force between underbody plow and the road surface (the scraping force) is the primary feedback signal. It also incorporates a number of secondary feedback signals (such as plow angle) into the control loop and a simple weighted algorithm has been used for this.

Reports: Annual Progress Report, July 1999

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.

Project Number: TR-414

Project Title: Superpave Mix Designs for Low Volume Roads

Agency: Iowa DOT, Scott County, Mahaska County, Mills County, Cerro Gordo County, Dubuque County, Pocahontas County, Cass County, Linn County, and Louisa County

Principal Investigator: Ed Engle and the respective County Engineer

Research Period: July 1, 1997 to December 31, 2003

Research Board Funding: $50,000

Funding Source: 100 percent State – 100 percent Secondary funds

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

Progress: All of the eight final projects are completed. Annual distress and performance surveys commenced in 1999.

Reports: Construction Report, September 2001

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 naturally be an attractive alternative for counties statewide. This is especially true as state ACC projects are shifted to 100% Superpave.

Project Number: TR-416

Project Title: Development of Materials Training Course for Technicians

Agency: Iowa State University

Principal Investigator: Brian Coree

Research Period: January 1, 1998 to November 30, 2002

Research Board Funding: $11,674

Funding Source: 100 percent State – 70 percent Primary funds, 20 percent Secondary funds and 10 percent Street funds

Objective: The objectives of the proposed research are: 1) develop a "Highway Materials Training Course for Technicians," comprised of a series of stand-alone modules of one and two-day classes covering the major material types relevant to highway works; 2) to develop both the instructor and participant packages; 3) to undertake pilot classroom instruction and to refine the developed instructional materials based upon participant feedback.

Progress: The materials are complete and shall be presented to the IHRB for approval in the Fall 2002.

Reports: None

Implementation: It is anticipated that technicians will benefit from exposure to a more general materials background, and perhaps feel empowered with a degree of ownership with a greater understanding of the importance and relevance of the tests that they routinely perform in the course of their work, and to avoid testing and evaluation errors due to lack of experience. It is anticipated that this program be offered annually by the DOT and that newly hired technicians will be expected to participate.

Project Number: TR-419

Project Title: Education on Urban Corridor Issues Through Computer Animation

Agency: Snyder and Associates

Principal Investigator: Gary Gamer

Research Period: May 21, 1998 to September 30, 2002

Research Board Funding: $30,000

Funding Source: 100 percent State – 45 percent Primary funds, 5 percent Secondary funds and 50 percent Street funds

Objective: The objective of this research is to develop a method of using a combination of photo-imaging and computer animation at much less expense to provide a visual aid to gain public acceptance of an urban safety upgrade project.

Progress: The roadway construction is complete. Filming of the final project will be done during the Fall of 2002. The final report will be presented to the IHRB in early 2003.

Reports: Interim Report, October 1998

Implementation: Implementation of this research will be through an evaluation of how photo-imaging and computer animation can be used in combination to cost-effectively give the average citizen an understanding of how a constructed design will compare to the current conditions. A before and after comparison of a corridor will also show how well the post-construction appearance can be represented by integration of imaging and animation into a video prior to actual construction.

Project Number: TR-420

Project Title: Field Evaluation of Alternative Load Transfer Device Locations in Low Traffic Volume Pavements

Agency: Iowa State University

Principal Investigator: James K. Cable and Curtis Greenfield

Research Period: July 30, 1998 to December 31, 2003

Research Board Funding: $98,478

Funding Source: 100 percent State – 80 percent Secondary funds and 20 percent Street funds

Objective: The objective of this research is to evaluate the placement of load transfer dowels in PCC pavements on low volume roads. The intention is to find strategic dowel placements that would decrease the number of dowels needed and make placement easier.

Progress: Paving was completed in Union County during the summer of 1998. Evaluations, including traffic counts and pavement performance indicators, have been performed for the two paving projects. The project monitoring has continued and is entering the last year. There are differences in the performance, but not enough to make solid recommendations on future construction at this time. The project has resulted in one thesis in 2002 and should remain on schedule at this time.

Reports: None

Implementation: If an optimized dowel placement regimen can be demonstrated, counties will be able to save significantly on paving projects - both from the cost of dowels and reduced labor in placement.

Project Number: TR-422

Project Title: Pretreatment for Reduction of Asphalt Absorption in Porous Aggregate

Agency: Louisa County

Principal Investigator: Ed Engle, John Hinrichsen and Robert Simmering

Research Period: August 1998 to December 2003

Research Board Funding: $14,000

Funding Source: 100 percent State – 40 percent Primary funds, 40 percent Secondary funds and 20 percent Street funds

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

Progress: The paving project was completed in the summer of 1998. Evaluations of the pavement are being performed in conjunction with another research project (HR-414) on an annual basis. The additive does not appear to have provided significant reduction in asphalt absorption into the aggregate. A final report is in preparation.

Reports: None

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.

Project Number: TR-424

Project Title: Steel Diaphragms in Prestressed Concrete Girder Bridges

Agency: Iowa State University

Principal Investigator: Robert Abendroth and Fouad S. Fanous

Research Period: January 1, 1999 to February 28, 2003

Research Board Funding: $178,358

Funding Source: 100 Percent State – 65 percent Primary funds, 25 percent Secondary funds, and 10 percent Street funds

Objective: The objectives of the research are:

1. Evaluate the state-of-the-art regarding the role of intermediate diaphragms in distributing lateral loads throughout PC girder bridge structures.
2. Investigate the static and dynamic-load response characteristics of different types and configurations of intermediate diaphragms in PC girder bridges.
3. 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.

Progress: Five members have been selected for the Project Advisory Committee. After an extended, difficult search, a graduate student has been assigned to work on this project. A survey was prepared and distributed to state bridge engineers. Work on a mathematical model for bridge analysis is progressing. Due mainly to the delay in obtaining the research assistant (graduate student), the project required a no-cost time extension. The final report is being prepared.

Reports: Quarterly Report, April 2002

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 proposed 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. If economical and sufficiently stiff intermediate steel diaphragms can be used to replace the conventional intermediate RC diaphragms, bridge construction time and costs should be reduced.

Project Number: TR-427

Project Title: Evaluation of High-Slump Concrete for Bridge Deck Overlays

Agency: Buchanan County

Principal Investigator: Brian Keierleber

Research Period: December 21, 1998 to December 31, 2004

Research Board Funding: $26,200

Funding Source: 100 percent State – 40 percent Primary funds, 30 percent Secondary funds and 30 percent Street funds

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.

Progress: Construction of two bridge deck overlays was completed in Fall 2000. Annual evaluations will be performed. A final report will be prepared by December 2004.

Reports: Construction Report, September 2001

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.

Project Number: TR-428

Project Title: Effective Structural Concrete Repair

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 percent State – 45 percent Primary funds, 45 percent Secondary funds, and 10 percent Street funds

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

Progress: Work has continued in the area of repairing damaged prestressed concrete (P/C) girders from overheight vehicles with fiber reinforced polymers (FRP). Two bridges (one on IA 65 in Altoona and the other on IA 34 over I 35 near Osceola) were tested prior to strengthening and the I 65 bridge was re-tested after the FRP was installed. A third P/C bridge has been tested in the damaged state. A design procedure and a field implementation manual have been developed for use by designers and maintenance personnel.

To determine other concrete repair problems, a meeting was held with several members of the Iowa DOT Office of Bridges and Structures. It was decided to evaluate (both in the laboratory and field) the effectiveness of wrapping columns with FRP to prevent chloride penetration. Five different sites were selected. Each will be wrapped with FRP from the five different manufacturers so that the effectiveness of different products can be determined. To date, two columns have been wrapped with FRP and a protective topcoat, specified by the manufacturer, was installed.

The laboratory portion of this investigation is also in progress. Slabs have been fabricated in the ISU Structures Laboratory. The five products used in the field will also be installed on laboratory test slabs. After installing the FRP, the slabs will be "flooded" with salt water to determine the permeability of the various FRPs under severe conditions. Concrete samples from the field installation and laboratory slabs will be collected and evaluated periodically for a minimum of 5 years.

Reports: Progress Report, June 2002

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.

Project Number: TR-429

Project Title: Evaluation of Appropriate Maintenance Repair and Rehabilitation (MR&R) Methods for Iowa Bridges

Agency: Iowa State University

Principal Investigator: Terry J. Wipf, Fouad S. Fanous and F. Wayne Klaiber

Research Period: February 1, 1999 to December 31, 2002

Research Board Funding: $195,060

Funding Source: 100 percent State – 45 percent Primary funds, 45 percent Secondary funds and 10 percent Street funds

Objective: The primary objective of the proposed research is to compile current information on MR&R techniques and implementation guidelines. The proposed research will provide guidance for designers as well as field personnel.

Progress: A summary of the literature search results (including results from the Iowa County survey) related to MR&R procedures has been prepared. This information will be a part of the draft final report that is currently in preparation. The MR&R procedures determined to be most useful for addressing the county bridge needs have been compiled. This information is being prepared into a format that will constitute a design manual. In addition, design procedures associated with some of the MR&R procedures have been developed for incorporation into the design manual. A time extension of the project was obtained. Work is proceeding on the development of the design manual and the final report will be completed by 4th quarter 2002.

Reports: Progress Report, August 2001

Implementation: The result of this research project will provide MR&R procedures that are systematic and will serve as guidelines to engineers and field personnel.

Project Number: TR-430

Project Title: Regional Approach to Landslide Interpretation and Repair

Agency: Iowa State University

Principal Investigator: Robert Lohnes and Bruce Kjartanson

Research Period: February 1, 1999 to March 31, 2001

Research Board Funding: $179,801

Funding Source: 100 percent State – 35 percent Primary funds and 65 percent Secondary funds

Objective: The objective of the proposed research is to provide Iowa county engineers and highway maintenance personnel with procedures that will allow them to efficiently and effectively interpret and repair or avoid landslides.

The proposed research will provide methods to distinguish areas of potential slope instability, identify incipient failure conditions and recognize the cause or causes of a landslide at a particular location. Based upon those interpretations, the most appropriate methods to restore stability to the site will be apparent.

Reports: Final Report

Implementation: Iowa county engineers and highway maintenance personnel for both the counties and the Iowa DOT will use the products of this research. The products are:

- Landslide susceptibility map. This will provide a guide for preliminary evaluation of landslide potential.
- Report on landslide assessment. This report (or manual) will provide a procedure for assessing the landslide potential of a given site and in situations where landslides have occurred, provide a method to determine the cause or causes of the slide. Recommendations for repairs will be included.
- Workshops on how to use report and map. These workshops will provide "hands-on experience" on how the information included in the other two products can be utilized.

Project Number: TR-431

Project Title: Reduction of Concrete Deterioration by Ettringite Using Crystal Growth Inhibition Techniques

Agency: Iowa State University

Principal Investigator: Robert Cody

Research Period: February 1, 1999 to February 28, 2001

Research Board Funding: $139,236

Funding Source: 100 percent State – 90 percent Primary funds and 10 percent Secondary funds

Objective: The objective of the proposed research is to experimentally determine whether commercial crystallization inhibitor chemicals will prevent or reduce ettringite formation in highway concrete, with the ultimate goal of reducing premature deterioration of highways. The proposed research has the potential to significantly reduce expensive highway repairs that are required because of premature concrete deterioration.

Reports: Final Report, February 2001

Implementation: If experiments prove successful, then applications of crystallization inhibitor solutions mixed with deicing brines, or powered inhibitor chemicals added to rock salt or CMA, might prove to be a highly cost-effective method of reducing secondary mineral damage to existing highways. After application of inhibitor-enhanced brines or solid deicers, solutions containing inhibitor molecules will infiltrate downward into the highly porous and permeable concrete slabs. Concrete slab pore fluids containing the inhibitors potentially will be modified so that ettringite precipitation will be reduced or prevented.

Mixing solid or liquid inhibitor chemicals deicers/anti-icers will require no modifications to existing equipment. Commercial inhibitors are effective in small concentrations (ppm) and the chemicals are not expensive. For example, Dequest 2060, a widely used boiler scale inhibitor costs $1.20/lb in large quantities. Costs of implementing such a program should be low compared to the costs of repairs to highways damaged by secondary mineral growth.

Project Number: TR-432

Project Title: Ultrathin PCC Overlay Extended Evaluation

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 percent State – 50 percent Primary funds, 45 percent Secondary funds and 5 percent Street funds

Objective: Evaluation of the following: 1.) conventional methods of slab removal and surface preparation for removal and replacement areas, 2.) the condition of the asphaltic concrete surface under removal and replacement areas, 3.) the cost/benefit of polypropylene fiber addition to the concrete, 4.) the performance of the rehabilitated sections, and 5.) the validation of the design methods of PCA and ACPA.

Progress: Monitoring of the site continues. Spot overlays of 2" without fiber sections were done in August of 2001.

Reports: Interim Report, July 2002

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

Project Number: TR-433

Project Title: HWYNEEDS - Methodology, Analysis and Evaluation

Agency: Iowa State University

Principal Investigator: Tom Maze and Omar Smadi

Research Period: May 1, 1999 to April 30, 2001

Research Board Funding: $89,265

Funding Source: 100 percent State – 20 percent Primary funds and 80 percent Secondary funds

Objective: This project covers the HWYNEEDS computer program and its use in the Quadrennial Needs Study. The HWYNEEDS program methodology will be analyzed and evaluated to investigate its appropriateness for use in the Quadrennial Needs Study.

Reports: Final Report, March 2001

Implementation: This HWYNEEDS - Methodology, Analysis and Evaluation will be evaluated against the counties needs and conditions.

Project Number: TR-434

Project Title: Use of Abrasives in Winter Maintenance

Agency: The University of Iowa

Principal Investigator: Wilfrid A. Nixon

Research Period: May 1, 1999 to July 31, 2000

Research Board Funding: $30,420

Funding Source: 100 percent State – 10 percent Primary funds, 80 percent Secondary funds and 10 percent Street funds

Objective: The objective of this project is twofold. First, by surveying the literature and the current practice to develop reference guidelines for best practice in abrasive application as a part of winter maintenance activities in Iowa. Second, the project will develop an outline of an experimental program to improve understanding of how abrasives work, and thus improve the guidelines for best practice based on the results of those experiments.

Reports: Final Report, December 2000

Implementation: This research will develop a comprehensive set of recommendations for abrasive use by state, county and city agencies.

Project Number: TR-435

Project Title: Thin Maintenance Surfaces - Phase II and Guidelines for Winter Maintenance on Thin Maintenance Surfaces

Agency: Iowa State University and The University of Iowa

Principal Investigator: Charles Jahren and Wilfrid A. Nixon

Research Period: July 1, 1999 to June 30, 2002

Research Board Funding: $117,030

Funding Source: 100 percent State – 55 percent Primary funds and 45 percent Secondary funds

Objective: There are five principal objectives for this research.

1. Continue monitoring of the performance of previously placed test sections;
2. Investigate possible improvements in the use of seal coat aggregates;
3. Select a seal coat design process to recommend for use by the State of Iowa;
4. Develop a micro-surfacing mix using local limestone; and
5. Develop guidelines for winter maintenance on thin maintenance surfaces.

Progress: The research work for the project is completed. The winter maintenance portion of the research is also complete. The final report for this project will be presented to the Research Board this fall.

Reports: None

Implementation: The results from this research should provide engineers and transportation decision makers with guidelines for the selection of materials, techniques and maintenance practices for thin maintenance surfaces.

Project Number: TR-436

Project Title: Retrofit Methods for Distortion Cracking Problems in Plate Girder Bridges

Agency: Iowa State University

Principal Investigator: Terry J. Wipf

Research Period: July 1, 1999 to August 31, 2002

Research Board Funding: $158,028

Funding Source: 100 percent State – 75 percent Primary funds, 20 percent Secondary funds and 5 percent Street funds

Objective: The objectives of this proposal are to: 1) verify the effects of the bolt loosening on one of the first retrofitted bridges, including long-term continuous monitoring of a retrofitted bridge, 2) investigate the retrofit method's applicability for bridges with I-beam diaphragms, and 3) study the cause and possible remedies for the failure of the retrofitted bolted connection in the two-beam bridges.

Progress: The identification and inspection of bridges to be field tested was completed. Six field load bridge tests have been done. Evaluation of data is in progress. Some problems with the data acquisition system occurred. This problem caused a significant delay in progress and required a time extension to the contract. A new data acquisition system was purchased. Field data from continuous monitoring has been reduced. A PowerPoint presentation of the progress of bridge tests was presented to the committee and a draft on 2 bridge tests has been written. The final report is being prepared.

Reports: Quarterly, July 2002

Implementation: The results of the proposed research study should provide guidance in maintaining steel girder bridges to the Office of Bridge Maintenance and Inspection of the Iowa DOT.

Specifically, the effectiveness of potential retrofit methods to be used by the Iowa DOT will be determined.

Project Number: TR-437

Project Title: Performance of Strip Seals in Iowa Bridges, Pilot Study

Agency: Iowa State University

Principal Investigator: Lowell Greimann and James Bolluyt

Research Period: August 16, 1999 to December 31, 2000

Research Board Funding: $43,334

Funding Source: 100 percent State – 60 percent Primary funds, 20 percent Secondary funds and 20 percent Street funds

Objective: The objectives of this research are to determine the causes of failures of strip seals in Iowa bridges and to identify possible solutions.

Reports: Final Report, April 2001

Implementation: Once the primary causes of the strip seal failures are identified, the solution to failure prevention would be apparent. If the solution is not apparent, further laboratory testing and field evaluation of seals may be appropriate.

Project Number: TR-438

Project Title: An Integral Abutment Bridge With Precast Concrete Piles

Agency: Iowa State University

Principal Investigator: Robert Abendroth

Research Period: July 1, 1999 to December 31, 2002

Research Board Funding: $142,903

Funding Source: 100 percent State – 60 percent Primary funds, 35 percent Secondary funds and 5 percent Street funds

Objective: The research objectives are:

1. 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.
2. 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.
3. Establish the longitudinal displacement verses temperature behavior for the abutments of the Tama County bridge.

Progress: The final field-measured data was obtained for the Tama County bridge. To date, a total of 16 months of data on concrete and air temperatures, bridge displacements, pile strains, and abutment rotations have been recorded.

Reports: Quarterly reports are prepared in January, April, July and October of each year.

Implementation: The results obtained from this research will provide bridge design engineers for the Iowa DOT with a better understanding of the behavior of the PCC abutment piles in the Tama County integral-abutment bridge. Engineers with the Bridge Design Section 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.

Project Number: TR-440

Project Title: Field and Laboratory Evaluation of Precast Concrete Bridges

Agency: Iowa State University

Principal Investigator: F. Wayne Klaiber, Terry J. Wipf and Mark Nahra

Research Period: November 1, 1999 to October 31, 2001

Research Board Funding: $137,580

Funding Source: 100 percent State – 85 percent Secondary funds and 15 percent Street funds

Objective: The primary objective of this research is to determine the strength of deteriorated precast concrete deck bridges (PCDBs). This will be accomplished through the field and laboratory testing of this type of bridge and the individual precast units.

Reports: Final Report, December 2001

Implementation: Results from this research make it possible to more accurately rate similar PCDBs. This information will be valuable for county engineers with such bridges and consultants who work with the various counties.

Project Number: TR-443

Project Title: Evaluation of Rammed Aggregate Piers for Highway Application in Iowa Soils

Agency: Iowa State University

Principal Investigator: John Pitt and David J. White

Research Period: January 1, 2000 to October 31, 2002

Research Board Funding: $148,938

Funding Source: 100 percent State – 50 percent Primary funds, 45 percent Secondary funds and 5 percent Street funds

Objective: The primary objective of this project is to evaluate a new method for soil reinforcement called Geopiers with Iowa soils, with particular emphasis on two problem areas.

1. Reinforcement of soft soils prior to construction of highway embankments in order to minimize settlement.
2. Reinforcement of embankment or cut toe slopes in order to prevent slope failures.

Progress:

- Projects have been selected for full-scale installations in an embankment foundation where the natural soils are soft and unstable and a poorly compacted bridge approach fill.

- Site evaluation prior to installation to determine in site engineering properties of soil with Pressuremeter, Dilatometer and Ko-Stepped Blade has been done.

- The design and construction of Geopiers test sections have been completed and documented.

- Monitoring of the performance of reinforced test sections is underway.

Reports: Quarterly Report, January 2001

Implementation: Results of the evaluation will be prepared in a summary report and made available to state, county and city agencies, which will provide a practical option to improve soft soils, reduce bridge approach settlement, and reinforce slopes and retaining structures.

Project Number: TR-444

Project Title: Demonstration Project Using Railroad Flat Cars for Low Volume Road Bridges

Agency: Iowa State University

Principal Investigator: F. Wayne Klaiber

Research Period: June 25, 2000 to November 30, 2002

Research Board Funding: $187,620

Funding Source: 100 percent State – 100 percent Secondary funds

Objective: The objective of this research is to design and construct two bridges using railroad flat cars (RRFC). The bridges will be instrumented and field load tested at the end of construction, and inspected and load tested periodically thereafter.

Progress: The Winnebago County (WC) bridge was field load tested twice last summer (2001). Test 1 was performed before flatcars were longitudinally connected, and Test 2 was performed immediately after construction was finished.

A laboratory connection specimen representing the longitudinal connection in the Buchanan County (BC) bridge was constructed and service tested in torsion and flexure before being later failed in torsion in Spring 2002. Results from the connection tests and analysis verified the strength in flexure and torsion of this connection for use in railroad flat car bridges.

The BC and WC bridges were both field load tested for the final time in July 2002. This testing took place approximately 12 months after the BC bridge was completed and 9 months after the WC bridge was completed. After reviewing the results, it is clear that the response of the two bridges to Iowa legal loads has not changed since they were initially opened to traffic in 2001.

Computer models have been generated to aid the analysis of RRFC bridges. The models accurately predict the behavior of the RRFC bridges to traffic loads and are in good agreement with the field load test results.

It is anticipated that the project final report will be completed early November 2002.

Reports: None

Implementation: The primary value of the research is to provide strength behavior information for these bridges, so that they can be used to replace deficient bridges in a cost effective manner. In addition, design and construction guidelines will be developed to assist engineers with this type of bridge. Construction of these bridges will be documented to assist others in the construction of additional railroad flatcar bridges.

Project Number: TR-445

Project Title: Development of Bridge Load Testing for Load Evaluation

Agency: Iowa State University

Principal Investigator: Terry J. Wipf, F. Wayne Klaiber and Douglas Wood

Research Period: May 22, 2000 to August 31, 2002

Research Board Funding: $176,876

Funding Source: 100 percent State – 65 percent Primary funds, 30 percent Secondary funds and 5 percent Street funds

Objective: The primary objective of this research is to investigate and develop a load testing process for evaluating and rating bridges on the highway system in Iowa. This is an initial step in the process of establishing an objectively tested bridge rating system.

Progress: Task 1 – Survey of other states – 95 percent complete.

Task 2 – Validation of load testing process – 85 percent complete

- Diagnostic load test evaluation of previously tested bridges
- Comparison of load rating methods
- Proof load test

Task 3 – Assessment of the analytical process – 100 percent complete

Task 4 – Load rating of posted bridges – 100 percent complete

The policy and procedure recommendations of load evaluation are half completed and the project final report is being drafted.

Reports: Quarterly Report – July 2002

Implementation: The results from this investigation will provide technical information and recommendations that engineers can use to more accurately evaluate existing bridges. In addition, the information will provide useful guidelines regarding actual bridge behavior that can be beneficial to engineers responsible for bridge design.

Project Number: TR-446

Project Title: Technology Transfer of "As Built Preliminary Surveys" by Total Station GPS, Video Logging and Laser Scanning

Agency: Iowa State University

Principal Investigator: Kandiah Jeyapalan

Research Period: June 1, 2000 to November 30, 2002

Research Board Funding: $214,150

Funding Source: 100 percent State – 65 percent Primary funds, 30 percent Secondary funds and 5 percent Street funds

Objective: The objectives of this project are to develop a user friendly positioning system using video logging and soft photogrammetry for the purpose of constructing "AS Built" surveys of bridges and culverts and to demonstrate the development and use of local geoid in preliminary and photogrammetric control surveys for Iowa engineers and surveyors.

Reports: Draft Final Report, June 2002

Implementation: The research should prove the feasibility of using soft photogrammetry and video logging for constructing "AS Built" surveys more efficiently. It will also provide methods for creating a local geoid for preliminary and control surveys.

Project Number: TR-447

Project Title: A Computer Program for the Hydraulic Design of Culverts

Agency: Digital Control, Inc.

Principal Investigator: LaDon Jones

Research Period: July 1, 2000 to June 30, 2001

Research Board Funding: $68,200

Funding Source: 100 percent State – 50 percent Primary funds, 40 percent Secondary funds and 10 percent Street funds

Objective: A computer program is needed that combines the data, methods and tasks required for Iowa DOT culvert design into a single, integrated, user-friendly, software package. The program should incorporate into one package the information and tools needed to perform the hydraulic culvert design from start to finish. Such a program will be developed for the Iowa DOT Preliminary Bridge Section, under the guidance of Mr. Dave Claman, with input from the primary users of the program, county, city and consulting engineers.

The culvert program will provide a quick and efficient way of calculating a range of various culvert sizes and types based on drainage area. The program will make it easier for Iowa DOT staff to determine the required size of structures along our highways and will facilitate staff review of consultant submittals of Iowa DOT projects. The program will enable the designer to evaluate various culvert sizes and design discharges quickly and efficiently.

Reports: Final Report, June 2001

Implementation: The computer program will be used by the Iowa DOT and Iowa's cities and counties as a quick, efficient tool for properly sizing and designing various culverts for Iowa roadways.

Project Number: TR-449

Project Title: Determination and Evaluation of Alternative Methods for Managing and Controlling Highway Related Dust

Agency: Iowa State University

Principal Investigator: Robert Lohnes

Research Period: March 1, 2001 to June 30, 2002

Research Board Funding: $58,135

Funding Source: 100 percent state – 100 percent Secondary funds

Objective: The objective of the research is to evaluate currently used and potential technology and products for dust control and to identify new alternative methods for controlling dust.

Progress: This project is complete as of June 2002. A final report will be presented to the Board at the September, 2002 meeting.

Reports: None

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

Project Number: TR-450

Project Title: Identification of Laboratory Techniques to Optimize Superpave HMA Surface Friction Characteristics

Agency: Perdue University

Principal Investigator: Rebecca S. McDaniel

Research Period: June 1, 2001 to January 31, 2004

Research Board Funding: $70,000

Funding Source: 50 percent Institute for Safe, Quiet, and Durable Highways, 25 percent Indiana DOT, and 25 percent State (100 percent Primary funds)

Objective: The main purpose of this research is to evaluate various blends of aggregates to optimize the combination of micro- and macrotexture 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: A thorough literature review has been conducted as planned for Phase I. A number of interviews with people active in friction measurements have also been conducted. Based on this review of the state of the art, tentative recommendations on suitable polishing and testing methods have been developed. An interim report to the study advisory committee is in preparation summarizing the recommendations. When the committee concurs on test methods to use, the research can proceed to the testing phase.

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.

Project Number: TR-451

Project Title: Investigation Into Improved Pavement Curing Materials and Techniques – Phases I & II

Agency: Iowa State University

Principal Investigator: Kejin Wang and James K. Cable

Research Period: December 1, 2000 to September 30, 2002

Research Board Funding: $70,718

Funding Source: 100 percent state – 60 percent Primary funds, 30 percent Secondary funds, and 10 percent Street funds

Objective: To identify and evaluate alternate curing materials and techniques to improve moisture retention in newly placed PCCP, and to develop a method for measuring effectiveness of the compound placed on the pavement at construction time.

Progress:
1. Finished seven designed tests for all reference specimens,
2. Finished Case I study as designed (3 types of curing compounds, sprayed at 3 different times, cured at room temperature); Two hours spraying was also tried for selected curing compound,
3. Finished tests of specimens with curing compound (Iowa currently used curing compound) and cured at 100° F (in oven) before and after spraying.

Part 1 of the project has been completed

Reports: Final Report, Part I, April 2002

Implementation: The results of this research can be used to provide an alternative set of materials for curing of pavements to enhance performance.

