# RESEARCH DEVELOPMENT AND TECHNOLOGY TRANSFER

**ANNUAL REPORT FEDERAL FISCAL YEAR 2018**

**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 2018, beginning October 1, 2017, and ending September 30, 2018.

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

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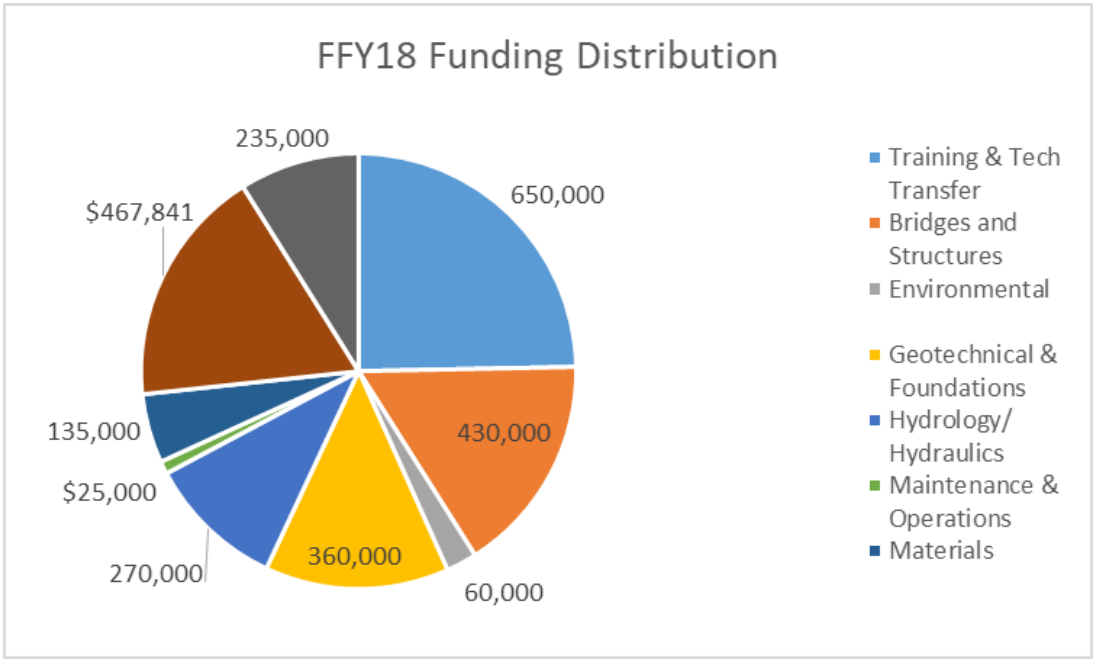
# FEDERAL FISCAL YEAR RD&T2 SUMMARY

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** | **2018** |
|---|---|
| | |
| **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 |
| Offsets from Completed Project Closures | $ 125,341 |
| **Total** | **$ 2,825,341** |
| | |
| **Expenditures & Obligations** | |
| NCHRP Dues | $ 351,999 |
| TRB Core Services | $ 115,842 |
| Pooled Fund Studies | $ 95,000 |
| NHI/ LTAP | $ 500,000 |
| T2 SP&R Match | $ 150,000 |
| Research Project (old projects increases) | $ 97,500 |
| Research Project Programming (New Obligations) | $ 1,515,000 |
| **Total** | **$ 2,825,341** |

## Research Funding Distribution in FFY18 (new projects, annual dues and project increases)

| *Research Funding Category* | *Total* |
|---|---|
| Administration & Policy | $0 |
| Bridges & Structures | $430,000 |
| Environmental | $60,000 |
| Geotechnical & Foundations | $360,000 |
| Hydraulics & Hydrology | $270000 |
| Maintenance & Operations | $25,000 |
| Materials & Construction | $135,000 |
| Safety & Traffic | $235,000 |
| Training & Tech Transfer | $650,000 |
| TRB & NCHRP Contributions | $467,841 |
| **Grand Total** | $2,632,841 |



# PROJECTS STARTED IN FFY2018

## 10 New projects in FFY2018 using SP&R funds-Part B, LTAP and State match:

| Title | FHWA Project # State Project # | Category | Federal $ | State $ | Total $ Project Funding |
|---|---|---|---|---|---|
| **Technology Transfer Program CY2018 (LTAP)** | LTAP041 NFHWY00330 | Training & Tech Transfer | 270,000 | 30,000 | 300,000 |
| **National Highway Institute (NHI) CY2018** | 2018(001) NFHWY00329 | Training & Tech Transfer | 350,000 | 0 | 350,000 |
| **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 |
| **Double Walled Pile Noise Model** | 4000187 HFHWY00130 | Environmental | 48,000 | 12,000 | 60,000 |
| **Precipitation Projections for Alaska** | 4000188 HFHWY00132 | Hydrology/ Hydraulics | 216,000 | 54,000 | 270,000 |
| | | TOTAL | | | 2,070,000 |

## 7 Pooled Funded projects in FFY2018 using 100% Federal SP&R Funds, Part B (no State funds):

| Title | FHWA Project # | Category | Total Current $ Project Funding (100% federal) |
|---|---|---|---|
| **Enhancement to the Intelligent Construction Data Management System (Veta) and Implementation** | TPF-5(334) | Materials | 10,000 |
| **Roadside Safety Research for MASH Implementation.** | TPF-5(343) | Safety | 25,000 |
| **Clear Roads II** | TPF-5(353) | Maintenance & Operations | 25,000 |
| **Wildlife Vehicle Collision Reduction and Habitat Connectivity** | TPF-5(358) | Traffic&Safety | 20,000 |
| **Unpaved Road Safety Pooled Fund Study** | Proposal 1419 | Traffic&Safety | 15,000 |
| **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 | 115,842 |
| | | Subtotal | **562,841** |
| | | Minus Dues | 467,841 |
| | | Pooled Fund Research Only | **95,000** |

