Mission
Invest in innovative research that develops, maintains, and assists Ohio in establishing a world class transportation system.

Goals
The primary goal of the RD&T2 program is to provide decision makers with the information and tools they need to meet the evolving transportation needs of Ohioans and the traveling public. The secondary goals of the program include: maximizing research investments; taking advantage of new technologies; and producing practical research results with strong implementation potential.

Jennifer Townley, Acting Deputy Director
Division of Planning

Scott Phinney, P.E., Administrator
Office of Statewide Planning & Research

Cynthia Jones, Section Head
Research Section

In cooperation with the U.S.
Department of Transportation, Ohio
Division of the Federal Highway Administration
ODOT’S STRATEGIC RESEARCH FOCUS AREAS

Ohio has one of the world’s largest transportation systems, creating opportunities as well as challenges for the state. ODOT uses strategic planning to take advantage of opportunities and meet the state’s challenges in a timely manner. Below are the RD&T² program’s three focus areas. The focus areas guide how the majority of program funds are expended. However, in acknowledgment of specialized or urgent needs program funding will not be limited to these broad based areas.

Transportation Infrastructure Preservation and Enhancement
ODOT’s largest asset is its transportation infrastructure, such as roads, bridges, intermodal facilities, railways and ports. Through usage and the passage of time, the system degrades and can become inadequate for both current and projected travel demands. Maintenance of the infrastructure presents many challenges as well as opportunities for improvements. Developing methods to better utilize resources and integrate advances in science, technology, and construction techniques will assist ODOT in efforts to both modernize and support our system.

Organizational Transformation
ODOT is faced with challenging situations brought about by economics, demographics, management trends, downsizing, shifts in federal funding, and increased maintenance needs. Research can guide ODOT in creating opportunities to foster innovation, leverage resources, and streamline and enhance both decision making and project delivery.

Transportation Safety
Ensuring the safety of those utilizing and maintaining our transportation system is a priority for ODOT. The traveling public expects the system to meet their individual needs in a manner that is safe, convenient, economic, and efficient with minimal disruption to their daily routines. In addition, protection for highway crews working on-location is a prominent concern. Identifying, developing and implementing corrective strategies before hazardous events occur is key to advancing a safe and reliable transportation system.
June 30, 2015

Jerry Wray
Director
Ohio Department of Transportation
1980 West Broad Street
Columbus, OH 43223

Dear Director Wray:

This letter grants our approval of the Final SFY 2016 Statewide Planning & Research (SPR) Program (Parts I & II).

We hereby approve your SFY 2016 SPR Program, Parts I & II, with the following understandings:

1. The US DOT Consolidated Planning Grant and Unified Planning Work Programs for the 17-Ohio MPOs are hereby approved.
2. Separate approvals will be required for any new planning or research studies, deletions, or significant modifications to existing studies consistent with current ODOT program management manuals.

With this approval, you are hereby authorized to proceed with the approved work and can begin to incur reimbursable costs effective July 1, 2015. Please direct questions about this approval to Frank Burkett, Senior Planning Specialist, at (614) 280-6838.

Sincerely,

[Signature]

Marisol R. Simon
Regional Administrator
Federal Transit Administration

By messenger (ODOT)

[Signature]

Laura S. Leffler
Division Administrator
Federal Highway Administration
# ODOT Research Financial Forecast

as of 5/28/15

<table>
<thead>
<tr>
<th>Current Year Budget (SFY16)</th>
<th>Future Year Budgets</th>
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<tr>
<td></td>
<td>SFY17</td>
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<tr>
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<td>Estimated Beginning Budget</td>
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<tr>
<th>Planned</th>
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<th>SFY18</th>
<th>SFY19</th>
<th>SFY20</th>
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Estimated Ending Balance

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<th>SFY19</th>
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<td>1</td>
<td>Operation &amp; Maintenance of a Statewide Crest-Stage Stream Gauging Network in Ohio</td>
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<td>2</td>
<td>Development of Transportation Asset Management Decision Support Tools</td>
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<td>Polymeric Thermochromic Dye for Improvement of Asphalt Pavement Durability</td>
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<td>Structures Research Services</td>
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<td>Effectiveness of Asphalt Penetrating Sealers in Extending New Asphalt Pavement Life</td>
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<td>Assessment of ODOT's Conduit Service Life Prediction Methodology</td>
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<td>Procedures for Waste Management from Street Sweeping and Storm Water Systems</td>
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<td>Evaluation of GPS/AVL Systems for Snow &amp; Ice Operations Resource Management</td>
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<td>Passenger Flow Estimation and Characteristics Expansion</td>
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<td>Evaluation of High Performance Pavement and Bridge Deck Wearing Surface Repair Materials</td>
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<td>Investigate PLOW Blade Optimization</td>
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<td>Development of a Pavement Marking Materials Matrix for ODOT District 11</td>
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<td>Alternative Stream Channel Maintenance at Bridge Crossings</td>
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<td>Development of an Overlay Design Procedure for Composite Pavements</td>
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<td>Evaluating Vegetation Management Practices for Woody and Herbaceous Vegetation</td>
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<td>Bubble Plate Implementation</td>
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<td>Implementation and Analysis of Epoke Research</td>
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<td>Enhancement of UASLOPE for Improving Implementation Efficiency</td>
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<td>Analysis of Ground Tire Rubber (GTR) in Mix Design on Local Roadways in Ohio</td>
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<td>Storm Water Best Management Practices for Local Roadways</td>
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<td>Investigation of In-Situ Strength of Various Construction/Widening Methods Utilized on Local Roads</td>
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<td>Geotechnical Engineering Research On-Call Services (ROC)</td>
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<td>Forensic Study of Early Failures with Unbonded Concrete Overlays</td>
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<td>Evaluation and Design of a TL-3 Bridge Guardrail System Mounted to Steel Fascia Beams</td>
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<td>Performance Comparison of Structural Steel Coating Systems</td>
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<td>Preliminary Evaluation of Cool-crete</td>
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<td>Effectiveness of Wildlife Mitigation Treatments on the Nelsonville Bypass</td>
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<td>Performance Comparison of Abutment and Retaining Wall Drainage Systems</td>
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<td>43 135031</td>
<td>Inspection, Repair, Retrofit Procedures, and Design Recommendations for Non-Redundant Steel Structures</td>
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<td>Bridge Trough Maintenance Evaluation on Finger Joint Bridges</td>
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<td>Understanding the Soil Plugging Mechanism in Large Open Ended Pipe</td>
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<td>Development and Field Testing of an Automatic Turning Movements Identification System</td>
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<td>A Comparison of Full Wave Inversion Technique to Assess Underground Voids</td>
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<td>Bonded Concrete Overlay (BCO) Cost Effectiveness Evaluation</td>
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$15,988,398.36
Project Title: Operation & Maintenance of a Statewide Crest-Stage Stream Gauging Network in Ohio

Research Agency: Ohio Department of Natural Resources

Researcher: Branden Vonins

State Job #: 134141

RFP #: 04-B

Status: Active

State Job #: 134141

RFP #: 04-B

Start Date: August 7, 2003

End Date: August 7, 2021

Classification: Standard

Project Type: Hydraulics

Technical Lead: Tom Birnbrich

Abstract:

STATEMENT OF NEED:
Flood magnitude and frequency data are not available for many stream sites in Ohio. Floods cause serious damage to private property as well as public buildings and highways every year. Floods also pose a risk of personal injury and death. Further knowledge of the magnitude and frequency of flooding could be used to reduce the risk associated with flooding.

STUDY OBJECTIVES:
The objectives of the Operation and Maintenance of a Statewide Crest-Stage Stream Gauging Network in Ohio study is to collect additional flood data at a selected stream sites throughout Ohio.

RESEARCH TASKS:
1. Systematically operate 18 gage sites and collect flood flow data for a period of at least 20 years.
2. If only flood data is needed, crest stages can be used in an efficient way by using the following methods
   a) Use Method A for sites with drainage area of 7 square miles or less with a suitable culvert.
   b) Use Method B for sites with drainage area of 45 to 100 square miles or less with channels that are not suitable for a theoretical channel rating.
   c) Use Method B for sites with drainage area of 5 to 45 square miles or less with channels that are suitable for a theoretical channel rating.
3. Install and operate a network of 18 crest stage gages (6 of Method A, 6 of Method B, 6 of Method C) for a period of 20 years.

PROJECT DELIVERABLES:
1. Annually published the instantaneous stream-flows above the base-peak flow in the Ohio District Water Resources Data Report.
2. Published and released within 12 months of the initiation of operation of the gages a USGS Fact Sheet identifying each of the 18 stream sites with crest-stage installed and the method of operation of the gages will be.
3. The Final report will be written to summarize the entire project at the completion of 20 years of data collection.
Abstract:

STATEMENT OF NEED:
Implementing transportation asset management is a process of continuous improvement. The importance of senior management support cannot be overstated. The benefits of asset management as a decision support tool in making crucial funding decisions, planning budget trade-offs, monitoring asset performance, reducing asset life-cycle costs, and optimizing resource allocations may not be as apparent as the required investments in data collection and integration, process and definition standardization, and management information system acquisition and implementation, etc. A prototype platform that can readily demonstrate the benefits and capabilities of asset management as a decision support tool to the senior management will be highly valuable in building consensus and support for implementing asset management throughout the Department. Currently, various data reside in multiple databases, while senior management often needs reports or presentations based on a summary of the data (i.e., metadata) to make decisions. Since data are frequently updated to reflect current condition and cost estimates, new report/presentation needs to be generated each time and it can become tedious or inconsistent, if not automated. A web-based platform that contains automatically generated up-to-date reports/presentations based on a set of standard templates and is capable of interactive what-if analysis to support executive level asset management decision-making is warranted.

STUDY OBJECTIVES:
The objective of "Managing Transportation Assets: Developing of Enabling Decision Support Tools" is to develop a web-based platform for asset management.

RESEARCH TASKS:
Task 1 - Conduct a best practices assessment of existing asset management practices.
Task 2 - Develop a prototype platform that contains enabling decision support tools and processes.
Task 3 - Perform a gap analysis to identify areas of critical needs for successful implementation.
Task 4 - Provide training to ODOT on prototype platform.

PROJECT DELIVERABLES:
1) Web-based platform that contains a set of decision support tools that demonstrate the benefits and capabilities of transportation asset management as a decision tool
2) Gap analysis results
3) Quarterly progress reports
4) Draft and approved versions of a final report and executive summary.
5) Article for Research newsletter (upon request)
6) Participation in required meeting
**Project Title:** Polymeric Thermochromic Dye for Improvement of Asphalt Pavement Durability  
**Research Agency:** Case Western Reserve University  
**Researcher:** Bill Yu  
**Status:** Active  
**State Job #:** 134661  
**RFP #:** 2012-23  
**Start Date:** July 10, 2012  
**End Date:** January 10, 2016  
**Classification:** OPREP  
**Technical Lead:** David Powers  
**Project Type:** Pavements

**Abstract:**

**STATEMENT OF NEED:**
The majority of highways in Ohio are surfaced with asphalt. The conventional asphalt has high solar absorbance due to its dark color. Consequently, the surface temperature of asphalt pavement can be considerably higher during summer than pavement with a lighter surface, i.e., concrete pavement. The dark color also means asphalt road radiate thermal energy faster during winter and therefore cools at a fast rate. The influence of thermal loads can be translated into reduced structural strength, increased rutting, accelerated aging of binders and thermal cracks; all compromise pavement performance. Pigments and seals have become available to change the color of an asphalt surface to make it lighter. However, common types of pigments are based on metallic powder or crystal salt, which does not have good compatibility with polymeric binders. ODOT experience indicated that the use of Verglimit, a crystalline phase change materials for thermal energy storage, resulted in failure of pavement. Polymeric dye, which feature excellent compatibility with asphalt binder, has promise to overcome the limitations and significantly increase the durability via its multifunctional roles.

**STUDY OBJECTIVES:**
The objective of “Evaluate the Performance of Multifunctional Polymeric Thermochromic Dye to Increase Durability of Asphalt Pavement” is to evaluate the effectiveness of multifunctional polymeric thermochromic dye to increase the longevity of asphalt pavement via multifunctional roles of both improving its optical properties and microstructure.
## Abstract:

**STATEMENT OF NEED:**
The Ohio Department of Transportation (ODOT) is a large state agency charged with management and maintenance a vast transportation system in Ohio. ODOT strives to execute its charge in the most effective and efficient manner possible. Frequently, ODOT encounters situations where low cost, short term research services are needed to meet immediate needs for system management and maintenance improvements. Some of the short term research needs may go unmet due to the imniacy of the need and the perceived long delay in navigating ODOT’s research process.

**STUDY OBJECTIVES:**
The objective of "Structures Research Services" is to establish an on-call contract with a research team possessing strong expertize in the field of structural engineering to conduct low cost, short term research in advance of identifying specific research needs.

**RESEARCH TASKS:**
Specific research tasks will be determined as needs arise. Potential research topics may include, but are not limited, to the following:

1. Assist with forensic investigations when concerns are raised about a bridge
2. Investigate physical properties and structural behavior on unique and special bridges to model and determine forces, capacities, failure, modes, etc.
3. Investigate the loadings within critical gusset plates using a photo-elastic material to better understand how the loads transfer through the gusset plate
4. Determine MSE wall long term stability and maintenance recommendations
5. Investigate concrete slab full depth cracking in continuous structures - causes and recommendations to alleviate cracking
Project Title: Effectiveness of Asphalt Penetrating Sealers in Extending New Asphalt Pavement Life


Researcher: Harold Von Quintus

Status: Active

State Job #: 134702

RFP #: 2013-18

Start Date: August 23, 2012

End Date: December 23, 2016

Classification: Standard

Technical Lead: Matt Blythe

Project Type: Pavements

Abstract:

STATEMENT OF NEED:
Over the last 30 years, the Ohio Department of Transportation (ODOT) has investigated the benefits of using various asphalt rejuvenators. To date, results have been mixed. ODOT would like to test several of these products in a controlled research study to measure their effectiveness in extending the life of new asphalt pavement.

STUDY OBJECTIVES:
The objective of this research is to evaluate three products currently used by ODOT, Replay, supplied by Ohio Pavement Systems Inc., Reclamite, supplied by Pavement Technology Inc., and Bio-Re-Stor, supplied by Asphalt Systems Inc.

RESEARCH TASKS:
1. Measure in place asphalt permeability both before and after treatment and after 4 years in service for all treated and control sections. Use the air-induced field permeameter, developed by the Kentucky Transportation Cabinet, for this testing. For additional information on this research visit: http://www.ktc.uky.edu/Reports/KTC_01_19_SPR216_00_1F.pdf. The number of tests and test location for this testing will be determined by the researcher.
2. Perform detailed pavement condition surveys for all treated and control sections initially and annually for 4 years. Use the methods defined by the Long Term Pavement Performance Distress Manual (FHWA-RD-03-031, June 2003). The 500 foot sections used as a part of this distress survey will remain constant throughout the evaluation period.
3. Perform sand patch testing according to ASTM E 965-96 (Reapproved 2006) for all treated and control sections. Complete the testing initially and annually for 4 years. The number of tests and locations for this testing will be determined by the researcher. The location of the testing will remain constant thought out the evaluation period.
4. The Department also wishes to collect skid testing data on the treated and untreated sections. It is known that asphalt rejuvenating products such as these will reduce the initial skid resistance of the pavement. The Department will collect both smooth tire and ribbed tire skid data on all the treated and untreated sections. The timing of this testing will occur before treatment, after treatment, at 7 days, and finally after 30 days. It will be the researcher's responsibility to coordinate with our skid testers to schedule this testing and to summarize the results.
5. The researcher should plan on pulling and testing at least three, 4 inch or larger cores from each test section to show that the pavement was relatively uniform in density between test sections. Maximum Specific Gravity values for this purpose can be taken from each days TE-199 quality control report available through the construction project. Testing must be performed by an approved and experienced technician.
Abstract:

The objective of this research is to design automated process improvements for ensuring QC/QA of asphalt and aggregate materials utilized by ODOT Contractors on highway projects. As ODOT moves towards becoming a leaner more efficient agency, research into the development of an automated process that enables Asphalt and Aggregate Contractors to directly input information into a system that conducts preliminary analysis for established quality controls measures is needed in order to fully streamline ODOT's management of highway materials.

Phase I of this project is complete and focused on researching the development of an automated process that enables Asphalt and Aggregate Contractors to directly input information into a system that conducts preliminary analysis for established quality control measures, which is needed in order to fully streamline ODOT's management of highway materials.

Phase 2 will develop the system in accordance with the approved interim report that was provided at the end of Phase I. Multiple user testing will be conducted throughout the development process, and adjustments to the system will be made based on testing as necessary to ensure proper functionality. Documentation will be developed and maintained on the system development in accordance with ODOT's IT requirements. The system will be developed with oversight from ODOT's IT division in collaboration with Outerbox (a subcontractor).