Project Number: TR-452

Project Title: Alternative Solutions to Meet the Service Needs of Low Volume Bridges in Iowa

Agency: Iowa State University

Principal Investigator: F. Wayne Klaiber

Research Period: March 1, 2001 to September 30, 2002

Research Board Funding: $48,865

Funding Source: 100 percent State – 100 percent Secondary funds

Objective: The object of this phase of the project is to develop a reference document to address common problems in low-volume road (LVR) bridges. This reference document will not only summarize previous IHRB sponsored research, but will also present pertinent information from other sources. Iowa county engineers need to be surveyed to determine problems they are having with LVR bridges. Also, their solutions to some of the bridge problems they have encountered need to be determined and summarized. A review of the collected data will reveal where inadequate information is available and enable the research team to develop a work plan to address areas where there is inadequate information.

Progress: The literature review portion of this project has been completed and appropriate summaries prepared. Summaries of past IHRB projects that are related to this investigation have also been prepared.

Due to a major oversight, the questionnaire prepared to obtain information from Iowa county engineers, Iowa consultants, etc. was never disseminated. This oversight will be corrected in fall 2002. Although NACE was contacted to obtain e-mailed addresses of the members (so that the questionnaire could be disseminated nationally), the Executive Director declined the request. The reason given was that the NACE membership receives too many questionnaires and thus he doesn't want to have another one sent to them.

Reports: None

Implementation: Local agencies in Iowa and elsewhere are beset by a combination of bridge deficiencies and the lack of funding to address the deficiencies. This research will provide a summary of approaches to this problem and evaluations to show which approaches worked best.

A product of the research will be a reference document that county and city engineers can use to help them decide how best to solve their LVR bridge problems.

Project Number: TR-453

Project Title: Low Water Stream Crossings in Iowa

Agency: Iowa State University

Principal Investigator: Robert Lohnes

Research Period: January 1, 2001 to March 31, 2002

Research Board Funding: $62,664

Funding Source: 100 percent State – 10 percent Primary funds, 80 percent Secondary funds and 10 percent Street funds

Objective: This research will identify possible guidelines for use of low water stream crossings, update previously developed design criteria, and recommend traffic control procedures to adequately advise road users of the existence and proper travel over low water crossings. A manual will be developed to offer clear, easily understood guidelines and accepted standards in an abbreviated format.

Progress: This project was complete and a final report accepted by the Board at their March 2002 meeting.

Reports: Final Report, March 2002

Implementation: The Low Water Stream Crossings Design Guide Manual for Iowa can be used by local agencies when considering low cost options for replacing deficient structures on low volume roads. This will be particularly beneficial with very low volume and minimum maintenance roads where structure replacement funding is unavailable and continuous, all-weather access is not necessary.

Project Number: TR-454

Project Title: Durable, Cost Effective Pavement Marking Materials – Phase I

Agency: Iowa State University

Principal Investigator: Gary B. Thomas

Research Period: January 1, 2001 to June 30, 2001

Research Board Funding: $43,640

Funding Source: 100 percent State – 50 percent Primary funds, 25 percent Secondary funds and 25 percent Street funds

Objective: The objective of this research is to evaluate the durability, performance, and placement procedure of pavement marking materials.

Reports: Final Report, June 2001

Implementation: The result of this phase of the project will be used to develop an appropriate method of getting durable and cost effective Pavement Marking Materials.

Project Number: TR-455

Project Title: Handbook of Simplified Practice for Traffic Studies

Agency: Iowa State University

Principal Investigator: Stephen J. Andrle

Research Period: March 1, 2001 to September 30, 2002

Research Board Funding: $37,400

Funding Source: 100 percent State – 20 percent Primary funds, 60 percent Secondary funds and 20 percent Street funds

Objective: There are two primary objectives for this project. The first objective is to develop a manual of traffic studies that is convenient for Iowa jurisdictions to use in assessing traffic issues. The second objective of the project is to develop a series of boilerplate scopes of work that local jurisdictions can use to hire outside consulting firms to perform traffic studies.

Progress: The project advisory committee met. Draft handbook was reviewed and the suggestions are being implemented.

Reports: None

Implementation: One of the main objectives of this project is to make the task of performing traffic studies less cumbersome for local jurisdictions. By providing boilerplate scopes of work, simplified procedures, and a manual that includes only the most commonly used studies, it is anticipated that local jurisdictions can and will be better prepared to perform the needed studies.

Project Number: TR-456

Project Title: Measuring Main-Channel Slopes for Major Rivers in Iowa

Agency: United States Geological Survey

Principal Investigator: David Eash

Research Period: April 18, 2001 to September 30, 2003

Research Board Funding: $107,800

Funding Source: 50 percent Federal and 50 percent State (50 percent Primary funds and 50 percent Secondary funds)

Objective: To measure Main Channel Slope (MCS) using GIS along major rivers in Iowa, plot graphs of those measurements, and compare them to manual measurements to determine if adjustments are necessary.

Progress: Main channels were digitized for approximately 145 major rivers in Iowa that have drainage areas greater than 100 square miles and are located in Hydrology Regions 2 and 3. Stream sites located approximately every 5 miles along each of these river reaches were digitized and main-channel slopes (10-85 percent slopes) were calculated for each of these stream sites using the Basinsoft program.

Best-fit curves have been developed for approximately 120 of the 145 graphs that will be included in the report. Earlier this summer graphs and tables were sent to Dave Claman, Iowa DOT Office of Bridges and Structures, for review. First draft of the report will be completed by about January 2003.

Reports: Progress Report, September 2002

Implementation: The results of this project will enable engineers, managers, and planners to estimate flood-frequency discharges with greater efficiency and predictive accuracy.

Project Number: TR-457

Project Title: Development of a Manual Crack Quantification and an Automated Crack Measurement System

Agency: The University of Iowa

Principal Investigator: Hosin "David" Lee

Research Period: April 1, 2001 to April 30, 2003

Research Board Funding: $73,997

Funding Source: 100 percent State – 60 percent Primary funds and 40 percent Secondary funds

Objective: To develop two software packages: one to verify the outputs of Roadware Inc. against Iowa DOT procedures; and the second to automatically process pavement crack data objectively and consistently.

Progress: A draft final report was submitted in May 2002. During the course of the review, it became apparent that the images provided for analysis did not correspond to the pavement management system output. The images are currently being assigned to the proper pavement manage sections for analysis. The revised analysis will require 6-12 months additional time.

Reports: Draft Final, May 2002

Implementation: The software packages will offer improved accuracy and consistency over the current labor-intensive manual system at a lower cost. This system will be implemented in Iowa DOT and selected cities and counties.

Project Number: TR-458

Project Title: Field Testing of Abrasive Delivery Systems in Winter Maintenance

Agency: The University of Iowa

Principal Investigator: Wilfrid A. Nixon

Research Period: May 1, 2001 to April 30, 2003

Research Board Funding: $151,920

Funding Source: 100 percent State – 30 percent Primary funds, 60 percent Secondary funds, and 10 percent Street funds

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 aim of this research is to develop the best method of placing abrasives on a road so that they remain in place and give a friction enhancement for as long as possible. The location for the field test has been determined and a DOT truck has been provided for the project and equipped with suitable delivery devices. Winter of 2001-2002 was too mild to provide any useful data. A one-year no cost extension will be requested to allow two years of data to be collected.

Reports: None

Implementation: Maintaining roads in winter, in Iowa is difficult. The safely 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.

Project Number: TR-459

Project Title: Reuse of Lime Sludge From Water Softening

Agency: Iowa State University

Principal Investigator: J(Hans) van Leeuwen

Research Period: August 15, 2001 to August 31, 2002

Research Board Funding: $27,433

Funding Source: 52 percent Outside Sources and 48 percent State (25 percent Primary funds and 75 percent Street funds)

Objective: The objectives are as follows:

1. Lime sludge in mixture with fly ash, soils and aggregate is to be tested for its suitability to prepare subbase for road construction.
2. Evaluate the use of lime sludge for fill and embankments as an admixture with other fill materials and fly ash.
3. Calcium Carbonate 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 of Buffalo, Iowa to be used in cement production.
4. Many power plants are already using calcium carbonate for sulfur dioxide removal. The present source of CaCo3 is limestone. Here the objective is to find means of preparing lime sludge to replace some of the limestone in powerplants.
5. 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.

Progress: So far, there have been five aspects that have been investigated to some deeper extent for this project.

1. Can make excellent fill material for bridge approaches and embankments from lime sludge, fly ash and bottom ash, low density and high strength.
2. It is possible to use lime sludge in cement production.
3. Lime sludge holds promise in power plants for SO2 capture.
4. Did not work for dust control. It should be studied in greater detail.
5. Did not improve soil strength in higher dosages. Effect of lime sludge on soil with cement and/or fly ash at low dosages should be studied further.

Reports: Interim Progress Report, August 2002

Implementation: The potential value of the lime sludge in Iowa is around 1 million dollars, against present disposal costs of also around 1 million dollars, 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.

Project Number: TR-460

Project Title: Living Snow Fences

Agency: The University of Iowa

Principal Investigator: Wilfrid A. Nixon

Research Period: September 1, 2001 to April 30, 2004

Research Board Funding: $89,971.00

Funding Source: 100 percent State – 50 percent Primary funds and 50 percent Secondary funds

Objective: The project has a number of objectives. First is to 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.

The second objective, is to 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.

A third objective is to develop suitable marketing stools 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: Work during the first winter of the project (2001-02 winter) made a comparative study of different snow fence types along a stretch of highway north of Tipton, Iowa. Six different fence configurations were used, three being standing corn rows, and three being lath fences. Given the relatively low snowfall of the winter, all six fences performed well, but it was noticeable that the corn rows stored snow between the rows of corn, rather than downwind of all the rows. Should this hold true in winters with heavier snowfall, it would be an extremely useful finding. To test this hypothesis, another set of corn row configurations will be tested in a nearby location this winter (2002-03). However, in this case, the corn rows will be at the edge of the field. If these configurations still store snow effectively without causing drifting across the road, it will be much easier to convince farmers to participate in the standing corn fence program, because leaving corn standing at the edge of the field is much easier than leaving rows in the center of a field.

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 would also be made available via e-mail to all subscribers to the snow and ice mailing list, and would be placed on the SICOP web site.

Project Number: TR-461

Project Title: Soil Stabilization of Non-Uniform Subgrade Soils

Agency: Iowa State University - CTRE

Principal Investigator: David J. White

Research Period: July 1, 2001 to June 30, 2003

Research Board Funding: $70,000

Funding Source: 61 percent Outside Sources and 39 percent State (60 percent Primary funds, 35 percent Secondary funds and 5 percent Street funds)

Objective: To determine what types of ash are available, which type works best for site conditions and soil types, what is the proper mix design and construction process, and what are the benefits.

Progress:

1. Extensive laboratory analysis is ongoing to measure engineering properties of fly ash/soil mixtures (i.e. unconfined compressive strength, CBR, stiffness, durability, etc.)

2. Ten fly ashes were collected from around the state and tested for initial and final set times and mixed with soil to measure the influence of compaction delay on strength and density.

3. Field DCP and GeoGauge tests were performed to measure strength and uniformity at three projects, i.e. cold-in-place recycled asphalt mixed with soil and fly ash at ISU, reclaimed hydrated fly ash as base material in Eddyville, and pavement removal in Jasper Co. at Hwy 330.

4. Specifications were developed for use of reclaimed conditioned fly ash (CFA) and reclaimed hydrated fly ash (HRA) as a subgrade material.

Reports: Quarterly Report, July 2002

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

Project Number: TR-462

Project Title: Manual for Roadside Control of Trees and Brush

Agency: University of Northern Iowa

Principal Investigator: Kirk Henderson

Research Period: September 1, 2001 to October 31, 2002

Research Board Funding: $61,560

Funding Source: 100 percent State - 30 percent Primary funds, 50 percent Secondary funds and 20 percent Street funds

Objective: To develop a manual that describes best practices for the control and removal or roadside tree and brush debris.

Progress: The final manual for Roadside Control of Trees and Brush is complete and will be presented to the Research Board this fall.

Reports: None

Implementation: Administrators and maintenance crews alike need to be involved in the policy writing process. Several regional training sessions would be necessary to train county supervisors, county engineers, roadside managers, operations managers, weed commissioners and maintenance personnel from each county.

Project Number: TR-463

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

Agency: The University of Iowa

Principal Investigator: Hosin "David" Lee

Research Period: August 24, 2001 to February 28, 2003

Research Board Funding: $99,804

Funding Source: 100 percent State – 40 percent Primary funds, 50 percent Secondary funds and 10 percent Street funds

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.

Progress: A study group of 15 tentative projects has been selected from the past pavement research projects funded through Iowa Highway Research Board. An extensive review on two project sites was done which involved the fast-track concrete pavement and foamed asphalt base stabilization. To validate the findings from the original studies, current field data was collected, which include visual crack survey, deflection measurement, and cores. The cores were tested for their indirect tensile strengths. The indirect tensile strengths were then compared against the deflection measurements.

Reports: Preliminary, March 2002

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.

Project Number: TR-464

Project Title: Erosion Control for Highway Applications – A Critical Review of Published Literature

Agency: The University of Iowa

Principal Investigator: Marian Muste

Research Period: December 1, 2001 to July 31, 2002

Research Board Funding: $30,000

Funding Source: 100 percent State – 50 percent Primary funds, 40 percent State funds and 10 percent Street funds

Objective: Phase I: Conduct a literature review and compile a synthesis of current practice short- and long-term erosion control methods utilized in highway applications.

Phase II: Expand on research objectives required to considerably improve mitigation methods with emphasis on transitioning from short- to long-term erosion control following construction.

Progress: A comprehensive literature review was done. Particularly useful information was obtained from state DOTs and from Iowa County Engineers. A contemporary, computer-based expert system for use by highway engineers was developed to provide guidance on erosion and sediment control methods.

Reports: Final, Phase I, May 2002

Implementation: The use of the newly developed literature will help in selecting means to minimize the impact of construction and maintenance operations and mitigating sediments and erosion concerns resulting in not only better roads, but a better environment.

Project Number: TR-466

Project Title: Evaluation of Unbonded Ultrathin Whitetopping of BrickStreets

Agency: Iowa State University

Principal Investigator: James K. Cable

Research Period: July 1, 2001 to June 30, 2006

Research Board Funding: $47,049

Funding Source: 100 percent State – 25 percent Primary funds, 10 percent Secondary funds and 65 percent Street funds

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:
- Construction was done in 2001.
- Monitoring of the site continues.
- Construction report is in progress.

Reports: Quarterly Report, April 2002

Implementation: Information gathered from the 3 reporting periods will be distributed to city administrators and the highway industry through the following:

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

Project Number: TR-467

Project Title: Investigation of the Modified Beam-in-Slab Bridge System

Agency: Iowa State University

Principal Investigator: F. Wayne Klaiber

Research Period: December 1, 2001 to November 30, 2003

Research Board Funding: $190,890

Funding Source: 100 percent State - 100 percent Secondary funds

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 modified beam-in-slab (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.

Progress: **Laboratory work:** A total of five laboratory specimens have been constructed; four have been tested to date. Two single bay specimens, 8 ft wide and 2 ft long, were constructed to test the applicability of two formwork specimens; both formwork systems met the goals of the research team. Two single bay specimens, 8 ft wide and 15 ft long, were constructed to investigate the strength of the MBIS system. The specimens were tested at service levels and at ultimate load to obtain the behavior of the system under simulated wheel loads. The fifth specimen was a three bay, 20 ft wide, 31 ft long bridge constructed in the ISU Structures Laboratory. This model bridge was constructed to investigate the load distribution characteristics and ultimate strength of the MBIS system. Service load testing of this specimen has been completed; the ultimate load test of this specimen will be performed during the fall of 2002.

Demonstration bridges (Tama County): The first demonstration bridge was constructed during the fall of 2001. Theoretical results indicate the bridge can carry Iowa legal loads. The structure is currently in service and will be field load tested in the fall of 2002.

The second demonstration bridge is in the final design phase. Construction of the bridge will be completed in late fall 2002. Construction of the demonstration bridge is being fully documented to assist others with the construction of future MBIS structures. The completed structure will be instrumented and tested once the concrete has cured; it will be re-tested during the summer of 2003.

Reports: None

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 materials are 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.

Project Number: TR-468

Project Title: Technology Transfer Program for the Iowa Highway Research Board

Agency: Iowa Department of Transportation

Principal Investigator: Mark Dunn

Research Period: December 1, 2001 to November 30, 2002

Research Board Funding: $10,000

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

Objective: The objective of this project is to provide improved research technology transfer and information distribution to the Iowa Highway Research Board and to transportation professionals in Iowa. Through electronic distribution of information, a wider audience can be obtained with reduced publication and distribution cost.

This project will also provide resources to cover facility costs for small workshops related to IHRB research when it would be beneficial to transfer technology.

Progress: Shortly after the start of this project, the Iowa DOT purchased equipment to mass produce CDs quickly. CD duplication and reproduction costs expected to be paid through this project were paid through the DOT Reproduction Office's budget. No outside services were required.

Two literature searches were performed by CTRE at Iowa State University in support of the IHRB's prioritization process. This project also covered meeting costs for the IHRB's meeting at field sites in Buchanan County.

Reports: None

Project Number: TR-469

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

Agency: Iowa State University

Principal Investigator: Paul G. Spry

Research Period: March 1, 2002 to February 29, 2004

Research Board Funding: $139,832

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

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

Progress: The contract for this research was executed in March 2002.

Reports: None

Implementation: The result from this research will probably prove to be a highly cost-effective method of reducing secondary mineral damage to 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.

Project Number: TR-470

Project Title: Development of a Method to Determine Pavement Damage Due to Detours and Haul Roads

Agency: Iowa State University

Principal Investigator: Omar Smadi

Research Period: April 1, 2002 to March 31, 2003

Research Board Funding: $59,272

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

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 and haul roads used temporarily by the Iowa DOT.

Progress:

1. A literature review of the current process of detour and haul roads at the Iowa DOT has been completed. Several contracts with DOT, City, and County staff have been made. The results are summarized and will be included in the final report. Also, examples of recent detour and haul roads compensation agreements were requested and individuals from the DOT district offices and local agencies were contacted.

2. A survey of the surrounding state practices in terms of detour and haul roads have been completed. A phone survey was conducted with staff from the following states:
   - Minnesota
   - Nebraska
   - South Dakota
   - Kansas
   - Missouri
   - Illinois
   - Wisconsin

Reports: None

Implementation: At the end of the project, a set of guidelines and procedures for a new process of developing detour and haul roads compensation will be presented. If approved, the Iowa DOT, cities, and counties involved in such activities, will us the newly developed methodology to determine their compensation.

Project Number: TR-471

Project Title: Evaluation of Using Non-Corrosive Deicing Materials and Corrosion Reducing Treatments for Deicing Salts

Agency: The University of Iowa

Principal Investigator: Wilfrid A. Nixon

Research Period: May 1, 2002 to April 30, 2004

Research Board Funding: $100,000

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

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: The progress has been made in determining tests to perform on concrete and related materials and also on identifying specific tests to conduct on ice melting and penetration capabilities.

Reports: Annual Report

Implementation: The results from 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 to the snow and ice mailing list.

Project Number: TR-472

Project Title: Investigation of Materials for the Reduction and Prevention of Corrosion on Highway Maintenance Equipement

Agency: The University of Iowa

Principal Investigator: Wilfrid A. Nixon

Research Period: May 1, 2002 to October 31, 2003

Research Board Funding: $80,000

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

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 project will examine both products and procedures that have been shown to minimize corrosion, and after testing, will determine which ones operate best. Researcher has gathered significant information and suitable progress is being made.

Reports: Progress Report

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 to the snow and ice mailing list.

Project Number: TR-473

Project Title: Rehabilitation of Concrete Pavements Utilizing Rubblization and Crack and Seat Methods

Agency: Iowa State University

Principal Investigator: Brian Coree

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

Research Board Funding: $178,197

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

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), and 3) to establish a structural and fatigue model and 4) to validate or calibrate the model using in-service pavement performance histories and the instrumented pavements on IA 141. Ultimately, provide a research report and implementable design guidelines to the Iowa DOT.

Progress: The development and testing of the initial computer model has been very successful and a comprehensive model has been developed that addresses a three-layer system (HMA overlay + Rubblized PCC + Subgrade) that is responsive to seasonal environmental impacts (monthly). It is this model that will be "calibrated" using field measurements and PMIS data of selected Iowa HMA overlaid rubblized PCC pavements.

Reports: None

Implementation: Responsibility for implementation rests primarily within the DOT. The PI will assist in any way necessary to this end and will provide implementable design guidelines to the Iowa DOT.

Project Number: TR-474

Project Title: Development of a Mix Design Process for Cold-In-Place Rehabilitation Using Foamed Asphalt

Agency: The University of Iowa

Principal Investigator: Hosin "David" Lee

Research Period: May 1, 2002 to January 31, 2003

Research Board Funding: $99,683

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

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

Progress: A comprehensive review of past research efforts, has been performed. To establish a baseline, the research efforts were directed towards the evaluation of current practices with foamed asphalt and emulsion for CIPR. A significant effort has been made to examine several design variables to determine what parameters should be part of the design process. The steering committee meeting took place on campus of The University of Iowa with members participating from Iowa DOT, Delaware county, and industry. The foamed asphalt laboratory equipment has been ordered.

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 shall 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 proposed study for implementation. Completion of the research by the winter of 2002/2003 will allow engineers to apply the mix design procedure on pilot projects during the 2003 construction season.

Project Number: TR-475

Project Title: Synthesis of Best Practices for Increasing Protection and Visibility of Highway Maintenance Vehicles

Agency: Iowa State University

Principal Investigator: Ali Kamyab

Research Period: March 1, 2002 to October 31, 2002

Research Board Funding: $25,000

Funding Source: 100 percent State - 40 percent Primary funds, 40 percent Secondary funds, and 20 percent Street funds

Objective: The object of this research project is to examine practices in enhancing visibility of highway maintenance vehicles involved in moving operations such as snow removal and shoulder operations, crack sealing, and pothole patching.

Progress: The final report will be presented to the Iowa Highway Research Board at the September meeting.

Reports: Quarterly Reports.

Implementation: The findings of this research will enable the maintenance staff to assess the applicability and impact of each method to their use and budget.

Project Number: TR-476

Project Title: A Computer Program for Valley Stage-Discharge Curves and Bridge Backwater Calculations

Agency: Digital Control, Inc.

Principal Investigator: LaDon Jones

Research Period: July 1, 2002 to June 30, 2003

Research Board Funding: $69,375

Funding Source: 100 percent State – 40 percent Primary funds, 40 percent Secondary funds and 20 percent Street funds

Objective: This project will produce integrated, user friendly, personal computer software that will estimate stage-discharge curves for valley cross-sections and perform bridge backwater calculations. The software will be written in Visual Basic 6.0 and will be a complete stand alone program that will run on computers using Microsoft Windows 95, 98, NT, 2000 or XP.

Progress: A contract for this research was executed in June 2002.

Reports: None

Implementation: The PC program will be utilized by city and county engineers, the Iowa DOT staff and consultants for the design of culverts and bridges along the State's primary and secondary road system.

Project Number: TR-477

Project Title: Total Cost of Transportation Analysis - Phase II

Agency: Iowa County Engineers Association Service Bureau

Principal Investigator: Steve DeVries

Research Period: July 1, 2002 to April 30, 2003

Research Board Funding: $29,635

Funding Source: 100 percent State – 100 percent Secondary funds

Objective: To use the transportation costs based analysis tools developed in HR-388 to prepare an accurate, current study of Iowa's county road system - using 2002 data. Once up-to-date physical and cost models have been set up, the data will be used to investigate system adequacy, operating cost needs, capital upgrade needs, and costs versus revenues. The analysis will be done on three levels: system wide, single county, and specific road segment. Results of the project will be reported to the Iowa County Engineers Association and the Needs Study replacement committee as background information to support their efforts in finding a replacement for the Quadrennial Needs Study based RUTF allocation system.

TR-477 will also devote time to more thoroughly research and determine average annual speeds of travel on various types of roads, refine the estimates of capital upgrade costs, review whether or not recent year expenditures have been enough to maintain system quality at a steady state, recheck human resource / travel time costs, and re-estimate accident costs.

Progress: A contract for this research was executed in June 2002.

Reports: None

Implementation: The results of this research effort will be employed to support efforts, by ICEA and the Needs Study Replacement Committee, to devise a new way of allocating the FM and Local Secondary portions of the state Road Use Tax Fund among the counties. It may also be used to evaluate and then demonstrate the adequacy of the county road network and establish how much ought to be spent on it each year.

Project Number: TR-478

Project Title: Evaluation of Composite Pavement Unbonded Overlays (Installation and Maintenance of Weigh In Motion Detection System on Iowa Highway 13 in Delaware County)

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 percent Federal and 20 percent State (100 percent Primary funds) This funding is provided as the required state matching funds for the FHWA project.

Objective:

1. The first is the site section and installation of the WIM site on Iowa Highway 13 north of Manchester, Iowa, by Dr. Jim Cable and representatives of the Office of Transportation Data Systems under the supervision of Mr. Phil Meraz.
2. The second objective is the successful operation and maintenance of this system by Mr. Meraz' staff to provide truck data to Dr. Cable throughout the life of the research contract.

Progress: Equipment is being prepared for a July/August 2002 installation date. Data collection is scheduled to begin immediately after equipment installation.

Reports: Quarterly Report, April 2002

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

Project Number: TR-479

Project Title: Investigation into Improved Pavement Curing Materials and Techniques: Part II (Phase III)

Agency: Iowa State University

Principal Investigator: James K. Cable

Research Period: June 1, 2002 to September 30, 2002

Research Board Funding: $96,828

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

Objective: The objectives of Phase I and II of this research were the following:

1. Identification and evaluation of alternative curing materials and techniques that meet the goals of the Iowa DOT to improve the moisture retention in newly placed PCCP. The techniques should be compatible with current construction techniques.

2. Evaluation of application methods for each alternative-curing compound.

3. Develop a suitable evaluation method for measuring the effectiveness of the compound on the pavement at construction time.

The objective of Phase III is the field evaluation of the products and application rates identified in Phases I and II as having promise to meet the original objectives.

Progress: A field site has been selected and construction arrangements have been made with the contractor for applying the materials. Construction is anticipated in July 2002.

Reports: None

Implementation: The results of this research can be used to provide an alternative set of materials to be used in the curing of pavements at all government levels to enhance the performance of concrete pavements. It has a benefit to HYPERPAVE activities at a national level to validate models that in turn result in improved concrete pavements across the nation.

It is proposed that the results be implemented through presentations and abstract distributions.

Project Number: HR-1027

Project Title: Secondary Road Research Coordinator

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: Ed Engle

Research Period: March 1980 to present

Research Board Funding: $70,000.00/yr. (covers salary and state share of costs for FICA, IPERS, health insurance, vehicle costs and expenses)

Funding Source: 100 percent State – 100 percent Secondary funds

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 18 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 Iowa Highway Research Board (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.

ANNUAL REPORT
OF
HIGHWAY DIVISION
HIGHWAY RESEARCH AND DEVELOPMENT
IN IOWA

SEPTEMBER 2003

Iowa Department of Transportation

ANNUAL REPORT
OF
HIGHWAY DIVISION
HIGHWAY RESEARCH AND DEVELOPMENT IN IOWA

FOR THE
FISCAL YEAR ENDING JUNE 30. 2003

OFFICE OF MATERIALS
(515) 239-1447

HIGHWAY DIVISION
IOWA DEPARTMENT OF TRANSPORTATION
AMES, IOWA 50010

SEPTEMBER 2003

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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, 2003; it is also a report on projects completed during the fiscal year beginning July 1, 2002, and ending June 30, 2003. Detailed information on each of the research and development projects mentioned in this report is available in the Office of Materials in the Highway Division of the Iowa Department of Transportation.

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 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 by the Iowa Department of Transportation Highway Division Director for a three-year term. The membership of the Research Board as of June 30, 2003 is listed in Table I.

The Research Board held eight regular meetings during the period of July 1, 2002 to June 30, 2003. Suggestions for research and development were reviewed at these meetings and recommendations were made by the Board.