# ACTIVE PROJECTS STARTED PRIOR TO FFY2018

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

| Title | FHWA Project # | Category | Federal $ | State $ | Total $ Project Funding |
|---|---|---|---|---|---|
| **Deployment FFY16/18** | 4000164 | Training & Tech Transfer | 144,000 | 36,000 | 180,000 |
| **FFY17/18 Research Administration** | 4000172 | Admin & Policy | 149,659 | 37,415 | 187,073 |
| **Examination of the Variability in Grout Cube Specimen Test Results** | 4000173 | Bridges & Structures | 80,000 | 20,000 | 100,000 |
| **NHS Innovative Pavement Design Research for Pavement Management System** | 4000174 | Materials | 120,000 | 30,000 | 150,000 |
| **Survey and Economic Analysis of Pavement Impacts from Studded Ture Use in Alaska** | 4000175 | Traffic & Safety | 60,000 | 15,000 | 75,000 |
| **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 |

## 7 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 |
| **Durability of Grouted Shear Stud Connections at Low Temperatures** | 4000162 | Bridges & Structures | 201,600 | 50,400 | 252,000 |
| **Transverse Seismic Design of Bridges with Pre-Cast Deck/Girder Elements** | 4000161 | Bridges & Structures | 201,600 | 50,400 | 252,000 |
| **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[1]+ 50,000(FFY18) |
| **Bald Eagle Nesting During Construction Research** | 4000167 | Environmental | 144,000 | 36,000 | 180,000 |
| ***$200,000 Participation from South Dakota DOT** | | | | | |

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

| Title | Federal Project # | Category | Federal $ | State $ | Total $ Current Project Funding |
|---|---|---|---|---|---|
| **Geotechnical Asset Management Thru Thermal Modeling-Dalton Hwy** | 4000138 | Geotechnical | 100,400 | 25,100 | 125,500 |
| **Dust Control Product Mix Design & Quality** | 4000157 | Materials & Construction | 115,200 | 28,800 | 144,000 |

## 2 Active projects started in FFY2013 or FFY14 using SP&R Part B funds:

| Title | DOT&PF Project # | Federal Project # | Category | Total $ Current Project Funding |
|---|---|---|---|---|
| **Seismic Repair of Reinforced Concrete Bridge Substructures** | Z839740000 | 4000142 | Bridges & Structures | 240,000 +40,000(FFY15) |
| **Optimizing Highway Patrol Investment Levels** | Z630680000 | 4000132 | Safety & Traffic | 270,000 |

## 4 Active research projects started prior to FFY2013 from individual STIP funded by 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 |

# Projects Completed in FFY2018 –PENDING Financial Closure

## 9 Projects completed in FFY2018:

| Title | DOT&PF Project # | Federal Project # | Total $ Project Funding |
|---|---|---|---|
| **Phase II: Development of an Unstable Slope Management Program Research** | Z634400000 | 4000090 | 600,000 (STIP) |
| **Experimental Feature Tencati Wicking Fabric Design** | Z643190000 | 4000147 | 30,000 |
| **Experimental Feature Wavetronic Radar Detection through Experimental Features** | Z643210000 | 4000145 | 35,000 |
| **Developing Guidelines for 2 Dimensional Model Review and Acceptance** | Z762690000 | 4000153 | 90,000 |
| **Frequency and Potential Severity of Red Light Running in Anchorage2** | Z762930000 | 4000156 | 120,000 |
| **Modeling Passing Lane Behavior on Two Lane Highways** | Z839800000 | 4000143 | 340,000 |
| **AASHTOWare Investigation** | Z839880000 | 4000144 | 750,000 |
| **Steel Fiber Reinforced Rubberized Concrete in Cold Regions** | HFHWY00001 | 4000159 | 90,000 |
| **Catastrophic Icefall Hazard Assessment, Avoidance Procedures, and Mitigation Strategies Phase 2** | HFHWY00051 | 4000168 | 160,000 |

# FFY18 Projects

# ADMINISTRATION & POLICY

## 4000144 AASHTOWARE INVESTIGATION

Principal Investigator: DOT&PF
Funding: $450,000+300,000
Project Manager: Sara Jarvis Completed March 2018.
Final Report available at
http://dot.alaska.gov/stwddes/research/assets/pdf/4000-144.pdf

AASHTOWare Preconstruction is a software package designed for transportation agencies. The software allows for automating processes during the planning, design and construction of a project. This project will test and evaluate AASHTOWare modules to determine if DOT&PF should implement statewide. Investigation will use project information from each region to evaluate pros and cons for a transition to AASHTOWare from current systems.

**Benefits to the State:** DOT&PF can reduce data entry time by connecting systems for reporting. Data can be entered once during the life of a project and used in different modules. AASHTOWare has been used in other states to connect to IRIS (DOT&PF Financial software) and it can replace a current database.


## 4000164 DEPLOYMENT FFY16-18

Principal Investigator: DOT&PF
Funding: $200,000
Project Manager: Carolyn Morehouse
Completed September 2018

Completed research project final reports sometimes sit on a shelf and are never implemented. This is not a good investment. Sometimes all that is needed is funding for additional action. This project provides funding for staff to review previous research for implementation effectiveness and if necessary, produce those deliverables needed for implementation. This funding is also used to implement current research projects that do not included implementation funding. Some examples of deployment are Bridge Design Workshop between North Carolina State University, Alaska universities and DOT&PF bridge staff and a hydraulic summit to formulate statewide research needs.

**Benefits to the State:** This funding supports the implementation of past of current research projects to improve statewide infrastructure.

# ADMINISTRATION & POLICY

## 4000172 RESEARCH ADMINISTRATION FFY17-18

Principal Investigator: DOT&PF
Funding: $200,000
Project Manager: Carolyn Morehouse
Completed September 2018

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.

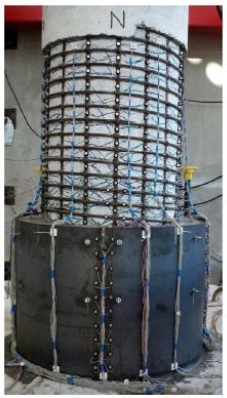
# BRIDGES & STRUCTURES

## 4000142 SEISMIC REPAIR OF REINFORCED CONCRETE BRIDGE SUBSTRUCTURES

Principal Investigator: Rudolf Seracino, Mervyn Kowalsky, and James M. Nau
Funding: $280,000 (SP&R)
Project Manager: Janelle White
Completion Date: September 2018
Closure Date: December 2018

The objective of this research is to develop a rapidly deployable post-earthquake repair technique for typical Alaska bridges that could provide extensive economic benefits by saving bridges that would otherwise be demolished after an earthquake.

