Annual Report of Highway Research and Development in Iowa

Iowa Department of Transportation
Highway Division
Office of Materials
December 1983

ANNUAL REPORT
OF
HIGHWAY RESEARCH AND DEVELOPMENT IN IOWA

FOR THE

FISCAL YEAR ENDING JUNE 30, 1983

OFFICE OF MATERIALS

(515)239-1447

HIGHWAY DIVISION

IOWA DEPARTMENT OF TRANSPORTATION

AMES, IOWA 50010

DECEMBER 1983

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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, 1983; it is also a report on projects completed during the fiscal year beginning July 1, 1982, and ending June 30, 1983. 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, 1983, is listed in Table 1.

The Research Board held ten regular meetings during the period of July 1, 1982 to June 10, 1983. Suggestions for research and development were reviewed at these meetings and recommendations were made by the Board.

TABLE 1

1983

IOWA HIGHWAY RESEARCH BOARD

Member	Term Expires	Alternate
Don A. Anderson Deputy Director, Operations Iowa DOT-Highway Division Ames, IA 50010 (515)239-1491	12-31-85	Chuck Huisman Materials Engineer Iowa DOT-Highway Division Ames, IA 50010 (515)239-1452
Dave Boylan, Dean College of Engineering Iowa State University Ames, IA 50011 (515)294-5933	12-31-85	Paul Peterson Associate 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	Charles Pestotnik Director, Office of Bridge Design Iowa DOT-Highway Division Ames, IA 50010 (515)239-1206
Bob Gumbert Tama County Engineer Toledo, IA 52342 (515)484-3341 SS#-086	12-31-84	Royce Fichtner Marshall County Engineer Marshalltown, IA 50158 (515)754-6343 SS#-064
Bob Hering Dean of Engineering University of Iowa Iowa City, IA 52242 (319)353-6603	12-31-84	Harry 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	Chuck Schmadeke Director of Public Works Iowa City, IA 52240 (319)356-5141
Ron Kirchner City Engineer Fort Dodge, IA 50501 (515)576-3601	12-31-83	Jay Schreiner City Engineer Ankeny, IA 50021 (515)964-5500
Nicholas Konrady Lucas County Engineer Chariton, IA 50049 (515)774-4013 SS#-059	12-31-83	Bob Simmering Muscatine County Engineer Muscatine, IA 52761 (319)263-6351 SS#-070
Don Linnan Buena Vista County Engineer Storm Lake, IA 50588 (712)732-1519 SS#-011	12-31-85	Rich Michaelis Carroll County Engineer Carroll, IA 51401 (712)792-3603 SS#-014
Don Lynam Adair County Engineer Greenfield, IA 50849 (515)743-6111 SS#-001	12-31-84	Carl Christensen Fremont County Engineer Sidney, IA 51652 (712)374-2613 SS#-036
Bill Moellering Fayette County Engineer West Union, Ia 52175 (319)422-3342 SS#-033	12-31-83	Neil Jorgensen Franklin County Engineer Hampton, IA 50441 (515)456-4671 SS#-035
Bob Percival District 5 Engineer Iowa DOT-Highway Division Fairfield, IA 52556 (515)472-4171 SS#250	12-31-84	Van R. Snyder District 4 Engineer Iowa DOT-Highway Division Atlantic, IA 50022 (712)243-3355 SS#-240
Jerry Petermeier Benton County Engineer Vinton, IA 52349 (319)472-2211 SS#-006	12-31-85	Bob De Wys Scott County Engineer Davenport, IA 52801 (319)326-8640 SS#-082

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, then the costs are shared.

Table II is a record of expenditures for research and development made during the fiscal year ending June 30, 1983. Total expenditure was $906,794.66, including support of the National Cooperative Highway Research Program (see page 5).

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 form 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 participation 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 district 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 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 in 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. 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 1983. 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 1983 financial summary is.

Beginning Balance 7-1-82		$1,136,258
Receipts		
Interest	$ 49,597	
Fed. Sec. Rd. (1 1/2% of receipts)...	198,300	
State RUTF (1 1/2% of receipts)	513,826	
External Research Income	87,121	
Sub-Total		848,844
Total Funds Available		$1,985,102
Obligation for Expenditures		
Obligated for Contract Research...	1,079,970	
Non-Contract Engineering Studies...	394,289	
Total Expenditures		$1,474,259
BALANCE 6-30-83		$ 510,843

SECONDARY ROAD TRAFFIC COUNT PROGRAM

During fiscal year 1983 the traffic count program conducted by the Office of Transportation Inventory on the Secondary Road System in 25 counties required a total of 2,000 four-hour manual counts, 600 eight-hour manual counts, 50 sixteen-hour manual counts, and 220 recorder counts. The traffic data from these counts was used to develop motor vehicle traffic flow maps for each county showing the average annual daily traffic (ADT) on specific road sections in each county. A secondary road inventory was completed in ten counties. This data provides the county engineer, highway engineer, planner and administrator with essential information needed to determine design standard, systematic classification of highways and the development of programs for improvement and maintenance of secondary roads.

TABLE II
FINANCIAL SUMMARY OF RESEARCH AND DEVELOPMENT PROJECTS
July 1, 1982 to June 30, 1983

Project	Total Funds Committed	Project Title	Primary Road Research Fund Expenditures	Secondary Road Research Fund Expenditures	Total Expenditures
140	55,000.00	Collection and Analysis of Stream Flow Data	39,602.50	12,102.50	51,705.00
173	10,060.00	A Computer Based Information System For County Equipment Cost Records			
188	50,000.00	Evaluation of Air Pollution Control Devices for Asphalt Pavement Recycling Operations			
192	3,340.00	An Evaluation of Dense Bridge Floor Concrete			
198	75,000.00	Preliminary Archaeological Investigation Along Proposed Highway Right-of-Way			
199	100,000.00	Upgrading Asphalt Surface Friction by Aggregate Sprinkle Treatments			
203	61,000.00	Joint Sealing with Various Sealants			
205	3,150.00	Effects of Special Aggregate on Bridge Deck Overlay Frictional Properties			
206	2,510.00	Cement Produced from Fly Ash and Lime			
208A	137,725.00	Alternative Methods of Stabilizing the Degrading Stream Channels in Western Iowa		23,110.91	23,110.91
209	100,346.85	Pavement Surface on Macadam Base - Adair Co.			
210	30,072.00	The Effect of Deer Reflectors on Deer-Vehicle Accidents			
211	143,207.00	Performance of Randomly-Oriented Fiber Reinforced Roadway Soils		12,034.26	12,034.26
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			
217	43,000.00	Reducing the Adverse Effects of Transverse Cracking			
219	11,200.00	Settlement at Culverts and Bridges			
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			
225	89,660.00	Characterization of Fly Ash for Use in Concrete	11,280.80	11,309.57	22,590.37
226	44,000.00	Iowa Research with Chem-Crete Bitumen			
227	34,855.00	Piling Stresses in Bridges with Integral Abutments	5,388.02	1,703.69	7,091.71
228	48,540.00	Engineering Study - Automating Iowa's Speed Monitoring Program	213.74		213.74
229	130,000	Alternate Flexible Overlays			
230	56,305.00	An Investigation of Signing needs at Local Road Interchanges		316.07	316.07
231	45,340.00	Special Surface Preparation Prior to Bituminous Overlays		42,204.59	42,204.59
232	4,105.00	Reducing the Problem of Transverse Cracking			
233	35,232.88	Field Demonstration and Evaluation of Foamed Asphalt		3,115.99	3,115.99
234	5,000.00	Compilation of Iowa Highway Laws			
235	49,850.00	Warrants for Rumble Strips on Rural Highways	1,805.39	4,129.78	5,935.17
236	88,143.00	Pottawattamie Co. Evaluation of Stabilizing Degrading Stream Channels			
237	87,065.00	Shelby Co. Stabilization of Degrading Stream Channels			
238	162,898.00	Strengthening Existing Single Span Steel Beam Concrete Deck Bridges	20,257.12	15,314.68	35,571.80
239	80,000.00	Secondary Bridges and Current Truck Length & Weight Laws		49,505.74	49,505.74
240	88,000.00	Systems to Control Corrosion in Concrete			
241	8,500.00	Development of EDMI Calibration Baseline	3,470.44	1,710.23	5,180.67
242	132,069.50	Economics of Alternative Solutions to the Secondary Roadway Problem		42,822.00	42,822.00
243	3,445.00	Production and Evaluation of Calcium Magnesium Acetate (CMA)			
244	9,700.00	Detection of Concrete Delaminations by Infrared Thermography	9,700.00		9,700.00
245	1,000.00	Dynamic Deflections to Determine Roadway Support Ratings			
246	118,000.00	Engineering Study - Reducing Sign Vandalism			
247	88,260.00	Design Criteria for Low Water Crossings		23,407.84	23,407.84
248	11,000.00	Evaluation of a Mobile Rut Depth Device for the Pavement Management Program			
249	10,000.00	Governor's Task Force on Iowa's Transportation Future		10,000.00	10,000.00
250	8,000.00	Determining the Thickness of Sound Concrete on Older Pavements			
251	49,970.00	Roadway Lighting on Secondary Roads in Iowa		24,830.24	24,830.24
252	52,945.00	Piling Stresses in Bridges with Integral Abutments - II	4,284.16	4,941.37	9,225.52
253	60,000.00	Experimental Use of Calcium Magnesium Acetate (CMA)	21,236.98		21,236.98
254	17,500.00	Highway/Railroad Grade Crossings - Identification and Signing			
255	55,506.00	Submerged Vanes for Control Streams	9,463.75	2,581.46	12,045.21
256	93,860.00	Perception and Interpretation of Advance Warning Signs on County Roads		19,023.96	19,023.96
257	132,740.00	Field Demonstration of Foamed Asphalt - Muscatine County			
258	115,870.00	Frost Action in Rocks and Concrete		363.61	363.61
259	89,390.00	Low Cost Fly Ash-Sand Stabilized Roadway			
260	45,665.00	Optimization of Soil Stabilization with Type C Fly Ash			
261	3,065.40	Modifications to Improve the Reliability of the Iowa DOT Frost Detector	450.00		450.00
262	70,580.00	Signing on Very Low Volume Rural Roads			
263	184,700.00	Engineering Study to Redesign the 24-Foot Secondary Bridge Standards			
264	41,660.00	Development of a Sufficiency Rating System for Secondary Roads			
1027	30,000.00/yr.	Secondary Road Research Coordinator		29,906.66	29,906.66
		Sub-Total	$127,152.89	$334,435.15	$461,588.04
HPR-1(89) NCHRP			5,843.50	874.65	6,718.15
HPR-1(90) NCHRP			33,130.92	5,173.63	38,304.55
HPR-2(120) NCHRP			4,599.69	731.17	5,330.86
HPR-2(121) NCHRP			4,307.18	644.68	4,951.86
HPR-2(123) HCHRP			1,697.74	269.27	1,967.01
HPR-4(182) NCHRP			9,627.05	1,470.14	11,097.19
HPR-PR-PL-1(19)		1982 Planning & Research Program		376,837.00	376,837.00
TOTAL			$186,358.97	$720,435.69	$906,794.66

This traffic data is also added to the Iowa Department of Transportation's Secondary Road Base Record. This record is utilized for the preparation of numerous reports and studies including the annual vehicle miles of travel, mileage summaries, need studies, special studies, accident analysis, etc.

RESEARCH PROJECT DESCRIPTIONS

The following portion of this report briefly describes research projects for which open files were maintained in the Office of Materials, Research Section during all or part of the fiscal year beginning July 1, 1982, and ending June 30, 1983. An open file for each project is maintained from the project's inception to completion; completion is signified by the acceptance of the final report and making the final payment. Each project description contains an implementation statement of the use now being made, or expected as result of the research effort.

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, 1983

Research Funding: $55,000 per year (matched by $55,000 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 stream 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 1982-1983 was in accordance with schedules established by the Water Resources Division.

Reports: Periodically, a summary report of magnitude and frequency of Iowa floods is prepared. 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-173

Project Title: A Computer Based Information System for County Equipment Cost Records

Agency: Iowa Department of Transportation, Highway Division

Principal Investigators: S. Johnson, J. K. Poyzer, J. D. Poyzer

Research Period: December 7, 1981, to August 22, 1983

Research Funding: $10,060

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

Objective: To enhance the current "Computer Based Information System for County Equipment Cost Records" so it provides more accurate and more timely reports to county engineers who use it.

Progress: A contract for services was negotiated with James Poyzer, a programmer/analyst from Des Moines Co-principal investigator is John Poyzer who worked on the original programs in 1975. The programs have been revised to allow for easy access to update and correct improper data entries. Also, the programs have been changed to accept individual county data for processing and to allow for several runs of data during the year. Several other minor changes were initiated to make the program more responsive to the counties' needs.

Reports: None

Implementation: Problems with the original program for county equipment cost records have made the output data unreliable for some counties. Program changes will allow for easy input to county equipment cost information and will result in much quicker return of accurate output data to the counties so the most cost-effective equipment can be identified and specified for future purchases.

Project Number: HR-188

Project Title: Evaluation of Air Pollution Control Devices for Asphalt Pavement Recycling Operations

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

Principal Investigator: R. Schiek

Research Period: April 11, 1977, to October 31, 1982

Research Funding: $50,000

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

Objective: To seek acceptable solutions to the air pollution problem created in the asphalt recycling process using modified conventional equipment.

Progress: The project was constructed in 1977 and all aspects were considered to be very successful. Recycled asphalt proved to be good quality material at a savings of approximately 30 cents per ton over virgin material. Through modifications of equipment, all D.E.Q. requirements for air pollution were easily met and the project gained nationwide and worldwide recognition.

Reports: Final Report, October 1982

Implementation: In the interest of conserving energy and material, the elimination of the problem of air pollution in the asphalt recycling process is a very desirable goal. The "drum in a drum" asphalt plant modification will prevent pollution while allowing normal production utilizing recycled materials. The plant modification is commercially available and will promote recycling, and in turn, conservation of natural resources.

Project Number: HR-192

Project Title: An Evaluation of Dense Bridge Floor Concrete

Agency: Iowa Department of Transportation

Principal Investigator: R. A. Britson

Research Period: May 1977, to May 31, 1983

Research Funding: $3,340

Funding Source: 100 percent State--Primary funds

Objective: To determine the feasibility of mixing, placing and finishing dense portland cement concrete using a super water reducing admixture in a bridge floor. To determine the economics, longevity and maintenance performance of dense portland cement concrete.

Progress: The project is located in the Town of Ackley on U.S. 20 in Hardin County. The construction involved the redecking of a multiple span overhead crossing over a railroad. It was proposed that approximately 25 percent of the bridge deck be placed full depth using a concrete containing a super water reducing admixture. A portion of a full depth bridge deck using concrete with a high range water reducer was placed in August 1977. Problems were encountered in pumping the concrete and in controlling slump and air content. Cores from the deck yielded good air contents for both the Standard D-57 concrete and the high range water reducer (HRWR) concrete. The calculated one-year strength for the D-57 concrete was 6650 psi and 8500 psi for the HRWR concrete. The chloride content was slightly higher in the D-57 concrete. The cores revealed good consolidation of both concretes, even though the bottom surface of the HRWR exhibited an open honeycomb appearance.

Reports: Final Report, May 1983

Implementation: There is still a need for an improved concrete to retard the intrusion of chlorides. This project will determine if the admixture is a solution to the problem of corrosion of steel in bridge decks.

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, 1984

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 has an ongoing contract 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-199

Project Title: Upgrading Asphalt Surface Friction by Aggregate Sprinkle Treatments

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: R. A. Shelquist

Research Period: June 1, 1978, to January 31, 1984

Research Funding: $42,500

Funding Source: 100 percent State--Primary funds

Objective: To determine the feasibility and cost effectiveness of using standard asphalt mixtures of local aggregates for 1" and 1 1/2" thick surface courses, followed by a surface sprinkle treatment of precoated hard, durable chips to produce a long-lasting, non-skid pavement surface.

Progress: This experimental type of resurfacing was applied on old U.S. 30 between Interstate 35 and the City of Nevada in 1978. Appearance is very good, with the exception of some corrugation which occurred during application. Texture depth tests by the silly putty method and friction tests of the sections are being conducted on a periodic basis.

Reports: Progress Report, July 1982

Implementation: This project will be utilized in the evaluation of paving materials and texturing. It will also assist in determining the effectiveness of sprinkle treatment in providing durable friction properties.

Project Number: HR-203

Project Title: Transverse Joint Sealing with Various Sealants

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

Principal Investigator: G. Hardy, V. J. Marks

Research Period: July 25, 1978, to October 31, 1983

Research Funding: $51,000

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

Objective: To evaluate the performance of pcc pavement contraction joints utilizing a variety of sealants and joint preparations and to identify an effective joint sealant system.

Progress: These experimental pavement joints were incorporated into a Secondary Road paving project in Dallas County during the 1978 construction season. Joint sealing procedures, materials and specifications were determined prior to construction. Six different sealant materials were used with three methods of joint cleaning. Other variables were introduced and some cost comparisons were made. Core samples for joint sealant analysis were taken in 1979 and 1980. Visual observations are being made annually. Evaluation of the various joint sealing procedures is completed. The silicone rubber joints exhibited the best performance.

Reports: Final Report, September 1983.

Implementation: Deterioration of joints and joint-related distress of pcc pavements has continued to be a major maintenance problem. This project has identified an effective method of joint preparation and sealing.

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: None

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

Project Number: HR-206

Project Title: Cement Produced from Fly Ash and Lime

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: W. Rippie

Research Period: April 1, 1979, to October 31, 1982

Research Funding: $2,510

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

Objective: To determine if a fly ash-lime cement with desirable characteristics can be produced, and to determine the combination of ingredients necessary to attain this end.

Progress: Fine crushed limestone and fly ash were obtained, pulverized and blended. The mixture was submitted to the Coal Research Laboratory of the University of West Virginia for fusion in an induction furnace. Some concrete strength specimens have been made and tested using the fused and crushed material as the cementitious ingredient.

Reports: Final Report, July 1982

Implementation: Additional research will be necessary to develop the new cement from limestone and fly ash.

Project Number: HR-208A

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

Agency: Iowa State University

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

Research Period: December 1, 1980, to November 30, 1983

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, have been 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 analysis of the proposed structures are in progress. One structure in Pottawattamie County is under construction. Final plans for one Shelby County structure have been completed.

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, 1983

Research Funding: $100,347

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 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. Road Rater evaluations of the pavement have been made. Some small areas of distress are visible, but the overall appearance of the pavement is good.

Reports: Construction Report, 1980

Implementation: This study will result in the ability to construct a pavement with improved performance in regard to D-cracking and subgrade failure 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 September 30, 1984

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. Additional data will be needed to determine any meaningful results from the installation of the deer reflectors. However, results from the first and second years of data indicate a possible decrease in deer-vehicle accidents. The reflectors are to be removed in July, 1983.

Reports: Progress report, June 1983

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

Project Number: HR-211

Project Title: Performance of Randomly-Oriented Fiber-Reinforced Roadway Soils (A Laboratory and Field Investigation)

Agency: Iowa State University

Principal Investigator: J. M. Hoover

Research Period: July 1, 1979 to February 28, 1983

Research Funding: $143,207

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

Objective: To conduct a laboratory and field investigation into the potential for improving soil-aggregate surface and roadway subgrade materials, and local base course materials by strengthening these material through fibrous reinforcement.

Progress: Field demonstration sections using a variety of fibers were constructed in Linn and Story counties during the summer of 1980. On the Linn County project, three different types and three different percentages of fibers were used. The Story County project was constructed on an existing gravel road. Some difficulty was experienced in mixing the fibers into the roadbed due to equipment failure.

Reports: Final Report, December 1982

Implementation: Due to economic restraints, new and cost-effective methods are needed for the improvement of subgrade base course construction. This project will aid in the development of new and improved design procedures.

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 March 1, 1985

Research Funding: $13,500

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.

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. A. Shelquist

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. 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, Iowa Department of Transportation, Highway Division

Principal Investigator: C. L. Baule

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

Research Funding: $156,289

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. 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. Evaluation will continue for a five-year period.

Reports: Construction Report, January 1981

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

*This project was 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-217

Project Title: Reducing the Adverse Effect of Transverse Cracking

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: V. J. Marks

Research Period: March 7, 1980, to January 31, 1984

Research Funding: $43,000

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: The research was incorporated into a primary project on Iowa 64 in Jones County, which was completed in September 1980. Some of the variations from standard construction practices used in this project included the following: 1. Use of an asphalt that is partially blown and less susceptible to temperature variations; 2. Variation in mix designs; 3. The sawing and sealing of transverse joints. No particular problems were experienced in this research. Density and gradation requirements were satisfactorily met. There is very little cracking in the pavement produced from the asphalt cement exhibiting low temperature susceptibility. The pavement produced from the highly temperature susceptible asphalt cement exhibits severe cracking. The sealant has failed in the sawed joints.

Reports: Construction Report, February 1981

Implementation: With the prevention of transverse cracking and subsequent crack deterioration, asphalt surfaced roads will last longer and require less maintenance and less frequent resurfacing.

Project Number: HR-219

Project Title: Settlement at Culverts and Bridges

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: W. E. Buss

Research Period: May 1980, to January 31, 1984

Research Funding: $11,200

Funding Source: 100 percent State--Primary funds

Objective: To identify cost-effective construction methods that may prevent settlement at culverts and bridges.

Progress: This research was incorporated into a grade, culvert, pavement widening and resurfacing project on Iowa 44 in Dallas County. Various methods of backfilling and bedding for bridges and culverts were completed by the contractor by extra work order. K-Krete, sand and Class A material with moisture control were used on the bridge approaches. K-Krete and Class A, B and C road stone were used in various combinations in the culvert replacement and backfill. No significant settlement has been noted to date.

Reports: Construction Report, December 1981

Implementation: The reduction in settlement will result in less maintenance and will provide the best method of backfill at a reasonable cost.

Project Number: HR-220

Project Title: Protection of Structural Concrete Substructures

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: J. Risch, J. Whiting

Research Period: May 1980, to July 15, 1985

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. 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 will be taken annually to monitor the chloride content of the pier column concrete.

Reports: Construction Report, February 1981

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. A. Shelquist

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. Periodic crack surveys have been made.

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, 1983

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

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

Project Number: HR-225

Project Title: Characterization of Fly Ash for Use in Concrete

Agency: Iowa State University

Principal Investigator: Turgut Demirel

Research Period: August 1, 1980, to October 31, 1983

Research Funding: $89,660

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

Objective: To determine the components or combinations of components in fly ash responsible for good or poor performance of concrete and to quantify fly ash variability.

Progress: Thirty-five fly ash samples were collected from seven power plants. Elemental analyses of all fly ash samples have been performed using x-ray fluorescence. Concrete mixes have been prepared and subjected to freeze-thaw testing and x-ray diffraction analysis.