TABLE I
2002-2003 IOWA HIGHWAY RESEARCH BOARD MEMBERS

Member	Term Expires	Alternate
John Adam Deputy Director Iowa DOT - Statewide Operations Bureau 800 Lincoln Way Ames, IA 50010 (515) 239-1333	12-31-05	Robert Younie Construction Engineer Iowa DOT - Dist. 1 1020 S. 4th Street Ames, IA 50010 (515) 239-1542
Lyle Brehm Tama County Engineer 1002 E. 5th 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
Robert Ettema Chair, 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	12-31-04 District 2	Andrew Smith Hancock County Engineer 855 State Street P.O. Box 70 Garner, IA 50438 (641) 923-2243 SS# 041
Roger Gould Process Management Engineer Engineering Bureau Iowa DOT - Highway Division 800 Lincoln Way Ames, IA 50010 (515) 239-1834	12-31-03	James Berger Director of Materials Iowa DOT - Highway Division 800 Lincoln Way Ames, IA 50010 (515) 239-1843
Lowell Greimann Dept of Civil & Const. Engineering Iowa State University 390 Town Engineering Building Ames, IA 50011 (515) 294-5586		-
Douglas Julius Sioux County Engineer 207 Central Avenue SE P.O. Box 17 Orange City, IA 51041 (712) 737-2248 SS# 084	12-31-03 District 3	Jon Ites Buena Vista County Engineer 215 E. 5th Street P.O. Box 368 Storm Lake, IA 50588 (712) 749-2540 SS# 011

Brian Keierleber Buchanan County Engineer 1511 1st Street East Independence, IA 50644-3123 (319) 334-6031 SS# 010	12-31-03 District 6	Clark Schloz Jackson County Engineer 201 W. Platt Maquoketa, IA 52060 (563) 652-4782 SS# 049
Jeff Krist Project Manager Public Works Department 209 Pearl Street Council Bluffs, IA 51503 (712) 328-4635	12-31-03	Richard Fosse City Engineer 410 E. Washington Iowa City, IA 52246-5717 (319) 356-5143
Kevin Mahoney Director of Highway Division Iowa DOT 800 Lincoln Way Ames, IA 50010 (515) 239-1124	12-31-03	Larry Jesse Director of Local Systems Iowa DOT - Highway Division 800 Lincoln Way Ames, IA 50010 (515) 239-1291
Charles Marker Cass County Engineer 5 W. 7th Street Atlantic, IA 50022 (712) 243-2442 SS# 015	12-31-05 District 4	John Rasmussen Montgomery County Engineer 406 W. 4th Street P.O. Box 95 Red Oak, IA 51566 (712) 623-5197 SS# 069
Mark Nahra Delaware County Engineer 2139 Highway 38 P.O. Box 68 Delaware, IA 52036 (563) 927-3505 SS# 028		-
Greg Parker City Streets Director 2101 6th Street S.W. Cedar Rapids, IA 52404 (319) 286-5826	12-31-05	John Joiner Civil Engineer 515 Clark Avenue P.O. Box 811 Ames, IA 50010 (515) 239-5165
John Selmer District Engineer Iowa Department of Transportation District 4 63200 White Pole Rd. P.O. Box 406 Atlantic, IA 50022 (712) 243-3355	12-31-04	Glen Miller Construction Engineer Iowa Department of Transportation District 4 63200 White Pole Rd. P.O. Box 406 Atlantic, IA 50022 (712) 243-3355
Christy Van Buskirk Keokuk County Engineer 101 S. Main Sigourney, IA 52591 (641) 622-2610 SS# 054	12-31-04 District 5	Roger Schletzbaum Marion County Engineer 402 Willetts Drive Knoxville, IA 50138 (641) 828-2225 SS# 063

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 and the Director 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, 2003. Total expenditure was $1,650,250.18.

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 Office of Materials, Research Section. In many instances. personnel from other offices are designated as principal investigators, 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 Office of Materials, Research Section, wishes to express its appreciation to other offices for their assistance.

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

The National Cooperative Highway Research Program (NCHRP) was organized by the American Association of State Highway Officials (now the American Association of State Highway and Transportation Officials--AASHTO). The program is administered by the Transportation Research Board, 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 0.0675 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. The secondary obligations to NCHRP are paid from the Secondary Road Research Fund.

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 twenty-four counties during fiscal year 2003 as part of the Annual Traffic Count Program. This activity consisted of 261 portable recorder classification counts, 4,145 portable recorder volume counts and 47 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 were physically inventoried for geometrics and current condition in ninety counties. This data provides county engineers, highway engineers, planners and administrators with essential information needed to determine design standards, to systematically classify highways, and to develop programs for improvement in maintenance of secondary roads.

SECONDARY ROAD RESEARCH FUND

Section 310.34 of the Iowa Code authorizes the Iowa Department of Transportation to set aside each year an amount not to exceed 1½ percent of the receipts to the Farm-to-Market Fund in a fund to be known as the Secondary Road Research Fund. This authorization was first made in 1949; it was repealed in 1963 and reinstated in 1965. When the fund was reinstated, the 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 2003 financial summary is:

Beginning Balance 7-1-02		$2,303,858.63
Receipts		
State Road Use Tax Fund (1½% of receipts)	$1,132,875.46	
Federal Aid Secondary (1½% of receipts)	0.00	
Research Income	1,163.67	
Sub-Total		$1,134,039.13
Total Funds Available		$3,437,897.76
Obligation for Expenditures		
Obligated for Contract Research	605,097.01	
Non-Contract Engineering Studies	95,933.56	
Total Expenditures		701,030.57
BALANCE 6-30-03		$2,736,867.19

STREET RESEARCH FUND

The Street Research Fund was established in 1989 under Section 312.3A of the Iowa Code. Each year two hundred thousand dollars 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 2003 financial summary is:

Beginning Balance (7-1-02)	$ 146,871
FY03 Street Research Funding	200,000
Total Funds Available for Street Research	$346,871

Obligated for Expenditure

HR-296	$ 45,000
TR-459	29,775
TR-474	1,499
TR-480	8,000
TR-481	6,000
TR-482	5,000
TR-483	7,289
TR-484	23,950
TR-485	3,876
TR-487	6,250
TR-488	4,500
TR-490	6,476
TR-491	10,000
TR-492	25,360
TR-493	9,821
TR-495	7,500
TR-497	2,998
TR-499	3,000

Total obligated for Expenditure	$206,294	
Ending Unobligated Balance 6-30-03		$140,577

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. There is no balance carried forward to the next fiscal year and uncommitted funds remain in the Primary Road Fund. The amount expended for contract research from the Primary Road Research Fund for FY03 was $694,901.52 and the estimate for FY04 is $750,000.

PROJECTS INITIATED DURING FY 2003

The new projects initiated during FY 2003 were:

TR-480, "Investigation of the Long Term Effects of Concentrated Salt Solutions on Portland Cement Concrete"
TR-481, "Identification of the Best Practices for the Design, Construction, and Repair of Bridge Approach Sections"
TR-482, "Determination of the Optimum Base Characteristics for Pavements"
TR-483, "Evaluation of Hot Mix Asphalt Moisture Sensitivity Using the Nottingham Asphalt Test Equipment"
TR-484, "Materials and Mix Optimization Procedures for PCC Pavements"
TR-485, "Erosion Control for Highway Applications - Phase II: Development and Implementation of a Web-Based Expert System for Erosion and Sediment Control Measures"
TR-486, "Development of Abutment Design Standards for Local Bridge Designs"
TR-487, "Development of Object Oriented Specifications for IADOT and Urban Standards"
TR-488, "Economics of Using Calcium Chloride vs. Sodium Chloride for Deicing/Anti-icing"
TR-489, "Innovative Solutions for Slope Stability Reinforcement and Characterization in Iowa Soils"
TR-490, "Stringless Portland Cement Concrete Paving"
TR-491, "Development of Winter Performance Measures for Highway Winter Maintenance Operations"
TR-492, "Embankment Quality Phase IV - Application to Unsuitable Soils"
TR-493, "Performance Evaluation of Steel Bridges: Phase II"
TR-494, "Statistical Analysis of Highway Needs Condition Data: Manual vs. Automated"
TR-495, "Field Evaluation of Compaction Monitoring Technology"
TR-497, "Manual of Iowa Drainage Law"
TR-498, "Field Testing of Railroad Flat Car Bridges"
TR-499, "Effectiveness of Electrochemical Chloride Extraction for the Iowa Avenue Pedestrian Bridge"
TR-500, "Evaluation of the Compensatory Wetland Mitigation Program in Iowa"

20 projects

Table II
FINANCIAL SUMMARY OF RESEARCH AND DEVELOPMENT PROJECT EXPENDITURES

July 1, 2002 to June 30, 2003

(Active projects with no current fiscal year expenditures are included)

Project	Total Funds Committed	Project Title	Primary Road Research Fund Expenditures	Secondary Road Research Fund Expenditures	Street Research Fund Expenditures	Total Expenditures
296	82,000	ISU Local Technical Assistance Program (LTAP)	10,000.00	49,216.69	32,925.66	92,142.35
370	10,000	Pipe Rehabilitation With Polyethylene Pipe Liners				
375	22,400	Transportation Research Board Education for County Engineers		1,920.36		1,920.36
391	163,741	Optimal Usage of De-Icing Chemicals When Scraping Ice				
394	672,152	Transportation Program Management System	9,319.91			9,319.91
399	299,932	Field Testing of Integral Abutments	129.52			129.52
412	65,000	Development of a Computer Controlled Underbody Plow				
414	50,000	Superpave Mix Designs for Low Volume Roads				
419	30,000	Education on Urban Corridor Issues	1,703.49			1,703.49
420	98,478	Field Evaluation of Alternative Load Transfer Device Locations in Low Traffic Volume		19,089.26	79.05	19,168.31
422	14,000	Pretreatment for Reduction of Asphalt Absorption in Porous Aggregate				
424	178,358	Steel Diaphragms in Prestressed Concrete Girder Bridges		31,219.25		31,219.25
427	26,200	Evaluation of High-Slump Concrete for Bridge Deck Overlays				
428	294,760	Effective Structural Concrete Repair	5,856.26	6,204.23		12,060.49
429	195,060	Evaluation of Appropriate Maintenance Repair and Rehabilitation Methods for Iowa				
432	183,903	Ultrathin Portland Cement Concrete Overlay Extended Evaluation	171.99	5,337.81	152.48	5,662.28
434	30,420	Use of Abrasives in Winter Maintenance	304.20	2,433.60	304.20	3,042.00
435	117,030	Thin Maintenance Surfaces - Phase II	6,436.52	5,266.32		11,702.84
436	158,028	Retrofit Methods for Distortion Cracking Problems in Plate Girder Bridges	5,202.51	11,546.56	5,955.16	22,704.23
438	142,903	Integral Abutment Bridge With Precast Concrete Piles	12,145.58	11,754.56		23,900.14
444	187,620	Demonstration Project Using Railroad Flatcars for Low Volume Road Bridges		35,110.32		35,110.32
445	176,876	Development of Bridge Load Testing Process for Load Evaluation		18,673.57	4,256.00	22,929.57
446	214,150	Technology Transfer of "As Built Preliminary Surveys" by Total Station GPS, Video Logging & Laser	1,198.99	9,339.99		10,538.98
449	58,135	Determination and Evaluation of Alternative Methods for Managing and Controlling Highway Related Dust		5,702.64		5,702.64
450	80,000	Identification of Laboratory Techniques to Optimize Superpave HMA Surface Friction Characteristics				
451	70,718	Investigation Into Improved Pavement Curing Materials and Techniques		13,273.33		13,273.33
452	48,865	Alternative Solutions to Meet the Service Needs of Low Volume Bridges in Iowa		11,767.52		11,767.52
456	107,800	Measuring Main-Channel Slopes for Major Rivers in Iowa		50,800.00		50,800.00
457	73,997	Development of a Manual Crack Quantification and an Automatic Crack Measurement System				
458	151,920	Field Testing of Abrasive Delivery Systems in Winter Maintenance	4,423.95	20,019.05	341.82	24,784.82
459	67,133	Reuse of Lime Sludge From Water Softening	107.29		1,952.05	2,059.34
460	87,924	Living Snow Fences	17,300.45	37,490.87		54,791.32
461	70,000	Soil Stabilization of Non-Uniform Subgrade Soils	14,670.42	22,702.84	2,183.09	39,556.35
462	61,560	Manual for Roadside Control of Trees and Brush	1,747.80	16,749.39	6,153.25	24,650.44
463	99,804	Field Performance Study of Past Iowa Pavement Research: A Look Back	12,906.94	44,751.65	9,000.00	66,658.59
464	30,000	Erosion Control for Highway Applications - A Critical Review of Published Literature	7,009.89	12,000.00	2,869.86	21,879.75
466	47,049	Evaluation of Unbonded Ultrathin Whitetopping of Brick Streets			518.35	518.35
467	190,890	Investigation of the Modified Beam-in-Slab Bridge System		99,610.17		99,610.17
468	10,000	Technology Transfer Program for the Iowa Highway Research Board (IHRB)	2,863.23	630.00		3,493.23
469	139,832	Reduction of Concrete Deterioration by Ettringite Using Crystal Growth Inhibition Techniques-Part II-Field Evaluation of Inhibitor Effectiveness	59,931.60			59,931.60
470	59,272	Development of a Method to Determine Pavement Damage Due to Detours and Haul Roads	19,516.95	20,575.19		40,092.14

Project	Total Funds Committed	Project Title	Primary Road Research Fund Expenditures	Secondary Road Research Fund Expenditures	Street Research Fund Expenditures	Total Expenditures
471	100,000	Evaluation of Using Non-Corrosive Deicing Materials and Corrosion Reducing Treatments for Deicing Salts	49,531.86	24,876.29	779.75	75,187.90
472	80,000	Investigation of Materials for the Reduction and Prevention of Corrosion on Highway Maintenance Equipment	28,113.26	1,450.27		29,563.53
473	178,197	Rehabilitation of Concrete Pavements Utilizing Rubblization and Crack and Seat Methods	46,854.70	31,178.08		78,032.78
474	129,671	Development of a Mix Design Process for Cold-In-Place Rehabilitation Using Foamed Asphalt	63,793.42	24,246.63	34,101.31	122,141.36
476	69,375	PCVAL: A Computer Program for Valley Stage-Discharge Curves and Bridge Backwater Calculations	22,592.25	24,840.00	8,673.75	56,106.00
477	29,635	Total Cost of Transportation Analysis - Phase II (HR-388 - Phase I)		3,816.35		3,816.35
478	49,520	Evaluation of Composite Pavement Unbonded Overlays (Installation and Maintenance of Weigh In Motion Detection System on Iowa Hwy 13 in Delaware Co.)	16,422.32			16,422.32
479	96,828	Investigation Into Improved Pavement Curing Materials and Techniques: Part II (Phase III)	56,524.34	6,965.00	2,322.41	65,811.75
480	80,000	Investigation of the Long Term Effects of Concentrated Salt Solutions on Portland Cement Concrete	36,000.00	36,000.00	8,000.00	80,000.00
481	120,000	Identification of the Best Practices for the Design, Construction, and Repair of Bridge Approach Sections	27,487.23	3,538.44		31,025.67
482	100,000	Determination of the Optimum Base Characteristics for Pavements	35,186.36			35,186.36
483	145,775	Evaluation of Hot Mix Asphalt Moisture Sensitivity Using the Nottingham Asphalt Test Equipment	44,175.22			44,175.22
484	159,666	Materials and Mix Optimization Procedures for PCC Pavements	11,824.35			11,824.35
485	38,757	Erosion Control for Highway Applications - Phase II: Development and Implementation of a Web-Based Expert System for Erosion and Sediment Control Measures	15,858.79	11,074.47	2,136.31	29,069.57
486	99,265	Development of Abutment Design Standards for Local Bridge Designs		15,438.28		15,438.28
487	124,999	Development of Object Oriented Specifications for IADOT and Urban Standards	29,539.31	2,822.46		32,361.77
488	90,000	Economics of Using Calcium Chloride vs. Sodium Chloride for Deicing/Anti-icing	6,903.88			6,903.88
489	198,462	Innovative Solutions for Slope Stability Reinforcement and Characterization in Iowa Soils	1,644.34	1,716.62		3,360.96
490	129,519	Stringless Portland Cement Concrete Paving				
491	100,000	Development of Winter Performance Measures for Highway Winter Maintenance Operations				
492	169,067	Embankment Quality Phase IV - Application to Unsuitable Soils				
493	196,421	Performance Evaluation of Steel Bridges: Phase II				
494	17,405	Statistical Analysis of Highway Needs Condition Data: Manual vs. Automated		13,175.10		13,175.10
495	75,000	Field Evaluation of Compaction Monitoring Technology				
497	59,965	Manual of Iowa Drainage Law				
498	121,096	Field Testing of Railroad Flat Car Bridges				
499	30,000	Effectiveness of Electrochemical Chloride Extraction for the Iowa Avenue Pedestrian Bridge				
500	6,802	Evaluation of the Compensatory Wetland Mitigation Program in Iowa				
1027	70,000	Secondary Road Research Coordinator		68,321.00		68,321.00
1080	29,997	Synthesis of Dowel Bar Research	7,414.96			7,414.96
1081	25,000	Development of In-Situ Detection Methods for Material Related Distress (MRD) in Concrete	2,087.44			2,087.44
			=========	=========	=========	==========
		Contract Research Subtotal	694,901.52	832,644.16	122,704.50	1,650,250.18
SPR-PR-PL-1(33)		FY2003 Planning & Research Program (Transportation Inventory Engineering Studies)		95,933.56		95,933.56
			=========	=========	=========	==========
		Non-contract Engineering Studies Subtotal		95,933.56		95,933.56
		Grand Total of Expenditures	694,901.52	928,577.72	122,704.50	1,746,183.74

Project Number: HR-296

Project Title: Iowa State University Local Technical Assistance Program (LTAP)

Agency: Iowa State University

Principal Investigator: Stephen J. Andrle

Research Period: October 1, 1986 to December 31, 2003

Research Board Funding: $100,000 per year

Funding Source: 36 percent Federal funds, 16 percent State Safety funds, 22% other sources and 26 percent State - 10 percent Primary funds, 45 percent Secondary funds and 45 percent Street funds

Objective: To promote research, encourage implementation and distribute research data.

Progress: The major tasks are:

1. publishing at least six newsletters per year
2. conducting at least 10 training courses/workshops per year
3. distribute publications
4. provide service and information to users
5. 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.

Project Number: HR-370

Project Title: Pipe Rehabilitation With Polyethylene Pipe Liners

Agency: Dallas County, Jefferson County, Jones County, Mahaska County, Taylor County, and the Iowa Department of Transportation, Highway Division

Principal Investigator: Brad Skinner, Gary Bishop, Dan Waid, Raymond Blessum, James Delozier and Ed Engle

Research Period: June 1, 1994 to December 31, 2001

Research Board Funding: $10,000

Funding Source: 100 percent State - 100 percent Secondary funds

Objective: The objective of the research is to demonstrate and evaluate the applicability of pipe rehabilitation with polyethylene pipe liners.

Reports: Final Report, April 2003

Implementation: If the use of polyethylene liners is successful, it will give engineers an economical alternative to the removal and replacement of deteriorated culverts.

Project Number: HR-375

Project Title: Transportation Research Board Education for County Engineers

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: Ed Engle

Research Period: November 1, 1994 to December 31, 2004

Research Board Funding: $22,400

Funding Source: 100 percent State - 100 percent Secondary funds

Objective: The objective of the project is to send two county engineers annually to the Transportation Research Board (TRB) Annual Meeting in Washington, D.C. for research education. County engineers selected are generally those starting their term as regular members of the Iowa Highway Research Board (IHRB). 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 2003, a total of 18 county engineers were sent to TRB.

Reports: None

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

Project Number: HR-391

Project Title: Optimal Usage of De-Icing Chemicals When Scraping Ice

Agency: The University of Iowa

Principal Investigator: Wilfrid A. Nixon

Research Period: May 21, 1996 to December 31, 2003

Research Board Funding: $163,741

Funding Source: 100 percent State - 70 percent Primary funds, 10 percent Secondary funds and 20 percent Street funds

Objective: The objective of the work proposed in this study is to determine the best combination of chemical application and scraping for removing the various types of ice from the road.

Progress: Preliminary testing has resulted in the development of test protocols, which allow for very good repeatability of test results (which is a necessary part of this project, since some effects may be small). Testing has concentrated on salt (sodium chloride) as a deicer, and has tested various quantities of salt, applied for varying length of time and in various forms (coarse granules, fine powder, etc.).

Reports: None

Implementation: A field guide would be developed which would contain for each chemical tested, the optimal application rate and delay time for that chemical for each ice type. This will improve winter ice removal, thereby, improving safety of the motoring public.

Project Number: HR-394

Project Title: Transportation Program Management System, Phases II - IV

Agency: Iowa County Engineers Association Service Bureau

Principal Investigator: Steve DeVries

Research Period: March 1, 1999 to September 30, 2003

Research Board Funding: $672,152

Funding Source: 100 percent State - 25 percent Primary funds, 70.7 percent Secondary funds, and 4.3 percent Street funds

Objective: The objective of this project is to create a centralized, automated system to support project programming and development tracking to:

a) reduce the potential for errors and conflicts.
b) speed up the process and deliver road improvements to the public more expeditiously.
c) decrease the total labor cost required to get programming and development work accomplished.
d) make the status of any project or action available to all parties who need to know on a "real-time" basis.
e) Improve communications and provide an on-line transcript of each projects' history.

Progress: The final system and report from the research are being completed and will be presented to the IHRB at its September 26, 2003 meeting.

Reports: None

Implementation: The results of this project will be a system that will both improve and expedite the current Transportation Program Management process. It will enable local agencies to reduce project errors, conflicts, and delays. All interested parties will be able to get a "real-time" project status at any time.

Project Number: HR-399

Project Title: Field Testing of Integral Abutments

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 percent State - 50 percent Primary funds, 35 percent Secondary funds and 15 percent Street funds

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:

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

Progress: Long-term monitoring of strains, displacements, and temperatures has been completed at both integral abutment bridges selected. Lab tests were conducted to determine the coefficient of thermal expansion and contraction of core samples taken from the decks. Analysis of these tests has been completed. The finite-element model for both bridges is complete. A calibration procedure that involves the comparison of analytically predicted and experimentally measured bridge displacement has been completed.

A final report is being completed and is expected to be presented to the IHRB in the fall of 2003.

Reports: Interim Report, June 1998

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.

Project Number: TR-412

Project Title: Development of a Computer Controlled Underbody Plow

Agency: The University of Iowa

Principal Investigator: Wilfrid A. Nixon

Research Period: August 1, 1997 to December 31, 2003

Research Board Funding: $65,000

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

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.

Progress: The MATLAB software package has allowed a base level program for fuzzy control of a snowplow to be developed. This has the capability of providing fuzzy control over a closed feedback loop, in which the force between underbody plow and the road surface (the scraping force) is the primary feedback signal. It also incorporates a number of secondary feedback signals (such as plow angle) into the control loop and a simple weighted algorithm has been used for this.

Reports: Annual Progress Report, July 1999

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.

Project Number: TR-414

Project Title: Superpave Mix Designs for Low Volume Roads

Agency: Iowa DOT, Scott County, Mahaska County, Mills County, Cerro Gordo County, Dubuque County, Pocahontas County, Cass County, Linn County, and Louisa County

Principal Investigator: Ed Engle and the respective County Engineer

Research Period: July 1, 1997 to December 31, 2003

Research Board Funding: $50,000

Funding Source: 100 percent State - 100 percent Secondary funds

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

Progress: All of the eight final projects are completed. Annual distress and performance surveys commenced in 1999.

Reports: Construction Report, September 2001

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 naturally be an attractive alternative for counties statewide. This is especially true as state ACC projects are shifted to 100% Superpave.

Project Number: TR-419

Project Title: Education on Urban Corridor Issues Through Computer Animation

Agency: Snyder and Associates

Principal Investigator: Gary Gamer

Research Period: May 21, 1998 to September 30, 2002

Research Board Funding: $30,000

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

Objective: The objective of this research is to develop a method of using a combination of photo-imaging and computer animation at much less expense to provide a visual aid to gain public acceptance of an urban safety upgrade project.

Reports: Final Report, March 2003

Implementation: Implementation of this research will be through an evaluation of how photo-imaging and computer animation can be used in combination to cost-effectively give the average citizen an understanding of how a constructed design will compare to the current conditions. A before and after comparison of a corridor will also show how well the post-construction appearance can be represented by integration of imaging and animation into a video prior to actual construction.

Project Number: TR-420

Project Title: Field Evaluation of Alternative Load Transfer Device Locations in Low Traffic Volume Pavements

Agency: Iowa State University

Principal Investigator: James K. Cable and Curtis Greenfield

Research Period: July 30, 1998 to December 31, 2003

Research Board Funding: $98,478

Funding Source: 100 percent State - 80 percent Secondary funds and 20 percent Street funds

Objective: The objective of this research is to evaluate the placement of load transfer dowels in PCC pavements on low volume roads. The intention is to find strategic dowel placements that would decrease the number of dowels needed and make placement easier.

Progress: Paving was completed in Union County during the summer of 1998. Evaluations, including traffic counts and pavement performance indicators, have been performed for the two paving projects. The project monitoring has continued and is entering the last year. There are differences in the performance, but not enough to make solid recommendations on future construction at this time.

Reports: Construction Report, December 1999

Implementation: If an optimized dowel placement regimen can be demonstrated, counties will be more inclined to use dowels in their paving projects.

Project Number: TR-422

Project Title: Pretreatment for Reduction of Asphalt Absorption in Porous Aggregate

Agency: Louisa County

Principal Investigator: Ed Engle, John Hinrichsen and Robert Simmering

Research Period: August 1998 to December 2003

Research Board Funding: $14,000

Funding Source: 100 percent State - 40 percent Primary funds, 40 percent Secondary funds and 20 percent Street funds

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

Progress: The paving project was completed in the summer of 1998. Evaluations of the pavement are being performed in conjunction with another research project (HR-414) on an annual basis. The additive does not appear to have provided significant reduction in asphalt absorption into the aggregate. A final report is in preparation.

Reports: None

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.

Project Number: TR-424

Project Title: Steel Diaphragms in Prestressed Concrete Girder Bridges

Agency: Iowa State University

Principal Investigator: Robert Abendroth and Fouad S. Fanous

Research Period: January 1, 1999 to October 31, 2003

Research Board Funding: $178,358

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

Objective: The objectives of the research are:

1. Evaluate the state-of-the-art regarding the role of intermediate diaphragms in distributing lateral loads throughout PC girder bridge structures.
2. Investigate the static and dynamic-load response characteristics of different types and configurations of intermediate diaphragms in PC girder bridges.
3. 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.

Progress: The finite-element analyses were completed for prototype, prestressed concrete (PC), girder bridges that were subjected to horizontal-impact forces. These forces represented the effect of an over-height-vehicle impact on the bottom flange of a PC girder. To confirm the accuracy of the finite-element models, calibrations were performed using the experimentally-determined displacement and strain results from a laboratory test of an approximately, one-half-scale, single-span, bridge model. This calibration process confirmed the finite-element, mesh sizes and the types of special, finite elements that were used in the bridge superstructures for the prototype bridges. The final report for the research project is nearing completion.

Reports: Quarterly Report, April 2002

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 proposed 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. If economical and sufficiently stiff intermediate steel diaphragms can be used to replace the conventional intermediate RC diaphragms, bridge construction time and costs should be reduced.

Project Number: TR-427

Project Title: Evaluation of High-Slump Concrete for Bridge Deck Overlays

Agency: Buchanan County

Principal Investigator: Brian Keierleber

Research Period: December 21, 1998 to December 31, 2004

Research Board Funding: $26,200

Funding Source: 100 percent State - 40 percent Primary funds, 30 percent Secondary funds and 30 percent Street funds

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.

Progress: Construction of two bridge deck overlays was completed in Fall 2000. Annual evaluations will be performed. Several additional bridge decks have been overlaid with this method successfully since these first projects. A final report will be prepared by December 2004.

Reports: Construction Report, September 2001

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.

