ANNUAL REPORT
of
Iowa Highway Research Board
Research and Development Activities
FY 2014

Attachment to
FY 2014 Annual Report
Research and
Technology Transfer Activities

IHRB
IOWA HIGHWAY
RESEARCH BOARD

IOWADOT

DECEMBER 2014

ANNUAL REPORT
OF
IOWA HIGHWAY RESEARCH BOARD
RESEARCH AND DEVELOPMENT ACTIVITIES

FOR THE
FISCAL YEAR ENDING JUNE 30, 2014

OFFICE OF RESEARCH AND ANALYTICS
(515) 239-1447
www.iowadot.gov/RA

PERFORMANCE AND TECHNOLOGY DIVISION
IOWA DEPARTMENT OF TRANSPORTATION
AMES, IOWA 50010

DECEMBER 2014

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LIST OF ACRONYMS

AASHTO - American Association of State Highway and
APWA - American Public Works Association
ASCE - American Society of Civil Engineers
DOT - Department of Transportation
FHWA - Federal Highway Administration
GIS - Geographic Information System
HMA - Hot Mix Asphalt
HPC – High Performance Concrete
IHRB - Iowa Highway Research Board
ISU - Iowa State University
LiDAR – Light Detection and Ranging
LRFD - Load and Resistance Factor Design
LTAP - Local Technical Assistance Program
LVR - Low Volume Road
MOVITE - Missouri Valley Section of the Institute of Transportation Engineers
NCHRP - National Cooperative Highway Research Program
SUDAS - Statewide Urban Designs and Specifications
TAC - Technical Advisory Committee
TRB - Transportation Research Board
UHPC - Ultra High Performance Concrete
USGS - United States Geological Survey
WMA – Warm Mix Asphalt
SPR - Statewide planning and research
AADT - Annual Average Daily Traffic
RFIDS – Motion Sensing Radio Transponders
CBM – Condition-Based Maintenance
MEMS – Micro Electra Mechanical Sensor
LRFR – load and Resistance Factor Rating
RCB – Reinforced Concrete Box
QA – Quality Assurance
DNR – Department of Natural Resources
FWD – Falling Weight Deflectometer
DCP – Dynamic Cone Penetrometer
NBIS – National Bridge Inspection Standards
OBS – Office of Bridge and Structures
BEC – Bridge Engineering Center
BBR – Bending Beam Rheometer
LOS – Level of Service
VE – Viscoelastic
FEA – Finite Element Analysis
LRFR – Load and Resistance Factor Rating

RESEARCH AND DEVELOPMENT

The Iowa DOT 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 "Iowa Highway Research Board Research and Development Activities FY2014" is submitted in compliance with Sections 310.36 and 312.3A, Code of Iowa, which direct the submission of a report of the Secondary Road Research Fund and the Street Research Fund, respectively. It is a report of the status of research and development projects in progress on June 30, 2014. It is also a report on projects completed during the fiscal year beginning July 1, 2013 and ending June 30, 2014. Detailed information on each of the research and development projects mentioned in this report is available from the Office of Research and Analytics, Performance and Technology Division, Iowa Department of Transportation. All approved reports are also online for viewing at: **www.iowadot.gov/research/reports.html**.

THE IOWA HIGHWAY RESEARCH BOARD

In developing a progressive, continuing and coordinated program of research and development, the Iowa DOT is assisted by the IHRB. This advisory group was established in 1949 by the Iowa State Highway Commission to respond to the research denoted in Sections 310.36 and 312.3A of the Code of Iowa.

The Research Board consists of 15 regular members: seven Iowa county engineers, four Iowa DOT engineers, one representative from Iowa State University, one from The University of Iowa, and two engineers employed by Iowa municipalities. Each regular member may have an alternate who will serve at the request of the regular member. The regular members and their alternates are appointed for a three year term. The membership of the Research Board for FY14 is listed in Table I and II.

The Research Board held several regular meetings during the period from July 1, 2013, through June 30, 2014. Suggestions for research and development were reviewed at these meetings and recommendations were made by the Board.

Members of the IHRB are serious about the future of transportation. Understanding that every research project has the potential to strengthen the infrastructure, save lives, time and precious resources, they work hard to make sure new methods, technologies and materials are developed efficiently and economically for application in the real world. **The IHRB has received national attention as a leader in transportation research implementation.**

TABLE 1: Jan 1 – Dec 31 2013 IOWA HIGHWAY RESEARCH BOARD

Member	Term Expires	Alternate
Ahmad Abu-Hawash, Chair Chief Structural Engineer Iowa DOT - Bridges and Structures 800 Lincoln Way Ames, IA 50010 (515) 239-1393 Email: Ahmad.Abu-hawash@dot.iowa.gov	12-31-15	Dave Claman Preliminary Bridge Engineer Iowa DOT - Bridges and Structures 800 Lincoln Way Ames, IA 50010 (515) 239-1487 Email: David.Claman@dot.iowa.gov
Kevin Jones Materials Testing Engineer Iowa DOT 800 Lincoln Way Ames, IA 50010 (515) 239-1237 Email: Kevin.Jones@dot.iowa.gov	12-31-15	Scott Schram Bituminous Materials Engineer Iowa DOT 800 Lincoln Way Ames, IA 50010 (515) 239-1604 Email: Scott.Schram@dot.iowa.gov
Vicki Dumdei District 2 Engineer Iowa DOT 1420 Fourth St. S.E. Mason City, IA 50401-4438 (641) 422-9465 Email:Victoria.Dumdei@dot.iowa.gov	12-31-13	David Little Assistant District 2 Engineer Iowa DOT 1420 Fourth St. S.E. Mason City, IA 50401-4438 (641) 422-9464 Email: David.Little@dot.iowa.gov
Robert Younie Director of Maintenance Iowa DOT 800 Lincoln Way Ames, IA 50010 (515) 239-1589 Email: Bob.Younie@dot.iowa.gov	12-31-14	Dan Sprengeler Work Zone Traffic Control Engineer Office of Traffic and Safety 800 Lincoln Way Ames, IA 50010 (515) 239-1823 Email: Dan.Sprengeler@dot.iowa.gov
Sarah Okerlund City Hall 515 Clark Avenue Ames, Iowa 50010 (515) 239-5169 Email: sokerlund@city.ames.ia.us	12-31-14	Dan Whitlow City Engineer 1225 6th Avenue – Suite 200 Marion, Iowa 52302 (319) 713-6340 Email: DWhitlow@cityofmarion.org
Ronald Knoche City Engineer 410 E. Washington Street Iowa City, IA 52240-1825 (319) 356-5138 Email: Ron-Kknoche@iowa-city.org	12-31-15	Bruce Braun Street Maintenance Administrator 216 SE 5th Street Des Moines, IA 50309 (515) 237-1371 Email: BABraun@dmgov.org
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TABLE 2: Jan 1 – Dec 31 2014 IOWA HIGHWAY RESEARCH BOARD

Member	Term Expires	Alternate
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RESEARCH AND DEVELOPMENT PROJECTS

Proposals for research and development are reviewed by the Iowa Highway Research Board. The Board's recommendations are transmitted to the director of the Performance and Technology Division of the Iowa Department of Transportation. Expenditure of research and development funds is then authorized on an individual project basis.

These expenditures may be charged to the Primary Road Research Fund, Secondary Road Research Fund or the Street Research Fund, depending on which road system will benefit from the project. If more than one jurisdiction's roads share in benefits, the costs are shared.

Table III is a record of expenditures for research and development made during the fiscal year ending June 30, 2014. Total expenditure was $1,606,164.14.

IN-HOUSE RESEARCH AND DEVELOPMENT

Research and development projects performed by Iowa DOT personnel are termed "in-house" projects. These projects may involve other departmental and field personnel in addition to personnel from The Office of Research and Analytics, Operations Research Section. In many instances, personnel from other offices are designated as a project principal investigator, which means that they have a major role in the planning, performance and analysis of the research.

Contract research funds may be used for material and equipment costs for in-house research, but cannot be used for salary or personal expenses of the participating personnel. Consequently, the contract amounts for in-house projects are relatively small. The Office of Research and Analytics, wishes to express its appreciation to other offices for their assistance.

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

The NCHRP was organized by the AASHTO. The program is administered by the TRB, a branch of the National Academy of Sciences.

The purpose of NCHRP is to provide the funds and direction for research in highway matters of national concern. The program is funded annually by all fifty states in an amount equal to 5.5% of the federal aid allocated to the states for State Planning and Research (SPR). 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 are conducted annually and funded from the Secondary Road Research Fund as Non Contract Engineering Studies. The Office of Systems Planning conducted traffic counts in 24 counties during fiscal year 2014 as part of the Annual Traffic Count Program. This activity consisted of 1660 portable recorder classification counts and 3570 portable recorder volume counts. Traffic volumes from these counts are used to develop Motor Vehicle Traffic Flow Maps for each county showing the (AADT) on specific road sections within each county.

Secondary roads geometrics and current condition inventories were requested from all 99 counties. This data provides county engineers, highway engineers, planners and administrators with essential information needed to determine design standards, to systematically classify highways, and to develop programs for improvement in maintenance of secondary roads.

SECONDARY ROAD RESEARCH FUND

Section 310.34 of the Iowa Code authorizes the Iowa Department of Transportation to set aside each year an amount not to exceed 1½% 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 fund was designated to finance engineering studies and research projects. The Iowa Department of Transportation accounting procedure for the Secondary Road Research Fund is based on obligations for expenditures on research projects and not the actual expenditures.

The fiscal year 2014 financial summary is:

Beginning Balance 7-1-13		$ 1,076,123.26
Receipts		
State Road Use Tax Fund		
(1½% of receipts)	$1,276,048.98	
Federal Aid Secondary		
(1½% of receipts)	0.00	
Research Income	0.00	
Sub-Total		$1,276,048.98
Total Funds Available		$2,352,172.24
Obligation for Expenditures		
Obligated for		
Contract Research	$784,973.29	
Non-Contract		
Engineering Studies	$85,664.39	
Total Expenditures		$870,637.68
Ending Balance 6-30-14		$1,481,534.56

STREET RESEARCH FUND

The Street Research Fund was established in 1989 under Section 312.3A of the Iowa Code. Each year $200,000 is set aside from the street construction fund for the sole purpose of financing engineering studies and research projects. The objective of these projects is more efficient use of funds and materials available for construction and maintenance of city streets. The Iowa Department of Transportation accounting procedure for the Street Research Fund is based on obligations for expenditures on research projects and not the actual expenditures. The fiscal year 2013 financial summary is:

Beginning Balance (7-1-13)	$128,110
FY14 Street Research Funding	$200,000
Total Funds Available for Street Research	$328,110
Total Obligated for Expenditure FY13	$195,784
Ending Unobligated Balance 6-30-14	$132,326

PRIMARY ROAD RESEARCH FUND

The Primary Road Research Fund is sourced from non-obligated funds of the Primary Road Fund. These funds can only be expended on Iowa DOT projects for which the funds were reserved, such as contracted research and project-specific research supplies or equipment. An estimate of Primary Road Research Fund expenditures is made prior to the beginning of each fiscal year. The amount expended for contract research from the Primary Road Research Fund for FY14 was $255,326.05 and the estimate for FY15 is $750,000.