Phase 2 activities will include a pilot build and evaluation of the automated process, which would involve developing, adjusting, and testing the system to ensure that it functions properly; developing an online, interactive training module or user manual as part of the system; and developing a programmer guide to be used by ODOT information technology (IT) staff.

Phase 2 is pending ODOT IT Governance approval in July 2014.
Abstract:

STATEMENT OF NEED:
Currently, ODOT manages and maintains approximately 100,000 culverts statewide. The design, evaluation, and service life predictions of these assets are done in accordance with the Location and Design (L&D) Manual, Volume 2 (available online at: http://www.dot.state.oh.us/Divisions/Engineering/Hydraulic/LandD/Pages/LDManual,Volume2.aspx). The existing design service life predictions are limited to culverts and do not include other conduits such as storm sewer. The data utilized to develop ODOT's methodology for predicting service life is from the 1970's. Since then, additional conduit types, material types, and protective coatings have been introduced. As a result, the manner in which ODOT currently predicts service life for conduits may no longer be appropriate. ODOT's current approach to conduit maintenance is reactionary. Deficiencies that are discovered by inspection or observations (i.e.: sinkholes) are addressed as they are identified. As a result, methods of conduit rehabilitation may be limited to more costly alternatives than would be available if a more proactive approach was available. An accurate service life estimate for conduit materials and protective coatings will allow ODOT to develop a proactive approach for conduit maintenance.

STUDY OBJECTIVES:
The research will evaluate the effectiveness of ODOT's current methodology for estimating service life of culverts and it will evaluate metrics to be used for storm sewer conduits. The research will evaluate and propose alternative metrics, as necessary, to ensure accurate and reliable service life predictions. It is expected that a service life estimate would be made using degradation models developed through the research for various materials and protective coatings currently used by ODOT.
Project Title: Procedures for Waste Management from Street Sweeping and Storm Water Systems

Research Agency: University of Akron

Researcher: Chris Miller

Status: Active

State Job #: 134731

State Fiscal Year: 2016

RFP #: 2013-02

Project Title: Procedures for Waste Management from Street Sweeping and Storm Water Systems

Project Type: Maintenance

Start Date: October 28, 2012

End Date: March 29, 2016

Classification: Standard

Abstract:

STATEMENT OF NEED:
Knowledge of handling waste materials from maintenance activities is currently limited. Temporary storage of collected material at ODOT facilities is currently allowed, but involves thorough understanding and better education of the regulations associated with the waste material. Once collected, the material is required to be properly separated into liquid and solid forms (decanting) prior to disposal at a waste facility. Currently, ODOT maintenance crews need economically feasible options for decanting this material once collected.

STUDY OBJECTIVES:
The research covered by this project may be utilized by multiple offices within ODOT. ODOT will use the research data and recommendations to update maintenance procedures and policies improving efficiency while decreasing regulatory risks. The material testing and literature research will be used to help inform regulatory entities for creating beneficial reuse strategies and ensuring ODOT’s interest are included. The research will help facility planning for use in optimizing equipment purchases and develop design criteria for ensuring purchased equipment is located and sized appropriate for demand requirements.
Project Title: Evaluation of GPS/AVL Systems for Snow & Ice Operations Resource Management

Research Agency: University of Akron

Researcher: Bill Schneider

State Job #: 134740

Status: Active

End Date: October 23, 2015

RFP #: 2013-01

Classification: Standard

Project Type: Maintenance

Technical Lead: Brian Olson

Abstract:

STATEMENT OF NEED:
Beginning with the 2009-2010 winter season, ODOT implemented a ten truck GPS/AVL resource management system pilot at Cuyahoga County's Independence Garage. For the past two winter seasons, ODOT has utilized the system and gathered information for the purposes of determining the advantages, disadvantages, and feasibility of using GPS/AVL as an enhanced method for the tracking and management of ODOT's snow and ice resources. Based on the experiences from the pilot, the following three implementation levels have been established for the potential incorporation of GPS/AVL into ODOT's snow and ice control program.

Level 1: Tracking of plow trucks
Level 2: Tracking of plow trucks with real-time snow & ice related telemetry
Level 3: Tracking of plow trucks with real-time snow & ice related telemetry and automated resource usage reporting

Thus far, ODOT has determined that GPS/AVL systems can be utilized to successfully track the real-time and historical locations of ODOT's plow trucks. However, the system's ability to be a true resource management system by providing consistent snow and ice removal related telemetry and producing accurate resource usage reports from the acquired data remains undetermined. Therefore, further evaluation and analysis of snow and ice based GPS/AVL systems is needed to assess the data accuracy required for automated resource usage reporting and the potential implementation of GPS/AVL as a resource management tool for ODOT's snow and ice removal operations.

STUDY OBJECTIVES:
The objective of this research is to identify, select, and implement GPS/AVL resource management systems in District 3 Medina County and District 4 Stark County and evaluate the technology's potential to provide consistent and accurate data for the purposes of real-time snow and ice operations management, automated resource usage reporting, and implementation into ODOT's winter maintenance program. The installations of GPS/AVL systems will include approximately 25 units at two garages in Medina County and 23 units at one garage in Stark County. The exact number of units will be determined prior to the implementation. In addition to the data provided from the Medina and Stark systems, data will be made available for evaluation from the existing GPS/AVL systems located in Cuyahoga, Delaware, and Madison counties.
Abstract:

STATEMENT OF NEED:
Travel Demand Forecasting Models (TDFM) employ many statistical models to generate estimates of trip generation, distribution and modal split in most urban areas. These models are then used in a variety of purposes, including transit alternatives analyses, roadway design and air quality conformity analyses. The Department maintains fifteen urban models in addition to the statewide TDFM. Modal Choice models in TDFMs are estimated from Transit On-Board Surveys. New On-Board Surveys are required by the FTA for certain projects such as New Starts, including new or extended fixed guideway service.

On-Board Surveys have traditionally been conducted by handing a paper survey to a boarding transit passenger and requesting the passenger to fill out the survey while on board the bus or train and returning it upon exiting. While there is always a mail-back option, few surveys are returned once the passenger alights from the vehicle. Therefore, the likelihood of receiving surveys from passengers who are only riding a few blocks is poor. To date, there have been efforts to factor surveys by distance, however, this has only been easily accommodated by service where tickets are read when entering and exiting stations, such as the DC Metro.

As On-Board Surveys are being or have recently been conducted in Cleveland, Columbus, and Cincinnati, it is appealing to quantify the bias found in reported distance so that these surveys could be re-weighted to accurately reflect transit usage. A more accurate representation in the TDFMs of current conditions will then allow for more representative transit patronage forecasts. This is important for the Department as it will affect District 8's Cincinnati Eastern Corridor. Other affected projects include GCRTA's Blue Line Extension, and possibly Bus Rapid Transit Service for COTA or Metro. Additionally, On-Board Surveys are expensive to collect. While new methods of collecting unbiased survey data are being tested in Atlanta and Los Angeles, these new methods have additional costs above that of a standard survey. Typically, the cost of an On-Board Survey is prohibitive for small and medium-sized urban areas. As Automatic Passenger Counters (APC) are being installed on newer buses, there may be an opportunity to use the APC data to estimate origin-destination flows without the cost of an On-Board Survey.

STUDY OBJECTIVES:
The objective of "Evaluation of Biases in Transit On-Board Surveys" is to quantify the amount of bias in the 2008 COTA On-Board Survey (and other similar On-Board Surveys), specifically in regards to distance traveled and inclusive of any others that the researcher discovers, and to determine appropriate methods to ameliorate those biases in the data. A secondary focus is to ascertain whether APC data can be used to approximate origin-destination flows that are collected as a part of an On-Board Survey.
### Project Title: Evaluation of High Performance Pavement and Bridge Deck Wearing Surface Repair Materials

**Research Agency:** Cleveland State University  
**Researcher:** Norbert Delatte  
**Status:** Active  
**State Job #:** 134816  
**End Date:** August 13, 2016  
**RFP #:** 2014-01  
**Standard Classification:** Pavements  
**Project Type:** Pavements

**Technical Lead:** Gary Middleton

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**Abstract:**

**STATEMENT OF NEED:**

The Ohio Department of Transportation has identified the need to specify durable, more permanent high performing pavement and bridge deck patching materials that allow for expediting pavement and bridge deck wearing surface repair for worker and user safety. Currently, either temporary or generally specified in-kind or like materials are being used to perform pavement patching. Usually, the Department provides generically specified cementitious or cold asphalt materials for patching wearing surfaces with varied performance characteristics. Current products used for this purpose are generally those that have been used for many decades for which competition exists. However, new or proprietary products are difficult to specify unless incorporated into a construction project for research purposes, an approved equal is permitted, or procurement of the product complies with the Department’s direct purchasing requirements. Consequently, this creates a situation in which the desired product is precluded from use.

**GOALS AND OBJECTIVES:**

- Identify/determine acceptable field performance criteria for comparative analysis of selected products.
- Install the products at mutually agreed locations as described herein.
- Evaluate the products based on field performance criteria.
- Provide updated field performance evaluation criteria based on the field performance analysis.
- Provide a comprehensive standard material and performance based generic specifications in the Standard ODOT Construction and Material Specifications or Supplemental Specifications format based on desired ASTM or equivalent material properties and field performance analysis.
- Provide a decision matrix for use of the recommended products.
Project Title: Investigate Plow Blade Optimization

Research Agency: University of Akron

Status: Active  State Job #: 134817

Start Date: August 19, 2013  End Date: August 19, 2015

Technical Lead: Doug Riffle

Researcher: Bill Schneider

RFP #: 2014-07

Classification: Standard

Project Type: Maintenance

Abstract:

STATEMENT OF NEED:
The single largest cost item in the maintenance budget for ODOT is snow and ice control (accounting for roughly $50 million in total expenses). One goal of snow and ice control is to provide adequate level of service to the motoring public, which is measured by regain time or the amount of time to recover after a snow event by increasing the vehicle speed to within 10 mph of speed limit. The major technique for snow removal on roadways is the use of snow plows and snow plow blades, or cutting edges. The plow blade is the component of the plowing system that makes contact with the roadway surface. Friction causes the blades to wear which requires eventually requires their replacement. The rate of deterioration is based on several factors including: the type of blade, roadway surface type, plowing speed, and the operator's plowing habits. Plows blades are commonly replaced two to three times per winter season which increases the maintenance cost. Plow blades are cumbersome and issues arise in terms of safety and efficiency when replacing them. Evaluations of varying slow plows will be made in Districts 3, 4, 5, and 12.

Winter maintenance is incredibly time and resource intensive for ODOT. This proposal is developed to provide ODOT with plow blades requiring fewer changes per season as well as recommendations for safely changing blades. The result will be lower overall costs based on the longer life of the plow blades, reduced maintenance costs, as well as increased safety by use of specialized changing equipment and decreasing the frequency at which employees will need to change plow blades.

GOALS AND OBJECTIVES:
Objective One - Determine a usage strategy based on safe, efficient, and cost effective methods for changing and purchasing plow blades.
Objective Two - Recommend specialized blade changing equipment to assist and protect operators.
Objective Three - Recommend plow blades based on condition types.
Project Title: Development of a Pavement Marking Materials Matrix for ODOT District 11

Research Agency: University of Akron

Researcher: Ala R. Abbas

Status: Active

State Job #: 134820

RFP #: 2014-09

State Job #: 134820

End Date: November 15, 2016

Classification: Standard

Project Type: Maintenance

Technical Lead: Bobby Taylor

Abstract:

STATEMENT OF NEED:
Pavement markings play a vital role in providing guidance to motorists during the day and at night under both normal and adverse weather conditions. A wide range of pavement marking materials are available, including alkyd (or solvent-based) and waterborne (or water-based) traffic paints, polyester, thermoplastic, epoxy, preformed tape, polyurea, methacrylate, and modified urethane. These materials vary in cost, effectiveness in providing a contrast in color from that of the underlying surface, visibility under adverse weather conditions such as rain and fog, adherence to different pavement surfaces, and durability under different traffic and environmental conditions. As a result, each of the previous factors must be considered in determining the optimum marking material.

The proposed study will evaluate the performance of three pavement marking materials (fast-dry traffic paint, polyester, and epoxy) in order to determine which materials are most suitable for the environmental and traffic conditions in ODOT District 11. The evaluation will include laboratory test procedures to examine the quality of the pavement markings and glass beads used in this study, and estimate the initial retroreflectivity of these materials. Results from the laboratory tests will be utilized to select a number of products to be evaluated in the field. The field evaluation will include two-lane and four-lane highways having a variety of pavement types, pavement condition, geometries, and traffic volumes. The field performance results will be analyzed to determine the service life of the various marking materials. In addition, these results will be used to estimate the life cycle cost of these materials and develop a material selection matrix for District 11. This new matrix will provide a repeatable methodology to assist the district's decision makers in selecting the most cost-effective pavement marking materials conforming to ODOT specifications that will meet budgetary limitations in District 11 from year to year.

GOALS AND OBJECTIVES:
The proposed research aims at evaluating the performance of selected pavement marking materials and developing a material selection matrix for utilization by District 11. The findings of the proposed study are expected to:
- Advance the state of the technology by identifying long lasting pavement markings that are visible during the day and at night under normal and adverse weather conditions.
- Improve safety for the traveling public on the roads in District 11 by using markings with increased visibility to maintain roadway delineation.
- Reduce costs by identifying durable materials to use under various conditions (highway classification, pavement surface, pavement condition, traffic level, etc.). The recommended materials are expected to last longer than those currently used in District 11, which will reduce both the amount of marking materials used and the frequency of restriping long lines in the district.
Project Title: Alternative Stream Channel Maintenance at Bridge Crossings

Research Agency: The Ohio State University

Researcher: Jon Witter

Status: Active

State Job #: 134821/135013

RFP #: 2014-05

Classification: Standard

Start Date: September 3, 2013

End Date: July 3, 2016

Technical Lead: John Stains

Project Type: Maintenance

Abstract:

STATEMENT OF NEED:
Historically, bridge design practices have excluded the impact place on stream channel morphology. Bridge structures can have significant impacts on stream channel morphology within their immediate vicinities. Human activity, including the construction of bridges causes channel instability. Stream channel instability is a major concern because it can compromise the safety of bridge foundations. The magnitude of instability that a channel experiences is a function of a variety of factors that include watershed characteristics, stream type, bank vegetation, bed and bank materials, and flow habit.

Typical hardened countermeasures can create a permanent solution, but this practice often leads to over-application of rock material or concrete leading to unnecessary costs. Permitting is also a costly endeavor when using rock material and concrete. Applying a Natural Channel Design (NCD) approach will introduce practices that consider bank stability while also limiting the degree of aggradation and degradation impacting the bridge opening. These practices are intuitively designed to consider both the form and the function of channel and the adjacent floodplain. The challenge associated with applying a NCD approach is that it typically requires more data collection and analysis to ensure the design is optimized for the specific application. This project will be initiated with a thorough site assessment and data collection process accompanied by research of available resources pertaining to NCD and the application to channel/bridge stability. The knowledge gained from this effort will translate to hands-on design and construction oversight of pilot projects to acclimate the state and local staff to these practices, with the project culminating in documentation and training on NCD methods.

GOALS AND OBJECTIVES:
- Create a baseline understanding of current practices and capabilities
- Identify appropriate pilot project locations for assessment and implementation of NCD methods.
- Provide research and compile data to support definitive study recommendations.
- Demonstrate techniques and assess project success/failure through post construction monitoring and disseminate knowledge through outreach education.
Abstract:

STATEMENT OF NEED:
Links between travel demand, transportation system characteristics, urban form and distribution of population and employment have been the focus of several studies in the literature. These links have been viewed as the sources of several challenges related to energy consumption, environmental quality and economic viability (Badoe and Miller, 2000; Ewing et al., 2011; Miller et al., 2004; Waddell, 2011).

Currently, the PIs on this OPREP proposal are developing a Regional Land-use Allocation Decision Analysis Model for ODOT as part of their project funded through the OPREP 2013 cycle (State Job number: 134624; Linking Land-Use, Transportation and Travel Behavior in Ohio). The current model forecasts the impacts of future land-use policies in Ohio, based on alternative assumptions of highway and mass transit corridor development, zoning and environmental constraints, and changes in travel behavior associated with auto trip generation rates and distances. The model will enable the decision makers make informed decisions regarding the future land-use policies, and transportation investments.

The model uses information concerning infrastructure availability (accessibility, sewer, water services), current land-use policies where available, and environmental constraints to allocate regional and county forecasts of population and employment to 40 acre cells in each metropolitan region of Ohio. The outputs of the land-allocation model inform the subsequent transportation models in terms of population and employment distribution to forecast auto trips and trip distances for each future scenario. These forecasting models estimate the number of auto trips and the associated distances as a function of household characteristics, population and employment distribution aggregated to the TAZ level.

