RESEARCH DEVELOPMENT AND TECHNOLOGY TRANSFER

ANNUAL REPORT FEDERAL FISCAL YEAR 2019

ALASKA DEPARTMENT OF TRANSPORTATION & PUBLIC FACILITIES

The Research Development and Technology Transfer (RD&T2) Section, within the Division of Design and Engineering Services of the Alaska Department of Transportation & Public Facilities (DOT&PF), provides research management, maintains an online library, provides technical assistance, training, and technology implementation services to DOT&PF, local transportation agencies, and their partners.

RD&T2 provides services largely through the collaborative relationships and financial support from the Federal Highway Administration. By leveraging resources and developing partnerships with a variety of transportation organizations, professionals and universities, RD&T2 taps into a vast network of expertise and eliminates duplication of effort. RD&T2 also provides an avenue for multidisciplinary support from a network of state agencies.

This is a report of the research, development, and technology transfer activities carried out by the DOT&PF and its partners. This report covers federal fiscal year 2019, beginning October 1, 2018, and ending September 30, 2019.

For additional information, contact:
Anna Bosin, P.E.
Manager for Research, Development, & Technology Transfer

Division of Statewide Design & Engineering Services
Alaska Department of Transportation & Public Facilities
2200 E 42nd Ave.
Anchorage, AK 99508
(907) 269-6208
anna.bosin@alaska.gov

Editorial/Writing: Anna Bosin, Drew Pavey, Ian Grant, David Waldo, Barry Benko
DOT&PF Research, Development & Technology Transfer Section

Website: Simon Howell

http://www.dot.state.ak.us/stwddes/research/

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FEDERAL FISCAL YEAR RD&T2 SUMMARY

RD&T2 received funding from the Federal Highway Administration's (FHWA) State Planning and Research Program (SP&R), Local Technical Assistance Program (LTAP), Surface Transportation Program (STP), and state matching funds (SM). Additionally, RD&T2 leverages funding with the Alaska University Transportation Center (AUTC), Pacific NW Transportation Consortium (PAC Trans) and the FWHA's Transportation Pooled Fund Program. There are other State Transportation Projects that have some research elements. These projects are not included in the fiscal summary

Funding Sources	2019
Revenues	
SP&R Program Funds (STIP ID#6451)	$ 2,200,000
NHI Funds (STIP ID#6452)	$ 350,000
State Funds (outside of match $)	$ 0
Local Technical Assistance Program	$ 150,000
Total	**$ 2,700,000**
Expenditures & Obligations	
NCHRP Dues	$ 351,999
TRB Core Services	$ 118,707
Pooled Fund Studies	$ 180,000
NHI/LTAP	$ 500,000
T2 SP&R Match	$ 150,000
Research Project (old projects increases)	$ 85,000
Research Project Programming (New Obligations)	$ 1,030,000
Total	**$ 2,415,706**

Research Funding Distribution in FFY19 (new projects, annual dues, pooled fund projects, training, and project increases)

Research Funding Distribution FFY19

- $470,706.00
- $450,000.00
- $20,000.00
- $75,000.00
- $435,000.00
- $650,000.00
- $270,000.00
- $125,000.00
- $134,237.00
- $60,000.00

Legend:
- Administration & Policy
- Construction
- Maintenance
- Bridges & Structures
- Hydraulics & Hydrology
- Safety
- Cold Region
- Materials
- Training & Tech Transfer
- TRB & NCHRP Contributions
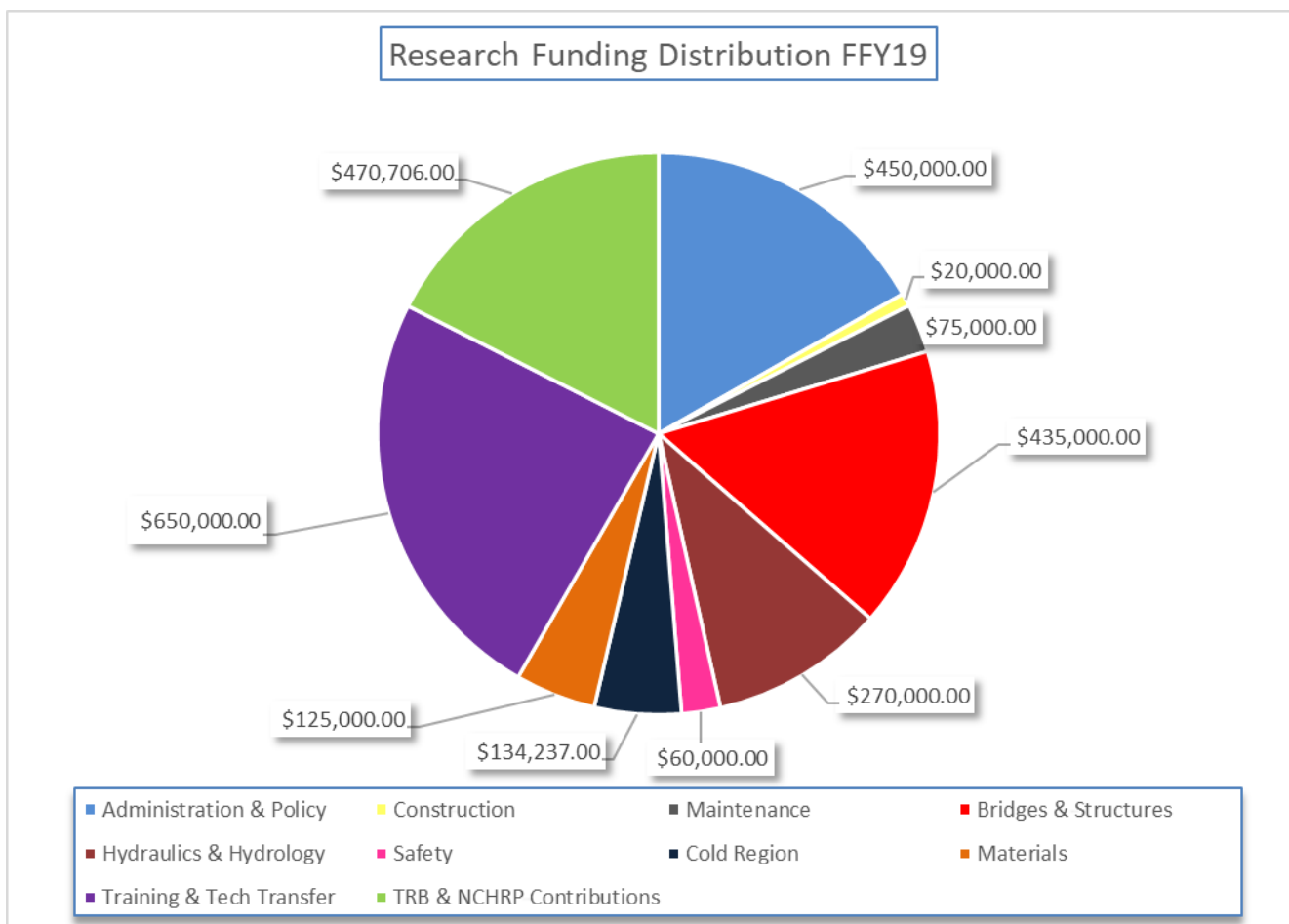
PROJECTS STARTED IN FFY2019