TR-665	Mitigation of Sedimentation at Multi-Box Culverts
TR-666	Investigation of Field Corrosion Performance and Bond/Development Length of Galvanized Reinforcing Steel
TR-667	Validation of Gyratory Mix Design in Iowa
TR-668	Impact of Curling and Warping on Concrete Pavement
TR-669	Statistical Summary of Selected Iowa Streamflow Data
TR-670	Iowa DOT Library Services, Collection, & Technology Assessment
TR-671	Performance Monitoring of Boone County Expo Pavement Sections: (Phase III)
TR-672	Autonomous Sensing Skin for Detection and Localization of Fatigue Cracks
TR-673	Design and Performance Verification of a Bridge Column/Footing/Pile System for Accelerated Bridge Construction (ABC)
TR-674	Evaluation of Otta Seal Surfacing for Low-Volume Roads In Iowa
TR-675	Assessment of PCC Concrete Setting Time and Joint Sawing
TR-676	Impacts of Internally Cured Concrete Paving on Contraction Joint Spacing
TR-677	Embankment Quality and Assessment of Moisture Control Implementation
TR-678	Flood-Estimation Comparisons for Small Drainage Basins in Iowa
TR-679	Upgrading Bridge Rails on Low Volume Roads in Iowa
TR 680	Laboratory and Field Evaluation of a Composite Glue-Laminated Girder to Deck Connection

16 Projects Initiated

PROJECTS COMPLETED DURING FY 2014

The following projects were completed during FY 2014 and project Final Reports were approved by the Iowa Highway Research Board:

TR-619   Development of Self-Cleaning Box Culvert Design - Phase II

TR-622   Maintenance and Design of Steel Abutment Piles in Iowa Bridges

TR-632   Low Cost Rural Road Surface Alternatives

TR-639   Development of Bio-Based Polymers for Use in Asphalt

TR-646   Development of Bridge Inspection, Load Rating & Maintenance Manuals

5 Projects Completed and Approved

Table III

FINANCIAL SUMMARY OF RESEARCH AND DEVELOPMENT PROJECT EXPENDITURES

July 1, 2013 to June 30, 2014

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

Project #	Project Title	Primary Road Research Fund Expenditures	Secondary Road Research Fund Expenditures	Street Research Fund Expenditures	Total Expenditures
HR140	Collection & Analysis of Streamflow Data		151,865.00	43,390.00	195,255.00
HR296	Local Technical Assistance Program (LTAP)		58,469.63	11,722.00	70,191.63
HR375	Transportation Research Board Education for County Engineers		8,759.62		8,759.62
HR1027	Secondary Road Research Coordinator (Annual Funds)		81,573.19		81,573.19
TR519	Developing Flood-Frequency Discharge Estimation Methods for Small Drainage Basins in Iowa		4,131.57	3,135.00	7,266.57
TR589	Updating U.S. Precipitation Frequency Estimates for the Midwestern Region	8,664.00	68,968.00	13,795.00	91,427.00
TR613	Study of the Impacts of Implements of Husbandry on Iowa Bridges	753.41			753.41
TR615	Connection Details and Field Implementation of UHPC Piles - Phase II: Use of Ultra-High Performance Concrete in Geotechnical and Substructure Applications	7,206.10			7,206.10
TR617	An Adaptive Field Detection Method for Bridge Scour Monitoring Using Motion-Sensing Radio Transponders (RFIDs)	429.00	33,418.00	6,683.00	40,530.00
TR619	Development of Self-Cleaning Box Culvert Design - Phase II - additional funding for field test approved 6/25/10 $9679	643.87	2,408.33		3,052.20
TR620	Update of RCB Culvert Standards to LRFD Specifications	3,626.92	23,388.21	10,142.51	37,157.64
TR622	Maintenance and Design of Steel Abutment Piles in Iowa Bridges		663.10		663.10
TR625	Improving Accuracy of Deflection & Camber Predictions for Prestressed Concrete Bridge Girders	39,344.75			39,344.75
TR626	Optimization of Snow Drifting Mitigation & Control Methods for Iowa Conditions		123,443.87	10,409.47	133,853.34
TR628	Alkali Content in Fly Ash Measuring & Testing Strategies for Evaluating Compliance	11,118.49		1,365.23	12,483.72
TR631	Automation of DEM Cutting for Hydrologic/Hydraulic Modeling	1,561.76			1,561.76
TR634	Pilot Construction for Granular Shoulder Stabilization	3,367.77			3,367.77
TR635	Warm Mix Asphalt Phase II: Evaluation of WMA Quality Assurance Testing Protocols	2,009.04			2,009.04
TR636	Bridge Damage Detection: Integration of Structural Health Monitoring System Concepts and Components – A Statewide Collaboration	81,847.35			81,847.35
TR637	Development of a Wireless MEMS Multifunction Sensor System and Field Demonstration of Embedded Sensors for Monitoring Concrete Pavements	34,585.25			34,585.25

ID	Project				
TR640	Optimizing Pavement Base, Subbase, and Subgrade Layers for Cost and Performance on Local Roads		46,146.35		46,146.35
TR641	Reflective Crack Mitigation Guide for Flexible Pavements	12,148.58			12,148.58
TR643	Evaluating Roadway Subsurface Drainage Practices	11,517.76			11,517.76
TR644	Development of Cost-Effective Timber Bridge Repair Techniques		30,000.00	15,000.00	45,000.00
TR645	Development and Integration of Advanced Timber Bridge Inspection Techniques for NBIS				-
TR646	Development of Bridge Inspection, Load Rating & Maintenance Manuals		22,628.85	22,501.57	45,130.42
TR649	Workshops on the Application of Load and Resistance Factor Design of Driven Piles in Iowa				-
TR654	Development of a Subgrade Drainage Model for Unpaved Roads		61,377.00	12,276.00	73,653.00
TR655	Updating the Iowa Culvert Hydraulics and Iowa Bridge Backwater Software		20,108.25		20,108.25
TR657	Evaluation of Low-Cost Signalized Intersection Red Light Running Countermeasures in Medium to Large Communities in Iowa		48,257.99	11,667.00	59,924.99
TR658	Development of Quality Standards for Inclusion of High Recycled Asphalt Pavement Content in Asphalt Mixtures - Phase 2		82,727.46	25,000.00	107,727.46
TR659	Development of Asphalt Dynamic Modulus Master Curve Using Falling Weight Deflectometer (FWD) Measurements		29,809.48	8,326.00	38,135.48
TR660	Investigation of Negative Moment Reinforcing in Bridge Decks		20,176.94	16,662.00	36,838.94
TR661	Evaluate the Need for Longitudinal Median Joints in Bridge Decks on Dual Structures		12,758.16	19,976.00	32,734.16
TR662	Evaluating Roadway Subsurface Drainage Practices – Phase II		68,842.55	21,146.00	89,988.55
TR663	Short Span County Bridge Standards		18,988.92	7,694.00	26,682.92
TR664	Low Cost Rural Surface Alternatives: Demonstration Project		48,930.26	20,329.00	69,259.26
TR669	Statistical Summary of Selected Iowa Streamflow Data		5,133.00	9,292.00	14,425.00
TR670	Iowa DOT Library Services, Collection, & Technology Assessment		7,685.19	2,417.00	10,102.19
TR675	Assessment of PCC Concrete Setting Time and Joint Sawing			2,444.18	
TR676	Impacts of Internally Cured Concrete Paving on Contraction Joint Spacing			4,178.06	
TR677	Embankment Quality and Assessment of Moisture Control Implementation			7,130.15	
	Project Total	218,824.05	1,080,658.92	306,681.17	1,606,164.14

HR-140

Agency:
United States Geological Survey

Principal Investigator:
Rob Middlemis-Brown

Research Period:
July 1, 1967 to September 30, 2014
Annual Renewal

Research Board Funding:
$260,340

Funding Source:
45% Federal funds, 55% State – 40% Primary funds 50% Secondary funds 10% Street funds

Collection and Analysis of Stream Flow Data

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

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

Reports: Annual Report, Flood Event Reports

Implementation: Flood frequency and discharge data is used for sizing hydraulic structures in Iowa. Structure design agencies use this data for their designs.

A researcher from the U.S. Geological Survey measures the high water mark on the Cedar River at the Janesville stream gage on June 10, 2008. The record discharge for this site was set that day with streamflow measured at 53,400 cfs. *Photo: U.S. Geological Survey*

HR-140L

Agency:
United States Geological Survey

Principal Investigator:
Rob Middlemis-Brown

Research Period:
October 1, 2013 – September 30, 2014

Research Board Funding:
$433,900

Funding Source:
40% Federal Funds, 60% State Funds – 83% Secondary funds and 17% Street funds

Request for Continuation of HR-140: "Collection and Analysis of Streamflow Data"

Objective: The continuation of HR-140 will ensure that streamflow data for Iowa are accurate, continuing the benefits this project has provided since 1968. The project will conduct, maintain, and publish hydrologic research that will provide engineers with the information they need to design effective bridges and culverts.

The objectives of the proposed research are to:
- Operate, maintain, and publish streamflow data for 21 continuous-record streamgages located throughout the State.
- Operate, maintain, and publish high-flow data for 80 partial-record (crest-stage) streamgages located throughout the State. Review and refine the existing crest-stage network to improve efficiency and reduce costs. Approximately eight non-real time crest-stage sites that are not producing beneficial peak-flow data to this study will be discontinued and those funds will be reprogramed to upgrade other sites to real-time.
- Collect and publish water-surface profiles, and storm and flood description information, for significant flood events of interest to the IDOT. Publish compilation report summarizing all flood-profile reports published by the USGS between 1963 and 2012.

Reports: None

Implementation: Engineers design bridges and culverts on flood plains for which damage may be incurred by occasional floods of varying magnitude. By using flood-frequency analyses to design structures on flood plains to either a specific probability or a specific calculated risk, such as a 1- or 2-percent chance that a given flood magnitude will be exceeded in any one year, engineers are able to standardize the risk factors involved with estimating flood-frequency discharges.

HR-296

Agency:
Iowa State University

Principal Investigator:
Keith Knapp

Research Period:
October 1, 1986 to December 31, 2014

Research Board Funding:
$145,000

Funding Source:
Federal funds, 15.4% Safety funds, State Funds, Workshop income funds State – 40% Primary funds 50% Secondary funds 10% Street funds

Iowa State University Local Technical Assistance Program (LTAP)

Objective: Assist Iowa's local governments with growing demands on local roads, streets, bridges, and public transportation. The center provides technical and managerial assistance to Iowa's local transportation officials through a variety of programs.

Progress: The current phase of the program is focusing on the following key areas to further its outlined goals:
- Publish *Technology News* newsletters
- Conduct training courses and workshops
- Distribute publications
- Provide service and information to users
- Present transportation safety information to rural communities by employing a Transportation Safety Circuit Rider

Reports: Newsletters, Annual Report

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.

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HR-375

Agency:
Iowa Department of
Transportation,
Performance and
Technology Division

**Principal
Investigator:**
Vanessa Goetz

Research Period:
November 1, 1994
to on-going

**Research Board
Funding:**
$87,400

Funding Source:
100% State - 100%
Secondary funds

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Transportation Research Board Education for County Engineers

Objective: Annually send county engineers to the TRB Annual Meeting in Washington, D.C., for research education. County engineers selected are generally those starting their term as regular members of the IHRB. Attendance at the TRB Annual Meeting gives county engineers serving on the IHRB a better understanding of research at a national and international level. Additional benefits may be gained as the county engineers begin to develop ideas for research from their experience at the TRB meeting.

Progress: Between 1995-2014, 32 County engineers have received funding through IHRB to attend the Annual TRB meeting in Washington, D.C.

Reports: None

Implementation: County engineers who have attended the conference say it is a highly valuable experience that educates and encourages them to better serve their counties and the IHRB.

Dr. Martin Wachs, Director, Transportation, Space and Technology Program, Rand Corporation, delivers the Thomas B. Deen Distinguished Lecture during TRBs 88th Annual meeting in Washington, D.C. on January 11, 2010.
Photo: Cable Risdon, Transportation Research Board

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TR-613

Agency:
Iowa State University

Principal Investigator:
Terry J. Wipf

Research Period:
January 25, 2010 – June 30, 2015

Research Board Funding:
$153,590

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

Study of the Impacts of Implements of Husbandry on Iowa Bridges

Objective: The objective of this study is to determine how the implements of husbandry distribute their load within a bridge structural system and to provide recommendations for accurately analyzing bridges for their loading effects. To achieve this objective the distribution of live load and dynamic impact effects for different types of agricultural vehicles will be determined by load testing and evaluating two general types of bridges. The types of equipment studied will include but is not limited to: grain wagons/grain carts, manure tank wagons, agriculture fertilizer applicators, and tractors. Once the effect of these vehicles has been determined, recommendations for the analysis of bridges for these non-traditional vehicles will be developed.

Progress: The project team has completed the development of the DF and DAF equations for both skewed and straight bridges, which were presented to the TAC. The team then began developing and has now made significant progress on the notional vehicles for implements of husbandry based on the collection of vehicles and bridges used in previous parts of the study. These vehicles were presented to the TAC, and the team will be working to address the questions and comments received.

Reports: None

Implementation: Engineers involved in the rating/evaluation of bridges for live load performance of bridges will be able to immediately be able to use the resulting information as the results will be given in a format commonly used by practicing engineers. The results of this study will most likely supplement existing standards by providing information/guidance not previously available.