This study is motivated by adding two crucial components to the Regional Land-use Allocation Decision Analysis Model: vehicle choice and a better understanding of the impacts of declines in population and employment. Vehicle choice will be greatly influenced by the cost of fuel in an era of increasing demand for fossil fuels. That, in turn, will impact not only travel behavior but also the revenues from gasoline taxes that are used to pay for roadway maintenance. Equally important are the population and employment trends in the past decades that have seen significant declines in most of Ohio’s metropolitan areas. Even within counties with net declines, there have been growth areas. By modeling those changes in greater detail, we will be able to provide insights not only to their impacts on travel and revenues but will also inform efforts at economic development that could reverse the trends.

GOALS AND OBJECTIVES:
1) Develop vehicle choice models to forecast the changes in vehicle fleet based on changing socio-economics and land-use characteristics.
2) Develop models to deal with both population and employment growth and decline.
3) Integrate the models discussed above into the existing land-use allocation decision model
4) Identify the impacts of potential future scenarios based on socio-economic changes, mass transit investments and land-use changes.
Abstract:

STATEMENT OF NEED:
A majority of ODOT's 4-lane and interstate highways are composite pavement; with the vast majority being Portland cement concrete (PCC) pavement overlaid with asphalt concrete (AC). Each year, ODOT rehabilitates several hundred miles of existing AC/PCC pavements by additional overlay. It is important to have an effective means to evaluate the existing AC/PCC pavements and to design the overlay thickness required to carry anticipated future traffic loading. The pavement overlay thickness design procedure currently exercised by ODOT works well for both flexible and rigid pavements, but it tends to produce overly conservative designs for composite pavements. For composite pavements with relatively thick asphalt overlays, the current design procedure consistently recommends very high overlay thickness that is deemed structurally unnecessary.

Research is needed to evaluate and verify the assumptions used for composite pavements in the current overlay design procedure and provide modifications as needed or to develop a new deflection based overlay design procedure for composite pavements.

The proposed study investigates the possible cause(s) and finds solution(s) to address the problem within the composite overlay design procedure and to verify and validate the revised procedure through actual pavements.

GOALS AND OBJECTIVES:
- The primary goal is to develop and validate a Falling Weight Deflectometer (FWD) deflection-based overlay design procedure for composite pavements and incorporate it into the most current version of ODOT's overall design software.
- Provide ODOT with the ability to mechanistically determine the effective thickness of the PCC slab portion of a composite pavement for use in the U.S. Army Corps of Engineers' equation for the design of unbonded concrete overlays.
Project Title: Evaluating Vegetation Management Practices for Woody and Herbaceous Vegetation

Research Agency: Davey Resource Group

Status: Active

State Job #: 134834

End Date: November 28, 2016

RFP #: 2014-02

Classification: Standard

Project Type: Maintenance

Technical Lead: Tom Corey

Abstract:

Phase I (6 months):
The objective of Phase I of this research was to conduct a four month in-depth analysis of ODOT’s current Integrated Vegetation Management (IVM) process and provide recommendations on how to improve safety, cost effectiveness, environmental compliance and reduce labor hours. Phase I is now complete and has revealed that ODOT lacks tools and techniques commonly used in cutting-edge rights-of-way (ROW) vegetation management programs, resulting in inefficiencies and increased program costs. Recommendations on process changes with potential cost savings for each were identified.

Phase II (30 months):
Phase II will validate the projected cost savings of selected recommendations by comparing the performance of new and alternative mechanical and chemical methods against ODOT’s standard vegetation management operating procedures. The attached Phase I interim report and decision matrix prepared for ODOT outlines the equipment and chemical testing that will be evaluated.

Benefits of this project include: 1) improved sight distances (safety) of the traveling public; 2) increased time between needed maintenance cycles on the rights-of-way; 3) reduced annual right-of-way vegetation management costs; 4) updated tools and techniques available for right-of-way maintenance; and 5) increased ODOT staff efficiency, knowledge and worker safety.

This project will require a great amount of project management and time that ODOT does not have the staff or availability to perform. Davey will be working with the Districts to monitor the vegetation management, document the progress of each method, and perform a cost benefit analysis that will assist ODOT in determining future changes to the vegetation management program. Objectives of Phase II include: 1) Utilize new mechanical methods for vegetation management; 2) Make use of new chemical methods for vegetation management; 3) Extend maintenance cycles for herbaceous and woody vegetation; 4) Better safety for workers and users; 5) Decrease the amount of noxious weeds on the rights-of-way; and 6) Improve the abilities of workers to utilize equipment and herbicides properly.
### Abstract:

A number of state and federal agencies are developing geotechnical databases which may be queried for information used for planning, design, and construction of new projects or the maintenance of existing projects. Unfortunately through the lack of standard data definition for geotechnical data, there exists significant difficulty in archiving, reusing, and sharing data. In 2005, a pooled fund study [TPF-5(111)] was initiated to establish a geotechnical data dictionary from which a national standard XML data interchange format schema could be established. This pooled fund resulted in a data interchange for geotechnical and geo-environmental transportation related data (DIGGS). DIGGS is positioned to be an international data transfer standard.

The objective of this project is to conduct additional testing, provide tool completion, and refinement. In order to ensure ongoing stability of DIGGS, transition of this tool to an institution capable of long-term hosting and management is needed. The significance of this new work is to reach the public delivery level for the DIGGS system and establish a permanent home for the system. The successful deployment of DIGGS 2.0 will produce tangible benefits for the state. It will enable efficient, compatible, and understandable information sharing among state and federal agencies. The centralized system will allow for quick retrieval of historical data, improved storage of new data, increased data sharing, and reductions in error due to the direct transfer of data. This will result in significant cost savings to the department as data searches for archived information will not be time consuming and the need for field technicians to duplicate past data collection is eliminated. It will capitalize on the benefits of collaborative development as compared to individual development of multiple independent systems. Software developers will be able to develop programs that fit within the framework and are compatible nationwide and internationally thereby reducing costs to users and increasing interchangeability among programs. Finally, in addition to transportation agencies, other potential users that can benefit from this system include natural resource and environmental agencies, consultants, and academics.
### Project Title: **Effective and Safe Berm Compaction for Shoulder Maintenance**

**Research Agency:** Case Western Reserve University  
**Researcher:** Bill Yu  
**Status:** Active  
**State Job #:** 134838  
**RFP #:** 2014-13  
**Start Date:** December 1, 2013  
**End Date:** April 1, 2016  
**Classification:** Standard  
**Project Type:** Maintenance  
**Technical Lead:** Tom Berning

### Abstract:

ODOT labor crews have experienced safety hazards such as roll overs during compaction of the berm using the current methodology. It is to the interest of ODOT and the traveling public to identify an effective, safe and cost effective method to perform berm placement. The study will evaluate the performance of alternative berm compaction technology on safety edge projects to improve the construction safety as well as effectiveness for berm compaction. The focus will be on a few innovative technologies that provide effective and safe berm compaction. Based on this study, the effectiveness of alternative methods for berm/shoulder compaction will be determined.

The results of this project will be summarized in the format compatible with ODOT specifications. Successful implementation of the project results will improve the longevity of berms and reduce the life cycle costs for pavement shoulder maintenance including time, material and labor. Recommendations will be provided to ODOT for incorporation of the research discoveries into ODOT specifications. This project could be of interest to other state DOTs and have far reaching national significance.
**Project Title:** Evaluation of ODOT's Culvert Boring Process

**Research Agency:** Bowling Green State University

**Status:** Active

**State Job #:** 134840/135014

**RFP #:** 2014-14

**Start Date:** December 2, 2013

**End Date:** August 1, 2015

**Classification:** Standard

**Project Type:** Maintenance

**Technical Lead:** Mark Atkinson

**Researcher:** Alan Atalah

**Abstract:**

ODOT inspects and evaluates its culverts on a regular basis. From these evaluations culvert work orders are generated, and recommend needed repairs or complete replacement when necessary. Complete culvert replacements are the focus of this research. ODOT maintenance personnel currently review replacement work orders and generate a cost estimate to replace the culvert to include labor, material, and equipment costs (including the appropriate overhead rates). If the cost estimate is less than the legal limit to perform such work (established currently at $50,000 by the ORC), then the work will be scheduled. If the cost estimate exceeds the legal limit, the work will be sold as a contract.

The conventional method utilized to replace a culvert involves closing the roadway, detouring traffic, excavating to remove the old culvert, and placing the new culvert. Two factors that are of major concern in this process include: replacing culverts under deep fills, and replacing culverts where large volumes of traffic are affected. Replacing a culvert under a deep fill adds significant cost and time to the project. In addition to increased costs, safety issues arise when working in deep excavations. User costs are the added costs experienced by the traveling public associated with the detour which is required when replacing culverts using the traditional method of excavation. The total user costs for any detour are driven by the volume of traffic, length of the detour, and the time in which the detour is in place.

This research will examine the cost effectiveness, safety and overall efficiency of culvert replacements using the jack and bore method versus the traditional method of excavation based on the depth of fill and user costs. Potential benefits include reduced costs, reduced noise, minimized traffic disruption, increased pedestrian safety, and fewer environmental impacts.
### Project Title: Optimization of Patching for Spray Injection Equipment

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<td>Jim Walton</td>
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<td>Researcher:</td>
<td>Ala R. Abbas</td>
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**Abstract:**

Pothole repair, often referred to as patching, is a costly and time consuming practice for localities, departments of transportation and highway agencies. These repairs are performed throughout the year, particularly during the winter months when the temperature drops below freezing with intermittent periods of thawing. Since hot mix asphalt plants are shut down during the winter, cold mix asphalt, which contains an emulsified or cutback asphalt, mixed with fine aggregates, is commonly used for these patches.

Patching using the spray injection method can be used to overcome the reduced adhesion between the patching material and the existing pavement. This method utilizes heated emulsion and virgin aggregate that are sprayed into the pothole. The mix of virgin aggregate and heated emulsion can be varied depending on the size and location of the pothole. However, the selection of the aggregate and emulsion combination as well as the optimum spray rate of the emulsion are critical to ensure the longevity of the patches.

This research will provide a comprehensive examination to determine the cost-effectiveness, benefits and limitations of the spray injection method, identify proper procedures for use, identify different aggregate and emulsion materials for use, and provide specifications for use and storage. If proven successful, the spray injection method could result in a longer lasting pothole patch which improves the safety of the traveling public, and reduces costs associated with duplicate repairs of a pothole.
Abstract:

Adjacent box-beams need to work together for a bridge to function effectively as a single unit. Structural performance of non-composite box-beam bridges is greatly dependent on the shear key, the connection details including the grout, waterproofing, and the tie rods. Severe leakage is commonly documented. Water leakage leads to premature aging and is the primary cause for corrosion of the prestressing strands and non-prestressed steel, which causes spalling and snapping of strands.

Prevention of water leakage is critical to minimize corrosion related deterioration at the longitudinal joints of adjacent box-beams. Any cracking along the joints and differential deflection of adjacent beams causes water proofing membrane to get damaged making water leakage inevitable. Most times the seeping water is contaminated with chloride from deicing materials which makes the concrete susceptible to corrosion related damage such as cracking and spalling.

This project is being conducted in collaboration with Ohio's Research Initiative for Locals (ORIL). This research was initiated by ODOT to establish the sources, causes and effects of inadequate waterproofing at joints and develop preventive measures through careful evaluation of alternatives on the state system. The scope of work was expanded to incorporate aspects specific to the local system such as: (1) analysis of adjacent precast reinforced concrete box-beams to establish the sources, causes and effects of inadequate waterproofing at the joints; (2) an evaluation of peel-and-stick waterproofing as a membrane alternative, (3) an analysis of grouting options/alternatives for keyway joints; and (4) develop preventive measures for existing and new box-beam bridges. The results of this research will provide a basis for better preparation of local officials to deal with system degradation of these structure types and maintenance of existing structures in addition to providing an opportunity for improvements in planning and design of new structures.
Project Title: Adaptive Video-based Vehicle Classification Technique for Monitoring Traffic

Research Agency: University of Cincinnati

Status: Active

State Job #: 134874

Start Date: April 1, 2014

End Date: August 1, 2015

Researcher: Heng Wei

RFP #: 2014-20

Classification: Student Study

Project Type: Planning

Technical Lead: Dave Gardner

Abstract:

Vehicle classification data is critical to applications in almost all fields of transportation, as it provides an indicator of how many commercial trucks use our roadways on a daily basis. This data is used to help design pavements, address safety issues, determine roadway usage for planning purposes, and has many other purposes. Currently, ODOT adapts FHWA's scheme F, axle-based classification standards (length-based classification boundaries to categorize vehicle types). ODOT practices the 3-bin length-based vehicular classification scheme to map passenger vehicles, single unit trucks, and multi-unit trucks. While this method has worked best on combined data from all states in classifying four general vehicle categories, a considerable amount of errors were found in how well the length bins performed when estimating aggregations of the FHWA 13 category classification scheme since multiple FHWA vehicle classes may have similar lengths. Also, ODOT currently has to install pavement sensors to collect this type of data. This requires us to shut down lanes, make cuts in the road, and is quite expensive.

This research project presents a technology that can possibly collect the same type of data that we have traditionally collected with pavement sensors, using a non-intrusive side-of-road-the-road camera. It could be more cost efficient and safer for ODOT. This research will address the challenges through the development and testing of the proposed Rapid Video-based Vehicle Identification (RVIS) system. It provides an easy and fast data extraction tool to present the fundamental data and information for ODOT to allocate their investment in rehabilitation, maintenance, materials and process more effectively.
### Bubble Plate Implementation

**Project Title:** Bubble Plate Implementation  
**Research Agency:** Ohio University  
**Researcher:** Gayle Mitchell  
**Status:** Active  
**State Job #:** 134881  
**RFP #:** 2014-IP1  
**Start Date:** February 4, 2014  
**End Date:** December 31, 2015  
**Classification:** Hydraulics  
**Technical Lead:** Becky Humphreys

**Project Type:** Implementation

---

**Abstract:**

The Ohio Department of Transportation (ODOT)'s Research Section in collaboration with the ODOT Office of Hydraulic Engineering is executing an in-house implementation study to further investigate findings and recommendations provided by Dr. Gayle Mitchell on the recently completed research project "Exfiltration Trenches for Post Construction Storm Water Management for Linear Transportation Projects." In support of this study, ODOT has requested the services of Dr. Mitchell and her team to fabricate and deliver two single and two double bubble plate filtration devices. These devices will be placed in various locations and monitored for performance assessment.
<table>
<thead>
<tr>
<th><strong>Project Title:</strong></th>
<th>Implementation and Analysis of Epoke Research</th>
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<tbody>
<tr>
<td><strong>Research Agency:</strong></td>
<td>University of Akron</td>
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<td>July 16, 2014</td>
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<td>July 16, 2015</td>
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<tr>
<td><strong>Technical Lead:</strong></td>
<td>Frank Phillips</td>
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<tr>
<td><strong>Project Type:</strong></td>
<td>Maintenance</td>
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</tbody>
</table>

**Abstract:**

With an annual expenditure of approximately $50 million (inclusive of labor, equipment, and materials), the single largest cost item in the maintenance budget for ODOT is snow and ice control. ODOT strives to provide an adequate level of service to the motoring public, which is measured by regain time or the amount of time to recover after a snow event by increasing the vehicle speed to within 10 miles per hour of the speed limit. The Epoke Sirius S4902 AST Combi Bulk Spreader (Epoke) is a type of material spreader used for winter maintenance activities. Recently, a research project was conducted (SJN: 134651) that demonstrated the potential for financial savings and efficiency improvements through the incorporation of the Epoke into winter maintenance operations. The previous study demonstrated that the Epoke is capable of spreading salt and brine up to three lanes wide and found it could reduce salt usage by 12%. When determining the costs savings and payback period of the Epoke, the researchers only considered the realized savings. There may actually be other costs savings that arise from the use of the Epoke, including roadway user savings, delay savings, and crash reduction savings. To ensure the Epoke is utilized appropriately, an implementation study has been commissioned to focus on four objectives: (1) validate the 12% salt savings estimate, (2) confirm the deployment strategy for the Epoke developed in the initial study, (3) estimate the cost savings of the Epoke including indirect user costs, and (4) develop a strategy for an ongoing evaluation of the Epoke by ODOT.