10 New projects in FFY2019 using SP&R funds-Part B, LTAP and State match:

Title	FHWA Project # State Project #	Category	Federal $	State $	Total $ Project Funding
Technology Transfer Program CY2019 (LTAP)	LTAP041 NFHWY00330	Training & Tech Transfer	270,000	30,000	300,000
National Highway Institute (NHI) CY2019	2018(001) NFHWY00329	Training & Tech Transfer	350,000	0	350,000
FFY 19/20 Research & Technology Deployment	4000(190) HFHWY00134	Rapid Research	120,000	30,000	150,000
FFY 19/20 Administration	4000(189) HFHWY00133	Administration	80,000	20,000	100,000
Portland Cement Treatments in Locations with Poor Embankment Material	000S920 HFHWY00151	Materials	104,000	26,000	130,000
Next Generation Project Selection Criteria	4000(193) NFHWY00443	Policy	100,000	25,000	125,000
Synthesis of Best Practices for Design and Construction of Roadways and Airports over Permafrost	000S927 HFHWY00154	Cold Region	107,389.60	26,847.40	134,237
RCFST to Cap-Beam GSS Connection	4000195 HFHWY00152	Bridges and Structures	320,000	80,000	400,000
Fish Passage Culvert Slip Linear Research	4000(198) HFHWY00182	Environmental	104,000	26,000	130,000
Incorporating Extreme Weather Event Considerations into the Alaska Highway Drainage Manual	4000(199) HFHWY00183	Hydrology/ Hydraulics	112,000	28,000	140,000
		TOTAL			**1,959,237**

11 Pooled Funded projects contributed in FFY2019 using 100% Federal SP&R Funds, Part B (no State funds):

Title	FHWA Project #	Category	Total Current $ Project Funding (100% federal)
Aurora	TPF-5(290)	ITS	25,000
Avalanche Research	TPF-5(337)	Maintenance	25,000
Enhancement to the Intelligent Construction Data Management System (Veta) and Implementation	TPF-5(334)	Construction	10,000
Roadside Safety Research for MASH Implementation.	TPF-5(343)	Safety	25,000
Clear Roads II	TPF-5(353)	Maintenance & Operations	25,000
Technology Exchange on Low Volume Road Design, Construction and Maintenance	TPF-5(379)	Design	10,000
Wildlife Vehicle Collision Reduction and Habitat Connectivity	TPF-5(358)	Safety	20,000
Unpaved Road Safety Pooled Fund Study	Proposal 1419	Safety	15,000
Connected Vehicles	TPF-5(389)	Administration	25,000
NCHRP Dues ALASKA	TPF-5(415)	National Dues	351,999
TRB Core Program Services for a Highway RD&T Program – Federal FY 2018/TRB FY 2019	TPF-5(378)	National Dues	118,707
		Subtotal	**650,706**
		Minus Dues	470,706
		Pooled Fund Research Only	**180,000**

ACTIVE PROJECTS STARTED PRIOR TO FFY2019

7 Active Projects started in FFY2018 using SP&R funds-Part B, LTAP and State match:

Title	FHWA Project # State Project #	Category	Federal $	State $	Total $ Project Funding
Minnesota Drive Ramp Microsurfacing Experimental Feature Monitoring	40000181 HFHWY00123	Materials	100,000	25,000	125,000
Using Unmanned Aerial Systems to Augment Monitoring Aufeis Directly Under Bridges in Alaska	4000182 HFHWY00124	Bridges and Structures	120,000	30,000	150,000
Testing Steel Post in Tube Options for use with MASH Compliant Guardrail End Treatments	4000183 HFHWY00127	Traffic & Safety	140,000	35,000	175,000
Rapid Repair of Column to Footing Phase 2	4000184 HFHWY00125	Bridges and Structures	224,000	56,000	280,000
Improved Permafrost Protection using Air Convection and Ventilated Shoulder Cooling Systems	4000185 HFHWY00126	Geotechnical & Foundations	88,000	22,000	110,000
Evaluation of Light Pole Foundation Embedment	4000186 HFHWY00129	Geotechnical & Foundations	200,000	50,000	250,000
Precipitation Projections for Alaska	4000188 HFHWY00132	Hydrology/ Hydraulics	216,000	54,000	270,000

5 Active projects started in FFY2017 using SP&R Part B funds:

Title	FHWA Project #	Category	Federal $	State $	Total $ Project Funding
NHS Innovative Pavement Design Research for Pavement Management System	4000174	Materials	120,000	30,000	150,000
Laboratory and Field Evaluation of Modified Asphalt Binder in Alaskan Pavements	4000176	Materials	68,000	7,000	85,000
High Abrasion-Resistant and Long-Lasting Concrete	4000177	Materials	56,000 +24,000	14,000+ +6,000	70,000+ +30,000(FFY18)
Pre-stressed Losses in Decked Bulb Tee Girders	4000178	Bridges & Structures	280,000	70,000	350,000
Safety Evaluation of Off-Highway Vehicle Use in Alaska	4000180	Traffic & Safety	83,200	20,800	104,000

4 Active projects started in FFY2016 using SP&R Part B funds:

Title	FHWA Project #	Category	Federal $	State $	Total $ Project Funding
Pile Length Determination at Unknown Bridge Foundations	000S875	Bridges & Structures	80,000	20,000	100,000
High Friction Surface Treatment (HFST) Material Monitoring-Experimental Feature	000S882	Materials	124,000	31,000	155,000
Steel Fiber Rubberized Concrete Material Monitoring Experimental Feature	4000165	Materials	36,000 +14,000	9,000 +3,500	45,000 +17,500(FFY18)
AASHTO MASH Compliant Two-Tube Metal Bridge Rail	4000169	Bridges & Structures	465,600 +40,000	66,400 +10,000	*532,000 +50,000(FFY18)
$200,000 Participation from South Dakota DOT					

1 Active projects started in FFY2015 using SP&R Part B funds:

Title	Federal Project #	Category	Federal $	State $	Total $ Current Project Funding
Dust Control Product Mix Design & Quality	4000157	Materials & Construction	115,200	28,800	144,000

4 Active research projects started prior to FFY2013 from individual STIP funding with SP&R funds:

Title	DOT&PF Project #	Federal Project #	Category	Total Current Project Funding
Transportation Asset Management Program	80880	000S793	Administration & Policy	350,000
Geotechnical Asset Management Program	80900	000S802	Geotechnical & Foundations	1,933,055
Geotechnical Asset Management - Stage II	63076	4000131	Geotechnical & Foundations	80,000
Unstable Slope Management - Phase II	62467	4000126	Geotechnical & Foundations	1,700,000