TR-614

Agency:
Iowa State
University

**Principal
Investigator:**
Sri Sritharan

Research Period:
November 20, 2009
–
August 31, 2012

**Research Board
Funding:**
$50,000

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

Structural Characterization of a UHPC Waffle Bridge Deck and its Connections

Objective: The objectives of this proposed research are to perform structural characterization of the UHPC waffle bridge deck panel designed for the bridge in Wapello County and its critical connections, and evaluate the system performance and ride ability of the panel top surface.

Progress: The Phase 1 Report, which is on the laboratory testing of the UHPC waffle deck, has been completed. The feedback received on the report from TAC and representatives of FHWA's Highway for LIFE program have been incorporated. FHWA has approved the final version of the Phase 1 report, thereby giving authorization for the production of UHPC panels for the field implementation which will take place in the next phase. The final report to IHRB will combine both Phase I and Phase II studies.

Construction of the prototype bridge was delayed, but was completed in fall 2011. Field testing of the Wapello County Bridge was completed in March 2012. The draft of the Phase-II report presenting the analysis and results from the field testing data was submitted to Coreslab Structures Inc. for review comments. Following analysis of field data, the draft version of the Final report to IHRB has been completed. The final report is anticipated to be completed by September 2014.

Reports: None

Implementation: The research findings of the project will be disseminated to designers and practitioners in the fields of structural and construction engineering.

TR-615

Agency:
Iowa State
University

**Principal
Investigator:**
Sri Sritharan

Research Period:
December 17, 2009
–
December 31, 2014

**Research Board
Funding:**
$210,000

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

Connection Details and Field Implementation of UHPC Piles - Phase II: Use of Ultra-High Performance Concrete in Geotechnical and Substructure Applications

Objective: The objectives chosen for the next phase of the project are to: 1) establish and test connection details to extend the length of UHPC piles in the field; 2) develop and test suitable details that can be used to connect the UHPC pile to concrete pile cap as well as to bridge abutment; 3) study a UHPC pile behavior as part of a bridge foundation in the field and compare its behavior to that of a steel H pile, and 4) develop a preliminary geotechnical design methodology.

Progress: Implementation problems have led to further project delay. Field evaluation has been impeded by malfunctioning of the data acquisition system. New equipment has been installed and data collection has now resumed. The team needs time to collect additional data, pushing the projected completion date to December 31, 2014.

Reports: None

Implementation: This research will contribute to establishing a cost-effective, durable pile for bridge infrastructure. The proposed laboratory tests will allow UHPC piles to be effectively extended without causing any construction delays, while the connection tests will establish details for anchoring the pile into pile caps and abutments, which may also be used for steel piles. The planned fields tests will not only confirm the expected behavior of the UHPC piles under real-world loading conditions, but will also create unique data that will enable preliminary evaluations to be completed on LRFD design of UHPC piles, examination of the effects of setup, and understanding the potential benefits of construction control for this pile type.

TR-617

Agency:
The University of Iowa

Principal Investigator:
Thanos Papanicolaou

Research Period:
June 1, 2010 – February 28, 2014

Research Board Funding:
$210,967

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

An Adaptive Field Detection Method for Bridge Scour Monitoring Using Motion-Sensing Radio Transponders (RFIDs)

Objective: The objective of this project is to utilize RFIDS on fully adaptive bridge monitoring and residual life prediction to minimize the problems inherent in human inspections of bridges. This will include an integrated CBM framework, integrating RFID sensors and sensing architecture for in-situ scour monitoring of critically scoured bridge structures. This will provide real-time state awareness datasets that can be used in making decisions on downtime, repair cost, and functionality.

Progress: The initial tasks have been completed. The project was extended until February 28, 2014. A request for an additional $40,101 was approved by the IHRB for the following additional tasks:
1. Improve the waterproofing of the newly developed transponders
2. Incorporate a MEMS inclinometer to the transponders to enhance the "folding chain" method for bridge scour depth estimation.
3. Incorporate the magnetic and dielectric properties of the river bed material into the software

Reports: July 25, 2014

Implementation: An RFID system fitted with data telemetry equipment can provide the ability to collect and transmit data to a maintenance office. Remote monitoring could mitigate the inefficiencies and dangers inherent in the current practices, as well as provide early warning of impending bridge failure and the ability to track long-term degradation as a result of scouring.

TR-619

Agency:
The University of Iowa

Principal Investigator:
Marian Muste

Research Period:
April 1, 2010 – September 30, 2013

Research Board Funding:
$156,159

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

Development of Self-Cleaning Box Culvert Design - Phase II

Objective: The overall objective of this project is to identify and/or develop methods for constructing—or retro-fitting—box culverts so that the typical flow through a culvert will clean the culvert's entrance area and barrels and keep the structure performing well with little or no maintenance. The new phase of the study will include, but not be limited to, preparing the implementation phase for the self-cleaning design at selected sites in Iowa and continue the multi-prong research on self-cleaning designs for other types of culverts, besides the 3-box culvert investigated in TR 545.

Progress: The routine monitoring at the Hwy 1 three-box culvert is ongoing. A real-time web camera is in place for continuous monitoring of the sedimentation development and a real-time stream-gage sensor is also operating continuously for flow monitoring. This project is now complete.

Reports: February 2, 2014

Implementation: The primary products of the project would be a practical report that provides design layouts and guidance for self-cleansing methods for use for new culverts and for retrofitting to existing culverts known to have a sedimentation problem. The report prepared will be formatted in a comprehensive and well-illustrated manner that directly helps engineers to select the self-cleaning method best suited for a culvert site.

TR-622

Agency:
Wiss, Janey, Elstner and Associates (WJE)

Principal Investigator:
Wade Clarke

Research Period:
August 1, 2010 – February 28, 2014

Research Board Funding:
$134,442

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

Maintenance and Design of Steel Abutment Piles in Iowa Bridges

Objective: The desired outcome of this research will yield:
1. Methods for addressing the problem of pile corrosion in existing bridges, and
2. A cost effective design methodology to prevent steel pile corrosion from occurring in new bridges in the future.

In addressing cost effective methods to prevent steel pile corrosion in new bridges, corrosion protection strategies will be developed that can be readily incorporated into contract specifications. These methods can be used and evaluated on upcoming bridge construction projects where steel pile corrosion is a concern.

Progress: This project is now complete.

Reports: 3/28/2014

Implementation: The project recommendations can be immediately implemented as changes to bridge construction specifications and specifications in maintenance contracts for existing structure repairs or preventive maintenance. Further, the work will provide a basis to develop recommendations to Iowa DOT maintenance staff to assist with optimizing the maintenance of bridge foundations.

TR-626

Agency:
The University of Iowa

Principal Investigator:
George Constantinescu

Research Period:
October 15, 2010 – March 31, 2015

Research Board Funding:
$151,430

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

Optimization of Snow Drifting Mitigation & Control Methods for Iowa Conditions

Objective: The overarching goal of this proposal is to optimize the design of passive snow-control measures for Iowa roadways such that the impact of drifting on the roads is minimized or eliminated. The focus of the research will be on providing optimized solutions for limited-area right-of-ways and topographies which favor snow drifting on roadways. This design optimization should result in cost-effective solutions to the snow drift problem that can be tailored for weather and road conditions that are the most common for the Iowa environment.

Progress: As part of this study, a novel methodology based on field monitoring of snow fences, field measurements of snow deposit profiles and numerical simulations was developed to assess the efficiency and improve the design of snow fences. The novel methodology was implemented for plastic snow fences that are commonly used on Iowa's roads. The study showed that the use of plastic snow fences with a porosity of 30% and a nondimensional bottom gap of about G/H=0.2-0.25 is a better option compared to the standard design used by the IDOT (fences with P=50% and G/H=0.1-0.2). The newly proposed fence design can store more snow over less distance from the fence, can work in more severe storm events and can be used with narrower rights of ways compared to the standard design used by the IDOT.

Reports: None

Implementation: A series of practical recommendations will be compiled by the project team to include the findings of the study in the Iowa snow fence design guidelines and illustrate the lifecycle cost benefits resulting from the new design implementation. The test cases and set up of the numerical model will be made available to IDOT for future use in new situations where the space constraints and local topography are of concern for the design of snow fences.

TR-628

Agency:
Iowa State University

Principal Investigator:
Scott Schlorholtz

Research Period:
January 1, 2012-
March 31, 2015

Research Board Funding:
$156,091

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

Alkali Content in Fly Ash Measuring & Testing Strategies for Evaluating Compliance

Objective: The objectives of this research project are as follows:
1. Determine if and at what content level fly ash with soda dosing has increased potential for alkali silica reactivity (ASR) as well as any other potential performance impacts in the concrete both during mixing and placing as well as long-term (good or bad).
2. Evaluate field concrete containing high-alkali fly ash and moderately reactive fine aggregate to see if ASR-related distress has occurred.
3. Determine a better method for determining available alkali in fly ashes with soda dosing. The method should be relatively simple and rapid in order to provide a QC tool for the fly ash marketer and QA test for the DOT. A specification content limit or performance level should be determined and recommended.
4. Perform a literature review and/or a survey to determine if there are other materials and methods for emission control that may impact the mid-west power plants and their fly ash chemistry.

Progress: Literature survey, field site selection, pavement survey, and material selection for lab studies have all been completed. Petrographic examinations of cores have begun. Additional core sites were added to the project, extending the examination timeline into 2014. Lab testing has been conducted and the chemical testing and mortar bar expansion are complete. Rapid mortar bar expansion testing is still in progress.

Reports: None

Implementation: The primary benefit from this research project will consist of an improved procedure for rapidly determining or calculating the available alkali content of fly ash. This will help Iowa DOT engineers to avoid using high-alkali fly ash in projects that could be susceptible to ASR. The improved procedure should also be less expensive to conduct; and hence, can be performed on a higher frequency to provide (QA) information on fly ash.

TR-631

Agency:
Iowa State University

Principal Investigator:
Brian Gelder

Research Period:
April 1, 2011 –
December 31, 2014

Research Board Funding:
$73,873

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

Automation of Digital Element Model (DEM) Cutting for Hydrologic/Hydraulic Modeling

Objective: The primary objectives for this project are:
1. Develop and program algorithms to enforce fine scale drainage on LiDAR DEMs for the state
2. Accurately enforce drainage on catchments larger than 24 acres in conjunction with the Iowa DNR and Iowa Institute for Hydraulic Research

Progress: Model is essentially complete; programming is complete other than minor bug fixes. Final report writing is more than 30% complete and project continues on track. Two No-cost Extensions have been granted to assure accuracy and total completion, with a projected completion date of December 31, 2014.

Reports: None

Implementation: These DEMs will be used by bridge and culvert engineers during initial design as well as by city and county engineers to correctly contributing area and the hydrologic characteristics of the contributing area as they design water conveyance structures. The actual algorithms for DEM enforcement are not likely to be used by the practicing engineer or administrator but will likely be used by DOT GIS professionals to support LiDAR database maintenance.

TR-632

Agency:
Iowa State University

Principal Investigator:
David White

Research Period:
July 1, 2011 –
July 30, 2013

Research Board Funding:
$50,000

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

Low Cost Rural Road Surface Alternatives

Objective: The proposed objectives of this research project are to:
1. Conduct a comprehensive literature survey of the state of practice for granular surface road construction with respect to freeze/thaw damage resistance
2. Develop recommendations with respect to conducting a phase 2 study to demonstrate various technologies.

Progress: This project is now complete. Phase II Demonstration project is now underway (TR-664).

Reports: December 12, 2013

Implementation: The benefits from this project will be to provide improved knowledge in the state-of-the practice for granular surface stabilization. The project will result in improved decision making and investment.

TR-637

Agency:
Iowa State University

Principal Investigator:
Halil Ceylan

Research Period:
Dec 2, 2013 – May 31, 2015

Research Board Funding:
$248,960

Funding Source:
100% State - 83% Secondary funds and 17% Street funds

Development of a Wireless MEMS Multifunction Sensor System and Field Demonstration of Embedded Sensors for Monitoring Concrete Pavements

Objective: Wireless multi-sensor networks are promising in that they have the potential to monitor structural health, supporting efficient operation and maintenance of civil infrastructure through simultaneous measurement of multiple properties. The primary objectives of the proposed research are twofold: 1) Develop a wireless MEMS multifunction sensor (WMS) system capable of real-time, remote monitoring of strain, moisture content, and temperature in pavement concrete, 2) Deploy some of the promising off-the-shelf RFID tags and sensors developed for monitoring concrete pavements in a live field project.

