Annual Report of Highway Research and Development in Iowa

Highway Division
Office of Materials
December 1985

Iowa Department of Transportation

ANNUAL REPORT
OF
HIGHWAY RESEARCH AND DEVELOPMENT IN IOWA

FOR THE
FISCAL YEAR ENDING JUNE 30, 1985

OFFICE OF MATERIALS
(515)239-1447

HIGHWAY DIVISION
IOWA DEPARTMENT OF TRANSPORTATION
AMES, IOWA 50010

DECEMBER 1985

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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; and second, to identify and implement improved engineering and management practices.

This report entitled, "Highway Research and Development in Iowa", is submitted in compliance with Section 310.36, Code of Iowa, which directs the submission of a report of the Secondary Road Research Fund. It is a report of the status of research and development projects which were in progress on June 30, 1985; it is also a report on projects completed during the fiscal year beginning July 1, 1984, and ending June 30, 1985. Detailed information on each of the research and development projects mentioned in this report is available in the Office of Materials, Highway Division, Iowa Department of Transportation.

IOWA HIGHWAY RESEARCH BOARD

In developing a progressive, continuing, 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.

The Research Board consist of 13 regular members; six county engineers, three DOT Highway Division 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, 1985, is listed in Table I.

The Research Board held nine regular meetings during the period of July 1, 1984 to June 30, 1985. Suggestions for research and development were reviewed at these meetings and recommendations were made by the Board.

TABLE I

1985 IOWA HIGHWAY RESEARCH BOARD

Member	Term Expires	Alternate
Steven W. Akes Guthrie County Engineer 200 N. 5th Street Guthrie Center, IA 50115 (515) 747-2274 SS#-039	12-31-87	Ralph Morrow Page County Engineer Clarinda, IA 51632 (712)542-2510 SS#-073
Donald A. Anderson Deputy Director, Operations Iowa DOT - Highway Division Ames, IA 50010 (515) 239-1491	12-31-85	Charles L. Huisman State Materials Engineer Iowa DOT - Highway Division Ames, IA 50010 (515) 239-1452
David R. Boylan, Dean College of Engineering Iowa State University 104 Marston Hall Ames, IA 50011 (515) 294-5933	12-31-85	Paul W. Peterson Assoc. Dean of Research Iowa State University 104 Marston Hall Ames, IA 50011 (515) 294-2336
George Calvert Deputy Director, Development Iowa DOT - Highway Division Ames, IA 50010 (515) 239-1461	12-31-85	George F. Sisson Road Design Engineer Iowa DOT - Highway Division Ames, IA 50010 (515) 239-1470
Robert Gumbert Tama County Engineer 101 S. Main Toledo, IA 52342 (515) 484-3341 SS#-086	12-31-87	Royce J. Fichtner Marshall County Engineer Courthouse Marshalltown, IA 50158 (515) 754-6343 SS#-064
Robert G. Hering Dean of Engineering University of Iowa Iowa City, IA 52242 (319) 353-6603	12-31-87	Harrison Kane, Chairman Civil & Env. Engr. Program University of Iowa Iowa City, IA 52242 (319) 353-4968
Raymond L. Holland City Engineer Bettendorf, IA 52722 (319) 359-0347	12-31-85	Charles J. Schmadeke Director of Public Works Iowa City, IA 52240 (319) 356-5141
Orville D. Ives Monona County Engineer Box 236 Onawa, IA 51040 (712) 423-2284 SS#-067	12-31-85	Richard Michaelis Carroll County Engineer Carroll, IA 51401 (712)792-3603 SS#-014
Neil Jorgenson Franklin County Engineer Box 118 Hampton, IA 50441 (515) 456-4671 SS#-035	12-31-86	Robert Haylock Butler County Engineer Courthouse Allison, IA 50602 (319) 267-2630 SS#-012
Gerald D. Petermeier Benton County Engineer 111 E. 3rd Street Vinton, IA 52349 (319) 472-2211 SS#-006	12-31-85	Robert DeWys Scott County Engineer Courthouse Davenport, IA 52801 (319) 326-8640 SS#-082
Wm. Jay Schreiner City Engineer 211 S.W. Walnut Ankeny, IA 50021 (515) 964-5500	12-31-87	Richard Ransom City Engineer City Hall Cedar Rapids, IA 52401 (319) 398-5026
Robert Simmering Muscatine County Engineer 1631 Isett Avenue Muscatine, IA 52761 (319) 263-6351 SS#-070	12-31-86	Milton L. Johnson Wapello County Engineer 501 S. Union Street Ottumwa, IA 52501 (515) 684-5425 ex. 147 SS#-090
Van R. Snyder District 4 Engineer Iowa DOT - Highway Division Atlantic, IA 50022 (712) 243-3355 SS#-240	12-31-87	James R. Bump District 3 Engineer Iowa DOT - Highway Division Sioux City, IA 51102 (712) 276-1451 SS#-230

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 or the Farm-to-Market Road Fund, depending on which road system will benefit from the project. If both primary and secondary 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, 1985. Total expenditure was $1,474,250.18, including support of the National Cooperative Highway Research Program.

IN-HOUSE RESEARCH AND DEVELOPMENT

Research and development projects performed by Highway Division personnel are termed "in-house" projects. These projects may involve other departmental and district 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 shown for in-house projects are relatively small and the Office of Materials, Research Section, wishes to express its appreciation to other offices and districts 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 Science.

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.

SECONDARY ROAD TRAFFIC COUNT PROGRAM

The Office of Transportation Inventory conducted traffic counts in twenty-five counties during fiscal year 1985 as part of the Annual Traffic Count Program. This activity consisted of 1,152 four-hour manual counts, 253 eight-hour manual counts, 128 sixteen-hour manual counts, and 2,242 recorder counts. Traffic volumes from these counts are used to develop Motor Vehicle Traffic Flow Maps for each county showing the Average Annual Daily Traffic "AADT" on specific road sections within each county.

Secondary roads were physically inventoried for geometrics and current condition in nine 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 1 1/2 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 reintstated in 1965. When the fund was reinstated, the use was designated to finance engineering studies and research projects. A summary of research and development expenditures from the Secondary Road Research Fund is itemized in Table II.

The values shown in Table II are actual research expenditures for fiscal year 1985. The Office of Transportation Inventory engineering studies include traffic counts and secondary road inventories. 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 expenditure. The Fiscal Year 1985 financial summary is.

Beginning Balance 7-1-84		$ 100,561
Receipts		
Interest	$ 42,647	
Federal Aid Secondary (1 1/2% of receipts)..	357,013	
State Road Use Tax Fund (1 1/2% of receipts)...	563,855	
Research Income	89,872	
Sub-Total		1,053,387
Total Funds Available		$1,153,948
Obligation for Expenditures		
Obligated for Contract Research...	181,292	
Non-Contract Engineering Studies...	307,762	
Total Expenditures		$ 489,054
BALANCE 6-30-85		$ 664,894

PRIMARY ROAD RESEARCH FUND

The Primary Road Research Fund is one of four programs included in the Contingency Programs Fund from 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 committed to contract research from the Primary Road Research Fund for FY85 was $385,000 and the estimate for FY86 is $345,000.

