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ANNUAL REPORT
Of
HIGHWAY RESEARCH
And
DEVELOPMENT
In
IOWA



HIGHWAY DIVISION
OFFICE OF MATERIALS

DECEMBER 1979

Disclaimer

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ANNUAL REPORT

HIGHWAY RESEARCH AND DEVELOPMENT IN IOWA

FOR THE FISCAL YEAR ENDING JUNE 30, 1979

By

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HIGHWAY DIVISION
IOWA DEPARTMENT OF TRANSPORTATION

DECEMBER 1979

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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, directing submission of a report of the Secondary Road Research Fund. It is a report on the status of research and development projects which were in progress on June 30, 1979; it is also a report on projects completed during the fiscal year beginning July 1, 1978 and ending June 30, 1979. 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 by the Highway Commission in 1949.

The Research Board consists of 13 regular members; six County Engineers, three 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 membership of the Research Board as of June 30, 1979 is listed in Table I.

The Research Board held eight regular meetings during the period of July 1, 1978 to June 30, 1979. Suggestions for research and development were reviewed at these meetings and recommendations were made by the Board.

TABLE I
IOWA HIGHWAY RESEARCH BOARD
JUNE 30, 1979

<u>Member</u>	<u>Alternate</u>
W. W. Amundson City Engineer Sioux City, IA 51100	R. Holland City Engineer Bettendorf, IA 52722
R. Betterton Greene County Engineer Jefferson, IA 50129	P. Dvorak Grundy County Engineer Grundy Center, IA 50638

TABLE I CONT.
IOWA HIGHWAY RESEARCH BOARD

<u>Member</u>	<u>Alternate</u>
D. R. Boylan, Dean College of Engineering Iowa State University Ames, IA 50011	P. W. Peterson Associate Dean of Research Iowa State University 104 Marston Hall Ames, IA 50011
G. Calvert Deputy Director, Development Iowa DOT-Highway Division Ames, IA 50010	T. E. McElherne Specifications Engineer Iowa DOT-Highway Division Ames, IA 50010
R. H. Given Deputy Director, Staff Iowa DOT-Highway Division Ames, IA 50010	F. O. Bloomfield Maintenance Engineer Iowa DOT-Highway Division Ames, IA 50010
W. A. Groskurth Mitchell County Engineer Osage, IA 50461	W. A. Moellering Fayette County Engineer West Union, IA 52175
R. C. Henely District 6 Engineer Iowa DOT-Highway Division Cedar Rapids, IA 52404	R. F. Percival District 5 Engineer Iowa DOT-Highway Division Fairfield, IA 52556
R. G. Hering Dean of Engineering University of Iowa Iowa City, IA 52240	K. Rim Associate Dean for Research University of Iowa Iowa City, IA 52240
E. Niebuhr City Engineer Clinton, IA 52732	R. Kirchner City Engineer Fort Dodge, IA 50501
L. G. Petersma Van Buren County Engineer Keosauqua, IA 52565	G. L. Gronvold Jefferson County Engineer Fairfield, IA 52556
E. Schornhorst Shelby County Engineer Harlan, IA 51537	D. J. Lynam Adair County Engineer Greenfield, IA 50849
D. R. Shaw Ida County Engineer Ida Grove, IA 51445	D. D. Linnan Buena Vista County Engineer Storm Lake, IA 50588
D. L. Smith Delaware County Engineer Manchester, IA 52057	L. Mattusch Clinton County Engineer Clinton, IA 52732

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 or 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 likewise shared.

Table II is a record of expenditures for research and development made during the fiscal year ending June 30, 1979. Total expenditure was \$ 439,962.74 including support of the National Cooperative Highway Research Program (see page 6).

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; they 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 their 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 1½ 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 (designated "Farm-to-Market") is itemized in Table II.

The values shown in Table II are actual research expenditures for fiscal year 1979. The Office of Transportation Inventory engineering studies included traffic counts and secondary road inventories. The Iowa Department of Transportation accounting procedure for the Secondary Road Research Fund is based upon obligations for expenditures on research projects and not the actual expenditure. The Fiscal Year 1979 financial summary is:

Beginning Balance 7-1-78		1,063,891
Receipts		
Interest	60,487	
Fed. Sec. Rd. (1½% of receipts) ...	142,233	
State RUTF (1½% of receipts)	<u>430,460</u>	
Sub-Total		<u>633,180</u>
Total Funds Available		1,697,071
Obligation for Expenditures		
Obligated for		
Contract Research ...	461,587	
Non-Contract		
Engineering Studies ...	<u>319,957</u>	
Total Expenditures		<u>781,544</u>
BALANCE (6-30-79)		951,527

SECONDARY ROAD TRAFFIC COUNT PROGRAM

During fiscal year 1979, the traffic count program conducted by the Office of Transportation Inventory on the Secondary Road System in 26 Counties required a total of 2,601 4-hour or 8-hour manual 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 8 counties and partially completed in 4 counties. This data provides the county engineer, highway engineer, planner, and administrator with essential information needed for the determination of design standards, systematic classification of highways, and the development of programs for improvement and maintenance of secondary roads.

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.