Progress: The research efforts during this quarter as well as accomplishments of past quarters were presented in the TAC meeting held on 09/30/2014. There were several discussions presented on the reliability of the sensors in the harsh construction/field environment. The project team also noted that hardly any commercial off-the-shelf (COTS) MEMS based moisture/strain sensors is available for pavement applications although a number of COTS MEMS sensors are available for automotive and other industries. Also, existing challenges were highlighted. The presentation focused on MEMS sensor development under three broad categories: high-sensitivity relative humidity/moisture MEMS sensor; flexible piezoresistive MEMS strain sensor; and flexible electromagnetic strain sensor.

Reports: None

Implementation: Wireless transmission of temperature data to construction staff can directly to alert them to freezing or elevated curing temperatures; development of future concrete strength forecasting models; monitor cold or hot weather effects on mix designs using certain materials, strength gain in concrete bridges, etc.; characterize early-age PCC curling behavior, etc.

Measurement of localized strain will be useful for pavement early damage detection and future condition evaluation. The strains measured by the proposed WMS could be used to estimate the remaining fatigue life using Miner's hypothesis in the context of mechanistic-empirical pavement design.

TR-639

Agency:
Iowa State University

Principal Investigator:
Chris Williams

Research Period:
November 22, 2011 – April 30, 2013

Research Board Funding:
$149,958

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

Development of Bio-Based Polymers for Use in Asphalt

Objective: The objectives of this project are to:
- Identify the most promising polymerization chemistries for forming linear-chain polymers from vegetable oils.
- Identify the triglycerides most amenable to such polymerization and collaborate with plant scientists to identify/develop agricultural feedstock best suited to express these.
- Develop the structure-property relationships crucial to the use of soybean-oil based thermoplastics in applications currently dominated by petrochemcially-derived polymers.

Progress: This project is now complete

Reports: February 2, 2014

Implementation: The benefits of this research are potentially utilizing Iowa source materials (e.g. soybean oil) for producing biopolymers for use in Iowa asphalt binders. Current market analysis illustrates that the material cost of the biopolymers is 40 percent lower than using butadiene with additional savings being provided via lower production costs. These lower costs will translate into lower costs of polymer modified asphalt. The handling of vegetable oils in producing the bioelastomers and subsequent linking with styrene is also much safer and has less impact on the environment. This should also create improved economic opportunities for soybeans resulting in economic value to the State of Iowa and maintaining soil qualities through a balanced crop rotation.

TR-640

Agency:
Iowa State University

Principal Investigator:
Tom Cackler

Research Period:
November 22, 2011 – December 31, 2014

Research Board Funding:
$150,000

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

Optimizing Pavement Base, Subbase, and Subgrade Layers for Cost and Performance on Local Roads

Objective: The objectives of this study include the following:
1. Determine the level of increased performance on local roads when PCC is placed on granular subbase or treated subgrade and quantify the performance and cost effectiveness.
2. Develop a user guide for various traffic, soils and pavement factors for optimized performance and financial benefits.

Progress: A team meeting was held on June 26, 2014 to evaluate and discuss the completed Field Data Report. A Pavement Condition Index (PCI) Prediction Model was developed by Dr. David white as a result of the testing. This model gives the pavement designer a tool for predicting pavement condition as a function of standard pavement design variables. Reliability of the pavement increases when the effect of natural variables are reduced or eliminated. Testing and software calculations show that on the average, pavement service life can be increased about 10 years when a properly drained granular subbase layer is used. It was determined that over time soil migration into the granular layer occurs. To minimize this movement, consideration of a separation barrier should be considered. The user guide will focus on the following: testing prior to design, acceptable subgrade systems, design and placement of subgrade separation barrier and design and placement of granular subbase and drainage system.

The next steps include review of draft user guide with TAC in Aug. 2014, revisions to guide based on TAC comments, and publication of user guide and Field Data Report in Sept. 2014.

Reports: None

Implementation: The guide will be published and circulated statewide by incorporating the findings into Chapter 6 of the SUDAS Design Manual. The guide will also be published on the IHRB and CP Tech Center Website. Upon completion of the study, SUDAS, County Engineers and Municipal Engineers would be responsible for applying the research results. Specific standards or practices that may be affected include SUDAS and the Iowa DOT design manual and specifications.

TR-641

Agency:
Iowa State University

Principal Investigator:
Chris Williams

Research Period:
November 22, 2011 – September 30, 2014

Research Board Funding:
$99,966

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

Reflective Crack Mitigation Guide for Flexible Pavements

Objective: The objectives of the study are:
1. Develop guidelines for project selection including but not limited to design considerations such as existing pavement type, thickness, and distress, patching needs, traffic, and minimum subgrade support required.
2. Review preferred practice of rubblization and crack & seat techniques and the selection of proper fracture size and how it relates to performance. Develop quantitative quality acceptance criteria for these projects and recommendations for the use of leveling course material.
3. Develop a mechanistic, performance-based life cycle cost analysis with the MEPDG to further aid in project selection using these crack mitigation techniques based on previously completed studies on reflective crack mitigation techniques.

Progress: A draft final report has been developed encompassing all of the research work. The research team accomplished far more on the NDE process for examining reflective cracking than originally anticipated in lieu of the mechanistic-empirical pavement design guide work (the M-E design software did not include the option for rubblization, crack & seat, and rock interlayer treatment investigated in the study, therefore the computer-based mechanical-empirical design trial was not able to be completed) and is included in the draft final report as well. An additional section on use/application of an asphalt interlayer is going to be derived from the Interlayer project report that is being finalized. The draft report will be provided to a technical editor for preparing the final report.

Reports: None

Implementation: The benefits of this research will be improved pavement performance for Iowa jurisdictional agencies and the Iowa DOT. The project will provide guidelines for assisting engineers in selecting cost effective strategies for mitigating reflective cracking. Further construction guidelines for the strategies for mitigating reflective cracking will also be provided—currently there are no guidelines for crack & seat and rubblization in Iowa.

TR-642

Agency:
The University of Iowa

Principal Investigator:
Witold F. Krajewski

Research Period:
February 1, 2012 – October 1, 2014

Research Board Funding:
$173,178

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

Pilot Project for a Hybrid Road-Flooding Forecasting System on Squaw Creek

Objective: This project is a 2-year plan for the design, implementation and evaluation of a hybrid flood forecasting system that combines real-time stream level observations with a state-of-the-art distributed hydrologic models called CUENCAS. The system will, over time, provide accurate predictions of flooding potential for each road/stream intersection in a river basin. The observation component of the system is accomplished with a stream-level sensing device, which uses ultrasound technology to measure the distance from the bridge deck to the stream water surface.

Progress: The project team has continually recorded stream stage data at 22 sites using the sonic IFC sensors since the spring of 2012. Due to a major drought Iowa experienced in the summer of 2012, data from that year were of little value for the project. In the spring and summer of 2013 several significant flood events were captured. The largest event occurred on May 27th 2013. The Squaw Creek near Lincoln Way in Ames crested near 10 feet, with an estimated discharge of 4220 cfs. The modeling efforts have concentrated in this event. At the time all of the installed IFC sensors where working and stage time series where collected at the 22 sites. Information collected was used to implement and test three flood forecasting models. Initial validation of the three models has been done, but several steps to revise and fix model parameters remain.

Reports: None

Implementation: A distributed flood-forecasting mathematical model capable of highly accurate predictions (i.e., with errors on the order of 1%) could replace the need for a network of observations by making predictions of flooding in all the intersections of roads and streams in a river network. However, the level of accuracy of current hydrologic models is much lower (~ 50% error), precluding their use as a sole forecasting tool of road conditions. In addition, the architecture of standard hydrologic models precludes the ability of forecasting flood levels on small tributaries. As an example, the National Weather Service provides routine stream level forecasts for about 100 locations in the state of Iowa. These forecasting locations usually correspond to large cities or highly populated regions, but provide no information on small creeks or the multiple intersections of roads and streams.

TR-644

Agency:
Iowa State University

Principal Investigator:
Brent Phares

Research Period:
August 27, 2012 – December 31, 2015

Research Board Funding:
$90,000

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

This project is jointly funded with the Minnesota Local Roads Research Board.

Development of Cost-Effective Timber Bridge Repair Techniques

Objective: Currently no sources of guidance for the repair of timber bridges exist. At the same time, county engineers have recognized several types of timber bridges that are in need of repair and maintenance; this represents a major concern. The goal of this project is to identify the state-of-the-practice of timber bridge repair through national and international search and to marry those repair techniques with the needs of county engineers. The efficacy of those techniques will then be evaluated from both engineering and fiscal perspectives. Through a multi-pronged approach, the most viable techniques will be communicated to engineers through a coordinated outreach effort.

Progress: Literature and county surveys are complete. A number of repair techniques have been identified for evaluation. Cost projections for the individual repair techniques are currently being developed and a repair manual is being written.

Reports: None

Implementation: The principal benefit of the work proposed here will be that local system engineers will have formal guidance for repairing timber bridge components. Currently county and city engineers have little to no state or national sources to which they can turn for guidance on the repair of timber bridges. This represents a significant problem as they strive to ensure the safety of the travelling public. The benefit of having such a resource will be measured by improving the overall condition of the transportation system and reducing system failures through implementation by local officials.

TR-645

Agency:
University of Minnesota - Duluth

Principal Investigator:
Brian K. Brashaw

Research Period:
August 13, 2012 – December 31, 2014

Research Board Funding:
$60,000

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

This project is jointly funded with the Minnesota Local Roads Research Board.

Development and Integration of Advanced Timber Bridge Inspection Techniques for NBIS

Objective: Inspections for timber bridges have been mostly limited to visual inspection, hammer sounding and probing. These techniques have proven appropriate for advanced decay detection, but are inadequate for early stage or internal deterioration. It is critical that efforts be conducted to develop and implement advanced timber inspection techniques into routine bridge inspections in accordance with NBIS requirements.

This project will result in improved assessment information that can be used to improve the safety and reliability of bridges. An experienced research team will identify and help implement an inspection protocol for timber bridges (with an emphasis on timber substructure) that can accurately assess structural condition and support the load rating process. Key milestones include the development of standard inspection protocols, integration of the results into bridge data management software, development of a customized inspection manual, outreach training for districts, recommendation of equipment purchases, and completion of an economic assessment on the use of advanced inspection techniques.

Progress: Various inspection techniques have been identified and inspection protocols are currently being developed.

Reports: None

Implementation: This project will provide clear implementation strategies that can be used to accurately identify deteriorated structural timber members and provide key information that can be used to adjust load ratings, develop repair strategies and improve maintenance. One outcome from the project will be a recommendation for the purchase of timber inspection equipment for sharing within the State. Training and outreach will be conducted for inspectors and engineers for each District. By providing training and access to advanced timber inspection equipment, the project will improve the safety and reliability of timber bridges.

TR-646

Agency:
HDR Engineering

Principal Investigator:
Phil Rossbach

Research Period:
May 10, 2012 –
September 30,
2013

Research Board Funding:
$289,494

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

Development of Bridge Inspection, Load Rating & Maintenance Manuals

Objective: Under a project funded by the Iowa Highway Research Board, HDR will provide services to the Iowa Department of Transportation to develop Bridge Inspection, Load Rating and Maintenance manuals with the intent of capturing existing OBS policies and procedures, and summarizing current and past knowledge of DOT staff in these areas. The manuals would utilize a .pdf format in order to have sections or pages that may be linked to Iowa DOT's Structure Inventory and Inspection Management System (SIiMS) software.

Progress: This project is now complete.

Reports: February 2, 2014

Implementation: The manuals will provide the required technical information and guidance to allow DOT Bridge staff and District maintenance personnel to consistently inspect, evaluate and maintain on-system bridges. A secondary benefit will be to provide a framework for policy guidance to local municipal and county bridge owners and employees as well as to independent bridge consulting firms working for the State or local entities.

TR-647

Agency:
Iowa State University

Principal Investigator:
Brent Phares

Research Period:
July 1, 2012 – November 30, 2014

Research Board Funding:
$143,391

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

Methods for Removing Concrete Decks from Bridge Girders

Objective: The objective of this work is to determine and/or develop the most cost-effective and efficient deck removal techniques for steel and prestressed concrete superstructure bridges. Further, the work proposed herein will include guidance on assessing and repairing steel girders that are damaged during removal of a deck. The following criteria will be considered as part of the evaluation: Impact on the future performance of the superstructure, cost, time, safety, and noise

Progress: The project team has completed the collection of information (via survey, meetings, and literature search) and has started the laboratory testing phase of the project. Testing of the deck specimens with partial concrete removal was completed and presented to the TAC. Small-scale shear connector specimen testing had also been completed. Several new removal techniques were selected that will be evaluated in the next quarter.