Bridge column repair has been studied for some time with several established techniques for repair for shear and confinement critical columns. However, there is little data available on repair of columns that are otherwise designed to modern standards. Similarly, there is little data available on developing an understanding of when repair is needed, and when repair is no longer feasible.




**Benefits to the State:** The bridge design engineer will have access to pre-qualified repair techniques that could be rapidly deployed according to the damage level observed after an earthquake. Significant savings when bridges that otherwise need to be replaced can be repaired. 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.

## 4000162 DURABILITY OF GROUTED SHEAR STUD CONNECTIONS AT LOW TEMPERATURES

Principal Investigator: James Nau (NC State University)
Funding: $252,000 (SP&R)
Project Manager: Janelle White
Estimated Completion: May 2019

The objective of this work is to optimize grout properties through material testing. The project will use weathered and un-weathered full size connection specimens to develop recommendations to maximize the durability of the shear stud connection. The behavior of full-scale connection subassemblies in as-built un-weathered condition and in weathered condition following freeze-thaw cycles characteristic of expected field conditions will be evaluated at temperatures as low as -40$_0$ C.

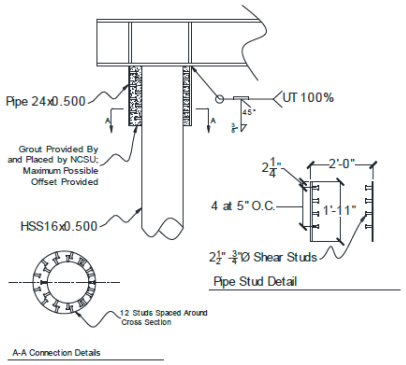



**Figure 1: Grouted Shear Stud Connection**

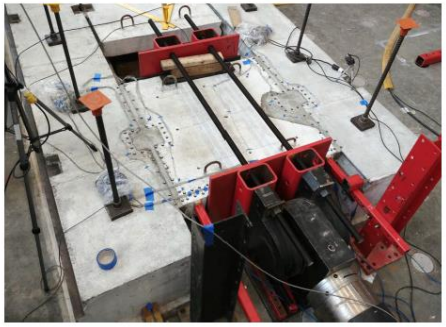
**Benefits to the State:** Bridge design engineers will gain knowledge on the durability of the grouted shear stud connection with regard to freeze-thaw resistance, and an understanding of connection performance at low temperatures typical in Alaska. The performance under simulated field conditions is essential in developing confidence in the design of this new alternate connection.

# BRIDGES & STRUCTURES

## 4000161 TRANSVERSE SEISMIC DESIGN OF BRIDGES WITH PIER CAST DECK GIRDER

Principal Investigator: Mervyn Kowalsky (NC State University)
Funding: $252,000 (SP&R)
Project Manager: Janelle White
Estimated Completion: May 2019

The objective of this research is to develop guidelines for the modeling and design of the longitudinal joints between precast girders under transverse seismic response. A bridge structure utilizing these connections was recently damaged in Alaska by an ice-flow event. The impact of the ice resulted in approximately one foot of lateral displacement of one column, while other columns did not deform. As a consequence, the bridge superstructure was deformed laterally between bents which resulted in minor damage to the grouted shear connections. Examination of this real life case study will be helpful in the development of the research plan for this project.



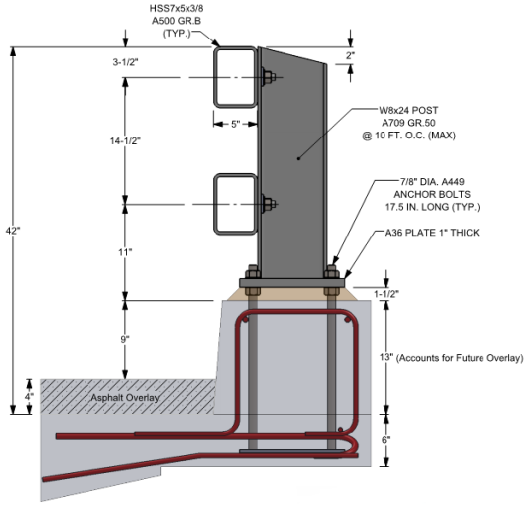
**Benefits to the State:** Bridge design engineers will be able to confidently predict lateral displacement profiles for these bridges, which is an essential component of the AASHTO seismic design and DDBD process. The existing practice of the AKDOT will either be verified by full scale data, or revised to ensure that damage in the deck does not occur under moderate to large earthquakes. Correlation of experimental data obtained as part of this research to field case studies of previously damaged bridges will also be possible.

## 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.



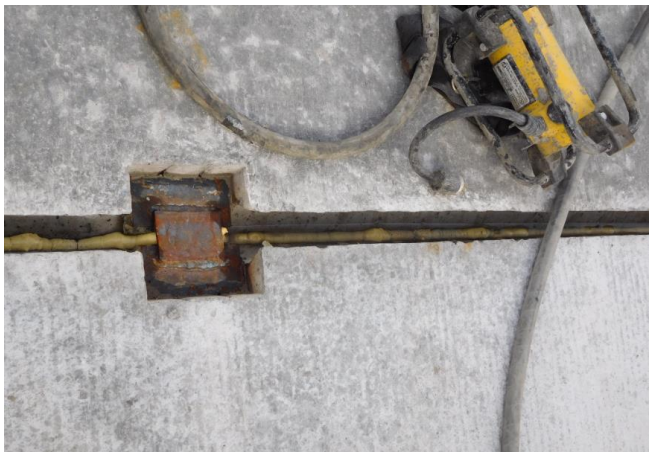
# BRIDGES & STRUCTURES

## 4000173 EXAMINATION OF THE VARIABILITY IN GROUT CUBE SPECIMEN TESTING RESULTS

Principal Investigator: Il Sang Ahn, Ph.D/Jenny Liu (UAF)
Funding: $100,000 (SP&R)
Project Manager: Janelle White
Estimated Completion: June 2019

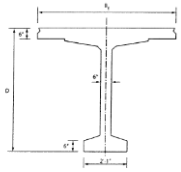
High Strength, non-shrink grout has been used to fill the longitudinal keyway joints between girders during the precast, pre-stressed decked bulb tee girder type bridges. The goal is to research the reason for variability in test results by reviewing different materials, the sampling method, quantity of water, and experience of lab technicians and construction field staff.