TABLE II
RESEARCH AND DEVELOPMENT EXPENDITURES
July 1, 1978 to June 30, 1979

<u>Project</u>	<u>Primary</u>	<u>Farm-to-Market</u>	<u>Total</u>
140	\$11,000.00	\$33,000.00	\$44,000.00
186	24,227.91	23,629.01	47,856.92
187	1,242.00	1,062.00	2,304.00
188	-	28,000.00	28,000.00
189	400.05	167.82	567.87
190	2,467.06	2,153.74	4,620.80
194	-	31,671.34	31,671.34
195	59,721.63	-	59,721.63
197	13,466.69	16,730.70	30,197.39
198	-	38,716.62	38,716.62
200	-	16,300.00	16,300.00
202	38,800.59	8,995.90	47,796.49
203	-	6,303.54	6,303.54
204	-	17,750.23	17,750.23
1013	1,555.12	-	1,555.12
Sub-total	\$152,881.05	224,480.90	377,361.95
NCHRP	56,333.35	5,537.21	61,870.56
HPR-2(113)	(411.95)	(58.97)	(470.92)
HPR-2(119)	1,051.86	149.29	1,201.15
TOTAL	\$209,854.31	\$230,108.43	\$439,962.74

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, 1978 and ending June 30, 1979. An open file for each project is maintained for the project's inception to completion; completion is signified by the acceptance of the final report and the making of the final payment. Each project description contains an implementation statement of the use now being made, or expected as a result of the research effort.

Project Number: HR-140

Project Title: Collection and Analysis of Stream Flow Data

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

Principal Investigator: D. K. Leifeste, U.S.G.S.

Contract Period: Project continued to September 30, 1980 by approval of the Director--Highway Division

Contract Amount: \$44,000 per year (matched by \$44,000 from the Department of Interior)

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

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

Research 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.

Project Activities: The Water Resources Division employs a staff of engineers and technicians who monitor and maintain a network of water measuring stations on Iowa streams. These measurements, along with data from special studies of selected streams, are compiled and analyzed to form the basis for predictions of future streamflow.

Progress: The progress during 1978-1979 was in accordance with schedules established by the Water Resources Division.

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

Project Number: HR-148

Project Title: Investigation of Pavement Wear in Relation to Studded Tire Use

Research Agency: Office of Materials, Research Section, Iowa Department of Transportation

Principal Investigator: V. J. Marks, Materials Research Section

Contract Period: August 20, 1969 to completion

Contract Amount: \$1,130

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

Research Objective: The objective of this project is to measure pavement wear caused by studded tires and to estimate the extend of future wear if studded tires remain legal in Iowa.

Project Activities: Annual surveys of studded tire use were made by Iowa DOT personnel during the years 1969 through 1978. The surveys were made by observing tires on parked vehicles in parking lots and on streets. Moving vehicle counts and wear measurements were also made to determine studded tire use and wear.

Progress: Final analysis of the studded tire wear measurements and the additional safety hazards involved, resulted in a recommendation that studded tires be banned in Iowa. The project has been completed.

Reports: Final report, June 1979.

Implementation: The findings from Research Project HR-148 are being used to support recommendations adopted by the Iowa Department of Transportation concerning the banning of studded tires in Iowa.

Project Number: HR-165

Project Title: Experimental Steel Fiber Reinforced Concrete Overlay

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

Principal Investigators: R. Betterton, Greene County and Vernon J. Marks
Materials Research Section

Contract Period: December 20, 1972 to completion

Contract Amount: \$60,000

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

Research Objectives: To determine the feasibility of mixing, placing and finishing various fibrous concrete overlays and to evaluate the overall performance, longevity and maintenance characteristics of the overlays.

Project Activities: A fibrous Portland Cement Concrete overlay was placed on 3.03 miles of Greene County Road E-53 (old US 30). The 40 different test sections contain various combinations of depth, cement content, steel fiber length and fiber content.

Progress: The fibrous concrete overlay and various control sections were placed in FY 1974. Performance was observed and crack survey reports were distributed annually. A final crack survey report was completed late in 1978. All experimental sections are serviceable and still in place, although some longitudinal cracking is evident.

Reports: Final report, December, 1978.

Implementation: Future use of the fibrous concrete will then depend primarily on its cost in comparison with other resurfacing techniques. Results from the project have shown that fibrous concrete can be used to produce thin, high performance highway pavement overlays. However, improvements in the cost-effectiveness of fibrous concrete are needed if this type of pavement resurfacing is going to be developed to any significant degree. Conventional concrete without fiber reinforcement was less expensive and yielded better performance.

Project Number: HR-176

Project Title: Recycled Asphalt Pavement

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

Principal Investigator: R. C. Henely, Kossuth County

Contract Period: May 1, 1975 to completion

Contract Amount: \$50,000

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

Research Objective: To conserve materials and establish techniques that will
lead to more economical reconstruction of asphalt paving.

Project Activities: Plans and specifications and cost estimates were com-
pleted early in 1975.

Progress: Construction of the proposed project was completed during the
summer of 1975. Observations will be made for a period of
several years.

Reports: A September 3, 1975 report has been prepared.

Implementation: This project proved that recycling of asphalt concrete is
feasible and that additional research was needed to solve
related problems. Research Project HR-1008 was constructed in 1976 due to
recommendations resulting from this project. In 1977, research project
HR-188 established asphalt recycling as a viable method of construction
that will conserve energy and materials. Kossuth County has accepted re-
cycled asphalt pavement as a standard reconstruction practice.

Project Number: HR-177

Project Title: Concrete Bridge Deck Repairs Using Injected Epoxy Resin

Research Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: E. O'Connor, Maintenance

Contract Period: May 6, 1975 to November, 1978

Contract Amount: \$3,000

Funding: 100 percent State, Primary funds

Research Objective: To provide the special equipment necessary for use in injecting epoxy resin in delaminated areas in bridge decks and to determine if this material does prevent or delay the formation of spalls in bridge decks.