Reports: Progress Report No. 4, February 1983

Implementation: The research will establish criteria for predicting the suitability of a given fly ash for use in highways in Iowa.

Project Number: HR-226

Project Title: Iowa Research with Chem-Crete Bitumen

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

Principal Investigator: D. Jespersen, K. Jones

Research Period: August 1980, to October 31, 1984

Research Funding: $44,000

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

Objective: To determine if Chem-Crete bitumen will provide significantly improved performance of the mix designs used, and to determine if a satisfactory asphalt concrete base can be made using a poorly graded sand.

Progress: Test sections of Chem-Crete resurfacing and standard asphalt resurfacing were constructed in September 1980 on Story County Roads E-57 and North Dakota Street Extension (Ames). Soon after construction, cracks in the Chem-Crete test sections appeared. The Chem-Crete Corporation is working with Story County to determine how to correct the problem. Evaluation will continue for a four-year period.

Reports: Construction Report, November 1981

Implementation: Products which result in improved characteristics of low quality aggregate will allow the use of locally available aggregate, thereby conserving resources and reducing cost.

Project Number: HR-227

Project Title: Piling Stresses in Bridges with Integral Abutments

Agency: Iowa State University

Principal Investigators: Lowell F. Greimann and Amde M. Wolde-Tinsae

Research Period: December 1, 1980, to August 31, 1982

Research Funding: $34,855

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

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

Progress: A questionnaire was sent to the 50 states, Puerto Rico, and the FHWA Region 15 Construction Office. The questions concerned limitations in bridge length, type and skew. The research for the original study was completed in February 1982, showing the 265-foot limitation to be very conservative. The study was extended to include skewed bridges with no additional funding.

Reports: Final Report, February 1982

Implementation: Currently, bridges with integral abutments are limited to 265 feet in Iowa. If the maximum safe length of these bridges is determined to be longer, savings of highway dollars would be realized.

Project Number: HR-228

Project Title: Engineering Study - Automating Iowa's Speed Monitoring Program

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: Shyamal Basu

Research Period: March 1, 1981, to March 31, 1983

Research Funding: $48,540

Funding Source: 100 percent State funds--78 percent Primary, 22 percent Farm-to-Market

Objective: To develop and make operational a system with flexible capabilities of collecting accurate speed data on all road systems in Iowa.

Progress: Inductance loops have been installed in the pavement at 33 sites. Six print/punch automatic speed monitoring devices have been obtained and checked for accuracy.

Reports: Final Report, February 1983

Implementation: The use of this automatic equipment will result in reduced cost of data collection while improving the quality of that data.

Project Number: HR-229

Project Title: Alternate Flexible Overlays

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

Principal Investigator: P. Schwarting, 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-230

Project Title: An Investigation of Signing Needs at Uncontrolled Local Road Intersections

Agency: Iowa State University

Principal Investigators: K. A. Brewer, W. F. Woodman

Research Period: April 1, 1981, to March 31, 1983

Research Funding: $56,305

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

Objective: To investigate the variety of legend and symbol face combinations of sign designs to determine whether there are any other combinations which may better communicate with drivers approaching local uncontrolled intersections. To identify the alternative courses of action available to any county encountering such a problem intersection on their local road system.

Progress: An Apple II computer was programmed to display a view of selected local road intersection approaches from "over the driver's shoulder." An array of sign displays was shown between each intersection type. A booth at the 1981 Iowa State Fair was used to obtain participation from rural residents in the driver communication tests. Four hundred and five responses were recorded and used for statistical analysis. The report contains findings from the surveys that were conducted as well as recommendations for dealing with problem local uncontrolled intersections.

Reports: Final Report, April 1982

Implementation: The project will identify courses of action counties may consider for a problem intersection on their local road system to improve safely, thus reducing accidents.

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 1986

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 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 thermal 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 March 1, 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. No cracking has been noted to date.

Reports: None

Implementation: The prevention of transverse cracking and subsequent deterioration will increase the life of asphalt surfaced roads and require less maintenance and less frequent resurfacing.

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 March 1, 1986

Research Funding: $35,229

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

Objective: To evaluate the performance of foamed asphalt as a stabilizing agent using existing soils and granular surfacing material; 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 has been conducting 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 will be evaluated. Nine different test sections will be 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 Investigator: L. Paff

Research Period: May 15, 1981 to December 31, 1983

Research Funding: $5,000

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

Objective: To provide a current annotated Iowa Highway, Road and Street Law publication.

Progress: Two law clerks were retained on a temporary basis to search out the laws and pertinent court cases and draft the publication for the Director of the Iowa DOT General Counsel Division.

Reports: None

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

Project Number: HR-235

Project Title: Warrants for Rumble Strips on Rural Highways

Agency: Iowa State University

Principal Investigator: R. L. Carstens

Research Period: June 16, 1981, to June 30, 1982

Research Funding: $49,850

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

Objective: To improve safety on rural highways by recommending guidelines or warrants for the use of rumble strips; to reassess the conclusions regarding rumble strip installations that were studied in the research project HR-184, "Determination of Rumble Strip Effectiveness."

Progress: An inventory of rumble strips in use on highways in Iowa was undertaken. Data was collected for 147 comparative locations and 109 locations, with before and after installation records. Accident data and physical characteristics of the locations were analyzed to determine what factors distinguished locations that experienced a reduction in accidents following rumble strip installation from those where no such reduction had occurred. The report suggests that in many instances, the installation of rumble strips will have no effect on the occurrence of accidents. However, analysis of before and after samples indicated that the accident rate could be expected to improve following installation of rumble strips only if it were above 2.5 accidents per million entering vehicles (MEV) at secondary locations and above 2.0 accidents per MEV at primary locations.

Reports: Final Report, June 1982

Implementation: A reduction of accidents would occur if rumble strips are installed where they are warranted but do not exist. Cost savings will arise if rumble strips are not installed where they are not warranted.

Project Number: HR-236

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

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

Principal Investigator: C. E. Hales, R. A. Lohnes, F. W. Klaiber, 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 analysis of the proposed structures are in progress. One structure is under construction.

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-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 Investigator: E. Schornhorst, R. A. Lohnes, F. W. Klaiber, 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 analysis of the proposed structures are in progress. Final plans for one structure have been completed.

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 have been post-tensioned. Strain measurements were determined under a heavily loaded truck after post-tensioning.

Reports: Final Report - Part I, February 1983

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-239

Project Title: Engineering Study to Evaluate Secondary Bridges with Respect to Current Truck Length and Weight Laws

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: J. P. Harkin

Research Period: August 25, 1981, to October 31, 1982

Research Funding: $80,000

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

Objective: To reanalyze the secondary bridge standard designs according to current length and weight laws of the State of Iowa.

Progress: An agreement was authorized with Wallace, Holland, Kastler and Schmitz Consulting Engineers to conduct the major portion of the work. Over 500 standard bridge designs were rated. The report contains the rating or each standard bridge and the calculations used to arrive at those ratings.

Reports: Final Report, October 1982

Implementation: The study will: 1. Avoid duplication of bridge evaluations and result in a cost savings for the counties; 2. Facilitate the bridge posting on the secondary road system; and 3. Aid in the evaluation of damaged or deteriorated bridges on the secondary road system.

Project Number: HR-240

Project Title: Systems to Control Corrosion in Concrete

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: J. E. Whiting, V. J. Marks

Research Period: April 1, 1982, to March 15, 1985

Research Funding: $88,000

Funding Source: 100 percent State--Primary funds

Objective: To field test protective systems for substructures and identify a system or systems that will halt corrosive activity.

Progress: The site selected for this research was Interstate 235 in Des Moines from 2nd Avenue to 9th Street. The research is to be incorporated into a pier rehabilitation project. The protective systems to be considered are cathodic protection, moisture starvation and oxygen starvation. Delays have been encountered due to problems of executing a contract with the cathodic specialty contractor.

Reports: None

Implementation: Many of the older bridge structures are exhibiting substantial deterioration. A system to halt corrosive activity would save millions of dollars in pier column rehabilitation.

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

Research 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.

Reports: Progress Report, January 17, 1983

Implementation: Use of the baseline and EDMI calibration procedure will assure survey accuracy and prevent loss due to 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 June 30, 1984

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 has been established and three counties have been selected to evaluate the cost-benefit investment strategies. Surveys will be conducted in Shelby, Hamilton and Linn counties which have been selected for the evaluation.

Reports: None

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-243

Project Title: Production and Evaluation of Calcium Magnesium Acetate (CMA)

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: W. Rippie

Research Period: January 2, 1982, to November 30, 1982

Research Funding: $3,445

Funding Source: 100 percent State--Primary funds

Objective: To evaluate the effectiveness of CMA as a deicer under actual use conditions and investigate the possibilities of producing CMA with a high magnesium acetate content and evaluate its properties.

Progress: About 10 tons of CMA deicer were produced in the Materials Laboratory for field use. Production was with a 6-cubic foot cement mixer and an older pug mill-type mixer. Two sections of highway near Ames were used in field trials.

Reports: Final Report, October 1982

Implementation: CMA as a deicing agent offers a potential savings by reducing corrosion of reinforcing steel in bridges.

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 December 31, 1983

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.

Reports: None

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-245

Project Title: Dynamic Deflections to Determine Roadway Support Ratings

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: V. J. Marks

Research Period: April 18, 1982, to March 31, 1983

Research Funding: $1,000

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

Objective: To determine if the Iowa DOT Road Rater can be used to determine support values for selected rigid pavements and layered systems.

Progress: The Iowa DOT Road Rater and the FHWA "Thumper" were used to determine the dynamic deflections on 25 different roadway sections. The sections included a variety of bases and pavement varying from a gravel surface on new grade to 10" of pcc and a 25" thick bituminous roadway. The Road Rater data and Thumper data yielded an excellent correlation.

Reports: Final Report, February 1983

Implementation: Improved testing and design procedures will yield the most cost effective pavement thicknesses that will provide the desired service life.

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 is being developed to be distributed to school children, the general public, and to the Iowa counties. Several counties will be selected to participate in the study by recording specific sign replacement information.

Reports: None

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 May 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 to be developed will include 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 will be contacted and asked for their input.

Reports: None

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 April 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 have been continual problems with the electronics. It is not yet operational.

Reports: None

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.

Project Number: HR-249

Project Title: Governor's Task Force on Iowa's Transportation Future

Agency: State of Iowa, Task Force

Principal Investigator: George P. Wilson

Research Period: July 1, 1982 to February 28, 1983

Research Funding: $10,000

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

Objective: To answer questions in regard to funding sources, transportation needs and cooperative roles of the various modes.

Progress: The Task Force developed 60 recommendations, 26 which dealt with the highway mode.

Report: Final Report, December 1982

Implementation: Implementation of some of the recommendations will improve efficiency and decrease the cost of highway construction, maintenance and administration.

Project Number: HR-250

Project Title: A Non-destructive Method for Determining the Thickness of Sound Concrete on Older Pavements

Agency: Iowa Department of Transportation, Highway Division and Donohue and Associates, Inc.

Principal Investigator: Vernon J. Marks

Research Period: August 15, 1982 to December 31, 1983

Research Funding: $8,000

Funding Source: 100 percent State--85 percent Primary, 15 percent Farm-to-Market

Objective: To evaluate the potential of determining the thickness of sound concrete by ground penetrating or down-looking radar.

Progress: Donohue and Associates personnel visited Iowa to conduct ground penetrating radar surveys on two occasions. They were not completely satisfied with the signal conditioning, amplification and recording system. Another radar survey is planned later in 1983.

Reports: Donohue and Associates, February 1983

Implementation: Early detection of joint deterioration would facilitate proper maintenance and rehabilitation.

Project Number: HR-251

Project Title: Roadway Lighting on Secondary Roads in Iowa

Agency: Iowa State University

Principal Investigator: R. L. Carstens

Research Period: September 1, 1982, to November 30, 1983

Research Funding: $49,970

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

Objective: To improve safety on secondary roads by defining locations where destination lighting may be expected to reduce the frequency of highway accidents.

Progress: An inventory of secondary road lighting installations is currently being conducted. Preliminary information indicates approximately 820 locations of lighting installations on secondary roads in Iowa. Accident data will be obtained through the ALAS records and analyzed to identify differences for accident rates at lighted locations and unlighted locations.

Reports: Progress Report, November 1982

Implementation: A reduction of accidents will occur if destination lighting is installed where it is warranted but does not exist. A cost savings will arise if destination lighting is not installed at locations were no accident reduction would be realized by installation.

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 September 30, 1983

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: An agreement has been completed and laboratory work has begun.

Reports: None

Implementation: The economic advantage of integral abutments can be realized for longer bridges.

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 30, 1984

Research Finding: $60,000

Funding Source: 100 percent State--Primary funds

Objective: To produce 100 tons of CMA 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. Modification in production methods may improve the performance of CMA.

Reports: None

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 are being obtained and will be installed at all active crossings. This will facilitate the collection of accident records.

Reports: None

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 February 29, 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. Some data has been obtained from the Nishnabotna River near U.S. 34 in Montgomery County where a field application is being considered.

Reports: None

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 March 31, 1984

Research Funding: $93,860

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

Reports: Progress Report, April 30, 1983

Implementation: By identifying the most effective advance warning sign, intersection safety will 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 planned 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-10 foamed asphalt cement will be constructed. The nine test sections will include two levels of moisture content, two levels of asphalt content and three levels of surface treatments.

Reports: None

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 will be conducted utilizing experimental methods for determining expansive pressures, rate of expansion and pore structure of rocks and concrete. With a successful effort in these areas, two ice porosimeters will be built to evaluate small pore sizes in rocks.

Reports: None

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 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 planned project is a 1.2-mile section of Des Moines County Road H-40. Various thicknesses of fly ash-cement-sand base will be constructed using a locally available dredge sand from the Mississippi River. A three-inch thick acc overlay will be placed over most of the base. A short section of base will receive only a single chip seal coat surface.

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, 1984

Research Funding: $45,665

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: None

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-261

Project Title: Modifications to Improve the Reliability of the Iowa DOT Frost Detector

Agency: Norbert K. Fox

Principal Investigator: N. K. Fox

Research Period: April 15, 1983, to May 31, 1984

Research Funding: $3,065.40

Funding Source: 100 percent State--Primary funds

Objective: To eliminate the falting of the Iowa DOT frost detector and verify its proper performance.

Progress: A potential electronic system has been identified that may eliminate the false signals on the sensors caused by tire strikes. This electronic system is being tested in the laboratory.

Reports: None

Implementation: A reliable frost detector system could quickly alert maintenance personnel of bridge icing conditions. More timely application of deicing salt will reduce accidents, tort liabilities and maintenance costs.

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 May 30, 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 will be conducted to identify practices with potential application. A survey of current practices in Iowa will be taken and recommendations will be formulated.

Reports: None

Implementation: A more uniform signing program across the state will provide improved safety and reduced tort liability on low traffic 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 will select one or more consultants.

Principal Investigator: J. Harkin

Research Period: June 1, 1983, to June 30, 1984

Research Funding: $184,700

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: A consultant will be retained to redesign the selected secondary bridge standards.

Reports: None

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 November 30, 1984

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 will be conducted. Current practices in Iowa and other states will be reviewed. A mathematical calculation procedure will be developed.

Reports: None

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

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: $30,000

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

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: 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 12 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 to understanding the problem and formulating solutions. Proper documentation and dissemination of reports will allow for timely technology transfer between the counties.

Annual Report of Highway Research and Development in Iowa

Iowa Department of Transportation
Highway Division
Office of Materials
December 1984

ANNUAL REPORT
OF
HIGHWAY RESEARCH AND DEVELOPMENT IN IOWA

FOR THE
FISCAL YEAR ENDING JUNE 30, 1984

OFFICE OF MATERIALS
(515)239-1447

HIGHWAY DIVISION
IOWA DEPARTMENT OF TRANSPORTATION
AMES, IOWA 50010

DECEMBER 1984

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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, 1984; it is also a report on projects completed during the fiscal year beginning July 1, 1983, and ending June 30, 1984. 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, 1984, is listed in Table 1.

The Research Board held nine regular meetings during the period of July 1, 1983 to June 30, 1984. Suggestions for research and development were reviewed at these meetings and recommendations were made by the Board.

TABLE I

1984

IOWA HIGHWAY RESEARCH BOARD

Member	Term Expires	Alternate
Don A. Anderson Deputy Director, Operations Iowa DOT - Highway Division Ames, IA 50010 (515)239-1491	12-31-85	Chuck Huisman Materials Engineer Iowa DOT - Highway Division Ames, IA 50010 (515)239-1452
Dave Boylan, Dean College of Engineering Iowa State University Ames, Iowa 50011 (515)294-5933	12-31-85	Paul 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	Charles Pestotnik Director, Office of Bridge Design Iowa DOT - Highway Division Ames, IA 50010 (515)239-1206
Bob Gumbert Tama County Engineer Toledo, IA 52342 (515)484-3341 SS#-086	12-31-84	Royce Fichtner Marshall County Engineer Marshalltown, IA 50158 (515)754-6343 SS#-064
Bob Hering Dean of Engineering University of Iowa Iowa City, IA 52242 (319)353-6603	12-31-84	Harry 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	Chuck Schmadeke Director of Public Works Iowa City, IA 52240 (319)356-5141
Orville Ives Monona County Engineer Box 236 Onawa, Iowa 51040 (712)423-2284 SS#067	12-31-85	Rich Michaelis Carroll County Engineer Carroll, IA 51401 (712)792-3603 SS#-014
Neil Jorgenson Franklin County Engineer Hampton, IA 50441 (515)456-4671 SS#-035	12-31-86	Robert Haylock Butler County Engineer Allison, IA 50602 (319)267-2630 SS#-012
Ron Kirchner City Engineer Ft. Dodge, IA 50501 (515)576-3601	12-31-84	Jay Schreiner City Engineer Ankeny, IA 50021 (515)964-5500
Don Lynam Adair County Engineer Greenfield, IA 50849 (515)743-6111 SS#-001	12-31-84	Steve Akes Guthrie County Engineer Guthrie Center, IA 50115 (515)747-2274 SS#-039
Bob Percival District 5 Engineer Iowa DOT - Highway Division Fairfield, IA 52556 (515)472-4171 SS#-250	12-31-84	Van R. Snyder District 4 Engineer Iowa DOT - Highway Division Atlantic, IA 50022 (712)243-3355 SS#-240
Jerry Petermeier Benton County Engineer Vinton, IA 52349 (319)472-2211 SS#-006	12-31-85	Bob DeWys Scott County Engineer Davenport, IA 52801 (319)326-8640 SS#-082
Bob Simmering Muscatine County Engineer Muscatine, IA 52761 (319)263-6351 SS#-070	12-31-86	Milt Johnson Wapello County Engineer Ottumwa, IA 52501 (515)684-5425 x147 SS#-090

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, then the costs are shared.

Table II is a record of expenditures for research and development made during the fiscal year ending June 30, 1984. Total expenditure was $1,680,354.14, 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 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 in 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 1984. 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 1984 financial summary is.

Beginning Balance 7-1-83		$ 510,843
Receipts		
Interest	$ 43,693	
Fed. Sec. Rd. (1 1/2% of receipts)..	259,594	
State RUTF (1 1/2% of receipts)	530,887	
External Research Income	82,545	
Sub-Total		916,719
Total Funds Available		$1,427,562
Obligation for Expenditures		
Obligated for		
Contract Research...	681,465	
Non-Contract		
Engineering Studies...	645,536	
Total Expenditures		$1,327,001
BALANCE 6-30-84		$ 100,561

SECONDARY ROAD TRAFFIC COUNT PROGRAM

During fiscal year 1984 the traffic count program conducted by the Office of Transportation Inventory on the Secondary Road System in 25 counties required a total of 2,219 four-hour manual counts, 214 eight-hour manual counts, 48 sixteen-hour manual counts, and 1,214 recorder counts. The traffic data from these counts was used to develop motor vehicle traffic flow maps for each county showing the average annual daily traffic (ADT) on specific road sections in each county. A secondary road inventory was completed in eight counties. This data provides the county engineer, highway engineer, planner and administrator with essential information needed to determine design standard, systematic classification of highways and the development of programs for improvement and maintenance of secondary roads.

TABLE II
FINANCIAL SUMMARY OF RESEARCH AND DEVELOPMENT PROJECT EXPENDITURES
July 1, 1983 to June 30, 1984

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	16,250.00	27,500.00	43,750.00
165	150,000.00	Experimental Steel Fiber Reinforced Concrete Overlay			
173	10,060.00	A Computer Based Information System For County Equipment Cost Records		1,246.75	1,246.75
198	75,000.00	Preliminary Archaeological Investigation Along Proposed Highway Right-of-Way			
199	100,000.00	Upgrading Asphalt Surface Friction by Aggregate Sprinkle Treatments			
203	51,000.00	Joint Sealing with Various Sealants			
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	3,437.97	10,404.59	13,842.56
209	100,346.85	Pavement Surface on Macadam Base - Adair Co.			
210	30,072.00	The Effect of Deer Reflectors on Deer-Vehicle Accidents	93.50		93.50
211	143,207.00	Performance of Randomly-Oriented Fiber Reinforced Roadway Soils		14,320.67	14,320.67
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			
217	43,000.00	Reducing the Adverse Effects of Transverse Cracking			
219	11,200.00	Settlement at Culverts and Bridges			
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	3,440.74		3,440.74
225	89,660.00	Characterization of Fly Ash for Use in Concrete	6,186.32	5,447.76	11,634.08
226	44,000.00	Iowa Research with Chem-Crete Bitumen			
229	130,000.00	Alternate Flexible Overlays		35,243.54	35,243.54
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		20,146.52	20,146.52
234	5,000.00	Compilation of Iowa Highway Laws	1,995.00		1,995.00
236	88,143.00	Pottawattamie Co. Evaluation of Stabilizing Degrading Stream Channels		48,186.14	48,186.14
237	87,065.00	Shelby Co. Stabilization of Degrading Stream Channels			
238	162,898.00	Strengthening Existing Single Span Steel Beam Concrete Deck Bridges	18,882.96	22,697.44	41,580.40
241	8,500.00	Development of EDMI Calibration Baseline		2,310.33	2,310.33
242	132,069.50	Economics of Alterrnative Solutions to the Secondary Roadway Problem		60,741.06	60,741.06
244	9,700.00	Detection of Concrete Delaminations by Infrared Thermography			
246	118,000.00	Engineering Study - Reducing Sign Vandalism		3,888.48	3,888.48
247	88,260.00	Design Criteria for Low Water Crossings		37,471.70	37,471.70
248	11,000.00	Evaluation of a Mobile Rut Depth Device for the Pavement Management Program	591.57		591.57
250	8,000.00	Determining the Thickness of Sound Concrete on Older Pavements	6,395.00	1,000.00	7,395.00
251	49,970.00	Roadway Lighting on Secondary Roads in Iowa		24,599.97	24,599.97

TABLE II
FINANCIAL SUMMARY OF RESEARCH AND DEVELOPMENT PROJECT EXPENDITURES
(cont.)