TABLE II
FINANCIAL SUMMARY OF RESEARCH AND DEVELOPMENT PROJECT EXPENDITURES
July 1, 1984 to June 30, 1985
(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	Total Expenditures
140	65,000.00	Collection and Analysis of Stream Flow Data	32,500.00	65,000.00	97,500.00
165	150,000.00	Experimental Steel Fiber Reinforced Concrete Overlay		75,000.00	75,000.00
198	75,000.00	Preliminary Archaeological Investigation Along Proposed Highway Right-of-Way			
205	3,150.00	Effects of Special Aggregate on Bridge Deck Overlay Frictional Properties			
208A	137,725.00	Alternative Methods of Stabilizing the Degrading Stream Channels in Western Iowa	242.41	3,604.77	3,847.18
209	100,346.85	Pavement Surface on Macadam Base - Adair Co.			
210	30,072.00	The Effect of Deer Reflectors on Deer-Vehicle Accidents			
213	13,550.00	Improved Asphalt Pavement Performance Through Crack Maintenance			
215	10,700.00	Improvement of Longitudinal Joints in Asphalt Pavements			
216	156,288.60	Asphalt Emulsion Bound Macadam			
220	8,000.00	Protection of Structural Concrete Substructures			
222	17,500.00	Retardation of Reflection Cracking Using Stabilizing Additive 5990			
224	8,000.00	Restoration of Frictional Characteristics on Older PCC Pavement			
229	130,000.00	Alternate Flexible Overlays			
231	45,340.00	Special Surface Preparation Prior to Bituminous Overlays			
232	4,105.00	Reducing the Problem of Transverse Cracking			
233	40,232.88	Field Demonstration and Evaluation of Foamed Asphalt		4,284.13	4,284.13
234	6,268.00	Compilation of Iowa Highway Laws			
236	88,143.00	Pottawattamie Co. Evaluation of Stabilizing Degrading Stream Channels		5,354.01	5,354.01
237	87,065.00	Shelby Co. Stabilization of Degrading Stream Channels			
238	162,898.00	Strengthening Existing Single Span Steel Beam Concrete Deck Bridges	19,161.25	15,247.23	34,408.48
241	8,500.00	Development of EDMI Calibration Baseline	529.56	320.44	850.00
242	132,069.50	Economics of Alterrnative Solutions to the Secondary Roadway Problem		17,618.39	17,618.39
244	9,700.00	Detection of Concrete Delaminations by Infrared Thermography			
246	118,000.00	Engineering Study - Reducing Sign Vandalism		3,680.20	3,680.20
247	88,260.00	Design Criteria for Low Water Crossings		9,246.64	9,246.64
248	11,000.00	Evaluation of a Mobile Rut Depth Device for the Pavement Management Program			
252	52,945.00	Piling Stresses in Bridges with Integral Abutments - II	5,447.97	4,994.65	10,442.62
253	72,000.00	Experimental Use of Calcium Magnesium Acetate (CMA)	31,025.98		31,025.98
254	17,500.00	Highway/Railroad Grade Crossings - Identification and Signing			
255	55,506.00	Submerged Vanes for Controlling Streams	5,823.19	3,620.78	9,443.97
256	101,960.00	Perception and Interpretation of Advance Warning Signs on County Roads		13,972.57	13,972.57
257	132,740.00	Field Demonstration of Foamed Asphalt - Muscatine County		12,724.00	12,724.00
258	115,870.00	Frost Action in Rocks and Concrete	19,632.57	19,770.99	39,403.56
259	89,390.00	Low Cost Fly Ash-Sand Stabilized Roadway		77,751.00	77,751.00
260	158,235.00	Optimization of Soil Stabilization with Type C. Fly Ash	8,937.36	37,592.80	46,530.16
262	70,580.00	Signing on Very Low Volume Rural Roads		7,838.93	7,838.93
263	365,800.00	Engineering Study to Redesign the 24-Foot Secondary Bridge Standards		162,178.09	162,178.09
264	41,660.00	Development of a Sufficiency Rating System for Secondary Roads		9,862.90	9,862.90

Table II (con't.)

265	300,000.00	Engineering Study for the Evaluation of Public Road Administration & Maintenance Alternatives	92,832.35	99,789.00	192,621.35
266	30,000.00	X-Ray Analysis of Carbonate Aggregate to Predict Concrete Durability	6,955.95	6,956.87	13,912.82
267	12,100.00	Engineering Study-Development of Training Aids for Snow Removal on Iowa's Secondary Roads		3,189.78	3,189.78
268	110,500.00	Evaluation of Magnitude and Frequency of Floods in Iowa	32,500.00	40,125.00	72,625.00
269	24,250.00	Data Acquisition and Computer Plotting of Delamtect Data	19,463.42		19,463.42
270	100,000.00	Development of Training Aids and Demonstration of Portland Cement Concrete Pavement Rehabilitation	93,660.74		93,660.74
271	56,335.00	Effects of Deicing Salt Compounds on Deterioration of PC Concrete	13,643.05		13,643.05
272	62,110.00	Development of a Conductometric Test for Frost Resistance of Concrete	2,076.21	455.93	2,532.14
273	124,834.00	Piling Stresses in Bridges With Integral Abutments - Phase 3			
274	66,000.00	Construction and Evaluation of Submerged Vanes for Stream Control			
275	41,577.00	Long Term Structural Movement			
276	32,000.00	Transverse Joint Sealing With Improved Sealants			
277	92,210.00	Cracking and Seating PCC Pavement Prior to Resurfacing to Retard Reflection Cracking			
278	89,700.00	Beneficial Effects of Selected Additives on Asphalt Cement			
1027	32,500.00/yr.	Secondary Road Research Coordinator		32,117.68	32,117.68
		Contract Research Sub-Total	$384,432.01	$732,296.78	$1,116,728.79
HPR-2 (121)		NCHRP pooled fund project for National Program for Skid Test and Calibration Centers	8,461.78	1,266.53	9,728.31
HPR-2 (124)		NCHRP pooled fund project for Asphalt Rubber Paving Materials	4,545.60	694.16	5,239.76
HPR-2 (127)		NCHRP pooled fund project for Cost Effective Geometric Design Standards for RRR Projects	4,093.53	625.13	4,718.66
HPR-4 (182)		NCHRP FY82 General Project Funding	7,865.94	1,201.20	9,067.14
HPR-4 (183)		NCHRP FY83 General Project Funding	26,478.12	3,192.79	29,670.91
HPR-4 (184)		NCHRP FY84 General Project Funding	9,118.33	1,059.28	10,177.61
HPR-PR-PL-1 (21)		FY 1985 Planning & Research Program (Transportation Inventory Engineering Studies)		288,919.00	288.919.00
		Noncontract Engineering Studies Sub-Total	$ 60,563.30	$296,958.09	$357.521.39
		Grand Total of Expenditures	$444,995.31	$1,029,254.87	$1,474,250.18

Project Number: HR-140

Project Title: Collection and Analysis of Stream Flow Data

Agency: Iowa City Office, Water Resources Division, United States Geological Survey, Department of Interior

Principal Investigator: J. J. Klein, U.S.G.S.

Research Period: Project continued to September 30, 1985

Research Funding: $65,000 per year (matched by $65,000 from the Department of the Interior)

Funding Source: 100 percent State funds--50 percent Primary, 50 percent Farm-to-Market

Iowa DOT Project Control: Mark F. Looschen, Bridge Design

Objectives: The objectives of Project HR-140 are to obtain information about the flow of water in Iowa streams with particular emphasis on the magnitude and frequency of floods and to compile and analyze this information for use by highway engineers engaged in the design of bridges, culverts and embankments.

Progress: The Water Resources Division employs a staff of engineers and technicians who monitor and maintain a network of gaging stations on Iowa streams. These measurements, along with data from special studies of selected streams and floods, are compiled and analyzed to form the basis for predictions of future streamflow. The progress during 1983-1984 was in accordance with schedules established by the Water Resources Division.

Reports: A summary report of magnitude and frequency of Iowa floods is prepared annually. Reports of selected floods are also available.

Implementation: The information obtained from Project HR-140 is used daily by DOT personnel in the design of bridges and culverts.

Project Number: HR-165

Project Title: Experimental Steel Fiber Reinforced Concrete Overlay

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

Principal Investigators: R. Betterton and V. Marks

Research Period: April 1, 1984, to March 31, 1989

Research Funding: $150,000

Funding Source: 67 percent State--Farm-to-Market funds, 33% Federal Funds

Objective: To evaluate the long term performance of fibrous and nonfibrous PC concrete overlays.

Progress: This project on Greene County Road E-53 just east of Jefferson was constructed in 1973. It included 33 fibrous and nine nonfibrous overlay sections over an old, badly broken portland cement concrete pavement. A final report on the original project was written in 1978. The overlay sections were evaluated again in 1983 at 10 years. The project has now been reopened to maintain the overlay sections as research through 15 years.