11 PROJECTS COMPLETED IN FFY2019 –PENDING FINANCIAL CLOSURE

Title	DOT&PF Project #	Federal Project #	Total $ Project Funding
FFY17/18 Research Administration	HFHWY00075	4000172	475,000
Double Walled Pile Noise Model	HFHWY00130	4000187	60,000
FFY16-18 Research and Technology Transfer Deployment	HFHWY00046	4000164	100,000
Transverse Seismic Design of Bridges with Pre-Case Deck/Girder	HFHWY00038	4000161	267,000
Seismic Repair of Reinforced Concrete Bridge Substructures	Z839740000	4000142	280,000
Examination of the Variability in Grout Cube Specimen Testing Results	HFHWY00076	4000173	100,000
Durability of Grouted Shear Stud Connections at Low Temperatures	HFHWY00039	4000162	272,000
Bald Eagle Nesting During Construction Research	HFHWY00050	4000167	180,000
Optimizing Highway Patrol Investment Levels vs. Crash Outcomes	Z630680000	4000132	266,680
Geotechnical Asset Management through Thermal Modeling for Dalton Highway	Z642300000	4000138	125,500
Survey and Economic Analysis of Pavement Impacts from Studded Tire Use in Alaska	HFHWY00078	4000175	125,000

DESCRIPTIONS FOR ACTIVE PROJECTS DURING FFY19

ADMINISTRATION & POLICY

4000190 DEPLOYMENT FFY19-20

Principal Investigator: DOT&PF
Funding: $150,000
Project Manager: Anna Bosin, P.E.
Estimated Completion: September 2020

This project is established to help DOT&PF research staff identify and facilitate deployment of promising state, national and international research products, services, programs and technologies within the Department. Tasks include necessary efforts such as technology transfer (education), marketing activities to implement completed research projects or products.

Benefits to the State: This funding supports integration of state and national research into DOT&PF business practices.

4000189 RESEARCH ADMINISTRATION FFY19-20

Principal Investigator: DOT&PF
Funding: $100,000
Project Manager: Anna Bosin, P.E.
Estimated Completion: September 2020

This project provides funding for staff salary and travel expenses to manage the statewide research program. This includes outreach to internal and external stakeholders and provides support for the State Transportation Innovation Committee (STIC), Everyday Counts Initiatives (EDC), and other innovations. Includes support for DOT&PF research project selection solicitation and approval, and program reporting. Also includes funding for rapid response research opportunities, workforce development and technology transfer.

Benefits to the State: This project enables the department to select the right research projects for the greatest benefit. It also funds other outreach and innovation opportunities.

000S793 TRANSPORTATION ASSET MANAGEMENT IN ALASKA

Principal Investigator: Brad Allen (AP Tech)
Funding: $280,000
Project Manager: Carolyn Morehouse, P.E.
Estimated Completion: December 2019

Research other state's processes and develop an Alaska specific asset management approach. Investigate current Bridge and Pavement Management systems for compliance with federal rulemaking and provide training for Alaska staff to conduct life-cycle planning, risk management, gap analysis and funding plan as described in federal rulemaking. Evaluate Organizational integration of asset management and make recommendations for improvement.

Benefits to the State: Establish life cycle planning scenario analysis for pavements and bridges. Conduct risk training workshop to help identify program gaps. Develop a mitigation plan for high risks. Develop a financial plan and investment strategy for the department. Define a process for cross asset allocation.

4000193 NEXT GENERATION PROJECT SELECTION CRITERIA

Principal Investigator: Kittelson & Assoc.
Funding: $125,000
Project Manager: Anna Bosin, P.E.
Estimated Completion: January 2022

The State Transportation Improvement Plan project selection process is not well defined for Alaska DOT&PF. As funding becomes tighter, a more transparent and scoring based process needs to be followed. This project will research other state DOT's performance-based planning and programming practices, policies and tools in support of the development of a decision system for Alaska DOT&PF. Provide workshops with the regional planning and decision making staff to develop the next iteration of project selection criteria that considers federal performance measures, asset management, rural needs, safety, and DOT&PF's strategic plan as well as other relevant policies.

Benefits to the State: DOT&PF will have a more transparent and comprehensive process for project prioritization and programming, maximizing the investment of federal dollars into the Alaska transportation system. This research will also support and enhance future investments in decision support system tools used for Asset Management.

COLD REGION

HFHWY00154 SYNTHESIS OF BEST PRACTICES FOR DESIGN AND CONSTRUCTION OF ROADWAYS AND AIRPORTS OVER PERMAFROST

Principal Investigator: Billy Conner (University of Alaska Fairbanks)
Funding: $150,000
Project Manager: Dave Waldo
Estimated Completion: December 31, 2020

This project is focused on studying the existing literature to develop a synthesis of best practices for practitioners of design and construction of roadways and airports on permafrost, knowledge which is not readily available for individuals in those fields. Topics of these studies will include, but are not limited to: how the formation of permafrost determines ice content and the resulting thaw settlement, how permafrost and climate change impact planning, data collection: including geotechnical information, vegetative cover, groundwater, etc., how construction scheduling impacts the performance of roadways over permafrost, which mitigation techniques to use and how and when to use them, how to include permafrost in asset management and life-cycle costs, and maintenance techniques for roadways over permafrost. The synthesis of these studies and information is intended to ultimately help designers and construction worker produce efficient and cost-effective work.

Benefits to the State: This project will provide all those working in areas affected by permafrost with easily accessible knowledge to successfully implement designs and products with permafrost ready-projects. This knowledge will allow the extension of the longevity for these project, had this knowledge otherwise not been implemented.
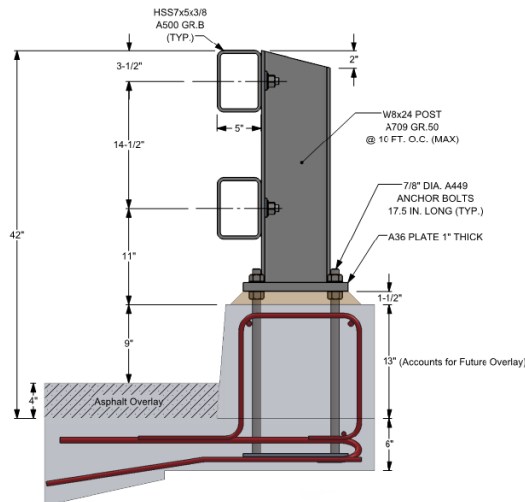
BRIDGES & STRUCTURES

4000169 TWO-TUBE METAL BRIDGE RAIL COMPLIANCE TESTING

Principal Investigator: William Williams (Texas A&M Transportation Institute)
Funding: $532,000 (SP&R)
Project Manager: Janelle White
Estimated Completion: December 2019

The objective is to test the current bridge rail to the "new" AASHTO MASH level 4 requirements so that the Department may continue to use the current two-tube railing on FHWA funded projects. The safety of a TL-4 will increase as a result of compliance with the new AASHTO standard. FHWA requires that crash-tested bridge rail be used on the NHS. Without an approved TL-4 bridge rail, the Department may risk losing federal funds.

Benefits to the State: The new railing will be incorporated into new bridge designs as soon as it has been accepted by FHWA. New standard drawings will be prepared and the Alaska Bridge and Structures Manual will be updated accordingly.