Project	Total Funds Committed	Project Title	Primary Road Research Fund Expenditures	Secondary Road Research Fund Expenditures	Total Expenditures
252	52,945.00	Piling Stresses in Bridges with Integral Abutments - II	16,623.21	16,399.23	33,022.44
253	60,000.00	Experimental Use of Calcium Magnesium Acetate (CMA)	14,340.07		14,340.07
254	17,500.00	Highway/Railroad Grade Crossings - Identification and Signing	880.32	7,932.20	8,812.52
255	55,506.00	Submerged Vanes for Controlling Streams	20,793.06	13,223.76	34,016.82
256	101,960.00	Perception and Interpretation of Advance Warning Signs on County Roads		26,671.80	26,671.80
257	132,740.00	Field Demonstration of Foamed Asphalt - Muscatine County		114,516.00	114,516.00
258	115,870.00	Frost Action in Rocks and Concrete	11,607.79	10,906.95	22,514.74
259	89,390.00	Low Cost Fly Ash-Sand Stabilized Roadway			
260	98,975.00	Optimization of Soil Stabilization with Type C. Fly Ash	8,200.87	36,111.66	44,312.53
261	3,065.40	Modifications to Improve the Reliability of the Iowa DOT Frost Detector	300.00		300.00
262	70,580.00	Signing on Very Low Volume Rural Roads		58,570.97	58,570.97
263	365,800.00	Engineering Study to Redesign the 24-Foot Secondary Bridge Standards		143,722.07	143,722.07
264	41,660.00	Development of a Sufficiency Rating System for Secondary Roads		22,127.95	22,127.95
265	300,000.00	Engineering Study for the Evaluation of Public Road Administration & Maintenance Alternatives	14,268.18	22,338.72	36,606.90
266	30,000.00	X-Ray Analysis of Carbonate Aggregate to Predict Concrete Durability	2,444.65	1,509.62	3,954.27
267	12,100.00	Engineering Study-Development of Training Aids for Snow Removal on Iowa's Secondary Roads		46.50	46.50
268	110,500.00	Evaluation of Magnitude and Frequency of Floods in Iowa			
1027	35,000.00/yr.	Secondary Road Research Coordinator		33,086.63	33,086.63
		Contract Research Sub-Total	$146,731.21	$822,369.01	$969,100.22
HPR-1 (90) NCHRP			10,313.63	1,610.54	11,924.17
HPR-2 (121) NCHRP			8,237.62	1,232.98	9,470.60
HPR-2 (123) NCHRP			4,808.66	734.33	5,542.99
HPR-2 (124) NCHRP			12,718.07	1,942.17	14,660.24
HPR-4 (182) NCHRP			16,379.15	2,501.26	18,880.41
HPR-4 (183) NCHRP			13,260.56	1,598.99	14,859.55
HPR-PR-PL-1 (20)		FY 1984 Planning & Research Program		635,916.00	635,916.00
		Noncontract Engineering Studies Sub-Total	$ 65,717.69	$645,536.27	$711,253.96
		Grand Total of Expenditures	$212,448.90	$1,467,905.28	$1,680,354.18

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, 1984

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: Fibrous PC Concrete Overlay Research in Greene County

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

Principal Investigator: R. Betterton

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 a badly broken old 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 is now being reopened to maintain the overlay sections as research through 15 years.

Reports: Ten year report, February 1984.

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

Project Number: HR-173

Project Title: A Computer Based Information System for County Equipment Cost Records

Agency: Iowa Department of Transportation, Highway Division

Principal Investigators: S. Johnson, J. K. Poyzer, J. D. Poyzer

Research Period: December 7, 1981, to August 22, 1983

Research Funding: $10,060

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

Objective: To enhance the current "Computer Based Information System for County Equipment Cost Records" so it provides more accurate and more timely reports to county engineers who use it.

Progress: A contract for services was negotiated with James Poyzer, a programmer/analyst from Des Moines Co-principal investigator is John Poyzer who worked on the original programs in 1975. The programs have been revised to allow for easy access to update and correct improper data entries. Also, the programs have been changed to accept individual county data for processing and to allow for several runs of data during the year. Several other minor changes were initiated to make the program more responsive to the counties' needs.

Reports: None

Implementation: Problems with the original program for county equipment cost records have made the output data unreliable for some counties. Program changes will allow for easy input to county equipment cost information and will result in much quicker return of accurate output data to the counties so the most cost-effective equipment can be identified and specified for future purchases.

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, 1985

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-199

Project Title: Upgrading Asphalt Surface Friction by Aggregate Sprinkle Treatments

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: R. A. Shelquist

Research Period: June 1, 1978, to January 31, 1984

Research Funding: $42,500

Funding Source: State--Primary funds and Federal participation in an extra work order.

Objective: To determine the feasibility and cost effectiveness of using standard asphalt mixtures of local aggregates for 1" and 1 1/2" thick surface courses, followed by a surface sprinkle treatment of precoated hard, durable chips to produce a long-lasting, non-skid pavement surface.

Progress: This experimental type of resurfacing was applied on old U.S. 30 between Interstate 35 and the City of Nevada in 1978. Appearance is very good, with the exception of some corrugation which occurred during application. Texture depth tests by the silly putty method and friction tests of the sections are being conducted on a periodic basis.

Reports: Final Report, June 1984

Implementation: This project will be utilized in the evaluation of paving materials and texturing. It will also assist in determining the effectiveness of sprinkle treatment in providing durable friction properties.

Project Number: HR-203

Project Title: Transverse Joint Sealing with Various Sealants

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

Principal Investigator: G. Hardy, V. J. Marks

Research Period: July 25, 1978, to October 31, 1983

Research Funding: $51,000

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

Objective: To evaluate the performance of pcc pavement contraction joints utilizing a variety of sealants and joint preparations and to identify an effective joint sealant system.

Progress: These experimental pavement joints were incorporated into a Secondary Road paving project in Dallas County during the 1978 construction season. Joint sealing procedures, materials and specifications were determined prior to construction. Six different sealant materials were used with three methods of joint cleaning. Other variables were introduced and some cost comparisons were made. Core samples for joint sealant analyses were taken in 1979 and 1980. Visual observations are being made annually. Evaluation of the various joint sealing procedures is completed. The silicone rubber joints exhibited the best performance.

Reports: Final Report, September 1983.

Implementation: Deterioration of joint-related distress of pcc pavements has continued to be a major maintenance problem. This project has precipitated improved joint preparation and sealing specifications.

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. The most recent results indicate improved friction from the hard durable aggregate.

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

Research Period: December 1, 1980, to July 31, 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. No Shelby County structures have been programmed.

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: $100,347

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 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. Road Rater evaluations of the pavement have been made. 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. Evaluation for an additional five years has been recommended.

Reports: Final Report October, 1984

Implementation: This study will result in the ability to construct a pavement with improved performance in regard to D-cracking and subgrade failure 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.

Reports: Progress report, June 1983

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

Project Number: HR-211

Project Title: Performance of Randomly-Oriented Fiber-Reinforced Roadway Soils (A Laboratory and Field Investigation)

Agency: Iowa State University

Principal Investigator: J. M. Hoover

Research Period: July 1, 1979 to February 28, 1983

Research Funding: $143,207

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

Objective: To conduct a laboratory and field investigation into the potential for improving soil-aggregate surface and roadway subgrade materials, and local base course materials by strengthening these materials through fibrous reinforcement.

Progress: Field demonstration sections using a variety of fibers were constructed in Linn and Story counties during the summer of 1980. On the Linn County project, three different types and three different percentages of fibers were used. The Story County project was constructed on an existing gravel road. Some difficulty was experienced in mixing the fibers into the roadbed due to equipment failure.

Reports: Final Report, December 1982

Implementation: Due to economic restraints, new and cost-effective methods are needed for the improvement of subgrade base course construction. This project will aid in the development of new and improved design procedures.

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 March 1, 1985

Research Funding: $13,500

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. A. Shelquist

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. 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, Iowa Department of Transportation, Highway Division

Principal Investigator: C. L. Baule

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

Research Funding: $156,289

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. 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. Evaluation will continue for a five-year period.

Reports: Construction Report, January 1981

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

*This project was 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-217

Project Title: Reducing the Adverse Effect of Transverse Cracking

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: V. J. Marks

Research Period: March 7, 1980, to May 31, 1984

Research Funding: $43,000

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: The research was incorporated into a primary project on Iowa 64 in Jones County, which was completed in September 1980. Some of the variations from standard construction practices used in this project included the following: 1. Use of an asphalt that is partially blown and less susceptible to temperature variations; 2. Variation in mix designs; 3. The sawing and sealing of transverse joints. No particular problems were experienced in this research. Density and gradation requirements were satisfactorily met. There is very little cracking in the pavement produced from the asphalt cement exhibiting low temperature susceptibility. The pavement produced from the highly temperature susceptible asphalt cement exhibits severe cracking. The sealant has failed in the sawed joints.

Reports: Final Report, May 1984

Implementation: With the prevention of transverse cracking and subsequent crack deterioration, asphalt surfaced roads will last longer and require less maintenance and less frequent resurfacing.

Project Number: HR-219

Project Title: Settlement at Culverts and Bridges

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: W. E. Buss

Research Period: May 1980, to May 31, 1984

Research Funding: $11,200

Funding Source: 100 percent State--Primary funds

Objective: To identify cost-effective construction methods that will prevent settlement at culverts and bridges.

Progress: This research was incorporated into a grade, culvert, pavement widening and resurfacing project on Iowa 44 in Dallas County. Various methods of backfilling and bedding for bridges and culverts were completed by the contractor by extra work order. Flowable mortar, sand and Class A material with moisture control were used on the bridge approaches. Flowable mortar and Class A, B and C road stone were used in various combinations in the culvert replacement and backfill. Better inspection may result in reduced settlement over culvert replacements. Class "C" stone backfill yielded the least settlement. Flowable mortar is a very cost effective viable method of backfilling.

Reports: Final Report, May 1984

Implementation: The reduction in settlement will result in less maintenance and will provide the best method of backfill at a reasonable cost.

Project Number: HR-220

Project Title: Protection of Structural Concrete Substructures

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: J. Risch, J. Whiting

Research Period: May 1980, to July 15, 1985

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. 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.

Reports: Construction Report, February 1981

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. A. Shelquist

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. 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

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

Project Number: HR-225

Project Title: Characterization of Fly Ash for Use in Concrete

Agency: Iowa State University

Principal Investigator: Turgut Demirel

Research Period: August 1, 1980, to October 31, 1983

Research Funding: $89,660

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

Objective: To determine the components or combinations of components in fly ash responsible for good or poor performance of concrete and to quantify fly ash variability.

Progress: Thirty-five fly ash samples were collected from seven power plants. Elemental analyses of all fly ash samples have been performed using x-ray fluorescence. Concrete mixes have been prepared and subjected to freeze-thaw testing and x-ray diffraction analysis.

Reports: Final Report, September 1983

Implementation: The research will establish criteria for predicting the suitability of a given fly ash for use in highways in Iowa.

Project Number: HR-226

Project Title: Iowa Research with Chem-Crete Bitumen

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

Principal Investigator: D. Jespersen, K. Jones

Research Period: August 1980, to October 31, 1984

Research Funding: $44,000

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

Objective: To determine if Chem-Crete bitumen will provide significantly improved performance of the mix designs used, and to determine if a satisfactory asphalt concrete base can be made using a poorly graded sand.

Progress: Test sections of Chem-Crete resurfacing and standard asphalt resurfacing were constructed in September 1980 on Story County Roads E-57 and North Dakota Street Extension (Ames). Soon after construction, cracks in the Chem-Crete test sections appeared. The Chem-Crete Corporation has been working with Story County to maintain the roadways.

Reports: Final Report, April 1984

Implementation: Products which result in improved characteristics of low quality aggregate will allow the use of locally available aggregate, thereby conserving resources and reducing cost.

Project Number: HR-229

Project Title: Alternate Flexible Overlays

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

Principal Investigator: R. Glasgow, 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 1986

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 thermal 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: Letter Report, November 1983

Implementation: The prevention of transverse cracking and subsequent deterioration will increase the life of asphalt surfaced roads and require less maintenance and less frequent resurfacing.

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 March 1, 1986

Research Funding: $35,229

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

Objective: To evaluate the performance of foamed asphalt as a stabilizing agent using existing soils and granular surfacing material; 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 has been conducting 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 Investigator: L. Paff

Research Period: May 15, 1981 to January 31, 1984

Research Funding: $5,000

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

Objective: To provide a current annotated Iowa Highway, Road and Street Law publication.

Progress: Two law clerks were retained on a temporary basis to search out the laws and pertinent court cases and draft the publication for the Director of the Iowa DOT General Counsel Division.

Reports: Final Report, January 1984

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

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 January 31, 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 has been established and three counties have been selected to evaluate the cost-benefit investment strategies. Surveys are being conducted in Shelby, Hamilton and Linn Counties which were selected for the evaluation. 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 December 31, 1983

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.

Reports: None

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 is being 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: None

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 May 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 will be contacted and asked for their input for the second phase of the research.

Reports: Design Manual, October 1983.

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.

Project Number: HR-250

Project Title: A Non-destructive Method for Determining the Thickness of Sound Concrete on Older Pavements

Agency: Iowa Department of Transportation, Highway Division and Donohue and Associates, Inc.

Principal Investigator: Vernon J. Marks

Research Period: August 15, 1982 to December 31, 1983

Research Funding: $8,000

Funding Source: 100 percent State--85 percent Primary, 15 percent Farm-to-Market

Objective: To evaluate the potential of determining the thickness of sound concrete by ground penetrating or down-looking radar.

Progress: Donohue and Associates personnel visited Iowa to conduct ground penetrating radar surveys on two occasions. They were not completely satisfied with the signal conditioning amplification and recording system. Another radar survey was conducted in 1983. The radar unit exhibited potential for locating voids and steel and also for determining the thickness of sound concrete. More development is needed.

Reports: Final Report, December 1983

Implementation: Early detection of joint deterioration would facilitate proper maintenance and rehabilitation.

Project Number: HR-251

Project Title: Roadway Lighting on Secondary Roads in Iowa

Agency: Iowa State University

Principal Investigator: R. L. Carstens

Research Period: September 1, 1982, to November 30, 1983

Research Funding: $49,970

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

Objective: To improve safety on secondary roads by defining locations where destination lighting may be expected to reduce the frequency of highway accidents.

Progress: An inventory of secondary road lighting installations was conducted. Information indicates that there are approximately 820 locations of lighting installations on secondary roads in Iowa. Accident data was obtained through the ALAS records and analyzed to identify differences for accident rates at lighted locations and unlighted locations.

Reports: Final Report, January 1984

Implementation: A reduction of accidents will occur if destination lighting is installed where it is warranted but does not exist. A cost savings will arise if destination lighting is not installed at locations were no accident reduction would be realized by installation.

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: None

Implementation: The economic advantage of integral abutments can be realized for longer bridges.

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 has been extended to develop lower cost methods of production.

Reports: Final Report, June 1983

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 February 29, 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. Some data has been obtained from the Nishnabotna River near U.S. 34 in Montgomery Count where a field application is being considered. The draft of the final report has been written.

Reports: None

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 December 31, 1984

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

Implementation: By identifying the most effective advance warning sign, intersection safety will 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: None.

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 initiated.

Reports: Progress Report, April 1984.

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 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 planned project is a 1.2-mile section of Des Moines County Road H-40. Various thicknesses of fly ash-cement-sand base will be constructed using a locally available dredge sand from the Mississippi River. A three-inch thick acc overlay will be 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, 1985

Research Funding: $98,975

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, October 1983and 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-261

Project Title: Modification to Improve the Reliability of the Iowa DOT Frost Detector

Agency: Norbert K. Fox

Principal Investigator: N. K. Fox

Research Period: April 15, 1983, to May 31, 1984

Research Funding: $3,065.40

Funding Source: 100 percent State--Primary funds

Objective: To eliminate the falsing of the Iowa DOT frost detector and verify its proper performance.

Progress: A potential electronic system was identified that may eliminate the false signals on the sensors caused by tire strikes. This electronic system was tested in the laboratory. The electronic system did not solve the problem and the project was terminated.

Reports: Final Report, January 1984

Implementation: A reliable frost detector system could quickly alert maintenance personnel of bridge deck icing conditions. More timely application of deicing salt will reduce accidents, tort liabilities and maintenance costs.

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 Sate--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 will 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, 1985

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 been contracted to redesign the 24' wide prestressed concrete and the concrete slab secondary bridge standards. Each new standard design will be released for county use upon completion.

Reports: None

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 November 30, 1984

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 are being reviewed. A mathematical calculation procedure will be developed.

Reports: Progress Report, June 1984

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 Investigator: V. Marks

Research Period: October 11, 1983, to June 20, 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: Status Report, June 1984

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: Interim Report, January, 1984

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 content of the presentation has been developed and some photographs have been taken.

Reports: None

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: $115,500 (matched by $115,500 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: The literature search and data analysis will be initiated soon.

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-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: $30,000

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 10 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.

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) 294-5932	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 Key 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 De.euw-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.

Annual Report of Highway Research and Development in Iowa

Highway Division
Office of Materials
December 1986

Iowa Department of Transportation

ANNUAL REPORT
OF
HIGHWAY RESEARCH AND DEVELOPMENT IN IOWA

FOR THE
FISCAL YEAR ENDING JUNE 30, 1986

OFFICE OF MATERIALS
(515)239-1447

HIGHWAY DIVISION
IOWA DEPARTMENT OF TRANSPORTATION
AMES, IOWA 50010

DECEMBER 1986

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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, 1986; it is also a report on projects completed during the fiscal year beginning July 1, 1985, and ending June 30, 1986. 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 consists 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, 1986, is listed in Table I.

The Research Board held seven regular meetings during the period of July 1, 1985 to June 30, 1986. Suggestions for research and development were reviewed at these meetings and recommendations were made by the Board.

TABLE 1 1986 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	Dale E. Miller Fremont County Engineer R.R. 2, Box 19 Sidney, IA 51652 (712) 374-2886 SS#-036
Donald A. Anderson Deputy Director, Operations Iowa DOT - Highway Division Ames, IA 50010 (515) 239-1491	12-31-88	Bernard C. Brown 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	12-31-88	Paul W. Peterson Assoc. Dean of Research Iowa State University 104 Marston Hall Ames, IA 50011 (515) 294-2336
George Calvert Director of Operations Research Iowa DOT - Highway Division Ames, IA 50010 (515) 239-1461	12-31-88	George F. Sisson Road Design Engineer Iowa DOT - Highway Division Ames, IA 50010 (515) 239-1470
Robert DeWys Scott County Engineer Courthouse Davenport, IA 52801 (319) 326-8640 SS#-082	12-31-88	Russell A. Krieg Buchanan County Engineer R. R. 2 Independence, IA 50644 (319) 334-6031 SS#-010
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 Haylock Butler County Engineer Courthouse Allison, IA 50602 (319) 267-2630 SS#-012	12-31-86	Richard O. Schiek Kossuth County Engineer Courthouse Algona, IA 50511 (515) 295-3320 SS#-055
Robert G. Hering Dean of Engineering University of Iowa Iowa City, IA 52242 (319) 353-6603	12-31-87	Jerald L. Schnoor Dept. of Civil & Envir. Engr. University of Iowa Iowa City, IA 52242 (319) 353-7262
Raymond L. Holland City Engineer Bettendorf, IA 52722 (319) 359-0347	12-31-88	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	12-31-88	Thomas G. Rohe Plymouth County Engineer Courthouse Le Mars, IA 51031 (712) 546-8956 SS#-075
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 3610 Park Avenue W. 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, 1986. Total expenditure was $826,347.06, 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

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 Inventory conducted traffic counts in twenty-four counties during fiscal year 1986 as part of the Annual Traffic Count Program. This activity consisted of 907 four-hour manual counts, 150 eight-hour manual counts, 45 sixteen-hour manual counts, and 2,290 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 reinstated 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 1986. 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 1986 financial summary is.

Beginning Balance 7-1-85		$ 664,894
Receipts		
Interest	$ 32,145	
Federal Aid Secondary (1 1/2% of receipts)..	313,224	
State Road Use Tax Fund (1 1/2% of receipts)...	600,908	
Research Income	100,930	
Sub-Total		1,047,207
Total Funds Available		$1,712.101
Obligation for Expenditures		
Obligated for Contract Research...	1,272,687	
Non-Contract Engineering Studies...	105,433	
Total Expenditures		$1,378,120
BALANCE 6-30-86		$ 333,981

TABLE II
FINANCIAL SUMMARY OF RESEARCH AND DEVELOPMENT PROJECT EXPENDITURES
July 1, 1985 to June 30, 1986
(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	85,625.00	Collection and Analysis of Stream Flow Data	16,250.00	42,812.50	59,062.50
165	150,000.00	Experimental Steel Fiber Reinforced Concrete Overlay			
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		14,810.94	14,810.94
213	13,550.00	Improved Asphalt Pavement Performance Through Crack Maintenance			
215	10,700.00	Improvement of Longitudinal Joints in Asphalt Pavements			
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		1,758.36	1,758.36
231	45,340.00	Special Surface Preparation Prior to Bituminous Overlays		713.70	713.70
233	40,232.88	Field Demonstration and Evaluation of Foamed Asphalt		5,033.60	5,033.60
234	6,268.00	Compilation of Iowa Highway Laws		750.92	750.92
236	88,143.00	Pottawattamie Co. Evaluation of Stabilizing Degrading Stream Channels			
237	87,065.00	Shelby Co. Stabilization of Degrading Stream Channels			
238	162,898.00	Strengthening Existing Single Span Steel Beam Concrete Deck Bridges	7,810.47	8,888.86	16,699.33
242	296,305.50	Economics of Alternative Solutions to the Secondary Roadway Problem		7,123.68	7,123.68
244	9,700.00	Detection of Concrete Delaminations by Infrared Thermography			
246	118,000.00	Engineering Study - Reducing Sign Vandalism		689.00	689.00
253	72,000.00	Experimental Use of Calcium Magnesium Acetate (CMA)	1,021.51		1,021.51
254	17,500.00	Highway/Railroad Grade Crossings - Identification and Signing			
256	101,960.00	Perception and Interpretation of Advance Warning Signs on County Roads		8,584.64	8,584.64
257	132,740.00	Field Demonstration of Foamed Asphalt - Muscatine County		2,619.24	2,619.24
258	115,870.00	Frost Action in Rocks and Concrete	19,884.42	20,992.43	40,876.85
259	89,390.00	Low Cost Fly Ash-Sand Stabilized Roadway		9,944.93	9,944.93
260	158,235.00	Optimization of Soil Stabilization with Type C. Fly Ash	9,735.63	31,218.91	40,954.54
263	740,800.00	Engineering Study to Redesign the 24-Foot Secondary Bridge Standards		3,753.00	3,753.00
264	41,660.00	Development of a Sufficiency Rating System for Secondary Roads		5,447.10	5,447.10
265	300,000.00	Engineering Study for the Evaluation of Public Road Administration & Maintenance Alternatives	22,807.85	8,249.98	31,057.83
266	30,000.00	X-Ray Analysis of Carbonate Aggregate to Predict Concrete Durability	5,599.40	6,556.13	12,155.53
268	110,500.00	Evaluation of Magnitude and Frequency of Floods in Iowa	13,375.00	14,750.00	28,125.00
269	24,250.00	Data Acquisition and Computer Plotting of Delamtect Data	2,361.58	2,425.00	4,786.58
270	100,000.00	Development of Training Aids and Demonstration of Portland Cement Concrete Pavement Rehabilitation			
271	103,870.00	Effects of Deicing Salt Compounds on Deterioration of PC Concrete	37,914.57	12,793.03	50,707.60
272	106,845.00	Development of a Conductometric Test for Frost Resistance of Concrete	25,272.25	29,274.12	54,546.37
273	138,514.00	Piling Stresses in Bridges With Integral Abutments - Phase 3	17,385.39	17,421.06	34,806.45
274	66,000.00	Construction and Evaluation of Submerged Vanes for Stream Control			
275	41,577.00	Long Term Structural Movement	24,222.03	5,618.30	29,840.33
276	32,000.00	Transverse Joint Sealing With Improved Sealants		12,701.08	12,701.08

Table II con't.)