Project Number: TR-428

Project Title: Effective Structural Concrete Repair

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 percent State - 45 percent Primary funds, 45 percent Secondary funds, and 10 percent Street funds

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

Progress: Work has continued in the area of FRP as a protective barrier to chloride penetration. Each of the five sites studied had wraps and a protective topcoat installed last fall (2002). Samples of concrete were gathered from each of these five sites in June 2003. The analysis of the samples indicated that there was no change in chloride levels after the first winter season.

In the laboratory, all five FRP wraps have been installed on a concrete slab. These wraps were installed in three layers so that there are sections on the slab that have one, two and three layers of the FRP wraps. In addition to the five wraps, both topcoats utilized as a protective UV cover were also installed. The slab was then flooded with a three percent salt solution for a ninety-day cycle. After the completion of a cycle, the slab was drained, samples were obtained and the slab was patched so it could be flooded again. To-date, two 90 day cycles have been completed. All five wraps and the two topcoats have successfully kept the chloride level below the corrosion threshold. However, the topcoats and one of the carbon wraps have displayed a small increase in the amount of chlorides that have penetrated through to the slab.

A report summarizing the work to date is currently being prepared. Also, a synopsis of the installation procedures used for each of the FRP wraps has been created for use by maintenance personnel. The synopsis will be included as an appendix to the final report.

Reports: Progress Report, June 2002

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.

Project Number: TR-429

Project Title: Evaluation of Appropriate Maintenance Repair and Rehabilitation (MR&R) Methods for Iowa Bridges

Agency: Iowa State University

Principal Investigator: Terry J. Wipf, Fouad S. Fanous and F. Wayne Klaiber

Research Period: February 1, 1999 to April 30, 2003

Research Board Funding: $195,060

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

Objective: The primary objective of the proposed research is to compile current information on MR&R techniques and implementation guidelines. The proposed research will provide guidance for designers as well as field personnel.

Reports: Final Report and Manual, May 2003

Implementation: The result of this research project will provide MR&R procedures that are systematic and will serve as guidelines to engineers and field personnel.

Project Number: TR-432

Project Title: Ultrathin PCC Overlay Extended Evaluation

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 percent State - 50 percent Primary funds, 45 percent Secondary funds and 5 percent Street funds

Objective: Evaluation of the following: 1) conventional methods of slab removal and surface preparation for removal and replacement areas, 2) the condition of the asphaltic concrete surface under removal and replacement areas, 3) the cost/benefit of polypropylene fiber addition to the concrete, 4) the performance of the rehabilitated sections, and 5) the validation of the design methods of Portland Cement Association (PCA) and American Concrete Paving Association (ACPA).

Progress: Monitoring of the site continues.

Reports: Interim Report, July 2002

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

Project Number: TR-434

Project Title: Use of Abrasives in Winter Maintenance

Agency: The University of Iowa

Principal Investigator: Wilfrid A. Nixon

Research Period: May 1, 1999 to July 31, 2000

Research Board Funding: $30,420

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

Objective: The objective of this project is twofold. First, by surveying the literature and the current practice to develop reference guidelines for best practice in abrasive application as a part of winter maintenance activities in Iowa. Second, the project will develop an outline of an experimental program to improve understanding of how abrasives work, and thus improve the guidelines for best practice based on the results of those experiments.

Reports: Final Report, March 2001

Implementation: This research will develop a comprehensive set of recommendations for abrasive use by state, county and city agencies.

Project Number: TR-435

Project Title: Thin Maintenance Surfaces - Phase II and Guidelines for Winter Maintenance on Thin Maintenance Surfaces

Agency: Iowa State University and The University of Iowa

Principal Investigator: Charles Jahren and Wilfrid A. Nixon

Research Period: July 1, 1999 to June 30, 2002

Research Board Funding: $117,030

Funding Source: 100 percent State - 55 percent Primary funds and 45 percent Secondary funds

Objective: There are five principal objectives for this research.

1. Continue monitoring of the performance of previously placed test sections;
2. Investigate possible improvements in the use of seal coat aggregates;
3. Select a seal coat design process to recommend for use by the State of Iowa;
4. Develop a micro-surfacing mix using local limestone; and
5. Develop guidelines for winter maintenance on thin maintenance surfaces.

Reports: Final Report, January 2003

Implementation: The results from this research should provide engineers and transportation decision makers with guidelines for the selection of materials, techniques and maintenance practices for thin maintenance surfaces.

Project Number: TR-436

Project Title: Retrofit Methods for Distortion Cracking Problems in Plate Girder Bridges

Agency: Iowa State University

Principal Investigator: Terry J. Wipf

Research Period: July 1, 1999 to January 31, 2003

Research Board Funding: $158,028

Funding Source: 100 percent State - 75 percent Primary funds, 20 percent Secondary funds and 5 percent Street funds

Objective: The objectives of this proposal are to: 1) verify the effects of the bolt loosening on one of the first retrofitted bridges, including long-term continuous monitoring of a retrofitted bridge, 2) investigate the retrofit method's applicability for bridges with I-beam diaphragms, and 3) study the cause and possible remedies for the failure of the retrofitted bolted connection in the two-beam bridges.

Reports: Final Report, January 2003

Implementation: The results of the proposed research study should provide guidance in maintaining steel girder bridges to the Office of Bridge Maintenance and Inspection of the Iowa DOT.

Specifically, the effectiveness of potential retrofit methods to be used by the Iowa DOT will be determined.

Project Number: TR-438

Project Title: An Integral Abutment Bridge With Precast Concrete Piles

Agency: Iowa State University

Principal Investigator: Robert Abendroth

Research Period: July 1, 1999 to September 30, 2003

Research Board Funding: $142,903

Funding Source: 100 percent State - 60 percent Primary funds. 35 percent Secondary funds and 5 percent Street funds

Objective: The research objectives are:

1. 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.
2. 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.
3. Establish the longitudinal displacement verses temperature behavior for the abutments of the Tama County Bridge.

Progress: A nine month, no cost, time extension was approved for this project. Work continued on the analysis of the experimentally measured data that was obtained during the field monitoring of the Tama County Bridge.

Reports: Quarterly reports are prepared in January, April. July and October of each year.

Implementation: The results obtained from this research will provide bridge design engineers for the Iowa DOT with a better understanding of the behavior of the PCC abutment piles in the Tama County integral-abutment bridge. Engineers with the Bridge Design Section 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.

Project Number: TR-444

Project Title: Demonstration Project Using Railroad Flat Cars for Low Volume Road Bridges

Agency: Iowa State University

Principal Investigator: F. Wayne Klaiber

Research Period: July 10, 2000 to November 30, 2002

Research Board Funding: $187,620

Funding Source: 100 percent State - 100 percent Secondary funds

Objective: The objective of this research is to design and construct two bridges using railroad flat cars (RRFC). The bridges will be instrumented and field load tested at the end of construction, and inspected and load tested periodically thereafter.

Reports: Final Report, February 2003

Implementation: The primary value of the research is to provide strength behavior information for these bridges, so that they can be used to replace deficient bridges in a cost effective manner. In addition, design and construction guidelines will be developed to assist engineers with this type of bridge. Construction of these bridges will be documented to assist others in the construction of additional railroad flatcar bridges.

Project Number: TR-445

Project Title: Development of Bridge Load Testing for Load Evaluation

Agency: Iowa State University

Principal Investigator: Terry J. Wipf, F. Wayne Klaiber and Douglas Wood

Research Period: May 22, 2000 to February 28, 2003

Research Board Funding: $176,876

Funding Source: 100 percent State - 65 percent Primary funds, 30 percent Secondary funds and 5 percent Street funds

Objective: The primary objective of this research is to investigate and develop a load testing process for evaluating and rating bridges on the highway system in Iowa. This is an initial step in the process of establishing an objectively tested bridge rating system.

Reports: Final Report, April 2003

Implementation: The results from this investigation will provide technical information and recommendations that engineers can use to more accurately evaluate existing bridges. In addition, the information will provide useful guidelines regarding actual bridge behavior that can be beneficial to engineers responsible for bridge design.

Project Number: TR-446

Project Title: Technology Transfer of "As Built Preliminary Surveys" by Total Station GPS, Video Logging and Laser Scanning

Agency: Iowa State University

Principal Investigator: Kandiah Jeyapalan

Research Period: June 1, 2000 to November 30, 2002

Research Board Funding: $214,150

Funding Source: 100 percent State - 65 percent Primary funds, 30 percent Secondary funds and 5 percent Street funds

Objective: The objectives of this project are to develop a user friendly positioning system using video logging and soft photogrammetry for the purpose of constructing "AS Built" surveys of bridges and culverts and to demonstrate the development and use of local geoid in preliminary and photogrammetric control surveys for Iowa engineers and surveyors.

Reports: Final Report, September 2002

Implementation: The research should prove the feasibility of using soft photogrammetry and video logging for constructing "AS Built" surveys more efficiently. It will also provide methods for creating a local geoid for preliminary and control surveys.

Project Number: TR-449

Project Title: Determination and Evaluation of Alternative Methods for Managing and Controlling Highway Related Dust

Agency: Iowa State University

Principal Investigator: Robert Lohnes

Research Period: March 1, 2001 to June 30, 2002

Research Board Funding: $58,135

Funding Source: 100 percent state - 100 percent Secondary funds

Objective: The objective of the research is to evaluate currently used and potential technology and products for dust control and to identify new alternative methods for controlling dust.

Reports: Final Report, June 2002

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

Project Number: TR-450

Project Title: Identification of Laboratory Techniques to Optimize Superpave HMA Surface Friction Characteristics

Agency: Perdue University

Principal Investigator: Rebecca S. McDaniel

Research Period: June 1, 2001 to January 31, 2004

Research Board Funding: $80,000

Funding Source: 50 percent Institute for Safe, Quiet, and Durable Highways funds, 25 percent Indiana DOT funds, and 25 percent State - 100 percent Primary funds

Objective: The main purpose of this research is to evaluate various blends of aggregates to optimize the combination of micro- and macrotexture 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: Research on this project was delayed by contractual issues between Purdue University and the Iowa DOT. The schedule for completion of the project will be revised after confirming with the panel next quarter. A review of possible technologies to polish and test the mixture samples is nearly complete. Late last year NCAT received a promising Japanese device, which may be lent to the project, but software problems delayed its use. The PI visited NCAT for another project at the end of October 2002 and saw the devices, which look very good. A report and request for extension will be reviewed by the research team next quarter prior to distribution to the SAC.

Reports: Quarterly Report, April - June 2003

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.

Project Number: TR-451

Project Title: Investigation Into Improved Pavement Curing Materials and Techniques – Phases I & II

Agency: Iowa State University

Principal Investigator: Kejin Wang and James K. Cable

Research Period: December 1, 2000 to September 30, 2002

Research Board Funding: $70,718

Funding Source: 100 percent state - 60 percent Primary funds, 30 percent Secondary funds, and 10 percent Street funds

Objective: To identify and evaluate alternate curing materials and techniques to improve moisture retention in newly placed PCCP, and to develop a method for measuring effectiveness of the compound placed on the pavement at construction time.

Reports: Final Report, April 2002

Implementation: The results of this research can be used to provide an alternative set of materials for curing of pavements to enhance performance.

Project Number: TR-452

Project Title: Alternative Solutions to Meet the Service Needs of Low Volume Bridges in Iowa

Agency: Iowa State University

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

Research Period: March 1, 2001 to October 31, 2003

Research Board Funding: $48,865

Funding Source: 100 percent State - 100 percent Secondary funds

Objective: The object of this phase of the project is to develop a reference document to address common problems in low-volume road (LVR) bridges. This reference document will not only summarize previous IHRB sponsored research, but will also present pertinent information from other sources. Iowa county engineers need to be surveyed to determine problems they are having with LVR bridges. Also, their solutions to some of the bridge problems they have encountered need to be determined and summarized. A review of the collected data will reveal where inadequate information is available and enable the research team to develop a work plan to address areas where there is inadequate information.

Progress: The literature review portion of this project has been completed and appropriate summaries prepared. Summaries of past IHRB projects that are related to this investigation have also been prepared.

Except for minimal response (only 26 responses were received) to the questionnaire that was sent to all Iowa County Engineers, the project is essentially completed. Upon the suggestion of S. DeVries of the Iowa County Engineers Association Service Bureau (ICEASB), the research team is mailing the questionnaire to those county engineers that haven't responded. The ICEASB has had good experience with obtaining responses to mailed questionnaires after a poor response to an initially e-mailed copy of the questionnaire.

Reports: None

Implementation: Local agencies in Iowa and elsewhere are beset by a combination of bridge deficiencies and the lack of funding to address the deficiencies. This research will provide a summary of approaches to this problem and evaluations to show which approaches worked best.

A product of the research will be a reference document that county and city engineers can use to help them decide how best to solve their LVR bridge problems.

Project Number: TR-456

Project Title: Measuring Main-Channel Slopes for Major Rivers in Iowa

Agency: United States Geological Survey

Principal Investigator: David Eash

Research Period: April 18, 2001 to September 30, 2003

Research Board Funding: $107,800

Funding Source: 50 percent Federal funds and 50 percent State - 50 percent Primary funds and 50 percent Secondary funds

Objective: To measure Main Channel Slope (MCS) using GIS along major rivers in Iowa, plot graphs of those measurements, and compare them to manual measurements to determine if adjustments are necessary.

Progress: The project is in final stages of completion. A final report is being completed and is expected to be presented to the IHRB in the fall of 2003.

Reports: Progress Report, September 2002

Implementation: The results of this project will enable engineers, managers, and planners to estimate flood-frequency discharges with greater efficiency and predictive accuracy.

Project Number: TR-457

Project Title: Development of a Manual Crack Quantification and an Automated Crack Measurement System

Agency: The University of Iowa

Principal Investigator: Hosin "David" Lee

Research Period: April 1, 2001 to December 31, 2003

Research Board Funding: $73,997

Funding Source: 100 percent State - 60 percent Primary funds and 40 percent Secondary funds

Objective: To develop two software packages: one to verify the outputs of Roadware Inc. against Iowa DOT procedures; and the second to automatically process pavement crack data objectively and consistently.

Progress: A draft final report was submitted in May 2002. During the course of the review, it became apparent that the images provided for analysis did not correspond to the pavement management system output. The images have been assigned to the proper pavement manage sections for re-analysis. The revised analysis required additional time. A final report is due in fall 2003

Reports: Draft Final, May 2002

Implementation: The software packages will offer improved accuracy and consistency over the current labor-intensive manual system at a lower cost. This system will be implemented in Iowa DOT and selected cities and counties.

Project Number: TR-458

Project Title: Field Testing of Abrasive Delivery Systems in Winter Maintenance

Agency: The University of Iowa

Principal Investigator: Wilfrid A. Nixon

Research Period: May 1, 2001 to April 30, 2004

Research Board Funding: $151,920

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

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. The lack of a good winter season the past two years has not helped in this regard.

Reports: None

Implementation: Maintaining roads in winter, in Iowa is difficult. The safely 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.

Project Number: TR-459

Project Title: Reuse of Lime Sludge From Water Softening in Road Construction

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 percent outside sources and 48 percent State - 25 percent Primary funds and 75 percent Street funds

Objective: The objectives are as follows:

1. Lime sludge in mixture with fly ash, soils and aggregate is to be tested for its suitability to prepare subbase for road construction.
2. Evaluate the use of lime sludge for fill and embankments as an admixture with other fill materials and fly ash.
3. Calcium Carbonate 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 of Buffalo, Iowa to be used in cement production.
4. Many power plants are already using calcium carbonate for sulfur dioxide removal. The present source of CaCO3 is limestone. Here the objective is to find means of preparing lime sludge to replace some of the limestone in powerplants.
5. 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.

Progress: The work is continuing after delays resulting from not being able to find a suitable graduate research assistant.

Reports: Interim Progress Report, August 2003

Implementation: The potential value of the lime sludge in Iowa is around 1 million dollars, against present disposal costs of also around 1 million dollars, 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.

Project Number: TR-460

Project Title: Living Snow Fences

Agency: The University of Iowa

Principal Investigator: Wilfrid A. Nixon

Research Period: September 1, 2001 to April 30, 2004

Research Board Funding: $87,924

Funding Source: 100 percent State - 50 percent Primary funds and 50 percent Secondary funds

Objective: (1) 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.
(2) 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.
(3) Develop suitable marketing stools 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: Two winters of testing have provided some interesting results. The living corn test, conducted just north of Tipton, has indicated that between 6 and 12 rows of corn, adjacent to the right of way (i.e. right at the edge of the farmer's field) have proven to be very effective snow fences over the last two winters. However, these have not been normal winters. The corn snow fences store a great deal of snow with the rows of corn, in contrast to a more traditional snow fence where almost all storage is downwind of the fence.

On the basis of these results, it seems that living snow fences can be placed much closer to the road (or the right of way) than traditional fences, but in the absence of a more normal winter, considerable care is needed in interpreting these results.

The project calls for a third winter of testing, which it is to be hoped will be "more normal" than the previous two winters. Ideally, a living corn fence will be placed in a similar area north of Tipton, with both six and twelve rows of corn. In addition, further observations of the switch grass living fence will be made in Pocahontas.

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 would also be made available via e-mail to all subscribers to the snow and ice mailing list, and would be placed on the SICOP web site.

Project Number: TR-461

Project Title: Soil Stabilization of Non-Uniform Subgrade Soils

Agency: Iowa State University - CTRE

Principal Investigator: David J. White

Research Period: July 1, 2001 to November 30, 2004

Research Board Funding: $70,000

Funding Source: 61 percent outside sources and 39 percent State - 60 percent Primary funds, 35 percent Secondary funds and 5 percent Street funds

Objective: To determine what types of ash are available, which type works best for site conditions and soil types, what is the proper mix design and construction process, and what are the benefits.

Progress: A 12-month extension was given by the IHRB. Laboratory testing has focused on determination of shear strength parameter values for soil/fly ash combinations tested in triaxial compression and determination of soil mineralogy from thermo gravimetric analysis (TGA).

Reports: Quarterly Report, April 2003

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

Project Number: TR-462

Project Title: Manual for Roadside Control of Trees and Brush

Agency: University of Northern Iowa

Principal Investigator: Kirk Henderson

Research Period: September 1, 2001 to October 31, 2002

Research Board Funding: $61,560

Funding Source: 100 percent State - 30 percent Primary funds, 50 percent Secondary funds and 20 percent Street funds

Objective: To develop a manual that describes best practices for the control and removal or roadside tree and brush debris.

Reports: Final Report, October 2002

Implementation: Administrators and maintenance crews alike need to be involved in the policy writing process. Several regional training sessions would be necessary to train county supervisors, county engineers, roadside managers, operations managers, weed commissioners and maintenance personnel from each county.

Project Number: TR-463

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

Agency: The University of Iowa

Principal Investigator: Hosin "David" Lee

Research Period: August 24, 2001 to September 30, 2003

Research Board Funding: $99,804

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

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.

Progress: All test sections from the selected pavement research projects funded through the Iowa Highway Research Board were evaluated. To validate the findings from the original studies, digital images were captured from all the remaining test sections. The deflections were measured and cores were taken from several test sections. Currently, images are being manually analyzed from the computer screen. The cores were tested for shear strength of the bonding area. The core test and image analysis results are being compared with the previous findings.

Reports: Preliminary, March 2002

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.

Project Number: TR-464

Project Title: Erosion Control for Highway Applications – A Critical Review of Published Literature

Agency: The University of Iowa

Principal Investigator: Marian Muste

Research Period: December 1, 2001 to July 31, 2002

Research Board Funding: $30,000

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

Objective: Phase I: Conduct a literature review and compile a synthesis of current practice short- and long-term erosion control methods utilized in highway applications.

Phase II: Expand on research objectives required to considerably improve mitigation methods with emphasis on transitioning from short- to long-term erosion control following construction.

Reports: Final Report, May 2002

Implementation: The use of the newly developed literature will help in selecting means to minimize the impact of construction and maintenance operations and mitigating sediments and erosion concerns resulting in not only better roads, but a better environment.

Project Number: TR-466

Project Title: Evaluation of Unbonded Ultrathin Whitetopping of BrickStreets

Agency: Iowa State University

Principal Investigator: James K. Cable

Research Period: July 1, 2001 to June 30, 2006

Research Board Funding: $47,049

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

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 given to the IHRB at the April 2003 meeting. Monitoring of the site continues.

Reports: Construction Report, August 2002

Implementation: Information gathered from the 3 reporting periods will be distributed to city administrators and the highway industry through the following:

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

Project Number: TR-467

Project Title: Investigation of the Modified Beam-in-Slab Bridge System

Agency: Iowa State University

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

Research Period: December 1, 2001 to November 30, 2003

Research Board Funding: $190,890

Funding Source: 100 percent State - 100 percent Secondary funds

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 modified beam-in-slab (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.

Progress: Five specimens were constructed and tested to investigate the behavior of the proposed Modified Beam in Slab Bridge (MBISB) system. Four single bay specimens were constructed and tested last year to evaluate the strength of the formwork and the MBISB system. A fifth specimen, a model bridge consisting of 3 bays was constructed in the ISU Structures Laboratory to investigate the load distribution characteristics and ultimate strength of the MBISB design. Service level load tests on this model were completed in September 2002. The specimen was then subjected to an ultimate flexural loading causing permanent deformations in the longitudinal members. Data gathered from testing the laboratory specimens aided in the design of the second demonstration bridge.

The first MBISB demonstration bridge was designed and constructed in Tama County during the fall of 2001 and then opened to traffic. The bridge was field tested in July 2003, to quantify the behavior of the structure.

The second demonstration bridge, also in Tama County, has been constructed and field tested. The structure utilizes 6 rolled W-sections in the MBISB system. The deck was placed on November 7, 2002 and opened to traffic.

Reports: None

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 materials are 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.

Project Number: TR-468

Project Title: Technology Transfer Program for the Iowa Highway Research Board

Agency: Iowa Department of Transportation

Principal Investigator: Mark Dunn

Research Period: December 1, 2002 to November 30, 2003

Research Board Funding: $10,000

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

Objective: The objective of this project is to provide improved research technology transfer and information distribution to the Iowa Highway Research Board and to transportation professionals in Iowa. Through electronic distribution of information, a wider audience can be obtained with reduced publication and distribution cost.

This project will also provide resources to cover facility costs for small workshops related to IHRB research when it would be beneficial to transfer technology.

Progress: Shortly after the start of this project, the Iowa DOT purchased equipment to mass produce CDs quickly. CD duplication and reproduction costs expected to be paid through this project were paid through the DOT Reproduction Office's budget. No outside services were required.

Two literature searches were performed by CTRE at Iowa State University in support of the IHRB's prioritization process. This project also covered meeting costs for the IHRB's meeting at field sites in Buchanan County.

Reports: None

Project Number: TR-469

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

Agency: Iowa State University

Principal Investigator: Paul G. Spry

Research Period: March 1, 2002 to February 29, 2004

Research Board Funding: $139,832

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

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

Progress: Three sets of cores from highways constructed in 1997 and in 1992 are being used. For each highway location, three sets of cores were obtained near the margins of the highway panel and three sets of cores were taken from the center of the panel. Samples of the cores used in the study were derived from two-inch thick slices from the top and the bottom of the core. These samples were subsequently divided into two sets so that chemical applications could be made on a weekly basis to one set and on a monthly basis to the other set. All of these samples were placed on the roof of the Science building. Further testing will be done this year.

Reports: Progress Report, May 2003

Implementation: The result from this research will probably prove to be a highly cost-effective method of reducing secondary mineral damage to 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.

Project Number: TR-470

Project Title: Development of a Method to Determine Pavement Damage Due to Detours and Haul Roads

Agency: Iowa State University

Principal Investigator: Omar Smadi

Research Period: April 1, 2002 to September 30, 2003

Research Board Funding: $59,272

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

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 and haul roads used temporarily by the Iowa DOT.

Progress: A six-month, no cost extension was granted.

Developed two approaches to determine damage: the condition based approach and the traffic based approach (MN DOT).

Reports: Quarterly Progress Report, April 2003

Implementation: At the end of the project, a set of guidelines and procedures for a new process of developing detour and haul roads compensation will be presented. If approved, the Iowa DOT, cities, and counties involved in such activities, will us the newly developed methodology to determine their compensation.

Project Number: TR-471

Project Title: Evaluation of Using Non-Corrosive Deicing Materials and Corrosion Reducing Treatments for Deicing Salts

Agency: The University of Iowa

Principal Investigator: Wilfrid A. Nixon

Research Period: May 1, 2002 to April 30, 2004

Research Board Funding: $100,000

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

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: Five different test types have been proposed to date. For each test, a written protocol is being developed. The liquid deicing chemicals tested to date in this project are sodium chloride, calcium chloride, calcium magnesium acetate (CMA), potassium acetate (KA), 20% ice ban - 80% salt brine mixture, caliber M-1000 and mineral brine. At present, it is not anticipated that any additional chemicals will be tested under this project.

Reports: Annual Report

Implementation: The results from 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 to the snow and ice mailing list.

Project Number: TR-472

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

Agency: The University of Iowa

Principal Investigator: Wilfrid A. Nixon

Research Period: May 1, 2002 to October 31, 2003

Research Board Funding: $80,000

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

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 literature review is now complete, and the lab and field test programs are being set up and will be completed by the end of the forth-coming winter season.

Reports: Progress Report

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 to the snow and ice mailing list.

Project Number: TR-473

Project Title: Rehabilitation of Concrete Pavements Utilizing Rubblization and Crack and Seat Methods

Agency: Iowa State University

Principal Investigator: Brian Coree

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

Research Board Funding: $178,197

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

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), and 3) to establish a structural and fatigue model and 4) to validate or calibrate the model using in-service pavement performance histories and the instrumented pavements on IA 141. Ultimately, provide a research report and implementable design guidelines to the Iowa DOT.

Progress: The "draft" design program is complete, awaiting calibration at the end of the project. A significant database of "theoretical" pavement is being compiled for both PCC and HMA overlaid PCC pavement structures. This is needed in later analysis. A method for rapid determination of subgrade properties under PCC pavement has been developed and checked. Details and histories of existing rubblized pavements have been obtained from the Office of Special Investigations.

Reports: Quarterly Progress Report, April 2003

Implementation: Responsibility for implementation rests primarily within the DOT. The PI will assist in any way necessary to this end and will provide implementable design guidelines to the Iowa DOT.

Project Number: TR-474

Project Title: Development of a Mix Design Process for Cold-In-Place Rehabilitation Using Foamed Asphalt

Agency: The University of Iowa

Principal Investigator: Hosin "David" Lee

Research Period: May 1, 2002 to December 31, 2003

Research Board Funding: $129,671

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

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

Progress: Phase I of this project is competed, and an interim report was presented to the IHRB at its June 2003 meeting. An extension of $29,988 was approved by the IHRB at its April 25, 2003 meeting to conduct Phase II of the project.

Reports: Interim Report, June 2003

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 shall 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 proposed study for implementation. Completion of the research by the winter of 2002/2003 will allow engineers to apply the mix design procedure on pilot projects during the 2003 construction season.

Project Number: TR-476

Project Title: A Computer Program for Valley Stage-Discharge Curves and Bridge Backwater Calculations

Agency: Digital Control, Inc.

Principal Investigator: LaDon Jones

Research Period: July 1, 2002 to September 30, 2003

Research Board Funding: $69,375

Funding Source: 100 percent State - 40 percent Primary funds, 40 percent Secondary funds and 20 percent Street funds

Objective: This project will produce integrated, user friendly, personal computer software that will estimate stage-discharge curves for valley cross-sections and perform bridge backwater calculations. The software will be written in Visual Basic 6.0 and will be a complete stand alone program that will run on computers using Microsoft Windows 95, 98, NT, 2000 or XP.

Progress: The software was completed by June 30, 2003. It is undergoing testing and the user manual is in preparation. A final report and the software and manual will be presented to the IHRB in the fall of 2003.

Reports: None

Implementation: The PC program will be utilized by city and county engineers, the Iowa DOT staff and consultants for the design of culverts and bridges along the State's primary and secondary road system.

Project Number: TR-477

Project Title: Total Cost of Transportation Analysis - Phase II

Agency: Iowa County Engineers Association Service Bureau

Principal Investigator: Steve DeVries

Research Period: July 1, 2002 to September 30, 2003

Research Board Funding: $29,635

Funding Source: 100 percent State - 100 percent Secondary funds

Objective: To use the transportation costs based analysis tools developed in HR-388 to prepare an accurate, current study of Iowa's county road system - using 2002 data. Once up-to-date physical and cost models have been set up. the data will be used to investigate system adequacy, operating cost needs, capital upgrade needs. and costs versus revenues.