Reports: None

Implementation: At the conclusion of this project, a suite of tools will exist that will allow bridge owners to make informed decisions regarding the removal of concrete decks from bridges. The outcomes of this work will be immediately implementable as standards of practice will be developed.

TR-648

Agency:
Iowa State University

Principal Investigator:
Peter Taylor

Research Period:
July 1, 2012 – June 30, 2016

Research Board Funding:
$83,049

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

Evaluation and Testing of a Light-Weight Fine Aggregate (LWA) Concrete Bridge Deck

Objective: The objective of this project is to perform laboratory and field testing and evaluation of a concrete bridge deck constructed with LWA concrete. The CP Tech Center will conduct material tests on the LWA and concrete mixtures used in the bridge deck, both in the lab and during construction. In addition, the BEC will conduct live load field tests to evaluate the performance and condition of the LWA deck and the control deck both at the time of placement and approximately 1 year after construction. Evaluation of performance will be made through comparisons with design assumptions, previous research, and the performance of the LWA deck compared to the control.

Progress: No further work is planned until the 12-month load test due Quarter 3, 2014. Dates for this test are being planned with Buchanan Co. Some repeat mixture evaluation will also be conducted.

Reports: None

Implementation: The benefits of this research include collected field data and information regarding the structural performance of LWA in concrete bridge decks compared to a similar bridge deck constructed of normal weight concrete. By providing internal moisture to the concrete, the LWA facilitates internal curing of the concrete, in turn, reducing the short and long term shrinkage cracking that often results during concrete curing. With no reduction in strength, concrete with reduced shrinkage cracking has a potential advantage over typical concrete mixtures in our Midwest climates and the subsequent use of deicing salts in the winter months. In addition, there is the potential for improved durability, as well as economic benefits as well.

TR-650

Agency:
Iowa State University

Principal Investigator:
Chris Williams

Research Period:
October 31, 2012-
October 31, 2014

Research Board Funding:
$144,882

Funding Source:
100% Federal

Development of Non-Petroleum Based Binders for Use in Flexible Pavements-Phase 2

Objective: The objective of this research is to use combinations of bio-oil and other polymers such as rubber for partial replacement in asphalt. Laboratory studies of full replacement blends will be on-going. The optimal blend should show improved shear resistance, reduced temperature susceptibility, and resistance to deformation. Once determined, this optimal blend will be used in a demonstration project.

Progress: There have been problems with the project regarding the adequate aging methods for this material. This difficulty impairs the low temperature characterization of the bio-binders. BBR bath is alcohol based (methanol and ethylene glycol), and cannot be used as it dissolves the bio-oil. Efforts are being made to pursue a suitable bath for the BBR. A demonstration paving project was not identified for the 2013 paving season—a fixed plant with either vertical mixing storage tanks (for asphalt) or a recirculation pump system is needed to react the tire rubber with the bio-oil and then blend with asphalt for partial replacement. An extension will likely be needed.

The research team has been working on identifying a demonstration paving project but has been unable to identify a contractor that has a liquid tank with internal mixing. The research team has been working on improving the liquid storage stability so that these specialized tanks are not needed. Additionally, the team has conducted mix tests and subsequent analysis on test results; these will be contained in the final report.

Reports: None

Implementation: A demonstration project will be conducted utilizing the bio-oil binder blends at approximately 5-6% asphalt replacement. The results of the project will provide useful information for future demonstration 6 projects at higher asphalt replacement amounts such as 10%, 25%, 50% and ultimately 100% replacement.

TR-651

Agency:
Iowa State University

Principal Investigator:
David Jeong

Research Period:
January 1, 2013-
September 30, 2015

Research Board Funding:
$120,000

Funding Source:
100% Federal

Iowa Pavement Asset Management Decision Framework

Objective: The project has five objectives to accomplish the final goal of developing a pavement asset management framework for selecting a pavement treatment through evaluating benefits of various treatment options from "do nothing" to full replacement.
1. Develop a framework for selecting feasible treatment options when the conditions of a pavement section is given
2. Develop a methodology in assessing return on investment values of various treatment options available for Iowa pavements
3. Develop a spreadsheet based decision aid tool for selecting the most appropriate treatment option that can be used by Iowa DOT as input to current system and used in a stand-alone mode by local transportation agencies.
4. Conduct case studies using the tool developed in this project and validate the tool.
5. Train Iowa DOT and local agency engineers for rapid dissemination of the tool

Progress: Additional literature review on best practices in other DOTs of the decision making process of pavement treatment selection and determining the level of service of pavements, as mentioned in the previous report, was completed and documented. The questionnaire was finalized and sent out to city and county engineers, with 74 total responses received. A formal process for evaluating the effectiveness of treatment projects based on the questionnaire has been established, and the analysis of the survey has been finished. The results of the analysis will be integrated into the treatment selection framework to be compatible with the city and county engineers' practices. An overall treatment selection framework was developed for Asphalt and Portland Cement Concrete Pavements. Treatment selection decision trees for different types of distresses are under development. In addition, distress threshold values are under development for local roads.

Reports: None

Implementation: One of the primary outputs of this research project will be a spreadsheet based tool that will assist the Iowa DOT pavement management engineers in evaluating feasible treatment options. The output of this project will be immediately available to the Iowa DOT through a training session. Iowa Cities and Counties will be able to use the tool as a stand-alone mode as well. This new tool will promote a more cost effective use of highway construction funds through defendable decisions on pavement treatments.

TR-652

Agency:
Iowa State University

Principal Investigator:
Neal Hawkins

Research Period:
January 1, 2013-
December 31, 2015

Research Board Funding:
$125,000

Funding Source:
100% Federal

Durable Pavement Marking and Grooving

Objective: The project objectives are to evaluate the pavement marking materials and installation procedures, including:
- Installation of a durable pavement marking test deck to evaluate these materials under Iowa roadway conditions. Use different combinations of marking materials, beads, and installation practices (surface applied and grooved). Monitor pavement marking performance in terms of durability (presence) and retroreflectivity over 24 months or 2 winters using high-speed video, under wet and dry conditions.
- Develop a performance versus cost guideline to assist state and local agencies in making more informed pavement marking selection decisions.
- Include test sections with short segments for each combination with a control section of surface applied markings in-between each. Dimensions of the groove should vary in depth, width and shape (90 degree vertical edges versus a groove which is more concave in shape).

Progress: The team is talking with contractors regarding possible grooving for the next construction season, working on test deck installation details, and preparing to discuss installation information with the project TAC. The meeting they had planned for early April of this year did not happen, so they are waiting until they can assemble as a group to discuss these details.

Reports: None

Implementation: The implementation and transferability of this work will support decision making on the selection, budgeting, and management of pavement marking guidance on public roadways. The results will be applicable to any roadway agency or authority.

TR-653

Agency:
Iowa State University

Principal Investigator:
Jeremy Ashlock

Research Period:
January 1, 2013-
December 31, 2014

Research Board Funding:
$82,707

Funding Source:
100% Federal

Assessment of Non-Destructive Testing Technologies for Quality Control/Quality Assurance of Asphalt Mixtures

Objective: The primary objective of the proposed research is to assess the accuracy and suitability of a range of NDE technologies for QC/QA of asphalt pavement. As described above, off the-shelf technologies to be examined include GeoGauge, low-radiation nuclear, and EM systems. Additionally, customized surface wave testing methods will be examined using ground-coupled and air-coupled sensors. Analyses of the surface wave tests will be performed using programs written by the ISU researchers.

Progress: Wireless sensors were lab tested and installed to examine their performance and survivability during and after construction. Temperature readings and a binary wet/dry moisture condition were read wirelessly through the pavement. Additional readings were also successfully taken on July 2. A teleconference was held with the sensor manufacturer, who will begin working on a prototype passive wireless asphalt strain gage using the same technology.

A TAC meeting was held on May 8, 2014 during which results of field and lab tests were presented. Due to the small range of densities on a single project, correlations between surface wave velocity and core density were low for a single site. When plotting data for all sites together, the wider range of densities resulted in a much better correlation to surface wave velocity, with the multichannel MASW approach providing better results than the single channel MSOR approach.

Reports: None

Implementation:
The anticipated research results will be applied by Iowa DOT engineers to improve the state of practice in QC/QA of asphalt pavements. Research findings will be reported in the form of NDE test procedures and recommendations. Assuming one or more of the NDE technologies are identified as suitable replacements for destructive coring, an Implementation plan will be formulated to include recommendations for calibration procedures, methods for assessing measurement variability, and procedures for routine performance of the NDE tests by Iowa DOT personnel.

TR-654

Agency:
The University of Iowa

Principal Investigator:
Thanos Papanicolaou

Research Period:
January 15, 2013-March 31, 2015

Research Board Funding:
$73,653

Funding Source:
100% State - 83% Secondary funds and 17% Street funds

Development of a Subgrade Drainage Model for Unpaved Roads

Objective: The objectives of this project are the following:
1. Determine if county roads are exhibiting moisture related distress or frost boil failure that can be attributed to poor subgrade drainage performance.
2. Determine whether there are design and/or maintenance alternatives that will improve subgrade drainage performance.
3. **Develop a model for evaluating post-construction subdrain performance using soil borings and/or NRCS soil maps. The model should work under saturated and unsaturated conditions and for a wide range of key design hydraulic and geotechnical parameters. The model reliability should be tested by using NRCS maps for identifying the soil type in the problem areas and comparing the maps to the collected soil cores from the problem areas.**

Progress: The project team has determined the saturated hydraulic conductivity (K_{sat}) of the soils in Iowa using texture and bulk density. The K_{sat} provides a reflection of the drainability of the sub-grade soil. Investigators are currently evaluating the effects of the range of conductivity values in the model on the length of time needed to drain the sub-grade material of gravel roads. They are identifying the problems soils that take a longer time period to drain.

Reports: None

Implementation: The final products of the proposed research are the following:
1. Provide an efficiency evaluation of current design of subbase drainage system which contains information of the different response of materials and drains to different hydrologic and climatic conditions.
2. A new and simple-to-use drainage model to evaluate subdrain performances of alternative designs to enhance the decision process of future roadway projects.
3. Provide improved specifications to design subsurface drainage systems able to ensure an excellent drainage under the climate and groundwater conditions of Iowa.

TR-655

Agency:
Digital Control, Inc.

Principal Investigator:
LaDon Jones

Research Period:
January 1, 2013-
December 31, 2014

Research Board Funding:
$48,600

Funding Source:
100% State - 83% Secondary funds and 17% Street funds

Updating the Iowa Culvert Hydraulics and Iowa Bridge Backwater Software

Objective: The objective of this project is to:
1. Convert the Iowa Culvert Hydraulics and Iowa Bridge Backwater software from the visual basic 6.0 programming language to the Microsoft .Net programming system using the VB.NET programming language and .NET framework 4.0.
2. Add the latest U.S.G.S. methods (IHRB TR-519) for estimating design flow rates at ungaged sites in Iowa to both software programs.
3. Update the standard culverts included in the culvert software and associated head loss estimates.
4. Review the methodology in the Bridge Backwater software to see if any changes or additions are needed.

Progress: The update to visual basic 6.0 is complete. Due to a delay in the implementation of StreamStats, the project has been delayed until early spring 2014 to complete the update in design flow rates.

Reports: None

Implementation: The updated culvert and bridge software will be utilized by city and county engineers, the Iowa DOT staff, the IDNR, and consultants, for the design of culverts and evaluation of bridge hydraulics along the State's primary and secondary road system. The programs will continue to be valuable tools for city and county engineers, the Iowa DOT and consulting engineers in Iowa. The updated programs will be available for downloading from the Iowa DOT website.