Winter maintenance is a time- and resource-intensive task for ODOT. This implementation study will provide increased insight into the benefits and implementation of the Epoke. The results may include a cost savings associated with the Epoke, indirect user savings, and an implementation plan that shows how to best utilize the Epoke system. ODOT will also be provided with a method for tracking the future savings associated with the Epoke to ensure the appropriate use of the equipment to receive the maximum return on investment.
Project Title: Evaluation and Analysis of Liquid Deicers for Winter Maintenance

Research Agency: University of Akron

Status: Active

State Job #: 134933

End Date: January 16, 2016

RFP #: 2015-01

Classification: Standard

Project Type: Maintenance

Abstract:

The purpose of this research is to provide stakeholders with information that will allow them to make informed decisions about safety for the traveling public as well as the cost effectiveness of each product available.

Ohio has a plethora of liquid deicers commercially available and the Ohio Department of Transportation would like to evaluate which deicers have minimal impacts on the environment, low corrosiveness, high melting capacity, and are compatible with ODOT’s equipment and materials. This research will evaluate ODOT’s current practices in the field and recommend deicers for various conditions. The recommended deicers will rank favorably in cost, have minimal environmental impact and corrosiveness. Melting capacity, longevity, compatibility and availability will also be considered.

There are four main objectives:
1. Determine the deicers that are compatible with ODOT’s equipment and materials with the lowest environmental impact and corrosiveness, and the highest melting capacity.
2. Conduct laboratory and field tests to evaluate the best deicers under various temperature, environmental, and roadway conditions.
3. Recommend deicers for various conditions that rank favorably in cost, minimal environmental impact, and minimal corrosiveness, melting capacity, longevity, compatibility and availability.
4. Evaluate the feasibility of implementation for liquid deicers based on ODOT’s current equipment and storage capabilities.

This project is being conducted in collaboration with Ohio’s Research Initiative for Locals (ORIL).
Project Title: Enhancement of UASLOPE for Improving Implementation Efficiency

Research Agency: University of Akron

Researcher: Robert Liang

State Job #: 134934

RFP #: 2015-IP2

Status: Active

State Job #: 134934

RFP #: 2015-IP2

Start Date: August 1, 2014

End Date: February 1, 2016

Classification: Implementation

Technical Lead: Alexander Dettloff

Project Type: Geotechnical

Abstract:

Each year, frequent landslides and slope failures occur along roadways, posing a major impact on the safety of the traveling public and adding a financial burden to ODOT and other highway agencies responsible for slope repairs and maintenance. Although preventing slope failures has been a main goal of ODOT’s Office of Geotechnical Engineering, there are still possibilities of occasional occurrences of slope failures due to unforeseen nature events, such as flooding, heavy precipitation, etc. Of the many remediation measures available for use by ODOT to fix slope failures, the most widely used method is drilled shafts. Through past research efforts, a computer program, UASLOPE 2.1 was developed for use in designing drilled shafts to stabilize an unstable slope. OGE Bulletin No. 7 provides design guidance and instructions for consultants on using UASLOPE 2.1. Recently, a student study (SJN: 134710) was conducted to investigate the use of the probabilistic approach in designing drilled shafts. At the completion of this study, several implementation items were identified by ODOT as being imperative for improving the efficiency of the UASLOPE 2.1 program.

The results of this implementation study will provide ODOT with a more robust version of UASLOPE that will: (1) provide more accurate semi-empirical load transfer factor equations, (2) allow for the repositioning of drilled shafts to model alternative designs, and (3) enable the combined use of ground anchors and drilled shafts as well as ground anchors and ground beams. In addition, the new version of UASLOPE will provide a more user-friendly interface, compatible to an MS Excel spreadsheet, which will increase the efficiency for design engineers, saving time in the preparation of input and output tables. Ultimately, the new version of UASLOPE will increase confidence in the design of drilled shafts on transportation projects in Ohio.
**Project Title:** Evaluation of Cost Effective Protective Coatings for ODOT Snow & Ice Equipment  

**Research Agency:** University of Akron  
**Researcher:** Chelsea Monty  
**Status:** Active  
**State Job #:** 134935  
**RFP #:** 2015-04  
**Start Date:** August 7, 2014  
**End Date:** December 7, 2015  
**Classification:** Standard  
**Project Type:** Maintenance  

**Technical Lead:** Jamie Hendershot

**Abstract:**

In winter maintenance, the chemicals used to keep roadways clear of snow and ice are highly corrosive to vehicles and equipment. Corrosion of snow and ice equipment is a major issue that results in increased maintenance and repair costs, reduced vehicle life, and increased vehicle downtime. Coatings are often applied to protect the bare metal from corrosive environments. Success of this project will provide ODOT with a corrosion prevention strategy that will increase public safety by preventing unexpected equipment failures, decreased downtime of snow and ice equipment, increased efficiency by decreasing downtime, and cost savings through reduction of rust related maintenance.

There are six main objectives for this study.
1. Knowledge of previous work determining the effectiveness of commercially available corrosion protective coatings.
2. Knowledge of current "Best Practice" for application of corrosion protective coatings.
3. Laboratory testing to determine the effectiveness of corrosion protective coatings.
4. Laboratory testing to determine the most appropriate application cycle for corrosion protective coatings, both initially and at regular maintenance intervals.
5. Development of "standard Operating Procedure" of most cost effective, durable, commercially available coating applicable for ODOT.
6. Cost-benefit analysis that considers capital equipment, service and maintenance, modifications to existing equipment, material usage, and environmental benefits.
### Project Title:
Implementation and Analysis of Snow Removal Wash Water Reuse Research

### Research Agency:
University of Akron

### Status:
Active

### State Job #:
134984

### Researcher:
Chris Miller

### RFP #:
2015-IP3

### Start Date:
July 17, 2014

### End Date:
February 17, 2016

### Classification:
Implementation

### Project Type:
Maintenance

### Technical Lead:
Jamie Hendershot

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**Abstract:**

Due to the corrosive nature of deicing chemicals (e.g. sodium chloride), ODOT maintenance trucks are washed frequently during the winter months at the 88 county and 132 outpost garages across the state. Most of the wash water is processed through an oil/water separator prior to being discharged to a sanitary sewer. However, there are a number of facilities without access to sanitary sewer for truck wash water disposal with an estimated generation of four million gallons per year. At these locations, wash water is generally stored until it can be transported to a treatment facility for disposal at costs ranging from $0.05 to $0.54/gallon. Recently, a research project (SJN: 134629) was conducted that focused on identifying cost effective, environmentally-sustainable strategies for managing this waste water. The research has provided ODOT with the most comprehensive analytic review of waste water in the county. The findings have demonstrated the potential for recycling a large percentage of waste water, which could result in cost savings due to a reduction in disposal fees and associated expenditures of transporting and handling of the waste water. In an effort to transition the research findings into ODOT’s daily operations, a pilot implementation project within Districts 10 and 4 is being conducted. Particular outcomes from the pilot will be: (1) verification of previous research recommendations for a 24-hour settlement period prior to reuse, (2) initiation of an in-house testing program for waste water, and (3) incorporation of a confidence rating into the cost analysis tool developed in the initial study.

Proper implementation of the research results should enable the recycling of a large percentage of wash water collected at county garages and outposts. Integrating these measures across an entire district is expected to result in significant cost savings. Statewide deployment could position ODOT for substantial cost savings. The pilot implementation project has been designed to quantify and verify these perceived savings in an effort to support statewide implementation. The disposal and treatment of waste water is dictated by external agencies (e.g.: EPA, municipalities, health departments, and WWTP). Scientifically based confirmation of the actual composition of our waste water combined with proven methods for reducing TDS and TSS provides ODOT with the leverage needed to negotiate lower disposal rates and/or access alternatives that were previously unavailable due to the perceived, unconfirmed composition of waste water.
**Project Title:** Extended Life Concrete Bridge Decks Utilizing Improved Internal Curing to Reduce Cracking  
**Research Agency:** Iowa State University  
**Researcher:** Peter Taylor  
**Status:** Active  
**State Job #:** 134985  
**RFP #:** 2015-10  
**Start Date:** April 30, 2015  
**End Date:** April 30, 2018  
**Classification:** Standard  
**Project Type:** Construction  
**Technical Lead:** Tim Sturges  

**Abstract:**

This research project should help ODOT prepare a specification that will increase the probability of achieving crack free, long-lasting decks. The research will develop a state-of-the-art bridge concrete that will give a unique consideration to coming up with the best mix characteristics that will ultimately extend bridge life and delay (or eliminate) the need to replace decks prior to superstructure replacement.

The two main objectives of this study:
1. The bridge deck will be crack-free immediately after construction.
2. The bridge deck has the strength and serviceability characteristics that will allow it to perform for up to 75 years of active service.
Project Title: Assessment of IRP Truck Licensing for Ohio Counties

Research Agency: University of Kentucky

Researcher: Andrew Martin

Status: Active

State Job #: 134988

Start Date: November 3, 2014

End Date: September 3, 2015

RFP #: 2015-ORIL5

Classification: ORIL

Project Type: Policy Development

Technical Lead: Anna Kazmich

Abstract:

International Registration Plan (IRP) is an agreement among 48 states, 10 Canadian Provinces and the District of Columbia whereby a motor carrier can register commercial vehicle fleets for travel in all IRP jurisdictions by filing the paperwork with the home (base) jurisdiction. Fees associated with the registration of these vehicles are apportioned to each IRP jurisdiction based on various factors including total mileage driven within a given jurisdiction. As an IRP participating state, Ohio's Department of Public Safety (ODPS) coordinates the apportionment of IRP registration fees between Ohio and other participating states. In addition, ODPS coordinates the distribution of registration revenue between Ohio's various state agencies, counties, townships, and municipalities.

While registration revenue is distributed to local public agencies, there is a perception of a disconnect between the percentage provided to locals versus the actual impact commercial vehicle fleets have on local roads. While the state system is designed to accommodate large quantities of commercial vehicles, local roads are less equipped and are therefore more susceptible to pavement deterioration and stress promulgated by these types of vehicles. As a result, local governments may find it necessary to perform rehabilitation and repair activities more frequently or even earlier than anticipated. However, the revenue stream from the registration of these vehicles does not seem to be keeping pace. A locally conducted case study has identified a situation in which this disparity exists. There is a presumption that this is not an isolated event and local governments may be missing out on revenues needed to maintain the integrity and safety of Ohio's local roadways. Research is needed to investigate the overall impact of IRP truck registration to Ohio counties and to provide recommendations for improvements (if warranted).

The goal of this research is to conduct an analysis to assess the economic impact of non-Ohio registered commercial vehicle fleets based within Ohio jurisdictions. The findings of this research will either support or disprove a perception of disproportionate funding allocations related to IRP registration revenue. As a result, this will enhance the state's ability to ensure the appropriate retrieval and allocation of IRP registration revenue for maintaining Ohio's roadways. It will also equip local officials with the tools needed to conduct their own investigations as the economic and business situation of their locality changes over time.
Project Title: Analysis of Ground Tire Rubber (GTR) in Mix Design on Local Roadways in Ohio

Research Agency: Ohio University

Researcher: Munir Nazzal

Status: Active

State Job #: 134989

RFP #: 2015-ORILA

Start Date: September 2, 2014

End Date: September 2, 2016

Classification: ORIL

Project Type: Materials

Technical Lead: Perry Ricciardi

Abstract:

For decades, transportation agencies have considered the incorporation of crumb rubber, now referred to as ground tire rubber (GTR), in asphalt mixtures to enhance the durability and longevity of pavements. In addition to the improvements in pavements, GTR has demonstrated the potential for positive environmental impacts through its reuse of recycled tires. While the benefits of using GTR appear to be great, the initial cost to implement GTR can often render the material as being cost-prohibited. ODOT has various specifications concerning asphalt mix designs (e.g.: Nos. 446 and 448) including GTR (e.g.: No. 887). While these specifications address the utilization of materials on interstates and highways, their direct application to local roadways may not be appropriate. Factors such as variations in traffic volume and traffic patterns (e.g.: intersections) may influence the performance of GTR resulting in the ODOT specifications being either over or under designed for local roads. Furthermore, advances in technology over the years have increased the options available to transportation agencies in regards to both application methods and products. Since 2005, GTR has been used on approximately 33 local roads and 3 state highways. This presents Ohio with the opportunity to analyze the actual in-field performance of GTR, assess the pros and cons of using the material, and determine if the life-cycle cost of the materials offsets the installation costs.

The goal of this two-phased research project is to assess the true life-cycle cost of GTR mixes on local roads within Ohio and identify opportunities for GTR to be more affordable. The objective is to develop specifications and supplemental QC/QA testing and acceptance criteria for GTR additive/mixture use on municipal and local roads. The results of this research will provide local officials with enhanced knowledge and a field validated assessment of the life-cycle cost of GTR enhanced mixes on its use and performance. The development of a specification for GTR use on local roads will encourage uniformity and provide clear guidance. This information will be of assistance to local decision makers in managing budgets and the proper utilization of GTR on their respective projects.
Project Title: Storm Water Best Management Practices for Local Roadways

Research Agency: GS&P/OH Inc.

Researcher: Mark McCabe

Status: Active

State Job #: 134990

RFP #: 2015-ORIL7

Start Date: September 9, 2014

End Date: September 9, 2015

Classification: ORIL

Technical Lead: Becky Humphreys

Project Type: Hydraulics

Abstract:

Environmental Protection Agency (EPA) regulations require the implementation of stormwater best management practices (BMPs) into roadway construction projects for post construction runoff. For local jurisdictions, the inclusion of these BMPs is difficult due to limited availability of space (i.e. right-of-way or easement). Urbanized areas pose additional challenges with the presence of sidewalks, houses, and businesses while many rural areas are faced with inadequate right-of-way widths. Further complicating the issue is the availability, or non-availability, of dedicated storm sewer systems in these areas.

A variety of products are commercially available for stormwater management and a tremendous amount of research has been performed to establish BMPs. ODOT’s Location and Design (L&D) Manual Volume 2 outlines several BMPs that have been approved by the Ohio EPA for use on federal aid projects. While information on BMPs is available, it is not necessarily easily manageable or focused on local roadway applications. A focused synthesis study to collect and analyze stormwater BMPs designed for utilization on Ohio’s local transportation system is needed to assist locals in the consideration of BMPs.

The goal of this research is to establish a methodology for recommending proven stormwater BMPs for use on Ohio’s local roadway system that satisfy current regulations and are cost effective in terms of construction and maintenance by local governments. The objective of this research is to develop a matrix of stormwater BMP alternatives for application on linear transportation projects on Ohio's local system. The results of this research will provide local officials with a simplified tool to assist decision makers in selecting optimal BMPs for specific applications. Ultimately, access to the findings of this research will aid locals in implementing the most efficient and cost effective stormwater BMPs enabling compliance with EPA regulations while adhering to budgetary constraints.
Project Title: Investigation of In-Situ Strength of Various Construction/Widening Methods Utilized on Local Roads

Research Agency: Ohio University

Researcher: Shad Sargand

Status: Active

State Job #: 134991

RFP #: 2015-ORIL3

Classification: ORIL

Start Date: August 11, 2014

End Date: February 11, 2016

Technical Lead: Adam Au

Project Type: Pavements

Abstract:

A common practice among local public agencies in Ohio is to reuse materials (e.g.: asphalt, concrete, Portland cement concrete, etc.) from projects to widening existing roads or backfill at other locations. A variety of other methods may also be utilized in conjunction with the repurposed materials (e.g.: fly ash, lime, fabric, etc.). The utilization of these techniques may be driven, in part, by budgetary constraints or material availability. While it is easy for local transportation officials to compare these methods based on costs, there is a lack of information available to compare the overall effectiveness of these methods in terms of projected strength or relative load capacity. In order to provide local governments with the tools necessary to assist in system preservation decisions, research into the performance of these methods is needed.

The goal of this research is to establish a range of structural coefficients (or moduli) for various materials utilized to widen/construct roads on Ohio's local system. The objective is to provide locals with a repeatable, non-destructive methodology to characterize the strength/load capacity of materials used in road widening/construction when established values are unavailable. The results of this research will provide local officials with enhanced knowledge and understanding of the potential structural integrity of materials being considered for use in roadway maintenance, improvement and construction projects. This will lead to more efficient design and greater confidence in the load carrying capacity of rural roads. It will provide a scientific basis for material selection to compliment the readily available cost data, which will aid locals in managing budgets and ensuring the fiscal integrity of local pavement preservation programs.
Project Title: Hydraulic Engineering Research On-Call Services (ROC)

Research Agency: Ohio University

Researcher: Shad Sargand

Status: Active

State Job #: 134993

End Date: August 13, 2016

RFP #: 2015-12

Classification: Standard

Project Type: Hydraulics

Technical Lead: Jeff Syar

Abstract:

The Ohio Department of Transportation (ODOT) is a large state agency charged with management and maintenance a vast transportation system in Ohio. ODOT strives to execute its charge in the most effective and efficient manner possible. Frequently, ODOT encounters situations where low cost, short term research services are needed to meet immediate needs for system management and maintenance improvements. Some of the short term research needs may go unmet due to the immediacy of the need and the perceived long delay in navigating ODOT's research process. To address this problem, ODOT has developed a "Research on Call" (ROC) procurement process to secure research services for low cost, short term research in advance of identifying specific research needs.