Project Activities: In 1975, \$3,000 was authorized for acquisition of an epoxy injection machine from a manufacturer in Topeka, Kansas. The equipment was delivered late in the summer of 1975. The Office of Materials assisted in the evaluation of the results over a three-year period.

Progress: Epoxy injections were made on three different bridges. Some problems were encountered in drilling holes and in the injection of the epoxy resin. The equipment seems to be more applicable to large areas of delamination. An effort to use the unit to repair cracks in a prestress beam was unsuccessful. Continued observation and monitoring of repaired deck areas will be required to determine long term results.

Reports: Final report, January, 1979.

Implementation: There has been only a limited opportunity to use the epoxy injection process to rebond delaminated areas in bridge decks, however, results to date would indicate that there are instances this repair procedure can be used advantageously.

Project Number: HR-178

Project Title: Pavement Deflection Study

Research Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: C. Potter, D. Heins, Materials

Contract Period: November 5, 1975 to March 1, 1979

Contract Amount: \$26,000

Funding: 100 percent State, Primary funds

Research Objective: To determine if the test equipment can provide data of sufficient accuracy to be used effectively in pavement design and to determine the seasonal deflection variation of flexible pavements.

Project Activities: The Road Rater was delivered by the manufacturer early in the spring of 1976. A tentative work plan for conducting a variety of pavement deflection studies was completed.

Progress: Correlations with Benkelman Beam data and AASHTO structural numbers have been obtained. There have been some equipment problems with the Road Rater, however, the unit has demonstrated its ability to increase the quantity of testing with the greater capacity for testing. An inventory program has been initiated.

Reports: Final report, February, 1979

Implementation: This project has proven that the Road Rater is a useful and effective tool in the design and maintenance of flexible pavements. A goal is to establish structural ratings for all primary flexible roadways in Iowa.

Project Number: HR-180A

Project Title: An Evaluation of an Epoxy Pavement Marking System

Research Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: J. H. Moody, Maintenance

Contract Period: April, 1976 to completion

Contract Amount: \$4,925

Funding: 100 percent State, Primary funds.

Research Objective: To determine if epoxy paint is an economical alternative to standard paint on high traffic multi-lane roadways and to determine if epoxy lane markings will last an entire winter season without replacement.

Project Activities: An experimental epoxy based paint developed by the H. B. Fuller Company and the Minnesota Department of Highways was applied on several lanes of Interstate 235 in Des Moines. Standard striping paint was also used in the vicinity for comparison purposes.

Progress: The sandblasting and painting was only partially completed due to equipment failure. Observations made following the application indicated some irregularities due to an improper mixture of the epoxy components. In September, 1979, the Century Fence Company replaced some of the pavement markings which were previously improperly applied. No problems were encountered during the application of the paint. Nighttime observation of the newly applied traffic paint has shown reflectivity equal to or better than standard lane markings. Evaluation of this newly applied line will continue for a minimum of three years.

Reports: HR-180 Final report, November, 1978.

Implementation: This project has shown that an application of properly mixed epoxy paint will provide more durable traffic lane markings for use on multiple lane highways. Further research is recommended using updated equipment for surface cleaning and epoxy paint application.

Project Number: HR-181

Project Title: The Evaluation of Macadam Stone Shoulders

Research Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: R. A. Shelquist, Materials

Contract Period: May 25, 1975 to completion

Contract Amount: \$8,143

Funding: 100 percent State, Primary funds

Research Objective: To determine the feasibility of using a Macadam Stone shoulder in place of the standard paved shoulder; to determine if there are any major problems associated with the construction and maintenance of Macadam Stone shoulders, and to evaluate the performance of Macadam Stone Shoulders.

Project Activities: This experimental type of shoulder construction was incorporated into a Dallas County project on US 6. Shoulder construction operations were observed and methods and procedures were recorded. Structural number comparisons between Macadam shoulders and recently constructed stabilized and paved shoulders is continuing.

Progress: The shoulder construction work has been completed. A recent visual observation showed that the shoulders with the asphalt concrete surface were performing well with no spots on the surface. The side with the cover aggregate seal has some damage and open surface. A visual and structural evaluation program will be continued for the duration of the project. Long term effects from traffic and environmental factors will also have to be determined.

Reports: A construction report was distributed in November, 1977.

Implementation: This project will provide an alternate cost effective shoulder design for high traffic volume roadways.

Project Number: HR-182

Project Title: An Evaluation of Cover Aggregate Stripping Characteristics

Research Agency: Iowa Department of Transportation, Highway Division

Principal Investigators: K. Isenberger, R. D. Smith, Materials and
B. Dunshee, Maintenance

Contract Period: May 25, 1976 to completion

Contract Amount: \$15,000

Funding: 100 percent State, Primary funds

Research Objective: To identify the stripping susceptibility of various types of cover aggregates in Iowa.

Project Activities: This research project was incorporated into the 1976 Iowa DOT Maintenance Contract seal coat program as a division of a project on Iowa 210 between Interstate 35 and Maxwell, Iowa. Twenty-nine different cover aggregate types were tested and standard seal coat specifications were used.

Progress: Samples to determine the amount of aggregate retained on the surface were taken at periodic intervals and results of the tests for aggregate retention were evaluated. Due to the influence of unexpected variables upon field samples, laboratory data are reliable for only the most general observations. Conclusions indicate that gravels as a group appear to be retained better than carbonates and rainfall shortly after seal coat placement can affect aggregate retention. Field observations were summarized and an analysis of skid resistance data was completed.

Reports: Final report, February, 1979.

Implementation: The research was used to rate the various aggregates for use as cover aggregates. A performance summary listing was developed as a guide to be used in cover aggregate construction or maintenance.

