

ANNUAL REPORT
Iowa Highway Research Board
Research and Development Activities
FY 2016



DECEMBER 2016

**ANNUAL REPORT
OF
IOWA HIGHWAY RESEARCH BOARD
RESEARCH AND DEVELOPMENT ACTIVITIES**

**FOR THE
FISCAL YEAR ENDING JUNE 30, 2016**

OFFICE OF RESEARCH AND ANALYTICS
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www.iowadot.gov/RA

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

DECEMBER 2016

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LIST OF ACRONYMS

AASHTO - American Association of State Highway and Transportation Officials
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
STIC – Statewide Transportation Innovation Council
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 Bridges 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's Research section is dedicated to *driving a quality research program that delivers targeted solutions for Iowa's transportation future.*

This report, entitled "Iowa Highway Research Board Research and Development Activities FY2016" 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, 2016. It is also a report on projects completed during the fiscal year beginning July 1, 2015 and ending June 30, 2016. 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 final 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 FY16 is listed in Table I and II.

The Research Board held several regular meetings during the period from July 1, 2015, through June 30, 2016. 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 and 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.**

2015 IOWA HIGHWAY RESEARCH BOARD

| <u>Member</u> | <u>Term Expires</u> | <u>Alternate</u> |
|--|---------------------|--|
| Ahmad Abu-Hawash 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 |
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2016 IOWA HIGHWAY RESEARCH BOARD

| <u>Member</u> | <u>Term Expires</u> | <u>Alternate</u> |
|--|---------------------|--|
| Ahmad Abu-Hawash Chief Structural Engineer Iowa DOT - Bridges and Structures 800 Lincoln Way Ames, IA 50010 (515) 239-1393 Email: Ahmad.Abu-hawash@dot.iowa.gov | 12-31-18 | 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 |
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| Tammy Nicholson Director of Office of Rail Iowa DOT 800 Lincoln Way Ames, IA 50010 (515) 239-1052 Email: Tamara.Nicholson@dot.iowa.gov | 12-31-17 | 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, Chair Civil Engineer II, City of Ankeny 220 W 1 st St Ankeny, IA 50023-1751 (515) 963-3526 Email: sokerlund@ankenyiowa.gov | 12-31-17 | Matt Cox City Engineer, City of Council Bluffs 209 Pearl Street Council Bluffs, IA 51503-0826 (712) 328-4635 Email: mcox@councilbluffs-ia.gov |
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| | | |
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RESEARCH AND DEVELOPMENT PROJECTS

Proposals for research and development are reviewed by the Iowa Highway Research Board. 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, or a combination and the costs are shared.

Table III is a record of expenditures for IHRB Projects made during the fiscal year ending June 30, 2016. Total expenditure was \$1,777,639.34.

Table III
FINANCIAL SUMMARY OF RESEARCH AND DEVELOPMENT PROJECT EXPENDITURES

| July 1, 2015 to June 30, 2016 <i>(Active projects with no current fiscal year expenditures are not included)</i> | | | | | |
|---|--|---|--|--|-----------------------|
| 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 | 13,017.00 | 221,289.00 | 26,034.00 | 260,340.00 |
| HR296 | Local Technical Assistance Program (LTAP) | 73,917.72 | 115,571.40 | 23,125.41 | 212,614.53 |
| HR375 | Transportation Research Board Education for County Engineers | | 3,666.64 | | 3,666.64 |
| TR620 | Update of RCB Culvert Standards to LRFD Specifications | | 8,783.01 | | 8,783.01 |
| TR637 | Development of a Wireless MEMS Multifunction Sensor System and Field Demonstration of Embedded Sensors for Monitoring Concrete Pavements | 62,192.44 | | | 62,192.44 |
| TR655 | Updating the Iowa Culvert Hydraulics and Iowa Bridge Backwater Software | 18,926.46 | 2,470.50 | | 21,396.96 |
| TR660 | Investigation of Negative Moment Reinforcing in Bridge Decks | | 19,222.53 | | 19,222.53 |
| TR661 | Evaluate the Need for Longitudinal Median Joints in Bridge Decks on Dual Structures | | 45,943.22 | | 45,943.22 |
| TR664 | Low Cost Rural Surface Alternatives: Demonstration Project | | 8,296.50 | | 8,296.50 |
| TR669 | Statistical Summary of Selected Iowa Streamflow Data | | 19,582.70 | | 19,582.70 |
| TR673 | Design and Performance Verification of a Bridge Column/Footing/Pile System for Accelerated Bridge Construction (ABC) | | 46,641.15 | | 46,641.15 |
| TR674 | Evaluation of Otta Seal Surfacing for Low-Volume Roads In Iowa | | 62,936.40 | | 62,936.40 |
| TR675 | Assessment of PCC Concrete Setting Time and Joint Sawing | | 16,390.49 | | 16,390.49 |
| TR676 | Impacts of Internally Cured Concrete Paving on Contraction Joint Spacing | | 41,868.98 | | 41,868.98 |
| TR677 | Embankment Quality and Assessment of Moisture Control Implementation | | 20,101.05 | | 20,101.05 |
| TR678 | Flood-Estimation Comparisons for Small Drainage Basins in Iowa | | 2,032.00 | | 2,032.00 |
| TR679 | Upgrading Bridge Rails on Low Volume Roads in Iowa | | 13,246.94 | 6,782.51 | 20,029.45 |