**Benefits to the State:** Develop a construction specification or lab testing method which will produce consistent testing results for grout in keyway joints on bridges.



## 4000178 PRE-STRESSED LOSSES IN DECKED BULB TEE GIRDERS

Principal Investigator: Il-Sang Ahn (UAF)
Funding: $350,000 (SP&R)
Project Manager: Janelle White
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.

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.

# BRIDGES & STRUCTURES

## 4000184 RAPID REPAIR OF COLUMN TO FOOTING PHASE 2

Principal Investigator: Dr. Mervyn Kowalsky (NC State)
Funding: $280,000 (SP&R)
Project Manager: Janelle White
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.

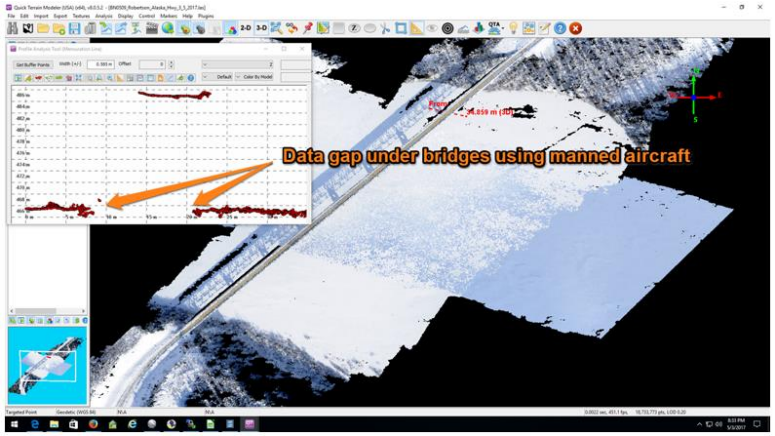
**Benefits to the State:**
The bridge design engineer will have access to additional pre-qualified repair techniques that could be rapidly deployed according to the damage level observed after an earthquake. The cost savings to the State of Alaska will be significant when bridges that otherwise need 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 measure



# ENVIRONMENTAL

## 4000167 BALD EAGLE NESTING DURING CONSTRUCTION

Principle Investigator: Jordan Muir, USFWS
Funding: $180,000 (SP&R)
Project Manager: Janelle White
Estimated Completion: December 2019

Collect field data on DOT&PF projects. Compare nest occupancy, productivity, and fidelity between impact and control nests. If significantly different, determine at what distance impacts occur. If not significantly different, USFWS may recommend DOT&PF not obtain Bald Eagle permits for certain activities.

**Benefits to the State:**
Discuss and implement policy modifications with USFWS based on findings. Use information to determine if USFWS Eagle Take Permit is recommended for DOT&PF road maintenance activities. If permit is recommended, use information to determine at what distance permit needed.

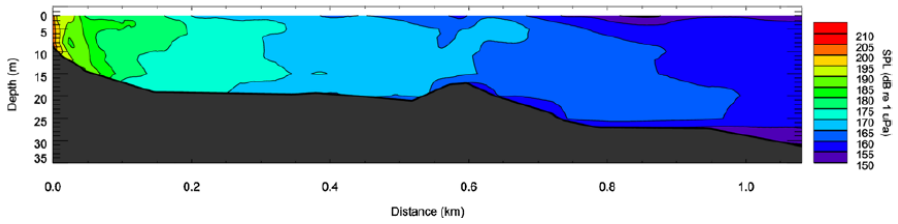
## 4000187 DOUBLE WALLED PILE NOISE MODEL

Principle Investigator: Melanie Austin, JASCO, Inc.
Funding: $60,000 (SP&R)
Project Manager: Janelle White
Estimated Completion: Spring 2020

Large marine mammal monitoring zones are required for offshore marine DOT&PF projects. It often takes 13 months or more to receive permits.

Prepare a noise model for a double walled pile and compare to single walled pile model and actual field collected data. Model two locations which were previously modeled for single walled piles. Compare the difference in noise level and the difference in required mitigation.

**Benefits to the State:**
Possibly reduce the in-water monitoring areas for marine mammals. Reduced project development costs.



# 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

## 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

## 4000132 GEOTECHNICAL ASSET MANAGEMENT - STAGE II

Principal Investigator: Various
Funding: $80,000, (Other STIP project)
Project Manager: Barry Benko, C.P.G
Estimated Completion: March 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 participating 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. In addition to reports published for the GAM research under Projects 000S802 and 4000126 (see previous pages), other deliverables to FHWA will include:

- An executive level summary,
- Individual graphics suitable for use in FHWA publications and pamphlets,
- PowerPoint presentation slides.

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

## 4000138 GEOTECHNICAL ASSET MANAGEMENT THROUGH THERMAL MODELING -DALTON HWY - EXPERIMENTAL FEATURE

Principal Investigator: Steve McGroarty and Jeff Currey
Funding: $125,000
Manager: Anna Bosin, P.E.
Estimated Completion: March 2019

Road embankments constructed on permafrost must be thermally stable in order to minimize long-term maintenance costs. Past thermal modeling studies have determined that the most critical model input parameters are soil surface temperatures. Typically, site-specific soil temperatures are not available and are estimated using air temperature records and a modifying *n*-factor. Material type, vegetation cover, and snow cover all affect *n*-factors and need additional site-specific studies under Alaskan conditions. Leveraging an upcoming reconstruction project on the Dalton Hwy MP 0-9, before and after temperature data will be collected with thermal monitoring instrumentation to study performance of Air Convection Embankment. Project will also determine site-specific thermal model n-factors for future thermal modeling, and develop relationship between snow depth and winter n-factors. Results will be used to improve thermal models.