Project Number: HR-184

Project Title: Determination of Rumble Strip Effectiveness

Research Agency: Iowa Department of Transportation, Highway Division

Principal Investigators: S. Basu, V. J. Marks, B. Dunshee

Contract Period: August, 1976 to completion

Contract Amount: None

Funding: (Maintenance Operation)

Research Objective: To identify the effectiveness of the rumble strip as a traffic safety device when used on a wide-spread basis in both rural and urban situations.

Project Activities: Written agreements were signed with each of the participating counties. The rumble strips were cut at approved, designated locations.

Progress: Total intersection related accident data was evaluated on a before and after basis. A saturation use of rumble strips was also studied. Results of this study indicate that the greatest benefit of this type of use can be derived from areas with low traffic volumes.

Reports: Final Report, January, 1979.

Implementation: The investigation of accidents at the various test sites showed that rumble strips were effective in reducing certain types of intersection accidents. No statistically significant effect of saturation use was found on total accidents, although there are indications that accidents may be reduced when used in low density or rural type areas.

Project Number: HR-186

Project Title: Evaluation of Changes in Productivity Resulting from
Removal of Soil for Highway Construction

Research Agency: Iowa State University

Principal Investigators: W. D. Shrader, S. J. Henning, Iowa State University

Contract Period: January 1, 1977 to December 31, 1980

Contract Amount: \$172,085

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

Research Objective: To evaluate changes in soil productivity caused by
removal of soil, to measure the effect on crop yields
of returning surface soil to varying conditions and various tillage prac-
tices and to determine the effects of land surface elevation above drainage
tile or perched water tables.

Project Activities: A four-year contract has been signed with Iowa State
University. Work is completed on the selection of
sites in several counties for borrow pits with desirable characteristics.

Progress: Four borrow pit sites have been selected for the research.
Temporary easements or rental arrangements have been worked
out. Borrow pit shaping, top soil replacement and crop planting were
completed at two of the site locations.

Reports: A second Annual Progress Report (1978) was completed and
distributed.

Implementation: Following completion of the project, a manual of practices
and procedures for selection and treatment of borrow areas
will be prepared. Crop yield reports for 1978 for the two sites were
received and evaluated. The two remaining sites were completed in October
and November, 1978. All four sites will be used for agricultural produc-
tion in 1979.

Project Number: HR-187

Project Title: Development of a Minicomputer Controlled Frost, Ice and Snow Detector for Bridge Hazard Monitoring

Research Agency: Cytroncis Incorporated

Principal Investigator: P. W. Poppe

Contract Period: January 13, 1977 to May 1, 1979

Contract Amount: \$19,500

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

Research Objective: To design, develop and deliver a microprocessor controlled frost, ice and snow detector with the capability to accurately detect frost, ice and snow in the presence of de-icing chemicals under normal conditions at bridge sites.

Project Activities: Laboratory testing, design and development work for Phase I were completed early in the project. Several modifications were made in the original equipment in an attempt to improve reliability.

Progress: Field testing of equipment could not be completed due to a lack of frost during the first winter season. Several extensions were granted for this project to allow for modification of equipment and additional field testing in attempts to attain the desired reliability. It was concluded that some of the technical problems could be corrected with additional equipment and testing. However, sensor damage and installation difficulties related to winter maintenance will continue to be major problems. The project was terminated, but final evaluation of the unit will be done by Iowa DOT Maintenance personnel. The frost and ice detector equipment was turned over to the Iowa DOT in the spring of 1979. Problems with damage to bridge deck sensors caused by snow plows and traffic and heater circuit limitation have resulted in a considerable amount of down time. The experience of the past winters again point out the environmental difficulties related to the maintenance and operation of frost and ice detector installations.

Reports: A progress report has been distributed.

Implementation: Modifications have improved the effectiveness of the detector, but further evaluation is necessary. The development of an effective frost, ice and snow detector will result in improved motorist safety, reduced tort liability and reduced annual expenditures for winter maintenance.

Project Number: HR-188

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

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

Principal Investigator: R. C. Henely

Contract Period: April 11, 1977 to completion

Contract Amount: \$50,000

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

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

Project Activities: A work plan has been completed. The project was let on June 21, 1977. Several contractors and equipment manufacturers showed an interest in the project.

Progress: The project was 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 world-wide recognition.

Reports: A progress report was distributed in December, 1977.

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-189

Project Title: A Study of the Spergen Formation of Southeastern Iowa

Research Agency: Iowa Geological Survey

Principal Investigator: B. L. Milne

Contract Period: April 12, 1977 to December 31, 1978

Contract Amount: \$4,880

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

Research Objective: To provide detailed geographic and stratigraphic information on the location of Spergen Formation in eight southeastern counties in Iowa. Efforts were made to trace the depth and characteristics of the Spergen in order to find potentially viable areas for mining or quarrying.

Project Activities: The research was carried out by the University of Iowa, Department of Geology. Attempts were made to designate desirable locations for further exploration.

Progress: Stratigraphic data was collected by the Iowa Geological Survey and field investigations were completed. Samples were collected at six localities and mapped in the subsurface in a seven county area. Well logs were selected from a computer printout, supplied by the Iowa Geological Survey.

Reports: Final Report, December, 1978.

Implementation: Copies of the final report were forwarded to the Iowa Limestone Producers Association for further distribution. The potential remains for additional research on the Spergen Formation of southeastern Iowa. Additional coring and rock analysis would be necessary to determine the physical properties of recommended sites.

Project Number: HR-191

Project Title: Bonded, Thin-Lift Non-Reinforced Portland Cement Concrete Resurfacing.