ODOT will identify small research projects that will be considered part of the ROC contract. ODOT will send a notification e-mail to the researcher identifying the project scope and requirements. The researcher has three weeks to respond to the written task request with the following information: Work Plan, Budget, Schedule, and Deliverables. ODOT will respond to that "proposal" within two weeks. Once there is an agreement between the researcher and ODOT, the researcher will receive an official project acceptance letter. The researcher may not begin work on the project until they have received the official project initiation letter via email from ODOT's Research Section.
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The Ohio Department of Transportation (ODOT) is a large state agency charged with management and maintenance a vast transportation system in Ohio. ODOT strives to execute its charge in the most effective and efficient manner possible. Frequently, ODOT encounters situations where low cost, short term research services are needed to meet immediate needs for system management and maintenance improvements. Some of the short term research needs may go unmet due to the immediacy of the need and the perceived long delay in navigating ODOT's research process. To address this problem, ODOT has developed a "Research on Call" (ROC) procurement process to secure research services for low cost, short term research in advance of identifying specific research needs.

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Project Title: Forensic Study of Early Failures with Unbonded Concrete Overlays

Research Agency: Ohio University

Researcher: Shad Sargand

Status: Active

State Job #: 134996

RFP #: 2015-06

Start Date: August 13, 2014

End Date: August 13, 2016

Classification: Standard

Technical Lead: Aric Morse

Project Type: Pavements

Abstract:

The Ohio Department of Transportation (ODOT) has constructed over 350 lane miles of Unbonded Concrete Overlays (UBCO). For the most part these overlays have performed as expected. However, occasionally an UBCO is constructed which performs below expectations.

The objective is to determine the mechanisms of failure responsible for each distress evident at the time of the study. The goal being to tie these mechanisms to the design, construction and/or materials practices or standards that can be modified to gain better performance and eliminate or delay these types of problems in the future. The research is expected to result in a better understanding of how to design and construct an unbonded concrete overlay. Ultimately, this research is expected to produce cost savings by preventing premature distress formations in unbonded concrete pavement overlays and reducing future maintenance costs to those projects through improved performance of the overlays.
**Project Title:** Evaluation and Design of a TL-3 Bridge Guardrail System Mounted to Steel Fascia Beams

**Research Agency:** RoadSafe LLC  
**Researcher:** Chuck Plaxico  
**Status:** Active  
**State Job #:** 134997  
**RFP #:** 2015-ORIL1  
**Start Date:** January 5, 2015  
**End Date:** May 5, 2017  
**Classification:** ORIL  
**Technical Lead:** Sean Meddles  
**Project Type:** Structures

**Abstract:**

For structures with concrete bridge decks, the railing system is typically connected to the deck. However, for bridges on Ohio's local road system, non-concrete bridge decks (e.g. timber, asphalt filled steel stay-in-place forms, fiber reinforced composite, etc.) are very common and require the railing connection to be located on the fascia beam. Although this fascia mounted system is performing well on the local system, a crash tested version is not available and it is ineligible for use on federal aid projects. Research is needed to evaluate and, if necessary, improve the design of a bridge guardrail system with steel bridge posts mounted to steel fascia beams.

The goal of this two-phased research project is to analyze and design a steel fascia beam mounted railing system for use on Ohio's local transportation system. The objective is to obtain MASH TL-3 approval of the designed system to allow for its use on federal aid and credit bridge projects. Since the connection would occur at the beam as opposed to the deck, the application of the system would be suitable with a myriad of bridge deck types. The ability to utilize materials other than concrete for bridge decks results in substantial cost savings for locals. Furthermore, the use of an approved railing system will enhance the overall safety of the traveling public and confidence in Ohio's local transportation system.
Project Title: Performance Comparison of Structural Steel Coating Systems

Research Agency: University of Dayton

Researcher: Elias Toubia

Status: Active

State Job #: 135004

RFP #: 2015-03

Start Date: October 6, 2014

End Date: February 6, 2016

Classification: Standard

Project Type: Materials

Abstract:

For the last twenty years, the Ohio Department of Transportation has primarily specified the use of the Three Coat Organic Zinc primer coat, Epoxy intermediate coat and Urethane finish coat (OZEU) system for the corrosion protection and aesthetic enhancement of structural steel. When the steel is prepared and the paint is applied properly, the three coat system has performed well. Paint manufacturers have developed new technology alternatives to the conventional three coat painting systems. ODOT needs to make sure the most cost effective methods are being used to extend the service life of its infrastructure assets.

This research will investigate if the Two Coat Organic Zinc and Polysiloxane Structural Steel Coating Systems would be quicker to apply than the Three Coat Organic Zinc, Epoxy and Urethane (OZEU) Structural Steel Coating Systems, and if they can perform as well or better in protecting structural steel from corrosion, while retaining gloss and color.
**Project Title:** Preliminary Evaluation of Cool-crete  
**Research Agency:** Ohio University  
**Researcher:** Eric Steinberg  
**Status:** Active  
**State Job #:** 135020  
**RFP #:** 2015-15  
**Start Date:** September 26, 2014  
**End Date:** September 26, 2015  
**Classification:** OPREP  
**Technical Lead:** Tim Sturges  
**Project Type:** Materials

**Abstract:**

Cracking of concrete bridge decks is a problem throughout the country. The cracking leads to the penetration of water and road salts that accelerates corrosion of reinforcement in the deck which can further increase cracking and detrimental effects. States have to invest significant resources to repair and replace damaged decks caused by the cracking. A new additive for concrete has been developed that could greatly improve on some of the difficult issues that the curing process of concrete creates.

The four objectives of this study are:
1. Measurement of internal temperatures during curing
2. Measurement of strains during curing caused by restraint
3. Testing for compressive strength and modulus of rupture material properties
4. Generation of thermal gradient through the deck samples to monitor effects

If Cool-crete shows superior behavior, it can be utilized as an option for better performing concrete in bridge decks as well as other locations susceptible to cracking.
**Project Title:** Effectiveness of Wildlife Mitigation Treatments on the Nelsonville Bypass  

**Research Agency:** Ohio University  

**Status:** Active  

**State Job #:** 135024  

**Researcher:** Deborah McAvoy  

**RFP #:** 2015-02  

**Start Date:** November 17, 2014  

**End Date:** April 17, 2017  

**Classification:** Standard  

**Project Type:** Environmental  

**Technical Lead:** Matthew Perlik  

**Abstract:**

U.S. Route 33 Nelsonville Bypass is a three-phase, 8.5-mile new construction of four-lane highway through Athens and Hocking County Ohio with a large portion bisecting Wayne National Forest, Ohio’s only National Forest. The Ohio Department of Transportation (ODOT) has worked closely with resource agencies and the Wayne National Forest to incorporate several mitigation treatments to protect wildlife in the area. The project was designed to restrict wildlife access to the highway to reduce vehicle wildlife interactions. However, the design also incorporated several features to make it permeable to wildlife migration.

This research will determine if the wildlife treatments are functioning as intended. This is important as a large amount of capital investment was made in these treatments. Further, this research will assist ODOT in designing these treatments for future projects, or indicate that they are not effective.
<table>
<thead>
<tr>
<th><strong>Project Title:</strong></th>
<th>Performance Comparison of Abutment and Retaining Wall Drainage Systems</th>
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<td><strong>Research Agency:</strong></td>
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<td><strong>Technical Lead:</strong></td>
<td>Jim Welter</td>
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**Abstract:**

Drainage behind abutment walls and retaining walls is vital to the performance of the abutment and approach slabs as it relates to potential settlement and rideability. The drainage system must retain the soil backfill while allowing water to pass out from behind the wall providing hydrostatic relief. Lack of proper drainage behind abutment and retaining walls can cause damage to the abutment walls, retaining walls, approach slabs, and expansion joints. Settlement at these locations can cause unsafe driving conditions.

This research will conduct a benefit analysis comparing ODOT’s current process of two feet of porous backfill with prefabricated composite drainage systems. The benefit analysis should reflect systems with potential to demonstrate a cost benefit. To accomplish this research, the scope of work should be divided into two phases. Phase 2 is contingent upon successful completion of Phase 1 and written authorization from ODOT’s Research Program. The scope of work should include, at a minimum, the activities noted below. Additional tasks may be included in the proposal by the research team as appropriate to ensure achievement of research objectives.
**Project Title:** Inspection, Repair, Retrofit Procedures, and Design Recommendations for Non-Redundant Steel Structures  
**Research Agency:** University of Cincinnati  
**Researcher:** James Swanson  
**Status:** Active  
**State Job #:** 135031  
**Start Date:** November 3, 2014  
**End Date:** November 3, 2015  
**RFP #:** 2015-ORIL6  
**Classification:** ORIL  
**Technical Lead:** Michael Brokaw  
**Project Type:** Structures

**Abstract:**

There are approximately 1500 structures in Ohio with the designation of fracture critical. Of these, approximately 900 pony trusses reside on the county system. As a result, counties are responsible for conducting specialized arms-length inspections on the fracture critical members (FCM) of these structures every twenty four months, in addition to the annual routine inspection. The FCM inspections are both costly and difficult to perform often due to the location of the members. While the tension zones in the steel pony members are categorized as fracture critical per FHWA’s Bridge Inspection Reference Manual (BIRM), a detailed analysis may prove otherwise. Research is needed to develop a modeling standard to analyze these structures and establish protocols, consistent with provisions outlined by FHWA, in order to refine fracture-critical designations.

The goal of this research is to provide analytical evidence and protocols that allow for the reduction of the number of fracture critical members to inspect on pony trusses utilized on Ohio's local roadway system. In addition to the analytical goal, there is an objective to develop a repair/retrofit procedure to eliminate non-redundancy or fracture critical elements of pony trusses, thereby transitioning from a non-redundant to quasi-redundant designation. The results of this research will provide local engineers with enhanced knowledge and understanding of the function of this structure type. It will also aid to educate bridge inspectors as to the actual in-field performance of pony trusses. Positive findings from this research will position locals for potential savings in terms of cost and time through the elimination of excessive and onerous inspections. This would further increase the desirability of the pony truss as a viable option to own and maintain; thereby, expanding its consideration for use by local transportation officials.
Project Title: Veteran's Glass City Skyway Ice Dashboard Implementation

Research Agency: University of Toledo
Researcher: Douglas K. Nims
Status: Active
State Job #: 135032
RFP #: 2015-IP4
State Job #: 135032
End Date: October 27, 2016
Classification: Implementation
Project Type: Structures
Technical Lead: Mike Gramza

Abstract:

The first research project recently concluded, and provided ODOT with a dashboard for monitoring ice events on the bridge stays. ODOT manages these icing events by closing lanes or the bridge as appropriate. To assist the operators in making these decisions, a real-time icing monitor, referred to as the “ice dashboard” was developed and a local icing weather station was installed on the VGCS. The dashboard integrates the local sensor information, regional weather and historical icing behavior of the bridge in a graphical manner that puts key information for managing icing events at the operators’ fingertips. Since its inception, ODOT operations has routinely used the dashboard to aid in making decisions about managing icing events.

There are two immediate issues with the present dashboard and sensor suite that need addressed through creation of an implementation project:

1. The dashboard has been transferred to the district in a stand-alone configuration. This has several implementation shortcomings from an operational perspective: ODOT needs to gain familiarity with the IT aspects of operating the dashboard and the current configuration does not have the interconnectivity, ability to grow as weather events occur, and transparency and flexibility to make it as robust as ODOT desires.

2. The sensor suite cannot directly detect the presence and state of ice on the stay.

The objective of this proposal is to locate and configure the dashboard app to maximize the utility to the operators of the VGCS. It is desired to do this as quickly as possible while maintaining the functionality of the dashboard through the upcoming winters of 2014-2015 and 2015-2016. District 2 has defined the requirements that the dashboard meet at the end of this project. In the long-run, to be effective in aiding the operators to make better decisions about managing icing events, the dashboard must be used and become a part of the culture of protecting the traveling public in an icing event. In addition, it must be hosted in an economical manner.
Project Title: Bridge Trough Maintenance Evaluation on Finger Joint Bridges

Research Agency: Ohio University

Status: Active

State Job #: 135049

Start Date: February 2, 2015

End Date: February 2, 2016

Technical Lead: Jim Mihelich

Researcher: Eric Steinberg

RFP #: 2015-09

Classification: Standard

Project Type: Maintenance

Abstract:

Highway maintenance crews within the Ohio Department of Transportation (ODOT) are tasked with cleaning debris that accumulates in the drainage trough underneath the bridge expansion joints. These troughs are often too high to reach with standard equipment. Without an access panel the trough is difficult to reach and clean. ODOT District 12 is interested in finding an efficient, cost effective and time saving way to accomplish this maintenance task.

The purpose of this research is to determine if design changes or equipment may be available to provide a better way of performing this important task.
Project Title: Graphical Design Task Order

Research Agency: Please Select

Status: Active  State Job #: 135071
Start Date: December 15, 2014  End Date: June 30, 2016

Researcher: Vicky Fout  RFP #: 2015-22

Classifcation: Program  Project Type: Planning

Technical Lead: Vicky Fout

Abstract:

This project will help publicize the transportation planning and research work occurring at ODOT. This will take the form of a task order to procure graphical design services on an as needed basis. This task order will aid in technology transfer activities, encourage implementation of findings, and overall enhance the final products developed through planning and research activities.
Project Title: Tack Coat Performance and Materials Study

Research Agency: Texas A&M Transportation Institute

Status: Active

State Job #: 135097

Start Date: February 17, 2015

End Date: August 17, 2016

Technical Lead: Craig Landefeld

Researcher: Bryan Wilson

RFP #: 2015-07

Classification: Standard

Project Type: Construction

Abstract:

Tack coats provide a bond between asphalt layers so they can act monolithically as one pavement section. Studies have shown that pavement layers that are not fully bonded fail significantly earlier than fully bonded sections. Conversely, application of too much tack material can result in flushing of the new mat or slippage failures. Currently ODOT typically specifies SS-1H, rubberized tack or Trackless Tack as our tack coat for paving layers. Application rates are typically between 0.04 to 0.075 gallons of emulsion per square yard. Some limited information tends to show that higher rates of tack may have delayed longitudinal cracking in pavements.

Even when tack is properly placed, projects have significant issues with tack being picked up by construction traffic prior to paving. The Department has seen a need for specification of a new Trackless Tack product due to construction issues that arise with other tack coat materials on certain projects. While the benefits during placement of Trackless Tack can be immediately noted, the premium cost and unknown long term performance of the material has limited its use. A study to analyze the pavement performance of different tack materials, application methods, and spray rates is needed. This would allow us to make better decisions about the value of more costly tack materials and the rates at which they should be applied.

The goal of the Department for this research is to evaluate the current practice as well as new equipment and application rates with regard to tack coat.
Project Title: Understanding the Soil Plugging Mechanism in Large Open Ended Pipe

Research Agency: Case Western Reserve University

Researcher: Bill Yu

Status: Active

State Job #: 135103

RFP #: 2015-14

Start Date: June 1, 2015

End Date: June 1, 2018

Classification: OPREP

Technical Lead: Jawdat Siddiqi

Project Type: 

Abstract:

Research is needed to study the soil plugging mechanism in large open-ended pipe. The knowledge will help to design methods to foster the development of soil plug in large diameter pipe piles used in ODOT projects. The results from this study will also help to develop guidelines on the design, construction, and QA/QC of large diameter pipe piles in transportation projects.

The goal of this research is to study the soil plugging mechanism in large open-ended pipe piles, especially for typical types of soils in Ohio. These will include a systematic collection of the existing experience on the design and construction of large open-ended pipe piles, conduct model experiments and computational modeling, and analyze the field data from ODOT construction projects. The longer term goal is to improve the design and construction method for large open ended pipe piles.
Abstract:

The goal of this research is will assist ODOT develop and evaluate a real-time system, which can automatically collect the Turning Movements Information at signalized intersections using signal control information and video detection data. To achieve this goal, the researcher, will be working in a partnership with Akron Metropolitan Area Transportation Study and the City of Akron's Traffic Engineering Division.