TR-477 will also devote time to more thoroughly research and determine average annual speeds of travel on various types of roads, refine the estimates of capital upgrade costs, review whether or not recent year expenditures have been enough to maintain system quality at a steady state, recheck human resource / travel time costs. and re-estimate accident costs.

Progress: The Total-cost-of-transportation model has been rebuilt, using 2002 physical and financial data. Subsequently, the analyses of optimal service levels. county road service adequacy, and prediction of future needs were redone. The model's results have also been used to develop a provisional method for computing county Road Use Tax allocation factors, and this information was presented to the Secondary Road Fund Distribution Advisory Committee for evaluation. Individual county and road segment service ratings are now being developed to complete the project. The final report will be presented to the IHRB at its September 2003 meeting.

Reports: None

Implementation: The results of this research effort will be employed to support efforts, by ICEA and the Needs Study Replacement Committee, to devise a new way of allocating the FM and Local Secondary portions of the state Road Use Tax Fund among the counties. It may also be used to evaluate and then demonstrate the adequacy of the county road network and establish how much ought to be spent on it each year.

Project Number: TR-478

Project Title: Evaluation of Composite Pavement Unbonded Overlays (Installation and Maintenance of Weigh In Motion Detection System on Iowa Highway 13 in Delaware County)

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 percent Federal funds and 20 percent State - 100 percent Primary funds This funding is provided as the required state matching funds for the FHWA project.

Objective:

1. The first is the site section and installation of the WIM site on Iowa Highway 13 north of Manchester, Iowa, by Dr. Jim Cable and representatives of the Office of Transportation Data Systems under the supervision of Mr. Phil Meraz.

2. The second objective is the successful operation and maintenance of this system by Mr. Meraz' staff to provide truck data to Dr. Cable throughout the life of the research contract.

Progress: Phase III contract field data collection work began after May 1, 2003 and will continue through August 31, 2006. The following dates for completion of each of the data collection items in this phase are established at this time:

1. Deflection testing to be done biannually and completed by May 31, 2006.
2. Visual distress surveys to be done biannually and compiled by May 31, 2006.
3. Joint faulting and joint opening testing to be done biannually and completed by May 31, 2006.
4. Longitudinal profiling testing to be conducted biannually and completed by May 31, 2006.
5. Coring of selected pavement locations to determine bond between layers will be done in year 3 and 5 of the contract and be completed by May 31, 2006.

Reports: Quarterly 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 contract.

Project Number: TR-479

Project Title: Investigation into Improved Pavement Curing Materials and Techniques: Part II (Phase III)

Agency: Iowa State University

Principal Investigator: James K. Cable

Research Period: June 1, 2002 to April 30, 2003

Research Board Funding: $96,828

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

Objective: The objectives of Phase I and II of this research were the following:

1. Identification and evaluation of alternative curing materials and techniques that meet the goals of the Iowa DOT to improve the moisture retention in newly placed PCCP. The techniques should be compatible with current construction techniques.

2. Evaluation of application methods for each alternative-curing compound.

3. Develop a suitable evaluation method for measuring the effectiveness of the compound on the pavement at construction time.

The objective of Phase III is the field evaluation of the products and application rates identified in Phases I and II as having promise to meet the original objectives.

Reports: Final Report, March 2003

Implementation: The results of this research can be used to provide an alternative set of materials to be used in the curing of pavements at all government levels to enhance the performance of concrete pavements. It has a benefit to HYPERPAVE activities at a national level to validate models that in turn result in improved concrete pavements across the nation.

It is proposed that the results be implemented through presentations and abstract distributions.

Project Number: TR-480

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

Agency: Michigan Technological University

Principal Investigator: Lawrence L. Sutter (Dave Huft, Project Manager. South Dakota DOT)

Research Period: July 15, 2002 to July 14, 2004

Research Board Funding: $80,000

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

Objective: The objectives of this project are 1) to determine the long-term effects of concentrated solutions of magnesium, sodium and calcium chloride as well as CMA or other alternative liquid deicers on durable Portland cement concrete. 2) to estimate the potential for reduction in performance and service life for pavements (jointed plain, reinforced and continuously reinforced) and structures subjected to various concentrated deicing brines.

Progress:

- Progress on the literature review continues. Although the researchers are still reviewing papers, a partial draft has been started and is being refined.
- A summary of the maintenance practices survey is near completion and will be completed within the next reporting cycle. It should be noted that survey responses are still coming in.
- Pavement core samples from sites in Idaho were received and cataloged.
- Core samples from Iowa, Colorado, and south Dakota have been sectioned and hardened air contents have been determined in accordance with ASTM C457.
- Most of the 2760 required 2" x 4" cylinder mortar specimens have been prepared.
- The final cylinders are scheduled to be completed August 15, 2003.
- The research team has spent considerable effort working out the logistics of testing the large number of specimens required for Phase I and this study.
- The guidance of the technical panel in establishing the required solutions strengths for testing is requested.

Reports: Quarterly Report, September 2003

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.

Project Number: TR-481

Project Title: Identification of the Best Practices for the Design, Construction, and Repair of Bridge Approach Sections.

Agency: Iowa State University

Principal Investigator: David J. White and Sri Sritharan

Research Period: August 15, 2002 to August 14, 2004

Research Board Funding: $120,000

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

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. 5) Recommend design, construction and maintenance alternatives.

Progress: 1) Literature review and first draft summarizing the information from the literature have been completed. 2) Fourteen bridge sites in and around Des Moines and Ames have been inspected. 3) A bridge at Highway 65 over South Skunk River has been selected for a detailed site investigation.

Reports: None

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:

- It is expected that maintenance personnel will adopt the newly established threshold criteria indicating needed repair/maintenance of bridge approaches.
- Bridge and earthwork contractors will improve quality construction to reduce the occurrence of the bump based on final recommendations.
- Field personnel will implement QM-E end-result quality assurance testing to ensure proper compaction of bridge embankment fills.
- Office of Soil Design will consider various ground improvement methods in areas where soft foundation conditions exist.
- Office of Bridge Design and Office of Soil Design will consider alternative design approaches the design of new bridges.

Project Number: TR-482

Project Title: Determination of the Optimum Base Characteristics for Pavements

Agency: Iowa State University

Principal Investigator: David J. White and Charles Jahren

Research Period: August 15, 2002 to February 14, 2004

Research Board Funding: $100,000

Funding Source: 100 percent State - 65 percent Primary funds, 30 percent Secondary funds, and 5 percent Street funds

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

- Identify the optimal range for both in-place stability and in-place permeability of granular base course material in Iowa;
- Develop reliable field QC tests to determine the in-place stability and permeability of granular base course materials;
- Develop end-result specification for the acceptance of granular bases based on these findings; and
- Identify alternative construction practices for the placement of permeable granular base layers in areas which have narrow or no shoulders for use as a haul road.

Progress: Laboratory investigations are being conducted on six aggregate materials including crushed aggregate (limestone and gravel materials) and recycled concrete, collected from several sources in Iowa. Laboratory experiments including gradation analysis, air permeability test, constant head permeability test, DCP test, clegg hammer test, stiffness using Geo-gauge are being conducted. A database of aggregate specifications followed by different states DOTs has been established.

Reports: Quarterly Progress Report, April 2003

Implementation: The proposed research is specific to Iowa, highway agencies and contractors statewide will implement results. However, final recommendations could be implemented at the regional/national level. Results will be communicated to practicing engineers and contractors through local/regional/national presentations and dissemination.

Project Number: TR-483

Project Title: Evaluation of Hot Mix Asphalt Moisture Sensitivity Using the Nottingham Asphalt Test Equipment

Agency: Iowa State University

Principal Investigator: Brian Coree

Research Period: August 1, 2002 to January 31, 2005

Research Board Funding: $145,775

Funding Source: 100 percent State - 65 percent Primary funds, 30 percent Secondary funds, and 5 percent Street funds

Objective: This research will develop one or more test protocols using the superpave gyratory compactor and the Nottingham Asphalt Tester 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.

Progress: A significant literature review is complete. Components of the proposed research have been checked and calibrated, e.g. the definition and measurement of saturation in sample preparation. A pilot study with trial mixtures has been undertaken. Actual sample testing will proceed in summer.

Reports: Quarter Progress Report, April 2003

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.

Project Number: TR-484

Project Title: Materials and Mix Optimization Procedures for PCC Pavements

Agency: Iowa State University

Principal Investigator: Scott Schlorholtz, Kejin Wang and Dale Harrington

Research Period: July 1, 2002 to January 31, 2004

Research Board Funding: $159,666

Funding Source: 49 percent Federal funds and 51 percent State - 50 percent Primary funds, 35 percent Secondary funds, and 15 percent Street funds

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.
- To 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: Tasks 1 through 4 of the work plan have been completed. They include a literature survey on mixing procedures and their influence on concrete performance. The selection of materials, laboratory studies and contractors was discussed with the Iowa DOT. A vibrating slope apparatus (VSA) was loaned from the FHWA and testing has begun. A moisture sensor availability study was done. A review panel for the project is nearly finalized.

Reports: Quarterly, April 2003

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.

Project Number: TR-485

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

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 percent State - 50 percent Primary funds, 40 percent Secondary funds, and 10 percent Street funds

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 Department of Transportation (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 (SWPPP) and other pertinent permitting requirements (e.g., state, local)

Progress: The objectives have been completed and the final report and program will be presented to the IHRB in the fall of 2003.

Reports: None

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.

Project Number: TR-486

Project Title: Development of Abutment Design Standards for Local Bridge Designs

Agency: Iowa State University

Principal Investigator: F. Wayne Klaiber, David J. White, and Terry J. Wipf

Research Period: December 1, 2002 to August 31, 2003

Research Board Funding: $99,265

Funding Source: 100 percent State - 100 percent Secondary funds

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.

Progress: A literature review and information search has been completed.

A valuable source of information has been the Iowa County Engineers. On June 10, 2003, a survey was sent to the county engineers to gather information on substructures used by various Iowa counties. Of the 99 counties, 42 have returned the completed survey.

At this time load calculations have also been completed. This includes dead loads for the different substructure systems. Also, the longitudinal loads such as wind loads on the structure and live load, longitudinal force (braking force), and lateral dead and live load earth pressures have been determined.

The Iowa DOT Bridge Design Manual (BDM) is being used as a guideline to determine the lateral and axial capacity of the abutment piles. However, the simple span bridge abutments being considered for this project do not qualify as standard stub abutments according to the BDM since they have much higher backwalls and do not utilize battered piles. For this reason, the assumptions made by the BDM are currently being investigated to determine if they are applicable for these abutment systems.

Reports: None

Implementation: The bridge abutments used by many counties do not qualify as standard stub abutments according to the BDM. 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.

Project Number: TR-487

Project Title: Development of Object Oriented Specifications for IADOT and Urban Standards

Agency: Iowa State University

Principal Investigator: Edward Jaselskis and Russell Walters

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

Research Board Funding: $124,999

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

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 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.

Progress: Thus far, OO-CAD (Object Oriented Computer Aided Design) specification demonstration has been developed. A focus group approach will be used to obtain feedback on this idea. Also there is current review of the urban and Iowa DOT specifications and exploration of database options to work in concert with the graphical software.

Reports: Quarterly Progress Report, April 2003

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.

Project Number: TR-488

Project Title: Economics of Using Calcium Chloride vs. Sodium Chloride for Deicing/Anti-icing

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 percent State - 70 percent Primary funds, 25 percent Secondary funds, and 5 percent Street funds

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: Studies are focusing on the relative performance of the two chemicals and mixtures of the two brines. The aim is to suggest the most cost effective mixture as a function of temperature. Experiments to find this are underway, and a suitable algorithm is being developed.

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 SICOP web site (www.sicop.net).

Project Number: TR-489

Project Title: Innovative Solutions for Slope Stability Reinforcement and Characterization in Iowa Soils

Agency: Iowa State University

Principal Investigator: David J. White

Research Period: March 1, 2003 to September 1, 2005

Research Board Funding: $198,462

Funding Source: 100 percent State - 25 percent Primary funds and 75 percent Secondary funds

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 sties (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. I.M.s) for determining shear strength parameters using the Borehole Shear Test (BST).
- Investigate and conduct simple pilot tests to evaluate various remediation techniques.
- Recommend design, construction and remediation alternatives for Iowa soil conditions to ensure slop stability of new embankment till and shallow backslopes.

Progress: In April and May, the research team visited a large landslide on B57 along the Des Moines River near Madrid. Following the initial field reconnaissance, air photos have been collected and examined to better understand the failure geometry. A topography laser scanning company from Florida has been contacted to discuss a field trail at this site. In June, the research team collected soil profile information near Sioux City, Iowa in loess for lab characterization, including shear strength parameters.

Reports: Quarterly Progress Report, July 2003

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.

Project Number: TR-490

Project Title: Stringless Portland Cement Concrete Paving

Agency: Iowa State University

Principal Investigator: James K. Cable and Edward Jaselskis

Research Period: December 1, 2002 to December 31, 2003

Research Board Funding: $129,519

Funding Source: 7 percent outside sources and 93 percent State - 45 percent Primary funds, 50 percent Secondary funds, and 5 percent Street funds

Objective: Evaluation of the use of robotic total station control to guide the Trimmer, Slipform Paver and Cure Cart in the alignment and depth control of the final Portland cement concrete pavement. The research will compare the results to the design depths, quantities, alignment, profile and smoothness obtained by other means in similar projects in Washington County.

Progress: An agreement to do the research was signed on July 1, 2003.

Reports: None

Implementation: This method can revolutionize the paving in state, county and city paving in areas of limited right of way. It has the potential to eliminate human error in conventional ground surveys and slipform paver control staking. This relates to application in up to 10,000 miles of county road pavements in Iowa alone. It also relates to providing faster construction of concrete pavements with less effort and funds being expended in alignment control and more in the product being placed. It could also have a positive impact on pavement smoothness, and relieving urban construction area congestion.

Implementation steps would include:
1. Presentations at ICPA and ACPA state conferences and workshops
2. Presentations at APWA and ICEA conferences
3. Publication in PCC and CTRE publications

Project Number: TR-491

Project Title: Development of Winter Performance Measures for Maintenance Operations

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 percent State - 80 percent Primary funds, 10 percent Secondary funds, and 10 percent Street funds

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 contract was executed between the Iowa DOT and The University of Iowa on June 11, 2003 to perform this research.

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 on a web site.

Project Number: TR-492

Project Title: Embankment Quality Phase IV - Application to Unsuitable Soils

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 percent State - 70 percent Primary funds, 15 percent Secondary funds, and 15 percent Street funds

Objective: Embankment Quality Phase IV research is to continue development and refinement of the Quality Management - Earthwork program (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: Project was initiated in May 2003.

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.

Project Number: TR-493

Project Title: Performance Evaluation of Steel Bridges: Phase II

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 percent State - 75 percent Primary funds, 20 percent Secondary funds, and 5 percent Street funds

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 contract was executed with Iowa State University to perform this research in March 2003.

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.

Project Number: TR-494

Project Title: Statistical Analysis of Highway Needs Condition Data: Manual vs. Automated

Agency: Iowa State University

Principal Investigator: Omar Smadi

Research Period: March 1, 2003 to September 30, 2003

Research Board Funding: $17,405

Funding Source: 100 percent State - 100 percent Secondary funds

Objective: The object of this project is to conduct a statistical analysis to examine the differences and/or similarities of the condition data collected manually and in an automated fashion. This information will help the advisory committee responsible for finding alternatives to the current highway needs process to make an informed decision whether HWYNEEDS should be converted to a PC platform and modified to be used by the counties to distribute the counties' share of the RUTF.

Progress: As of June 30th, all of the tasks related to the statistical analysis had been completed. Staff support to the advisory committee has been provided to investigate the possibility of distributing RUTF among the counties based on a regression equation that considers condition.

Reports: None

Implementation: The results will be reported to the project advisory committee. The committee will use the information in developing a recommendation for future Road Use Tax Fund distribution methods for Iowa counties.

Project Number: TR-495

Project Title: Field Evaluation of Compaction Monitoring Technology

Agency: Iowa State University

Principal Investigator: E. Thomas Cackler

Research Period: May 15, 2003 to February 28, 2004

Research Board Funding: $75,000

Funding Source: 40 percent other sources and 60 percent State - 80 percent Primary funds, 10 percent Secondary funds, and 10 percent Street funds

Objective: The projects objectives are as follows:

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

Progress: Project initiated in May 2003.

Reports: None

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 American Association of State Highway and Transportation Officials (AASHTO) Subcommittee on Construction's priorities of research into rapid, real-time testing.

Project deliverables include:

- Field validation of compaction monitoring technology on earthwork and asphalt paving applications.
- Identification of the technology's potential benefits to contractors and project owners.
- Model QC/QA guidelines to be used with the technology.

Project Number: TR-497

Project Title: Manual of Iowa Drainage Law

Agency: Iowa State University

Principal Investigator: Stephen J. Andrle

Research Period: July 1, 2003 to March 31, 2004

Research Board Funding: $59,965

Funding Source: 100 percent State - 20 percent Primary funds, 75 percent Secondary funds, and 5 percent Street funds

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.

Progress: The project was initiated July 1, 2003.

Reports: None

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 interested others 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.

Project Number: TR-498

Project Title: Field Testing of Railroad Flat Car (RRFC) Bridges

Agency: Iowa State University

Principal Investigator: F. Wayne Klaiber

Writing

Research Period: June 1, 2003 to September 30, 2004

Research Board Funding: $121,096

Funding Source: 100 percent State - 100 percent Secondary funds

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

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

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 expand the current level of knowledge in the area of using RRFC for LVR bridges and 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.

Project Number: TR-499

Project Title: Effectiveness of Electrochemical Chloride Extraction (ECE) for the Iowa Avenue Pedestrian Bridge

Agency: NNW, Inc.

Principal Investigator: Steven Jacobsen and Hosin "David" Lee (The University of Iowa)

Research Period: July 15, 2003 to January 31, 2004

Research Board Funding: $30,000

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

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 Iowa people.

Progress: An agreement was signed July 25, 2003 to conduct the research.

Reports: None

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.

The results of this investigation will be available on-line. Area engineers and contractors would also be invited to view the ECE process during the extraction.

Project Number: TR-500

Project Title: Evaluation of the Compensatory Wetland Mitigation Program in Iowa

Agency: Iowa Department of Transportation

Principal Investigator: Kelly Poole

Research Period: July 24, 2003 to July 31, 2004

Research Board Funding: $6,802

Funding Source: 100 percent State - 100 percent Primary funds

Objective: This research will focus on characterizing wetland mitigation projects at a minimum of 24 randomly selected sites. The research objectives are to
1) determine if project areas meet the definition of a jurisdictional wetland, and
2) determine degree of compliance with requirements specified in Clean Water Act Section 404 permits.

Progress: The project was initiated July 24, 2003.

Reports: None

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.

Project Number: HR-1027

Project Title: Secondary Road Research Coordinator

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: Ed Engle

Research Period: March 1980 to present

Research Board Funding: $70,000.00/yr. (covers salary and state share of costs for FICA, IPERS, health insurance, vehicle costs and expenses)

Funding Source: 100 percent State - 100 percent Secondary funds

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 18 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 Iowa Highway Research Board (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.

Project Number: HR-1080

Project Title: Synthesis of Dowel Bar Research

Agency: Iowa State University

Principal Investigator: Max Porter

Research Period: July 1, 2001 to August 15, 2002

Research Board Funding: $29,997

Funding Source: 100 percent State - 100 percent Primary funds

Objective: The objective of the study was to investigate the latest completed and on-going research from across the nation to locate the gaps and duplications in recent dowel bar research.

Reports: Final Report, August 2002

Implementation: The results of this synthesis will guide the nation's research program concerning the use of alternative materials and shapes for pavement dowel bars.

Project Number: HR-1081

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

Agency: Iowa State University

Principal Investigator: Scott Schlorholtz and Kejin Wang

Research Period: January 1, 2003 to December 31, 2003

Research Board Funding: $25,000

Funding Source: 100 percent State - 100 percent Primary funds

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.

Progress: Ground penetrating radar (GPR) technique was selected for a preliminary round of "proof-of-concept" trails. The Mandli pavement profile scanner (PPS) system was also selevted for use in the preliminary round of "proof-of-concept" trails; however, technical problems delayed the use of that system until Phase 2 of the project.

GPR surveys were carried out over a variety of Portland cement concrete pavements using two different systems. Surveys conducted with both sets of equipment have produced test results capable of identifying subsurface distress in two of the three sites that were investigated. Both systems failed to detect distress in a single pavement that exhibited extensive cracking. The initial positive results presented here indicate that a more thorough study (incorporating refinements to the system, data collection and analysis) is needed.

Reports: None

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.

ANNUAL REPORT
OF
HIGHWAY DIVISION
HIGHWAY RESEARCH AND DEVELOPMENT
IN IOWA

DECEMBER 2004

Attachment 6 to
FY 2004 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, 2004

RESEARCH AND TECHNOLOGY BUREAU
(515) 239-1447
www.dot.state.ia.us/materials/research/research_home

HIGHWAY DIVISION
IOWA DEPARTMENT OF TRANSPORTATION
AMES, IOWA 50010

DECEMBER 2004

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LIST OF ACRONYMS

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

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, 2004; it is also a report on projects completed during the fiscal year beginning July 1, 2003, and ending June 30, 2004. 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.

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, 2004, is listed in Table I.

The Research Board held seven regular meetings during the period of July 1, 2003, to June 30, 2004. Suggestions for research and development were reviewed at these meetings and recommendations were made by the Board.

TABLE I
2003-2004 IOWA HIGHWAY RESEARCH BOARD MEMBERS

Member	Term Expires	Alternate
John Adam Deputy Director Iowa DOT - Statewide Operations Bureau 800 Lincoln Way Ames, IA 50010 (515) 239-1333	12-31-05	Robert Younie Construction Engineer Iowa DOT - District 1 1020 S. 4th Street Ames, IA 50010 (515) 239-1542
Lyle Brehm Tama County Engineer 1002 E. 5th 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
Robert Ettema Chair, 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	12-31-04 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	James Berger Director of Materials Iowa DOT 800 Lincoln Way Ames, IA 50010 (515) 239-1843
Lowell Greimann Dept of Civil, Const. & Env. Engr. Iowa State University 390 Town Engineering Bld. Ames, IA 50011 (515) 294-5586		-
Jon Ites Buena Vista County Engineer 215 E. 5th 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	Ahmad Abu-Hawash Chief Structural Engineer Iowa DOT - Bridges and Structures 800 Lincoln Way Ames, IA 50010 (515) 239-1393
Jeff Krist Project Manager Public Works Department 209 Pearl Street Council Bluffs, IA 51503 (712) 328-4635	12-31-06	Richard Fosse City Engineer 410 E. Washington Iowa City, IA 52246-5717 (319) 356-5143
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 6th 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		-
Greg Parker City Streets Director 2101 6th Street S.W. Cedar Rapids, IA 52404 (319) 286-5826	12-31-05	John Joiner Civil Engineer 515 Clark Avenue P.O. Box 811 Ames, IA 50010 (515) 239-5165
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
John Selmer District Engineer Iowa DOT - District 4 63200 White Pole Rd. P.O. Box 406 Atlantic, IA 50022 (712) 243-3355	12-31-04	Glen Miller Construction Engineer Iowa DOT - District 4 63200 White Pole Rd. P.O. Box 406 Atlantic, IA 50022 (712) 243-3355
Christy Van Buskirk Keokuk County Engineer 101 S. Main Sigourney, IA 52591 (641) 622-2610 SS#-054	12-31-04 District 5	Roger Schletzbaum Marion County Engineer 402 Willetts Drive Knoxville, IA 50138 (641) 828-2225 SS# 063

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, 2004. Total expenditure was $1,930,473.09.

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 investigators, which means that they have a major role in the planning, performance and analysis of the research.

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

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

The National Cooperative Highway Research Program (NCHRP) was organized by the American Association of State Highway Officials (now the American Association of State Highway and Transportation Officials--AASHTO). The program is administered by the Transportation Research Board, 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 2004 as part of the Annual Traffic Count Program. This activity consisted of 290 portable recorder classification counts, 5,200 portable recorder volume counts and 53 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 were physically inventoried for geometrics and current condition in 90 counties. This data provides county engineers, highway engineers, planners and administrators with essential information needed to determine design standards, to systematically classify highways, and to develop programs for improvement in maintenance of secondary roads.

SECONDARY ROAD RESEARCH FUND

Section 310.34 of the Iowa Code authorizes the Iowa Department of Transportation to set aside each year an amount not to exceed 1½ percent of the receipts to the Farm-to-Market Fund in a fund to be known as the Secondary Road Research Fund. This authorization was first made in 1949; it was repealed in 1963 and reinstated in 1965. When the fund was reinstated, the 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 2004 financial summary is:

Beginning Balance 7-1-03		$2,736,867.19
Receipts		
State Road Use Tax Fund (1½% of receipts)	$1,159,198.96	
Federal Aid Secondary (1½% of receipts)	0.00	
Research Income	0.00	
Sub-Total		$1,159,198.96
Total Funds Available		$3,896,066.15
Obligation for Expenditures		
Obligated for Contract Research	1,291,773.25	
Non-Contract Engineering Studies	0.00	
Total Expenditures		1,291,773.25
BALANCE 6-30-04		$2,604,293.15

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 2004 financial summary is:

Beginning Balance (7-1-03)	$ 140,577
FY04 Street Research Funding	200,000
Total Funds Available for Street Research	$340,577
Total obligated for Expenditure	$318,765
Ending Unobligated Balance 6-30-04	$21,812

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 FY04 was $871,347.15 and the estimate for FY05 is $750,000.