Reports: Ten year report, February 1984 & January 1985 (TRB).

Implementation: The long term performance data will provide design and planning data for other PC concrete overlays.

Project Number: HR-198

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

Agency: State Archaeologist (University of Iowa)

Principal Investigator: D. Anderson, State Archaeologist

Research Period: July 1, 1977, to June 30, 1986

Research Funding: $75,000 (Revolving Fund)

Funding Source: 100 percent State--Farm-to-Market 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 examination.

Progress: The Iowa Department of Transportation contracts with the State Archaeologist to perform the needed preliminary investigations and prepare the necessary reports. Secondary road construction sites with archaeological value are being examined in advance of construction. Under a new Iowa DOT policy, a revolving fund has been established within the Secondary Road Research Fund to initially pay for the services of a survey contractor. Billings are then made to the counties and cities for their proportionate share of costs incurred. Additional funds were allocated to the revolving fund due to an unanticipated heavy load of Phase 2 testing activity. High potential sites, located through Phase 1 surface survey techniques, required additional subsurface examination in order to establish significance.

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

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

Project Number: HR-205

Project Title: Effects of Special Aggregate on Bridge Deck Overlay Frictional Properties

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: V. J. Marks

Research Period: December 14, 1978, to December 31, 1985

Research Funding: $3,150

Funding Source: 100 percent State--Primary funds

Objective: To evaluate the benefit of incorporating a hard, durable aggregate in a dense pc concrete bridge deck overlay to provide frictional property longevity.

Progress: Special coarse aggregate was used in two bridge deck overlay projects on Interstate 35 near Ankeny. Resurfacing of the bridge decks was completed in the summer of 1979. The use of special aggregates resulted in a more consistent mix with improved workability and greater ease of finishing and texturing. Friction testing is being conducted on the bridges on a regular basis.

Reports: Friction Testing Summary

Implementation: Hard, durable aggregates will help to provide improved frictional property longevity in bridge deck overlays.

Project Number: HR-208A

Project Title: Evaluation of Control Structures for Stabilizing Degrading Stream Channels in Western Iowa

Agency: Iowa State University

Principal Investigators: R. A. Lohnes, F. W. Klaiber, and T. Austin

Research Period: December 1, 1980, to September 30, 1985

Research Funding: $137,725

Funding Source: 100 percent State--Farm-to-Market funds

Objective: To design and install several types of grade stabilization control structures in at least two streams in western Iowa, instrument them, and scientifically document their effectiveness.

Progress: Six demonstration sites, three in Shelby County and three in Pottawattamie County, were selected for initial field installation and operational studies. Preliminary designs for the control structures have been completed. The designs include three vertical sheet-pile structures, two soil-cement structures, and one pre-cast concrete structure. Hydraulic and structural analyses of the proposed structures are in progress. One structure in Pottawattamie County originally designed as a sheet-pile structure was changed to a gabion structure and was completed in 1983. Plans for a sheet-pile structure are being developed by Shelby County for construction in 1986.

Reports: Progress Report, May 1983

Implementation: Bridge structures are expensive to construct and maintain. If more economical methods of grade stabilization can be developed, it will result in shorter bridges and save millions of dollars for counties in western Iowa.

Project Number: HR-209

Project Title: Pavement Surface on Macadam Base

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

Principal Investigator: D. J. Lynam

Research Period: June 26, 1979, to December 31, 1989

Research Funding: $100,346.85

Funding Source: 100 percent State--Farm-to-Market funds

Objective: To determine the feasibility, economics and performance of placing pc concrete on macadam base while developing design criteria by varying the thickness of the pc concrete and to determine if the macadam base is effective in reducing D-cracking deterioration of concrete produced with limestone having poor durability characteristics.

Progress: Construction was completed on approximately two miles of Adair County Road G-61 in 1979. Seven different roadway typical sections were utilized. A variation in shoulder construction with improved drainage was incorporated into one section. One mile of 6" thick pcc pavement adjacent to the experimental construction was included in the evaluation of the research. Minor construction problems were initially encountered in placing the thin section of pcc on the stone base. Some small areas of distress are visible, but the overall appearance of the pavement is good. No D-cracking has been observed on either the test sections or the control section. The evaluation period of the project has been extended to continue through 1989.

Reports: Final Report October, 1984

Implementation: This study may result in the ability to construct a more durable pavement with a more stable subgrade at a lower cost.

Project Number: HR-210

Project Title: The Effect of Deer Reflectors on Deer-Vehicle Accidents

Agency: Iowa Conservation Commission, Iowa Department of Transportation, Highway Division

Principal Investigator: L. Gladfelter, H. Dolling

Research Period: June 15, 1979, to January 31, 1985

Research Funding: $30,072

Funding Source: 100 percent State--Primary funds

Objective: To evaluate the "Swareflex" and Bosch reflector system in reducing deer-vehicle accidents, to determine a cost benefit ratio for the system and to identify deer crossing areas throughout the state for possible implementation of the system.

Progress: Traffic counting equipment was installed at five designated sites. Deer-vehicle accident records were maintained for one year prior to the installation of the reflectors. The study areas selected are distributed around the state to include different driving conditions, traffic volumes and deer densities. Red Swareflex reflectors were mounted at four sites. Silver reflectors purchased from the Robert Bosch Corporation were installed at one site for comparison purposes. A number of Swareflex reflectors had to be replaced due to a design problem. Results from the first and second years of data indicated a possible decrease in deer-vehicle accidents. The reflectors were removed in July, 1983 and accident data was collected through June 30, 1984. The reflectors appeared to be effective at some locations but inconclusive as to general effectiveness.

Reports: Final report, December 1984

Implementation: An effective deer reflector will reduce deer-vehicle accidents and thereby result in savings to the motorist.

Project Number: HR-213

Project Title: Improved Asphalt Surfaces and Asphalt Resurfacing Performance Through Crack Maintenance

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: R. R. Samuelson

Research Period: November 12, 1979, to April 1, 1986

Research Funding: $13,550

Funding Source: 100 percent State--Primary funds

Objective: To provide better asphalt roadways through evaluation of various combinations of cleaning and crack preparation, and to identify the most effective maintenance procedure and the most effective preparation in providing improved resurfacing performance.

Progress: A Vanguard 2000 PSI waterblaster was purchased from a Des Moines distributor. This high-pressure washer was used extensively for joint and crack maintenance on various primary and interstate highways. An experimental section was established on Iowa 7 west of Fort Dodge.

Reports: Progress Report, January 1983

Implementation: Better methods of joint and crack maintenance will result in improved riding qualities and may permit the use of thinner overlays on asphalt roadways.

Project Number: HR-215

Project Title: Improvement of Longitudinal Joints in Asphalt Pavement

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: R. W. Monroe

Research Period: March 5, 1980, to January 31, 1987

Research Funding: $10,700

Funding Source: 100 percent State--Primary funds

Objective: To identify construction procedures that will provide an improved longitudinal centerline joint.

Progress: Asphalt widening and resurfacing were completed on Iowa 44 in Guthrie and Dallas counties in August 1980. Repetitive sections of seven different treatments of the longitudinal joint were included in the project. Core samples to determine densities were taken that fall. Visual observations are made annually.

Reports: Construction Report, February 1981

Implementation: Improved methods for construction of longitudinal joints will result in increased life of asphalt resurfacing by reducing joint deterioration.

Project Number: HR-216

Project Title: Emulsion Treated Macadam Base*

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

Principal Investigator: C. L. Baule

Research Period: April 28, 1980, to January 15, 1985

Research Funding: $156,288.60

Funding Source: 100 percent State--Farm-to-Market funds

Objective: To identify and construct a cost-effective asphalt emulsion bound macadam section and to evaluate the performance of an asphalt bound macadam as compared to unbound macadam.

Progress: Construction of the macadam sections was completed in September 1980. Six different roadway sections using bound or unbound macadam base were compared to an asphalt surface on an asphalt treated base. The most serious problem encountered in the project was the inability to obtain complete coating of the emulsion treated materials. More favorable weather conditions and modified construction procedures helped alleviate this problem. Riding quality and overall appearance of this experimental pavement is satisfactory.