TR-656

Agency:
Iowa State
University

Principal Investigator:
Halil Ceylan

Research Period:
May 9, 2013-
April 30, 2015

Research Board Funding:
$167,967

Funding Source:
100% Federal

Biofuel Co-Product Use for Pavement Go-Materials Stabilization: Phase II, Comprehensive Laboratory Evaluation & characterization and field Demonstration

Objective: The proposed research is a follow-up investigation of the IHRB research project entitled "Biofuel Co-product Uses for Pavement Geo-materials Stabilization". The objectives of this proposed Phase II research are to gain a deeper understanding of how BCP-soil stabilization works for different soil types and under a variety of conditions encountered in the field before this technology can be put into practice successfully. This research also seeks to address the potential challenges and issues that could arise with the introduction of a new soil stabilizer in the field. The specific objectives are:

- Evaluate the effect of BCP addition on strength performance for a wide range of soils encountered in Iowa
- Evaluate the durability (moisture sensitivity and freeze-thaw condition) of BCP treated soils
- Evaluate the effect of BCP addition to soils on the environment
- Characterize the microstructure of BCP-soil mixture to better understand the mechanism of BCP soil stabilization
- Establish a laboratory test protocol for mixture design and testing procedures for BCP stabilized soil
- Execute a field demonstration project using the developed BCP-soil stabilization technology

Progress: The research team executed the lab test program developed using Iowa loess soil collected from Monona County, conducting soil engineering properties characterization and compaction tests on the samples. Analysis will be compiled upon completion of strength and durability evaluations, which will be conducted in the coming months. At present, the team is considering samples from the soil near the proposed field demonstration site in Buchanan County.

Reports: None

Implementation: If the research results are successful, the research findings will be directly used by Iowa's city, county, and DOT engineers to improve their soil stabilization practice. The research findings will be reported in the form of a final report as well as recommended design practice. The procedure for applying and storing lignocellulosic-based soil stabilizers will also be described in the final report which will be useful for the practicing engineer.

TR-657

Agency:
Kansas University

Principal Investigator:
Steven Schrock

Research Period:
May 15, 2013-
February 28, 2015

Research Board Funding:
$70,000

Funding Source:
100% State - 83% Secondary funds and 17% Street funds

Evaluation of Low-Cost Signalized Intersection Red Light Running Countermeasures in Medium to Large Communities in Iowa

Objective: The proposed research is to study the effectiveness of the confirmation light system at two to four high crash/high violation Iowa intersections in either medium or large communities. This study is designed to complement the studies being conducted in the Kansas communities of Lawrence and Overland Park in an effort to reduce red light running in the Midwest.   Moreover, effectiveness of the confirmation light system will be evaluating the change in number of red light running violations over a short and long period using video data in collaboration with interested communities. The evaluation method will be a before-after study design along with the use of control intersections and spillover intersections to determine if the countermeasure is positively or negatively affecting the treated intersections and/or other intersections in the study communities.

Progress: The blue confirmation lights were installed at one signalized intersection in Altoona and one signalized intersection in Waterloo. After consulting with the city, one approach at the treatment intersection in Waterloo was not equipped because the signal was protected/permitted. The research team has received positive feedback from residents of both cities.

The one month video study was conducted and data is currently being reduced. A 3 month study is scheduled to begin the first week of December. The research team also provided turning movement volumes to the City of Altoona for signal timing. Currently the data reduction is underway and at this time the team does not have immediate results from the 1 month study. However, based on the study underway in Kansas, the research team is seeing a considerable reduction in red light running violations, which we hope will be the same for both Iowa communities at the treatment intersections.

Reports: None

Implementation: These methods are intended to support rapid deployment of more confirmation light systems in Iowa if the study shows significant effectiveness. A key component to the research project deliverables is the tech transfer summary which the research team expects the Iowa DOT office of traffic and safety to champion to disseminate throughout Iowa.

TR-658

Agency:
University of Iowa

Principal Investigator:
Hosin Lee

Research Period:
May 15, 2013-
January 31, 2015

Research Board Funding:
$150,000

Funding Source:
100% State - 83% Secondary funds and 17% Street funds

Development of Quality Standards for Inclusion of High Recycled Asphalt Pavement Content in Asphalt Mixtures – Phase 2

Objective: The objectives of this phase 2 study are to:
1. Build a test section utilizing HMA mix designs with up to 50% RAP materials
2. Evaluate the moisture sensitivity of High-RAP mixtures
3. Characterize the low-temperature fracture behavior of High-RAP mixtures
4. Monitor the condition of the field test section in one year after the construction
5. Develop a design guide for High-RAP mixtures including fractionation process and construction quality control.

Both laboratory and field mixtures will be examined, which would help answer the question that how much blending occurs between the binder in RAP and virgin binder.

Progress: Test sections have been built with 20%, 25%, and 30% binder replacement using Fractionated RAP materials. The project team is performing the moisture susceptibility behavior testing using samples collected from the field. There will be a TAC meeting in early January to review the test results.

Reports: None

Implementation: The implementation outlook for this research effort is very realistic given a field test section with varying RAP amounts up to 50% to be constructed in Iowa. The results of this study shall provide a foundation leading to a modified mix design process with High-RAP contents.

TR-659

Agency:
Iowa State
University

**Principal
Investigator:**
Halil Ceylan

Research Period:
May 15, 2013-
May 14, 2014

**Research Board
Funding:**
$49,956

Funding Source:
100% State - 83%
Secondary funds
and 17% Street
funds

Development of Asphalt dynamic Modulus Master Curve Using Falling Weight Deflectometer (FWD) Measurements

Objective: The objective of this study is to develop the asphalt dynamic modulus master curve directly from time histories of routinely collected FWD test data for use in MEPDG/DARWin M-E flexible pavement analysis and rehabilitation design.

Progress: The research team developed an inverse mapping model using a comprehensive forward database developed from viscoelastic forward simulations of over 10,000 full-depth asphalt pavement case scenarios. A draft report was developed to present the background, rationale, and detailed research efforts on the development of the FWD backcalculation approach for HMA dynamic modulus master curves.

The team then completed and submitted the draft final research results at the TAC meeting held April 30, 2014. Recognizing the significance of the study's findings, potential follow-up studies were discussed and recommended by the TAC. The project final report was presented to IHRB members at the July 2014 meeting. Future research opportunities will be discussed with the TAC and IHRB members.

Reports: July 25, 2014

Implementation: Based on the outcome of this study, the research findings will be directly used by Iowa City, county, and DOT engineers to efficiently develop HMA dynamic modulus master curves from routine FWD data. The research findings will be reported in the form of a final report as well as recommended alternatives that will improve the characterization of HMA dynamic modulus master curve.

TR-660

Agency:
Iowa State University

Principal Investigator:
Brent Phares

Research Period:
May 1, 2013-
April 30, 2015

Research Board Funding:
$99,970

Funding Source:
100% State - 83% Secondary funds and 17% Street funds

Investigation of Negative Moment Reinforcing in Bridge Decks

Objective: The objectives of this work are to:
- Investigate OBS policy concerning the amount of negative moment reinforcing required, over piers, to provide continuity in a bridge deck. Specifically, determine if the office policy regarding the amount of negative moment reinforcing steel over the piers is conservative.
- Investigate the OBS policy regarding terminating negative moment steel at the eighth points of bridge spans.
- Investigate the impact of terminating the negative moment reinforcing steel at one cross-section versus staggering the termination points.
- Investigate the contribution of secondary moments to bridge performance in negative moment regions.

Progress: The data collected for the five tested bridges have been analyzed and are being used to calibrate analytical models which will then be used to study OBS' policy with regard to negative movement steel. The first model is nearly complete, revealing that predicted stresses are well below those believed to initiate cracking. This model is being scrutinized to help the team understand if these outcomes are merely the result of a difference in assumed behavior.

Reports: None

Implementation: The results of this work should be immediately implementable as the project has the very specific goal of examining very specific portions of the current Iowa DOT OBS bridge design process. Should the research results show that change is necessary, warranted, or allowable, the form and format of the research plan will allow for direct identification of sources of change and their impact.

TR-661

Agency:
Iowa State University

Principal Investigator:
Brent Phares

Research Period:
May 1, 2013-
April 30, 2015

Research Board Funding:
$119,857

Funding Source:
100% State - 83% Secondary funds and 17% Street funds

Evaluate the Need for Longitudinal Median Joints in Bridge Decks on dual Structures

Objective: The main objective of this research is to determine the maximum width of a continuous deck that can be used without overstress. To achieve this objective, analytical techniques including FEA will be used to investigate the true behavior of decks with various widths under typical loadings due to temperature change, concrete shrinkage, and live loads. Experimental testing will be conducted in order to provide validation of the analytical models. Based on the outcome of the analytical and experimental investigations, the maximum continuous deck width will be recommended for different types of bridges and guidelines will be developed for the usage of longitudinal deck joints on dual structures.

Progress: The project team has completed the calibration of the analytical model and the parametric study for the focus bridge. The outcomes from the models tend to indicate that the propensity for cracking does not result from bridge width details; rather, it seems to be a result of temperature restraint.

Reports: None

Implementation: Engineers involved in designing bridges will immediately be able to use the resulting information as the results will be given in a format commonly used by design engineers. The results of this study will improve bridge construction for the Iowa DOT, counties, and cities. The results of this study will likely provide design guidelines based upon the rigorous analytical study.

TR-662

Agency:
Iowa State University

Principal Investigator:
Halil Ceylan

Research Period:
June 10, 2013-
Dec 31, 2014

Research Board Funding:
$126,878

Funding Source:
100% State - 83% Secondary funds and 17% Street funds

Evaluating Roadway Subsurface Drainage Practices – Phase II

Objective: The proposed research is a follow-up investigation of the IHRP research project entitled "Evaluating Roadway Subsurface Drainage Practices". The primary objectives of this proposed Phase II research are listed below:

- Evaluate the seasonal variation effects (dry Fall 2012 vs. wet Spring/Summer 2013, etc.) on subdrain outlet condition and performance
- Investigate the characteristics of tufa pumice formation in Iowa subdrain outlets (i.e., identify the factors influencing the tufa formation and prevention, at what stage does tufa formation start influencing subdrain outlet performance, etc.)
- Investigate the condition of composite pavement subdrain outlets
- Examine the effect of resurfacing/widening/rehabilitation on subdrain outlets (e.g., the effects of patching on subdrain outlet performance)
- Identify a suitable drain outlet protection mechanism (like a headwall) and design for Iowa subdrain outlets based on a survey of nearby states

Progress: The research team executed the 2014 field investigation plan focusing on rehabilitated pavements. About 120 drainage spots in 23 sites, as recommended by the TAC and district engineers, were inspected during the field investigation. The team was also invited to present headwall and slash pad design and specifications in other states during the Iowa DOT Headwall Implementation Meeting held on June 30, 2014.

During the next quarter, the team will focus on organizing and analyzing performance data of inspected rehabilitated pavements and developing a questionnaire based on the feedback from the Headwall Implementation Meeting to collect more details on headwall practices in nearby states.

Reports: None

Implementation: Based on the outcome of this study, the research findings will be directly used by city, county, and DOT engineers across Iowa to assess the performance of their pavement subdrains and improve their drainage practices. The research findings will be reported in the form of a final report as well as recommended alternatives that will improve the performance of pavement subsurface drainage systems.

TR-663

Agency:
HDR Engineering

Principal Investigator:
Phil Rossbach

Research Period:
July 16, 2013 -
October 1, 2014

Research Board Funding:
$46,164

Funding Source:
100% State - 83% Secondary funds and 17% Street funds

Short Span County Bridge Standards

Objective: The Phase 1 effort involves researching short span prefabricated bridge components, developing a preferred concept for the superstructure and abutments, developing working sketches of proposed components, refining those concepts, and identifying elements or details to be tested. Research of the prefabricated components will begin by assembling information already developed and accumulated by Iowa DOT as well as researching prefabricated components developed by other agencies.

From this information, HDR will develop or short list concepts and details for further refinement. Although a concrete box superstructure has been identified as a viable alternative, other structure types will be considered in Phase I prior to refinement of the structure type.

Progress: An initial project concept was presented to the TAC and approved for further development. Preliminary engineering to determine the constraints on the design is currently ongoing. Phase II and III are now underway.

Reports: None

Implementation: In intend of refining these prefabricated bridge standards is to develop a system that has the potential to improve bridge construction, accelerate project delivery, improve worker safety, increase cost-effectiveness, reduce impacts to the traveling public by reducing traffic disruptions and duration of detours, and allow local engineers to construct the bridges.

Low Cost Rural Surface Alternatives: Demonstration Project

Objective: The proposed demonstration project will implement and monitor a selected set of these technologies over a two-mile section of Vail Avenue from Highway 175 to 310th street in Hamilton County, IA. The objectives of the proposed research project are to:

- Perform field testing of a range of granular surface stabilization technologies on a two-mile long demonstration project in Hamilton County, Iowa.
- Measure and document the performance of the demonstration roadway sections before, during, and after a seasonal freeze/thaw cycle.
- Assess the initial cost, relative performance, maintenance requirements, and long term life-cycle costs of the different stabilization techniques.
- Identify the most effective and most economical alternatives for minimizing or eliminating frost heave/boil issues before they occur.