4000178 PRE-STRESSED LOSSES IN DECKED BULB TEE GIRDERS

Principal Investigator: Il-Sang Ahn (UAF)
Funding: $350,000 (SP&R)
Project Manager: Ian Grant
Estimated Completion: December 2023
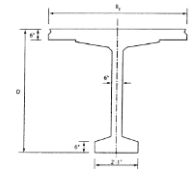
The AASHTO LRFD Bridge Design Specifications provides guidance for the calculation of pre-stress losses in precast concrete beams. Changes in 2007, of the AASHTO code results in inconsistent pre-stress loss predictions for decked bulb-tee girders such as those used by the Department. The simplified procedure for pre-stress loss prediction results in much less loss than that predicted from the previous versions of the AASHTO codes and are less than that resulting from the "refined" method of the current code.

The objective of this project is to conduct a five year study of decked bulb-tee girders to measure the pre-stress losses of actual girders. The results may be used for designing future girders allowing for fewer girder lines and longer bridge spans.

Benefits to the State: Better design predictions for long-term pre-stress losses may result in longer spans, fewer girder lines or shallower girders. Saving one girder line would save the Department about $75k per span (~5% of bridge cost) for the typical highway bridge. More accurate per-stress loss values would result in more accurate girder strength predictions.

BRIDGES & STRUCTURES CONT.

Each bridge would be designed using this refined method for the calculation of pre-stress losses in precast concrete beams. The research findings would be included in the Department's Bridge and Structures Manual and possible in the AASHTO LRFD Bridge Design Specifications.

4000184 RAPID REPAIR OF COLUMN TO FOOTING PHASE 2

Principal Investigator: Dr. Mervyn Kowalsky (NC State)
Funding: $280,000 (SP&R)
Project Manager: Ian Grant
Estimated Completion: May 2022

The objective of this research is to further develop a rapidly deployable post-earthquake repair technique for typical Alaska bridges.

The research work includes: verifying behavioral mechanisms developed in Phase 1 of the project, investigating options for a simplified repair process through alternative connections between adjoining members, evaluating alternative forming options for the repair region, studying the use of rebar couplers for fractured bars and evaluate residual drift limits within the context of complete bridge structures. The researchers will consider the feasibility of new techniques for underwater applications.

Benefits to the State:
The bridge design engineer will have access to additional pre-qualified repair techniques that could be rapidly deployed according to the damage level observed after an earthquake. The cost savings to the State of Alaska will be significant when bridges that otherwise need to be replaced can be repaired. Further, the indirect economic and social impacts of not rapidly returning a bridge to

service following an extreme event will be many times greater than the direct replacement cost, particularly considering the lack of redundancy in the Alaskan road transportation network.

4000182 USING UNMANNED AERIAL SYSTEMS (UAS) TO AUGMENT MONITORING AUFEIS DIRECTLY UNDER BRIDGES IN ALASKA
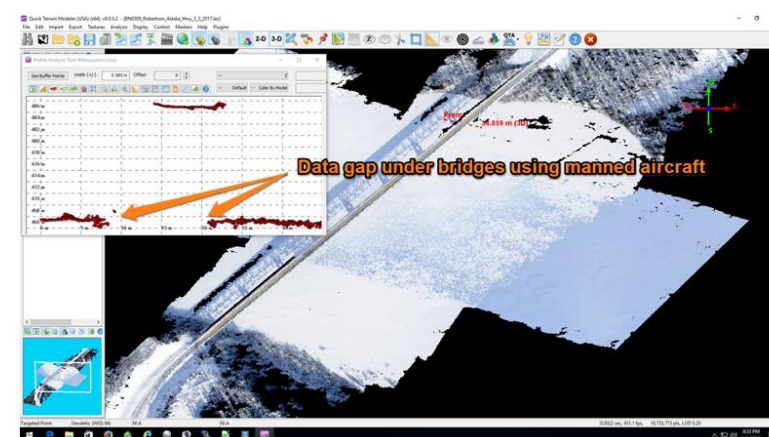
Principal Investigator: Dr. Jessica Cherry (UAF)
Funding: $150,000 (SP&R)
Project Manager: Janelle White
Estimated Completion: December 2022

The objective of this research is to determine the usefulness of using UAS (drone aircraft) to fly under bridges in Alaska in order to capture precise data about the interactions between bridge structures and abutments with seasonal aufeis, and to merge these data with larger extent datasets captured by the manned aircraft.

Benefits to the State:
Completed datasets will help to build a systematic and seasonal record of bridge-to-aufeis measurements

BRIDGES & STRUCTURES CONT.

4000195 REINFORCED CONCRETE FILLED STEEL TUBE TO CAP BEAM GROUTED SHEAR STUD CONNECTION

Principal Investigator: Mervyn J Kowalsky, Giorgio Proestos
Funding: $400,000
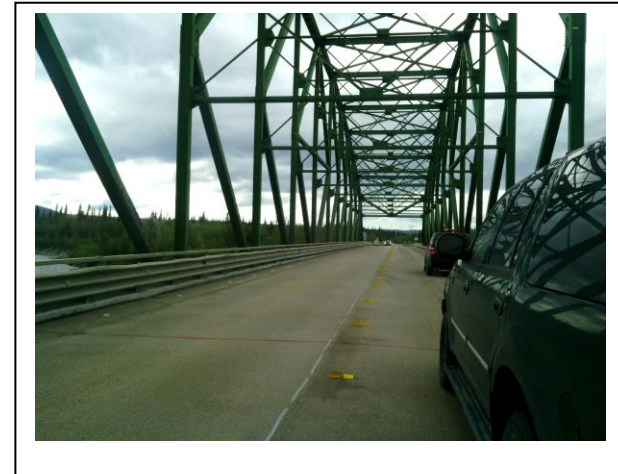Project Manager: Ian Grant
Completion Date: June 2023
Closure Date: December 2023

The purpose of this research is to develop Accelerated Bridge Construction connections for Reinforced Concrete Filled Steel Tube and Reinforced Concrete bridge systems that use "external socket" and "external pocket" connections. This is distinctly different from existing "pocket" and "socket" connections that are internal to the cap and can compromise seismic behavior. Lessons learned from the development of the steel bridge system (termed the "Grout Shear Stud (GSS) Connection") will be valuable as the connections described in this proposal are developed.

Benefits to the State:
If results prove to be beneficial, they could be implemented in further design options for GSS connections for RC and RCFST systems. Successful implementation will ideally result in more rapid construction which is an important consideration during Alaska's short construction season.

ENVIRONMENTAL

HFHWY00182 FISH PASSAGE CULVERT SLIP LINER RESEARCH

Principle Investigator: N/A
Funding: $130,000
Project Manager: Ian Grant
Estimated Completion: N/A

The goal of this research project is to work with Fish & Game to establish criteria for baffle design in liners. The project is a coordinated effort between DOT&PF and Fish & Game staff and will include technical transfer workshops. The project will integrate engineering topics with fish biology topics. The anticipated end result is an updated MOA between DOT&PF and Fish & Game.