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	11,025.92	7,510.12	18,536.04
279	76,175	Cracking and Seating PCC Pavement Prior to Resurfacing to Retard Reflective Cracking			
280	300,000	An Engineering Study to Update the Box Culvert Standards			
281	35,000	Effects of Pavement Surface Texture on Noise and Frictional Characteristics			
282	295,000	A Low Cost Automatic Weight and Classification System	3,310.55		3,310.55
283	15,000	Pavement Texturing by Milling	14,644.67		14,644.67
284	50,790	Development of Multiplan Microcomputer Spreadsheets for County Hydraulic and Highway Engineering Computations		10,602.79	10,602.79
285	91,950	Measuring Discharge at Crest-Stage Gaging Stations Using Tracer-Dilution Methods	21,250.00		21,250.00
286	174,200	Development of a Rational Characterization Method for Iowa Fly Ash	3,227.08	6,664.15	9,891.23
287	87,430	Strengthening of Existing Continuous Composite Bridges	4,702.41	7,071.93	11,774.34
288	39,750	Field Evaluation of Bonded Concrete Resurfacing	25,684.24		25,684.24
289	12,800	Engineering Study - Training Aids to Reduce Potential County Liability			
290	25,200	Ice Retardant Pavement	22,420.00		22,420.00
291	14,200	Performance of Nongrouted Thin, Bonded PCC Overlays		2,261.94	2,261.94
292	19,350	Field Evaluation of Integral Abutment Bridges			
293	150,000	Pavement Instrumentation			
294	80,175	Ammonium Phosphate/Fly Ash Road Base Construction			
1027	32,500.00/yr.	Secondary Road Research Coordinator		27,860.50	27,860.50
		Contract Research Sub-Total	$309,904.97	$336,901.94	$646,806.91
HPR-2 (121)		NCHRP pooled fund project for National Program for Skid Test and Calibration Centers	10,040.25	1,502.80	11,543.05
HPR-2 (127)		NCHRP pooled fund project for Cost Effective Geometric Design Standards for RRR Projects	1,514.20	231.22	1,745.42
HPR-4 (183)		NCHRP FY83 General Project Funding	9,854.87	1,188.33	11,043.20
HPR-4 (184)		NCHRP FY84 General Project Funding	35,414.02	4,114.09	39,528.11
HPR-4 (185)		NCHRP FY85 General Project Funding	17,284.48	2,090.56	19,375.04
HPR-PR-PL-1 (21)		FY 1985 Planning & Research Program (Transportation Inventory Engineering Studies)		96,305.33	96,305.33
		Noncontract Engineering Studies Sub-Total	$ 74,107.82	$105,432.33	$179,540.15
		Grand Total of Expenditures	$384,012.79	$442,334.27	$826,347.06

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 FY86 was $385,000 and the estimate for FY87 is $600,000.

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: John Klein, U.S.G.S.

Research Period: Project continued to September 30, 1986

Research Funding: $85,625 per year (matched by $85,625 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 1985-1986 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: Ronald Betterton and Vernon 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, 1987

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. The program has been very effective infacilitating archaeological investigations of local system projects.

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 March 31, 1986

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. Wayne 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 were completed. The designs included three vertical sheet-pile structures, two soil-cement structures, and one pre-cast concrete structure. Hydraulic and structural analyses of the proposed structures were performed. One structure in Pottawattamie County, originally designed as a sheet-pile structure, was changed to a gabion structure and was completed in 1983.

Reports: Final Report, July 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 save millions of dollars for counties in western Iowa.

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: Dwight Rorholm

Research Period: November 12, 1979, to March 31, 1987

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, October 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. A graph of % of longitudinal cracking versus age is being maintained for each treatment.

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-220

Project Title: Protection of Structural Concrete Substructures

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: John 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: Roderick Monroe

Research Period: July 1, 1980, to February 28, 1987

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 June 30, 1986

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 was conducted annually.

Reports: Final Report, June 1986.

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: Rolly Glasgow, and Clyde 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: Warren 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-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 pit run sand is being evaluated. Nine different test sections were constructed on 4.2 miles of county road A-91 in 1983.

Reports: Final Report, July 1985

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

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. The summary has been compiled in a manner to allow for periodic updating.

Reports: The compilation was updated June 1985

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: Charles Hales, Robert Lohnes, Fred Klaiber and Tom Austin

Research Period: July 10, 1981, to June 1, 1987

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. Because of higher than anticipated construction costs and difficulty in obtaining additional funds, only one structure has been built. The 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: Eldo Schornhorst, Robert Lohnes, Fred Klaiber and Tom Austin

Research Period: July 10, 1981, to June 1, 1987

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. One structure was designed and carried to a letting but no bids were received. A sheet-pile structure is currently being designed for construction during 1987. A proposal to extend the research period to include this construction will be made in the near future.

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 March 31, 1985

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 and Part III, 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-242

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

Agency: Iowa State University and Linn County

Principal Investigator: Phillip Baumel

Research Period: July 1, 1982 to July 31, 1987

Research Funding: $296,305.50

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 have been analyzed and costs for various vehicles have been established. A User's Manual has been developed which permits computer modeling of traffic on a road system to determine benefit-cost ratios of abandoning selected road segments from the system.

Reports: Final Report, December 1985, User's Manual, January 1986.

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: Complete

Reports: Final Report, January 1986

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: Mark Callahan

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 incidence and cost of sign vandalism.

Progress: Research was conducted at Iowa State University. From the findings of that research, a public awareness campaign has been established. Posters and tri-fold leaflets have been developed to be distributed to public schools and driver license offices throughout the state. Television and radio public service announcements have also been developed to be aired in the near future. Several counties have been selected to participate in a study to evaluate the effectiveness of this campaign.

Reports: Progress Report, September 1984

Implementation: It is estimated that over $1 million is spent in Iowa each year on replacing vandalized signs. One state achieved over a 50% reduction in sign vandalism through the use of an aggressive public awareness campaign.

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 June 30, 1987

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 in 1982 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. Additional CMA deicer will be produced in 1986. This material will be evaluated in the Davenport area.

Reports: Final Report, June 1983, Addendum to Final Report September 1984, Progress Report, June 1985

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: Neil Volmer, Peggy Baer

Research Period: February 4, 1983, to January 31, 1987

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-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 were 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: Robert Simmering and Howard 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 pit run 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 was successful.

Reports: Final Report, April 1986

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: Sylvester Klassen and Howard 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: Construction Report, January 1986

Implementation: There are plentiful supplies of blow sand, fine pit run 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: John Pitt

Research Period: May 1, 1983, to January 31, 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 have been used with various sources of fly ash. Some chemicals have yielded substantial increases in compressive strength.

Reports: Progress Report, April 1985.

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-263

Project Title: An Engineering Study to Update Secondary Bridge Standards

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

Principal Investigator: William Lundquist

Research Period: June 1, 1983, to June 30, 1988

Research Funding: $740,800

Funding Source: $440,800 State--Farm-to-Market funds; $300,000 Federal Funds*

Objective: To redesign the secondary bridge standard plans to HS20 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 multi-span prestressed concrete, the continuous concrete slab, and the simple span concrete slab secondary bridge standards. Crash testing of the secondary bridge rail has been included in a FHWA project. The redesign of the 30' wide multi-span prestressed concrete, the continuous concrete slab, and the simple span concrete slab secondary bridge standards is in progress. Additional redesign is underway to bring both the 24' and 30' widths to meet HS20 loadings.

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.

*This project includes 80 percent matching money from Federal Bridge Replacement Funds.

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 have been collected by a questionnaire and personal interviews. The contractor visited four other states with different administrative and maintenance practices.

Reports: Final Report and Executive Summary, August 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 January 31, 1987

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. Fly ash has beneficial results in many cases. Durability of crushed stone correlates with at least two trace mineral contents. X-ray diffraction and florescence evaluation of many carbonate aggregate samples have been conducted. Iron in the dolomite crystal structure causes a shift in the d-spacing of dolomite peaks. The resulting d-spacing correlates with service records.

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-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 March 31, 1987

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 have been compiled. A literature search for the latest method of stream flow and flood stage calculation has been completed. Flood magnitude and frequency prediction methodology is being developed. A draft final report 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 computers available in Iowa DOT field offices.

Progress: Complete and equipment is being used routinely.

Reports: Final Report - September 1985

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: Robert Given

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 Concrete Pavement Rehabilitation 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: Progress Report, May 1986

Implementation: The training aids will promote more effective maintenance of our pavements and 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: John Pitt, Dah-Yinn Lee and Wendell Dubberke

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

Research Funding: $103,870

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. The loss of durability does not correlate with sodium chloride, but does correlate with sulphate content.

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

Reports: Phase I Report, January 1986

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: Turgut Demirel, B. V. Enustun, Scott Schlorholtz, and Sam Moussalli

Research Period: February 1, 1985, to January 31, 1987

Research Funding: $106,845

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. There was a change noted in conductivity of non-air entrained concrete specimens after only a few freeze/thaw cycles that indicates potential of predicting durability. There is an interesting relationship of the relative conductivity of concrete between electrodes at different spacing.

Reports: Progress Report, November 1985

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: Lowell Greimann, Fouad Fanous

Research Period: March 1, 1985 to June 30, 1987

Research Funding: $138,514

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: The field evaluation is being conducted on special piling driven near the Town Engineering Building on the Iowa State University Campus.

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: Jacob 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: Construction was completed in 1985 in the West Nishna River near US 34 at Red Oak. Evaluation is continuing.

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: Terry Wipf

Research Period: May 1, 1985 to February 28, 1986

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: The three methods of measuring long term structural movement evaluated as part of this project were surveying, analytical photogrammetry and tilt sensors. The study showed that either tilt sensors or analytical photogrammetry could be used to accurately measure long-term structural movement. It was recommended that these two systems be used to monitor one or more bridges for two years.

Reports: Final Report, February 1986

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: Charles Cabalka and Mark Callahan

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. Visual evaluation of the joints is being made semi-annually.

Reports: Construction Report, April 1986

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: Wes Smith and Ken 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 includes 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 being constructed on Hamilton County Road R-33. The cracking and seating of the PCC pavement have been completed. The asphalt overlays will soon be completed as well.

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: Dah-Yinn 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: Laboratory evaluation of AC-13 polymer additive, 3M additive 5990 (Asphadur) and hydrated lime in asphalt cement has begun. The properties appear to be quite different.

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-279

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

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

Principal Investigators: Dale Miller and Ken Pesch

Research Period: June 1, 1985, to July 1, 1991

Research Funding: $76,175

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

Objective: To evaluate the effect of crack spacing and seating of pcc pavement prior to resurfacing on reflective cracking and structural rating

Progress: The project will include breaking a 2-mile pcc pavement section with transverse cracking at 2, 3 & 5 feet intervals. A portion of the project will be overlaid with 3 inches of asphaltic concrete and a portion will be overlaid with 4 inches of asphaltic concrete. The project is to be constructed on Fremont County Road J-46 in 1986.

Reports: None

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

Project Number: HR-280

Project Title: An Engineering Study to Update the Box Culvert Standards

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

Principal Investigator: William Lundquist

Research Period: July 31, 1985, to July 31, 1987

Research Funding: $300,000

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

Objective: To develop single span box culvert standards, headwalls and bell joints for use by the Iowa counties.

Progress: Stanley Consultants, Inc. of Muscatine, Iowa, began work in February 1986. Twenty four different single barrel box culverts will be designed for sizes from 5'x3' to 12'x12', with 9 different fills and 4 different skewed headwalls (0^{o}, 15^{o}, 30^{o} and 45^{o}). Approximately 90% of the work has been completed to date. A proposal to expand this project to include the development of twin box culvert standards has been presented to the Highway Research Board.

Reports: None

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

Project Number: HR-281

Project Title: Effects of Pavement Surface Texture on Noise and Frictional Characteristics

Agency: Iowa Department of Transportation

Principal Investigator: Roman Dankbar

Research Period: July 16, 1985, to January 31, 1987

Research Funding: $35,000

Funding Source: 100 percent State--Primary funds

Objective: To measure the effects of modified surface texturing on traffic noise and frictional characteristics.

Progress: An area of I-380 southbound from Cold Stream Avenue south 2000 ft. was selected for texturing by diamond grinding. Noise and friction measurements were made before and after texturing and continue to be made periodically.

Reports: None

Implementation: If noise levels and friction values can be maintained at acceptable levels, diamond grinding may be a method to prevent complaints of traffic noise caused by transverse comb texturing in urban areas.

Project Number: HR-282

Project Title: A Low Cost Automatic Weight and Classification System

Agency: Iowa Department of Transportation, Minnesota Department of Transportation and the Federal Highway Administration

Principal Investigator: Bill McCall

Research Period: August 1, 1985 to April 1, 1987

Research Funding: $295,000

Funding Source: State--Primary funds-34%; Minnesota DOT-25%; FHWA-41%

Objective: To examine the reliability of the low cost WIM system through field trials, to evaluate the accuracy of axle and gross vehicle weight measurements and to investigate the performance of the classification system.

Progress: The advisory panel selected Castle Rock Consultants as the contractor for this project. The Contractor has completed the review of related research. They are now developing the test program.

Reports: None

Implementation: A low cost WIM system will provide improved truck monitoring which will aid enforcement and design to extend pavement life thereby yielding substantial savings.

Project Number: HR-283

Project Title: Pavement Texturing by Milling

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: Cedarapids, Inc., Vernon Marks

Research Period: September 15, 1985, to January 31, 1986

Research Funding: $15,000

Funding Source: 100 percent State--Primary Funds

Objective: To produce an acceptable surface texture with a milling machine modified with an increased number of cutting teeth.

Progress: A Cedarapids-Wirtgen 1900c mill with 412 teeth (3 times the standard number) was used to rehabilitate the surface of one AC and two PC pavements. The texture varies with the forward speed of the mill with a slower speed yielding smoother texture. The resulting texture was relatively smooth, but did increase the tire noise.

Reports: None

Implementation: Achieving an acceptable texture by milling would result in substantial savings from profiling the many miles of rutted AC pavement and faulted PC pavements when compared to current profiling costs.

Project Number: HR-284

Project Title: Development of Multiplan Microcomputer Spreadsheets for County Hydraulic and Highway Engineering Computations

Agency: Iowa State University

Principal Investigator: Ken Brewer

Research Period: November 1, 1985, to April 30, 1987

Research Funding: $50,790

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

Objective: To develop "Multiplan" spreadsheet solutions to a set of selected hydraulic and highway engineering computations of common interest to county engineers and to make them available to each county through a series of one-day workshops.

Progress: An advisory committee of county engineering personnel has been formed to help direct the research effort. The committee has met twice with the principal investigator and established priorities for specific program solutions to be developed. Several programs have been developed and are in the process of being revised to meet the specific needs of the counties. A list of workshops has been scheduled for early 1987 to help users become familiar with the programs

Reports: None

Implementation: Many counties lack the time and personnel to write all the needed programs for their specific brand of computer. Spreadsheet solutions operate nearly identically in all computer spreadsheet versions, allowing easy training, use and trouble shooting of programs.

Project Number: HR-285

Project Title: Measuring Discharge at Crest-Stage Gaging Stations Using Tracer-Dilution Methods

Principal Investigator: Phil Soenksen

Research Period: November 1, 1985, to September 30, 1988

Research Funding: $91,950

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

Objective: To obtain complete stage and discharge hydrographs on small streams without the use of manpower at the sites during the flood event.

Progress: Equipment has been obtained and will be installed on selected streams to obtain flow data during the high flows of the 1986 spring period.

Reports: None

Implementation: Improved flood discharge data will permit more accurate design and reduce the design factor of safety necessary, thereby generating a cost savings in the construction of future structures.

Project Number: HR-286

Project Title: Development of a Rational Characterization Method for Iowa Fly Ash

Agency: Iowa State University

Principal Investigator: Turgut Demirel

Research Period: December 1, 1985, to November 30, 1988

Research Funding: $174,200

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

Objective: To develop a test method to characterize Class C fly ash and ensure consistent performance.

Progress: X-ray diffraction techniques are being used to analyze numerous samples of fly ash from selected power plants that provide fly ash for Iowa DOT projects. Chemical compound contents are determined. Scanning electron microscopy and thermal analysis are also being used.

Reports: None

Implementation: There is a substantial cost savings from substituting fly ash for portland cement. This research will ensure proper quality of concrete with fly ash substitution.

Project Number: HR-287

Project Title: Strengthening of Existing Continuous Composite Bridges

Agency: Iowa State University

Principal Investigators: F. Wayne Klaiber and Kenneth Dunker

Research Period: November 1, 1985, to January 31, 1987

Research Funding: $87,430

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

Objective: To determine the feasibility of strengthening continuous composite bridges.

Progress: Materials have been obtained to construct the 1/3 scale model bridge. Construction in the Iowa State University Structural Laboratory is beginning.

Reports: None

Implementation: Strengthening of continuous composite bridges would reduce the number of bridges requiring posting of maximum traffic weights.

Project Number: HR-288

Project Title: Field Evaluation of Bonded Concrete Resurfacing

Agency: Construction Technology Laboratories

Principal Investigator: Shiraz D. Tayabji

Research Period: January 1, 1986, to September 30, 1986

Research Funding: $39,750

Funding Source: 100 percent State Funds--67 percent Primary, 33 percent Farm-to-Market

Objective: To perform condition surveys and load testing of pavement overlays and to verify design procedures for bonded resurfacings.

Progress: Field testing of five sites for this project has been completed. Deflections and stresses in the concrete were determined under both an 18,000 pound single axle and a 34,000 pound tandem axle. The data are now being analyzed.

Reports: None

Implementation: This research will improve the design of bonded overlay rehabilitation of pavement. There will be a savings through reduced overdesign and through extended life by avoiding under design.

Project Number: HR-289

Project Title: Engineering Study - Training Aids to Reduce Potential County Liability

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: Mark Callahan

Research Period: January 1, 1986, to June 1, 1987

Research Funding: $12,800

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

Objective: To develop a training slide/tape presentation which will illustrate situations and actions that could potentially contribute to highway accidents. The presentation will also show what remedial actions can be taken to improve highway safety.

Progress: An advisory committee of county engineers has been formed to help direct the research effort. With assistance from the committee, a script will be developed.

Reports: None

Implementation: Proper planning, design, construction and maintenance will avoid mitigating situations and reduce highway-related tort claims

Project Number: HR-290

Project Title: Ice Retardant Pavement

Agency: City of Des Moines

Principal Investigator: John P. Bellizzi

Research Period: February 3, 1986, to March 31, 1991

Research Funding: $25,200

Funding Source: 100 percent State--Primary Funds

Objective: To evaluate the effectiveness of ice-retardant additives to the surface course of asphalt pavement in Iowa; to develop operational procedures for placing and maintaining asphalt concrete containing ice-retardant additives.

Progress: The location for use of the ice-retardant additive has been selected and a similar intersection has been identified for accident history comparison. The Verglimit has been purchased and has been stored in City of Des Moines facilities.

Reports: None

Implementation: Use of the ice-retardant additive will improve safety by providing continuous deicing at selected high frequency snow and ice related accident locations.

Project Number: HR-291

Project Title: Performance of Nongrouted Thin, Bonded PCC Overlays

Agency: Iowa Concrete Paving Association, Monroe County and the Iowa Department of Transportation, Highway Division

Principal Investigators: Mark Kaler, Wendell Folkerts, Milt Johnson and John Lane

Research Period: March 1, 1986, to October 1, 1990

Research Funding: $14,200

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

Objective: To evaluate the performance of the nongrouted sections of a thin, bonded PCC overlay in Monroe and Wapello Counties.

Progress: A contract has been initiated with the Iowa Concrete Paving Association. Road Rater testing has been conducted to determine the structural rating. The first series of cores have been obtained and tested for bond strength.

Reports: None

Implementation: PCC bonded overlays are currently bonded to the existing surface by placing a thin film of sand-cement grout ahead of the paving operation. If adequate bond without grout can be achieved for the overlay, approximately $1.00 per square yard of overlay could be saved.

Project Number: HR-292

Project Title: Field Evaluation of Integral Abutment Bridges

Agency: Iowa State University

Principal Investigator: Darrel D. Girton

Research Period: March 1, 1986, to July 31, 1986

Research Funding: $19,350

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

Objective: To determine expansion or contraction of integral bridges as related to air and deck temperatures; to measure the effects of abutment movement on stresses in the bridge; to develop guidelines that will permit safe design of longer integral abutment bridges.

Progress: Methods and needed equipment for evaluation of integral abutment bridges have been developed.

Reports: None

Implementation: This research will allow longer bridges without expansion assemblies which will result in substantial savings due to longer maintenance free bridge life.

Project Number: HR-293

Project Title: Pavement Instrumentation

Agency: Iowa Department of Transportation, Highway Division, Iowa State University, Federal Highway Administration

Principal Investigator: Roman Dankbar

Research Period: April 1, 1986, to December 31, 1988

Research Funding: $150,000

Funding Sources: 50 percent State--Primary Funds, 50 percent FHWA

Objective: To evaluate the magnitude and frequency of dynamic loads applied to the pavement as related to the static loads used in pavement design and the demonstration of instrumentation for evaluation of pavement design and performance.