Currently, Turning Movements Information is collected manually with handheld devices in the field, which is tedious and labor intensive involving high cost. Previous efforts on this problem relied on a mathematical model by solving an O-D matrix in which the turning movements represent distributions of the arriving flow at each intersection approach. However, such a matrix cannot be mathematically solved with using supplementary volume data from the local detectors; yet previous studies showed that the results from the O-D method are not accurate. Therefore, driven by the need to identify vehicle turning movements automatically in different geometric and traffic control conditions, an Automatic turning Movement Identification System (ATMIS) has been developed in the transportation Laboratory of The University of Akron. By interfacing with existing signal controller and detection devices, the system was tested in a laboratory environment using video from the field. The results from the preliminary lab experiment showed that the methodology is very promising and it can potentially be expanded and enhanced for field applications.
Project Title: A Comparison of Full Wave Inversion Technique to Assess Underground Voids

Research Agency: Ohio Department of Transportation

Status: Active

State Job #: 506898

Start Date: June 5, 2014

End Date: September 5, 2015

Technical Lead: Chris Merklin

Researcher: Kirk Beach

RFP #: IH-004

Classification: In-House

Project Type: Planning

Abstract:

To determine the risk of subsidence, techniques are needed to quickly assess the presence or absence of underground voids underlying our roadways. Conventional means of exploration are typically used which include drilling in concert with several geophysical surveys. Because current geophysical methods have application limitations, a battery of geophysical techniques are generally used in aggregate to develop an understanding of complex subsurface conditions. A new geophysical method has been introduced which promises to provide good results without the limitations of other geophysical methods.

The new method incorporates a seismic surface wave field using a full waveform inversion technique. The primary advantage of this technique is in its ability to generate all possible wave propagation modes, using both P and S waves, for analysis to infer complex geologic settings.

This study will compare selected geophysical methods with the Full Waveform Inversion Technique. Results of the surveys will be compared with conventional geophysical techniques and validated by drilling and sampling. This project will be 12 months long under the direction of Mr. Chris Merklin of the Office of Geotechnical Engineering with the Ohio Department of Transportation.
Project Title: Bonded Concrete Overlay (BCO) Cost Effectiveness Evaluation

Research Agency: Ohio Department of Transportation

Status: Active

State Job #: 510029

Start Date: December 8, 2014

End Date: June 30, 2017

Technical Lead: Adam Au

Abstract:

STATE FUNDED ONLY; NOT ELIGIBLE FOR FEDERAL CONTRIBUTION

The project is to place a 2.7 mile bonded concrete overlay in District 11 in FY2016 and monitor the pavement performance. This test section performance will be compared to other rehabilitation options using existing degradation curves and allow an evaluation using a life cycle cost analysis.

ODOT does not currently consider using concrete overlays for minor rehabilitation strategies. The goal of this research project is to determine whether the increased initial construction costs are justified based on pavement performance improvement and longer life cycle.

This project will be 60 months long under Adam Au in Office of Pavement Engineering.
**Project Title:** Evaluation of Optional and/or Replacement Concrete Sealers  
**Research Agency:** Ohio Department of Transportation  
**Status:** Active  
**State Job #:** 526980  
**Start Date:** September 15, 2012  
**End Date:** February 15, 2018  
**Classification:** In-House  
**Researcher:**  
**RFP #:** 2012-27  
**Project Type:** Materials  
**Technical Lead:** Maria Kerestly  

**Abstract:**

The purpose of this research is to investigate application issues, to study the performance of the epoxy-urethane concrete sealers, and to do a comparative study on the durability of the epoxy-urethane sealers and three new participating concrete sealer products.

In 2008, the Office of Materials Management (OMM) was receiving numerous calls from the districts concerning failures of concrete sealers. OMM investigated these failures and found that the problems were not due to material issues. The findings of the investigations led to the creation of a PowerPoint presentation on the best application practices for epoxy-urethane concrete sealers. The presentation was the result of a cooperative effort between OMM and the producers of the currently approved epoxy-urethane concrete sealers. In the presentation, the epoxy-urethane producers stressed the importance of the proper preparation of concrete surfaces in order to achieve optimum sealer performance. Concrete sealing was then formatted under a new work type, Work Type 57. The presentation became the bases of the training required under Work Type 57. As the training was implemented, the number of reported sealer failures decreased.

Concrete sealer applicators were spending more time and effort trying to achieve the properly prepared concrete surfaces that were required. Consequently, they expressed a desire for a more user friendly sealer product to be approved by the State of Ohio. Contractors wanted sealer products requiring less surface preparation time.

At the district level, the focus was increasingly toward aesthetics. Districts wanted new sealer products that did not create the unsightliness of the highly visible epoxy-urethane failures.
## Proposed Projects for Funding in FY 2016

<table>
<thead>
<tr>
<th>Solicitation #</th>
<th>Project Title</th>
<th>Project Duration (months)</th>
<th>Total Estimated Cost ($)</th>
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<tr>
<td>1* 2014-16</td>
<td>Estimating External Travel Using Purchased Third-Party Data</td>
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<td>2* 2015-17</td>
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<td>3* 2015-21</td>
<td>LUC-2-1682 Long Term Maintenance of the Anthony Wayne Suspension Bridge Main Cables</td>
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<td>Route Optimization for ODOT Snow Plow Trucks, Phase 1</td>
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<td>Earthen Berm Noise Reduction Analysis</td>
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<td>Evaluation of Safety Practices for Short Duration Work Zones</td>
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<td>Assessment of Salt Procurement and Distribution Processes</td>
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<td>Effective and Efficient Roadside Ditch Cleaning Using BMP's for Erosion and Sediment Control</td>
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<td>Evaluation of Technology for School Bus Stop Ahead Signs</td>
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<td>Reduction of Bridge Deck Cracking through Alternative Material Usage</td>
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<td>Update Regional Skew Characteristics of Annual Peak Flows Through StreamStats</td>
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<td>Impacts of Design Exceptions on Highway Safety</td>
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<td>Bridge Condition Index for Transportation Asset Management in Ohio</td>
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<td>Development, Testing and Validation of TERM, the Toolbox for the Evaluation of Ramp Metering</td>
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<td>Structures Research On-Call Services</td>
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<td>25 2016-20</td>
<td>No Boundaries Roadway Maintenance Practices</td>
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<td>Cost Benefit Analysis for Culvert Replacement</td>
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<td>Best Practices of Road User Maintenance Agreements Amongst Local Government Agencies in Ohio</td>
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<td>Structural Benefits of Concrete Paving of Steel Culvert Inverts</td>
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# Proposed Projects
for Funding in FY 2016

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<th>Project Title</th>
<th>Project Duration (months)</th>
<th>Total Estimated Cost</th>
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<td>Development of Recommendations to Address IRP Truck Licensing Impacts for Ohio Counties</td>
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<td>31</td>
<td>Technical Editing for Ohio DOT Research Reports</td>
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<td>32</td>
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* FY 2015 encumbrance in process for June start date $5,135,854.52
**Project Title:** Estimating External Travel Using Purchased Third-Party Data  

**Research Agency:** The Ohio State University  

**Project Type:** Planning  

**Technical Lead:** Rebekah Anderson  

**Status:** Proposed  

**State Job #:** 134877  

**RFP #:** 2014-16  

**Classification:** Standard  

**Start Date:**  

**End Date:**  

**Abstract:**  

Roadside O-D surveys have historically been conducted by the Department or its consultants. These surveys require staff to stop all traffic on each surveyed road and therefore can be costly and bothersome to motorists. Furthermore, the Department prefers not to stop traffic on Interstate Routes (IR) for these surveys. Surveys were conducted at over 700 locations from 1995-1997 at a cost of around $7M for the purpose of TDM estimation. Between 1997 and 2002, surveys were conducted at 10 cities to determine the need for bypasses or other transportation improvements. In 2008, surveys were conducted around Allen County to expand the TDM study area. In 2009, the Department studied the use of Automatic License Plate Recognition (ALPR) cameras to capture the through traffic on IR 75 through Allen County. However, the ALPR cameras are only able to collect the traffic that is traveling the entire IR through the study area as only 4 cameras are owned by the Department.

Third-party OD datasets have recently become commercially available for transportation planning purposes. These datasets are produced from various types of data and can be purchased from Inrix, Airsage, ATRI and others.

This research project will determine whether third-party datasets are able to replace roadside O-D surveys. Datasets will be obtained for the Lima-Allen County Regional Planning Commission (LACRPC) model area from at least three vendors and will be compared to the 2008 Cordon Survey and 2009 ALPR study for Allen County. Trip purposes will be imputed from the datasets as best as possible if they are not already commercially available. O-D matrices (both Internal-External (I-E) and External-External (E-E)), time of day (TOD) patterns and trip purposes will be compared. Resident vs. non-resident may also be compared.
<table>
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<tr>
<th>Project Title:</th>
<th>Earthen Berm Noise Reduction Analysis</th>
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<tr>
<td>Technical Lead:</td>
<td>Noel Alcala</td>
</tr>
<tr>
<td>Researcher:</td>
<td>Seth Young</td>
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<td>Project Type:</td>
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Abstract:

ODOT constructs approximately 12 miles of new concrete noise barriers each year. This can result in unforeseen costs during the construction of the barrier, and also assumes typical maintenance costs. ODOT would benefit from having another option for a noise barrier that can be frequently constructed with lower construction and maintenance costs. ODOT’s Office of Environmental Services has found very little data and research about the benefit of earthen berms compared to concrete and fiberglass with regard to the abatement of noise, and is interested in determining the benefits of an earthen berm noise barrier.

The primary objective of this research is to determine the acoustic benefit of various earthen berm heights compared to same height concrete barriers. This analysis should also address whether a shorter earthen berm provides the same acoustic benefit as a taller concrete barrier. Another objective is to determine the cost benefit to using earthen berms in lieu of the concrete barrier.
**Project Title:** Validation and Calibration of Finite Element of Forces in Wingwalls  

<table>
<thead>
<tr>
<th>Research Agency</th>
<th>E. L. Robinson Engineering of Ohio, Co.</th>
<th>Researcher:</th>
<th>Jamal Nusairat</th>
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<td>Technical Lead:</td>
<td>Steve Taliaferro</td>
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**Abstract:**

ODOT has been designing and installing bridges using abutments and wingwalls with turnback support using drilled shafts placed in bedrock, as recommended in the 2007 ODOT Bridge Design Manual and 2012 AASHTO LRFD Specifications. This construction technique is more economical and adapts well to site conditions in Ohio. The design has been simulated using 3-dimensional finite element models [e.g. E.L. Robinson Engineering, 2013 for ALL-75-0703 Bridge], but there is insufficient data to validate these models. The models indicate that the dominant force is uplift from the drilled shafts.

To validate the finite element models and ensure the design concept is safe, sound, and economical, it is proposed that a new bridge in Ohio be instrumented to obtain the data. The instrumentation would be designed to measure the amount of load and the stress (critical stress) transferred from the abutment to the wingwall at the interface and the forces in the drilled shafts, whether caused by loads or by environmental factors such as temperature changes or soil moisture.

The research will benefit ODOT in understanding the behavior of the drilled shafts supporting abutments during construction and service life. The research will help in understanding the load mechanism and help improve the design methodology for similar type of substructures in addition to some design guides to be included in the ODOT Bridge Design Manual.
### Project Title:
LUC-2-1682 Long Term Maintenance of the Anthony Wayne Suspension Bridge Main Cables

### Research Agency:
University of Toledo

### Researcher:
Douglas K. Nims

### Status:
Proposed

### State Job #:

### RFP #:
2015-21

### Start Date:

### End Date:

### Classification:
Student Study

### Project Type:
Structures

### Technical Lead:
Mike Gramza

---

### Abstract:

The Anthony Wayne Bridge, Ohio's only suspension bridge, is undergoing an extensive rehabilitation. Prior to taking action to preserve the cables, ODOT must decide what measures to take to evaluate the condition of the cables, how best to rehabilitate the cables to slow their aging and how to monitor the degradation in the cables' strength as they age.

The three goals of this study are:
1. Determine the current condition of the main cables.
2. Determine a rehabilitation technology to most efficiently and economically slow their aging.
3. Select a long term monitoring strategy that accurately tracks the changes the condition of the cables over time.

This research should help ODOT make decisions for preserving the cables.
**Project Title:** Route Optimization for ODOT Snow Plow Trucks, Phase 1  
**Research Agency:** University of Akron  
**Researcher:**  
**Status:** Proposed  
**State Job #:** 135157  
**RFP #:** 2015-23  
**Start Date:** June 1, 2015  
**End Date:** June 1, 2016  
**Classification:** Standard  
**Technical Lead:** Jamie Hendershot  
**Project Type:**  

**Abstract:**

ODOT employs a variety of specialty equipment such as Epoke® bulk spreaders and the Viking-Cives TowPlow as part of its winter maintenance fleet. In addition to optimizing the snow and ice routes for its standard snow plow trucks, ODOT wants to determine the best way to implement the specialty equipment within its fleet. Through advanced route optimization, specialty equipment may be included in the analysis to determine the optimal locations to deploy various types of equipment under different weather severity scenarios.

This project is divided into two phases. The first phase includes a pilot study for District 1 (located in northwestern Ohio) and District 10 (located in southeastern Ohio). Phase I results will determine whether or not to move forward with Phase II, which will include the remaining districts.

Authorization for Phase II will be made in a separate request based on the results of Phase I.
**Project Title:** Evaluation of Safety Practices for Short Duration Work Zones  

**Research Agency:** Texas A&M Transportation Institute  

**Status:** Proposed  

**State Job #:** 135201  

**RFP #:** 2016-01  

**Start Date:**  

**End Date:**  

**Classification:** Standard  

**Technical Lead:** Shawn Rostorfor  

**Project Type:**  

---  

**Abstract:**

As part of our mission statement the Ohio Department of Transportation (ODOT) has determined that improved safety is a core focus area. The department would like to eliminate fatalities in our short duration (less than 24-48 hours) work zones. This research is mostly concerned with safety during a variety of activities requiring our maintenance crews to work adjacent to fast moving high volume traffic.

The goal of this research is to identify cost effective and safer alternatives to the current procedures used by ODOT maintenance crews during short duration work zone operations. The main objectives of this research are to evaluate the current ODOT safety practices, identify and conduct a preliminary assessment of temporary traffic control alternatives (devices and methods) and recommend temporary traffic control alternatives for further evaluation. The findings from this research will either validate current ODOT practices or result in recommendations for improvements to ensure the safe and efficient flow of traffic in short duration maintenance operations.
Project Title: Assessment of Salt Procurement and Distribution Processes

Research Agency: University of Akron

Status: Proposed

State Job #: RFP #: 2016-02

Start Date: End Date: Standard Classification

Technical Lead: Project Type:

Abstract:

The Ohio Department of Transportation (ODOT) has, as one of its guiding principles, to be the standard of excellence for winter maintenance. In support of this principle, it is essential to have efficient and effective processes in terms of material acquisition, storage, and distribution. Currently, ODOT procures salt for winter maintenance activities through a twice a year, multi-vendor bid process. The awarded contracts are inclusive of materials for the State as well as various local entities (e.g.: cities, townships, counties).

The goal of this research is to optimize ODOT’s salt processes from procurement to utilization. The objectives of this research are to: (1) establish a methodology for assessing ODOT’s processes, (2) develop a matrix of best and current practices with a focus on procurement, storage and logistics as well as additional areas identified by the researcher as appropriate, and (3) identify recommendations to handle short, mid, and long term improvements for contract, logistics, storing and maintenance of salt.

Salt is the number one expense for maintenance materials. To be good stewards with the state’s funds, ODOT is looking to minimize spending and increase service. Some potential benefits of this research study include eliminating ineffective processes, increasing efficiencies, decreasing time delays and cost savings.
Abstract:

Recent national sustainability efforts by such organizations as FHWA and state legislatures and DOTs have led to increased use of reclaimed asphalt shingles (RAS) and higher reclaimed asphalt pavement (RAP) contents. In addition, state DOTs spend over 20% of their budgets on asphalt and can receive substantial cost savings by increasing use of RAS and RAP. This occurs by decreasing the amount of virgin asphalt binder (derived from crude oil) required in RAS and RAP asphalt mixes. Virgin asphalt binder is the most expensive component of asphalt mixtures even though used in small amounts by weight. There is, however, a point of diminishing returns. As asphalt mixtures have less and less virgin binder an increase in durability issues become evident resulting in increased maintenance costs and lower expected life. The way most DOTs deal with this is to put higher amounts of RAS and RAP in lower asphalt layers and lower amounts in surface asphalt mixes.

Recent ODOT project work with RAS suggest current methods and limits may exceed what is desired for performance. Historically, performance benefits of RAS and RAP have been quantified by measuring rutting resistance, which will always improve with harder aged binders and less amounts of softer virgin binders. However, durability performance entails far more than rutting. It also entails crack propagation resistance, fatigue resistance, moisture damage resistance and raveling resistance as well as performance in freeze/thaw conditions in northern climates such as Ohio.