As of October 2019, this project has no willing project champion. DOT&PF is reaching out to several individuals. There is interest to participate, but little interest in taking up the mantle of Project Champion.

Benefits to the State:
This research would benefit both agencies involved due to the fact that Fish & Game would have a clearer idea of what parameters would be required for culverts and slip liners. It would benefit DOT&PF as well to optimize these culverts for flow while also doing minimal damage to anadromous fish.

Photo by Maddie Wezlick, DOT&PF

GEOTECHNICAL

000S802 GEOTECHNICAL ASSET MANAGEMENT

Principal Investigator: Various
Funding: $1,933,055 Research out of $2,700,000 (STIP)
Project Manager: Barry Benko, C.P.G.
Project Completed: December 2018

Efforts under this project and its sister research projects (see 4000126 and 4000132) created the Geotechnical Asset Management (GAM) program architecture for AKDOT&PF. Major accomplishments by the researchers included:

- Completed baseline asset inventories.
- Developed systems for indexing and classification of asset condition state.
- Inspections to establish baseline condition states of assets.
- Created GAM life cycle cost analytical framework
  - Cost models
  - Treatment models
  - Deterioration models
  - Risk models
- Incorporated asset databases into GIS platform.
- Developed tools for tracking asset performance over time.
- Risk register estimating risk exposure with respect to safety, mobility, and direct maintenance from each individual condition-rated geotechnical assets (rock slope, unstable soil slope and embankment, and retaining wall classes). Risk was expressed in dollar cost basis and with level of risk grade.
- Used adverse-event tracking tool to aggregate risk scores for risk determination on a per-one-mile NHS highway segment basis.

- Published a Geotechnical Asset Management Plan, including all asset management plan components specified in 23 CFR 515.

The following reports were published for the project in FFY18:
- Geotechnical Asset Management Plan (second edition), by Paul D. Thompson
- Risk Based Framework for Geotechnical Asset Management, by Shannon & Wilson, Inc.

This project also directly supported the content in two additional reports authored in FFY2018 by the principal investigators working in sister 4000126 (see next project description); these two projects are inextricably linked ─ in topical content, findings dependency, and shared resources.

Benefits to the State: The GAM program is an important element of the overall implementation of best TAM practices for DOT&PF. The GAM program defines the role that geotechnical assets take in both primary roles like rock slopes, and in supporting roles such as embankments supporting pavement structure. The research for this project will take the Department many steps forward in understanding the characteristics of geotechnical assets as to the length of service life, condition during service, appropriate service levels and performance measures, incorporation of risk management, determination of life cycle costs, identification of critical data elements required, and development of the means to store and use the data in support of a decision-support framework for managing our transportation system.

GEOTECHNICAL CONT.

4000126 UNSTABLE SLOPE MANAGEMENT – STAGE II

Principal Investigator: Darren Beckstrand, Landslide Technology
Funding: $1,700,000 (STIP)
Project Manager: Barry Benko, C.P.G.
Estimated Completion: December 2019

This effort will complete the development of the Unstable Slope Management Program (USMP), initiated in 2009 and featuring a baseline inventory effort that commenced in 2010 (see closed RD&T2 Project T2-10-04). This research project is closely paired with associated projects 000S802 *Geotechnical Asset Management* and 4000126 *Geotechnical Asset Management - Stage II.*

Investigators finished the architecture of the USMP database system in FFY2017, and used it to establish the master database for management of all the asset classes targeted in the Alaska DOT&PF GAM Program: rock slopes, unstable soil slopes & embankments, retaining walls, and material sites. In FFY18 investigators continued development of the GIS platform (ArcGIS On-line) that houses the databases for the three of the four targeted geotechnical asset classes in the GAM Program (much of the data for the material site asset class is hosted in a different platform).

The following research project reports (teamed with Project 000S802, see previous project description) by investigators at Landslide Technology Inc. were published in FFY2018:

- *Statewide Geotechnical Asset Management Program Development ─ Final Report for Rock Slopes, Unstable Soil Slopes and Embankments, Retaining Walls, and Material Sites*;

- *Tongass Corridor ─ Geotechnical Asset Management Research.*

Benefits to the State: Unstable slopes along the State's routes present critical risks to safety and mobility in the transportation system. This research effort will enable the realization of sound asset management, resulting in the most economic allocation of resources to unstable slopes.

Drilling of the soil and rock slope on Glenn Highway
Photo: Terry Barber

GEOTECHNICAL CONT.

4000113 EXPERIMENTAL FEATURE: CONSTRUCTION OF AN AIR CONVECTION EMBANKMENT (ACE) WITH NON-ANGULAR ACE FILL

Principal Investigator: Steve McGroarty, NR Materials Engineer
Funding: $33,000 (SP&R)
DOT&PF Project Manager: Dave Waldo
Estimated Completion: March 31, 2020

This experimental feature will test the constructability and effectiveness of an ACE with non-angular ACE fill (rounded or cobbles). Using the non-angular material, we will test both a traditional ACE cross section and an insulated conventional embankment with ACE shoulder treatment on a section of the Alaska Highway MP 1354-1364, known to have differential settlement due to permafrost thaw.

Benefits to the State: ACE embankments have historically been constructed with angular riprap like material, which is not available along many Alaskan road segments. Use of non-angular fill could significantly reduce the cost of ACE applications.

4000185 IMPROVED PERMAFROST PROTECTION USING AIR CONVECTION AND VENTILATED SHOULDER COOLING SYSTEM

Principal Investigator: UAF
Funding: $110,000 (SP&R)
DOT&PF Project Manager: Dave Waldo
Estimated Completion: December 31, 2022

Highway design in Alaska's permafrost zones remains challenging due to the large amount of thaw unstable foundation soil that must be traversed. While project routing sometimes allows designers to avoid areas of thaw unstable permafrost, this is not always possible. The data available from the Thompson Drive experimental installation will be analyzed in order to accurately characterize the cooling effectiveness of the ACE, ventilated shoulder, and hairpin thermosyphon cooling features.

Benefits to the State:
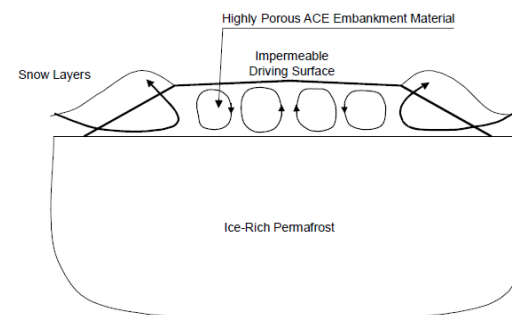Prepare a Modeling Guide for ACE Embankments and ACE Shoulders using TEMP/W and Air/W.

FIGURE 1   Pattern of wintertime pore air circulation in an ACE.

GEOTECHNICAL CONT.