Progress: A review has been conducted to identify the most effective current technology in evaluation instrumentation. A contract has been executed with Iowa State University for their participation.

Reports: None

Implementation: Improved design data from long term monitoring instrumentation will extend pavement life and will make possible the selection of the most economical design.

Project Number: HR-294

Project Title: Ammonium Phosphate/Fly Ash Road Base Construction

Agencies: Story County and Iowa State University

Principal Investigators: Del Jespersen and John Pitt

Research Period: May 1986 to July 1991

Research Funding: $80,175

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

Objective: To evaluate construction and service performance of ammonium phosphate fly ash treated base courses of limestone aggregate and unprocessed sand.

Progress: A 1.8 mile section of R-63 north of its intersection with E-29 in Story County has been selected for the project. Two mixes, two thicknesses and two wearing courses are to be tested.

Reports: None

Implementation: Trace chemicals have the ability to increase the strength of fly ash dramatically and to affect its set time. The inexpensive modification of Iowa fly ashes can increase the economic benefit of fly ash for many highway related uses.

Project Number: HR-1027

Project Title: Secondary Road Research Coordinator

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: Kevin Jones

Research Period: March 5, 1980, to present

Research Funding: $32,500.00/yr.

Funding Source: 100 percent State--Farm-to-Market 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: Kevin Jones, the present Secondary Road Research Coordinator, will soon be promoted to another postion. A replacement for Mr. Jones is currently being sought. Mr. Jones has visited 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 12 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.

Annual Report of Highway Research and Development in Iowa

Highway Division
Office of Materials
October 1987

Iowa Department of Transportation

ANNUAL REPORT
OF
HIGHWAY RESEARCH AND DEVELOPMENT IN IOWA

FOR THE
FISCAL YEAR ENDING JUNE 30, 1987

OFFICE OF MATERIALS
(515)239-1447

HIGHWAY DIVISION
IOWA DEPARTMENT OF TRANSPORTATION
AMES, IOWA 50010

OCTOBER 1987

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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, 1987; it is also a report on projects completed during the fiscal year beginning July 1, 1986, and ending June 30, 1987. 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 consists 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, 1987, is listed in Table I.

The Research Board held ten regular meetings during the period of July 1, 1986 to June 30, 1987. Suggestions for research and development were reviewed at these meetings and recommendations were made by the Board.

TABLE 1
1987 IOWA HIGHWAY RESEARCH BOARD

Member	Term Expires	Alternate
Donald A. Anderson Deputy Director, Operations Iowa DOT - Highway Division Ames, IA 50010 (515) 239-1491	12-31-88	Bernard C. Brown State Materials Engineer Iowa DOT - Highway Division Ames, IA 50010 (515) 239-1452
Gerhard W. Anderson Deputy Director, Development Iowa DOT - Highway Division Ames, IA 50010 (515) 239-1461	12-31-88	George F. Sisson Road Design Engineer Iowa DOT - Highway Division Ames, IA 50010 (515) 239-1470
David R. Boylan, Dean College of Engineering Iowa State University 104 Marston Hall Ames, IA 50011 (515) 294-5933	12-31-88	Paul W. Peterson Assoc. Dean of Research Iowa State University 104 Marston Hall Ames, IA 50011 (515) 294-2336
Robert DeWys Scott County Engineer Courthouse Davenport, IA 52801 (319) 326-8640 SS#-082	12-31-88	Russell A. Krieg Buchanan County Engineer R. R. 2 Independence, IA 50644 (319) 334-6031 SS#-010
Robert Gumbert Tama County Engineer 101 S. Main Toledo, IA 52342 (515) 484-3341 SS#-086	12-31-87	David Anthoney Boone County Engineer Courthouse Boone, IA 50036 (515) 432-6321 SS#-008
Robert Haylock Butler County Engineer Courthouse Allison, IA 50602 (319) 267-2630 SS#-012	12-31-89	Richard O. Schiek Kossuth County Engineer Courthouse Algona, IA 50511 (515) 295-3320 SS#-055
Robert G. Hering Dean of Engineering University of Iowa Iowa City, IA 52242 (319) 335-5766	12-31-87	Jerald L. Schnoor Dept. of Civil & Envir. Engr. University of Iowa Iowa City, IA 52242 (319) 335-5649
Raymond L. Holland City Engineer Bettendorf, IA 52722 (319) 359-0347	12-31-88	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	12-31-88	Thomas G. Rohe Plymouth County Engineer Courthouse Le Mars, IA 51031 (712) 546-8956 SS#-075
Mike McClain Appanoose County Engineer Courthouse Centerville, IA 52544 (515) 856-6193 SS#-004	12-31-89	S. J. Klassen Des Moines County Engineer 513 N. Main, RM B-11 Burlington, IA 52601 (319) 753-8241 SS#-029
Eldon Rike Adams County Engineer Courthouse Corning, IA 50841 (515) 322-3910 SS-#002	12-31-87	Jim Christensen Page County Engineer P.O. Box 234 Clarinda, IA 51632 (712) 542-2510 SS-#073
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
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, 1987. Total expenditure was $1,688,287.04

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. 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 Inventory conducted traffic counts in twenty-five counties during fiscal year 1987 as part of the Annual Traffic Count Program. This activity consisted of 24 eight-hour manual counts, 50 sixteen-hour manual counts, and 4,150 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 ten 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 reinstated 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 1987. 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 1987 financial summary is.

Beginning Balance 7-1-86		$ 333,981
Receipts		
Interest	$ 14,997	
Federal Aid Secondary (1 1/2% of receipts)..	75,998	
State Road Use Tax Fund (1 1/2% of receipts)...	615,366	
Research Income	320,822	
Sub-Total		1,027,183
Total Funds Available		$1,361,164
Obligation for Expenditures		
Obligated for Contract Research...	763,708	
Non-Contract Engineering Studies...	468,812	
Total Expenditures		$1,232,520
BALANCE 6-30-87		$ 128,644

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 expended for contract research from the Primary Road Research Fund for FY87 was $420,645.55 and the estimate for FY88 is $575,000.

TABLE II
FINANCIAL SUMMARY OF RESEARCH AND DEVELOPMENT PROJECT EXPENDITURES
July 1, 1986 to June 30, 1987
(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	85,625.00	Collection and Analysis of Stream Flow Data	42,812.50	42,812.50	85,625.00
165	150,000.00	Experimental Steel Fiber Reinforced Concrete Overlay			
198	75,000.00	Preliminary Archaeological Investigation Along Proposed Highway Right-of-Way			
213	13,550.00	Improved Asphalt Pavement Performance Through Crack Maintenance			
215	10,700.00	Improvement of Longitudinal Joints in Asphalt Pavements			
220	8,000.00	Protection of Structural Concrete Substructures			
222	17,500.00	Retardation of Reflection Cracking Using Stabilizing Additive 5990			
229	130,000.00	Alternate Flexible Overlays		335.23	335.23
231	45,340.00	Special Surface Preparation Prior to Bituminous Overlays		628.70	628.70
236	88,143.00	Pottawattamie Co. Evaluation of Stabilizing Degrading Stream Channels			
237	87,065.00	Shelby Co. Stabilization of Degrading Stream Channels			
238	162,898.00	Strengthening Existing Single Span Steel Beam Concrete Deck Bridges	1,600.00		1,600.00
242	296,305.50	Economics of Alternative Solutions to the Secondary Roadway Problem		91,065.43	91,065.43
246	118,000.00	Engineering Study - Reducing Sign Vandalism		6,325.61	6,325.61
253	72,000.00	Experimental Use of Calcium Magnesium Acetate (CMA)	3,175.42		3,175.42
254	17,500.00	Highway/Railroad Grade Crossings - Identification and Signing			
257	132,740.00	Field Demonstration of Foamed Asphalt - Muscatine County		1,448.82	1,448.82
258	115,870.00	Frost Action in Rocks and Concrete	6,433.75	5,510.33	11,944.08
259	89,390.00	Low Cost Fly Ash-Sand Stabilized Roadway		176.42	176.42
260	158,235.00	Optimization of Soil Stabilization with Type C Fly Ash	4,773.14	21,664.63	26,437.77
263	740,800.00	Engineering Study to Redesign the 24-Foot Secondary Bridge Standards		70,528.99	70,528.99
265	300,000.00	Engineering Study for the Evaluation of Public Road Administration & Maintenance Alternatives	7,097.06	6,598.74	13,695.80
266	30,000.00	X-Ray Analysis of Carbonate Aggregate to Predict Concrete Durability			
268	110,500.00	Evaluation of Magnitude and Frequency of Floods in Iowa	9,375.00	375.00	9,750.00
270	100,000.00	Development of Training Aids and Demonstration of Portland Cement Concrete Pavement Rehabilitation	2,000.00		2,000.00
271	103,870.00	Effects of Deicing Salt Compounds on Deterioration of PC Concrete	26,279.11	13,152.73	39,431.84
272	154,295.00	Development of a Conductometric Test for Frost Resistance of Concrete	25,518.60	23,614.68	49,133.28
273	138,514.00	Piling Stresses in Bridges With Integral Abutments - Phase 3	36,058.78	38,066.08	74,124.86
274	66,000.00	Construction and Evaluation of Submerged Vanes for Stream Control			
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		5,699.85	5,699.85
278	89,700.00	Beneficial Effects of Selected Additives on Asphalt Cement	23,626,79	14,319.27	37,946.06
279	76,175.00	Cracking and Seating PCC Pavement Prior to Resurfacing to Retard Reflective Cracking		75,947.30	75,947.30

Table II con't.)

280	300,000.00	An Engineering Study to Update the Box Culvert Standards		185,066.23	185,066.23
281	35,000.00	Effects of Pavement Surface Texture on Noise and Frictional Characteristics			
282	295,000.00	A Low Cost Automatic Weight and Classification System	65,241.45		65,241.45
283	15,000.00	Pavement Texturing by Milling			
284	50,790.00	Development of Multiplan Microcomputer Spreadsheets for County Hydraulic and Highway Engineering Computations		29,568.21	29,568.21
285	91,950.00	Measuring Discharge at Crest-Stage Gaging Stations Using Tracer-Dilution Methods	11,425.00	21,250.00	32,675.00
286	174,200.00	Development of a Rational Characterization Method for Iowa Fly Ash	43,960.77	41,872.84	85,833.61
287	87,430.00	Strengthening of Existing Continuous Composite Bridges	29,201.88	28,441.96	57,643.84
288	39,857.81	Field Evaluation of Bonded Concrete Resurfacing		10,198.57	10,198.57
289	12,800.00	Engineering Study - Training Aids to Reduce Potential County Liability			
290	25,200.00	Ice Retardant Pavement		38.41	38.41
291	14,200.00	Performance of Nongrouted Thin, Bonded PCC Overlays	27,932.23	9,828.99	37,761.22
292	118,525.00	Field Evaluation of Integral Abutment Bridges	9,378.66		9,378.66
293	150,000.00	Pavement Instrumentation		23,967.01	23,967.01
294	80,175.00	Ammonium Phosphate/Fly Ash Road Base Construction	37,125.85		37,125.85
295	114,606.00	Field Measurement of Bridges for Long Term Structural Movement			
296	41,667.00	Iowa State University Technology Transfer Center		13,814.67	13,814.67
297	71,440.00	Development of an Economic Dust Palliative for Limestone Surfaced Secondary Roads			
298	83,495.00	Correlation of Locally-Based Performance of Asphalts With Their Physicochemical Parameters	4,659.52	20,592.99	25,252.51
299	74,610.00	Control of Concrete Deterioration Due to Trace Compounds in Deicers	1,758.04		1,758.04
300	25,122.00	Iowa Development of Roller Compacted Concrete - Benton County	1,212.00	22,610.00	23,822.00
301	61,452.00	Iowa Development of Roller Compacted Concrete-Mills County			
302	129,980.00	Alternate Methods of Bridge Strengthening			
303	100,000.00	Field Evaluation of Cold In-Place Recycling of Asphalt Concrete			
304	16,852.00	Production of Acetic Acid for CMA Deicer			
305	93,084.00	Development of an Expert System for Forecasting Frost on Bridges and Roadways in Iowa			
1027	32,500.00/yr.	Secondary Road Research Coordinator		19,251.33	19,251.33
		Contract Research Sub-Total	$420,645.55	$844,771.52	$1,265,417.07
HPR-2 (121)		NCHRP pooled fund project for National Program for Skid Test and Calibration Centers		1,194.35	1,194.35
HPR-2 (126)		NCHRP pooled fund project for Integrated Drainage Design Computer System		148.34	148.34
HPR-2 (127)		NCHRP pooled fund project for Cost Effective Geometric Design Standards for RRR Projects		2,235.55	2,235.55
HPR-4 (182)		NCHRP FY82 General Project Funding		858.32	858.32
HPR-4 (183)		NCHRP FY83 General Project Funding		3,389.14	3,389.14
HPR-4 (184)		NCHRP FY84 General Project Funding		4,883.16	4,883.16
HPR-4 (185)		NCHRP FY85 General Project Funding		926.45	926.45
HPR-4 (186)		NCHRP FY86 General Project Funding		482.90	482.90
HPR-PR-PL-1 (23)		FY 1987 Planning & Research Program (Transportation Inventory Engineering Studies)		408,751.76	408,751.76
		Noncontract Engineering Studies Sub-Total		$422,869.97	$422,869.97
		Grand Total of Expenditures	$420,645.55	$1,267,641.49	$1,688,287.04

Project Number: HR-140

Project Title: Collection and Analysis of Stream Flow Data

Agency: Iowa City Office, Water Resources Div., U.S. Geological Survey, Dept. of Interior

Principal Investigator: Richard Engberg, U.S.G.S.

Research Period: Project continued to September 30, 1987

Research Funding: $85,625 per year (matched by $85,625 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 1986-1987 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: Ronald Betterton and Vernon 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: Stephen Lensink, Acting State Archaeologist

Research Period: July 1, 1977 to June 30, 1987

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. 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. The program has been very effective in facilitating archaeological investigations of local system projects.

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-213

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

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: Dwight Rorholm

Research Period: November 12, 1979 to April 30, 1987

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.

Reports: Final Report, April 1987

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 were made annually.

Reports: Final Report, January 1987

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

Project Number: HR-220

Project Title: Protection of Structural Concrete Substructures

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: John 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: Roderick Monroe

Research Period: July 1, 1980 to February 28, 1987

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 was placed and sections with varying percentages of stabilizing Additive 5990 in the asphalt concrete mixture were incorporated into the project. Most of the joints and cracks have reflected through the surface.

Reports: Final Report, February 1987

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

Project Number: HR-229

Project Title: Alternative Flexible Overlays

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

Principal Investigators: Tom Snyder and Clyde Leonard

Research Period: March 1981 to November 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: Warren Davison

Research Period: May 1981 to July 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-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: Charles Hales, Robert Lohnes, Fred Klaiber and Tom Austin

Research Period: July 10, 1981 to July 31, 1987

Research Funding: $88,143

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

Objective: To design and construct a grade stabilization control structure for Keg Creek, instrument it, and scientifically document its effectiveness.

Progress: Preliminary designs for three control structures were completed. The designs included a vertical sheet-pile structure, a soil-cement structure, and a pre-cast concrete structure. Hydraulic and structural analyses of the proposed structures were done. Because of higher than anticipated construction costs and difficulty in obtaining additional funds, only one structure was built. The 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: Eldo Schornhorst, Robert Lohnes, Fred Klaiber and Tom Austin

Research Period: July 10, 1981 to June 1, 1992

Research Funding: $87,065

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

Objective: To design and construct a grade stabilization control structure for Long Branch Creek in Shelby County, instrument it, and scientifically document its effectiveness.

Progress: Preliminary designs for the control structure included two vertical sheet-pile structures and a soil-cement structure. Hydraulic and structural analyses of the proposed structures were completed. One structure was designed and carried to a letting but no bids were received. A sheet-pile structure is currently being designed for construction during 1988. A proposal to extend the research period to include this construction will be made in the near future.

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 March 31, 1985

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 1, February 1983, Part II and Part III, 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-242

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

Agency: Iowa State University and Linn County

Principal Investigator: Phillip Baumel

Research Period: July 1, 1982 to July 31, 1987

Research Funding: $296,305.50

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 have been analyzed and costs for various vehicles have been established. A User's Manual has been developed which permits computer modeling of traffic on a road system to determine benefit-cost ratios of abandoning selected road segments from the system.

Reports: Final Report, December 1985, User's Manual, January 1986.

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-246

Project Title: Engineering Study - Reducing Sign Vandalism

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: Mark Callahan

Research Period: June 14, 1982 to February 1989

Research Funding: $118,000

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

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

Progress: Research was conducted at Iowa State University. From the findings of that research, a public awareness campaign has been established. Posters, tri-fold leaflets and bumper stickers have been developed and distributed to schools, county offices, and driver licensing stations throughout the state. Television and radio public service announcements have also been developed. Several counties have been selected to participate in a study to evaluate the effectiveness of this campaign.

Reports: Progress Report, January 1987

Implementation: It is estimated that over $1 million is spent in Iowa each year on replacing vandalized signs. One state achieved over a 50% reduction in sign vandalism through the use of an aggressive public awareness campaign.

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 30, 1988

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 in 1982 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 were demonstrated by Cedarapids, Inc. while producing 50 tons of CMA deicer. Additional CMA deicer was produced in 1986. This material is being evaluated in the Davenport area.

Reports: Final Report, June 1983, Addendum to Final Report September 1984, Progress Report, June 1985 Progress Report, March 1987

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: Neil Volmer, Peggy Baer

Research Period: February 4, 1983 to January 31, 1987

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. Sign installations at the highway/railroad grade crossings have been completed.

Reports: Final Report, January 1987

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

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: Robert Simmering and Sam Moussalli

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 pit run 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. Performance Evaluation is continuing.

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 was completed 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 was successful.

Reports: Final Report, April 1986

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: Sylvester Klassen and Sam Moussalli

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. Evaluation is continuing.

Reports: Construction Report, January 1986

Implementation: There are plentiful supplies of blow sand, fine pit run 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: John Pitt

Research Period: May 1, 1983 to January 31, 1987

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 have been used with various sources of fly ash. Some chemicals have yielded substantial increases in compressive strength.

Reports: Final Report, January 1987.

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-263

Project Title: An Engineering Study to Update Secondary Bridge Standards

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

Principal Investigator: William Lundquist

Research Period: June 1, 1983 to June 30, 1988

Research Funding: $740,800

Funding Source: 60% State--Farm-to-Market funds; 40% FHWA Bridge Replacement Funds

Objective: To redesign the secondary bridge standard plans to HS20 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 multi-span prestressed concrete, the continuous concrete slab, and the simple span concrete slab secondary bridge standards. Crash testing of the secondary bridge rail has been included in a FHWA project. The redesign of the 30' wide multi-span prestressed concrete, the continuous concrete slab, and the simple span concrete slab secondary bridge standards is in progress. Additional redesign is underway to bring both the 24' and 30' widths to meet HS20 loadings.

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-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 have been collected by a questionnaire and personal interviews. The contractor visited four other states with different administrative and maintenance practices.

Reports: Final Report and Executive Summary, August 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 January 31, 1987

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. Fly ash has beneficial results in many cases. Durability of crushed stone correlates with at least two trace mineral contents. X-ray diffraction and florescence evaluation of many carbonate aggregate samples have been conducted. Iron in the dolomite crystal structure causes a shift in the d-spacing of dolomite peaks. The resulting d-spacing correlates with service records.

Reports: Final Report, January 1987

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-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 September 30, 1987

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 have been compiled. A literature search for the latest method of stream flow and flood stage calculation has been completed. Flood magnitude and frequency prediction methodology is being developed. A draft final report is being reviewed by U.S.G.S. personnel.

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-270

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

Agency: Iowa Concrete Paving Association

Principal Investigator: Robert Given

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 Concrete Pavement Rehabilitation 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: Progress Report, May 1986

Implementation: The training aids will promote more effective maintenance of our pavements and 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: John Pitt, Dah-Yinn Lee and Wendell Dubberke

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

Research Funding: $103,870

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. The loss of durability does not correlate with sodium chloride, but does correlate with sulphate content.

Progress: Laboratory testing was completed. Tests have been conducted with various deicing salts.

Reports: Final Report, January 1987

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: Turgut Demirel, B. V. Enustun, Scott Schlorholtz

Research Period: February 1, 1985 to January 31, 1988

Research Funding: $154,295

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. There was a change noted in conductivity of non-air entrained concrete specimens after only a few freeze/thaw cycles that indicates potential of predicting durability. There is an interesting relationship of the relative conductivity of concrete between electrodes at different spacing. Testing is now being conducted on air entrained concrete made with marginal aggregate.

Reports: Progress Report, November 1986

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: Lowell Greimann, Fouad Fanous

Research Period: March 1, 1985 to November 30, 1987

Research Funding: $138,514

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: The field evaluation was conducted on special piling driven near the Town Engineering Building on the Iowa State University Campus. The data is being analyzed and the final report is being prepared.

Reports: Progress Report, March 1987

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: Jacob 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: Construction of a vane system in the West Nishna River near US 34 at Red Oak was completed in 1985. Evaluation is continuing.

Reports: Progress Report, January 1987

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

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: Charles Cabalka and Mark Callahan

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. Visual evaluation of the joints is being made semi-annually.

Reports: Construction Report, April 1986

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: Wes Smith and Richard Mumm

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 included 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 was overlaid with 2 inches, a portion with 3 inches and a portion with 4 inches of asphaltic concrete. The project was constructed on Hamilton County Road R-33.

Reports: Construction Report, April 1987

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: Dah-Yinn Lee

Research Period: June 1, 1985 to September 30, 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: Laboratory evaluation of AC-13 polymer additive, 3M additive 5990 (Asphadur) and hydrated lime in asphalt cement has begun. The properties appear to be quite different. The direction of the project has been modified to include evaluation and analysis of some modifiers that have just recently been introduced to the use of asphalt cement in pavement. Many tests were conducted on the asphalt mixtures containing the additives. These results were compared to the asphalt mixture with no additive.

Reports: Progress Report, August 1986

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-279

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

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

Principal Investigators: Charles Marker and Glenn Miller

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

Research Funding: $76,175

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

Objective: To evaluate the effect of crack spacing and seating of pcc pavement prior to resurfacing on reflective cracking and structural rating

Progress: The project included breaking a 2-mile pcc pavement section with transverse cracking at 3 foot intervals. A portion of the project was overlaid with 3 inches of asphaltic concrete and a portion overlaid with 4 inches of asphaltic concrete. The project is located on Fremont County Road J-46. Construction was completed in October 1986.