Reports: Final Report, January 1985

Implementation: Macadam base projects in the past have provided excellent drainage characteristics. The use of asphalt emulsion binder may result in energy savings and improved stability, while still providing a relatively low-cost roadway base.

*This project is part of U.S. DOT project No. 55, "Asphalt Emulsions for Highway Construction," and was funded in part with $35,000 of FHWA Region 15 funds.

Project Number: HR-220

Project Title: Protection of Structural Concrete Substructures

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: J. Risch

Research Period: May 1980, to July 15, 1989

Research Funding: $8,000

Funding Source: 100 percent State--Primary funds

Objective: To field test the long-term effectiveness of several available products or procedures for their ability to protect concrete surfaces against the intrusion of chloride ions.

Progress: A substantial number of cores were drilled from bridge pier columns on I-235 in Des Moines and I-380 in Cedar Rapids to determine the chloride contamination. Relatively new pier columns of two bridges over I-380 in Cedar Rapids were selected for treatment to prevent chloride intrusion. A number of commercially available waterproofing products were used, with varying application rates and surface preparation methods, to determine their potential for preventing chloride intrusion. Cores are being taken periodically to monitor the chloride content of the pier column concrete. Chloride intrusion into these columns which are farther from the roadway is at a slower rate than anticipated. This requires a longer research period.

Reports: Progress Report, December 1984

Implementation: A protective system will prevent the intrusion of chlorides into structural concrete and will help to prevent the need for repairs which are both difficult and expensive.

Project Number: HR-222

Project Title: Retardation of Reflection Cracking Using Stabilizing Additive 5990

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: R. W. Monroe

Research Period: July 1, 1980, to June 30, 1986

Research Funding: $17,500

Funding Source: 100 percent State--Primary funds

Objective: To evaluate the use of Stabilizing Additive 5990 (a mixed polymer in granular form) as a method of reducing cracking in asphaltic concrete overlays.

Progress: A crack survey was made of the existing portland cement concrete prior to construction. The asphaltic concrete resurfacing has been laid. Sections with varying percentages of stabilizing Additive 5990 in the asphalt concrete mixture were incorporated into the project. Periodic crack surveys have been made. A substantial amount of the joints and cracks have reflected through the surface.

Reports: None

Implementation: Any product or method that will prevent reflection cracking will save maintenance funds spent for crack sealing.

Project Number: HR-224

Project Title: Restoration of Frictional Characteristics on Older PCC Pavement

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: V. J. Marks

Research Period: July 1, 1980 to December 31, 1985

Research Funding: $8,000

Funding Source: 100 percent State--Primary funds

Objective: To identify a cost-effective method of restoring the friction characteristics on older pcc pavement.

Progress: Three experimental applications of systems to improve the texture of pcc have been applied to older pavement. Transverse grooving was cut into a northbound lane of I-29 at the north edge of Council Bluffs adjacent to a longitudinal grooving safety enhancement project in July 1980. A very thin lift (about 1/2 inch) of hot sand asphalt was placed on I-80/I-35 at the north edge of Des Moines in September 1980. A small patch (4' x 4') of latex modified concrete surface dressing was placed on northbound I-35 just south of Ames to determine its durability. Friction testing of the grooving and hot sand asphalt is being conducted annually.

Reports: Construction Report, April 1981 and annual friction summaries.

Implementation: A cost-effective method of restoration of pcc friction properties will yield substantial savings.

Project Number: HR-229

Project Title: Alternative Flexible Overlays

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

Principal Investigators: R. Glasgow, and C. Leonard

Research Period: March 1981, to October 1987

Research Funding: $130,000

Funding Source: 100 percent State--Farm-to-Market funds

Objective: To construct and evaluate several bituminous concrete base overlays which have the potential to reduce future maintenance and construction costs.

Progress: Eight different test sections of cold-laid bituminous overlays were constructed in September 1981 on Osceola County Roads A-34 and A-46. Aggregate for four of the test sections consisted of salvaged asphalt pavement and new aggregate combined. The other four test sections contained only new aggregate. Four types of asphalt binder were mixed with each aggregate to develop the eight test sections. A seal coat has been placed on all test sections to provide a wearing surface. Evaluation will continue for six years.

Reports: Construction Report, February 1983

Implementation: Identification of a surface which is less prone to transverse cracking will result in a substantial savings due to increased life and reduced maintenance of asphalt concrete pavements.

Project Number: HR-231

Project Title: Special Surface Preparation Prior to Bituminous Overlay

Agency: Cerro Gordo County and Iowa Department of Transportation, Highway Division

Principal Investigator: W. Davison

Research Period: May 1981, to April 1987

Research Funding: $45,340

Funding Source: 100 percent State--Farm-to-Market funds

Objective: To identify an effective crack sealing procedure which will extend the service life of a roadway and lower maintenance costs.

Progress: Four crack sealing methods were done in May 1982, on Cerro Gordo County Road S-25. The crack filling materials were standard emulsion sealer, rubberized asphalt sealer, pressure-injected fly ash-cement slurry and pressure-injected limestone-emulsion slurry. Three test sections were formed by repeating the four crack sealing procedures along the length of the project. Overlays for the three sections were 2" of Type "B" asphalt cement concrete, 1 1/2 of Type "B" asphalt cement concrete, and a limestone-emulsion slurry seal. Crack sealing with the limestone-emulsion slurry injection was discontinued after several unsuccessful attempts at mixing the material. Evaluation will continue for a five-year period.

Reports: Construction Report, January 1983

Implementation: A procedure of properly sealing transverse cracks prior to a bituminous overlay should extend the life of the overlay, reduce maintenance costs, and improve the ride quality of the roadway.

Project Number: HR-232

Project Title: Reducing the Problem of Transverse Cracking

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: R. Merritt and V. Marks

Research Period: May 1, 1981, to May 31 1985

Research Funding: $4,105

Funding Source: 100 percent State--Primary funds

Objective: To identify a method of reducing the adverse effect of transverse cracking and improving the performance of asphalt pavement.

Progress: Engineering fabric was used in full depth asphalt construction on a Jones County project. For two experimental sections, the fabric was placed on grade beneath the asphalt treated base. The fabric was placed between lifts of the asphalt treated base for two other sections. A few cracks have occurred. The fabric was torn in two at the crack.

Reports: Final Report, March 1985

Implementation: This research has shown that this type of fabric does not significantly reduce the frequency of transverse cracking. This project will promote other research to provide a solution to this problem.

Project Number: HR-233

Project Title: Field Demonstration and Evaluation of Foamed Asphalt

Agency: Iowa State University.

Principal Investigator: D. Y. Lee

Research Period: May 1, 1981, to September 30, 1985

Research Funding: $40,232.88

Funding Source: 100 percent State--Farm-to-Market funds

Objective: To evaluate the performance of foamed asphalt mixes using local materials as base and surface courses; to correlate field strength characteristics and performances of foamed mixes with laboratory strength characteristics and performances; and to develop specifications and evaluate construction procedures and inspection tests.

Progress: Iowa State University conducted laboratory evaluation of foamed asphalt with various aggregate and soil-aggregate mixtures. Preliminary evaluation was conducted for a Shelby County project. It was determined that additional aggregate was necessary in a Shelby County soil-aggregate roadbed material to achieve a satisfactory foamed mix. Funds for the additional aggregate were not available and the Shelby County project was dropped. A Muscatine County foamed asphalt project (HR-257) utilizing 3/8" minus limestone tailings and pitrun sand is being evaluated. Nine different test sections were constructed on 4.2 miles of county road A-91 in 1983.

Reports: None

Implementation: Foamed asphalt offers potential for energy conservation and the utilization of marginal locally available aggregates.