PROJECTS INITIATED DURING FY 2004

The new projects initiated during FY 2004 were:

TR-496, "Development of Standard Plans for the Design of Single Span Pretensioned, Prestressed Concrete Beam Bridges with Concrete Abutments"
TR-501, "Optimization and Management of Materials in Earthwork Construction"
TR-502, "Evaluation of Long Term Field Performance of Cold In-Place Recycled Roads"
TR-503, "Utility Cut Repair Techniques - Investigation of Improved Utility Cut Repair Techniques to Reduce Settlement in Repaired Areas"
TR-504, "Extensions to the Iowa Culvert Hydraulics Software - The Design of Energy Dissipators"
TR-505, "Improving PCC Mix Consistency & Production by Mixing Improvements"
TR-506, "Determination and Evaluation of Alternate Methods for Managing and Controlling Highway-Related Dust, Phase II - Demonstration Project"
TR-507, "Thin Maintenance Surfaces Phase III - Municipal Streets and Low-Volume Rural Roads"
TR-508, "Design Guide and Construction Specifications for NPDES Site Runoff Control"
TR-509, "AASHTO 2002 Pavement Design Guide Implementation Plan - Phases I and II"
TR-510, "Laboratory Study of Structural Behavior of Alternative Dowel Bars"
TR-511, "Design and Construction Procedures for Concrete Overlay and Widening of Existing Pavements"
TR-512, "Measuring Pavement Profile at the Slipform Paver"
TR-513, "Decision Support Model for Assessing Archaeological Survey Needs for Bridge Replacement Projects in Iowa"
TR-514, "Development of a Manual of Practice for Roadway Maintenance Workers"
TR-515, "A Guide for Monitoring and Protecting Bridge Waterways Against Scour"
TR-516, "Measurement of Seasonal Changes and Spatial Variation in Pavement Subgrade Support Properties - A Link to Pavement Performance"
TR-517, "Guidelines for Safety Treatment of Roadside Culverts"
TR-518, "Monitoring Wind-Induced Vibrations/Stresses in a High Mast Lighting Tower"
TR-519, "Developing Flood-Frequency Discharge Estimation Methods for Small Drainage Basins in Iowa"
TR-520, "Evaluation of Dowel Bar Retrofits for Local Road Pavements"

21 projects

Table II
FINANCIAL SUMMARY OF RESEARCH AND DEVELOPMENT PROJECT EXPENDITURES
July 1, 2003 to June 30, 2004

(Active projects with no current fiscal year expenditures are included)

Project	Total Funds Committed	Project Title	Primary Road Research Fund Expenditures	Secondary Road Research Fund Expenditures	Street Research Fund Expenditures	Total Expenditures
296	100,000/year	ISU Local Technical Assistance Program (LTAP)	10,000.00	11,603.67	45,000.00	66,603.67
375	22,400	Transportation Research Board Education for Co. Engineers				
394	672,152	Transportation Program Management System	16,652.00	47,222.38	2,839.91	66,714.29
399	299,932	Field Testing of Integral Abutments				
412	65,000	Development of a Computer Controlled Underbody Plow				
414	50,000	Superpave Mix Designs for Low Volume Roads				
419	30,000	Education on Urban Corridor Issues	1,179.64	150.00	1,500.00	2,829.64
420	98,478	Field Evaluation of Alternative Load Transfer Device Locations in Low Traffic Volume		26,552.79	15,459.52	42,012.31
422	14,000	Pretreatment for Reduction of Asphalt Absorption in Aggregate				
424	178,358	Steel Diaphragms in Prestressed Concrete Girder Bridges	4,168.32	6,266.43	1,007.87	11,442.62
427	26,200	Evaluation of High-Slump Concrete for Bridge Deck Overlays	1,027.06	770.30	770.30	2,567.66
428	294,760	Effective Structural Concrete Repair	4,695.91	1,519.75		6,215.66
429	195,060	Evaluation of Appropriate Maintenance Repair and Rehabilitation Methods for Iowa	8,777.65	8,765.02	1,928.12	19,470.79
432	183,903	Ultrathin PCC Overlay Extended Evaluation	22,874.78	9,036.44	990.16	32,901.38
438	142,903	Integral Abutment Bridge With Precast Concrete Piles	560.32	5,486.83	5,078.25	11,125.40
450	80,000	Identification of Laboratory Techniques to Optimize Superpave HMA Surface Friction Characteristics				
452	48,865	Solutions to Meet the Service Needs of Low Volume Bridges		4,886.45		4,886.45
456	107,800	Measuring Main-Channel Slopes for Major Rivers in Iowa	10,900.00	3,100.00		14,000.00
457	73,997	Development of a Manual Crack Quantification and an Automatic Crack Measurement System				
458	151,920	Field Testing of Abrasive Delivery Systems in Winter Maint.		13,503.43		13,503.43
459	67,133	Reuse of Lime Sludge From Water Softening	8,677.56		20,898.83	29,576.39
460	87,924	Living Snow Fences				
461	70,000	Soil Stabilization of Non-Uniform Subgrade Soils	2,278.17	1,797.16	1,316.91	5,392.24
463	99,804	Field Performance Study of Past Iowa Pavement Research				
466	47,049	Evaluation of Unbonded Ultrathin Whitetopping of Brick Streets	668.60	267.40	1,738.20	2,674.20
467	190,890	Investigation of the Modified Beam-in-Slab Bridge System		42,737.33		42,737.33
468	10,000	Technology Transfer Program for the IHRB		224.00		224.00
469	139,832	Reduction of Concrete Deterioration by Ettringite Using Crystal Growth Inhibition Techniques-Part II-Field Evaluation	38,408.05	10,968.56	12,424.23	61,800.84
470	59,272	Development of a Method to Determine Pavement Damage Due to Detours and Haul Roads	1,752.82	5,771.05	2,555.12	10,078.99
471	100,000	Evaluation of Using Non-Corrosive Deicing Materials and Corrosion Reducing Treatments for Deicing Salts		6,623.72	3,720.25	10,343.97
472	80,000	Investigation of Materials for the Reduction and Prevention of Corrosion on Highway Maintenance Equipment	9,921.31	14,571.73		24,493.04
473	178,197	Rehabilitation of Concrete Pavements Utilizing Rubblization and Crack and Seat Methods	8,360.30	63,496.71		71,857.01
474	228,469	Development of a Mix Design Process for Cold-In-Place Rehabilitation Using Foamed Asphalt	40,154.43	16,114.23	3,421.53	59,690.19
476	69,375	PCVAL: A Computer Program for Valley Stage-Discharge Curves and Bridge Backwater Calculations	22,592.25	24,840.00	8,673.75	56,106.00
477	29,635	Total Cost of Transportation Analysis - Phase II		2,500.22		2,500.22
478	49,520	Evaluation of Composite Pavement Unbonded Overlays				
480	80,000	Long Term Effects of Concentrated Salt Solutions on PCC				
481	120,000	Identification of the Best Practices for the Design, Construction, and Repair of Bridge Approach Sections	20,526.80	36,661.08		57,187.88
482	100,000	Determination of the Optimum Base Characteristics for Pvmts.	29,813.64	30,000.00	5,000.00	64,813.64
483	145,775	Evaluation of Hot Mix Asphalt Moisture Sensitivity Using the Nottingham Asphalt Test Equipment	37,651.63	5,996.54		43,648.17
484	159,666	Materials and Mix Optimization Procedures for PCC Pavements	66,252.08	27,603.38	2,138.59	95,994.05
485	38,757	Development and Implementation of a Web-Based Expert System for Erosion and Sediment Control Measures		374.11		374.11

Project	Total Funds Committed	Project Title	Primary Road Research Fund Expenditures	Secondary Road Research Fund Expenditures	Street Research Fund Expenditures	Total Expenditures
486	99,265	Development of Abutment Design Standards for Local Bridge Designs		72,090.34		72,090.34
487	124,999	Development of Object Oriented Specifications for IADOT and Urban Standards	24,917.84	57,125.53	6,016.85	88,060.22
488	90,000	Economics of Using Calcium Chloride vs. Sodium Chloride for Deicing/Anti-icing	49,129.85			49,129.85
489	198,462	Innovative Solutions for Slope Stability Reinforcement and Characterization in Iowa Soils	39,378.55	62,354.12		101,732.67
490	129,519	Stringless Portland Cement Concrete Paving	38,980.57	38,278.85		77,259.42
491	100,000	Development of Winter Performance Measures for Highway Winter Maintenance Operations	30,056.74			30,056.74
492	169,067	Embankment Quality Phase IV - Application to Unsuitable Soils	64,782.71			64,782.71
493	196,421	Performance Evaluation of Steel Bridges: Phase II	7,661.17			7,661.17
494	17,405	Statistical Analysis of Highway Needs Condition Data: Manual vs. Automated		3,996.15		3,996.15
495	75,000	Field Evaluation of Compaction Monitoring Technology	55,913.93			55,913.93
496	179,250	Development of Standard Plans for the Design of Single Span Pretensioned, Prestressed Concrete Beam Bridges with Concrete Abutments		27,397.79		27,397.79
497	59,965	Manual of Iowa Drainage Law	11,430.83	27,891.57		39,322.40
498	121,096	Field Testing of Railroad Flat Car Bridges		51,102.13		51,102.13
499	30,000	Effectiveness of Electrochemical Chloride Extraction for the Iowa Avenue Pedestrian Bridge	17,491.78			17,491.78
500	6,802	Evaluation of the Compensatory Wetland Mitigation Program	2,000.00			2,000.00
501	175,000	Optimization & Management of Materials in Earthwork Construction	17,263.08	6,191.60		23,454.68
502	145,216	Evaluation of Long Term Field Performance of Cold In-Place Recycled Roads	27,161.45	2,298.36		29,459.81
503	119,412	Utility Cut Repair Techniques	24,943.66		6,075.03	31,018.69
504	40,000	Extensions to the Iowa Culvert Hydraulics Software - The Design of Energy Dissipators	6,818.40			6,818.40
505	164,764	Improving PCC Mix Consistency & Production by Mixing Improvements	17,559.62		4,245.02	21,804.64
506	107,070	Determination and Evaluation of Alternate Methods for Managing and Controlling Highway-Related Dust, Phase II		21,526.09		21,526.09
507	86,373	Thin Maintenance Surfaces Phase III - Municipal Streets and Low-Volume Rural Roads	13,176.85	10,597.61	1,495.31	25,269.77
508	207,800	Design Guide and Construction Specifications for NPDES Site Runoff Control	15,800.58	2,637.81	8,485.92	26,924.31
509	75,003	AASHTO 2002 Pavement Design Guide Implementation Plan	15,866.56			15,866.56
510	57,992	Lab Study of Structural Behavior of Alternative Dowel Bars	13,137.28			13,137.28
511	101,578	Design and Construction Procedures for Concrete Overlay and Widening of Existing Pavements	2,504.72			2,504.72
512	75,000	Measuring Pavement Profile at the Slipform Paver	1,081.36	812.79		1,894.15
513	50,000	Decision Support Model for Assessing Archaeological Survey Needs for Bridge Replacement Projects in Iowa		1,775.48		1,775.48
514	64,991	Development of a Manual of Practice for Roadway Main. Wrkrs.		482.05		482.05
515	80,816	A Guide for Monitoring and Protecting Bridge Waterways Against Scour		5,922.85		5,922.85
516	40,000	Measurement of Seasonal Changes and Spatial Variation in Pavement Subgrade Support Properties				
517	24,995	Guidelines for Safety Treatment of Roadside Culverts				
518	80,819	Monitoring Wind-Induced Vibrations/Stresses in a High Mast Lighting Tower				
519	78,000	Developing Flood-Frequency Discharge Estimation Methods for Small Drainage Basins in Iowa				
520	146,708	Evaluation of Dowel Bar Retrofits for Local Road Pavements				
1027		Secondary Road Research Coordinator		74,454.44		74,454.44
1081	25,000	Development of In-Situ Detection Methods for Material Related Distress (MRD) in Concrete	6,396.30			6,396.30
			=========	=========	=========	==========
		Contract Research Total	871,347.15	896,346.27	162,779.67	1,930,473.09

HR-296

Iowa State University Local Technical Assistance Program (LTAP)

Agency:
Iowa State University

Principal Investigator:
Duane Smith

Research Period:
October 1, 1986 to December 31, 2004

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

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

Transportation Research Board Education for County Engineers

Agency:
Iowa Department of Transportation, Highway Division

Principal Investigator:
Edward J. Engle

Research Period:
November 1, 1994, on-going

Research Board Funding:
$22,400

Funding Source:
100% State - 100% Secondary funds

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 2004, a total of 18 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-394

Transportation Program Management System, Phase I-IV

Agency:
Iowa County Engineers Association Service Bureau

Principal Investigator:
Steve DeVries

Research Period:
August 1, 1996 to September 30, 2003

Research Board Funding:
$672,152

Funding Source:
100% State - 25% Primary funds, 70.7% Secondary funds and 4.3% Street funds

Objective: The objective of this project is to create a centralized, automated system to support project programming and development tracking to do the following:

- reduce the potential for errors and conflicts,
- speed up the process and deliver road improvements to the public more expeditiously,
- decrease the total labor cost required to get programming and development work accomplished,
- make the status of any project or action available to all parties who need to know on a real-time basis, and
- improve communications and provide an on-line transcript of each project's history.

Reports: Final Report, September 2003

Implementation: The results of this project will be a system that will both improve and expedite the current Transportation Program Management process. It will enable local agencies to reduce project errors, conflicts, and delays. All interested parties will be able to get real-time project status at any time.

HR-399

Field Testing of Integral Abutments

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

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.

Progress: Long-term monitoring of strains, displacements, and temperatures has been completed at both integral abutment bridges selected. Lab tests were conducted to determine the coefficient of thermal expansion and contraction of core samples taken from the decks. Analysis of these tests has been completed. The finite-element model for both bridges is complete. A calibration procedure that involves the comparison of analytically predicted and experimentally measured bridge displacement has been completed.

A final report is being completed and is expected to be presented to the IHRB in the fall of 2004.

Reports: Interim Report, August 1998

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

Development of a Computer Controlled Underbody Plow

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

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.

Progress: The methodology required that first the force signature of an underbody plow scraping ice be studied. The forces indicate when the underbody plow is successfully scraping ice and also when it is not. In the latter case, the blade will likely ride along the top of the ice surface and not remove any significant amount of ice.

Optimal performance results when the ratio of vertical scraping force to horizontal scraping force lies within a certain range. Under normal operating conditions, the underbody plow blade angle must be set and continuously adjusted to achieve this operating range.

The approach chosen was to use a combination of fuzzy logic and neural network algorithms such that an appropriate measure of control was developed for the system. An algorithm has been developed that meets the system requirements and tested electronically. The project scope specifically excluded field testing this system; thus, any field implementation would require further study.

The final report of this project is being written and should be completed by December 31, 2004.

Reports: None

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

Superpave Mix Designs for Low Volume Roads

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

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.

Progress: All of the eight final projects are completed. Regular distress and performance surveys have been performed. The draft final report is nearing completion and will be presented to the Board in fall of 2004.

Reports: Construction Report, September 2001

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.

Gyratory mix design process

TR-419

Education on Urban Corridor Issues Through Computer Animation

Agency:
Snyder and Associates, Inc.

Principal Investigator:
Todd J. Happel

Research Period:
May 21, 1998 to September 30, 2002

Research Board Funding:
$30,000

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

Objective: The objective of this research is to develop a method of using a combination of photo-imaging and computer animation at much less expense to provide a visual aid to gain public acceptance of an urban safety upgrade project.

Reports: Final Report, March 2003

Implementation: Implementation of this research will be through an evaluation of how photo-imaging and computer animation can be used in combination to cost-effectively give the average citizen an understanding of how a constructed design will compare to the current conditions. A before and after comparison of a corridor will also show how well the post-construction appearance can be represented by integration of imaging and animation into a video prior to actual construction.

TR-420

Field Evaluation of Alternative Load Transfer Device Locations in Low Traffic Volume Pavements

Agency:
Iowa State University

Principal Investigator:
James K. Cable

Research Period:
July 30, 1998 to December 31, 2003

Research Board Funding:
$98,478

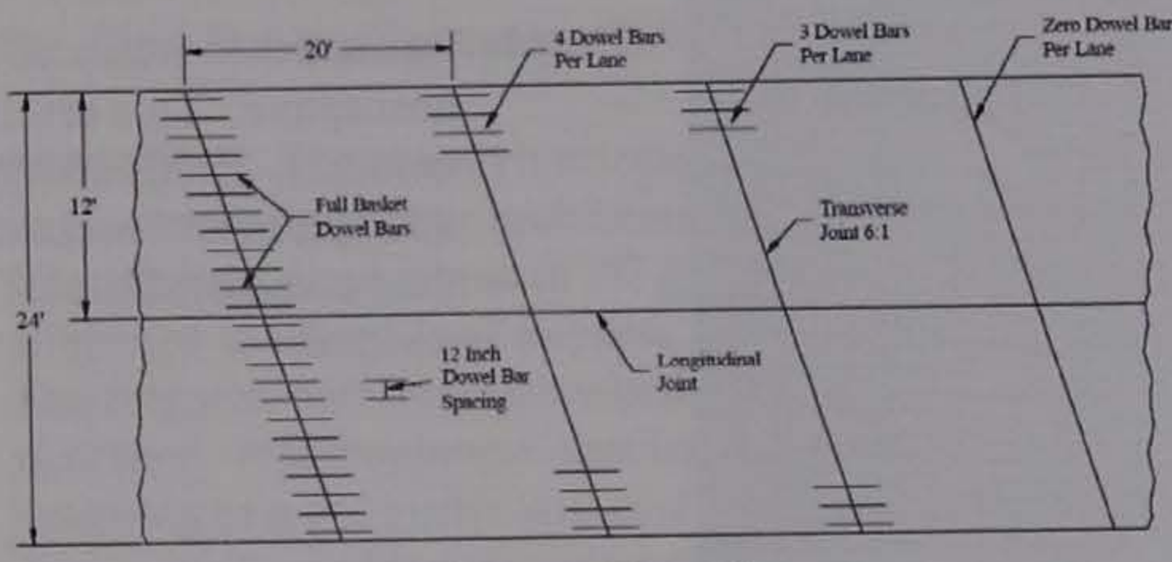
Funding Source:
100% State - 80% Secondary funds and 20% Street funds

Alternative dowel basket locations can provide material and construction savings.

Objective: The objective of this research is to evaluate the placement of load transfer dowels in PCC pavements on low volume roads. The intention is to find strategic dowel placements that would decrease the number of dowels needed and make placement easier.

Reports: Final Report, February 2004

Implementation: If an optimized dowel placement regimen can be demonstrated, counties will be more inclined to use dowels in their paving projects.



Typical Dowel Bar Placement

TR-422

Pretreatment for Reduction of Asphalt Absorption in Porous Aggregate

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

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.

Progress: The paving project was completed in the summer of 1998. Evaluations of the pavement have been performed in conjunction with another research project (TR-414). The additive does not appear to have provided significant reduction in asphalt absorption into the aggregate. A final report is in preparation.

Reports: None

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

Steel Diaphragms in Prestressed Concrete Girder Bridges

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

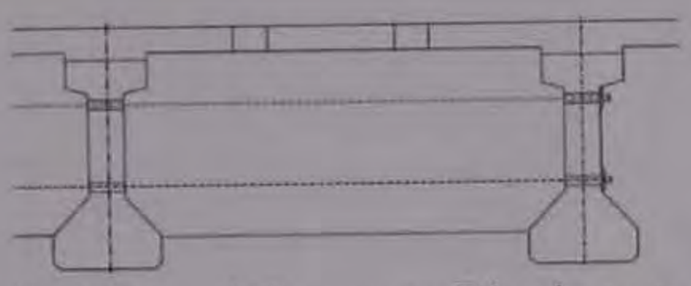
Funding Source:
100% State -
65% Primary funds,
25% Secondary funds
and 10% Street funds

Objective: The objectives of the research are the following:

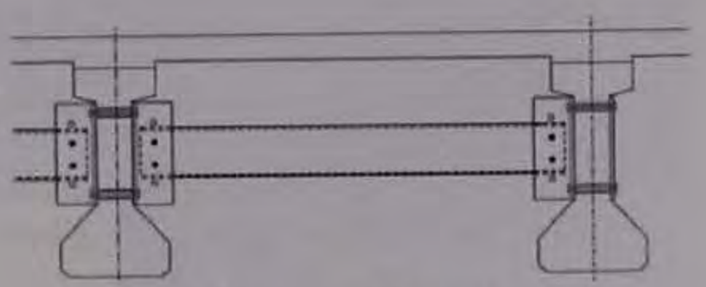
- Evaluate the state-of-the-art regarding the role of intermediate diaphragms in distributing lateral loads throughout PC girder bridge structures.
- Investigate the static and dynamic-load response characteristics of different types and configurations of intermediate diaphragms in PC girder bridges.
- 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

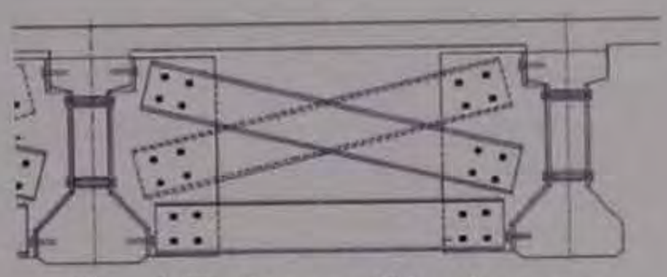
Implementation: The research results will provide bridge design engineers with a better understanding of the behavior of intermediate diaphragms in PC girder bridges that are subjected to lateral load impacts from over-height vehicles. The research will establish whether an intermediate structural steel 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

Evaluation of High-Slump Concrete for Bridge Deck Overlays

Agency:
Iowa Department of Transportation and Buchanan County

Principal Investigator:
Edward J. 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.

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.

Progress: Construction of two bridge deck overlays was completed in Fall 2000. Several additional bridge decks have been overlaid with this method successfully since these first projects. A final report will be prepared by December 2005.

Reports: Construction Report, September 2001

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

Effective Structural Concrete Repair

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

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-429

Evaluation of Appropriate Maintenance Repair and Rehabilitation (MR&R) Methods for Iowa Bridges

Agency:
Iowa State University

Principal Investigator:
Terry J. Wipf, Fouad S. Fanous and F. Wayne Klaiber

Research Period:
February 1, 1999 to April 30, 2003

Research Board Funding:
$195,060

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

Objective: The primary objective of the proposed research is to compile current information on MR&R techniques and implementation guidelines. The proposed research will provide guidance for designers as well as field personnel.

Reports: Final Report and Manual, May 2003

Implementation: The result of this research project will provide MR&R procedures that are systematic and will serve as guidelines to engineers and field personnel.

Jacketing of Deteriorated Timber Piles

TR-432

Ultrathin PCC Overlay Extended Evaluation

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

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.

Progress: Data collection in the form of FWD, coring and distress surveys have been completed and are under analysis at this time. A draft report is being prepared for delivery.

Reports: Construction Report, July 2000 and Interim Report, July 2002

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

An Integral Abutment Bridge With Precast Concrete Piles

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

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 2004.

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

Identification of Laboratory Techniques to Optimize Superpave HMA Surface Friction Characteristics

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 December 31, 2004

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

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: The dynamic friction tester and circular texture meter were received in March. The Purdue machine shop completed fabrication of a laboratory polisher for accelerating the polishing of slabs of hot mix. Sources of aggregates for testing are being determined in consultation with members of the TAC and the Co-PI at ISU. Aggregate selection and sampling is in progress. A graduate student has been selected to work on the project.

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-452

Alternative Solutions to Meet the Service Needs of Low Volume Bridges In Iowa

Agency:
Iowa State University

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

Research Period:
March 1, 2001 to July 31, 2004

Research Board Funding:
$48,865

Funding Source:
100% State - 100% Secondary funds

Objective: The objective of this phase of the project is to develop a reference document to address common problems in LVR bridges. This reference document will not only summarize previous IHRB sponsored research, but will also present pertinent information from other sources. Iowa county engineers need to be surveyed to determine problems they are having with LVR bridges. Also, their solutions to some of the bridge problems they have encountered need to be determined and summarized. A review of the collected data will reveal where inadequate information is available and enable the research team to develop a work plan to address areas where there is inadequate information.

Reports: Final Report, September 2004

Implementation: Local agencies in Iowa and elsewhere are beset by a combination of bridge deficiencies and the lack of funding to address the deficiencies. This research will provide a summary of approaches to this problem and evaluations to show which approaches worked best.

A product of the research will be a reference document that county and city engineers can use to help them decide how best to solve their LVR bridge problems.

There are approximately 22,000 bridges on Iowa's Secondary Road System.

TR-456

Measuring Main-Channel Slopes for Major Rivers in Iowa

Agency:
United States Geological Survey

Principal Investigator:
David Eash

Research Period:
April 18, 2001 to September 30, 2003

Research Board Funding:
$107,800

Funding Source:
50% Federal funds and 50% State - 50% Primary funds, 50% Secondary funds

Objective: To measure main channel slope using GIS along major rivers in Iowa, plot graphs of those measurements, and compare them to manual measurements to determine if adjustments are necessary.

Reports: Final Report, October 2003

Implementation: The results of this project will enable engineers, managers, and planners to estimate flood-frequency discharges with greater efficiency and predictive accuracy.

TR-457

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

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

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.

Progress: A draft final report was submitted in May 2002. During the course of the review, it became apparent that the images provided for analysis did not correspond to the pavement management system output. The images have been assigned to the proper pavement manage sections for re-analysis. The revised analysis required additional time. A final report is due in fall 2004.

Reports: Draft Final, May 2004

Implementation: The software package will offer improved accuracy and consistency over the current labor-intensive manual system at a lower cost. This system will be implemented in Iowa DOT and selected cities and counties.

TR-458

Field Testing of Abrasive Delivery Systems in Winter Maintenance

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

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. Completion of the project together with the final report is anticipated in June 2005.

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

Reuse of Lime Sludge from Water Softening in Road Construction

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

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 (CaCO3) 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 CaCO3 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.

Progress: The graduate assistant on this project continues the work on developing other uses of lime sludge. Lime sludge has a low permeability and lends itself for use as a barrier material in landfills. Measuring permeability using a flexible wall permeameter will be done this semester. As well, leaching tests will be done to find whether any heavy metals escape from the coal combustion ashes in the mix. Another new application will include developing a better dewatering lagoon for water treatment plants without significant capital costs.

Reports: None

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

Living Snow Fences

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.

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: Three winters of testing have provided some interesting results. The living corn test, conducted just north of Tipton, has indicated that between 6 and 12 rows of corn, adjacent to the right-of-way (i.e. right at the edge of the farmer's field) have proven to be very effective snow fences over the last three winters. The corn snow fences store a great deal of snow with the rows of corn, in contrast to a more traditional snow fence where almost all storage is downwind of the fence.

In recent tests, 12 rows performed better at catching snow particles and offering wind protection than 6 rows. Conclusion - 12 rows of corn provide the best alternative to the traditional snow fence in terms of performance and cost effectiveness.

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

Soil Stabilization of Non-Uniform Subgrade Soils

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

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.

Progress: Freeze-thaw and wet-dry durability test data were compiled for the stabilized limestone screenings project. Results show that the cement kiln dust stabilized limestone screenings are not feasible as a construction material due to poor freeze-thaw durability. Statistical analysis of the finite element modeling results for the subgrade uniformity study shows that a link exists between subgrade non-uniformity and pavement fatigue resistance. As subgrade non-uniformity increases, pavement performance decreases.

Reports: None

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

TR-463

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

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

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.

Progress: All test sections from the selected pavement research projects funded through the Iowa Highway Research Board were evaluated. To validate the findings from the original studies, digital images were captured from all the remaining test sections. The deflections were measured and cores were taken from several test sections. Currently, images are being manually analyzed from the computer screen. The cores were tested for shear strength of the bonding area. The core test and image analysis results are being compared with the previous findings.

Reports: Draft Final, May 2004

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

Evaluation of Unbonded Ultrathin Whitetopping of Brick Streets

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

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.

Progress: Five specimens were constructed and tested to investigate the behavior of the proposed MBIS bridge system. Four single bay specimens were constructed and tested in 2001 to evaluate the strength of the formwork and the MBIS bridge system. A fifth specimen, a model bridge, was constructed in the ISU Structures Laboratory to investigate the load distribution characteristics and ultimate strength of the MBIS bridge design. Data gathered from testing the laboratory specimens aided in the design of the second demonstration bridge.

The first MBIS bridge demonstration bridge was designed and constructed in Tama County during the fall of 2001 and then opened to traffic. The bridge was field tested in July 2003, to quantify the behavior of the structure. The second demonstration bridge, also in Tama County, has been constructed and field tested. The structure utilizes six rolled W-sections in the MBIS bridge system. The deck was placed on November 7, 2002, and opened to traffic.

A final report will be presented to the Board in the fall 2004.

Reports: None

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.

TR-468

Technology Transfer Program for the Iowa Highway Research Board

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

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. Through electronic distribution of information, a wider audience can be obtained with reduced publication and distribution cost.

This project will also provide 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 03-04.