Reports: Construction Report, April 1987

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

Project Number: HR-280

Project Title: An Engineering Study to Update the Box Culvert Standards

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

Principal Investigator: William Lundquist

Research Period: July 31, 1985 to January 31, 1988

Research Funding: $300,000

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

Objective: To develop single and twin span box culvert standards, headwalls and bell joints for use by the Iowa counties.

Progress: Stanley Consultants, Inc. of Muscatine, Iowa, began work in February 1986. Twenty four different single barrel box culverts have been designed for sizes from 5'x3' to 12'x12', with 9 different fills and 4 different skewed headwalls (0^{o}, 15^{o}, 30^{o} and 45^{o}). These have been distributed to the counties. Similar work is being done on the twin box culverts.

Reports: Single Box Culvert Standards

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

Project Number: HR-281

Project Title: Effects of Pavement Surface Texture on Noise and Frictional Characteristics

Agency: Iowa Department of Transportation

Principal Investigator: Roman Dankbar

Research Period: July 16, 1985 to February 28, 1987

Research Funding: $35,000

Funding Source: 100 percent State--Primary funds

Objective: To measure the effects of modified surface texturing on traffic noise and frictional characteristics.

Progress: An area of I-380 southbound from Cold Stream Avenue south 2000 ft. was selected for texturing by diamond grinding. Noise and friction measurements were made before and after texturing and continue to be made periodically.

Reports: Final Report, February 1987

Implementation: If noise levels and friction values can be maintained at acceptable levels, diamond grinding may be a method to prevent complaints of traffic noise caused by transverse comb texturing in urban areas.

Project Number: HR-282

Project Title: A Low Cost Automatic Weight and Classification System

Agency: Iowa Department of Transportation, Minnesota Department of Transportation and the Federal Highway Administration

Principal Investigator: Bill McCall

Research Period: August 1, 1985 to November 30, 1987

Research Funding: $295,000

Funding Source: State--Primary funds-34%; Minnesota DOT-25%; FHWA-41%

Objective: To examine the reliability of the low cost WIM system through field trials, to evaluate the accuracy of axle and gross vehicle weight measurements and to investigate the performance of the classification system.

Progress: The advisory panel selected Castle Rock Consultants as the contractor for this project. The Contractor has completed the review of related research. The Weigh-in-Motion System has been installed on Interstate 35, in Iowa and US 10 in Minnesota. Weight, speed and classification data from both of these sites are being analyzed.

Reports: Task Reports and Monthly Progress Reports through January 1987

Implementation: A low cost WIM system will provide improved truck monitoring which will aid enforcement and design to extend pavement life thereby yielding substantial savings.

Project Number: HR-283

Project Title: Pavement Texturing by Milling

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: Cedarapids, Inc., Vernon Marks

Research Period: September 15, 1985 to January 31, 1987

Research Funding: $15,000

Funding Source: 100 percent State--Primary Funds

Objective: To produce an acceptable surface texture with a milling machine modified with an increased number of cutting teeth.

Progress: A Cedarapids-Wirtgen 1900c mill with 412 teeth (3 times the standard number) was used to rehabilitate the surface of one AC and two PC pavements. The texture varies with the forward speed of the mill with a slower speed yielding smoother texture. The resulting texture was relatively smooth, but did increase the tire noise. There was some spalling of the joints in the pcc pavement.

Reports: Final Report, January 1987

Implementation: Achieving an acceptable texture by milling would result in substantial savings from profiling the many miles of rutted AC pavement and faulted PC pavements when compared to current profiling costs.

Project Number: HR-284

Project Title: Development of Multiplan Microcomputer Spreadsheets for County Hydraulic and Highway Engineering Computations

Agency: Iowa State University

Principal Investigator: Ken Brewer

Research Period: November 1, 1985 to August 31, 1987

Research Funding: $50,790

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

Objective: To develop "Multiplan" spreadsheet solutions to a set of selected hydraulic and highway engineering computations of common interest to county engineers and to make them available to each county through a series of one-day workshops.

Progress: An advisory committee of county engineering personnel has been formed to help direct the research effort. The committee has met twice with the principal investigator and established priorities for specific program solutions to be developed. Several programs have been developed. A list of workshops was scheduled during early 1987 to help users become familiar with the programs. Fifty-eight county representatives attended the workshops. Six sets of Microsoft Multiplan were transferred to the Iowa DOT.

Reports: None

Implementation: Many counties lack the time and personnel to write all the needed programs for their specific brand of computer. Spreadsheet solutions operate nearly identically in all computer spreadsheet versions, allowing easy training, use and trouble shooting of programs.

Project Number: HR-285

Project Title: Measuring Discharge at Crest-Stage Gaging Stations Using Tracer-Dilution Methods

Agency: Iowa City Office, Water Resources Div., U.S. Geological Survey, Dept. of Interior

Principal Investigator: Phil Soenksen

Research Period: November 1, 1985 to September 30, 1988

Research Funding: $91,950

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

Objective: To obtain complete stage and discharge hydrographs on small streams without the use of manpower at the sites during the flood event.

Progress: Equipment has been obtained and was installed on selected streams to obtain flow data during the high flows of the 1986 spring period. Data collection is continuing.

Reports: None

Implementation: Improved flood discharge data will permit more accurate design and reduce the design factor of safety necessary, thereby generating a cost savings in the construction of future structures.

Project Number: HR-286

Project Title: Development of a Rational Characterization Method for Iowa Fly Ash

Agency: Iowa State University

Principal Investigator: Turgut Demirel

Research Period: December 1, 1985 to November 30, 1988

Research Funding: $174,200

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

Objective: To develop a test method to characterize Class C fly ash and ensure consistent performance.

Progress: X-ray diffraction techniques are being used to analyze numerous samples of fly ash from selected power plants that provide fly ash for Iowa DOT projects. Chemical compound contents are determined. Scanning electron microscopy and thermal analysis are also being used.

Reports: Annual Progress Report No. 1, November 1986

Implementation: There is a substantial cost savings from substituting fly ash for portland cement. This research will ensure proper quality of concrete with fly ash substitution.

Project Number: HR-283

Project Title: Pavement Texturing by Milling

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: Cedarapids, Inc., Vernon Marks

Research Period: September 15, 1985 to January 31, 1987

Research Funding: $15,000

Funding Source: 100 percent State--Primary Funds

Objective: To produce an acceptable surface texture with a milling machine modified with an increased number of cutting teeth.

Progress: A Cedarapids-Wirtgen 1900c mill with 412 teeth (3 times the standard number) was used to rehabilitate the surface of one AC and two PC pavements. The texture varies with the forward speed of the mill with a slower speed yielding smoother texture. The resulting texture was relatively smooth, but did increase the tire noise. There was some spalling of the joints in the pcc pavement.

Reports: Final Report, January 1987

Implementation: Achieving an acceptable texture by milling would result in substantial savings from profiling the many miles of rutted AC pavement and faulted PC pavements when compared to current profiling costs.

Project Number: HR-284

Project Title: Development of Multiplan Microcomputer Spreadsheets for County Hydraulic and Highway Engineering Computations

Agency: Iowa State University

Principal Investigator: Ken Brewer

Research Period: November 1, 1985 to August 31, 1987

Research Funding: $50,790

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

Objective: To develop "Multiplan" spreadsheet solutions to a set of selected hydraulic and highway engineering computations of common interest to county engineers and to make them available to each county through a series of one-day workshops.

Progress: An advisory committee of county engineering personnel has been formed to help direct the research effort. The committee has met twice with the principal investigator and established priorities for specific program solutions to be developed. Several programs have been developed. A list of workshops was scheduled during early 1987 to help users become familiar with the programs. Fifty-eight county representatives attended the workshops. Six sets of Microsoft Multiplan were transferred to the Iowa DOT.

Reports: None

Implementation: Many counties lack the time and personnel to write all the needed programs for their specific brand of computer. Spreadsheet solutions operate nearly identically in all computer spreadsheet versions, allowing easy training, use and trouble shooting of programs.

Project Number: HR-285

Project Title: Measuring Discharge at Crest-Stage Gaging Stations Using Tracer-Dilution Methods

Agency: Iowa City Office, Water Resources Div., U.S. Geological Survey, Dept. of Interior

Principal Investigator: Phil Soenksen

Research Period: November 1, 1985 to September 30, 1988

Research Funding: $91,950

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

Objective: To obtain complete stage and discharge hydrographs on small streams without the use of manpower at the sites during the flood event.

Progress: Equipment has been obtained and was installed on selected streams to obtain flow data during the high flows of the 1986 spring period. Data collection is continuing.

Reports: None

Implementation: Improved flood discharge data will permit more accurate design and reduce the design factor of safety necessary, thereby generating a cost savings in the construction of future structures.

Project Number: HR-286

Project Title: Development of a Rational Characterization Method for Iowa Fly Ash

Agency: Iowa State University

Principal Investigator: Turgut Demirel

Research Period: December 1, 1985 to November 30, 1988

Research Funding: $174,200

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

Objective: To develop a test method to characterize Class C fly ash and ensure consistent performance.

Progress: X-ray diffraction techniques are being used to analyze numerous samples of fly ash from selected power plants that provide fly ash for Iowa DOT projects. Chemical compound contents are determined. Scanning electron microscopy and thermal analysis are also being used.

Reports: Annual Progress Report No. 1, November 1986

Implementation: There is a substantial cost savings from substituting fly ash for portland cement. This research will ensure proper quality of concrete with fly ash substitution.

Project Number: HR-287

Project Title: Strengthening of Existing Continuous Composite Bridges

Agency: Iowa State University

Principal Investigators: F. Wayne Klaiber and Kenneth Dunker

Research Period: November 1, 1985 to July 31, 1987

Research Funding: $87,430

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

Objective: To determine the feasibility of strengthening continuous composite bridges.

Progress: A 1/3 scale model bridge was constructed in the Iowa State University Structural Laboratory. Testing of various methods of strengthening is in progress.

Reports: Progress Report, March 1986

Implementation: Strengthening of continuous composite bridges would reduce the number of bridges requiring posting of maximum traffic weights.

Project Number: HR-288

Project Title: Field Evaluation of Bonded Concrete Resurfacing

Agency: Construction Technology Laboratories

Principal Investigator: Shiraz D. Tayabji

Research Period: January 1, 1986 to November 30, 1986

Research Funding: $39,857.81

Funding Source: 100 percent State Funds--67 percent Primary, 33 percent Farm-to-Market

Objective: To perform condition surveys and load testing of pavement overlays and to verify design procedures for bonded resurfacings.

Progress: Field testing of five sites for this project has been completed. Deflections and stresses in the concrete were determined under both an 18,000 pound single axle and a 34,000 pound tandem axle. The data are now being analyzed.

Reports: Final Report, November 1986

Implementation: This research will improve the design of bonded overlay rehabilitation of pavement. There will be a savings through reduced overdesign and through extended life by avoiding under design.

Project Number: HR-289

Project Title: Engineering Study - Training Aids to Reduce Potential County Liability

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: Mark Callahan

Research Period: January 1, 1986 to June 1, 1988

Research Funding: $12,800

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

Objective: To develop a training slide/tape presentation which will illustrate situations and actions that could potentially contribute to highway accidents. The presentation will also show what remedial actions can be taken to improve highway safety.

Progress: An advisory committee of county engineers has been formed to help direct the research effort. With assistance from the committee, a script has been developed. Modifications proposed by the DOT Legal Division have been made.

Reports: None

Implementation: Proper planning, design, construction and maintenance will avoid mitigating situations and reduce highway-related tort claims

Project Number: HR-290

Project Title: Ice Retardant Pavement

Agency: City of Des Moines

Principal Investigator: John P. Bellizzi

Research Period: February 3, 1986 to March 31, 1991

Research Funding: $25,200

Funding Source: 100 percent State--Primary Funds

Objective: To evaluate the effectiveness of ice-retardant additives to the surface course of asphalt pavement in Iowa; to develop operational procedures for placing and maintaining asphalt concrete containing ice-retardant additives.

Progress: The location for use of the ice-retardant additive has been selected and a similar intersection has been identified for accident history comparison. The experimental Verglimit section was constructed on Euclid Avenue from 1st Street to Columbia Street in August 1986. Very few periods of evaluation were presented during the winter of 1986-87 due to the mild winter.

Reports: Progress Report, December 1986

Implementation: Use of the ice-retardant additive will improve safety by providing continuous deicing at selected high frequency snow and ice related accident locations.

Project Number: HR-291

Project Title: Performance of Nongrouted Thin, Bonded PCC Overlays

Agency: Iowa Concrete Paving Association, Monroe County and the Iowa Department of Transportation, Highway Division

Principal Investigators: Wendell Folkerts, Wapello County Engineer and John Lane

Research Period: March 1, 1986 to October 1, 1990

Research Funding: $14,200

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

Objective: To evaluate the performance of the nongrouted sections of a thin, bonded PCC overlay in Monroe and Wapello Counties.

Progress: A contract has been initiated with the Iowa Concrete Paving Association. Road Rater testing was conducted to determine the structural rating. Two series of cores were obtained and tested for bond strength.

Reports: Construction Report, August 1986

Implementation: PCC bonded overlays are currently bonded to the existing surface by placing a thin film of sand-cement grout ahead of the paving operation. If adequate bond without grout can be achieved for the overlay, approximately $1.00 per square yard of overlay could be saved.

Project Number: HR-292

Project Title: Field Evaluation of Integral Abutment Bridges

Agency: Iowa State University

Principal Investigator: Darrel D. Girton

Research Period: March 1, 1986 to April 30, 1988

Research Funding: $118,525

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

Objective: To determine expansion or contraction of integral abutment bridges as related to air and deck temperatures; to measure the effects of abutment movement on stresses in the bridge; to develop guidelines that will permit safe design of longer integral abutment bridges.

Progress: Methods and needed equipment for evaluation of integral abutment bridges have been developed. Two integral abutment bridges have been selected for field evaluation during substantial temperature variations.

Reports: Task 1 Report, September 1986

Implementation: This research will allow longer bridges without expansion assemblies which will result in substantial savings due to longer maintenance free bridge life.

Project Number: HR-293

Project Title: Pavement Instrumentation

Agency: Iowa Department of Transportation, Highway Division, Iowa State University, Federal Highway Administration

Principal Investigator: Roman Dankbar

Research Period: April 1, 1986 to May 1, 1989

Research Funding: $150,000

Funding Sources: 50 percent State--Primary Funds, 50 percent FHWA

Objective: To evaluate the magnitude and frequency of dynamic loads applied to the pavement as related to the static loads used in pavement design and the demonstration of instrumentation for evaluation of pavement design and performance.

Progress: A contract has been executed with Iowa State University for their participation. A review has been conducted to identify the most effective current technology in evaluation instrumentation. Five tubes were placed, evenly spaced, in the subbase crossing the westbound lane of I-80 in Pottawattamie County. Nuclear instruments are pulled through the tubes at set time intervals to get recordings of moisture content and density of the subbase.

Reports: None

Implementation: Improved design data from long term monitoring instrumentation will extend pavement life and will make possible the selection of the most economical design.

Project Number: HR-294

Project Title: Ammonium Phosphate/Fly Ash Road Base Construction

Agencies: Story County and Iowa State University

Principal Investigators: Del Jespersen and John Pitt

Research Period: May 1986 to July 1991

Research Funding: $80,175

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

Objective: To evaluate construction and service performance of ammonium phosphate fly ash treated base courses of limestone aggregate and unprocessed sand.

Progress: A 1.8 mile section of R-63 north of its intersection with E-29 in Story County was selected for the project. Construction of the project was completed in September 1986. Two mixes, two thicknesses and two wearing courses are being tested.

Reports: Construction Report, April 1987

Implementation: Trace chemicals have the ability to increase the strength of fly ash dramatically and to affect its set time. The inexpensive modification of Iowa fly ashes can increase the economic benefit of fly ash for many highway related uses.

Project Number: HR-295

Project Title: Field Measurement of Bridges for Long Term Structural Movement

Agency: Iowa State University

Principal Investigator: Terry J. Wipf

Research Period: June 1, 1986 to December 31, 1987

Research Funding: $114,606

Funding Source: 100 percent State--Primary Funds

Objective: To design a data acquisition system for tilt sensing equipment and to monitor pier movement on two bridges and to assess effects of the movements on the entire structure.

Progress: Tilt Sensor Systems have been attached to the Karl King Bridge over the Des Moines River in Fort Dodge and on a pier of the Mississippi River bridge at Lansing. Data is being collected. The tilt sensors are showing movements that appear to be related to temperature.

Reports: None

Implementation: An effective system of monitoring long term movement of structures will reduce the potential of serious failure and emergency closure of critical river crossings.

Project Number: HR-296

Project Title: Iowa State University Technology Transfer Center

Agency: Iowa State University

Principal Investigator: Stanley Ring

Research Period: October 1, 1986 to September 30, 1987

Research Funding: $41,667

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

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

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-297

Project Title: Development of an Economic Dust Palliative for Limestone Surfaced Secondary Roads

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

Principal Investigators: Kenneth Burgeson and Turgut Demirel

Research Period: December 1, 1986 to November 30, 1988

Research Funding: $71,440

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

Objective: To identify a cost-effective dust palliative for use on limestone surfaced secondary roads in competition with or as an alternate to sodium chloride or calcium chloride.

Progress: Bentonite treated limestone samples show potential as an economical and effective dust palliative. Testing will continue to determine the optimum bentonite concentration, followed by field testing.

Reports: Progress Report, June 1987

Implementation: Finding a low cost dust palliative to treat Iowa's 70,000 miles of limestone surfaced roads can save the counties a substantial amount of money each year.

Project Number: HR-298

Project Title: Correlation of Locally-Based Performance of Asphalts With Their Physicochemical Parameters

Agency: Iowa State University

Principal Investigator: Dah-Yinn Lee

Research Period: January 26, 1987 to January 31, 1988

Research Funding: $83,495

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

Objective: To establish test criteria and specifications for asphalts based on simple physicochemical methods.

Progress: A contract for conduct of the research has been executed. The High Pressure Liquid Chromatography (HPLC) equipment has been obtained. Asphalt cements are being obtained from a variety of sources and tested.

Reports: None

Implementation: The ability to identify those asphalts which would not crack in the highway would effect significant savings of highway maintenance funds.

Project Number: HR-299

Project Title: Control of Concrete Deterioration Due to Trace Compounds in Deicers

Agency: Iowa State University

Principal Investigator: John Pitt

Research Period: April 1, 1987 to May 31, 1988

Research Funding: $74,610

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

Objective: To:

1. Characterize deicing salts used in Iowa.
2. Determine how deicer induced concrete deterioration is influenced by field factors.
3. Define the deterioration mechanism

Progress: A contract has been executed for the conduct of the research.

Reports: None

Implementation: The research will identify compounds which cause the deterioration and support changes in specifications to reduce the amount or eliminate these compounds from deicing salts. This will extend pavement life and reduce maintenance.

Project Number: HR-300

Project Title: Iowa Development of Roller Compacted Concrete

Agency: Highway Division, Iowa Dept. of Transportation and Manatt's, Inc.

Principal Investigators: O. J. Lane and Mark Callahan

Research Period: April 13, 1987 to December 30, 1987

Research Funding: $25,122

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

Objective: To investigate the performance of a roller compacted concrete test section subjected to continuous loading by a legally loaded truck.

Progress: Manatt's, Inc. of Brooklyn, Iowa, agreed to construct the test section in its Ames facility yard. The slab was placed and loaded in April 1987. The section will be monitored for nine months.

Reports: None

Implementation: Roller compacted concrete is a zero slump portland cement concrete mixture that is spread with asphalt concrete equipment. Because of the ease and simplicity of RCC pavement construction, savings of up to one third the cost of portland cement concrete pavement construction are possible.

Project Number: HR-301

Project Title: Iowa Development of Roller Compacted Concrete - Mills County

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

Principal Investigator: O. J. Lane, Mark Callahan and Jerry Hare

Research Period: May 1, 1987 to April 30, 1992

Research Funding: $61,452

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

Objective: To investigate the performance of Roller Compacted Concrete (RCC) in carrying traffic loads frequently encountered on Iowa's Secondary road system.

Progress: Construction of a quarter mile section of RCC was to be completed in the summer of 1987 pending the results of research conducted in HR-300. After viewing the HR-300 test section, the Mills County engineer decided not to use RCC on the 1/4 mile section of pavement.

Reports: None

Implementation: Roller compacted concrete is a zero slump portland cement concrete mixture that is placed with asphalt concrete paving equipment. Because of the ease and simplicity of RCC pavement construction, savings of one third or more of the cost of portland cement concrete pavement construction are possible.

Project Number: HR-302

Project Title: Alternate Methods of Bridge Strengthening

Agency: Iowa State University

Principal Investigators: F. Wayne Klaiber, Kenneth F. Dunker, and Terry J. Wipf

Research Period: June 8, 1987 to September 30, 1988

Research Funding: $129,980

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

Objective: To determine the feasibility of strengthening stringer bridges by the addition of partial end restraint, to determine the most efficient location of end restraint brackets, and the effect of end restraint on the supporting substructure unit.

Progress: A contract for services to conduct the research has been executed.

Reports: None

Implementation: Alternate methods will be available for strengthening bridges which are structurally deficient according to current standards.

Project Number: HR-303

Project Title: Field Evaluation of Cold In-Place Recycling of Asphalt Concrete

Agency: Tama County

Principal Investigators: Robert Gumbert and Richard Mumm

Research Period: June 1, 1987 to June 1, 1992

Research Funding: $100,000

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

Objective: To identify an effective, affordable method of widening an existing 18 feet wide pavement (AC resurfacing over PCC) to provide a 24 feet wide finished surface capable of carrying traffic satisfactorily.

Progress: The plans have been developed. Construction is planned for the spring of 1988.

Reports: None

Implementation: A successful cold in-place recycling will provide a cost effective method of rehabilitating older resurfaced roadways. This will provide improved safety.

Project Number: HR-304

Project Title: Production of Acetic Acid for CMA Deicer

Agency: University of Iowa

Principal Investigator: Paul L. Peterschmidt

Research Period: June 1, 1987 to December 31, 1987

Research Funding: $16,852

Funding Source: 100 percent State--Primary Funds

Objective: To find the optimum method of producing acetic acid from corn for the production of CMA deicer

Progress: A contract for services to conduct the research has been executed.

Reports: None

Implementation: The potential of CMA deicer is tied directly to finding an economical method of producing acetic acid.

Project Number: HR-305

Project Title: Development of an Expert System for Forecasting Frost on Bridges and Roadways in Iowa

Agency: Iowa State University

Principal Investigator: Eugene Takle

Research Period: July 6, 1987 to June 30, 1989

Research Funding: $120,303

Funding Source: 77 Percent State--Primary Funds, 13 Percent Freeze Notis, 10 Percent Iowa State University

Objective: To improve reliability of forecasts of frost on roads and bridges in Iowa, namely through a synthesis of meteorologcial data, frost-occurrence data, numerical modeling and operational experience, achieved by combining standard analysis methods with a tool from the general area of artificial intelligence known as an expert system.