Progress: A TAC meeting was held on April 11, 2014 to discuss the construction methods, QC, traffic control, and other details of the chemical stabilized Sections 15-17 to be constructed by Manatts. Logistics of the remaining field testing plan were also discussed. The geocomposite Section 18 was constructed on June 5 and 6, 2014. The construction process and as-built cross-section profile were documented for the final report. The construction costs were documented and analyzed for the sections completed by the end of June 2014. The start and end of each section were GPS located, and the GPS data were documented in a GIS file for future use. Additional field testing was conducted to determine changes in shear strength and stiffness, as well as lab testing to measure degradation of aggregates under impact-crushing effects. The findings from this testing will be analyzed and compiled in the final report.

Reports: None

Implementation: For the benefit of the public, it is important that the results of the research can be easily implemented by the Iowa DOT. To ensure translation of the research results into practice, technology transfer documents will be created with the assistance of the publications division at ISU's Institute for Transportation.

TR-665

Agency:
University of Iowa

Principal Investigator:
Marian Muste

Research Period:
August 27, 2013 –
September 30, 2015

Research Board Funding:
$166,566

Funding Source:
100% State Planning & Research Part II

Mitigation of Sedimentation at Multi-Box Culverts

Objective: The proposed project will systematically identify the likelihood of culvert sedimentation based on stream and culvert geometry along with the soil characteristics of the area drained by the culvert. These relationships will be analyzed and disseminated to inform and improve current culvert design specifications used by IDOT and county engineers.

The following specific goals will be integral part of the proposed study:
- Conduct the analysis on aerial photographs of a significant sample of 2- and 3-box culverts located in various soil areas throughout the state
- Estimate the rates of sedimentation using previously-taken aerial photographs
- Conduct field surveys to accurately quantify sedimentation volumes, the origin of the materials, and additional factors involved in sedimentation
- Develop analytic relationships to capture the functional relationship between stream-to-culvert ratios and soil erodibility and the rate of sedimentation for various soil erodibility factors
- Develop a matrix for complementing the culvert design process
- Review current culvert design specifications and formulate provisions to account for local soil characteristics in the design of future culverts

Reports: None

Implementation: The report prepared from this study will be formatted in a comprehensive and well-illustrated manner that will directly help engineers to complement current flow transport considerations with sediment transport concerns customized for various Iowa state regions. If thought necessary, the methods could be introduced and explained in a workshop setting. They will also be introduced and explained during presentations made in two Iowa conferences.

TR-666

Agency:
Iowa State
University

**Principal
Investigator:**
Brent Phares

Research Period:
August 15, 2013 –
December 31, 2014

**Research Board
Funding:**
$65,805

Funding Source:
100% State
Planning &
Research Part II

Investigation of Field Corrosion Performance and Bond/Development Length of Galvanized Reinforcing Steel

Objective: The proposed investigation will determine the effectiveness of using galvanized steel reinforcing bars compared to the current practice of coating the bars with epoxy. The effectiveness of the galvanizing process will be tested and monitored on the yet-to-be-constructed Buchanan County demonstration bridge, the materials for which were provided at no cost by the galvanizing industry, whose vigorous interest offers a unique opportunity to conduct this testing.

The objectives of this work are to:
- Gather information on the use/acceptance of galvanized reinforcing steel by the national and international engineering community.
- Install and monitor corrosion monitoring sensors in the yet-to-be-constructed Buchanan County demonstration bridge.
- Conduct laboratory testing to study bond and development length of galvanized reinforcing bars.

Progress: The research team installed corrosion sensors in the subject bridge and have monitored them periodically since. The team also cast the lab specimens and investigated the performance of galvanized bars as compared to epoxy-coated bars. The team is now in the process of finalizing the project report. An extension has been granted, making the new completion date December 31, 2014.

Reports: None

Implementation: The results of this work will shed much-needed light on the use of galvanized reinforcing bars. Where possible, and as mentioned above, implementation information will be included in the project final report.

TR-667

Agency:
Iowa State University

Principal Investigator:
R. Christopher Williams

Research Period:
January 7, 2014 – June 30, 2015

Research Board Funding:
$150,173

Funding Source:
100% State Planning & Research Part II

Validation of Gyratory Mix Design in Iowa

Objective: This research will evaluate existing pavements in Iowa to determine whether ultimate in-place density has been achieved as designed. Field cores from a variety of traffic levels will be assessed for in-place density and compared to the design density level. The impacts of lowering void levels of lab compacted mixes will be studied, tested, and analyzed to predict the performance of the pavement over a 20-year life cycle in the field.

Progress: The experimental plan has been finalized and field projects have been selected for inclusion in the study. Each interstate in Iowa has had at least one field core from surface mixes (30 Million ESAL) evaluated for bulk density. Detailed QC/QA information is being analyzed for all mixes. The research team is collaborating with the Iowa DOT for collection of mixture information and plant reports as well as obtaining the remaining field cores. Pavement surveys will be conducted using the PMIS in coordination with the Iowa DOT.

Reports: None

Implementation: The Iowa DOT can apply the research to the general mix design practices throughout the state. If no changes are needed and the study finds that asphalt roadways in Iowa are adequate at all design levels, then only minimal (or no) changes will be needed; however, it is likely that from this project, changes will be recommended. If changes are recommended, they may be added to the mix design specifications to ensure that asphalt mixes are being designed at proper air void and asphalt contents. Overall, the changes will work toward improving laboratory-field correlations and asphalt mix design specifications in Iowa.

TR-668

Agency:
Iowa State University

Principal Investigator:
Halil Ceylan

Research Period:
October 23, 2013 –
April 30, 2015

Research Board Funding:
$119,997

Funding Source:
100% State Planning & Research Part II

Impact of Curling and Warping on Concrete Pavement

Objective: The proposed project will survey pavement samples across Iowa to determine the long-term effects of curling and warping due to environmental changes on the lifetime performance of the pavement.

The project will identify and precisely survey selected pavement panels under wet, dry, warm, and cold conditions, assessing load transfer between selected panels and their neighbors. With this information, the team will then correlate data of the mixture, construction details, climate, and amount of curling/warping against performance of pavement in terms of load transfer and cracking. This will allow them to develop recommendations regarding the amount of curling and warping considered acceptable.

Progress: The research team has developed a preliminary experimental field test plan which was presented at the kick-off TAC meeting (3/27/2014) to discuss and answer questions TAC members may have had. Following the meeting, the team incorporated the TAC's comments into the field test site selection process. Seven sites were selected: (1) US-30 section nearby Ames, Story County, East, MP. 152.20 to 156.20, (2) US-151 sections nearby Cedar Rapids, Linn County, MP. 33.48 to 36.58, (3) US-151 sections nearby Cedar Rapids, Linn County, MP. 30.12 to 33.48, (4) US-30 sections nearby Marshalltown, Marshall County, MP. 188.86 to 193.10, (5) US-34 sections nearby Burlington, Des Moines County, (6) I-80 sections nearby Casey, Adair County, MP. 73.32 to 85.75 (MP. 85.20), and (7) Mortensen Rd from State Ave. to Ames Middle School, Ames. Some sites could be replaced with other sites recommended by Iowa DOT if traffic control can be facilitated. The field testing plan was also further elaborated by specifying survey components, survey frequency and times, number of slabs for measurement, direction of curling measurements, etc.

Reports: None

Implementation: Based on the outcome of this study, the research findings will be directly used by city, county, and DOT engineers across Iowa to assess the impact of curling and warping on Iowa concrete pavement. The research findings will be reported in the form of a final report as well as recommendations regarding the amount of curling and warping considered acceptable in Iowa. Guidelines on achieving these limits will be provided based on literature and past experience. The final report and recommendations will also be published on the IHRB and ISU CP Tech Center Website.

TR-669

Agency:
US Geological Survey

Principal Investigator:
David Eash

Research Period:
October 1, 2013 – September 30, 2015

Research Board Funding:
$185,850

Funding Source:
70% Federal funds, 30% State funds – 83% Secondary funds, 17% Street funds

Statistical Summary of Selected Iowa Streamflow Data

Objective: The proposed project will compile a statistical summary of streamflow trends, including 23 new streamgages that began operation between 1987 and 2003 which were not included in the last report.

The proposed project will compile two sets of statistics (1) long-term for the entire period of record and (2) recent-term for the 1984-2013 period of record. The recent-term statistics (second set) will only be computed for streamgages with streamflow records pre-dating the 1984 water year. The statistics will be computed for streamflow data collected at continuous-record streamgages in Iowa with at least 10 years of record. The statistics will be compiled on the daily mean and annual instantaneous peak values of streamflow data collected through water year 2013 (which ends September 30, 2013).

Reports: None

Implementation: Statistics will be computed using USGS programs SWSTAT, ADAPS, NWIS, PeakFQ using EMA, and WIE. Microsoft Word and Excel software will be used to format the data for making the statistics publication-ready.

The proposed project will provide updated Iowa streamflow statistics to water users, managers, and planners, enabling them to make decisions that are based on more up-to-date streamflow information.

TR-670

Agency:
HS InFocus, LLC

Principal Investigator:
David Hemingway-Turner

Research Period:
November 18, 2013 – August 31, 2014

Research Board Funding:
$14,500

Funding Source:
100% State - 83% Secondary funds and 17% Street funds

Iowa DOT Library Services, Collection & Technology Assessment

Objective: The proposed project will assist the Iowa DOT Library in creating and implementing meaningful improvements to their services and methods by which they are delivered through technology enhancements. By examining the Library's users' current usage trends and surveying Library staff, HS InFocus will be able to identify areas in need of improvement, recommend the appropriate solutions, and implement these solutions to increase the overall effectiveness of the DOT Library.

Reports: None

Implementation: This assessment will be accomplished by working with the Library staff and also by reaching out to the DOT researchers themselves to determine their needs. Once the needs have been assessed, HS InFocus will work with Library staff to determine the best options to deliver technology solutions to meet the staff and customers' expectations.

Performance Monitoring of Boone County Expo Pavement Sections: Phase III

Objective: The primary goal of this project is to conduct performance monitoring tests on sections of pavement at the Central Iowa Expo to assess environmental impacts on the test sections for a 3-year period. The pavement at this site is new (paved in 2013) and the various pavement foundation systems provide significantly different support conditions, making it a prime location to conduct research on a broad scale. Specific assessments of seasonal changes, changes in foundation layer support, subbase layer permeability, in-ground stresses under loading, and water table changes, as well as examinations of surface layer distresses and erosion over time will be conducted to fulfill these objectives. Ultimately, this performance monitoring system will help researchers understand how to improve the overall quality of the pavement foundation system for Iowa roads.

Progress: The project team performed in situ testing on all test sections during the freeze-thaw in April 2014. Iowa DOT performed 6" core sampling at 66 test locations selected by ISU on PCC pavement sections. ISU performed dynamic cone penetrometer (DCP) and core hole permeability (CHP) tests at selected core locations. Falling weight deflectometer tests were conducted on all test sections (HMA and PCC) with 20 test points per street.

Lab tests to assess freeze-thaw and frost-heave susceptibility were performed on 6 subgrade samples with different percentages of fly ash and cement and 9 subbase layer samples with different percentages of cement and fibers. Additionally, lab testing was initiated on subgrade and subbase later samples to determine the dielectric constant of the material as a function of moisture content in as-compacted, frozen, and thawed states.

Reports: None

Implementation: Results will contribute to improved performance of a vital component of Iowa infrastructure. The benefits from this project will provide improved knowledge in the state-of-the-practice for secondary and primary roadways, performance of improved foundation layers. The project will result in improved decision making and investment in Iowa roadways.

TR-672

Agency:
Iowa State
University

**Principal
Investigator:**
Simon Laflamme

Research Period:
January 9, 2014 –
December 31, 2015

**Research Board
Funding:**
$92,150

Funding Source:
100% State
Planning &
Research Part II

Autonomous Sensing Skin for Detection and Localization of Fatigue Cracks

Objective: The proposed research will develop an autonomous sensing system for the detecting and localizing of fatigue cracks. The proposed sensing system, Soft Elastomeric Capacitors (SECs), are matrices of sensors that will allow for real-time, wireless monitoring of fatigue cracks which is unfeasible by current methods. By developing and testing these devices, researchers will determine their merit for future use in the autonomous monitoring of fatigue cracks.