The researcher's goals and objectives will include determining suitable test methods and equipment for testing of RAS, RAP and virgin mixtures in order to distinguish expected crack propagation resistance and durability performance of each. Phase 1 of the work will be to evaluate, with ODOT liaison concurrence, available methods and equipment to determine which is best suited for further work. Phase 2, with written authorization from ODOT's research office, will perform extended testing using the selected method to prove its suitability and allow recommendations for specification limits and test standards to be made. If Phase 2 is authorized, the researcher will be asked to develop a proposal for the approved solution(s) and an addendum to the contract will be issued by the Research Section.
**Abstract:**

The Ohio Department of Transportation (ODOT) maintenance crews maintain approximately 43,000 lane miles of open roadside ditches. These activities allow storm water to readily exit the roadway, eliminate obstructions, and restore ditches to their proper shape. Open roadside ditches impact the functional and environmental aspects of the transportation system. When the ditches are not maintained they can obstruct the necessary and designed flow of storm water from the roadway. That can lead to safety concerns of water and/or ice on the roadway as well as premature roadway failure from saturated subsurface.

The researcher will work closely with ODOT maintenance crews in Putnam and Mahoning County to research how to improve upon ODOT’s current roadside ditching process and provide recommendations on how to improve safety, production and cost effectiveness. To accomplish this research, the scope of work should be divided into two phases. Phase 2 is contingent upon successful completion of Phase 1 and written authorization from ODOT’s Research Program. Phase 1 of the research requires a comprehensive look at how ODOT currently maintains roadside ditches, and will provide recommendations on how to increase efficiency and decrease labor hours. Environmental issues are a major concern for the department and need to be considered in the first phase by making recommendations for BMPs dealing with erosion and sediment control.
Abstract:

The Ohio Department of Transportation (ODOT) is experiencing significant premature pavement failures (e.g. rutting, potholes, pavement distresses) on rural routes as a result of multiple overlay projects over multiple years. ODOT believes this has been caused by poor subsurface drainage leading to premature pavement failures. Currently ODOT experiences high costs when using contractors for installation of aggregate drains when tied to resurfacing projects.

The researcher is to conduct an in-depth analysis of ODOT’s current method of addressing saturated sub base issues prior to resurfacing projects and provide recommendations on how to cost effectively increase the longevity of pavement in rural areas by developing a matrix of alternatives that will compare and contrast solutions. The researcher will also provide an analysis of current equipment, materials and technology (e.g. rock saws, compactor, and equipment to run those) available for handling subsurface drainage installation for current resurfaced roads and future resurfacing projects.

The scope of work should be divided into two phases. Phase 2 is contingent upon successful completion of Phase 1 and written authorization from ODOT’s Research Program.
**Project Title:** Evaluation of Technology for School Bus Stop Ahead Signs  
**Research Agency:** Toxcel, LLC  
**Status:** Proposed  
**State Job #:** 135200  
**RFP #:** 2016-06  
**Start Date:**  
**End Date:**  
**Classification:** Standard  
**Technical Lead:** Eric Beery  
**Project Type:**

### Abstract:

Every year The Ohio Department of Transportation (ODOT) receives calls from concerned citizens about drivers that simply ignore school bus stop signs. Research has shown that students are three to four times more likely to be killed while boarding or leaving the bus than while riding the bus (Transportation Research Board 1989). Through this research ODOT would like to look at evolving technologies to determine if there is anything available to aid in the effectiveness of school bus stop ahead signs. Of particular concern are the rural areas with curvy roads providing an inability for drivers to see the school bus stop within a safe distance and therefore terrain and roadway geometrics should be considered.

The objective of this research is to evaluate the current ODOT practice for school bus stop sign placement, identify available technology for school bus stop signs and identify practices by other DOT’s or municipalities that could enhance or replace the current practice. Recommendations need to incorporate school districts and school bus drivers. Findings should improve safety and be cost effective.

The scope of work should be divided into two phases. Phase 2 is contingent upon successful completion of Phase 1 and written authorization from ODOT’s Research Section.
Project Title: Evaluating the Particle Size Distribution of Ohio's Stormwater Runoff

Research Agency: To Be Determined

Researcher: Becky Humphreys

Status: Proposed

State Job #: RFP #: 2016-07

Start Date: End Date: Standard

Classification: Project Type: Hydraulics

Technical Lead: Becky Humphreys

Abstract:

With the creation of the United States Environmental Protection Agency's (U.S. EPA) Clean Water Act (CWA), our surface waters are more protected. Implementation of section 402 of the CWA requires the Ohio Department of Transportation (ODOT) to obtain coverage under a National Pollutant Discharge Elimination System (NPDES) general permit to discharge stormwater runoff from ODOT's owner/operated storm sewer system. To comply with one aspect of this permit, ODOT is required to address Post-construction Water Quality Best Management Practices (BMPs) that require the removal of 80% of particulate matter (PM) measured as total suspended solids (TSS) from stormwater runoff. Although, the permit does not specify the particle size distribution (PSD) to use when testing the separation (sequestration) efficiency of a BMP, understanding PSD is an important factor when assessing impacts to receiving streams.

The research goals and objectives are to quantify the PSD generated on the roadway system and transported in roadway stormwater runoff. The research will provide data specific to PM associated with Ohio roadways that will allow ODOT to better assess and determine new or revisions to the current post-construction water quality BMPs in ODOT's Location and Design Manual Volume 2, which in turn will allow ODOT to better demonstrate removal efficiencies specifically associated with Ohio roadway PM; the ultimate goal being able to demonstrate compliance with OEPA's CGP requirements.
Abstract:

Grade crossing safety is one of the primary missions of the Ohio Rail Development Commission (ORDC). 55% of Ohio's 5,800 public grade crossings are now equipped with modern lights and gates, and a total of 115 grade crossings have been closed since the year 2000. In Fiscal Years 2011 and 2012, a total of $47.7 million was invested in 153 safety projects throughout the state. As a result, grade crossing accidents, fatalities, and injuries have been reduced to a record 10-year low, through 2012. The State of Ohio has for many years been using the FRA/Ohio Formula to develop a hazard ranking index for all Ohio public crossings, which serves as the basis for selecting most of Ohio's active warning device projects. This index is supplemented by an in-field diagnostic review to assess grade crossings. As ORDC continues to move forward with crossing upgrades, the project selection process has become more nuanced. The FRA/Ohio Formula provides one perspective in making safety investments, but the need for additional project selection resources has become apparent.

The goal of the project is to provide a better understanding of the hazard ranking formulas currently in use. The selected project consultant will conduct a preliminary overview of hazard ranking formulas, identifying and reviewing the most commonly used formulas. This will include an investigation into Ohio's current use of the FRA/Ohio Formula as well as Ohio's current grade crossing programs and issues. ORDC, in conjunction with Public Utilities Commission of Ohio, will then select a list of hazard ranking methodologies for additional consideration. This will include a combination of survey documents and interviews with practitioners of other formulas. This, along with a detailed evaluation of the selected formulas, will help ORDC determine what data is needed to effectively operate each formula, the availability of required data, and the effort required to gather additional data.

This project will increase knowledge of the available crossing hazard ranking methodologies, which benefits ODOT by enhancing safety and providing additional resources to guide project selection. ORDC seeks to continue the downward trend of railroad crossing accidents. Though accidents are at an all-time low, nearly 3,000 crossings in the State lack active warning devices. Additional hazard ranking resources, supplemented by field reviews, will help ensure that wisely chosen safety interventions continue to occur at the State's most hazardous crossings.
Project Title: Determining Optimum Thickness for Long-Life Concrete Pavement in Ohio

Research Agency: Ohio University

Researcher:

Status: Proposed

State Job #: State Job #: State Job #:

RFP #: 2016-09

Classification: OPREP

Project Type: Pavements

Technical Lead: Adam Au

Start Date: Start Date:

End Date:

Classification:

Abstract:

The main objective of this study is to provide guidance on the selection of concrete slab thickness required to achieve long term performance considering the effect of slab dimensions, concrete slab support, and climatic conditions on critical stresses. The study will include proposed changes to the design, construction, and material procedures/specifications that, if adopted and implemented, will significantly increase PCC pavement lifetimes and reduce maintenance costs.

Although concrete pavement has shown its evidence for a long last time in service, sometimes it still experiences functional failure and premature failure. ODOT has conducted extensive research focused on improving concrete pavement performance. The rigid pavement design procedure in the 1993 AASHTO Guide for the Design of Pavement Structures, in which a slab thickness can be selected and will result a great improvement in concrete terminal serviceability, is a good example of improving concrete pavement performance. However, other factors also play a major role in concrete pavement performance. This is a 28 month project will be conducted by Dr. Shane L. Gilkey of Ohio University in collaboration with Ohio Concrete, Inc.
### Project Title:
Effectiveness of Design-Build Project Delivery Method in ODOT's Program

### Research Agency:
Bowling Green State University

### Status:
Proposed

### State Job #:

### RFP #:
2016-10

### Start Date:

### End Date:

### Researcher:
Ghada Gad

### Classification:
OPREP

### Project Type:
Construction

### Technical Lead:
Eric Kahlig

### Abstract:

This would assist ODOT in performing a proper evaluation of a project's delivery method.

ODOT has increasingly used Design-build (DB) in projects of different characteristics other than highway projects, because of its pronounced advantages, such as improved project timing, reduced costs, clear quality control, and enhanced innovation opportunities. However, ODOT may not be able to gain the desired benefits in all its DB projects with different characteristics. The objective of this study is to provide ODOT with an assessment of the effectiveness of DB PDM use in projects with different characteristics (type, size, and complexity) through evaluation of the projects' measurable performance criteria (time, cost, quality, etc...). The effectiveness assessment will provide ODOT with quantitative measures that could enhance its decision-making process in selection of candidate projects for DB project delivery, and thus realize better project performance in its overall transportation system. This is a 15 month project will be conducted by Dr. Ghada M. Gad of Bowling Green State University, and Dr. Douglas Gransberg of Iowa State University.
**Project Title:** Reduction of Bridge Deck Cracking through Alternative Material Usage  

**Research Agency:** University of Akron  

**Status:** Proposed  
**RFP #:** 2016-11  
**State Job #:**  
**Classification:** OPREP  

**Researcher:**  
**End Date:**  
**Project Type:** Structures  
**Technical Lead:** Waseem Khalifa  

**Start Date:**  

**Abstract:**

During the previous and ongoing investigations and researches about cracking behavior, epoxy coated bars (ECB) has been found that is contributed to the problem of wider cracks although it may be not the core of the cause. However, the problem of the ECB can be solved by either to add of polypropylene fiber or basalt fiber Minibar to concrete, or to use alternative coatings/coated bars. The goals of this research it to reduce the extent and severity of cracking in bridge decks through alternative material usage. The project will provide a basis for better preparation for the Department to deal with potential system degradation (structural slab bridges) and minimization of cracking in new structural slab bridges thereby reducing the life cycle cost and increasing the longevity of such bridges. This is a 24 month project conducted by Dr. Anil Patnaik of the University of Akron in collaboration with Euclid Chemical Company and BASF corp.
Project Title: Update Regional Skew Characteristics of Annual Peak Flows Through StreamStats

Research Agency: U.S. Geological Survey

Researcher: Greg Koltun

Status: Proposed

State Job #: RFP #: 2016-12

Start Date: End Date:

Technical Lead: Jeff Syar

Classification: OREP

Project Type: Hydraulics

Abstract:

Accurate flood-frequency characteristics are required to design safe bridges and culverts. Unfortunately, flood-frequency characteristics can be determined directly only at stream crossings located at or near streamflow-gaging stations with long periods of peak-flow record. Consequently, at most stream crossings, flood-frequency characteristics must be estimated. Those estimates typically have been determined from regional regression equations for streams that are unregulated and drain predominately rural areas. The last such set of regional regression equations developed for Ohio was based on peak-flow data collected through water year 2001.

The goals of this research are to (1) evaluate and update regional estimates of skewness in peak-flow time series, (2) update flood-frequency estimates for Ohio streamflow gages based on the updated regional skew information and peak-flow data collected through water year 2014, (3) develop new regional regression equations relating selected basin characteristics to peak flows with annual exceedance probabilities ranging from 0.5 to 0.002, and (4) implement the regional regression equations in the U.S. Geological Survey's StreamStats application (http://streamstats.usgs.gov).
### Abstract:

The data collected from this project could provide petrographical and chemical evidence of dedolomitization of Ohio's dolostone aggregate sources over regular intervals of time using different methods, and will contribute to ODOT's new concrete freeze thaw test parameters.

The goal of this project is to employ state-of-the-art scientific/analytical methods for sample characterization and analysis including using Polarized Light Microscopy (PLM), Scanning Electron Microscopy (SEM) with Energy Dispersive X-ray microanalysis (SEM/EDS), and X-ray Powder Diffraction (XRD) to identify the presence of dedolomitization in Ohio-sourced dolostone aggregates and concretes produced using these aggregates. This project will be overseen by Dr. John R. Farver of Bowling Green State University.
<table>
<thead>
<tr>
<th>Project Title:</th>
<th>Fundamental Evaluation of the Interaction between RAS/RAP and Virgin Asphalt Binders</th>
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<td>Researcher:</td>
<td>Munir Nazzal</td>
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<td>Materials</td>
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<tr>
<td>Technical Lead:</td>
<td>David Powers</td>
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</table>

**Abstract:**

The results of project will lead to designing and producing durable asphalt mixes containing RAS/RAP, to lowering the life cycle costs of pavements as well as improving their environmental impacts, to the development of sustainable pavement structures in Ohio. This will allow ODOT to have more insight into how the RAS/RAP and virgin new binders interact with each other. This will then guide ODOT in how to specify the usage of RAS/RAP in the future to ensure long lasting pavements.

The asphalt mixture producers and ODOT increased the use of the readily available recycled materials such as Reclaimed Asphalt Pavement (RAP) and Recycled Asphalt Shingles (RAS) in flexible pavement mixtures. However, using RAS and higher amounts of RAP in new paving mixtures may cause the resultant mixture to be more prone to load and non-load associated cracking and adhesion/cohesion failures during the service life of the pavement. The main objective of this project is to study the interfacial zone between the RAS/RAP and virgin asphalt binders and evaluate its properties that affect the fatigue cracking and moisture damage resistance of mixtures containing RAP and RAS materials.
Project Title: Investigate Feasibility of GPR to Measure In-Place Density of New Asphalt Pavement

Research Agency: Infrastructure Management and Engineering, Inc.

Researcher: Arudi Rajagopal

Status: Proposed

State Job #: 135158

RFP #: 2016-15

Classification: OPREP

Start Date: End Date: OPREP

Technical Lead: Craig Landefeld

Project Type:

Abstract:

Investigate Feasibility of GPR to Measure In-Place Density of New Asphalt Pavement

Density of asphalt mixtures is one of the most important properties to monitor during construction of hot mix asphalt pavements. Density is deemed important in asphalt pavement construction since it influences the void structure of the asphalt mixture. When the air voids are lower than a specified value, the constructed pavements will experience rutting, shoving and bleeding due to plastic flow. When the air voids are higher than a specified value, the mixture will allow water and air to permeate into the structure resulting in water damage, oxidation, raveling and cracking. Since density of an asphalt mixture varies throughout its life, the voids also vary proportionally. The voids must be low enough initially to prevent permeability of air and water and high enough after a few years of traffic to prevent plastic flow.

Traditionally, density has been measured in the laboratory using core samples. However, cores provide data at only a limited number of random locations. Some organizations supplement cores with data from a nuclear or electrical density gauge. The Ohio Department of Transportation requires the contractors obtain cores to determine in-place density of the compacted mixture as a percentage of the average QC Maximum Specific Gravity (MSG) for the production day the material was placed. In Ohio, data from the cores are used to calibrate the electrical density gauge. At the end of the job, the department marks ten locations for taking core samples. The core samples are tested by the State to verify density of compacted asphalt mixture.

Extensive research completed in Finland in the late 1990s verified the ability to measure asphalt air void content with Ground Penetrating Radar (GPR). The air void values were obtained from GPR-based dielectric measurements using a small number of cores for calibration. The researcher's objectives and goals include documenting GPR technology as applied to measurement of asphalt mixture in-place density, design and develop a statistically valid field and lab experiment, compare GPR data with results from cores and electric gauge, process the data and generate information that can assist ODOT to develop QC/QA specifications for acceptance of the compacted asphalt mixtures. Some of the benefits of this study are that GPR is non-destructive, it can provide rapid measurements with immediate results, compared to core sampling at isolated spots, data sampling can encompass up to 100% of the paved area and the results can depict quality and uniformity of density through the project.
Abstract:
The objective of this study is to facilitate the appropriate use of design exceptions through the evaluation of the safety performance of design exceptions and mitigation techniques used for their implementation. This will provide a wider range of design values for ODOT to achieve greater success in implementing appropriate design solutions. This research will a) summarize past design exceptions by documenting their frequency and reason for use; b) evaluate the effect of mitigation actions as a result of design exceptions; and c) determine any safety implications stemming from adopting design policies and practices related to design exceptions.
**Project Title:** Bridge Condition Index for Transportation Asset Management in Ohio  
**Research Agency:** The Ohio State University  
**Researcher:** Abdollah Shafieezadeh  
**Status:** Proposed  
**State Job #:**  
**RFP #:** 2016-17  
**Start Date:**  
**End Date:**  
**Classification:** OPREP  
**Technical Lead:** Jared Backs  
**Project Type:** Structures

**Abstract:**

This research proposes a practical and efficient measure called bridge condition index (BCI) for reliable condition assessment of Ohio bridges through effective utilization of ODOT's bridge databases. The products of this research will directly contribute to the strategic goals of ODOT in maintaining Ohio's transportation systems and enhancing their efficiency, safety, and capacity.