Project Number: HR-234

Project Title: Compilation of Iowa Highway Laws

Agency: Iowa Department of Transportation, Office of General Counsel

Principal Investigators: L. Paff and K. Jones

Research Period: April 1, 1985 to January 1, 1986

Research Funding: $6,268

Funding Source: 100 percent State funds--40 percent Primary, 60 percent Farm-to-Market

Objective: To provide a current annotated Iowa Transportation Law manual.

Progress: Two law clerks were retained on a temporary basis to search out the laws and pertinent court cases and produce an "Iowa Transportation Laws (Annotated)" manual in 1982. To keep the manual current, a law clerk has been retained during the summer of 1985 to make changes and updates.

Reports: Final Report, January 1984

Implementation: With this handy reference to ascertain applicable laws and decisions, transportation engineers will avoid oversight that may result in costly legal claims.

Project Number: HR-236

Project Title: Pottawattamie County Evaluation of Control Structures for Stabilizing Degrading Stream Channels

Agency: Pottawattamie County, Iowa State University and the Iowa Department of Transportation, Highway Division

Principal Investigators: C. E. Hales, R. A. Lohnes, F. W. Klaiber and T. Austin

Research Period: July 10, 1981, to June 1, 1986

Research Funding: $88,143

Funding Source: 100 percent State--Farm-to-Market funds

Objective: To design and construct three types of grade stabilization control structures for Keg Creek, instrument them, and scientifically document their effectiveness.

Progress: Preliminary designs for the control structures have been completed. The designs include a vertical sheet-pile structure, a soil-cement structure, and a pre-cast concrete structure. Hydraulic and structural analyses of the proposed structures have been completed. One structure originally designed as a sheet-pile structure was changed to a gabion structure and completed in 1983.

Reports: Construction Report, January 1985

Implementation: Bridge structures are expensive to construct and maintain. If more economical methods of grade stabilization can be developed, it will result in shorter bridges and savings of millions of dollars for counties in western Iowa.

Project Number: HR-237

Project Title: Shelby County Evaluation of Control Structures for Stabilizing Degrading Stream Channels

Agency: Shelby County, Iowa State University and the Iowa Department of Transportation, Highway Division

Principal Investigators: E. Schornhorst, R. A. Lohnes, F. W. Klaiber and T. Austin

Research Period: July 10, 1981, to June 1, 1986

Research Funding: $87,065

Funding Source: 100 percent State--Farm-to-Market funds

Objective: To design and construct three types of grade stabilization control structures for two creeks in Shelby County, instrument them, and scientifically document their effectiveness.

Progress: Preliminary designs for the control structures have been completed. The designs include two vertical sheet-pile structures and a soil-cement structure. Hydraulic and structural analyses of the proposed structures were completed. A sheet-pile structure is currently being designed for construction during 1986.

Reports: None

Implementation: Bridge structures are expensive to construct and maintain. If more economical methods of grade stabilization can be developed, it will result in shorter bridges and savings of millions of dollars for counties in western Iowa.

Project Number: HR-238

Project Title: Strengthening Existing Single Span Steel Beam Concrete Deck Bridges

Agency: Iowa State University

Principal Investigator: F. W. Klaiber

Research Period: July 1, 1981, to September 30, 1984

Research Funding: $162,898

Funding Source: 100 percent State funds--50 percent Primary, 50 percent Farm-to-Market

Objective: To design and install post-tensioning strengthening on two single span steel beam concrete deck bridges, instrument them, and document their performance over a period of two years following post-tensioning.

Progress: A bridge on a Farm-to-Market road in Dickinson County and a bridge on Iowa 144 in Greene County have been post-tensioned. Strain measurements were determined under a heavily loaded truck after post-tensioning.

Reports: Final Report - Part I, February 1983, Part II, March 1985

Implementation: Bridges that do not meet current standards for live load carrying capacity could have the capacity restored, causing posted limits to be raised or removed. In some cases, bridges which have been restricted to one-lane traffic could have the restriction removed.

Project Number: HR-241

Project Title: Development of Electronic Distance Measuring Instrument (EDMI) Calibration Baseline

Agency: Iowa State University

Principal Investigator: K. Jeyapalan

Research Period: March 8, 1982, to March 31, 1984

Rsearch Funding: $8,500

Funding Source: 100 percent State--47 percent Primary, 53 percent Farm-to-Market funds

Objective: To develop a mathematical model to determine the scale and constant of the EDMI; to develop a computer program for calculation of the EDMI scale and constant; and to evaluate the stability of the baseline.

Progress: The baseline was established on an Iowa State University farm southwest of Ames. Measurements indicated no movement of the monuments. Some EDMI's were calibrated using a program developed for the project.

Reports: Final Report, March 1984

Implementation: Use of the baseline and EDMI calibration procedure will assure survey accuracy and prevent loss due to the legal action.

Project Number: HR-242

Project Title: Economics of Alternative Solutions to the Secondary Road Problem*

Agency: Iowa State University and Linn County

Principal Investigator: C. P. Baumel

Research Period: July 1, 1982 to November 30, 1985

Research Funding: $132,069.50

Funding Source: 100 percent State--Farm-to-Market funds

Objective: To estimate the benefits and costs of alternative investment strategies in solving the rural road and bridge problem.

Progress: An advisory board of county engineers was established and three counties were selected to evaluate the cost-benefit investment strategies. Surveys were conducted in Shelby, Hamilton and Linn Counties. Data is being analyzed and costs for various vehicles have been established.

Reports: Progress Report, January 1984.

Implementation: A procedure will be developed that will allow county governments to best utilize limited funding in maintaining necessary roadways in a cost-effective program.

*This project is part of a larger project funded by the Program of University Research, U.S. Department of Transportation.

Project Number: HR-244

Project Title: Detection of Concrete Delaminations by Infrared Thermography

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: B. Brown

Research Period: May 1, 1982 to January 31, 1986

Research Funding: $9,700

Funding Source: 100 percent State--Primary funds

Objective: To assess the accuracy, dependability, and potential of the infrared thermographic technique of detecting bridge deck delaminations.

Progress: Fifteen bridges and five miles of thin bonded portland cement concrete have been surveyed by Donohue and Associates of Sheboygan, Wisconsin. These infrared thermography surveys have been compared to conventional delamination testing methods.

Reports: Summary and Strip Charts of Survey

Implementation: Surveys of a great number of structures could be made in a given amount of time, thereby assisting in the timely programming of deck replacement or repair projects.

Project Number: HR-246

Project Title: Engineering Study - Reducing Sign Vandalism

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: K. Jones

Research Period: June 14, 1982, to February 1988

Research Funding: $118,000

Funding Source: 100 percent State--Farm-to-Market funds

Objective: To reduce the incidents and cost of sign vandalism.

Progress: A survey was sent to the counties asking about accidents at locations where a sign had been vandalized. Educational material and sign identification material has been developed to be distributed to school children, the general public, and to the Iowa counties. Several counties have been selected to participate in the study by recording specific sign replacement information.

Reports: Progress Report, September 1984

Implementation: The Federal Highway Administration estimates that at least 10 percent of all highway signs are vandalized each year. This costs Iowa counties over $1 million per year. One state conducted a public awareness campaign and achieved over a 50 percent reduction in signs being vandalized.

Project Number: HR-247

Project Title: Design Criteria for Low Water Crossings

Agency: Iowa State University

Principal Investigator: R. L. Rossmiller

Research Period: June 1, 1982, to August 31, 1984

Research Funding: $88,260

Funding Source: 100 percent State--Farm-to-Market funds

Objective: To develop a design procedure for low water stream crossings for use by the Iowa county engineers and to demonstrate the design procedure through field demonstration projects and training seminars.

Progress: The design procedure manual developed includes design criteria for the evaluation of the hydraulic, hydrologic, erosion control, structural, and location considerations for low water stream crossings in Iowa. Iowa counties currently experimenting with the crossings were contacted and asked for their input for the second phase of the research.

Reports: Design Manual, October 1983; Addendum to Design Manual, June 1984

Implementation: Iowa has nearly 8,000 deficient bridges on roads carrying less than 50 vehicles per day. Public demand is strong in favor of keeping these roads open. It is not economically feasible to replace the deficient bridges with new bridge structures. Low water stream crossings are a possible solution on many of very low volume roadways.