Research Agency: Clayton County and Iowa Department of Transportation,
Highway Division

Principal Investigator: M. L. Johnson

Contract Period: May 16, 1977 to completion

Contract Amount: \$50,000

Funding: 100 percent State, Farm-to-Market

Research Objective: The research objectives are: 1. To establish methods and procedures for surface preparation for p.c. concrete resurfacing; 2. To establish mixing procedures using super water reducing admixtures and to study the economics and performance of portland cement resurfacing; 3. To determine if this method of overlay can be considered as a viable alternative for concrete pavement restoration.

Project Activities: A contract was signed with Clayton County. The plans and specifications have been completed. The project was let in July, 1977.

Progress: A thin-bonded low slump portland cement concrete overlay was placed on a 1.3 mile portion of a secondary Clayton County road in September, 1977. No major problems were experienced in mixing and proportioning the concrete. An adequate bond was developed and the project is performing well. Evaluation will continue for a five year period.

Reports: A construction report has been completed, September, 1977.

Implementation: This research will determine whether bonded, thin-lift non-reinforced portland cement resurfacing is a viable alternative for concrete pavement restoration and rehabilitation. Based upon the success of this project, a thin-bonded overlay rehabilitation was used on I-80 in Pottawattamie County.

Project Number: HR-192

Project Title: An Evaluation of Dense Bridge Floor Concrete

Research Agency: Iowa Department of Transportation, Highway Division

Principal Investigators: R. W. Pratt, J. V. Bergren

Contract Period: May, 1977 to completion

Contract Amount: \$3,340

Funding: 100 percent State, Primary funds

Research 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.

Project Activities: The project is located in the Town of Ackley on US 20 in Hardin County. The construction involved the re-decking 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.

Progress: 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: A construction report has been completed, December, 1977.

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

Project Number: HR-194

Project Title: Mission Oriented Dust Control and Surface Improvement Processes for Unpaved Roads

Research Agency: Iowa State University

Principal Investigator: J. M. Hoover

Contract Period: July 1, 1977 to December 31, 1979

Contract Amount: \$99,860

Funding: 100% State, Farm-to-Market funds

Research Objective: To identify current practices, products and specifications of potentially economic dust control systems and to plan, design and construct a series of demonstration test sections in several regions in Iowa for the purpose of evaluating materials, construction costs and performance of various dust control methods.

Project Activities: A contract has been signed with Iowa State University and an Advisory Committee has been selected. Site selection, based on geographic/geologic regions in the State, has been completed. Additional sites were added in order to get adequate representation of soil aggregate characteristics of the various regions.

Progress: Current dust control practices and specifications are being evaluated. Dust collectors were established at all locations this spring and dust collection techniques will be continued until construction. Design testing and recommendations to individual counties for test section construction is nearly completed. Categories of products for use on individual test sections have been recommended to counties.

Reports: Semi-annual progress reports have been submitted.

Implementation: The project will identify alternate practices and the most economical methods of dust control.

Project Number: HR-195

Project Title: Field Performance and Evaluation of Slurry Seal Coats

Research Agency: Iowa State University

Principal Investigator: D. Y. Lee

Contract Period: July 1, 1977 to August 31, 1980

Contract Amount: \$91,000

Funding: 100 percent State, Primary funds

Research Objective: To evaluate performance characteristics of materials native to Iowa and applicability of other materials in slurry seals, mix designs and to correlate laboratory tests with field performance.

Project Activities: This project is the second phase of a two part study. Construction on Phase II, a field performance evaluation of slurry seals was delayed due to inflated costs. Under a revised schedule, the project was let in April, 1978 and a time extension through August 31, 1980 was granted with an additional \$11,000 in research construction funding.

Progress: Application of the slurry seal test sections and approximately half of the control sections were completed in September, 1978. Problems were encountered in obtaining the optimum emulsion content. Some test sections failed and were replaced. Resurfacing of the remaining control sections was completed during the 1979 construction season. Evaluation of the test sections will be continued.

Reports: None

Implementation: The project will provide a basis for the development and preparation of slurry seal, design methods, criteria, procedures and specifications for the successful application of slurry seal as an economic pavement maintenance alternative.

Project Number: HR-197

Project Title: Fatigue Behavior of High Air Content Concrete--Phase II

Research Agency: Iowa State University

Principal Investigator: D. Y. Lee, F. W. Klaiber

Contract Period: October 1, 1977 to January 31, 1979

Contract Amount: \$49,425

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

Research Objective: To determine the effects of various air contents, various water-cement ratios, and different aggregate types on the flexural fatigue strength of plain concrete and to develop fatigue curves that incorporate these effects.

Project Activities: Materials for the project have been purchased and the first batch of concrete was poured in January, 1978. Fatigue testing began in February, 1978. Fifteen series of concrete were investigated in the study. Variables consisted of air-content, water-cement ratios, coarse aggregate types and fine aggregate types.

Progress: A planning meeting was held in November, 1977. Aggregate and material sources were determined and material combinations were modified in order to obtain better results. Conclusions from the study indicate that the fatigue behavior of plain concrete in flexure is affected by the air content and by the water-cement ratio. The project has been completed.

Reports: Final Report, February, 1979.

Implementation: The fatigue curves developed in this study will be compared to those followed in the Iowa DOT pavement design procedures. Results from the study collaberate well with data from the Portland Cement Association.