Reports: None

TR-469

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

Agency:
Iowa State University

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

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

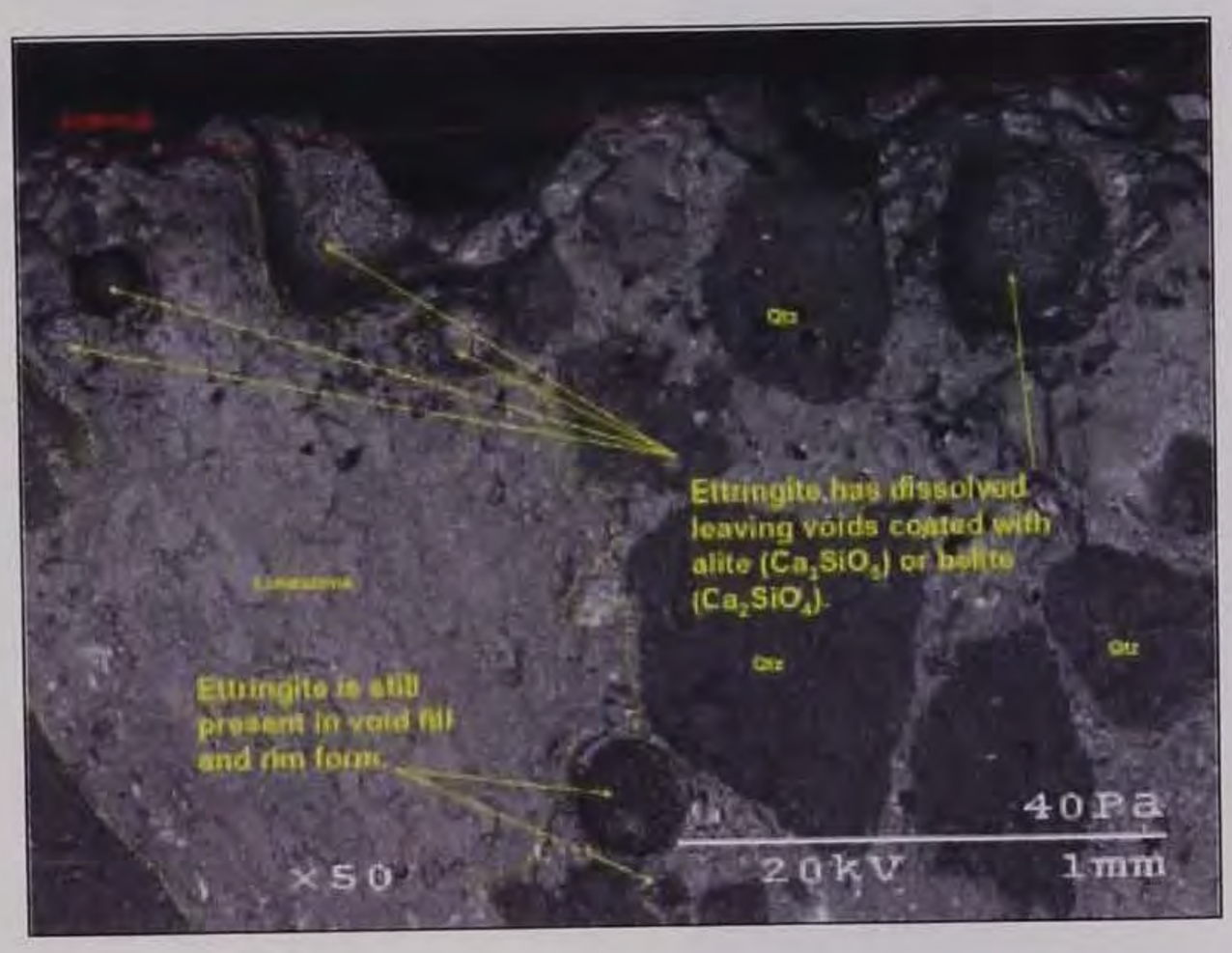
Research Board Funding:
$139,832

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

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 damage to 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

Development of a Method to Determine Pavement Damage Due to Detours and Haul Roads

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

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 and haul roads used temporarily by the Iowa DOT.

Progress: A draft final report was submitted in June 2004 and will be presented in the fall of 2004

Reports: Draft Final Report, June 2004

Implementation: At the end of the project, a set of guidelines and procedures for a new process of developing detour and haul roads compensation will be 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

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

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

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: The following tests were performed with liquid deicing chemicals:

- Ice melting test
- Freezing point test
- Ice penetration test
- Viscosity test
- Specific gravity test

The results of these tests will be presented in 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

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

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

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 Pacific Northwest Snowfighters testing was used to determine the corrosivity of a variety of different chemicals on steel and aluminum. The corrosivity will be related to the corrosion of distilled water, and will be reported as a millimeters per year of corrosion when final results are presented. The final report is being prepared and should be completed by March 31, 2005.

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 December 31, 2004

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.

Progress: A mechanistically-based design method for HMA overlays over rubblized and cracked and seated PCC pavements has been developed. The method has been partially validated using the field results from the instrumented sections of IA 141 near Grimes, Iowa. A report is in its final stages of preparation, and will include a computer program which will allow the designer to estimate the required thickness of HMA overlay for various levels of performance.

Reports: None

Implementation: Responsibility for implementation rests primarily within the DOT. The PI will assist in any way necessary to this end and will provide implementable design guidelines to the Iowa DOT.

TR-474

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

Agency:
The University of Iowa

Principal Investigator:
Hosin "David" Lee

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

Research Board Funding:
$228,469

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

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: RAPs were collected from six different sources across the state of Iowa, 1500 lbs. from each construction site. The collected RAP materials were sieved into stockpiles of five different sizes. The steering committee meeting took place on campus of The University of Iowa with members participating from Iowa DOT, Delaware County, and industry. The simple performance testing equipment has been ordered.

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-476

A Computer Program for Valley Stage-Discharge Curves and Bridge Backwater Calculations

Agency:
Digital Control, Inc.

Principal Investigator:
LaDon Jones

Research Period:
July 1, 2002 to
September 30, 2003

Research Board Funding:
$69,375

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

Objective: This project will produce integrated, user friendly, personal computer software that will estimate stage-discharge curves for valley cross-sections and perform bridge backwater calculations. The software will be written in Visual Basic 6.0 and will be a complete stand-alone program that will run on computers using Microsoft Windows 95, 98, NT, 2000 or XP.

Reports: Final Report, October 2003

Implementation: The computer program will be utilized by city and county engineers, the Iowa DOT staff and consultants for the design of culverts and bridges along the state's primary and secondary road system.

TR-477

Total Cost of Transportation Analysis - Phase II

Agency:
Iowa County Engineers Association Service Bureau

Principal Investigator:
Steve DeVries

Research Period:
July 1, 2002 to September 30, 2003

Research Board Funding:
$29,635

Funding Source:
100% State - 100% Secondary funds

Objective: To use the transportation costs based analysis tools developed in HR-388 to prepare an accurate, current study of Iowa's county road system - using 2002 data. Once up-to-date physical and cost models have been set up, the data will be used to investigate system adequacy, operating cost needs, capital upgrade needs, and costs versus revenues.

TR-477 will also devote time to more thoroughly research and determine average annual speeds of travel on various types of roads, refine the estimates of capital upgrade costs, review whether or not recent year expenditures have been enough to maintain system quality at a steady state, recheck human resource / travel time costs, and re-estimate accident costs.

Reports: Final Report, September 2003

Implementation: The results of this research effort will be employed to support efforts, by ICEA and the Needs Study Replacement Committee, to devise a new way of allocating the Farm-to-Market and Local Secondary portions of the state Road Use Tax Fund among the counties. It may also be used to evaluate and then demonstrate the adequacy of the county road network and establish how much ought to be spent on it each year.

TR-478

Evaluation of Composite Pavement Unbonded Overlays

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

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.

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

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

Agency:
Michigan Technological University

Principal Investigator:
Lawrence L. Sutter

Research Period:
July 15, 2002 to July 14, 2004

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

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: The literature review continues as additional information becomes available. There is not a consensus in the literature on some key aspects of the study requiring the research team to continue to search for reliable and widely accepted sources of information.

- Work has continued on preparing thin sections from the field core samples for petrographic analysis, and slab specimens for determination of chloride ion ingress.
- The majority of the effort for this reporting period was in finalizing the Phase I laboratory experiments involving exposure of mortar specimens to various deicer solutions. Preliminary results to date are presented.
- Petrographic analysis is being employed in an attempt to understand the various types of deterioration that has occurred.

Reports: Progress Report, April 2004

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

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

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

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.

Progress: 1) Literature review and first draft summarizing the information from the literature have been completed. 2) Multiple bridge sites in and around Des Moines and Ames have been inspected. 3) A bridge at Highway 65 over South Skunk River has been selected for a detailed site investigation. 4) A lab scale abutment drainage model has been developed.

Reports: None

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-482

Determination of the Optimum Base Characteristics for Pavements

Agency:
Iowa State University

Principal Investigator:
David J. White

Research Period:
August 15, 2002 to May 31, 2004

Research Board Funding:
$100,000

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

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

- Identify the optimal range for both in-place stability and in-place permeability of granular base course material in Iowa;
- Develop reliable field QC tests to determine the in-place stability and permeability of granular base course materials;
- Develop end-result specification for the acceptance of granular bases based on these findings; and
- Identify alternative construction practices for the placement of permeable granular base layers in areas which have narrow or no shoulders for use as a haul road.

Progress: A Final report was presented and approved by the IHRB in May 2004

Reports: Final Report, May 2004

Implementation: The proposed research is specific to Iowa; highway agencies and contractors statewide will implement results. However, final recommendations could be implemented at the regional/national level. Results will be communicated to practicing engineers and contractors through local/regional/national presentations and dissemination.

TR-483

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

Agency:
Iowa State University

Principal Investigator:
Brian J. Coree

Research Period:
August 1, 2002 to January 31, 2005

Research Board Funding:
$145,775

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

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.

Progress: Asphalt mixtures of varying moisture sensitivities have been fabricated and tested using the proposed protocol: dynamic testing in the NAT. The results are somewhat disappointing and are no better than might be obtained from the existing AASHTO-T-283 protocol. An examination of the results led to further sub-study that studied the distribution of air voids in the samples and the effects of such distribution on the test results. It is clear that some samples are damaged by the process of sample preparation and this damage masks the damage due to the effect of moisture. This observation applies to both the proposed protocol and the existing AASHTO-T-283 procedures. A final report and recommendations are in final preparation.

Reports: None

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

Materials and Mix Optimization Procedures for PCC Pavements

Agency:
Iowa State University

Principal Investigator:
Scott Schlorholtz

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

Research Board Funding:
$159,666

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

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:

- Chemical testing for uniformity of Portland Cement, blended cement and slag samples obtained from the Iowa DOT is being conducted. To date, over 70 samples have been analyzed for DOT.
- Experiments that study how premature stiffening is influenced by cementitious material composition, mixing procedure and temperature are being conducted.
- Potential field projects have been identified for 2004.

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

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

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

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).

Progress: The objectives have been completed and the final report and program are currently under review. Final presentation will be done in the fall of 2004.

Reports: None

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

Development of Abutment Design Standards for Local Bridge Designs

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

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.

Progress: A literature review and information search has been completed.

On June 10, 2003, a survey was sent to the county engineers to gather information on substructures used by various Iowa counties. Of the 99 counties, 42 returned the completed survey.

Load calculations have also been completed. These included dead loads for the different substructure systems; longitudinal loads such as wind loads on the structure and live load, longitudinal force (braking force), and lateral dead and live load earth pressures.

The project has been completed and a final report will be submitted to the Board in the fall of 2004.

Reports: None

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

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

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

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.

Progress: A draft final report was submitted in April 2004 and is currently being reviewed. Final presentation will be complete in fall of 2004.

Reports: Draft Final Report, April 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

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

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

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: In addition to the freeze point curves for various mixes of the two brines, ice melting capacity tests and specific gravity tests have also been run. Results from the latter indicate they will be very helpful in ensuring proper mixing of the two brines, while the former will give a clear measure of the appropriate quantities of the mix to use, and thus feed directly into the cost-benefit analysis. The final report will be completed by the end of March 2005.

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).

TR-489

Innovative Solutions for Slope Stability Reinforcement and Characterization in Iowa Soils

Agency:
Iowa State University

Principal Investigator:
David J. White

Research Period:
March 1, 2003 to September 1, 2005

Research Board Funding:
$198,462

Funding Source:
100% State - 25% Primary funds and 75% Secondary funds

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: Pile load tests were conducted in a manner similar to large-scale direct shear tests. The 14 load tests suggest the influence of soil type, pile size, and pile spacing on the stabilization potential for micropiles. The test data is being analyzed to determine whether load transfer of pile subject to lateral soil movement is predicted with existing analytical models and software of laterally loaded piles. The prediction of pile behavior is a principal objective in demonstrating the stability of pile-stabilized slopes. A number of field trips have been made and more than 10 slope failures have been identified. Preliminary investigations, including soil characterization on a few slides, have been carried out.

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-490

Stringless Portland Cement Concrete Paving

Agency:
Iowa State University

Principal Investigator:
James K. Cable and Edward J. Jaselskis

Research Period:
December 1, 2002 to February 28, 2004

Research Board Funding:
$129,519

Funding Source:
7% outside sources and 93% State - 45% Primary funds, 50% Secondary funds and 5% Street funds

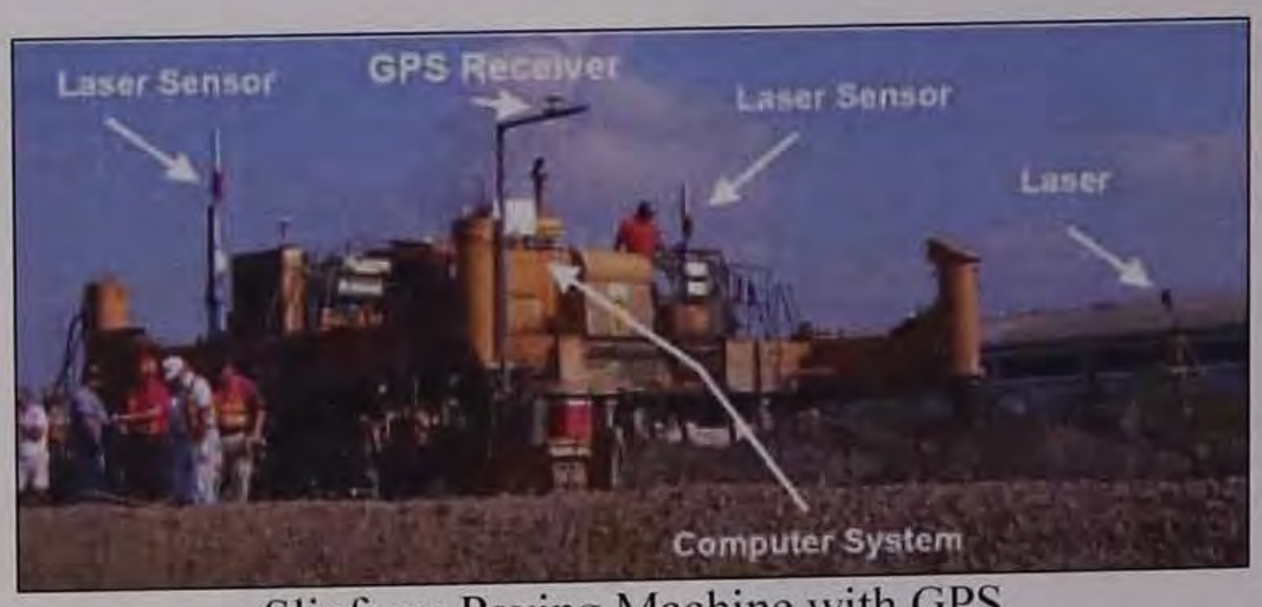
Objective: Evaluation of the use of robotic total station control to guide the Trimmer, Slipform Paver and Cure Cart in the alignment and depth control of the final Portland cement concrete pavement. The research will compare the results to the design depths, quantities, alignment, profile and smoothness obtained by other means in similar projects in Washington County.

Reports: Final Report, February 2004

Implementation: This method can revolutionize paving in state, county and city areas of limited right-of-way. It has the potential to eliminate human error in conventional ground surveys and slipform paver control staking. This relates to application in up to 10,000 miles of county road pavements in Iowa alone. It also relates to providing faster construction of concrete pavements with less effort and funds being expended in alignment control and more in the product being placed. It could also have a positive impact on pavement smoothness, and relieving urban construction area congestion.

Implementation steps would include:

- Presentations at ICPA and ACPA state conferences and workshops.
- Presentations at APWA and ICEA conferences.
- Publication in PCC Center and CTRE publications.



Slipform Paving Machine with GPS Guidance Equipment Attached

TR-491

Development of Winter Performance Measures for Maintenance Operations

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

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: The literature review has been completed and will be updated through the life of the project as new papers are published. Potential storm classification schemes are being evaluated and a storm severity index has been developed.

The remainder of the project will be examining performances and costs for winter maintenance with the different winter storm scenarios.

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

Embankment Quality Phase IV - Application to Unsuitable Soils

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

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: Progress was slowed due to the delay in identification of suitable construction projects for this work. Lab testing and field dynamic cone penetrometer testing has been started. Pilot project selection has begun.

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

Performance Evaluation of Steel Bridges - Phase II

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

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 contract was executed with Iowa State University to perform this research in March 2003. Development of a monitoring plan is 25% complete.

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-494

Statistical Analysis of Highway Needs Condition Data: Manual vs. Automated

Agency:
Iowa State University

Principal Investigator:
Omar Smadi

Research Period:
March 1, 2003 to September 30, 2003

Research Board Funding:
$17,405

Funding Source:
100% State - 100% Secondary funds

Objective: The object of this project is to conduct a statistical analysis to examine the differences and/or similarities of the condition data collected manually and in an automated fashion. This information will help the advisory committee responsible for finding alternatives to the current highway needs process to make an informed decision whether HWYNEEDS should be converted to a Windows-based environment and modified to be used by the counties to distribute the counties' share of the Road Use Tax Fund.

Reports: Final Report, September 2003

Implementation: The results have been reported to the project advisory committee. The committee will use the information in developing a recommendation for future Road Use Tax Fund distribution methods for Iowa counties.

TR-495

Field Evaluation of Compaction Monitoring Technology

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

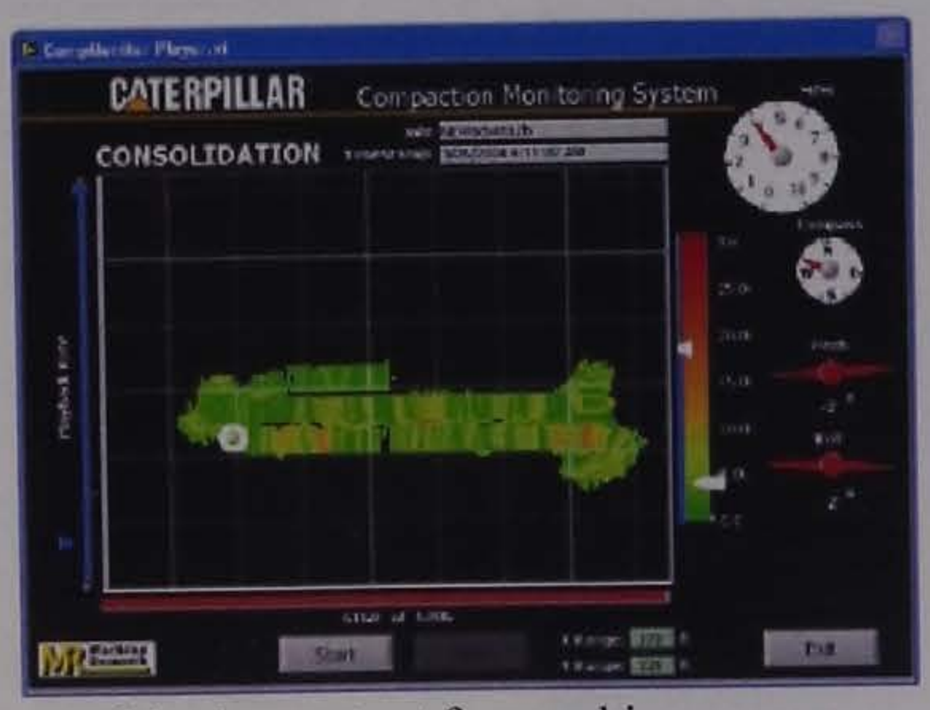
Funding Source:
40% other sources and 60% State - 80% Primary funds, 10% Secondary funds and 10% Street funds

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

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

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

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.

Progress: This project is approximately 20% complete. CADD drawings are being developed and the structural design of the abutments is underway.

Reports: None

Implementation: All drawing files will be included in Microstation format for the final submittal for both standard series. Upon final review and approval, the detail sheets will be made available in 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

Manual of Iowa Drainage Law

Agency:
Iowa State University

Principal Investigator:
Stephen J. Andrle

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

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.

Progress: Draft chapters of the manual have been produced. The project advisory committee will review and comment on the material. The legal review is nearly complete. A final report is expected in fall 2004.

Reports: None

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

Field Testing of Railroad Flat Car (RRFC) Bridges

Agency:
Iowa State University

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

Research Period:
June 1, 2003 to March 31, 2005

Research Board Funding:
$121,096

Funding Source:
100% State - 100% Secondary funds

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

Progress: The research has been completed and a final report is being written.

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 expand the current level of knowledge in the area of using RRFC for LVR bridges and 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

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

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

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.

Progress: The research is complete; the final report will be presented to the Board in the fall of 2004.

Reports: None

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

Evaluation of the Compensatory Wetland Mitigation Program in Iowa

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

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.

Progress: The project final report is being written and will be presented in the fall of 2004.

Reports: None

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

Optimization and Management of Materials in Earthwork Construction

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

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 just started. Literature review (task 1) and forensic investigation (task 2) are underway. A major part of literature review has been completed and two site visits have been completed to analyze the problems related to earthwork optimization.

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

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

Agency:
Iowa State University and The University of Iowa

Principal Investigator:
Charles Jahren and Hosin "David" Lee

Research Period:
November 1, 2003 to April 30, 2005

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

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: ISU passed inventory information to The U of I to conduct pavement distress surveys.

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

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

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

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 documenting the literature and practices obtained from several states and Iowa cities (Cedar Rapids, Ames, Council Bluffs, Sioux City, Des Moines, Mason City, Waterloo, Dubuque, Bettendorf, and Davenport). The research team met with Ames City Street Maintenance Supervisors, Dave Cole and Dale Weber, on April 2, 2004, and obtained samples of backfill material used in trenches. This material will be tested in the laboratory.

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

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

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

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.

Progress: A contract has been executed between the Iowa DOT and Digital Control, Inc. to conduct the research. The final report and software are expected to be presented to the Board in December 2004.

Reports: None

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

Improving PCC Mix Consistency and Production by Mixing Improvements

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

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: The literature review is mostly complete. Laboratory tests are ongoing investigating optimal cement mixing regimens.

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

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

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

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.

Progress: Dust measurement equipment has been purchased. The test locations in Story County have been selected and a test protocol developed. A wet spring delayed application of treatments until late May and continued rain hampered data collection. Initial measurements were completed in early July.

Reports: None

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.

TR-507

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

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

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: The literature review is mostly complete. Test locations have been selected. Work has begun to develop technology transfer material.

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

Design Guide and Construction Specifications for NPDES Site Runoff Control

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

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: A draft outline and format for the erosion and sediment control chapter has been developed. Interim BMP design standards are being developed. This will serve as the main source for information until the manual is completed.

Reports: None

Implementation: 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

AASHTO 2002 Pavement Guide Implementation Plan - Phases I and II

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

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

Progress: As of April 2004, the Guide Software has not been released by NCHRP. The researchers were granted a no-cost extension to September 30, 2004.

Reports: None

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

Laboratory Study of Structural Behavior of Alternative Dowel Bars

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

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 total of 18 concrete specimens have been cast (using 1/8 - and ½ inch gap) with three dowel types: elliptical steel, circular steel and elliptical GFRP. Three specimens included strain gages. Specimens are ready to be tested. Models are being developed using finite element analysis for the AASHTO T253-76 test setup and using the stiffness matrix method for a beam on elastic foundation.

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

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

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

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.

Progress: Planning for installation of temperature probes and strain gages at some 18 locations in the pavement has been completed. Installation and monitoring will begin in summer 2004. The data will be used to develop and calibrate the design model.

Reports: None

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

Measuring Pavement Profile at the Slipform Paver

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

Objective: This research is directed at evaluation of equipment and methods to measure profile being produced at the slip-form 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.

Progress: The test sections have been designed and a project selected for the testing. Testing will be performed in July and August 2004 on U.S. 30 near Le Grand, Iowa.

Reports: None

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.

TR-513

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

Agency:
The University of Iowa - Office of the State Archaeologist

Principal Investigator:
Joe Alan Artz

Research Period:
April 1, 2004 to March 31, 2005

Research Board Funding:
$50,000

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

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 was developed. A total of 1,870 reports on Phase I archaeological survey projects that included a bridge were examined to identify the extent and methodology of subsurface testing. For each report, data on testing methodology, numbers of tests, and depth of testing were compiled in an Access database. Only tests conducted in areas mapped as alluvial soils were considered in compiling data.

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

Development of a Manual of Practice for Roadway Maintenance Workers

Agency:
Iowa State University

Principal Investigator:
Duane Smith

Research Period:
May 1, 2004 to April 30, 2005

Research Board Funding:
$64,991

Funding Source:
100% State - 100% Secondary funds

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 steering committee has been selected and planning meetings are scheduled. Handbooks have been gathered and categorized.

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

A Guide for Monitoring and Protecting Bridge Waterways Against Scour

Agency:
The University of Iowa

Principal Investigator:
Robert Ettema and Thanos Papanicolaou

Research Period:
April 1, 2004 to March 31, 2005

Research Board Funding:
$80,816

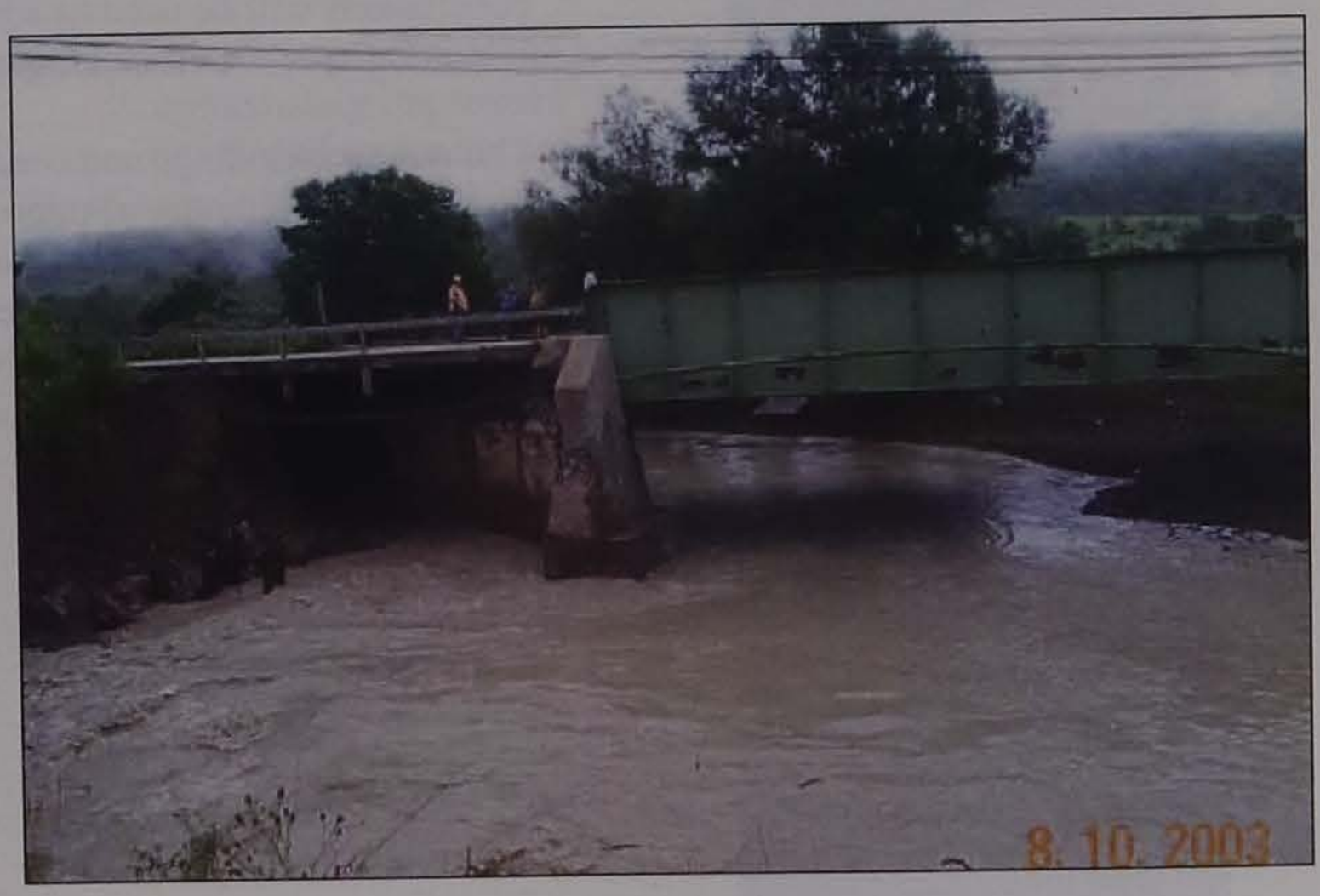
Funding Source:
100% State - 40% Primary funds, 55% Secondary funds and 5% Street funds

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.