**Benefits to the State:**
This project will help refine thermal modeling to design future embankments or reconstructed embankments on permafrost to facilitate design of the least expensive thermally stable embankment. This will reduce maintenance.

# GEOTECHNICAL

## 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.

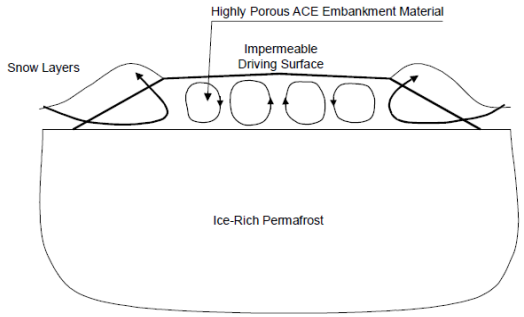



FIGURE 1 Pattern of wintertime pore air circulation in an ACE.

# GEOTECHNICAL

## 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.

# HYDROLOGY & HYDRAULICS

## 000S875 PILE LENGTH DETERMINATION AT UNKNOWN BRIDGE FOUNDATIONS

Principal Investigator: Murthy Guddati (North Carolina State University)
Funding: $261,230 (NHPP)
Project Manager: Janelle White
Estimated Completion: September 30, 2019

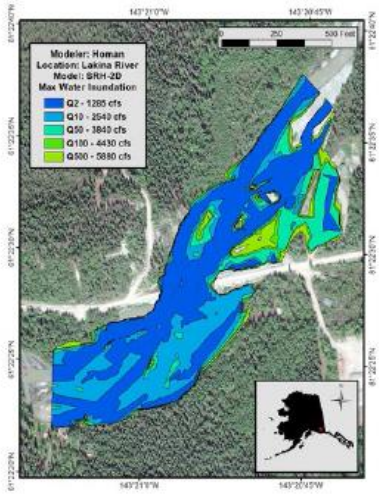
NCSU has recently developed laboratory methods of instrumentation, testing and data processing for estimating pile lengths (named Effective Dispersion Analysis of Reflections – EDAR). It is anticipated that EDAR will first be adapted and calibrated at a sample group of control bridges with known pile 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.

## 4000153 DEVELOPING GUIDELINES FOR 2-DIMENSIONAL MODEL REVIEW AND ACCEPTANCE

Principal Investigator: Horacio Toniolo, (UAF)
Funding: $90,000 (SP&R)
Project Manager: Janelle White
Project Completed: January 2018

The research team from UAF will use SRH-2D, RAS-2D and IRIC to model two projects. The primary numerical models will be used in two different morphological settings: moderate and significant contractions. Results between the various models will be compared. Guidelines for preferred model will be prepared.




**Benefits to the State:** Guidelines will be prepared which will define what is "acceptable" or "comparable" when reviewing 2-D modeling results.

# HYDROLOGY & HYDRAULICS

## 4000188 FUTURE PROJECTIONS OF PRECIPITATION ON ALASKA INFRASTRUCTURE

Principal Investigator: Tom Kurkowski, Scenarios Network for Alaska & Arctic Planning (SNAP)
Funding: $270,000
Project Manager: Janelle White
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.

# MAINTENANCE

## 4000168 CATASTROPHIC ICEFALL HAZARD ASSESSMENT, AVOIDANCE PROCEDURES, AND MITIGATION STRATEGIES PHASE 2

Principal Investigator: David Scapato (Scarptec Inc.)
Funding: $160,000 (SP&R)
Project Manager: Anna Bosin, P.E.
Estimated Completion: June 2019

This is the second phase that follows the literature review. Scarptec Inc. will visit the seven predetermined sites to evaluate geometry, risk, contributing factors, and mitigation strategies. Mitigation strategies will include M&O activities as well as short and long-term permanent solutions with planning level estimates for the Department to consider for each site

**Benefits to the State:** A tiered approach to mitigation for seven sites along NHS routes in Alaska that need specialized ice fall mitigation strategies which take into account risk to the traveling public.

*Photo: Seward Highway MP 113.2 crash caused by icefall April 6th, 2012.*

# MATERIALS & CONSTRUCTION

## 4000159 USE OF STEEL FIBER REINFORCED RUBBERIZED CONCRETE IN COLD REGIONS

Principal Investigator: Osama Abaza
Funding: $90,000 +17,500(SP&R)
Project Manager: Anna Bosin
Completed December 2017
Completion Certification April 2018

Studded tires can cause significant rutting issues in Alaska on asphalt pavement. This project will attempt to use a concrete mix design to preserve the road surface. This project will create material samples and test for rutting resistance, comprehensive strength, friction and freeze/thaw properties. Once the sample has passed the lab tests, a test panel will be added to a Central Region Design project for field testing. The Principle investigator will monitor the panel installation and make recommendations for future monitoring.

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

## STEEL FIBER RUBBERIZED CONCRETE MATERIAL MONITORING-EXPERIMENTAL FEATURE

Principal Investigator: Osama Abaza
Funding: $45,000 (SP&R)
Project Manager: Anna Bosin
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.

# MATERIALS & CONSTRUCTION

## 4000113 EXPERIMENTAL FEATURE: POLYESTER CONCRETE APPROACH SLABS

Principal Investigator: Leslie Daugherty, P.E., Bridge Engineer, Statewide
Funding: $51,000 (SP&R)
Project Manager: Carolyn Morehouse, P.E.
Completed December 2017

This experimental feature evaluates polyester concrete for approach slabs on the Parks Highway MP 239-252 Rehabilitation construction project. A post construction report was submitted to FHWA in Dec 2014 that compared structural performance of various types of slabs to include polyester concrete, Class-A concrete, and paved asphalt approaches without a slab. The polyester concrete is high-strength, rapid-setting, and water impermeable. The concrete provides protection from chlorides and other contaminants to help protect the steel reinforcement giving longer life. Superior abrasion and skid resistance allow for a safe and durable driving surface. With a rapid curing time, traffic was allowed to drive on the slab in about 4 hours which was beneficial on the Parks Highway during the middle of Summer. Polyester concrete does not crack or delaminate even through extreme freeze/thaw cycles and has a higher compressive strength than conventional concrete. Year 1 to 3 monitoring is complete and all reports submitted to FHWA.