A number of state DOTs and federal agencies have developed and implemented several bridge performance measures. An essential component of bridge management systems is performance measures which assist bridge owners in taking appropriate maintenance, rehabilitation, and repair (MR&R) actions to right bridges at the right time and cost. These metrics are useful for a specific set of goals that are defined based on the type of decisions to be made by stakeholders; however, they do not fully satisfy the set of requirements mentioned previously. This is due to a number of factors such as (1) inability to properly represent the condition state of bridges and indicate critical needs for bridge preservation, (2) large subjectivities in determination of involved parameters, (3) unavailability of some key data required for the calculation of the metrics, and (4) high complexity of procedures, among other factors.
<table>
<thead>
<tr>
<th><strong>Project Title:</strong></th>
<th>Development, Testing and Validation of TERM, the Toolbox for the Evaluation of Ramp Metering</th>
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<tr>
<td><strong>Research Agency:</strong></td>
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<tr>
<td><strong>Researcher:</strong></td>
<td>Jonathan Corey</td>
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<td><strong>Technical Lead:</strong></td>
<td>Dave Holstein</td>
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**Abstract:**

The goal of this research is to identify the critical factors in ramp metering operations and performance and incorporate those factors into a model suitable for Monte Carlo simulation at reasonable speeds within either Excel or a server and website environment. This model would estimate critical factors such as vehicle speeds and density in the ramp regions as well as safety factors such as speed variability and operational factors like queuing and volumes. The Toolbox for the Evaluation of Ramp Metering (TERM) would require a minimum of information, such as the ramp and mainline volumes, geometric factors such as acceleration lane length, ramp queue capacity with the goal of limiting the number of input factors to those absolutely critical to ensuring accurate and meaningful results.
The Ohio Department of Transportation (ODOT) is a large state agency charged with management and maintenance a vast transportation system in Ohio. ODOT strives to execute its charge in the most effective and efficient manner possible. Frequently, ODOT encounters situations where low cost, short term research services are needed to meet immediate needs for system management and maintenance improvements. Some of the short term research needs may go unmet due to the immediacy of the need and the perceived long delay in navigating ODOT's research process.

The objective of "Structures Research Services" is to establish an on-call contract with a research team possessing strong expertise in the field of structural engineering to conduct low cost, short term research in advance of identifying specific research needs.

RESEARCH TASKS:
Specific research tasks will be determined as needs arise. Potential research topics may include, but are not limited, to the following:

1) Assist with forensic investigations when concerns are raised about a bridge
2) Investigate physical properties and structural behavior on unique and special bridges to model and determine forces, capacities, failure, modes, etc.
3) Investigate the loadings within critical gusset plates using a photo-elastic material to better understand how the loads transfer through the gusset plate
4) Determine MSE wall long term stability and maintenance recommendations
5) Investigate concrete slab full depth cracking in continuous structures - causes and recommendations to alleviate cracking
<table>
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<th>Project Title:</th>
<th>No Boundaries Roadway Maintenance Practices</th>
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**Abstract:**

Through this pooled fund project, the Missouri Department of Transportation plans to work with other State Departments of Transportation (DOTs) to establish a program in order to facilitate the implementation of promising innovations and technologies. This project will provide a forum for State DOTs to share their maintenance innovations with each other, support technology transfer activities and develop marketing and deployment plans for the implementation of selected innovations. Resources will be provided for implementing the innovations that includes travel, training and other technology transfer activities.

It is anticipated that this consortium would become the national forum for state involvement in the technical exchange needed for collaboration and new initiatives, and be a forum for advancing the application and benefit of research technologies. State participation in this process will be through the pooled fund. FHWA, industry and others will be invited to participate in the project discussions and activities. Workshops could be provided for the states participating in the pooled fund project. This project will help DOTs to save time and money by not investing in the same research that has already been performed by other State DOTs. Hence rather than having each DOT identify and implement research separately, DOTs can work collectively through this pooled fund project. The Missouri DOT will serve as the lead state for the execution of the pooled fund project described in this proposal. The Missouri DOT will handle all administrative duties associated with the project.

1) Identify promising innovations and technologies ready for implementation within Maintenance activities, developed by the participating State DOTs; 2) Develop marketing plans for selected ready to deploy innovations and technologies; 3) Organize training classes about specific research topics for member State DOTs.
Project Title: Cost Benefit Analysis for Culvert Replacement

Research Agency: To Be Determined

Status: Proposed
State Job #: 

Start Date: 
End Date: 

Classification: Standard

RFP #: 2016-21

Technical Lead: Scott Lucas

Project Type: 

Abstract:

The Ohio Department of Transportation (ODOT) desires to enhance field safety and the productivity of its culvert replacement procedures. To advance this goal, ODOT is seeking assistance to perform a cost-benefit analysis on a recently completed research study that looked at three different methods of culvert replacement: open/cut, jack and bore, and pipe bursting. This project will perform an independent analysis comparing ODOTs current culvert replacement procedures and other methods to determine whether changes would be cost effective.
Best Practices of Road User Maintenance Agreements Amongst Local Government Agencies in Ohio

Ohio University

Roger Green

Proposed

RFP # 2016-ORIL1

ORIL

Technical Lead: Anna Kuzmich

Maintenance

Road User Maintenance Agreements (RUMAs) are legal agreements between local governments and for-profit organizations outlining the responsibility for road construction and repairs resulting from excessive damage to local infrastructure caused by those organizations' activities. These RUMAs can also stipulate travel routes for heavy equipment haulers in order to ensure safety and help minimize damage to roadways as well as specify testing methods and rating criteria organizations are required to follow. The recent boom in the oil and gas industry in eastern Ohio has brought the use of RUMAs to the forefront. In 2012, Ohio passed Senate Bill 315 which requires well operators to enter into RUMAs or demonstrate a good-faith effort to do so. ODOT in collaboration with the Ohio Department of Natural Resources, the County Engineer's Association of Ohio, and various local transportation officials created a RUMA template to assist local governments in developing RUMAs, but it is not a mandated/standard document. Many counties and townships have taken this template and modified it to meet their specific purposes. As a result, a plethora of RUMA versions are in existence within Ohio. As industries such as oil and gas, wind power, coal, and timber expand or relocate production in Ohio, the utilization of RUMAs varies. The variations in requirements, language, and execution of Ohio RUMAs can lead to confusion not only among local governments, but also with the organizations/industries attempting to enter into these agreements. The issue is further complicated as some local governments may be using RUMAs in situations where they are not necessarily appropriate. A fair amount of research has been conducted nationally on the subject of RUMAs; however, it is not necessarily easily manageable or accessible to local transportation officials. A focused synthesis study to identify the current best practices for RUMAs is needed.

The goal of this research is to conduct a synthesis of current practices related to the development and execution of RUMAs. The objective of this research is to identify current best practices and provide recommendations for RUMA development to assist Ohio's local transportation officials. The results of this research will highlight the practices that have produced the best return on investment in a clear and concise manner. This will provide inexperienced agencies with a better understanding on how to approach these agreements while more experienced agencies will have exposure to different philosophies and applications. Not only will local governments benefit from this research, but the industries/organizations that typically enter into these agreements may also benefit. This research can provide them with a better understanding of what local governments are trying to accomplish with RUMAs. A thorough review of the findings may also help industries to anticipate what may be required by the RUMAs used in specific counties, thereby helping them to estimate potential costs and efforts for the their expanded development into a particular region.
Project Title: Synthesis of Research on Load Capacity of Concrete Slabs Without Plans

Research Agency: University of Cincinnati

Researcher: Richard Miller

Status: Proposed

State Job #: RFP #: 2016-ORIL2

Start Date: End Date: ORIL

Classification: Structures

Project Type: Structures

Technical Lead: Amjad Waheed

Abstract:

Approximately 6,550 small span concrete slab bridges exist in Ohio. Of these bridges, approximately 1,234 (19%) do not have any plans. Many of these structures, still in-service today, were built decades ago; some dating as far back as the 1930s. The vast majority of these bridges are on the local system as less than 20 can be found on state routes. Some counties have as many as 30 of these slab bridges with no plans while other counties find a significant portion of their inventory (approximately 31% or 133 bridges) comprised of these structures all without plans. While these structures are routinely inspected and given a general appraisal rating, a mechanism for load rating these structures is either unavailable or unknown by county engineers. As a result, county engineers rely on past performance and engineering judgment to determine the approximate load capacity of the structure. This likely leads to an overly conservative evaluation. Exacerbating this issue, recent developments in industries, such as oil and gas, have some counties experiencing sudden and significant increases in heavy truck traffic on these structures. These bridges were not built with the expectation of the size and quantity of this traffic. In order to optimize the usefulness of these bridges and ensure the safety of the traveling public, a simple, low-cost scientifically-based method for determining the load capacity of these structures is needed.

The goal of this research is to identify a simple, low-cost, reliable method for county and city engineers to use to evaluate the load capacity of concrete slab bridges without plans. The objective of this research is to perform an in-depth synthesis study to identify the current state of practice and, if an established method is not identified, indicate the future steps necessary in order to achieve the stated goal. The results of this research will aid in optimizing the usefulness of these structure's performance and anticipated lifespan, and enhance the overall safety of the traveling public. As larger and heavier vehicles continue to expand their use of the local system, having greater confidence in the load capacity of these structures becomes a more pressing concern. This research will not only improve the understanding of the current condition of these structures, but assist local transportation officials in understanding their true capacity and limitations.
Project Title: Structural Benefits of Concrete Paving of Steel Culvert Inverts

Research Agency: Ohio University

Researcher: Teruhisa Masada

Status: Proposed

State Job #: RFP #: 2016-ORIL3

Start Date: End Date: ORIL

Classification: Project Type: Hydraulics

Technical Lead: Doug Gruver

Abstract:

Over time, a steel culvert invert will experience invert material loss due to corrosion and abrasive flow. The material loss progresses from minor perforations to ultimate invert loss if corrective action to protect the culvert invert is not taken. Invert material loss can lead to erosion of the supporting backfill which is an integral component for the structural integrity of a steel culvert. A common corrective maintenance action is to place 4-6 inches of concrete onto the invert of the steel culvert for the bottom 1/3 of the rise of the culvert. Light reinforcing mesh is attached to the culvert and concrete is poured and shaped to the bottom of the barrel in most applications. If total invert loss or significant backfill erosion has occurred and the exiting shape is unaffected, additional measures may be required such as: additional reinforcing steel and replacement of the backfill with cementitious materials.

This corrective maintenance action is cost effective and widely used because it seals the culvert invert, prevents backfill loss, and provides a protective layer between the abrasive flow and the steel material. However, the impact of this corrective maintenance action on the structural integrity of the culvert is unknown. Additionally, it is unknown if additional reinforcement is required when there is total invert loss and the existing shape is unaffected. While it is clear that the pipe has been weakened by the loss of the steel section, it is unclear if the stiffness of the added concrete compensates and restores the culvert to its original strength. Furthermore, once the floor is sealed with concrete, inspectors are unable to visually confirm additional damage to the remaining steel. This could adversely impact load capacity ratings causing some culverts to receive a higher load rating than is actually warranted. Research is needed to verify the viability of this practice and provide engineers with scientifically-based guidance on its proper application.

The goal of this research is to enhance the understanding of the mechanics of steel culverts and the impact that this common corrective maintenance action has on the structural integrity of the steel culvert. The objectives of this research are to: (1) determine and quantify the influence the repair has on the structural integrity of the culvert system, (2) determine if additional reinforcing steel is required when there is total invert loss, and (3) develop a scientifically-based, cost effective, repeatable methodology engineers can use to evaluate repairs to steel culvert inverts with deteriorated inverts. The results of this research may influence ODOT's current standard specifications for metal culverts (item 611.11). The findings will enable engineers to make more informed decisions on which culverts are ripe for the invert rehabilitation and the most appropriate application of this practice.
**Project Title:** Development of Recommendations to Address IRP Truck Licensing Impacts for Ohio Counties  
**Research Agency:** University of Kentucky  
**Researcher:** Andrew Martin  
**Status:** Proposed  
**State Job #:**  
**RFP #:** 2016-ORIL4  
**Start Date:**  
**End Date:**  
**Classification:** ORIL  
**Technical Lead:** Anna Kuzmich  
**Project Type:** Planning

**Abstract:**

International Registration Plan (IRP) is an agreement among 48 states, 10 Canadian Provinces and the District of Columbia whereby a motor carrier can register commercial vehicle fleets for travel in all IRP jurisdictions by filing the paperwork with the home (base) jurisdiction. Fees associated with the registration of these vehicles are apportioned to each IRP jurisdiction based on various factors including total mileage driven within a given jurisdiction. As an IRP participating state, Ohio's Department of Public Safety (ODPS) coordinates the apportionment of IRP registration fees between Ohio and other participating states. In addition, ODPS coordinates the distribution of registration revenue between Ohio's various state agencies, counties, townships, and municipalities.

While registration revenue is distributed to local public agencies, there is a perception of a disconnect between the percentage provided to locals versus the actual impact commercial vehicle fleets have on local roads. While the state system is designed to accommodate large quantities of commercial vehicles, local roads are less equipped and are therefore more susceptible to pavement deterioration and stress promulgated by these types of vehicles. As a result, local governments may find it necessary to perform rehabilitation and repair activities more frequently or even earlier than anticipated. However, the revenue stream from the registration of these vehicles does not seem to be keeping pace. A locally conducted case study has identified a situation in which this disparity exists. There is a presumption that this is not an isolated event and local governments may be missing out on revenues needed to maintain the integrity and safety of Ohio's local roadways. Research is needed to investigate the overall impact of IRP truck registration to Ohio counties and to provide recommendations for improvements (if warranted).

The goal of this research is to expanded upon a previously conducted study (SJN: 134988) aimed at assessing the economic impact of non-Ohio registered commercial vehicle fleets based within Ohio jurisdictions. The objective of this new project is to provide recommendations for short- and long-term solutions to address the registering and/or fee allocation process for IRP registration within Ohio. The findings of this research will either support or disprove a perception of disproportionate funding allocations related to IRP registration revenue. As a result, this will enhance the state's ability to ensure the appropriate retrieval and allocation of IRP registration revenue for maintaining Ohio's roadways. It will also equip local officials with the tools needed to conduct their own investigations as the economic and business situation of their locality changes over time.
Project Title: Technical Editing for Ohio DOT Research Reports
Research Agency: CTC & Associates LLC
Status: Proposed
State Job #: 135154
Researcher: Kim Linsenmayer
RFP #: ADMIN-F
Start Date: End Date:
Classification: Program
Technical Lead: Cynthia Gerst
Project Type: Technology Transfer

Abstract:

This is for technical editing services for final reports that are not conducive to communicating the results in a clear and concise manner. Recently, we have received draft final reports from Researchers incapable of revising the report to communicate the research and findings in an organized, clear fashion. The technical reviewers have commented it takes a couple hours to review a small portion of the report.

A request for qualifications was issued to various firms, and CTC & Associates LLC was selected. A personal services contract will be issued for these services. The services include a complete review for content, clarity, grammar, and style. Services will be billed at an hourly rate per the agreed upon contract.
### Project Title: AASHTOWare Project Bids

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**Abstract:**

Currently, the AASHTOWare Project Expedite software supports electronic bidding and has done so for over twenty years. Understandably, it is imperative that this system be kept current with evolving technology and business requirements. This proposed software development effort involves developing the AASHTOWare Project Bids software as the replacement for the existing AASHTOWare Project Expedite software with enhanced functionality to meet evolving technology and transportation agency business requirements.

The development of the AASHTOWare Project Bids software will result in an efficient and modernized code base incorporating the more than twenty years of industry experience gained throughout the lifespan of the AASHTOWare Project Expedite software. AASHTO will then be able to offer value through better compatibility with the latest operating environments of licensees and bidders, improved performance, and more efficient, cost effective maintenance and enhancement efforts throughout the product lifecycle.
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