4000186 EVALUATION OF LIGHT POLE FOUNDATION EMBEDMENT

Principal Investigator: William Williams, P.E.
Funding: $250,000 (SP&R)
DOT&PF Project Manager: Janelle White
Estimated Completion: December 2020

Research the impact of a vehicle on the light pole:
1. Survey how other DOTs handle this issue and provide similar guidance.
2. Provide a literature review of any similar studies that have already been undertaken.
3. Develop an analytical program to address the knowledge gaps and determine the acceptable risk of a base failing from a vehicle impact.
4. Perform crash testing to validate the analytical program for various soil conditions common in Alaska.

Benefits to the State:
Potential reduction in foundation size could result in huge cost savings to the Alaska DOT&PF since every light pole foundation developed by DOT&PF engineers or by consultants over the last six years has resulted in large pile foundations in Southeast Alaska.

GEOTECHNICAL CONT.

4000132 GEOTECHNICAL ASSET MANAGEMENT - STAGE II

Principal Investigator: [Multiple]
Funding: $80,000, (STIP project)
Project Manager: Barry Benko, C.P.G
Closure certification from FHWA: May 2019

The project supported four research contracts for developing Geotechnical Asset Management (GAM) concepts for Alaska DOT&PF: GAM plan development; a risk management framework for GAM; service life, service level, performance measures and condition indices; and life cycle cost analysis for geotechnical assets. FHWA is participated in funding these GAM development contracts through an Infrastructure Research & Technology (IRT) program allocation to research and develop Geotechnical Asset Management principles and practices for eventual deployment in Alaska and other state or local government transportation agencies. An important aspect of the project is that the findings and deliverables are extended to an audience beyond DOT&PF.

Benefits to the State:
This project brings the participation of FHWA – including funding and a technical advisory role – to development of GAM for the State.

HYDROLOGY & HYDRAULICS

000S875 PILE LENGTH DETERMINATION AT UNKNOWN BRIDGE FOUNDATIONS

Principal Investigator: Murthy Guddati (North Carolina State University)
Funding: $261,230 (NHPP)
Project Manager: Anna Bosin, P.E.
Estimated Completion: October 30, 2019

NCSU has recently developed laboratory methods of instrumentation, testing and data processing for estimating pile lengths (named Effective Dispersion Analysis of Reflections – EDAR). It is anticipated that EDAR will first be adapted and calibrated at a sample group of control bridges with known pile lengths. Based on these results, EDAR will be applied to bridges with unknown pile lengths. The primary focus of the current project will be concrete-filled steel pipe piles.

Benefits to the State: The field testing could lead to replacement of borehole testing for pile length estimating. There is potential for reduced operational costs and perhaps more frequent testing, leading to improved safety and reduced maintenance costs.

4000188 FUTURE PROJECTIONS OF PRECIPITATION ON ALASKA INFRASTRUCTURE

Principal Investigator: Tom Kurkowski, Scenarios Network for Alaska & Arctic Planning (SNAP)
Funding: $270,000
Project Manager: Ian Grant
Estimated Project Completion: December 2022

The objective of this research is to acquire downscaled, model bias-corrected projected precipitation for all of Alaska so the data can be used by all DOT&PF projects. The data is expected to be transmitted in a report that documents and justifies the analysis procedure. This information will be used for a wide variety of calculations and hence it is needed for numerous return intervals and durations that will be provided later. DOT&PF hydraulic infrastructure has design lives that range from a few years to 75 years. Therefore, the projected precipitation data is needed for every decade to the year 2100.

Benefits to the State: Projected precipitation data are needed to design hydraulic structures, such as bridges and culverts, which must function effectively over timespans of decades or centuries. The effects of structural failure can be costly in terms of remediation and repair, or catastrophic in terms of human health and safety. Conversely, over-building can lead to significant budgetary inefficiency.

HYDROLOGY & HYDRAULICS CONT.

HFHWY00183 INCORPORATING EXTREME WEATHER EVENT CONSIDERATIONS INTO THE ALASKA HIGHWAY DRAINAGE MANUAL

Principal Investigator: Gabe Wolken & Jacquelyn Overbeck (Alaska Geological & Geophysical Surveys)
Funding: $140,000
Project Manager: Ian Grant
Estimated Completion: December 2020

There have been advancements in Alaska hydrology and in climate science since Chapter 7 (Hydrology) of the Alaska Highway Drainage Manual was last updated June 1995. This project would bring our publication up-to-date by engaging researchers in the field to help draft the chapter to reflect the state of science in academia. The Federal Highways Administration (FHWA) recommends that states adopt design policies similar to those covered in its Hydraulic Engineering Circular No. 17, which present s a framework for practitioners wishing to for potential climatic changes over time.

Benefits to the State: The State of Alaska and the FHWA promote the integration of climate considerations into our transportation design and asset management endeavors. This project will provide designers with hydrologic tools needed to justify additional resiliency provisions and countermeasures aimed at addressing extreme weather events.

MATERIALS & CONSTRUCTION

STEEL FIBER RUBBERIZED CONCRETE MATERIAL MONITORING-EXPERIMENTAL FEATURE

Principal Investigator: Osama Abaza
Funding: $45,000 (SP&R)
Project Manager: Anna Bosin, P.E.
Estimated Completion: December 2021

This project is the follow-up on experimental feature monitoring plan for 4000159 (above mentioned project). The test panel was installed on Abbott Road in Anchorage, AK during summer construction of 2017. The 120' long section is instrumented to collect stress/strain readings and temperature year-round. Road friction data will be collected annually as well as compared with DOT&PF's annual Pavement Management System data (Ridability, Rut Depth, and Cracking) to evaluate the overall performance of the slab. The Principle investigator will make recommendations for future implementation based on the 3-year post construction study.

Benefits to the State: Potential cost savings if this mix design lasts longer than conventional asphalt mix designs.

4000157 DUST CONTROL PRODUCT MIX DESIGN

Principal Investigator: David L. Barnes, Ph.D., P.E.
Funding: $144,000 (SP&R)
Project Manager: Dave Waldo
Estimated Completion: December 31, 2019 (closing documents submitted

This project will develop a test method which will aid in the selection of palliatives, establish the mix design for site specific use of dust palliatives and liquid stabilizers, determine surface material requirements for their use, and recommend qualified product lists. Also, establish guidance for designers and a dust palliative construction specification laying out requirements and/or guidance for the various palliatives on the market, the mix design procedure, and other supportive information to support test protocols and design criteria.

Dust columns are located in Northern and Central Region. A complete test method has been submitted for incorporation into the ATM, and hosted on AUTC's website along with training videos. Final implementation webinar scheduled for March to highlight test procedure, review training videos, and possible changes due to the introduction of a new column design.

Benefits to the State: A uniform lab and field testing procedure, as well as mix design procedures, will allow for widespread use of an assortment of dust palliatives and soil stabilizers for multiple transportation applications. This will ultimately reduce life cycle costs of our road system, improve road and runway safety, and improve quality of life and health for residents.

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MATERIALS & CONSTRUCTION CONT.