Polyester concrete use in Alaska has been limited to a bridge deck overlay on the Susitna River Bridge. However, numerous states, such California, Washington, and Nevada, have used this system for bridge deck repairs and overlay projects on major highways. In states like Washington and California where traffic volume is high and this product has been used for over a decade, results show the concrete is performing as expected with no major signs of wear.

**Benefits to the State:** This research determined that polyester concrete may be a practical, cost saving alternative to traditional concrete methods for approach slab and deck construction depending on location. It could save millions in traffic control costs and impacts to the traveling public on future bridge retrofit and deck projects.

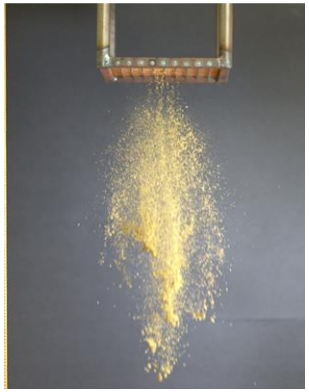
# MATERIALS & CONSTRUCTION

## 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 2019

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. Split samples have been successfully tested and shown corresponding results. The test method is nearing completion. Beta training videos are available and the specification is drafted. Some further testing is necessary to insure method follows videos and is repeatable.



**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.

## 4000174 NHS INNOVATIVE PAVEMENT DESIGN RESEARCH FOR PAVEMENT MANAGEMENT SYSTEM

Principal Investigator: DOT&PF
Funding: $150,000
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 and 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.

# MATERIALS & CONSTRUCTION

## 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 2020

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.

## 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 2020

Modified Asphalt Binders have been used for some time in DOT&PF pavement design, but mix designs have used varying quantities 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 more consistently applied for certain conditions. 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.

# MATERIALS & CONSTRUCTION

## 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.

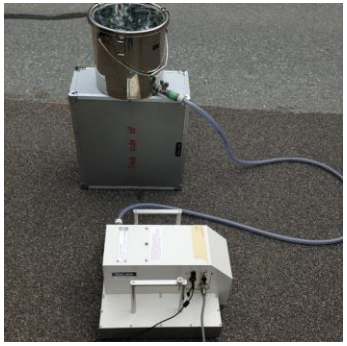


*Photo: Dynamic Friction Test on recently installed HFST*
*Credit: CR DOT&PF Materials Staff*

## 4000181 EXPERIMENTAL FEATURE HIGH FRICTION MINNESOTA DRIVE RAMP MICROSURFACING EXPERIMENTAL FEATURE MONITORING

Principal Investigator: DOT&PF
Funding: $125,000
Project Manager: Anna Bosin, P.E.
Estimated Completion: December 2022

During summer 2018, DOT&PF Central Region will construct ramps using Microsurfacing treatment. This treatment is used by states in the lower 48 to compact excessive rutting. There will be a post construction report due after the construction is complete estimated at December 2019. There will be three additional years of monitoring to evaluate the materials performance. This will be the first application is Alaska and will determine if the material can with stand the cold 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.

# SAFETY & TRAFFIC

## 4000132 OPTIMIZING HIGHWAY PATROL INVESTMENT LEVELS

Principal Investigator: Dr. Osama Abaza, PhD
Funding: $100,000
Project Manager: Anna Bosin, P.E.
Estimated Completion: March 2019

State crash data shows fatal crashes occur more often on rural high speed highways, and higher volume highways. The highest density of severe crashes occurs within the State's four designated Safety Corridors. There is a need to optimize highway enforcement performance levels (and in turn optimize the State's funding) so that highway travel is no longer a leading risk.

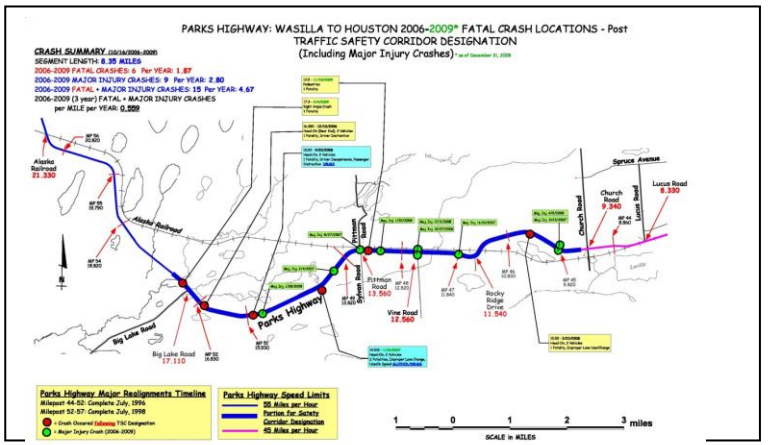
How can enforcement be directly linked to road safety when officers provide multiple duties away from roads? Reductions in citations or arrests could falsely indicate staffing reductions are possible when they may actually be needed to continue the trend.

This research project will focus on documenting the benefits of enforcement presence and the costs associated with enforcement presence on some of the higher risk road segments in Alaska. The study is expected to include the use of GPS based automated tracking technologies to quantify the presence of enforcement patrol vehicles throughout the Central Region and portions of the Northern Region connected roadway system. The study will develop a benefit/cost relationship for fatal and major injury crashes compared to the cost of the enforcement hours and produce a sensitivity analysis to optimize the cost vs benefit of reduced crashes.

**Benefits to the State:** Annual audits of the Traffic Safety Corridors emphasize the importance of increased enforcement to combat aggressive driving, DUls and speeding, but do not quantify how much additional enforcement is needed. This project's approach of tracking officer presence will provide a full picture of enforcement impacts on our highways.

