RESEARCH DEVELOPMENT AND TECHNOLOGY TRANSFER

ANNUAL REPORT FEDERAL FISCAL YEAR 2021

ALASKA DEPARTMENT OF TRANSPORTATION & PUBLIC FACILITIES

MASH Testing DOT&PF Bridge Rail Design- Texas A&M

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 2021, beginning October 1, 2020, and ending September 30, 2021**.

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FEDERAL FISCAL YEAR 2021 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), FHWA's State Transportation Innovation Council grant (STIC), FHWA's Technology Transfer training grant, and FWHA's Transportation Pooled Fund Program. There are other individual State Transportation Projects that have some research and/or innovation elements. These projects are not included in the fiscal summary.

Funding Sources	**2021**
Revenues	
SP&R Program Funds (STIP ID#6451)	$ 2,519,400
NHI Funds (STIP ID#6452)	$ 350,000
AASHTO Technical Service Programs (STIP ID#25836)	$ 220,000
Local Technical Assistance Program (Grant)	$ 150,000
Total	**$ 3,239,400**
Expenditures & Obligations	
NCHRP Dues	$ 351,999
TRB Core Services	$ 121,336
AASHTO Technical Service Program	$ 199,134
Pooled Fund Studies	$ 240,000
NHI/LTAP	$ 500,000
T2 SP&R Match for LTAP	$ 150,000
Research Project (old projects increases-mini–RWIS Pilot Project)	$ 31,425
Research Project Programming (New Obligations)	$ 1,483,923
Total	**$ 3,077,817**

RESEARCH & TRAINING PROJECTS STARTED IN FFY2021

10 New Training & Research Projects in FFY2021 using SP&R funds-Part B, LTAP and State match:

Title	FHWA Project # State Project #	**Category**	Federal $	State $	**Total $ Project Funding**
Technology Transfer Program CY2021 (LTAP)	LTAP(043) NFHWY00585	**Training & Tech Transfer**	270,000	30,000	**300,000**
National Highway Institute CY2021 (NHI)	2020(002) NFHWY00586	**Training & Tech Transfer**	350,000	0	**350,000**
Equipment Visibility in Sub-Arctic Winter Conditions	000S(944) HFHWY00219	**Safety**	40,000	10,000	**50,000**
Seismic Behavior of High Strength Reinforcing Steel at Low Temps	4000(205) HFHWY00220	**Bridge**	294,976	73,744	**368,720**
UAV Bridges and Structures Condition Inspections	4000(206) HFHWY00221	**Bridge**	149,055.20	37,263.80	**186,319**
Research Administration FFY21-22	4000(207) HFHWY00222	**Administration**	125,700	31,425	**157,125**
Research Deployment FFY21-22	000S(945) HFHWY00223	**Rapid Research**	125,700	31,425	**157,125**
Landslide Collides with Highways: Measuring its Impact to Inform Future Mitigation	4000(139) HFHWY00212	**Geotechnical**	271,720	67,930	**339,650**
Alaska Connected and Autonomous Vehicle Strategic Plan	000S(946) HFHWY00224	**Innovation**	79,987	19,997	**99,984**
Left-Side Delineation for Blowing Snow	000S(949) HFHWY00227	**Safety/Experimental Feature**	100,560	25,140	**125,700**
				TOTAL	**2,134,623**