4000174 NHS INNOVATIVE PAVEMENT DESIGN RESEARCH FOR PAVEMENT MANAGEMENT SYSTEM

Principal Investigator: DOT&PF
Funding: $150,000 (SP&R)
Project Manager: Andrew Pavey
Estimated Completion: December 2020

Designing, constructing and maintaining asphalt roadways is a challenge anywhere, but is especially difficult considering the conditions in Alaska. With long winters and studded tire usage for about two thirds of every year, rutting is a major safety issue. Permafrost conditions can create extreme roughness that is usually beyond typical maintenance remedies to correct. Temperature extremes cause widespread cracking, stretching maintenance resources. The search for innovative methods of design and maintenance continues and requires a method to collect data for analysis and determination of what works best for the least cost.

This project provides for innovative design, construction and maintenance data to be collected, analyzed, and applicable data placed into the pavement management system database and tracked for performance. With over 15-years of detailed distress data already available and new data collected yearly, the new pavement management system can track and model innovations such as hard aggregate, warm mix asphalt, and use of rubber and polymers in mix designs.

Benefits to State: Selecting mix designs that resist rutting and cracking, and rejecting those that fail will create safer and longer lasting roadways and allow funding previously needed for frequent rehabilitation and maintenance activities to be used elsewhere.

HIGH ABRASION-RESISTANT AND LONG-LASTING CONCRETE

Principal Investigator: Dr. Jenny Liu, UAF
Funding: $112,290 CESTiCC, $60,000 Third Party, $70,000 DOT&PF (SP&R)
Project Manager: Anna Bosin, P.E.
Estimated Completion: December 2019

Rutting in high traffic intersections is a common pavement distress in Anchorage, AK and other high traffic northern states. Studded tire wear abrades the pavement surface in the wheel path and contributes to millions of dollars of road maintenance costs. In Alaska, concrete has had limited implementation at intersections due to costs and inflexibility during cold region freeze/thaw cycles. New additives in production appear to be more durable and cost-effective. The key is to identify a cost effective mix design that can compete with flexible pavement design and reduce the life-cycle costs of replacing intersections where rutting continues to be a problem.

This project includes a literature review and survey, laboratory testing and mix design development, design and specification writing for a test section to be installed, life-cycle cost analysis, and recommendations.

Benefits to the State: Provide the lowest life-cycle cost paving option for rutted intersections.

MATERIALS & CONSTRUCTION CONT.

4000177 LABORATORY AND FIELD EVALUATION OF MODIFIED ASPHALT BINDER IN ALASKAN PAVEMENTS

Principal Investigator: Dr. Jenny Liu, UAF
Funding: $85,000 DOT&PF (SP&R), $179,846 CESTiCC, $20,000 Third Party
Project Manager: Andrew Pavey
Estimated Completion: December 2019

Modified Asphalt Binders have been used for some time in DOT&PF pavement design, but mix designs have used varying binders throughout the state. Enough time has passed post construction to evaluate the effectiveness of those mix designs for the regions and identify any changes that could be made for optimal binder performance. This project will conduct both lab and field evaluation of the performance (i.e. rutting, and low temperature cracking) of various modified asphalt binder and mixes to quantify the performance benefits of the materials.

Benefits to the State: This project will aide designers in selecting pavement mix design parameters for certain project conditions for optimal pavement lifecycle performance to minimize maintenance costs.

000S882 HIGH FRICTION SURFACE TREATMENT MONITORING-EXPERIMENTAL FEATURE

Principal Investigator: DOT&PF
Funding: $155,000 DOT&PF (SP&R)
Project Manager: Anna Bosin, P.E.
Estimated Completion: December 2019

During summer 2016, DOT&PF Central Region constructed 28 High Friction Surface Treatment installations throughout the region as safety countermeasures for various crash contributing factors. The project was funded by the Highway Safety Improvement Program, which will evaluate the material's safety improvement once there is 3 years of post-construction crash data to compare with the prior 3 years of crash data. The product is relatively new to Alaska and there is limited published data on the wear under harsh northern climates. This project was approved for experimental feature monitoring to evaluate the material wearing over 3 years post-construction. Friction data is collected for each site annually and the Pavement Management System characteristics will be evaluated (i.e. rut depth, cracking, ridability). The department found that the material does not last in high traffic volume locations and will use the information to make recommendations on future installations.

Benefits to State HFST is approximately $30/SY installed. The Department needs to determine its life-cycle costs separately from the crash benefit to determine the best recommendations for future use as an effective crash countermeasure.

Photo: Dynamic Friction Test on recently installed HFST
Credit: CR DOT&PF Materials Staff

MATERIALS & CONSTRUCTION CONT.

4000181 EXPERIMENTAL FEATURE MINNESOTA DRIVE RAMP MICROSURFACING MONITORING
Funding: $125,000
Project Manager: Drew Pavey (SP&R)
Estimated Completion: December 2022

During the summer of 2020, DOT&PF Central Region will place a highly modified microsurfacing treatment on Minnesota Drive ramps. This treatment is used by states in the lower 48 as a cost effective way to extend the life of their roads. A post construction report will be completed by December 2020 after the construction is completed. There will be three additional years of monitoring to evaluate the materials performance. This will be the first application of microsurfacing by DOT&PF and will determine if the material can with stand the winter seasons and studded tire use.

Benefits to the State: If successful, this could save the state millions of dollars and improve safety in high pavement rutting locations.

HFHWY00151 PORTLAND CEMENT TREATMENTS IN LOCATIONS WITH POOR EMBANKMENT MATERIAL
Principal Investigator: Margaret Darrow
Funding: $130,000 (SP&R)
Project Manager: Dave Waldo
Estimated Completion Date: June 2020

The objective of this research is to perform tests on the frost susceptibility and compressive strength of soil samples provided by ADOT&PF Northern Region Materials Section. High quality aggregate is not readily available in a specific project area, often requiring it to be imported from long distances, resulting in high costs. ADOT&PF NRMS is considering using Portland cement to treat locally available fine-grain soils. Concerns with using cement-treatment fine-grained soils are potential frost susceptibility and lack of compressive strength.

Benefits to the State:
If successful, this research will provide the Northern Region with readily available resources cement treatments. The successful implementation of this will allow the Northern Region to look locally instead of relying on importing from outside sources where prices can be comparatively expensive as opposed to local resource usage. Not only will this benefit those in northern areas in the financial sense, but also in the efficiency sense, and completion of job timelines as well.

SAFETY & TRAFFIC

4000180 SAFETY EVALUATION OF OFF-HIGHWAY VEHICLE USE IN ALASKA

Principal Investigator: Dr. Nathan Belz, UAF
Funding: $104,000 DOT&PF (SP&R), $60,000 Pactrans
Project Manager: Anna Bosin, P.E.
Estimated Completion: December 2020

Traffic volumes and crash history of off-highway vehicles (e.g. snow machine, all-terrain vehicles, dog sleds) are not well documented in rural Alaska. Trauma registry data indicate that users are being hurt on roadways. This indicates a lack of reporting of crashes in many parts of the state, but by how much? How much OHV traffic is on rural roadways? How much conflict between users is happening? The DOT&PF needs to learn more about the use before resources and countermeasures can be implemented to address the injuries.