Project Number: HR-198

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

Research Agency: State Archaeologist (University of Iowa)

Principal Investigator: M. McKusick

Contract Period: July 1, 1977 to June 30, 1979

Contract Amount: \$33,000

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

Research Objective: 1. To determine well in advance of highway construction if proposed planning corridors contain known or probable sites of archaeological value. 2. To locate such sites and describe their limits as accurately as possible without resorting to excavation or other detailed examination.

Project Activities: The Iowa Department of Transportation had an on-going contract with the State Archaeologist to perform the needed preliminary investigations and prepare the necessary reports.

Progress: Secondary road construction sites with archaeological value are being examined in advance of construction. Under a new Iowa DOT policy, a revolving fund will be established within the Secondary Road Research Fund to initially pay for the services of a survey contractor and to prepare billings to the counties and cities for their proportionate share of costs incurred.

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

Implementation: The project will be beneficial as 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

Research Agency: Iowa Department of Transportation, Highway Division

Principle Investigator: R. A. Shelquist

Contract Period: June 1, 1978 to December 31, 1983

Contract Amount: \$42,500

Funding: 100 percent State, Primary funds

Research Objective: To determine the feasibility and cost effectiveness of using standard asphalt mixtures of local aggregates for 1" and 1½" thick surface courses followed by a surface sprinkle treatment of pre-coated hard, durable chips to produce a long lasting non-skid pavement surface.

Project Activities: Preconstruction plans and arrangements were completed. The contract was let on May 23, 1978. This experimental type of resurfacing was applied on old US 30 between Interstate 35 and the City of Nevada.

Progress: The paving and sprinkle treatments have been completed. Appearance is very good with the exception of some corregation which occurred during application. Texture depth testing by the silly putty method has been completed for all test sections.

Reports: Progress Report, October, 1979.

Implementation: This project will be utilized in the evaluation of paving materials and texturing. It will also assist in determining the effectiveness of maintenance practices to increase skid resistance.

Project Number: HR-200

Project Title: Fly Ash In Portland Cement Concrete Pavement-Monona County

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

Principal Investigator: O. D. Ives

Contract Period: February 21, 1978 to completion

Contract Amount: \$16,300

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

Research Objective: 1. To evaluate problems related to shipping, storing, and placing fly ash. 2. To establish a procedure for batching, mixing and placing concrete with specified air content. 3. To demonstrate that concrete of comparable quality can be produced.

Project Activities: Plans and specifications were completed and the project was let early in the spring of 1978. Samples of the fly ash were obtained from the source and a history of sample testing was completed prior to construction.

Progress: Paving on Monona County Road E-54 was completed in June, 1978. Minor modifications were made in the batching system, but no special problems were encountered in the paving operation using conventional equipment. General appearance and workmanship of the concrete appears to be satisfactory. The concrete produced appears to date to be of a comparable quality to standard portland cement concrete.

Reports: Construction Report, December, 1978.

Implementation: Laboratory studies and limited field use has shown that the utilization of fly ash in concrete has resulted in a cost savings and material conservation along with the disposal of a waste product. Results of the use of fly ash in p.c. concrete in Monona County have been encouraging. It was recommended that specifications be developed for portland cement concrete using fly ash for paving and structural work.

Project Number: HR-201

Project Title: Fly Ash in Portland Cement Concrete Pavement-Woodbury County

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

Principal Investigator: C. E. Leonard

Contract Period: March, 1978 to completion

Contract Amount: None (no additional cost)

Research Objective: 1. To determine the problems related to shipping, storing and batching fly ash. 2. To establish procedure for mixing, and placing uniform concrete using fly ash. 3. To demonstrate that concrete of comparable quality can be produced.

Project Activities: The proposed research was incorporated into two bridge replacement projects on Iowa 982. The project includes paving two bridge approach sections at two bridge construction sites.

Progress: Construction on these two bridge replacement projects was completed in October, 1978. No problems were observed in handling or in batching fly ash through a central ready mix plant. Little difference was noted in paving with fly ash mixes as compared to standard concrete mixes.

Reports: Construction Report, May, 1979

Implementation: Fly ash can be used successfully in paving mixes. Quality control test results show that specification air content, slump and flexural strength can be achieved with normal paving operations.

Project Number: HR-202

Project Title: Wind Tunnel Analysis to Determine the Effect of Adjustment in the Adjacent Topography on Drifting Snow at Highway Grade Separations.

Research Agency: Iowa State University

Principal Investigator: S. L. Ring

Contract Period: June 1, 1978 to July 13, 1979

Contract Amount: \$61,151

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

Research Objective: 1. To reproduce blowing and drifting snow using scale models in a wind tunnel. 2. To analyze effects of strategically placed vegetation, snow fences or structures in order to make recommendations for controlling drifting snow at highway grade separations.

Project Activities: A contract agreement was negotiated and model parameters based on highway design criteria were established. A literature search was completed and field interviews to obtain information on drifting snow were conducted.

Progress: Scale models were constructed and tested in the wind tunnel to reproduce snow drifting phenomenon. The model was modified to represent the introduction of plantings and changes in the physical configuration of the adjacent topography. The effects of snow drifting phenomenon were then observed and recommendations for field testing were made.

Reports: Final Report, June, 1979

Implementation: The study will provide design criteria to reduce the economic costs of accidents vehical removal, maintenance operations and travel delay caused by the problem of snow drifting at highway grade separations.

Project Number: HR-203

Project Title: Transverse Joint Sealing with Various Sealants

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

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

Contract Period: July 25, 1978 to December 31, 1983

Contract Amount: \$51,000

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

Research 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.

Project Activities: 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.

Progress: 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 the spring of 1979. Visual observations are being made periodically.

Reports: Progress Report, July, 1979.