Progress: The research is fully underway with the first four tasks to be completed under the project: 1) Establish an advisory panel of engineers from DOT, counties, and cities to seek input regarding the structure and content of manual. 2) Prepare a preliminary, detailed outline for manual. 3) Meet engineers to discuss monitoring procedure. 4) Review the bridge-waterway portions of the monitoring procedures presently in use by DOT, counties, and cities.

Reports: None

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

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

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

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: A contract has been executed between the Iowa DOT and ISU to conduct the research.

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

Guidelines for Safety Treatment of Roadside Culverts

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

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: A contract has been initiated between the Iowa DOT and the University of Nebraska - Lincoln to conduct the research.

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

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

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

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: A contract has been executed between the Iowa DOT and ISU to conduct the research.

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

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

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

Objective: The objectives of this study are to develop and evaluate flood-frequency discharge estimation methods for rural, ungaged streams in Iowa with drainage areas less than 50 square miles. Specifics objectives are 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 computing using Bulletin 17B flood-frequency analyses.

Progress: A contract has been executed between the Iowa DOT and the USGS to conduct the research.

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

Evaluation of Dowel Bar Retrofits for Local Road Pavements

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

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.
- Determinate the relative cost of elliptical shaped dowels (FRP and steel) for the retrofit project.

Progress: A contract has been executed between the Iowa DOT and ISU to conduct the research.

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.

HR-1027

Secondary Road Research Coordinator

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

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 15 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

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

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

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.

Progress: The ground penetrating radar system can easily map the location of the rebar in concrete slabs. Three-dimensional representations of the objects can be easily created if the data is collected in an organized fashion. Results for detecting alkali silica reaction expansion and cracking are less clear, although there is clearly a loss of signal in the region where cracking would be expected. The test slabs are being monitored weekly to refine the measurements.

The pavement profile scanner is expected to be in Iowa in late July and August of 2004. The system will be used to recollect data from the four field sites that were documented in the phase I report. The new results will be compared to the test results obtained in 2003 to see if system refinements have impacted the quality of the data produced by the pavement profile scanner.

Reports: None

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.

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

HIGHWAY DIVISION
IOWA DEPARTMENT OF TRANSPORTATION
AMES, IOWA 50010

DECEMBER 2005

TABLE OF CONTENTS

LIST OF ACRONYMS

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

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.

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

Member	Term Expires	Alternate
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. 5th 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. 5th 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 6th 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	-	-
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.

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.

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.

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		$1,158,278.52
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		$1,209,336.27
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	200,000
Total Funds Available for Street Research	$221,812
Total obligated for Expenditure	$220,855
Ending Unobligated Balance 6-30-05	$957

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)

oject	Total Funds Committed	Project Title	Primary Road Research Fund Expenditures	Secondary Road Research Fund Expenditures	Street Research Fund Expenditures	Total Expenditures
40	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 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

Project	Total Funds Committed	Project Title	Primary Road Research Fund Expenditures	Secondary Road Research Fund Expenditures	Street Research Fund Expenditures	Total Expenditures
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

Collection and Analysis of Stream Flow Data

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

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^2 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

Iowa State University Local Technical Assistance Program (LTAP)

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

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

Transportation Research Board Education for County Engineers

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

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

Field Testing of Integral Abutments

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

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

Development of a Computer Controlled Underbody Plow

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

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

Superpave Mix Designs for Low Volume Roads

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

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

Gyratory mix design process

TR-422

Pretreatment for Reduction of Asphalt Absorption in Porous Aggregate

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

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

Steel Diaphragms in Prestressed Concrete Girder Bridges

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

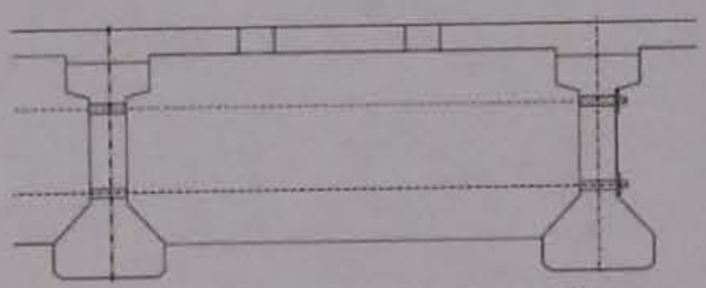
Funding Source:
100% State -
65% Primary funds,
25% Secondary funds
and 10% Street funds

Objective: The objectives of the research are the following:

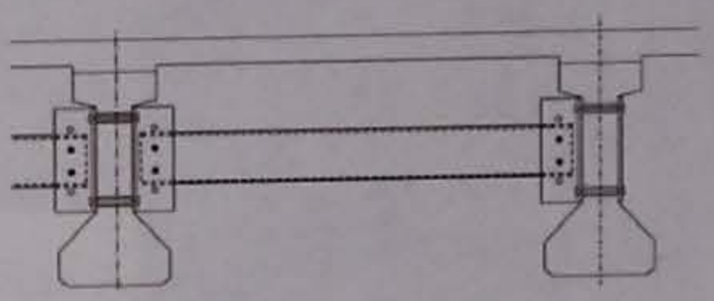
- Evaluate the state-of-the-art regarding the role of intermediate diaphragms in distributing lateral loads throughout PC girder bridge structures.
- Investigate the static and dynamic-load response characteristics of different types and configurations of intermediate diaphragms in PC girder bridges.
- 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

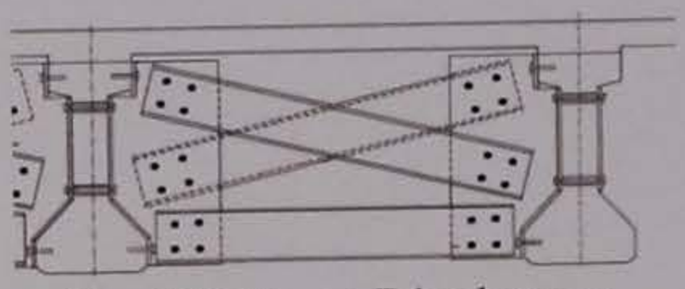
Implementation: The research results will provide bridge design engineers with a better understanding of the behavior of intermediate diaphragms in PC girder bridges that are subjected to lateral load impacts from over-height vehicles. The research will establish whether an intermediate structural steel 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

Evaluation of High-Slump Concrete for Bridge Deck Overlays

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

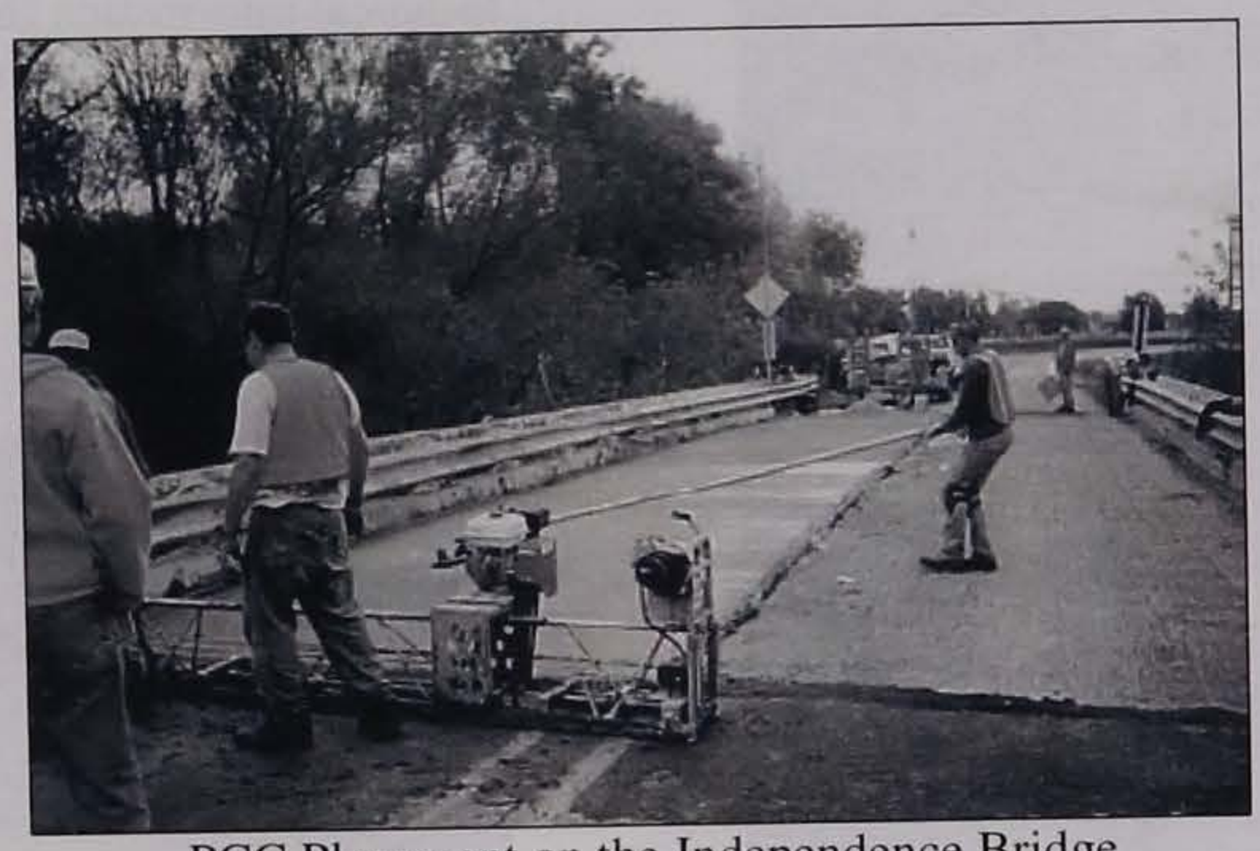
Funding Source:
100% State -
40% Primary funds,
30% Secondary funds
and 30% Street funds

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

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

Effective Structural Concrete Repair

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

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

Ultrathin PCC Overlay Extended Evaluation

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

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

An Integral Abutment Bridge With Precast Concrete Piles

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

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

Identification of Laboratory Techniques to Optimize Superpave HMA Surface Friction Characteristics

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

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

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

Agency:
The University of Iowa

Principal Investigator:
Hosin "David" Lee

Research Period:
April 1, 2001 to June 30, 2004

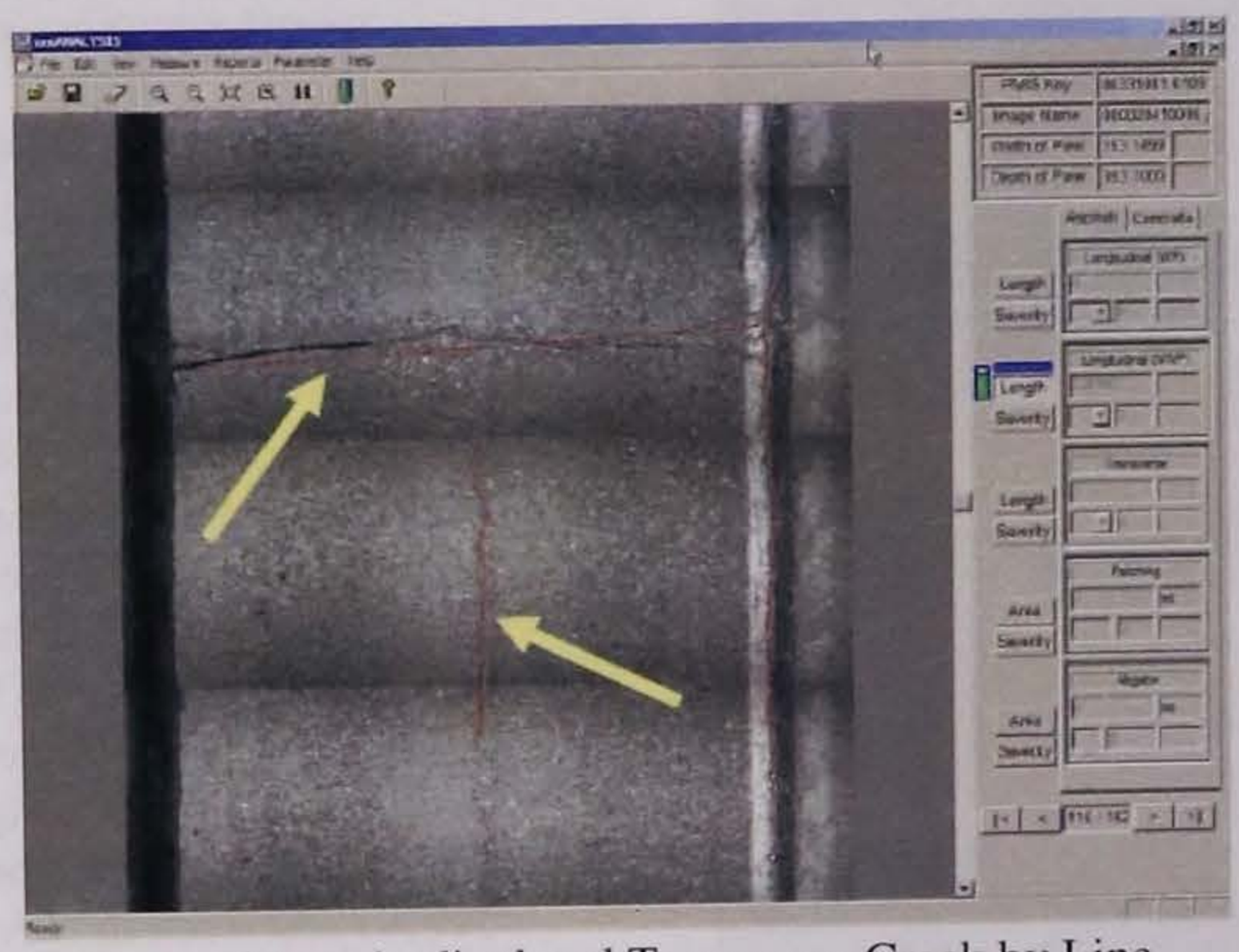
Research Board Funding:
$73,997

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

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

Field Testing of Abrasive Delivery Systems in Winter Maintenance

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

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

Reuse of Lime Sludge from Water Softening in Road Construction

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

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 (CaCO3) 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 CaCO3 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

Living Snow Fences

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.

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

Soil Stabilization of Non-Uniform Subgrade Soils

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

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

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

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

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

Evaluation of Unbonded Ultrathin Whitetopping of Brick Streets

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

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

Technology Transfer Program for the Iowa Highway Research Board

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

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

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

Agency:
Iowa State University

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

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

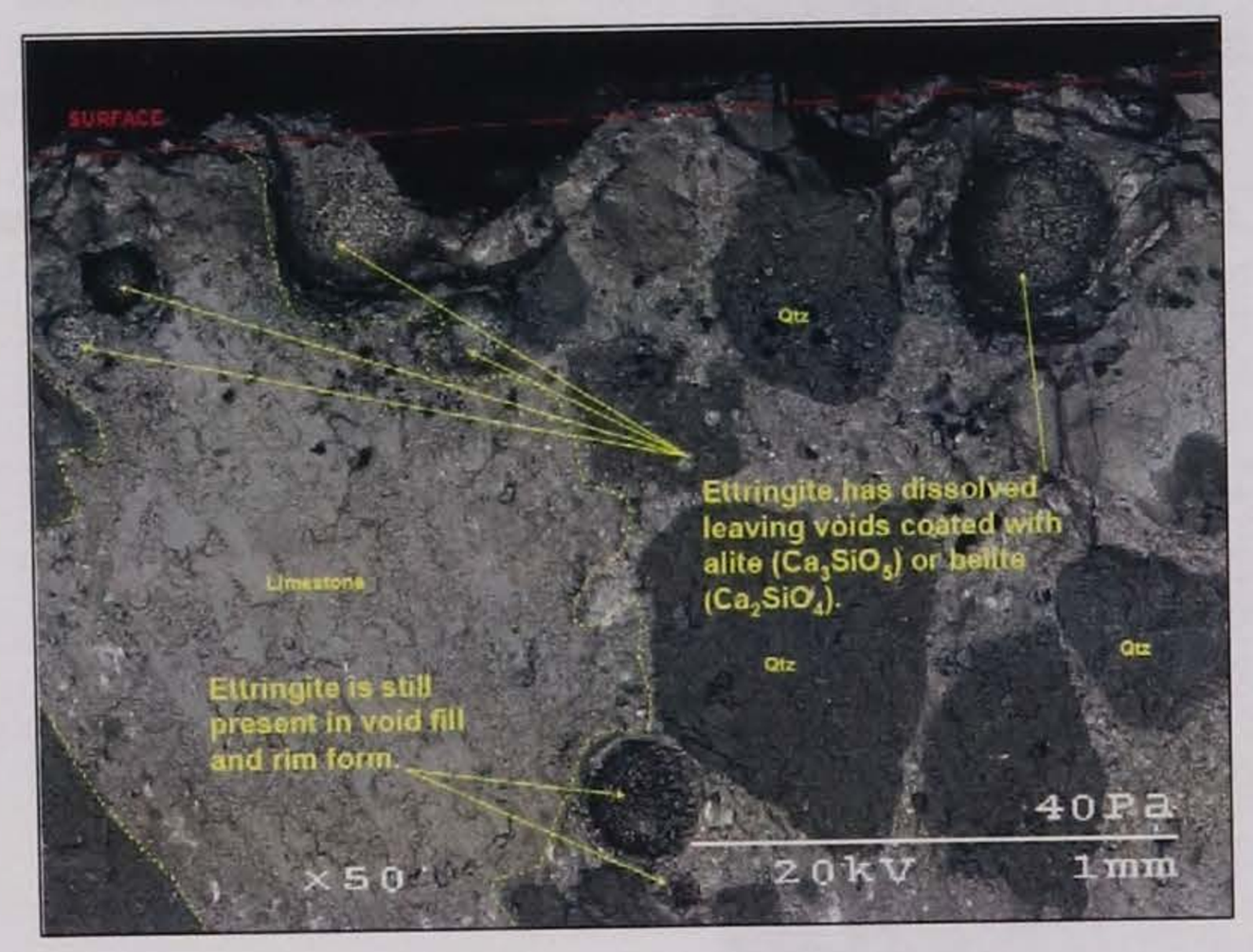
Research Board Funding:
$139,832

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

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

Development of a Method to Determine Pavement Damage Due to Detours

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

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

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

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

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

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

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

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

Rehabilitation of Concrete Pavements Utilizing Rubblization and Crack and Seat Methods

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

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

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

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

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

Evaluation of Composite Pavement Unbonded Overlays

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

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.

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

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

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

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- and Mg++ 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

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

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

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

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

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

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

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

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

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

Development of Abutment Design Standards for Local Bridge Designs

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

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

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

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

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

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

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

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).

TR-489

Innovative Solutions for Slope Stability Reinforcement and Characterization in Iowa Soils

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

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

Development of Winter Performance Measures for Maintenance Operations

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

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

Embankment Quality Phase IV - Application to Unsuitable Soils

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

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

Performance Evaluation of Steel Bridges - Phase II

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

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

Field Evaluation of Compaction Monitoring Technology

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

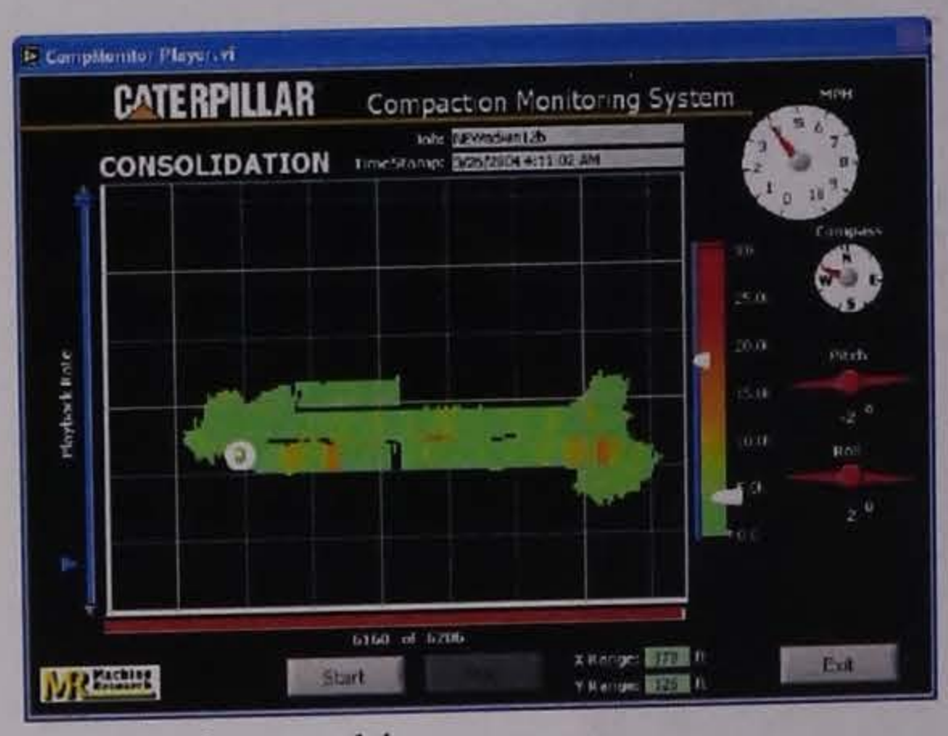
Funding Source:
40% other sources and 60% State - 80% Primary funds, 10% Secondary funds and 10% Street funds

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

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

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

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

Manual of Iowa Drainage Law

Agency:
Iowa State University

Principal Investigator:
Stephen J. Andrle

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

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

Field Testing of Railroad Flat Car (RRFC) Bridges

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

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

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

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

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

Evaluation of the Compensatory Wetland Mitigation Program in Iowa

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

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

Optimization and Management of Materials in Earthwork Construction

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

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

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

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

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

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

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

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

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

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

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

Improving PCC Mix Consistency and Production by Mixing Improvements

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

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

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

Agency:
Iowa State University

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

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

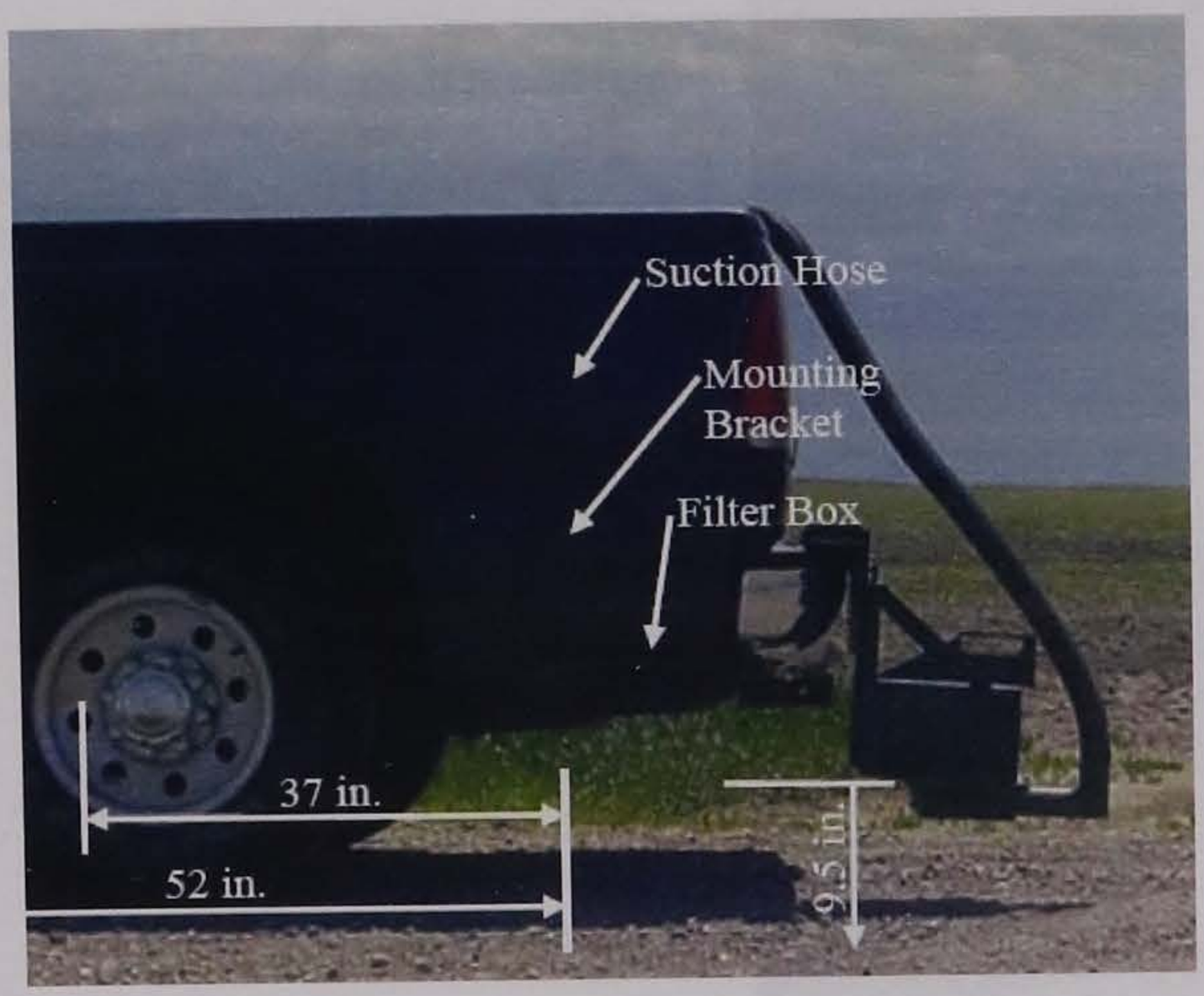
Research Board Funding:
$107,070

Funding Source:
100% State - 100% Secondary funds

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

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

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

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

Design Guide and Construction Specifications for NPDES Site Runoff Control

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

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

AASHTO 2002 Pavement Guide Implementation Plan - Phases I and II

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

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

Laboratory Study of Structural Behavior of Alternative Dowel Bars

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

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

Measuring Pavement Profile at the Slipform Paver

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

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

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

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

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

Development of a Manual of Practice for Roadway Maintenance Workers

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

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

A Guide for Monitoring and Protecting Bridge Waterways Against Scour

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

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

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

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

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

Guidelines for Safety Treatment of Roadside Culverts

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

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 my 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

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

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

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

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

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

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. Specifics 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 computing 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

Evaluation of Dowel Bar Retrofits for Local Road Pavements

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

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.
- Determinate 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

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

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

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

Investigation of Steel Stringer Bridges: Substructures and Superstructures

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

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

Appropriate Traffic Calming Techniques for Small Iowa Communities

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

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

Review of Inconsistencies Between SUDAS and Iowa DOT Specifications

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

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

Design Guide for Improved Quality of Roadway Subgrades and Subbases

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

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

Feasibility of Cooperative Development of Wetland Mitigation Projects

Agency:
Iowa State University

Principal Investigator:
Timothy Ellis
Stephen J. Andrle

Research Period:
December 1, 2004 to September 30, 2005

Research Board Funding:
$59,925

Funding Source:
100 % State -
75% Primary funds,
25 % Secondary funds

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

Guidelines for Removal of Traffic Control Devices in Rural Areas

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

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

Development of a New Process for Determining Design Year Traffic

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

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

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

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

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

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

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

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

Effective Shoulder Design and Maintenance

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

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

Evaluation of Transverse Joint Forming Methods in PCC Pavement

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

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

Evaluation of Design Flood Frequency Methods for Iowa Streams

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

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

Design Procedures and Field Monitoring of Submerged Barbs for Streambank Protection

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

Objectives: (1) Model hydraulically the performance of a proposed submerged barb design for the US-169 bridge site. (2) Perform a comprehensive field stuffy 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

Reuse of Lime Sludge from Water Softening and Coal Combustion Byproducts

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

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

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

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

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

Using Scanning Lasers for Real-Time Pavement Thickness Measurement

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

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

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

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

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

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

Agency:
Iowa State University

Principal Investigator:
Stephen J. Andrle

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

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

Secondary Road Research Coordinator

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

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

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

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

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.