11 POOLED FUNDED PROJECTS DOT&PF PARTICIPATED IN FFY2021 USING 100% FEDERAL SP&R FUNDS, PART B (NO STATE FUNDS):

Title	FHWA Project #	Category	Current $ Project Funding (100% federal)
Aurora (FY20-24)	TPF-5(290)	ITS	*25,000
Avalanche Research	TPF-5(337)	Maintenance	*25,000
Roadside Safety Research for MASH Implementation	TPF-5(343)	Safety	*25,000
Clear Roads Phase II	TPF-5(353)	Maintenance & Operations	25,000
Road Usage Charge West	TPF-5(451)	Finance	25,000
Developing and Calibrating Fragmental Rockfall Models using Physics Engines	TPF-5(459)	Geology	30,000
Unpaved Road: A Research Collaboration to Determine Crash Causation and Countermeasures	Solicitation 1419	Safety	**15,000
Assessment and Repair of Pre-Stressed Bridge Girders Subjected to Over-Height Truck Impacts	TPF-5(462)	Bridge	45,000
Connected Vehicles	TPF-5(389)	ITS	25,000
NCHRP Dues- ALASKA	TPF-5(415)	National Dues	351,999
TRB Core Program Services for a Highway RD&T Program – Federal FY 2020/TRB FY 2021	TPF-5(378)	National Dues	121,336
		Total	**713,335.00**

FY21 contribution sent in prior fiscal year(s), not included in FFY21 total*

Solicitation withdrawn, not included in FFY21 total**

ACTIVE PROJECTS STARTED PRIOR TO FFY2021

8 ACTIVE PROJECTS STARTED IN FFY2020 USING SP&R FUNDS-PART B AND STATE MATCH:

Title	FHWA Project # State Project #	Category	Federal $	State $	Total $ Project Funding
Low Temp Perform Friction Pendulum Bearing Inundated w/ice	4000(197) HFHWY00181	BRIDGE	240,000	60,000	300,000
Evaluation of Liquefaction-Induced Lateral Spread	4000(200) HFHWY00198	GEOTECHNICAL	114,152	28,538	142,690
Optimized Decked Bulb-Tee Girder for Alaska	4000(202) HFHWY00201	BRIDGE	221,664	55,416	277,080
LED Traffic Signal Luminance	4000(203) HFHWY00202	TRAFFIC	203,655	50,913	254,569
Unmanned Aerial Systems Business Model Assessment for DOT&PF	000S(938) HFHWY00207	INNOVATION	120,000	30,000	150,000
Framework for Culvert Asset Management in Alaska	000S(937) HFHWY00208	HYDROLOGY	115,865	28,966	144,832
Mini Road Weather Information Systems Pilot Project	000S(936) HFHWY00204	INNOVATION	89,987	22,497	112,484 (+$31,425 FFY21)
Urban Workzone User Impacts (AC from FFY21)	000S(948) HFHWY00226	TRAFFIC	100,000	25,000	125,000

6 ACTIVE PROJECTS STARTED IN FFY2019 USING SP&R FUNDS-PART B AND STATE MATCH:

Title	FHWA Project # State Project #	Category	Federal $	State $	Total $ Project Funding
Portland Cement Treatments in Locations with Poor Embankment Material	000S(920)	Materials	104,000	26,000	125,000
Synthesis of Best Practices for Design and Construction of Roadways and Airports over Permafrost	000S(927) HFHWY00154	Cold Region	107,389	26,847	134,237
RCFST to Cap-Beam GSS Connection	4000(195) 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

5 ACTIVE PROJECTS STARTED IN FFY2018 USING SP&R PART B FUNDS & STATE MATCH:

Title	FHWA Project # State Project #	Category	Federal $	State $	Total $ Project Funding
Minnesota Drive Ramp Microsurfacing Experimental Feature Monitoring	40000(181) HFHWY00123	Materials	100,000	25,000	125,000
Using Unmanned Aerial Systems to Augment Monitoring Aufeis Directly Under Bridges in Alaska	4000(182) HFHWY00124	Bridges and Structures	120,000	30,000	150,000

Rapid Repair of Column to Footing Phase 2	4000(184) HFHWY00125	Bridges and Structures	224,000	56,000	280,000
Improved Permafrost Protection using Air Convection and Ventilated Shoulder Cooling Systems	4000(185) HFHWY00126	Geotechnical & Foundations	113,140	28,285	141,425
Evaluation of Light Pole Foundation Embedment	4000(186) HFHWY00129	Geotechnical & Foundations	200,000	50,000	250,000