Progress: A contract has been executed for the conduct of the research.

Reports: None

Implementation: The development of a system which would improved the reliability of frost predictions would lead to improvements in road safety and reduce costs of manpower and deicing materials spent on false alarms.

Project Number: HR-1027

Project Title: Secondary Road Research Coordinator

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: Mark Callahan

Research Period: March 5, 1980 to present

Research Funding: $32,500.00/yr.

Funding Source: 100 percent State--Farm-to-Market 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: Mark Callahan has visited 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 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.

Annual Report of Highway Research and Development in Iowa

Highway Division
Office of Materials
November 1988

Iowa Department of Transportation

ANNUAL REPORT
OF
HIGHWAY RESEARCH AND DEVELOPMENT IN IOWA

FOR THE
FISCAL YEAR ENDING JUNE 30, 1988

OFFICE OF MATERIALS
(515)239-1447

HIGHWAY DIVISION
IOWA DEPARTMENT OF TRANSPORTATION
AMES, IOWA 50010

NOVEMBER 1988

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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, 1988; it is also a report on projects completed during the fiscal year beginning July 1, 1987, and ending June 30, 1988. 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 consists 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, 1988, is listed in Table I.

The Research Board held seven regular meetings during the period of July 1, 1987 to June 30, 1988. Suggestions for research and development were reviewed at these meetings and recommendations were made by the Board.

Table I

1988 IOWA HIGHWAY RESEARCH BOARD

Member	Term Expires	Alternate
Donald A. Anderson Deputy Director, Operations Iowa DOT - Highway Division Ames, IA 50010 (515) 239-1491	12-31-88	Bernard C. Brown State Materials Engineer Iowa DOT - Highway Division Ames, IA 50010 (515) 239-1452
Gerhard W. Anderson Deputy Director, Development Iowa DOT - Highway Division Ames, IA 50010 (515) 239-1461	12-31-88	George F. Sisson Road Design Engineer Iowa DOT - Highway Division Ames, IA 50010 (515) 239-1470
David Anthoney Boone County Engineer Courthouse Boone, IA 50036 (515) 432-6321 SS#-008	12-31-90	Steven J. Holcomb Grundy County Engineer Courthouse Grundy Center, IA 50638 (319) 824-6912 SS#-038
David R. Boylan, Dean College of Engineering Iowa State University 104 Marston Hall Ames, IA 50011 (515) 294-5933	12-31-88	Paul W. Peterson Assoc. Dean of Research Iowa State University 104 Marston Hall Ames, IA 50011 (515) 294-2336
James R. Bump District 3 Engineer Iowa DOT - Highway Division P.O. Box 987 Sioux City, IA 51102 (712) 276-1451 SS#-230	12-31-90	Robert I. Bortle District 2 Engineer Iowa DOT - Highway Division P.O. Box 741 Mason City, IA 50401 (515) 423-7584 SS#-220
Robert DeWys Scott County Engineer Courthouse Davenport, IA 52801 (319) 326-8640 SS#-082	12-31-88	Russell A. Krieg Buchanan County Engineer R. R. 2 Independence, IA 50644 (319) 334-6031 SS#-010
Robert Haylock Butler County Engineer Courthouse Allison, IA 50602 (319) 267-2630 SS#-012	12-31-89	Richard O. Schiek Kossuth County Engineer Courthouse Algona, IA 50511 (515) 295-3320 SS#-055
Robert G. Hering Dean of Engineering University of Iowa Iowa City, IA 52242 (319) 335-5766	12-31-90	Jerald L. Schnoor Dept. of Civil & Envir. Engr. University of Iowa Iowa City, IA 52242 (319) 335-5649
Raymond L. Holland City Engineer Bettendorf, IA 52722 (319) 344-4055	12-31-88	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	12-31-88	Thomas G. Rohe Plymouth County Engineer Courthouse Le Mars, IA 51031 (712) 546-8956 SS#-075
Mike McClain Appanoose County Engineer Courthouse Centerville, IA 52544 (515) 856-6193 SS#-004	12-31-89	S. J. Klassen Des Moines County Engineer 513 N. Main, RM B-11 Burlington, IA 52601 (319) 753-8241 SS#-029
Richard Ransom City Engineer City Hall Cedar Rapids, IA 52401 (319) 398-5026	12-31-90	Larry Stevens City Engineer Box 1010 Oskaloosa, IA 52577 (515) 673-7472
Eldon Rike Adams County Engineer Courthouse Corning, IA 50841 (515) 322-3910 SS-#002	12-31-90	Jim Christensen Page County Engineer P.O. Box 234 Clarinda, IA 51632 (712) 542-2510 SS-#073

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, 1988. Total expenditure was $1,134,161.43

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. 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 Inventory conducted traffic counts in twenty-five counties during fiscal year 1988 as part of the Annual Traffic Count Program. This activity consisted of 21 eight-hour manual counts, 50 sixteen-hour manual counts, and 4,300 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 eleven 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 reinstated 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 1988. 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 1988 financial summary is.

Beginning Balance 7-1-87		$ 128,644
Receipts		
Interest	$ 10,671	
Federal Aid Secondary (1 1/2% of receipts)..	203,501	
State Road Use Tax Fund (1 1/2% of receipts)...	647,309	
Research Income	185,160	
Sub-Total		1,046,641
Total Funds Available		$1,175,285
Obligation for Expenditures		
Obligated for Contract Research...	459,990	
Non-Contract Engineering Studies...	282,608	
Total Expenditures		$ 742,598
BALANCE 6-30-88		$ 432,687

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 expended for contract research from the Primary Road Research Fund for FY88 was $473,452.41 and the estimate for FY89 is $500,000.

TABLE II
FINANCIAL SUMMARY OF RESEARCH AND DEVELOPMENT PROJECT EXPENDITURES
July 1, 1987 to June 30, 1988
(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	92,475.00	Collection and Analysis of Stream Flow Data	42,812.50	46,237.50	89,050.00
165	185,586.00	Experimental Steel Fiber Reinforced Concrete Overlay			
198	75,000.00	Preliminary Archaeological Investigation Along Proposed Highway Right-of-Way			
220	8,000.00	Protection of Structural Concrete Substructures			
229	130,000.00	Alternate Flexible Overlays		232.87	232.87
231	45,340.00	Special Surface Preparation Prior to Bituminous Overlays		125.24	125.24
236	88,143.00	Pottawattamie Co. Evaluation of Stabilizing Degrading Stream Channels			
242	296,305.00	Economics of Alternative Solutions to the Secondary Roadway Problem		32,085.95	32,085.95
246	118,000.00	Engineering Study - Reducing Sign Vandalism		7,901.18	7,901.18
253	72,000.00	Experimental Use of Calcium Magnesium Acetate (CMA)	160.97		160.97
257	132,740.00	Field Demonstration of Foamed Asphalt - Muscatine County			
259	89,390.00	Low Cost Fly Ash-Sand Stabilized Roadway			
263	440,800.00	Engineering Study to Redesign the 24-Foot Secondary Bridge Standards		1,346.13	1,346.13
268	110,500.00	Evaluation of Magnitude and Frequency of Floods in Iowa			
270	2,000.00	Development of Training Aids and Demonstration of Portland Cement Concrete Pavement Rehabilitation			
272	154,295.00	Development of a Conductometric Test for Frost Resistance of Concrete	23,706.85	22,959.18	46,666.03
273	138,514.00	Piling Stresses in Bridges With Integral Abutments - Phase 3	8,911.31	2,327.90	11,239.21
274	66,000.00	Construction and Evaluation of Submerged Vanes for Stream Control	7,830.00		7,830.00
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	19,167.09	14,050.41	33,217.50
279	76,175.00	Cracking and Seating PCC Pavement Prior to Resurfacing to Retard Reflective Cracking			
280	300,000.00	An Engineering Study to Update the Box Culvert Standards		23,640.92	23,640.92
282	100,000.00	A Low Cost Automatic Weight and Classification System	33,897.33		33,897.33
284	50,790.00	Development of Multiplan Microcomputer Spreadsheets for County Hydraulic and Highway Engineering Computations		8,099.00	8,099.00
285	91,950.00	Measuring Discharge at Crest-Stage Gaging Stations Using Tracer-Dilution Methods	13,300.00	11,425.00	24,725.00
286	174,200.00	Development of a Rational Characterization Method for Iowa Fly Ash	18,377.41	11,521.43	29,898.84
287	87,430.00	Strengthening of Existing Continuous Composite Bridges	9,256.98	7,647.38	16,904.36
288	39,858.00	Field Evaluation of Bonded Concrete Resurfacing	923.57	3,051.43	3,975.00

Table II con't.)

289	12,800.00	Engineering Study - Training Aids to Reduce Potential County Liability		22.92	22.92
290	25,200.00	Ice Retardant Pavement			
291	14,200.00	Performance of Nongrouted Thin, Bonded PCC Overlays			
292	167,905.00	Field Evaluation of Integral Abutment Bridges	26,135.88	26,209.00	52,344.88
293	75,000.00	Pavement Instrumentation	33,182.27		33,182.27
294	80,175.00	Ammonium Phosphate/Fly Ash Road Base Construction		51,582.99	51,582.99
295	114,606.00	Field Measurement of Bridges for Long Term Structural Movement	48,047.81		48,047.81
296	52,083.00	Iowa State University Technology Transfer Center	22,869.45	27,992.83	50,862.28
297	71,440.00	Development of an Economic Dust Palliative for Limestone Surfaced Secondary Roads		27,265.37	27,265.37
298	142,785.00	Correlation of Locally-Based Performance of Asphalts With Their Physicochemical Parameters	46,570.52	16,266.35	62,836.87
299	74,610.00	Control of Concrete Deterioration Due to Trace Compounds in Deicers	46,026.92	8,880.71	54,907.63
300	25,122.00	Iowa Development of Roller Compacted Concrete - Benton County			
302	129,980.00	Alternate Methods of Bridge Strengthening	32,708.54	19,815.59	52,524.13
303	100,000.00	Field Evaluation of Cold In-Place Recycling of Asphalt Concrete			
304	16,852.00	Production of Acetic Acid for CMA Deicer	12,716.19		12,716.19
305	93,084.00	Development of an Expert System for Forecasting Frost on Bridges and Roadways in Iowa	26,850.82		26,850.82
306	110,415.00	Investigation of Uplift Failures in Flexible Pipe Culverts		2,341.76	2,341.76
307	35,000.00	Sediment Control in Bridge Waterways			
308	142.435.00	Strengthening of an Existing Continuous Span Steel Beam-Concrete Deck bridge by Post-Tensioning		498.61	498.61
309	78,760.00	An Investigation of Emulsion Stabilized Limestone Screenings			
310	96,088.00	Precast, Prestressed Concrete Panel Subdecks in Skewed Bridges			
311	25,000.00	Creep and Resilient Modulus Testing of Asphalt Mixtures			
312	93,913	Low Cost Techniques of Base Stabilization in Dubuque County			
1027	32,500.00/yr.	Secondary Road Research Coordinator		10,090.79	10,090.79
		Contract Research Sub-Total	$473,452.41	$383,618.44	$857,070.85
HPR-2 (126)		Pooled fund project for Integrated Drainage Design Computer System		174.61	174.61
HPR-2 (127)		Pooled fund project for Cost Effective Geometric Design Standards for RRR Projects		90.84	90.84
HPR-2 (129)		Pooled fund project for Evaluation of Wetland Mitigation Measures		244.13	244.13
HPR-2 (134)		Pooled fund project for Test an Evaluation of Bridge Rail		644.51	644.51
HPR-4 (185)		NCHRP FY85 General Project Funding		4,349.70	4,349.70
HPR-4 (186)		NCHRP FY86 General Project Funding		1,196.12	1,196.12
HPR-4 (187)		NCHRP FY87 General Project Funding		528.32	528.32
HPR-PR-PL-1 (24)		FY 1988 Planning & Research Program (Transportation Inventory Engineering Studies)		269,862.35	269,862.35
		Noncontract Engineering Studies Sub-Total		$277,090.58	$277,090.58
		Grand Total of Expenditures	$473,452.41	$660,709.02	$1,134,161.43

Project Number: HR-140

Project Title: Collection and Analysis of Stream Flow Data

Agency: Iowa City Office, Water Resources Div., U.S. Geological Survey, Dept. of Interior

Principal Investigator: Richard Engberg, U.S.G.S.

Research Period: Project continued to September 30, 1988

Research Board Funding: $92,475 per year (matched by $92,475 from the Department of the Interior)

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

Iowa DOT Project Control: Bradley C. Barrett, 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 1987-1988 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: Ronald Betterton and Vernon Marks

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

Research Board Funding: $185,586

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 been extended 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: State Archaeologist

Research Period: July 1, 1977 to December 31, 1988

Research Board 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. 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. The program has been very effective in facilitating archaeological investigations of local system projects.

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-220

Project Title: Protection of Structural Concrete Substructures

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: John Risch

Research Period: May 1980 to July 15, 1989

Research Board 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-229

Project Title: Alternative Flexible Overlays

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

Principal Investigators: Tom Snyder and Clyde Leonard

Research Period: March 1981 to November 1987

Research Board 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: Fourteen test sections of cold laid bituminous overlays were constructed in September 1981 on Osceola County roads A-34 and A-46. Four sections were road mixed using milled asphalt as one aggregate source. Mix for the remaining sections was plant mixed and paver laid. After a six year evaluation, the test sections using a MC-3000 cutback asphalt performed as well as the control section of Type B asphalt mix.

Reports: Final Report, March 1988

Implementation: Identification of a durable and inexpensive overlay mix 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: Warren Davison

Research Period: May 1981 to July 1987

Research Board 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. After five years of research, it was evident crack sealing does extend the life of an overlay. However, the benefits of crack filling with any of the materials used in this research project are not beneficial enough to warrant the added cost of the crack filling operation. Improved materials and better crack filling techniques need to be developed before this operation can become successful.

Reports: Final Report, September 1987

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-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: Charles Hales, Robert Lohnes, Fred Klaiber and Tom Austin

Research Period: July 10, 1981 to July 31, 1987

Research Board Funding: $88,143

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

Objective: To design and construct a grade stabilization control structure for Keg Creek, instrument it, and scientifically document its effectiveness.

Progress: Preliminary designs for three control structures were completed. The designs included a vertical sheet-pile structure, a soil-cement structure, and a pre-cast concrete structure. Hydraulic and structural analyses of the proposed structures were done. Because of higher than anticipated construction costs and difficulty in obtaining additional funds, only one structure was built. The structure, originally designed as a sheet-pile structure, was changed to a gabion structure and completed in 1983. The structure has performed satisfactorily. The structure has needed slight repairs but the stream has been stabilized upstream from the structure.

Reports: Final Report, September 1987

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: Eldo Schornhorst, Robert Lohnes, Fred Klaiber and Tom Austin

Research Period: July 10, 1981 to December 31, 1992

Research Board Funding: $87,065

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

Objective: To design and construct a grade stabilization control structure for Long Branch Creek in Shelby County, instrument it, and scientifically document its effectiveness.

Progress: Hydraulic and structural analyses of the proposed structures were completed. One structure was designed and carried to a letting but no bids were received. A new sheet-pile structure has been designed for construction during 1988. A proposal to extend the research period to include this construction has been accepted by the IHRB.

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-242

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

Agency: Iowa State University and Linn County

Principal Investigator: Phillip Baumel

Research Period: July 1, 1982 to January 31, 1989

Research Board Funding: $296,305

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 have been analyzed and costs for various vehicles have been established. A User's Manual has been developed which permits computer modeling of traffic on a road system to determine benefit-cost ratios of abandoning selected road segments from the system. Educational program material is being developed in order to train county personnel in the use of the software.

Reports: Final Report, August 1987, User's Manual, January 1986.

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-246

Project Title: Engineering Study - Reducing Sign Vandalism

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: Mark Callahan

Research Period: June 14, 1982 to December 1992

Research Board Funding: $118,000

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

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

Progress: Research was conducted at Iowa State University. From the findings of that research, a public awareness campaign has been established. Posters, tri-fold leaflets and bumper stickers have been developed and distributed to schools, county offices, and driver licensing stations throughout the state. Television and radio public service announcements have also been developed. Several counties have been selected to participate in a study to evaluate the effectiveness of this campaign.

Reports: Progress Report, January 1987

Implementation: It is estimated that over $1 million is spent in Iowa each year on replacing vandalized signs. One state achieved over a 50% reduction in sign vandalism through the use of an aggressive public awareness campaign.

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 30, 1988

Research Board 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 in 1982 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 were demonstrated by Cedarapids, Inc. while producing 50 tons of CMA deicer. Additional CMA deicer was produced in 1986. This material was evaluated on I-280 in the Davenport area. Results to date indicate that the CMA as a deicer is not as effective as rock salt. The CMA was also more difficult to handle.

Reports: Final Report, June 1983, Addendum to Final Report September 1984, Progress Reports, June 1985, March 1987

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-257

Project Title: Field Demonstration of Foamed Asphalt - Muscatine County

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

Principal Investigators: Robert Simmering and Sam Moussalli

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

Research Board 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 pit run 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. Performance evaluation is continuing.

Reports: Construction Report, December 1984

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

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: Sylvester Klassen and Sam Moussalli

Research Period: April, 1983 to August 31, 1989

Research Board 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. Evaluation is continuing.

Reports: Construction Report, January 1986

Implementation: There are plentiful supplies of blow sand, fine pit run 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-263

Project Title: An Engineering Study to Update Secondary Bridge Standards

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

Principal Investigator: William Lundquist

Research Period: June 1, 1983 to July 31, 1988

Research Board Funding: $440,800

Funding Source: 60% State--Farm-to-Market funds; 40% FHWA Bridge Replacement Funds

Objective: To redesign the secondary bridge standard plans to HS20 loading and make other appropriate changes to meet current design standards.

Progress: Stanley Consultants, Inc. of Muscatine, Iowa was awarded a contract to update the Iowa DOT secondary road 24 foot and 30 foot wide bridge standards to meet HS20 loadings. All work on these standards has been completed.

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-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 September 30, 1987

Research Board 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: Bradley Barrett

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 have been compiled. A literature search for the latest method of stream flow and flood stage calculation has been completed. Flood magnitude and frequency prediction methodology has been developed. A final report is being reviewed by U.S.G.S. personnel.

Reports: Final Report, 1987

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-270

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

Agency: Iowa Concrete Paving Association

Principal Investigator: Robert Given

Research Period: September 21, 1984 to September 30, 1988

Research Board Funding: $ 2,000

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

Objective: To demonstrate various Concrete Pavement Rehabilitation 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: Progress Report, May 1986

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

Project Number: HR-272

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

Agency: Iowa State University

Principal Investigators: Turgut Demirel, B. V. Enustun, Scott Schlorholtz

Research Period: February 1, 1985 to January 31, 1988

Research Board Funding: $154,295

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. There was a change noted in conductivity of non-air entrained concrete specimens after only a few freeze/thaw cycles that indicates potential of predicting durability. There is an interesting relationship of the relative conductivity of concrete between electrodes at different spacing. Testing was completed on air entrained concrete made with marginal aggregate.

Reports: Final Report, April 1988

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: Lowell Greimann, Fouad Fanous

Research Period: March 1, 1985 to July 31, 1988

Research Board Funding: $138,514

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: The field evaluation was conducted on special piling driven near the Town Engineering Building on the Iowa State University Campus. The data was analyzed and the final report was presented.

Reports: Final Report, December 1987

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: Jacob Odgaard

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

Research Board 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: Construction of a vane system in the West Nishna River near US 34 at Red Oak was completed in 1985.

Reports: Final Report, March 1988

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

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: Charles Cabalka and Mark Callahan

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

Research Board 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 was 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. Evaluation of the joints is being made semi-annually.

Reports: Construction Report, April 1986

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: Wes Smith and Richard Mumm

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

Research Board 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 included breaking a 2.5 mile section of PCC pavement into pieces ranging in size from 2 to 3 foot and from 4 to 5 foot. Also, overlay thicknesses of 2 inches, 3 inches, and 4 inches were placed on the broken slab. The project was constructed on Hamilton County Route R-33.

Reports: Construction Report, April 1987

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: Dah-Yinn Lee

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

Research Board 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: Laboratory evaluation of AC-13 polymer additive, 3M additive 5990 (Asphadur) and hydrated lime in asphalt cement has begun. The properties appear to be quite different. The direction of the project has been modified to include evaluation and analysis of some modifiers that have just recently been introduced to the use of asphalt cement in pavement. Many tests were conducted on the asphalt mixtures containing the additives. These results were compared to the asphalt mixture with no additive and presented in a final report.

Reports: Final Report, August 1987

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-279

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

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

Principal Investigators: Charles Marker and Glenn Miller

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

Research Board Funding: $76,175

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

Objective: To evaluate the effect of crack spacing and seating of pcc pavement prior to resurfacing on reflective cracking and structural rating

Progress: The project included breaking a 2-mile pcc pavement section with transverse cracking at 3 foot intervals. A portion of the project was overlaid with 3 inches of asphaltic concrete and a portion overlaid with 4 inches of asphaltic concrete. The project is located on Fremont County road J-46. Construction was completed in October 1986.

Reports: Construction Report, April 1987

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

Project Number: HR-280

Project Title: An Engineering Study to Update the Box Culvert Standards

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

Principal Investigator: William Lundquist

Research Period: July 31, 1985 to January 31, 1988

Research Board Funding: $300,000

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

Objective: To develop single and twin span box culvert standards, headwalls and bell joints for use by the Iowa counties.

Progress: Stanley Consultants, Inc. of Muscatine, Iowa began work in February 1986. Twenty four different single barrel box culverts have been designed for sizes from 5'x3' to 12'x12', with 9 different fills and 4 different skewed headwalls (0^{o}, 15^{o}, 30^{o} and 45^{o}). These have been distributed to the counties. Similar work has also been completed on the twin box culverts.

Reports: Single and Twin Box Culvert Standards

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

Project Number: HR-282

Project Title: A Low Cost Automatic Weight and Classification System

Agency: Iowa Department of Transportation, Minnesota Department of Transportation and the Federal Highway Administration

Principal Investigator: Bill McCall

Research Period: August 1, 1985 to June 30, 1988

Research Board Funding: $100,000

Funding Source: State--Primary funds-34%; Minnesota DOT-25%; FHWA-41%

Objective: To examine the reliability of the low cost WIM system through field trials, to evaluate the accuracy of axle and gross vehicle weight measurements and to investigate the performance of the classification system.

Progress: The advisory panel selected Castle Rock Consultants as the contractor for this project. The Weigh-in-Motion System has been installed on Interstate 35 in Iowa and US 10 in Minnesota. Weight, speed and classification data from both of these sites are being analyzed. The project is considered complete for a system which will function in PCC and ACC.