Data collected could be presented graphically, comparing "hours" of police presence by year against crash experience by severity, citation, or aggressive/impairs violations. Having this information organized could reveal unrecognized correlations and permit a new level of decision-making to be applied to safety and enforcement efforts on State Highways, helping to optimize the State's investment in law enforcement. This project was extended an additional 18 months to collect a total of 3 years of data. Draft final report being reviewed by DOT staff. Estimate publishing in March 2019.

**Photo:** This map shows an analysis of fatal crash locations on a Parks Highway Safety Corridor, Graphic from the Alaska Highway Safety Office website http://www.dot.alaska.gov/stwdplng/hwysafety/safety_corridors.shtml



# SAFETY & TRAFFIC

## 4000145 EXPERIMENTAL FEATURE: WAVETRONIX© RADAR TRAFFIC DETECTION

Principal Investigator: Sarah Schacher, P.E., Northern Region Preconstruction
Funding: $35,000 (SP&R)
Project Manager: Carolyn Morehouse
Completion: January 2018

This experimental feature tested the effectiveness and constructability of Wavetronix© Radar on two major arterials (Johansen Expressway and Airport Way) in Fairbanks as compared to traditional in-ground loops and video detection currently employed at signalized intersections in Fairbanks

Wavetronix© radar is a radar based detection system for intersections that can effectively detect vehicles in weather conditions that can cause problems for typical video based detection systems. Because the detection uses radar and not light, like video detection, environmental factors like low light, shadows, and heavy ice fog don't have as pronounced of an effect on the system capability to detect vehicles.

The product was successfully installed at eight intersections on Airport Way in Fairbanks. Post Construction report was submitted to FHWA Jan 2015 and followed by three annual reports. To date there is a noticeable decrease in false calls due to environmental factors and the accuracy of detection has improved for all intersections, translating to improved cycle times in all directions. This product will be used as standard within the state.

Devices were installed in the last four intersections on the Johansen Expressway in the fall of 2015, and will be monitored over the winter. Two years of monitoring occurred and found similar success. The third year monitoring was canceled.

**Benefits to the State:** Wavetronix© system has proven to be effective, it can replace in-ground loops and video detection for signal systems in Alaska. This is expected to provide significant maintenance cost savings and reduced impacts to the traveling public due to malfunction during commonly occurring weather


Wavetronix Radar Detection

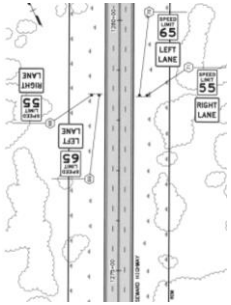
# SAFETY & TRAFFIC

## 4000143 MODELING PASSING LANE BEHAVIOR ON 2-LANE HIGHWAYS

This project will create design models to predict the passing risk level at a variety of configuration on two lane rural highways in Alaska. The following are two projects support the modeling effort.

### #1 ANALYZING DRIVER BEHAVIOR IN PASSING ZONES WITH DIFFERENTIAL SPEED LIMITS

Principal Investigator: Rob Lang, Ph.D., Osama Abaza, Ph.D., (Co-PI)-UAA
Funding: $165,000 (SP&R)
Project Manager: Anna Bosin, P.E.
Estimated Completion: February 2018
Final Report Link:
http://dot.alaska.gov/stwddes/research/assets/pdf/4000-143.pdf

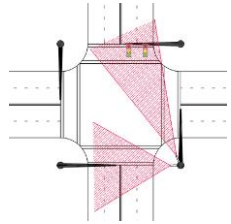



This project follows a previous DOT&PF funded driver simulation study that evaluated signing and striping scenarios in rural passing lanes to recommend optimal passing maneuvers. Implementation of that study's results followed by including a new signing configuration of differential speed limits for the passing lanes between MP 59-66 of the Seward Highway in the DOT&PF Central Region paving project during summer, 2015. This study will conduct a before/after analysis to examine the real-world effects of differential speed limits on traffic flow characteristics, along with drivers' perception of this change.

**Benefits to the State:** Recommendations and a final report could help define optimal characteristics for passing lane efficiency.

### #2 MODELING PASSING ZONE BEHAVIOR AND SIGHTDISTANCE ON RURAL TWO-LANE HIGHWAYS

Principal Investigator: Billy Connor P.E. (UAF – AUTC), Nathan Belz, Ph.D. (UAF – AUTC)
Funding: $110,000 (SP&R), $83,849 PacTrans
Project Manager: Anna Bosin, P.E.
Estimated Completion: February 2018
Final Report Link:



http://dot.alaska.gov/stwddes/research/assets/pdf/143pactrans.pdf

UAF researchers will conduct a driver-simulator-based study in partnership with University of Idaho to investigate passing maneuvers in two-lane rural highways under different geometric configurations and for different driver groups and for different vehicle types. Passing decisions will be modeled using data that are collected using scenarios modeled after segments of interest along the Seward Highway, Parks Highway, and Sterling Highway. Participants in the study will complete a driving simulator session and a questionnaire to further documenting the characteristics of their behavior.

**Benefits to the State:** The outcome of the project will provide the DOT&PF's with models that can be used to predict the risk level on two-lane rural highway and may contribute to modifications to striping specifications and improved maintenance operations for rural highways in Alaska.

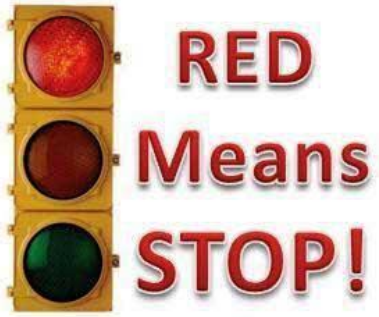
# SAFETY & TRAFFIC

## 4000156 FREQUENCY & POTENTIAL SEVERITY OF RED LIGHT RUNNING IN ANCHORAGE, PHASE II

Principal Investigator: Dr. Osama Abaza, UAA
Funding: $120,000 (SP&R)
Project Manager: Anna Bosin, P.E.
Estimated Completion: -May 2019

This study will evaluate six intersections in Anchorage, AK during fall and winter conditions and collect signal timing data and video at each location for analysis. Analysis includes the severity of the red light running infractions as well as recommendations for countermeasures. Data for 2018 was added to the analysis delaying the project for 15 months.