Project Number: HR-248

Project Title: Evaluation of a Mobile Rut Depth Measuring Device for the Pavement Management Program

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: Vernon J. Marks

Research Period: July 10,1982, to September 30, 1984

Research Funding: $11,000

Funding Source: 100 percent State--73 percent Primary, 27 percent Farm-to-Market funds

Objective: To evaluate a mobile, non-contact method for determining rut depths and to compare this system to manually obtained data.

Progress: A commercial mobile rut depth measuring device was ordered from SIE Geosource of Fort Worth Texas. The equipment was delivered, but there were continual problems with the electronics. The project was terminated and the rut depth device was returned to the manufacturer as it did not function satisfactorily.

Reports: Final Report, September 1984

Implementation: A mobile rut depth measuring device would improve data collection for the pavement management program with reduced hazard and traffic conflict at a substantial savings. Other mobile rut depth devices will be evaluated.

Project Number: HR-252

Project Title: Piling Stresses in Bridges with Integral Abutments II

Agency: Iowa State University

Principal Investigator: A. M. Wolde-Tinsae, L. F. Griemann

Research Period: October 1, 1982, to August 31, 1984

Research Funding: $52,945

Funding Source: 100 percent State--50 percent Primary, 50 percent Farm-to-Market funds

Objective: To determine the maximum length to which bridges with integral abutments can be safely designed.

Progress: A laboratory model was developed to evaluate piling stresses in integral abutment bridges. Formulas were developed to calculate maximum length with integral abutments. Current Iowa standards are very conservative.

Reports: Final Report, August 1984

Implementation: The economic advantage of integral abutments can be realized for longer bridges by eliminating expensive expansion assemblies and preventing early deterioration of piers and abutments requiring costly repairs.

Project Number: HR-253

Project Title: Experimental Use of Calcium Magnesium Acetate (CMA)

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: Wallace Rippie

Research Period: October 15, 1982 to April 1, 1986

Research Finding: $72,000

Funding Source: 100 percent State--Primary funds

Objective: To develop and evaluate continuous CMA mixing technology to reduce cost of production and further evaluate its deicing capabilities.

Progress: Bids were taken for the production of 100 tons of CMA. The low bidder, W. G. Block Co. produced 61 tons of a 1 part sand, 1 part CMA mix. This was delivered to Ames and used on four miles of U.S. 30 and 3.5 miles of U.S. 69. The CMA was effective as a deicing product, but not as effective as sodium chloride. The project was extended to develop lower cost methods of production. Bulk handling of materials and continuous production through a heated pugmill was demonstrated by Cedarapids, Inc. while producing 50 tons of CMA deicer.

Reports: Final Report, June 1983, Addendum to Final Report September 1984

Implementation: Identification, development and subsequent use of a non-corrosive deicing material would reduce the deterioration of highway structures and reduce environmental damage.

Project Number: HR-254

Project Title: Highway/Railroad Grade Crossings - Identification and Signing

Agency: Iowa Department of Transportation, Railroad Division

Principal Investigator: N. Volmer, P. Baer

Research Period: February 4, 1983, to January 10, 1986

Research Funding: $17,500

Funding Source: State--10% Primary, 90% Farm-to-Market funds. These funds were used for Phase I to obtain $157,000 FHWA funds which are 90% of the total Phase I cost.

Objective: To improve safety at highway/railroad crossings throughout the state by ensuring accurate accident records and upgrading passive signs.

Progress: New metal identification tags were obtained and were installed at all active crossings. Accident data is being collected.

Reports: Progress Report, January 1984.

Implementation: Accurate accident records will prioritize crossings for allocation of crossing safety improvement funds and thereby improve highway safety.

Project Number: HR-255

Project Title: Submerged Vanes for Flow Control and Bank Protection in Streams at Roads and Highways

Agency: University of Iowa

Principal Investigator: A. J. Odgaard, J. F. Kennedy

Research Period: February 1, 1983, to July 31, 1984

Research Funding: $55,506

Funding Source: 100 percent State--65 percent Primary, 35 percent Farm-to-Market funds

Objective: To develop an optimum vane-structure design and layout and to quantify the degree to which this bank protection measure reduces bank erosion.

Progress: A model demonstrating the effectiveness of the submerged vanes has been constructed in a circular flume of the University of Iowa Hydraulics lab. The fine sand in the flume can be deposited as desired by a change in vane orientation. Data has been obtained from the Nishnabotna River near U.S. 34 in Montgomery County where a field application will be constructed during the 1985 construction season.

Reports: Final Report July, 1984

Implementation: The cost to control stream bank erosion, especially near highways, could be reduced by a substantial amount and also be environmentally acceptable.

Project Number: HR-256

Project Title: Perception and Interpretation of Advance Warning Signs on County Roads

Agency: Iowa State University

Principal Investigator: K. A. Brewer

Research Period: February 1, 1983, to June 30, 1985

Research Funding: $101,960

Funding Source: 100 percent State--Farm-to-Market funds

Objective: To analyze the detection, recognition and decision process characteristics of drivers for the symbol stop-ahead advance warning sign in contrast to a small set of other signs.

Progress: The main thrust of the research was to design and conduct two laboratory experiments. The first experiment tested speed of detection and speed of recognition of the signs from an array of signs. The second experiment determined whether there are differences among signs in communicating to a driver that a stop sign is ahead. Data gathered from the experiments was analyzed to determine the effectiveness of the symbol stop-ahead advance warning sign in Iowa.

Reports: Final Report, March 1984, Addendum to Final Report, June 1985

Implementation: By identifying the most effective advance warning sign, intersection safety may be improved.

Project Number: HR-257

Project Title: Field Demonstration of Foamed Asphalt - Muscatine County

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

Principal Investigators: R. Simmering and H. Konrady

Research Period: April 18, 1983, to July 1, 1988

Research Funding: $132,740

Funding Source: 100 percent State--Farm-to-Market funds

Objective: To evaluate the performance of foamed asphalt as a stabilizing agent using locally available 3/8" minus limestone tailings and pitrun sand to construct a bituminous base course; to correlate field strength characteristics and performances of foamed asphalt mixes with laboratory strength characteristics and performances; and to develop specifications and evaluate construction procedures and inspection tests.

Progress: The project is a 4.2-mile section of Muscatine County Road A-91. Nine test sections comprised of a base 4 inches thick, using locally available sand and 3/8" minus limestone material mixed with AC-5 foamed asphalt cement were constructed in September of 1983. The nine test sections include two levels of moisture content, two levels of asphalt content and three levels of surface treatments.

Reports: Construction Report, December 1984

Implementation: Foamed asphalt offers potential for energy conservation and the utilization of marginal locally available aggregates.

Project Number: HR-258

Project Title: Frost Action in Rocks and Concrete

Agency: Iowa State University

Principal Investigator: Turgut Demirel

Research Period: April 1, 1983, to April 30, 1986

Research Funding: $115,870

Funding Source: 100 percent State funds--50 percent Primary, 50 percent Farm-to-Market

Objective: To develop a new methodology for estimating the frost susceptibility of porous rocks and concrete material.

Progress: Research is being conducted utilizing experimental methods for determining expansive pressures, rate of expansion and pore structure of rocks and concrete. Vycor samples have been used with conductometric testing to verify the ice porosimeter system. Preliminary results were promising and construction of the ice porosimeter has been completed. Aggregate samples are being evaluated.

Reports: Progress Report, March 1985.

Implementation: The development of a better method of determining the frost susceptibility of aggregates will prevent the use of nondurable aggregate and yield greater pcc pavement life.

Project Number: HR-259

Project Title: Low Cost Fly Ash-Sand Stabilized Roadway

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

Principal Investigators: S. Klassen and H. Konrady

Research Period: April, 1983, to July 1, 1988

Research Funding: $89,390

Funding Source: 100 percent State--Farm-to-Market funds

Objective: To develop a low cost fly ash stabilized roadway using locally available unprocessed sands and to correlate field strength characteristics and performance of the base with laboratory strength characteristics and pavement design assumptions.