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

Project Number: HR-204

Project Title: Safer Construction and Maintenance Practices to Minimize Potential Liability by Counties from Highway Accidents

Research Agency: Iowa State University

Principal Investigator: R. L. Carstens

Contract Period: September 1, 1978 to September 30, 1979

Contract Amount: \$38,335

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

Research Objective: To give county engineers guidance in the selection and implementation of measures that will reduce the potential liability of counties for accidents resulting from alleged imperfections in highway facilities.

Project Activities: A literature search dealing with tort claims for counties has been completed. An analysis of tort claim experience derived from questionnaire responses from 85 counties was also completed. Studies to evaluate blading operations and methods of developing advisory speeds on curves on unsurfaced roads were also undertaken.

Progress: Analysis of data has been completed and a tentative list of recommendations has been circulated to advisory groups for evaluation. Additional suggestions are being solicited.

Reports: A final report is being completed.

Implementation: This study will assist county engineers in establishing guidelines relating to highway construction and maintenance practices, including the use of traffic control devices that will improve highway safety and reduce the potential liability by counties.

Project Number: HR-205

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

Research Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: V. J. Marks

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

Contract Amount: \$3,150

Funding: 100 percent State, Primary funds

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

Project Activities: Approval was granted and specifications were approved for incorporating the special coarse aggregate into two bridge deck overlay projects on Interstate 35 near Ankeny, Iowa.

Progress: 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.

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

Research Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: W. Rippie

Contract Period: April 1, 1979 to June 30, 1980

Contract Amount: \$2,510

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

Research 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.

Project Activities: The materials and supplies have been obtained from various sources and laboratory work is underway. Facilities at the Coal Research Laboratory at the University of West Virginia will be utilized to melt and process materials in the production of the new cement.

Progress: Initial laboratory work has been completed. A group of samples has been forwarded to the West Virginia Laboratory for processing.

Reports: None

Implementation: In view of continued shortages of portland cement, utilization of fly ash, a waste product, will conserve energy and increase cement supply for construction projects.

Project Number: HR-207

Project Title: Feasibility of Wind-Powered Aeration of Rest Area Lagoons

Research Agency: Iowa State University

Principal Investigator: J. L. Cleasby

Contract Period: June 1, 1979 to September 20, 1979

Contract Amount: \$8,870

Funding: 100 percent State, Primary funds

Research Objective: To evaluate the feasibility of using wind-powered equipment to aerate rest area lagoons to permit existing lagoons to accommodate higher seasonal BOD loadings than were intended in the original lagoon design.

Project Activities: Phase I will include an evaluation of load projections on rest area lagoons, lagoon design, seasonal aeration requirements and Iowa DEQ regulations. The design of the lagoons was studied and a survey of the interstate rest areas was conducted.

Progress: The project has been completed. Conclusions indicate certain disadvantages to wind-powered aeration of rest area lagoons, the greatest being the fact that wind speeds are lowest during the time when the need for aeration is the greatest. Also, equipment costs are higher for wind-powered aeration than for conventional equipment. Rest area lagoons will continue to be monitored, particularly those with apparent problems.

Reports: Final Report, September, 1979

Implementation: The results of this study will result in a substantial savings to the Iowa DOT. The savings arises from a change in environmental quality standards developed for municipalities due to the unique loading of rest area lagoons. The change will eliminate the need for some reconstruction.

Project Number: HR-208

Project Title: Alternative Methods of Stabilizing the Degrading Stream Channels in Western Iowa

Research Agency: Iowa State University

Principal Investigator: R. H. Lohnes

Contract Period: June 1, 1979 to September 30, 1980

Contract Amount: \$79,254

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

Research Objective: To develop and evaluate several alternative methods of stabilizing the degrading channels of the streams and gullies in the loess hills of western Iowa.

Project Activities: A comprehensive inventory of grade stabilization structures will be conducted early in the project. A selected number of successful and problem structures will be chosen for detailed documentation and analysis. Phase I will also consist of a review of related work already completed and the effects of freeze-thaw cycles will be studied.

Progress: An inventory of channel stabilization structures is being reviewed and cost data is being collected. Topographic maps, airphotos and plans of structures are being obtained. Collection of soil samples and additional field testing and laboratory work is also underway.

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 the savings of millions of dollars for counties in western Iowa.

Project Number: HR-209

Project Title: Pavement Surface on Macadam Base

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

Principal Investigator: D. J. Lynam

Contract Period: June 26, 1979 to December 31, 1983

Contract Amount: \$100,347

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

Research Objective: To determine the feasibility, economics and performance of placing pc concrete 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 and deterioration of concrete produced with limestone of poor durability characteristics.

Project Activities: Construction and evaluation will be completed on approximately two miles of Adair County Road G-61. Seven different roadway construction procedures will be utilized. A variation in shoulder construction will be incorporated into one section. One mile adjacent to the experimental construction will be included in the evaluation of the research.

Progress: Preconstruction activity has been completed. A photo file record of the existing grade has been completed. Construction will be completed in the fall of 1979.

Reports: None

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

Project Number: HR-210

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

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

Principal Investigator: L. Gladfelter, H. Dolling, G. Albansoder

Contract Period: June 15, 1979 to September 30, 1983

Contract Amount: \$30,072

Funding: 100 percent State, Primary funds

Research Objective: To evaluate the "Swareflex" 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.

Project Activities: Equipment is being selected and purchased. Installation of traffic counting equipment at the designated sites is underway. Deer-vehicle accident records will be maintained for one year prior to the installation of the reflectors. The study areas selected are distributed around the State so as to reflect different driving conditions, traffic volume and deer densities.