**Benefits to the State**: Reduce the number of crashes that occur relative to red light running and assist local enforcement with red light running identifiers.




## 4000175 - SURVEY AND ECONOMIC ANALYSIS OF PAVEMENT IMPACTS FROM STUDDED TIRE USE IN ALASKA

Principal Investigator: Osama A. Abaza, C.Eng, Ph.D
Funding: $75,000 (SP&R)
Project Manager: Dave Waldo
Estimated Completion: December 2019

The study will examine the extent of usage of studded tires in the state, and alternative solutions which might be cost effective for the Alaskan roadway network.

The researcher will collect comprehensive studded tire tax revenue data and compare to the pavement costs associated solely with studded tire usage.

Also, survey the current tire options in Alaska and their published testing results, to draw conclusion for ratios of studded tires/non-studded tires currently on the road system.

**Benefits to the State:** Quantifying the financial impacts of studded tire wear will help the state make an informed decision on their continued use.

# 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.

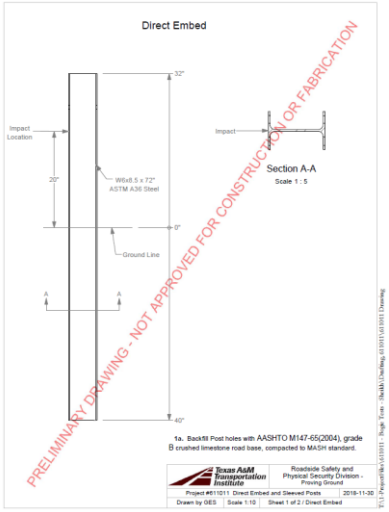
This project will review multiple sources for injury data as well as conduct traffic counts in several remote communities to determine the use of OHVs.

**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:**
Benefits of the Steel Posts-in-Tubes option for GETs:

- 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
Project Manager: Carolyn Morehouse, 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. Others are ready for field application and are listed below.

| **Project Title (construction project)** | **Amount** | **Estimated Completion Date** |
|---|---|---|
| Polyester Concrete Approach Slabs (Parks MP 239-252) | $51,000 | Dec 31, 2017 (complete) |
| 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.

Bridge No. **1141** Br. Name **Antler Creek** Date **07/16/17**
Inspector **Murray / Knapp** Frame **2**
**NE Approach Slab**

# SUPPLEMENTAL RESEARCH & TECHOLOGY PROGRAM

## POOLED FUND STUDIES

Principal Investigator: Varies
Funding: $95,000 (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 | DOT&PF FFY 2015 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 | TPF-5(353) | Minnesota DOT | $25,000 | http://www.pooledfund.org/Details/Study/604 Tom Renninger |
| 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/Pam Golden |

# 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.

## CY2017 PROGRAM DASHBOARD

- Total number of classroom training sessions: **65**
- Total number of classroom participants: **1216**
- Total number of on-line modules completed: **316**

## CY2018 PROGRAM DASHBOARD

- Total number of classroom training sessions: **69**
- Total number of classroom participants: **896**
- Total number of on-line modules completed: **243**

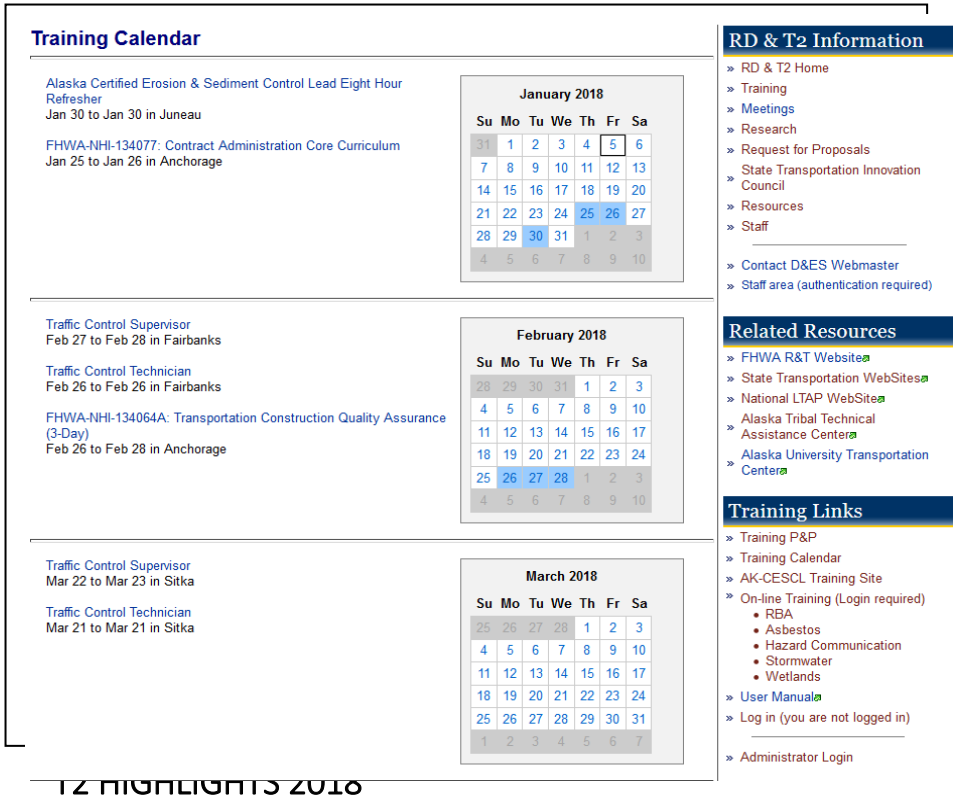
## LOCAL TECHNICAL ASSISTANCE PROGRAM: $300,000

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 2018

- NEPA on-line training modules posted to T2 website as part of STIC project implementation.
- Multi Sector General Permit on-line training modules posted to T2 website.
- Continued development of on-line video streaming page.
- On-going management/delivery of the ATSSA and Alaska CESCL training programs.
- Participation and outreach related to STIC program.