Progress: The project is progressing as scheduled. Sensor validation (Task I) is almost completed and a paper on results has been submitted to TRB. First TAC meeting is scheduled for August.

Reports: None

Implementation: This work will produce a prototype of an autonomous strain gage system capable of monitoring fatigue cracks over large surfaces. It will be applicable as-is, but further work on the device will result in miniaturization of the sensing system for significantly improving on its applicability. Upon convincing results, it will be possible to produce these devices at large for applications to Iowa's transportation infrastructure.

TR-673

Agency:
Iowa State
University

**Principal
Investigator:**
David J. White

Research Period:
June 1, 2014 –
March 31, 2016

**Research Board
Funding:**
$214,552

Funding Source:
57% Federal
Funds, 43% State –
83% Secondary
funds, 17% Street
funds

Design and Performance Verification of a Bridge/Column/Footing/Pile System for Accelerated Bridge Construction (ABC)

Objective: The proposed project will conduct an in-depth study and analysis of the merits and deficiencies of the Accelerated Bridge Construction (ABC) methodologies which have been gaining momentum nationwide. Based on their findings, this analysis will allow researchers to develop a codified system for ABC implementation which will facilitate the usage of these practices for bridge substructures in Iowa. The information can then be disseminated and used by engineers to enhance bridge construction in the future.

Progress: A student assistant has been recruited to participate on the project, and project work has begun.

Reports: None

Implementation: The research topic will be of national interest, and the results will be distributed through publication of technical papers and presentations at technical conferences. Researchers will also collaborate appropriately and disseminate project results through the recently formed UTC-ABC.

TR-674

Agency:
Iowa State University

Principal Investigator:
Halil Ceylan

Research Period:
May 1, 2014 – March 24, 2015

Research Board Funding:
$149,995

Funding Source:
100% State - 83% Secondary funds and 17% Street funds

Evaluation of Otta Seal Surfacing for Low-Volume Roads in Iowa

Objective: The proposed research will determine the relative effectiveness of the Otta seal coat system on low-volume, low-grade aggregate roads compared to traditional bituminous seal coat surfaces, and compared to maintenance of granular surfaced roads. Additionally, the proposed project will:

- Develop a guide for road selection in regard to the use of Otta seals as an alternative, and develop guidelines for construction of Otta seals.

- Identify local projects that could be sites for field demonstrations to represent a range of locally available aggregate in different areas of the state. This study would fund the cost of testing and evaluating the cost-benefit prospects of participating projects.

- Evaluate installed Otta seals' performance through seasonal changes (i.e. winter, spring/thaw, summer, etc.), environment, and traffic loading conditions through laboratory testing and field demonstration.

Progress: The project team focused the first quarter of the project on a comprehensive literature review to assess the state-of-the-art and state-of-the-practice on the use of Otta seal surfacing for unpaved roads. Key issues focused on included history, required materials properties (both aggregate and binder), design, construction, performance, economic viability, etc. These findings, along with the proposed approach, will be presented at the first TAC meeting to be scheduled during the next quarter.

Reports: None

Implementation: Based on the outcome of the study, Iowa city, county, and state engineers will be able to determine the usefulness of the Otta seal technology on various pavement types across the state. The final report and recommendations will be published on the IHRB and ISU InTrans/PROSPER Website.

Additionally, a technology transfer sheet will be created and presentations will be made at local/regional conferences, as well as an executive presentation to the IHRB which will be made available to be used at local/regional meetings. Pictures and videos taken throughout the project will also be provided to the IHRB. Results of this study will be disseminated in the form of journal publications and conference presentations. Investigators will incorporate the findings of this study in to the undergraduate/graduate level courses in Geotechnical/ Pavement Engineering.

TR-675

Agency:
Iowa State University

Principal Investigator:
Peter Taylor

Research Period:
May 1, 2014 – October 31, 2015

Research Board Funding:
$74,938

Funding Source:
100% State - 83% Secondary funds and 17% Street funds

Assessment of PCC Concrete Setting Time and Joint Sawing

Objective: The proposed research project will seek to establish a standard timeframe for contractors to begin sawing joints in slabs on grade, an issue which leads to problems both with the concrete's integrity (e.g., raveling or cracking), as well as disputes between agencies and the contractors when such failures occur. This project will assess the suitability of three different approaches to evaluating when the concrete is at prime sawing temperature and consistency—p-wave, i-button/maturity meter, and calorimetry—and analyze the results in order to develop a protocol for implementing whichever method is most effective.

Progress: The project team Confirmed with Iowa DOT that they are unlikely to find conventional sawing locations in-state. Negotiations started with the Minnesota DOT to locate suitable candidate sites. The team has identified six sites, and paving dates are currently being coordinated.

Reports: None

Implementation: Project results will be distributed to the engineering community through the publication of technical papers in the engineering press and presentations at bridge and transportation conferences, and through posting of pertinent information on the websites of the Iowa DOT and the CP Tech Center.

TR-676

Agency:
Iowa State University

Principal Investigator:
Peter Taylor

Research Period:
April 15, 2014 – April 30, 2016

Research Board Funding:
$120,000

Funding Source:
100% State - 83% Secondary funds and 17% Street funds

Impacts of Internally Cured Concrete Paving on Contraction Joint Spacing

Objective: The objective of the proposed work is to perform laboratory and field testing and evaluate a concrete pavement constructed with and without internally cured (IC) concrete in an overlay section to determine whether this method is applicable in pavements as it is with cement concretes. The CP Tech Center will conduct material tests on the concrete mixtures used in the pavement during construction. Sensors will be embedded in the pavement to monitor temperature and moisture profiles. These sensors will be examined periodically over one year to observe seasonal affects. In addition, surveys will be conducted quarterly to observe and record the amount of warping cracking as a function of daily and seasonal environmental changes.

Reports: None

Implementation: Project results will be distributed to the engineering community through the publication of technical papers in the engineering press and presentations at bridge and transportation conferences, and through posting of pertinent information on the websites of the Iowa DOT and the CP Tech Center.

TR-677

Agency:
Iowa State University

Principal Investigator:
David White

Research Period:
May 15, 2014 – November 30, 2015

Research Board Funding:
$155,795

Funding Source:
100% State - 83% Secondary funds, 17% Street funds

Embankment Quality and Assessment of Moisture Control Implementation

Objective: The objective of this research is to review grading projects statewide and assess the implementation of compaction with moisture control and contractor quality control operations during embankment construction. Based on the findings, recommendations will be provided to modify the specification language as needed and/or field testing methods to ensure compliance with the moisture control criteria.

In order to accomplish these objectives, a work plan will be developed consisting of the following tasks:

- Review existing literature on moisture/density control best practices
- Identify 8 to 12 grading projects representing the range of Iowa soil conditions
- Develop a check list of information needed at each project site
- Conduct independent field and laboratory testing at selected projects
- Compare findings of testing results with the project QC and QA measurements
- Determine if the field process or specifications need to be updated based on the findings
- Provide report and presentation deliverables

Progress: The ISU research team met with Iowa DOT staff on May 21, 2014 to kick off the project. Nine active grading projects across Iowa were identified by the Iowa DOT for field testing. The selected projects consisted of cohesive and cohesionless materials with moisture and/or moisture/density specification. Additional items were discussed, including the status of the projects, specification documents used for 2013 and 2014 letting projects, methods for obtaining project QC data, Van Dykes information for each project, safety on project sites, and establishing TAC. The team then visited five of the nine sites and began data collection. They have plans to visit each site by the end of the quarter.

Reports: None

Implementation: The results of this study will be published on the IHRB website. Specific standards or practices that may be affected include Iowa DOT specifications and possibly the grading certification materials.

TR-678

Agency:
US Geological Survey

Principal Investigator:
David Eash

Research Period:
May 1, 2014 – January 30, 2015

Research Board Funding:
$46,400

Funding Source:
40% Federal, 60% State – 83% Secondary funds, 17% Street funds

Flood-Estimation Comparisons for Small Drainage Basins in Iowa

Objective: The proposed study will compare flood estimates calculated from different flood-estimation methods to determine which of these methods provides the best estimates for small drainage basins in Iowa. The study will perform two sets of flood-estimation comparisons: one for streamgages with drainage areas less than 2 square miles and another for streamgages with drainage areas between 2 and 20 square miles. The necessity for these comparisons comes with the implementation of Iowa StreamStats and the publication of new flood-estimation regression equations for Iowa.

Reports: None

Implementation: EMA/MGB flood estimates will be computed using the PeakfqSA program version 0.974. StreamStats multi-variable flood estimates will be obtained from Eash and others. Single-variable regression equation, Iowa Runoff Chart, and WRIR 87-4132 estimates will be calculated with spreadsheet formulas. TR-55 flood estimates will be calculated using the NRCS Win TR-55 program (NRCS, 2009). Once the comparisons are complete, IDOT will be able to formulate a policy recommendation about which flood-estimation method to use for each specified drainage area size, which will in turn inform and benefit other engineers, managers, and planners on the matter.

TR-679

Agency:
Iowa State University

Principal Investigator:
Brent Phares

Research Period:
July 1, 2014 – December 31, 2015

Research Board Funding:
$50,000

Funding Source:
100% State – 83% Secondary funds, 17% Street funds

Updating Bridge Rails on Low Volume Roads in Iowa

Objective: The objective of the project is to improve the bridge barrier rail rating system which is used by county engineers for upgrading bridge rails on LVRs in Iowa by:

- Validating the recommendations made by Bigelow et al. in 2010 by performing an updated system-wide crash analysis.
- Evaluating the potential impact of implementing the 2010 recommendations.
- Proposing updated factors/criteria to be used in a future, updated I.M.

Reports: None

Implementation: Several members of the research team have significant past experience working with Iowa County Engineers and implementing bridge and traffic safety research into usable formats. This experience, along with interaction throughout the project with the TAC, will ensure a successful completion of the project and implementation of its findings.

Since this topic also has implications to other nearby states, it is anticipated that many other states and counties will be interested in the results of the project. These results will be distributed to the engineering community through the publication of technical papers in the engineering press, and presentations at bridge and transportation conferences and workshops. Posting of pertinent information on the ISU Institute for Transportation website will be made.

TR-680

Agency:
Iowa State University

Principal Investigator:
Brent Phares

Research Period:
July 1, 2014 – June 30, 2017, 2015

Research Board Funding:
$74,992

Funding Source:
100% Federal

Laboratory and Field Evaluation of a Composite Glue-Laminated Girder to Deck Connection

Objective: The objective of this project is to aid in the development of the next generation timber bridge by:
- Performing laboratory testing of an innovative, field installed girder to deck connection detail that results in composite structure
- Documenting the construction of the Buchanan County Bridge using video and other formats
- Performing a field evaluation that includes measuring changes in live load response over time and documenting the performance of the thing epoxy overlay.

Reports: None

Implementation: County engineers are in need of cost-effective bridge solutions. There have been recent advancements of timber as a bridge building material. This project will serve as a demonstration of the construction and performance of highly engineered timber bridges. It will serve as a vehicle for continuing to improve the efficiency of timber bridge components. This research project will therefore increase the number and cost-effectiveness of bridge solutions available to them.

HR-1027

Agency:
Iowa Department of Transportation

Principal Investigator:
Vanessa A. Goetz

Research Period:
March 1980 –
On-going

Research Board Funding:
$85,000/year
(covers salary and state share of costs for FICA, IPERS, health insurance, vehicle costs and expenses)

Funding Source:
100% State - 100% Secondary funds

Secondary Road Research Engineer

Objective: This is a full-time position at the Iowa DOT. The coordinator's jobs are to act as a research liaison with all of the county engineers and solicit new, innovative and progressive ideas. He or she also actively promotes research for solutions to problems and ideas that will improve quality and reduce costs on the secondary road system.

Progress: Vanessa Goetz continues communications with county engineers to discuss problems encountered by secondary road departments and to discuss current research projects throughout the year.

At any one time as much as 50 percent of IHRB projects involve the secondary road system, including secondary projects with consultants. The coordinator assists these counties with special testing, evaluation and writing of reports necessary to the research and keeps county engineers updated on the latest important research results.

Reports: None

Implementation: There are many problems that are unique to the secondary road system in Iowa. These problems are often common to several counties. Coordination between counties is necessary for understanding the problems and formulating solutions. Proper documentation and dissemination of research results allows for timely technology transfer to and between the counties.