Progress: Traffic counters have been installed in each of the designated areas to document changes in traffic volumes during the study period. Records are being maintained on deer-vehicle accidents at all selected sites.

Reports: None

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

Project Number: HR-1008

Project Title: Evaluation of Recycled Asphalt Concrete-Kossuth County

Research Agency: Federal Highway Administration, Iowa Department of
Transportation, Highway Division

Principal Investigator: R. P. Henely

Contract Period: June , 1976 to February, 1980.

Contract Amount: \$30,000

Funding: 100 percent Federal funds

Research Objective: To determine and evaluate the properties of the recycled asphalt, the load bearing capacity and performance of the completed pavement, pollution control capacity of the plant and appurtenances, operational aspects of scarification crushing and processing equipment and the economic viability of recycling asphalt pavements on a large scale.

Project Activities: The old asphalt material was ripped, salvaged and stockpiled for crushing. No serious problems were encountered in the mixing and paving operations. An energy savings was realized in using the recycled asphalt, however, an air pollution problem persisted at the mixing plant in spite of efforts to correct it.

Progress: Visual inspection indicated that the recycled asphalt concrete pavement is performing well. Air pollution requirements were not met on this project, but were achieved in a 1977 project.

Reports: Construction Report, September, 1977.

Implementation: An impressive savings in energy and in the conservation of resources was realized in the completion of this project. More consideration will be given to the recycling of old asphalt pavements in the future.

Project Number: HR-1011

Project Title: Recycling Cass County I-80 Asphalt Concrete

Research Agency: Iowa Department of Transportation, Highway Division

Principal Investigator: R. A. Shelquist

Contract Period: August, 1977 to completion

Contract Amount: \$12,000

Funding: 100 percent Federal funds

Research Objective: 1. To test handling and processing procedures.
2. To develop design criteria. 3. To evaluate performance of this recycled material which was damaged by moisture, temperature and traffic.

Project Activities: Approximately 40,000 tons of asphalt concrete were removed and piled for storage in Cass County. Laboratory tests indicate that the material has considerable value when upgraded with approximately 35% virgin material. Field trial was necessary to verify laboratory findings.

Progress: Approximately 300 tons of this recycled material was placed on a test section of U.S. 169 south of Algona. The salvaged mix was blended with virgin aggregate and placed 1½ inches thick on old portland cement concrete pavement. An inspection was made following one full year of service. Although the surface does have a very dry and somewhat ravelled appearance which may be attributed to low asphalt content, there was no evidence of rutting or shoving from traffic.

Reports: Final Report, December, 1978.

Implementation: In light of test results after one year of experience, it may be concluded that it is feasible to recycle the salvaged asphalt concrete. Laboratory tests and field observation indicate that with certain limitations, a satisfactory and uniform mixture can be produced through recycling procedures.

Project Number: HR-1012

Project Title: Evaluation of Asphalt Sprinkle Treatment to Provide a Non-Skid Surface.

Research Agency: Federal Highway Administration, Iowa Department of Transportation, Highway Division

Principal Investigator: D. D. Jordison

Contract Period: January 18, 1978 to January, 1981

Contract Amount: \$10,000

Funding: 100 percent State, Primary funds

Research Objective: To determine the feasibility and cost effectiveness of using a standard asphalt mixture of local aggregates for surface courses, followed by a sprinkle treatment of non-polishing aggregates to produce a durable, non-skid pavement surface.

Project Activities: During the 1977 construction season, several projects were initiated by the Highway Division of the Iowa DOT using sprinkle applications of high grade aggregate to achieve the desired non-skid surface.

Progress: Several different sprinkle treatment projects using various aggregates were completed during the 1977 construction season. All projects are performing well, although some aggregate loss is evident on certain projects. Periodic field reviews will continue.

Reports: "Sprinkle Treatments", FHWA Interim Report-June, 1978.

Implementation: The sprinkle treatment procedure saves money by utilizing a limited amount of expensive aggregates, while providing a longer lasting pavement texture and improving the frictional coefficients of the pavement.

Project Number: HR-1013

Project Title: Consolidation Monitoring Device

Research Agency: Federal Highway Administration, Iowa Department of
Transportation, Highway Division

Principal Investigator: V. J. Marks

Contract Period: June 1, 1978 to December 1, 1978

Contract Amount: \$11,110

Funding: 100 percent Federal funds

Research Objective: To evaluate the usefulness, accuracy, precision and reproducibility of a device which continuously monitors the consolidation of plastic portland cement concrete pavements under production conditions.

Project Activities: A license to use the CMD was obtained from the U.S. Nuclear Regulatory Commission. It was required that the device be under the direct supervision of a qualified person at all times. Laboratory evaluation and calibration was completed in the Materials Laboratory at the Iowa DOT. The CMD was used during the months of June and July on Iowa 44 in Audubon and Guthrie Counties. Data was collected on over five miles of paving operation. Records on maintenance, operation and a safety log were also maintained. The project has been completed.

Progress: Results of the evaluation testing indicated that in its present state, the CMD is not a reliable instrument. Under field conditions, the air gap is difficult to maintain. Any variation from the prescribed distance for the air gap causes the accuracy of the readings to suffer. Mounting and adjustment problems were also experienced in field testing.

Reports: Final Report, November, 1978.

Implementation: This device, which automatically monitors and records density during pavement construction, may be utilized in allowing strength specifications to be met more easily. However, some modification should be made to either measure the air gap between the sensor head and the concrete surface and compensate for the difference or automatically control the air gap. A modification of this type would improve the accuracy and operation of the CMD unit.