Progress: The project is a 1-mile section of Des Moines County Road H-40. Various thicknesses of fly ash-cement-sand base were constructed using a locally available dredge sand from the Mississippi River. A three-inch thick acc overlay was placed over the base.

Reports: None

Implementation: There are plentiful supplies of blow sand, fine pitrun sand and the by-products from the production of concrete sand available in many areas of Iowa. Fly ash is also available to many areas of Iowa and is considered a waste product. The combination of these two materials has the potential for use as a low-cost base material for secondary road construction.

Project Number: HR-260

Project Title: Optimization of Soil Stabilization with Type C Fly Ash

Agency: Iowa State University

Principal Investigator: J. M. Pitt

Research Period: May 1, 1983, to April 30, 1986

Research Funding: $158,235

Funding Source: 100 percent State funds--80% Farm-to-Market, 20% Primary

Objective: To identify cost effective methods by which the newer varieties of fly ash can be used more efficiently for stabilized bases and subbases.

Progress: Laboratory testing has identified some chemicals that may provide beneficial reactions when used with fly ash. Various chemicals will be used with various sources of fly ash.

Reports: Progress Report, May 1984.

Implementation: Improvement in the cementitious characteristics of fly ash will increase utilization of fly ash, a waste product, and reduce roadway construction costs by decreasing the demand for more expensive portland cement.

Project Number: HR-262

Project Title: Signing on Very Low Volume Rural Roads

Agency: Iowa State University

Principal Investigator: R. L. Carstens

Research Period: May 1, 1983, to July 31, 1984

Research Funding: $70,580

Funding Source: 100 percent State--Farm-to-Market funds

Objective: To improve safety on secondary roads by formulation of traffic control device recommendations for low traffic volume roads.

Progress: A literature review was conducted to identify practices with potential application. A survey of current practices in Iowa was conducted and recommendations were made.

Reports: Final Report, July 1984

Implementation: A more uniform signing program across the state may provide improved safety and reduces tort liability on low traffice volume secondary roadways.

Project Number: HR-263

Project Title: An Engineering Study to Redesign the 24-Foot Secondary Bridge Standards

Agency: The Highway Division of the Iowa DOT and Stanley Consultants, Inc.

Principal Investigator: J. Harkin

Research Period: June 1, 1983, to June 30, 1986

Research Funding: $365,800

Funding Source: 100 percent State--Farm-to-Market funds

Objective: To redesign the 24-foot width secondary bridge standard plans to H20 loading and make other appropriate changes to meet current design standards.

Progress: Stanley Consultants, Inc. of Muscatine, Iowa, has completed the redesign of the 24' wide prestressed concrete and the continuous concrete slab secondary bridge standards.The consultant is currently redesigning the 24' wide simple span concrete slab secondary bridge standards. Crash testing of the secondary bridge rail has been submitted for inclusion in a FHWA project.

Reports: New bridge standards

Implementation: The Iowa counties make extensive use of the secondary bridge standard designs. The standard designs eliminate the need for extensive design work by individual counties for most bridge projects.

Project Number: HR-264

Project Title: Development of a Sufficiency Rating System for Secondary Roads

Agency: Iowa State University

Principal Investigator: C. R. Mercier

Research Period: June 1, 1983, to July 31, 1985

Research Funding: $41,660

Funding Source: 100 percent State--Farm-to-Market funds

Objective: To develop a system for rating secondary roadways to determine project priorities and budgetary needs.

Progress: An inventory of data sources has been conducted. Current practices in Iowa and other states were reviewed. A mathematical calculation procedure was developed for use by the Iowa counties.

Reports: Final Report, June 1985

Implementation: A sufficiency rating system will improve the cost effectiveness of secondary roadway planning and budgeting.

Project Number: HR-265

Project Title: Engineering Study for the Evaluation of Public Road Administation and Maintenance Alternatives

Agency: Iowa Department of Transportation, Highway Division and DeLeuw-Cather Engineering Management Services

Principal Investigators: V. Marks and J. Banks

Research Period: October 11, 1983, to August 31, 1985

Research Funding: $300,000

Funding Source: 100 percent State--50 percent Primary, 50 percent Farm-to-Market Funds

Objective: To evaluate the economic and other impacts associated with uniform design standards, consolidation of maintenance and transfer of roads with regard to state, county and city jurisdictions.

Progress: A 12-member advisory panel including four state, four county and four municipal representatives has been appointed. Proposals were received from consultants. The advisory panel selected DeLeuw-Cather Engineering Management services to conduct the project. The contractor has met periodically with the advisory panel. Data has been collected by a questionnaire and personal interviews. The contractor visited four other states with different administrative and maintenance practices.

Reports: Draft Final Report, June 1985

Implementation: Public road administration and maintenance options will be identified which will yield economic benefits.

Project Number: HR-266

Project Title: X-Ray Analysis of Carbonate Aggregates to Predict Concrete Durability

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: W. Dubberke

Research Period: November 1, 1983, to October 31, 1986

Research Funding: $30,000

Funding Source: 100 percent State--50 percent Primary, 50 percent Farm-to-Market Funds

Objective: To determine if a thorough analysis of the pore and chemical properties of an aggregate is sufficient to predict the service life of concrete produced with same.

Progress: Testing of various carbonate aggregates before and after treatment with sodium chloride and before and after freeze and thaw testing is being conducted with the x-ray equipment at Iowa State University. Tests have shown poorer durability after salt treatment. Some additives reduce the effect of salt treatment on lower quality coarse aggregate.

Reports: Progress Report, January, 1985

Implementation: More rapid and reliable methods of predicting service life of PCC pavement would result in reduced maintenance and lower life cycle costs for paved roadways.

Project Number: HR-267

Project Title: Development of Training Aids for Snow Removal on Iowa's Secondary Roads

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: K. Jones

Research Period: January 16, 1984, to March 31, 1985

Research Funding: $12,100

Funding Source: 100 percent State--Farm-to-Market Funds

Objective: To develop a training slide/tape presentation which will aid the county engineers and maintenance foremen in preparing maintenance personnel for the snow removal season.

Progress: The slide/tape presentation, "Snow Removal on Iowa's Secondary Raods," was developed with the cooperation of several Iowa counties. The program covers preparation for winter, snow and ice removal, and after storm care of equipment.

Reports: Slide/Tape Presentation, December 1984

Implementation: The public is not very tolerant of problems of snow removal. With proper preparation and training, maintenance forces can handle most storm situations effectively without problems.

Project Number: HR-268

Project Title: Evaluation of Magnitude and Frequency of Floods in Iowa.

Agency: Iowa City Office, Water Resources Division, United States Geological Survey, Department of the Interior.

Principal Investigator: J. J. Klein, U.S.G.S.

Research Period: June 1, 1984, to November 30, 1986

Research Funding: $110,500 (matched by $110,500 from the Department of the Interior)

Funding Source: 100 percent State funds -- 50 percent Primary, 50 percent Farm-to-Market

Iowa DOT Project Control: Mark F. Looschen

Objective: To evaluate all available surface water data from Iowa streams and publish a comprehensive methodology for statistically estimating the magnitude and frequency of floods in Iowa.

Progress: Flood stage data has been compiled. A literature search for the latest method of stream flow and flood stage calculation has been completed.

Reports: None

Implementation: Updated information and improved methods of estimating floods will result in more accurate determination of the size of drainage structure needed and thereby yield a monetary savings.

Project Number: HR-269

Project Title: Data Acquisition and Computer Plotting of Delamtect Data

Agency: D & D Digital Systems

Principal Investigators: Douglas Jacobson, Richard E. Horton

Research Period: August 23, 1984 to July 31, 1985

Research Funding: $24,250

Funding Source: 100 percent State funds - 90 percent Primary, 10 percent Farm-to-Market

Objective: To develop an electronic system to record Delamtect data for analysis by personal computer available in Iowa DOT field offices.

Progress: Construction of all data collection equipment has been completed. All components have been attached to the Delamtect. Trial runs of data collection and reduction have been conducted. The program for data reduction is now being debugged.