| | | | | | |
|-------------------|--|------------|--------------|------------|--------------|
| TR682 | Standard for Single Span Prefabricated Bridges- Phase III | | 317,150.70 | 35,750.78 | 352,901.48 |
| TR683 | Bridge Workshop - Use of Ultra-High Performance Concrete for Bridges | 2,749.81 | | | |
| TR684 | Laboratory and Field Evaluation of an Alternative UHPC Mix and an Associated UHPC Bridge | 33,404.02 | 5,283.79 | | 38,687.81 |
| TR685 | Feasibility of Gravel Road and Shoulder Recycling | 46,095.63 | 12,081.21 | | 58,176.84 |
| TR686 | Guidance on Traffic Sign Effectiveness, Installation, and removal | 18,367.62 | 16,848.96 | | 35,216.58 |
| TR689 | County Engineers Education: Low Volume Road Conference | | 2,853.67 | | |
| TR692 | Investigation of Stream-Channel and Watershed Delineations and Basin-Characteristic Measurements using LiDAR Data for Small Drainage Basins in Iowa Located Within the Des Moines Lobe Landform Region | 63,165.00 | 36,540.63 | | 99,705.63 |
| TR696 | Installation Guidance for Centerline and Edgeline Rumble Strips in Narrow Pavements | 24,000.00 | 30,000.00 | 325.94 | 54,325.94 |
| TR697 | Prevention and Restoration of Early Joint Deterioration | 14,681.05 | | | 14,681.05 |
| TR698 | Concrete Overlay Performance on Iowa's Roadways | 32,327.87 | | | 32,327.87 |
| TR699 | Real-time Flood Forecasting and Monitoring Systems for Highway Overtopping in Iowa | 81,152.86 | | | 81,152.86 |
| TR700 | Prevention of Longitudinal Cracking in Iowa Widened Concrete Pavement | 832.55 | | | 832.55 |
| TR701 | Evaluation of the Use of Link Slabs in Bridge Projects | 6,807.70 | | | 6,807.70 |
| TR703 | Update Depth of Cover Tables for Concrete and Corrugated Pipe | 12,255.36 | | | 12,255.36 |
| TR704 | Performance Based Evaluation of cost Effective Aggregate Options for Granular Roadways | 51.14 | | | 51.14 |
| TR706 | County Use of the BridgeWatch | 13,150.00 | 16,437.00 | 3,288.00 | 32,875.00 |
| TR708 | Organization of the 2016 Innovative Projects Program | 32,000.00 | 40,000.00 | 8,000.00 | 80,000.00 |
| Expenditure Total | | 549,094.23 | 1,125,238.47 | 103,306.64 | 1,777,639.34 |

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 2016 financial summary is:

| | | |
|--|-----------------|-----------------------|
| Beginning Balance 7-1-15 | | \$ 1,786,362.91 |
| Receipts | | |
| State Road Use Tax Fund (1½% of receipts) | \$ 1,593,632.27 | |
| Federal Aid Secondary (1½% of receipts) | 0.00 | |
| Research Income | <u>\$ 0.00</u> | |
| Sub-Total | | <u>\$1,593,632.27</u> |
| Total Funds Available | | \$3,379,995.18 |
| Obligation for Expenditures | | |
| Obligated for | | |
| Contract Research | \$1,672,475.84 | |
| Non-Contract | | |
| Engineering Studies | <u>\$ 0.00</u> | |
| Total Expenditures | | \$1,672,475.84 |
| Ending Balance 6-30-16 | | \$1,707,519.34 |

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 2016 financial summary is:

| | |
|---|--------------------|
| Beginning Balance (7-1-15) | \$144,039 |
| FY16 Street Research Funding | <u>\$200,000</u> |
| Total Funds Available for Street Research | \$344,039 |
| Total Obligated for Expenditure FY16 | <u>(\$222,626)</u> |
| Ending Unobligated Balance 6-30-16 | \$121,412 |

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 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 FY16 was \$549,094.23 and the estimate for obligations for FY17 is \$750,000.

PROJECTS INITIATED DURING FY 2016

The following projects were initiated in FY 16.