This project will review multiple sources for injury data as well as conduct traffic counts in several remote communities to determine the use of OHVs.

Benefit to the State: Safety funds are data driven and must adhere to reported crash data and traffic data to direct projects and programs. This project will create a baseline of data for evaluation as well as make recommendations to improve data collection and crash reporting in rural Alaska. The interim results will help the Department address OHVs in the Strategic Highway Safety Plan update being conducted in 2018.

4000183 – MASH TESTING GUARDRAIL END TREATMENTS

Principal Investigator: Nauman Sheikh (TTI)
Funding: $175,000 (SP&R)
Project Manager: Anna Bosin, P.E.
Estimated Completion: December 2019

This project will compare the behavior of steel posts-in-tubes in soils as compared to direct buried steel posts, using bogie testing, Finite Element Analysis, and potentially full scale crash testing. The project hopes to demonstrate that post-in-tubes can be used as an alternative to direct buried posts.
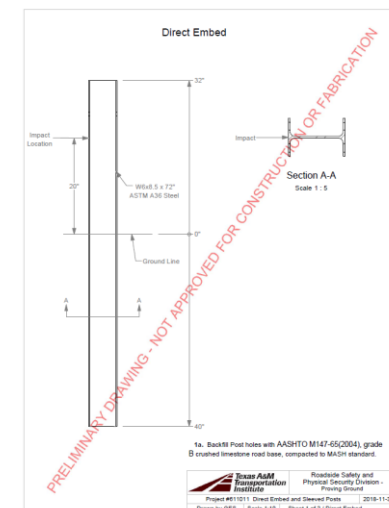
Benefits to the State:
- Improved safety for motorists - return damaged GETs to service faster. Repair of post-in-tube GETs is easier and quicker during all times of year, however freezing conditions increase repair challenges.
- Improved safety for M&O staff or contractors - repair activities can be conducted from behind the guardrail using hand tools regardless of conditions.
- Reduced cost - Posts and rail can be repaired without a driver/puller truck, using shoulder work traffic control and limiting or avoiding full lane closures.

SUPPLEMENTAL RESEARCH & TECHOLOGY PROGRAM

4000113 EXPERIMENTAL FEATURES

Principal Investigator: Varies
Funding: $226,900 (SP&R)
Project Manager: Anna Bosin, P.E.
Completion Date: varies

The Federal Highway Administration (FHWA) Experimental Features Program encourages innovation in state highway design and construction. Experimental features incorporated into highway projects under this program are eligible for federal funding participation, which is normally limited to more proven and conventional items. Another advantage of the program is that if an experimental feature fails for any reason, FHWA will pay for its repair or replacement. Experimental features are often physical objects but can also include techniques for using conventional materials. The RD&T2 Program maintains an account to support evaluations of Experimental Features for a time period requested by FHWA - normally 3-5 years. Some experimental features need some additional testing before field application and those projects are set up as a separate stand-alone project. Active field applications are listed below.

Project Title (construction project)	Amount	Estimated Completion Date
Construction of an air convection embankment with non-angular ACE	$33,000	March 31, 2020
Construction of an ACE and ACE Shoulders with 1"-2" Rounded ACE Fill	$68,000	June 30, 2022
Construction of Road Embankments with Reduced ACE Shoulder Top-Widths	$74,900	June 30, 2022

Benefits to the State: DOT&PF can conduct research and evaluate experimental features during construction and monitor results.

SUPPLEMENTAL RESEARCH & TECHOLOGY PROGRAM CONT.

POOLED FUND STUDIES

Principal Investigator: Varies
Funding: $180,000 (100% FHWA SP&R)
Completion Date: varies

Benefits to the State: When significant or widespread interest is shown in solving transportation-related problems, research, planning, and technology transfer activities, they may be jointly funded by several federal, state, regional, and local transportation agencies, academic institutions, foundations, or private firms as a pooled fund study. The FHWA Transportation Pooled Fund (TPF) Program allows federal, state, and local agencies and other organizations to combine resources to support transportation research studies.

DOT&PF participates in the following pooled fund studies. Details and status are available at http://www.pooledfund.org/.

Pooled Fund Project Title	Study ID	Lead Agency	FFY 2019 Funding	Project Website/DOT&PF Technical Lead
Roadside Safety Research for MASH Implementation	TPF-5(343)	Washington DOT	$25,000	http://www.pooledfund.org/Details/Study/592 Jeff Jeffers
Clear Roads Winter Highway Operations II	TPF-5(353)	Minnesota DOT	$25,000	http://www.pooledfund.org/Details/Study/604 Anna Bosin
Enhancement to the Intelligent Construction Data Management System (Veta) and Implementation	TPF-5(334)	Minnesota DOT	$10,000	http://www.pooledfund.org/Details/Study/583 Rich Giessel
Wildlife Vehicle Collision Reduction and Habitat Connectivity	TPF-5(358)	Nevada Department of Transportation	$20,000	http://www.pooledfund.org/Details/Study/610 Jon Knowles
Unpaved Road Rural Safety	1419	Iowa DOT	$15,000	No link/Dan Adamzak

Pooled Fund Project Title	Study ID	Lead Agency	DOT&PF FFY 2019 Funding	Project Website/DOT&PF Technical Lead
Connected Vehicles	TPF-5(389)	Virginia DOT	$25,000	http://www.pooledfund.org/Details/Study/642 Anna Bosin
Aurora Program	TPF-5(435)	Iowa DOT	$25,000	http://www.pooledfund.org/Details/Study/658 Lisa Idell Sassi
Avalanche Research	TPF-5(337)	Colorado DOT	$25,000	http://www.pooledfund.org/Details/Study/586 Anna Bosin
Technology Exchange on Low Volume Road Design, Construction, and Maintenance	TPF-5(379)	Iowa Department of Transportation	$10,000	http://www.pooledfund.org/Details/Study/379 Anna Bosin

ALASKA TECHNOLOGY TRANSFER

Housed within DOT&PF's Research Section, Technology Transfer (T2) provides support to federal, state, and local governments and other transportation personnel. We are comprised of two programs, integrated to provide a seamless training and technology transfer service.

CY2019 PROGRAM DASHBOARD
- Total number of classroom training sessions: **70**
- Total number of classroom participants: **1118**
- Total number of on-line modules completed: **278**

LOCAL TECHNICAL ASSISTANCE PROGRAM: $300,000

LTAP is a national network of centers funded by FHWA. LTAP's mission is to foster a safe, efficient, and environmentally sound surface transportation system by improving skills and increasing knowledge of the transportation workforce and decision makers. LTAP's primary focus:
- Training events and programs
- Newsletters, tech briefs, online library

NATIONAL HIGHWAY INSTITUTE: $350,000

These STP funds provide transportation-related education programs to AK DOT&PF employees to help improve the quality of the state's highway system through technology transfer to the planning, design, construction, and maintenance personnel working for Alaska's transportation infrastructure.T2 Highlights 2019

- On-going management/delivery of the ATSSA and Alaska CESCL training programs.
- Participation and outreach related to STIC program.
- Civil Rights Compliance On-line training development