Reports: Letter report, November 1984.

Implementation: An electronic method of reducing and plotting Delamtect data will reduce the labor and time required for determining the amount and location of bridge deck delamination.

Project Number: HR-270

Project Title: Development of Training Aids and Demonstration of Portland Cement Concrete Pavement Rehabilitation

Agency: Iowa Concrete Paving Association

Principal Investigator: M. J. Knutson

Research Period: September 21, 1984, to March 31, 1988

Research Funding: $100,000

Funding Source: 2% State--Primary Funds, 98% Federal Funds

Objective: To demonstrate various CPR techniques, to develop specifications and evaluate various materials and to educate those responsible for maintenance of PCCP roads, streets and airports.

Progress: The rehabilitation has been completed on 63rd Street (Iowa Route 28) south of Interstate 235 in Des Moines. The first demonstration was held on October 25, 1984. the second demonstration was held on February 28, 1985. Slide-tape and video training aids have been developed. Periodic testing and evaluation of pavement condition is continuing.

Reports: Initial Report, April 1985

Implementation: The training aids will promote more effective maintenance of our pavements a subsequently longer serviceable life.

Project Number: HR-271

Project Title: Effects of Deicing Salt Compounds on Deterioration of Portland Cement Concrete

Agency: Iowa State University

Principal Investigators: J. M. Pitt, D. Y. Lee and W. Dubberke

Research Period: December 1, 1984 to November 30, 1985

Research Funding: $56,335

Funding Source: 100 percent State funds - 75 percent Primary, 25 percent Farm-to-Market

Objective: To define deleterious mechanisms resulting from harmful trace compounds introduced into Portland cement concrete via deicing salts, to define the extent and economic significance of trace compound poisoning in Iowa, and to determine quantitative salt specification parameters aimed at reducing the harmful influence of deicers.

Progress: Laboratory testing is continuing. Tests have been conducted with various deicing salts.

Reports: None

Implementation: The reduction or elimination of deterioration of Portland cement concrete at pavement joints would cause money to become available for other areas of pavement maintenance and construction.

Project Number: HR-272

Project Title: Development of a Conductometric Test for Frost Resistance of Concrete

Agency: Iowa State University

Principal Investigators: T. Demirel, B. V. Enustun, S. M. Schlorholtz, and S. G. Moussalli

Research Period: February 1, 1985, to January 31, 1986

Research Funding: $62,110

Funding Source: 100 percent State funds - 50 percent Primary, 50 percent Farm-to-Market

Objective: To develop a laboratory test method that would rapidly and accurately predict the performance of concrete subjected to freeze-thaw action.

Progress: Initial durability testing using conductivity has appeared promising.

Reports: None

Implementation: A rapid accurate test of Portland cement concrete durability would prevent the use of nondurable aggregates thereby increasing pavement life and reducing maintenance costs.

Project Number: HR-273

Project Title: Piling Stresses in Bridges with Integral Abutments - Phase 3

Agency: Iowa State University

Principal Investigators: L. Greimann, F. Fanous

Research Period: March 1, 1985 to September 30, 1986

Research Funding: $124,834

Funding Source: 100 percent State - 50 percent Primary, 50 percent Farm-to-Market funds

Objective: To further increase confidence in the design of longer integral abutment bridges by experimental verification of previous analytical models.

Progress: Laboratory investigation into construction of the model has been initiated.

Reports: None

Implementation: The use of integral abutments for longer bridges will reduce maintenance costs and increase the life before rehabilitation.

Project Number: HR-274

Project Title: Construction and Evaluation of Submerged Vanes for Stream Control

Agency: Iowa department of Transportation Highway Division and the University of Iowa

Principal Investigator: J. Odgaard

Research Period: April 1, 1985, to October 31, 1987

Research Funding: $66,000.

Funding Source: 100 percent State - Primary Funds

Objective: To determine the practicality and effectiveness of using Iowa Vanes to control bank erosion on Iowa Streams.

Progress: The materials have been selected and the design is completed. Construction will be completed during 1985.

Reports: None

Implementation: Stream control with Iowa vanes will prevent damage to highway structures by providing more effective stream control than previous methods.

Project Number: HR-275

Project Title: Long Term Structural Movement

Agency: Iowa State University

Principal Investigator: T. Wipf

Research Period: May 1, 1985 to October 31, 1985

Research Funding: $41,577.

Funding Source: 100 percent State--81 percent Primary, 19 percent Farm-to-Market

Objective: To identify and determine the effectiveness of various techniques for measuring long term structural deformations.

Progress: A contract has been initiated with the research agency. The special testing equipment has been ordered.

Reports: None

Implementation: Monitoring long term structural movement will decrease the potential of emergency closing of critical major river crossings.

Project Number: HR-276

Project Title: Transverse Joint Sealing With Improved Sealants

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

Principal Investigators: C. Cabalka and K. Jones

Research Period: April 1, 1985, to July 1, 1990

Research Funding: $32,000

Funding Source: 100 percent State--Farm-to-Market Funds

Objective: To evaluate several types of contraction-joint sealers, most of which, meet Iowa DOT Standard Specification for material for filling and sealing sawn contraction joints.

Progress: An extra work order has been negotiated to include 22,000 linear feet of experimental contraction joint work on a Jasper County project. Special sawing and cleaning was performed and eight different sealants were installed on a pcc paving project on county route T-12 in 1985.

Reports: None

Implementation: Deterioration of joints and joint related distress of pcc pavements has continued to be a major maintenance problem. The project will identify the most effective joint preparation and sealant.

Project Number: HR-277

Project Title: Cracking and Seating PCC Pavement Prior to Resurfacing to Retard Reflective Cracking

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

Principal Investigators: W. Smith and K. Meeks

Research Period: June 1, 1985, to July 1, 1996

Research Funding: $92,210

Funding Source: 100 percent State--Farm-to-Market Funds

Objectives: To evaluate the effect of various sizes of cracking and seating of pcc pavement prior to resurfacing on reflective cracking and structural rating

Progress: The project will include breaking a 2.5-mile pcc pavement section into 2-to 3-foot and 4-to 5-foot size pieces. A portion of the project will be overlaid with 2 inches, a portion with 3 inches and a portion with 4 inches of asphaltic concrete. The project is to be constructed on Hamilton County Road R-33 in 1986.

Reports: None

Implementation: If cracking and seating can retard reflective cracking in asphaltic concrete overlays, it will reduce routine maintenance and prolong the life of the overlay.

Project Number: HR-278

Project Title: Beneficial Effects of Selected Additives on Asphalt Cement Mixes

Agency: Iowa State University

Principal Investigator: D. Y. Lee

Research Period: June 1, 1985, to May 31, 1987

Research Funding: $89,700

Funding Source: 100 percent State Funds--60 percent Primary, 40 percent Farm-to-Market

Objective: To review the state of knowledge on asphalt additives and to evaluate the most promising additives in their effects on relevent properties of asphalt cements and to identify the specific benefits of the additives and establish guidelines for optimal use.

Progress: A contract has been initiated with the research agency.

Reports: None

Implementation: The research will provide the testing capabilities to evaluate polymer additives for asphalt cement and identify those with economic benefits. The use of effective polymer additives will extend asphalt pavement life and reduce maintenance which will yield substantial savings.

Project Number: HR-1027

Project Title: Secondary Road Research Coordinator

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: K. Jones

Research Period: March 5, 1980, to present

Research Funding: $32,500.00/yr.

Funding Source: 100 percent State--Farm-to-Market

Objective: To maintain research liaision 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: Kevin Jones, an Engineer with the Iowa DOT, currently holds the position of "Secondary Road Research Coordinator" in the Office of Materials. Many of the county engineers have been visited to discuss problems being encountered by the secondary road departments and to discuss present research projects during the year. At present, there are 11 active research projects that involve experimental construction by counties. The coordinator assists these counties with special testing, evaluation, and writing of construction and final reports necessary to the research.

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 will allow for timely technology transfer between the counties.