TR-683, “Bridge Workshops - Use of Ultra-High Performance Concrete for Bridges”

TR-697, “Prevention and Restoration of Early Joint Deterioration”

TR-698, “Concrete Overlay Performance on Iowa's Roadways”

TR-699, “Real-time Flood Forecasting and Monitoring Systems for Highway Overtopping in Iowa”

TR-700, “Prevention of Longitudinal Cracking in Iowa Widened Concrete Pavement”

TR-701, “Evaluation of the Use of Link Slabs in Bridge Projects”

TR-703, “Update Depth of Cover Tables for Concrete and Corrugated Pipe”

TR-704, “Performance Based Evaluation of Cost-Effective Aggregate Options for Granular Roadways”

TR-705, “Evaluation of the Performance of a Short-Span T-beam Bridge in Buchanan County”

TR-706, “County Use of the BridgeWatch”

TR-708, “Organization of the 2016 Innovative Projects Program”

TR-709, “Effectiveness of Pavement Preservation Techniques”

TR-710, “Partially Grouted Revetment for Low Volume Road Bridges”

TR-711, “Investigation of Exterior Girder Rotation and the Effect of Skew during Deck Placement”

TR-712, “Evaluate, Modify and Adapt the Concrete Works Software for Iowa's Use”

TR-713, “Load Rating of Standard Bridges for Special Hauling Vehicles”

16 Projects Initiated

PROJECTS COMPLETED DURING FY 2016

The following projects were completed during FY 2016 and project Final Reports were approved by the Iowa Highway Research Board. Links to the available final reports are provided.

TR-620, “Update of RCB Culvert Standards to LRFD Specifications”

<http://www.iowadot.gov/bridge/finalprog.htm>

TR-625, “Improving Accuracy of Deflection & Camber Predictions for Prestressed Concrete Bridge Girders”

<http://publications.iowa.gov/20447/>

TR-637, “Development of a Wireless MEMS Multifunction Sensor System and Field Demonstration of Embedded Sensors for Monitoring Concrete Pavements” <http://publications.iowa.gov/22658/>

TR-641, “Reflective Crack Mitigation Guide for Flexible Pavements” <http://publications.iowa.gov/20449/>

TR-645, Funding participation in “Development and Integration of Advanced Timber Bridge Inspection Techniques for NBIS” – MN led project. <http://www.dot.state.mn.us/bridge/pdf/insp/timber-bridge-inspection-manual.pdf>

TR-648, “Evaluation and Testing of a Light-Weight Fine Aggregate Concrete Bridge Deck in Buchanan County, Iowa” <http://publications.iowa.gov/22239/>

TR-650, “Development of Non-Petroleum Based Binders for Use in Flexible Pavements- Phase 2”

<http://publications.iowa.gov/20463/>

TR-651, “Iowa Pavement Asset Management Decision Framework” <http://publications.iowa.gov/20731/>

TR-654, “Development of a Subgrade Drainage Model for Unpaved Roads”

<http://publications.iowa.gov/20730/>

TR-655, “Updating the Iowa Culvert Hydraulics and Iowa Bridge Backwater Software”

TR-660, “Investigation of Negative Moment Reinforcing in Bridge Decks” <http://publications.iowa.gov/20465/>

TR-661, “Evaluate the Need for Longitudinal Median Joints in Bridge Decks on Dual Structures”

<http://publications.iowa.gov/20466/>

TR-667, “Validation of Gyrotory Mix Design in Iowa” <http://publications.iowa.gov/22605/>

TR-668, “Impact of Curling and Warping on Concrete Pavement” <http://publications.iowa.gov/22611/>

TR-669, “Statistical Summary of Selected Iowa Streamflow Data through September 30, 2013”

<http://publications.iowa.gov/21900/>

TR-675, “Assessment of PCC Concrete Setting Time and Joint Sawing” <http://publications.iowa.gov/20589/>

TR-677, “Embankment Quality and Assessment of Moisture Control Implementation”

<http://publications.iowa.gov/21901/>

TR-678, “Flood-Estimation Comparisons for Small Drainage Basins in Iowa”

<http://publications.iowa.gov/20467/>

TR-679, “Upgrading Bridge Rails on Low Volume Roads in Iowa” <http://publications.iowa.gov/22592/>

TR-682, “Standard for Single Span Prefabricated Bridges-Phase III”

<http://www.iowadot.gov/bridge/countybrgstd.htm>

TR-686, “Guidance on Traffic Sign Effectiveness, Installation, and Removal”

TR-694, “Temporary Traffic Control Handbook for Local Agencies” <http://publications.iowa.gov/21890/>

TR-697, “Prevention and Restoration of Early Joint Deterioration”

23 Projects Completed and Approved