Reports: Final Report, May 1988.

Implementation: A low cost WIM system will provide improved truck monitoring which will aid enforcement and design to extend pavement life thereby yielding substantial savings.

Project Number: HR-284

Project Title: Development of Multiplan Microcomputer Spreadsheets for County Hydraulic and Highway Engineering Computations

Agency: Iowa State University

Principal Investigator: Ken Brewer

Research Period: November 1, 1985 to August 31, 1987

Research Board Funding: $50,790

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

Objective: To develop "Multiplan" spreadsheet solutions to a set of selected hydraulic and highway engineering computations of common interest to county engineers and to make them available to each county through a series of one-day workshops.

Progress: An advisory committee of county engineering personnel has been formed to help direct the research effort. The committee has met twice with the principal investigator and established priorities for specific program solutions to be developed. Several programs have been developed. A list of workshops was scheduled during early 1987 to help users become familiar with the programs. Fifty-eight county representatives attended the workshops. Six sets of Microsoft Multiplan were transferred to the Iowa DOT.

Reports: Final report, July 1987

Implementation: Many counties lack the time and personnel to write all the needed programs for their specific brand of computer. Spreadsheet solutions operate nearly identically in all computer spreadsheet versions, allowing easy training, use and trouble shooting of programs.

Project Number: HR-285

Project Title: Measuring Discharge at Crest-Stage Gaging Stations Using Tracer-Dilution Methods

Agency: Iowa City Office, Water Resources Div., U.S. Geological Survey, Dept. of Interior

Principal Investigator: Phil Soenksen

Research Period: November 1, 1985 to September 30, 1988

Research Board Funding: $91,950

Funding Source: 100 percent State funds--50 percent Primary, 50 percent Farm-to-Market (Matched by USGS)

Objective: To obtain complete stage and discharge hydrographs on small streams without the use of manpower at the sites during the flood event.

Progress: Equipment has been obtained and was installed on selected streams to obtain low data during the high flows of the 1986-1987 period. Data collection is continuing.

Reports: None

Implementation: Improved flood discharge data will permit more accurate design and reduce the design factor of safety necessary, thereby generating a cost savings in the construction of future structures.

Project Number: HR-286

Project Title: Development of a Rational Characterization Method for Iowa Fly Ash

Agency: Iowa State University

Principal Investigator: Turgut Demirel

Research Period: December 1, 1985 to November 30, 1988

Research Board Funding: $174,200

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

Objective: To develop a test method to characterize Class C fly ash and ensure consistent performance.

Progress: X-ray diffraction techniques are being used to analyze numerous samples of fly ash from selected power plants that provide fly ash for Iowa DOT projects. Chemical compound contents are determined. Scanning electron microscopy and thermal analysis are also being used.

Reports: Annual Progress Reports No. 1, November 1986 and No. 2, November 1987

Implementation: There is a substantial cost savings from substituting fly ash for portland cement. This research will ensure proper quality of concrete with fly ash substitution.

Project Number: HR-287

Project Title: Strengthening of Existing Continuous Composite Bridges

Agency: Iowa State University

Principal Investigators: F. Wayne Klaiber and Kenneth Dunker

Research Period: November 1, 1985 to July 31, 1987

Research Board Funding: $87,430

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

Objective: To determine the feasibility of strengthening continuous composite bridges.

Progress: A 1/3 scale model bridge was constructed in the Iowa State University Structural Laboratory and tested by various methods of strengthening.

Reports: Final Report, July 1987

Implementation: Strengthening of continuous composite bridges would reduce the number of bridges requiring posting of maximum traffic weights.

Project Number: HR-288

Project Title: Field Evaluation of Bonded Concrete Resurfacing

Agency: Construction Technology Laboratories

Principal Investigator: Shiraz D. Tayabji

Research Period: January 1, 1986 to November 30, 1986

Research Board Funding: $39,857.81

Funding Source: 100 percent State Funds--67 percent Primary, 33 percent Farm-to-Market

Objective: To perform condition surveys and load testing of pavement overlays and to verify design procedures for bonded resurfacings.

Progress: Field testing of five sites for this project has been completed. Deflections and stresses in the concrete were determined under both an 18,000 pound single axle and a 34,000 pound tandem axle. The data are now being analyzed.

Reports: Final Report, November 1986

Implementation: This research will improve the design of bonded overlay rehabilitation of pavement. There will be a savings through reduced overdesign and through extended life by avoiding under design.

Project Number: HR-289

Project Title: Engineering Study - Training Aids to Reduce Potential County Liability

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: Mark Callahan

Research Period: January 1, 1986 to December 31, 1988

Research Board Funding: $12,800

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

Objective: To develop a training slide/tape presentation which will illustrate situations and actions that could potentially contribute to highway accidents. The presentation will also show what remedial actions can be taken to improve highway safety.

Progress: An advisory committee of county engineers was formed to help direct the research effort. With assistance from the committee, a script was developed. Modifications proposed by the DOT Legal Division have been made to the script and 35mm slides of relevant conditions are being taken.

Reports: None

Implementation: Proper planning, design, construction and maintenance will improve safety, avoid mitigating situations and reduce highway-related tort claims

Project Number: HR-290

Project Title: Ice Retardant Pavement

Agency: City of Des Moines

Principal Investigator: John P. Bellizzi

Research Period: February 3, 1986 to March 31, 1991

Research Board Funding: $25,200

Funding Source: 100 percent State--Primary Funds

Objective: To evaluate the effectiveness of ice-retardant additives to the surface course of asphalt pavement in Iowa; to develop operational procedures for placing and maintaining asphalt concrete containing ice-retardant additives.

Progress: The location for use of the ice-retardant additive has been selected and a similar intersection has been identified for accident history comparison. The experimental Verglimit section was constructed on Euclid Avenue from 1st Street to Columbia Street in August 1986. Very few periods of evaluation were presented during the winter of 1986-87 due to the mild winter. During the high humidity summer seasons the surface sometimes became wet.

Reports: Interim Report, May 1988

Implementation: Use of the ice-retardant additive will improve safety by providing continuous deicing at selected high frequency snow and ice related accident locations.

Project Number: HR-291

Project Title: Performance of Nongrouted Thin, Bonded PCC Overlays

Agency: Iowa Concrete Paving Association, Monroe County and the Iowa Department of Transportation, Highway Division

Principal Investigators: Wapello County Engineer, currently Wendell Folkerts; Iowa Concrete Paving Association Construction Engineer, currently Gordon Smith; and the DOT Portland Cement Concrete Engineer, currently Jim Grove.

Research Period: March 1, 1986 to October 1, 1990

Research Board Funding: $14,200

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

Objective: To evaluate the performance of the nongrouted sections of a thin, bonded PCC overlay in Monroe and Wapello Counties.

Progress: A contract has been initiated with the Iowa Concrete Paving Association. Road Rater testing was conducted to determine the structural rating. Two series of cores were obtained and tested for bond shear strength.

Reports: Construction Report, August 1986

Implementation: PCC bonded overlays are currently bonded to the existing surface by placing a thin film of sand-cement grout ahead of the paving operation. If adequate bond without grout can be achieved for the overlay, approximately $1.00 per square yard of overlay could be saved.

Project Number: HR-292

Project Title: Field Evaluation of Integral Abutment Bridges

Agency: Iowa State University

Principal Investigator: Darrel D. Girton

Research Period: March 1, 1986 to June 30, 1989

Research Board Funding: $167,905

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

Objective: To determine expansion or contraction of integral abutment bridges as related to air and deck temperatures; to measure the effects of abutment movement on stresses in the bridge; to develop guidelines that will permit safe design of longer integral abutment bridges.

Progress: Methods and needed equipment for evaluation of integral abutment bridges have been developed. Two integral abutment bridges have been selected for field evaluation during substantial temperature variations. Field testing is underway.

Reports: Task 1 Report, September 1986

Implementation: This research will allow longer bridges without expansion assemblies which will result in substantial savings due to longer maintenance free bridge life.

Project Number: HR-293

Project Title: Pavement Instrumentation

Agency: Iowa Department of Transportation, Highway Division,
Iowa State University, Federal Highway Administration

Principal Investigator: Roman Dankbar

Research Period: May 1, 1986 to May 1, 1989

Research Board Funding: $75,000

Funding Sources: 100 percent State--Primary Funds (Matched by $113,000 FHWA Funds)

Objective: To evaluate the magnitude and frequency of dynamic loads applied to the pavement as related to the static loads used in pavement design and the demonstration of instrumentation for evaluation of pavement design and performance.

Progress: A contract has been executed with Iowa State University for their participation. A review has been conducted to identify the most effective current technology in evaluation instrumentation. Five tubes were placed, evenly spaced, in the subbase crossing the westbound lane of I-80 in Pottawattamie County. Nuclear instruments are pulled through the tubes at set time intervals to get recordings of moisture content and density of the subbase. Some 120 instruments have been installed in a 40 ft. segment of reconstructed pavement.

Reports: Interim Report, March 1988

Implementation: Improved design data from long term monitoring instrumentation will extend pavement life and will make possible the selection of the most economical design.

Project Number: HR-294

Project Title: Ammonium Phosphate/Fly Ash Road Base Construction

Agencies: Story County and Iowa State University

Principal Investigators: Del Jespersen and John Pitt

Research Period: May 1986 to July 1991

Research Board Funding: $80,175

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

Objective: To evaluate construction and service performance of ammonium phosphate fly ash treated base courses of limestone aggregate and unprocessed sand.

Progress: A 1.8 mile section of R-63 north of its intersection with E-29 in Story County was selected for the project. Construction of the project was completed in September 1986. Two mixes, two thicknesses and two wearing courses are being tested.

Reports: Construction Report, April 1987

Implementation: Trace chemicals have the ability to increase the strength of fly ash dramatically and to affect its set time. The inexpensive modification of Iowa fly ashes can increase the economic benefit of fly ash for many highway related uses.

Project Number: HR-295

Project Title: Field Measurement of Bridges for Long Term Structural Movement

Agency: Iowa State University

Principal Investigator: Terry J. Wipf

Research Period: June 1, 1986 to December 31, 1987

Research Board Funding: $114,606

Funding Source: 100 percent State--Primary Funds

Objective: To design a data acquisition system for tilt sensing equipment and to monitor pier movement on two bridges and to assess effects of the movements on the entire structure.

Progress: Tilt Sensor Systems have been attached to the Karl King Bridge over the Des Moines River in Fort Dodge and on a pier of the Mississippi River bridge at Lansing. Data is being collected. The tilt sensors are showing movements that appear to be related to temperature.

Reports: None

Implementation: An effective system of monitoring long term movement of structures will reduce the potential of serious failure and emergency closure of critical river crossings.

Project Number: HR-296

Project Title: Iowa State University Technology Transfer Center

Agency: Iowa State University

Principal Investigator: Tom Maze

Research Period: October 1, 1987 to December 31, 1988

Research Board Funding: $52,083

Funding Source: 100 percent State Funds--33 percent Primary, 67 percent Farm-to-Market

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

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-297

Project Title: Development of an Economic Dust Palliative for Limestone Surfaced Secondary Roads

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

Principal Investigators: Kenneth Burgeson and Turgut Demirel

Research Period: December 1, 1986 to November 30, 1988

Research Board Funding: $71,440

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

Objective: To identify a cost-effective dust palliative for use on limestone surfaced secondary roads in competition with or as an alternate to sodium chloride or calcium chloride.

Progress: Bentonite treated limestone samples show potential as an economical and effective dust palliative. Testing will continue to determine the optimum bentonite concentration, followed by field testing.

Reports: Progress Report, Task II, February 1988

Implementation: Finding a low cost dust palliative to treat Iowa's 70,000 miles of limestone surfaced roads can save the counties a substantial amount of money each year.

Project Number: HR-298

Project Title: Correlation of Locally-Based Performance of Asphalts With Their Physicochemical Parameters

Agency: Iowa State University

Principal Investigator: Dah-Yinn Lee

Research Period: January 26, 1987 to May 31, 1989

Research Board Funding: $142,785

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

Objective: To establish test criteria and specifications for asphalts based on simple physicochemical methods.

Progress: A contract for conduct of the research has been executed. The High Pressure Liquid Chromatography (HPLC) equipment has been obtained. Twelve asphalt samples and 6 core samples have been obtained from a variety of sources and have been tested.

Reports: Task I Report, January 1988

Implementation: The ability to identify those asphalts which would not crack in the highway would effect significant savings of highway maintenance funds.

Project Number: HR-299

Project Title: Control of Concrete Deterioration Due to Trace Compounds in Deicers

Agency: Iowa State University

Principal Investigator: John Pitt

Research Period: April 1, 1987 to December 31, 1988

Research Board Funding: $74,610

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

Objective: To:

1. Characterize deicing salts used in Iowa.
2. Determine how deicer induced concrete deterioration is influenced by field factors.
3. Define the deterioration mechanism

Progress: Laboratory testing of concrete and mortar specimens in salt brine with varying concentrations of sulfates is in progress.

Reports: Progress Report, June 1988

Implementation: The research will identify compounds which cause the deterioration and support changes in specifications to reduce the amount or eliminate these compounds from deicing salts. This will extend pavement life and reduce maintenance.

Project Number: HR-300

Project Title: Iowa Development of Roller Compacted Concrete

Agency: Highway Division, Iowa Dept. of Transportation and Manatt's, Inc.

Principal Investigators: O. J. Lane and Mark Callahan

Research Period: April 13, 1987 to December 31, 1988

Research Board Funding: $25,122

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

Objective: To investigate the performance of a roller compacted concrete test section subjected to continuous loading by a legally loaded truck.

Progress: Manatt's, Inc. of Brooklyn, Iowa, agreed to construct an RCC test section in its Ames facility yard. The slab was placed and loaded in April 1987. The section will be monitored for nine months.

Reports: None

Implementation: Roller compacted concrete is a zero slump portland cement concrete mixture that is spread with asphalt concrete equipment. Because of the ease and simplicity of RCC pavement construction, savings of up to one third the cost of portland cement concrete pavement construction are possible.

Project Number: HR-302

Project Title: Alternate Methods of Bridge Strengthening

Agency: Iowa State University

Principal Investigators: F. Wayne Klaiber, Kenneth F. Dunker, and Terry J. Wipf

Research Period: June 8, 1987 to September 30, 1988

Research Board Funding: $129,980

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

Objective: To determine the feasibility of strengthening stringer bridges by the addition of partial end restraint, to determine the most efficient location of end restraint brackets, and the effect of end restraint on the supporting substructure unit.

Progress: The project has been primarily aimed at two methods of strengthening. These two methods are providing partial end restraint and post-compression of stringers. Laboratory testing of these methods is in progress.

Reports: Progress Report, January 1988

Implementation: Alternate methods will be available for strengthening bridges which are structurally deficient according to current standards.

Project Number: HR-303

Project Title: Field Evaluation of Cold In-Place Recycling of Asphalt Concrete

Agency: Tama County

Principal Investigators: Robert Gumbert and Richard Mumm

Research Period: June 1, 1987 to June 1, 1994

Research Board Funding: $100,000

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

Objective: To identify an effective, affordable method of widening an existing 18 feet wide pavement (AC resurfacing over PCC) to provide a 24 feet wide finished surface capable of carrying traffic satisfactorily.

Progress: The plans have been developed. Construction is planned for the spring of 1989.

Reports: None

Implementation: A successful cold in-place recycling will provide a cost effective method of rehabilitating older resurfaced roadways. This will provide improved safety.

Project Number: HR-304

Project Title: Production of Acetic Acid for CMA Deicer

Agency: University of Iowa

Principal Investigator: Paul L. Peterschmidt

Research Period: June 1, 1987 to June 30, 1988

Research Board Funding: $16,852

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

Objective: To find the optimum method of producing acetic acid from corn for the production of CMA deicer

Progress: The research identified three by-products of corn wet milling as potential inexpensive food stocks to produce acetic acid. The most promising bacteria identified were acetobacterium woodii, acetobacterium carbinolicum and acetogenium kivui.

Reports: Final report, May 1988

Implementation: The potential of CMA deicer is tied directly to finding an economical method of producing acetic acid.

Project Number: HR-305

Project Title: Development of an Expert System for Forecasting Frost on Bridges and Roadways in Iowa

Agency: Iowa State University

Principal Investigator: Eugene Takle

Research Period: July 6, 1987 to June 30, 1989

Research Board Funding: $[illegible],084

Funding Source: 100 percent State--Primary Funds

Objective: To improve reliability of forecasts of frost on roads and bridges in Iowa, namely through a synthesis of meteorologcial data, frost-occurrence data, numerical modeling and operational experience, achieved by combining standard analysis methods with a tool from the general area of artificial intelligence known as an expert system.

Progress: A contract has been executed for the conduct of the research. A questionnaire has been completed.

Reports: Summary of questionnaire

Implementation: The development of a system which would improved the reliability of frost predictions would lead to improvements in road safety and reduce costs of manpower and deicing materials spent on false alarms.

Project Number: HR-306

Project Title: Investigation of Uplift Failures in Flexible Pipe Culverts

Agency: Iowa State University

Principal Investigators: T. Al Austin, F. Wayne Klaiber, and Robert A. Lohnes

Research Period: January 1, 1988 to June 30, 1989

Research Board Funding: $110,415

Funding Source: 100 percent State--10% Primary, 90% Secondary

Objective: A number of large CMP culverts have failed in Iowa in recent years. The objective of the proposed research is to analyze the forces to which large CMP culverts are subjected. Once this is accomplished, new culvert tie down designs can be developed to prevent future culvert failures.

Progress: Field trips to culvert failure locations have been made to study the causes of the failures. Also, a computer program has been developed to aid in analyzing appropriate tie down guidelines based on worst case scenerios of forces acting on culverts.

Reports: None

Implementation: Proper tie down designs is essential in preventing CMP culvert floatation failures. New design guides for retrofitting existing culverts and anchoring new culverts will prevent future failures.

Project Number: HR-307

Project Title: Sediment Control in Bridge Waterways

Agency: University of Iowa

Principal Investigator: A. Jacob Odgaard

Research Period: January 15, 1988 to March 31, 1989

Research Board Funding: $35,000

Funding Source: 100 percent State--10% Primary, 90% Secondary

Objective: To develop guidelines for the application of the vane technique for sediment control at bridge waterways. The guidelines will make the technique readily applicable to engineers charged with the construction and maintenance of river crossings.

Progress: A contract for conduct of the research has been executed.

Reports: None

Implementation: Proper placement of water vanes will redirect water flow under the center spans of bridges, thereby preventing sedimentation from restricting proper water flow.

Project Number: HR-308

Project Title: Strengthening of an Existing Continuous Span Steel Beam-Concrete Deck Bridge by Post-Tensioning

Agency: Iowa State University

Principal Investigator: F. Wayne Klaiber and Kenneth F. Dunker

Research Period: February 1, 1988 to October 31, 1989

Research Board Funding: $142,435

Funding Source: 100 percent State funds--34% Primary, 66% Farm-to-Market

Objective: The objective is to design and install a post-tensioning strengthening system on a continuous span, steel beam-concrete bridge deck instrument the bridge for determination of deflections and strains, and document the bridges behavior.

Progress: A contract has been executed and research is underway.

Reports: None

Implementation: Strengthening of existing continuous span, steel beam-concrete deck bridges could restore load carrying capacity, reduce the number of bridges requiring posting or increase the limits for maximum traffic weights.

Project Number: HR-309

Project Title: An Investigation of Emulsion Stabilized Limestone Screenings

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

Principal Investigator: Jerry Nelson, James M. Hoover, and Mark Callahan

Research Period: May 20, 1988 to January 31, 1994

Research Board Funding: $78,760

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

Objective: The objective of project HR-309 is to construct an experimental base using several variations of a waste limestone screenings/emulsion mix. Residual asphalt contents of 2.5%, 3.5%, and 4.5% will be used on test sections of 4 inch and 6 inch compacted thicknesses. A control section of 6 inches of untreated limestone screenings will be included for comparative purposes.

Progress: Project plans have been developed and a contract awarded. Construction is scheduled to begin the first week of August 1988.

Reports: None

Implementation: Finding useful ways of incorporating waste aggregate into construction of lower level roads will ease the burden of disposal for contractors and reduce the cost of construction for counties.

Project Number: HR-310

Project Title: Precast, Prestressed Concrete Panel Subdecks in Skewed Bridges

Agency: Iowa State University

Principal Investigator: Dr. Robert E. Abendroth

Research Period: June 1, 1988 to November 30, 1989

Research Board Funding: $96,088

Funding Source: 100 percent State--30% Primary, 70% Farm-to-Market Funds

Objective: The objective is to determine the behavior of precast, prestressed concrete panels used as permanent forms for reinforced concrete bridges at abutment or pier diaphragm locations

Progress: A contract has been signed with Iowa State University to conduct the research. A literature review is under way.

Reports: None

Implementation: This research will reduce the potential for cracking near skewed piers and abutments and extend the maintenance-free life of these bridge decks.

Project Number: HR-311

Project Title: Creep and Resilient Modulus Testing of Asphalt Mixtures

Agency: Iowa Department of Transportation

Principal Investigator: Vernon J. Marks

Research Period: June 15, 1988 to December 31, 1990

Research Board Funding: $25,000

Funding Source: 100 percent State--Primary Funds

Objective: The objective of this research is to determine if a correlation exists between creep and/or resilient modulus testing and field performance.

Progress: Construction of a creep testing device that will test three specimen simultaneously is nearing completion. A Retsina Mark VI resilient modulus apparatus has been ordered. Four and six inch diameter cores are being obtained from asphalt concrete pavements that exhibit substantial rutting and some with negligable rutting.

Reports: None

Implementation: The improved testing methods will enable more accurate prediction of performance of asphalt concrete mix designs and thereby reduce rutting of asphalt concrete pavements.

Project Number: HR-312

Project Title: Low Cost Techniques of Base Stabilization in Dubuque County

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

Principal Investigator: Mark C. Jobgen and Mark Callahan

Research Period: August 22, 1988 to December 31, 1993

Research Board Funding: $93,913

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

Objective: To evaluate four base stabilization techniques and determine which, if any, will provide enough strength to carry local heavy vehicle loads.

Progress: A contract has been signed with Dubuque County to perform the work. Work is scheduled to begin in early fall, 1988.

Reports: None

Implementation: If an inexpensive base stabilization technique can be developed, a significant number of secondary roads could be improved without requiring asphalt or portland cement concrete paving.

Project Number: HR-1027

Project Title: Secondary Road Research Coordinator

Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: Mark Callahan

Research Period: March 5, 1980 to present

Research Board Funding: $32,500.00/yr.

Funding Source: 100 percent State--Farm-to-Market 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: Mark Callahan has visited 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 10 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.