2 ACTIVE PROJECTS STARTED IN FFY2017 USING SP&R PART B FUNDS & STATE MATCH:

Title	FHWA Project # State Project #	Category	Federal $	State $	Total $ Project Funding
NHS Innovative Pavement Design Research for Pavement Management System	4000174 HFWY00077	Materials & Construction	120,000	30,000	150,000
Pre-stressed Losses in Decked Bulb Tee Girders	4000(178) HFHWY00081	Bridges & Structures	280,000	70,000	350,000

7 PROJECTS COMPLETED IN FFY2021 –PENDING FINANCIAL CLOSURE

Title	DOT&PF Project #	Federal Project #	Total $ Project Funding
FFY 19/20 Research Administration	HFHWY00133	4000(189)	135,000 +35,000 (FFY2020)
FFY19/20 Research & Technology Deployment	HFHWY00134	4000(190)	150,000
Next Generation Project Selection Criteria	NFHWY00443	4000(193)	125,000
Portland Cement Treatments in Locations with Poor Embankment Material	HFHWY00151	000S(920)	125,000
Roads and Airfields Construction on Permafrost-	HFHWY00154	000S(927)	

A Synthesis of Practice			
Steel Fiber Rubberized Concrete Material Monitoring Experimental Feature	HFHWY00049	4000(165)	62,500
Precipitation Projections for Alaska	HFHWY00132	4000(188)	270,000

DESCRIPTIONS FOR NEW PROJECT STARTS AND ACTIVE PROJECTS DURING FFY21

ADMINISTRATION & POLICY

000S945/ HFHWY00223 RESEARCH DEPLOYMENT FFY21-22

Principal Investigator: DOT&PF
Funding: $157,125
Project Manager: Anna Bosin, P.E.
Estimated Completion: December 2022

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.

4000207/ HFHWY00222 RESEARCH ADMINISTRATION FFY21-22

Principal Investigator: DOT&PF
Funding: $157,125
Project Manager: Anna Bosin, P.E.
Estimated Completion: December 2022

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.

BRIDGES & STRUCTURES

4000184 RAPID REPAIR OF COLUMN TO FOOTING PHASE 2

Principal Investigator: Dr. Mervyn Kowalsky (NC State)
Funding: $280,000
Project Manager: Shane Moller
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.

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

Principal Investigator: Dr. Mervyn Kowalsky, Giorgio Proestos (NC State)
Funding: $400,000
Project Manager: Shane Moller
Estimated Completion: June 2023

The purpose of this research is to develop Accelerated Bridge Construction connections for Reinforced Concrete Filled Steel Tube (RCFST) 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.

4000182 USING UNMANNED AERIAL SYSTEMS (UAS) TO AUGMENT MONITORING AUFEIS DIRECTLY UNDER BRIDGES IN ALASKA

Principal Investigator: UAF
Funding: $150,000
Project Manager: Shane Moller
Completion: December 2021

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.

4000200 EVALUATION OF LIQUEFACTION-INDUCED LATERAL SPREAD FROM RECENT ALASKA EARTHQUAKES

Principal Investigator: Joey Yang (UAA)
Funding: $142,690
Project Manager: Andrew Pavey
Estimated Completion: December 2022

The objective of this study is to evaluate how the free-field lateral spread can be different for the Alaskan conditions, and how the pinning effects of abutments can be modeled when the crust is frozen.

Benefits to the State:
Recommend an empirical model and modification factor for lateral spread estimation for frozen ground conditions. Develop a framework and simple model for assessing the pinning effects of bridge abutments for frozen ground conditions.

4000201 OPTIMIZED DECKED BULB-TEE GIRDERS FOR ALASKA

Principal Investigator: Dr. Mervyn Kowalsky, Ranji Ranjithan, (NC State)
Funding: $277,080
Project Manager: Shane Moller
Estimated Completion: January 2023

Over the last 10 years, bridge girder cross sections have become regional in nature, with many state DOTs adopting their own unique sections at either the state or regional level. Historically, such cross sections were developed without any consideration of an ‘optimized shape’, or if optimization was employed, it was done so for girders without a deck. The objective of this research is to develop an optimized deck girder cross section with a new shape using meta-heuristic global optimization techniques. It is envisioned that several different competing cross section alternatives that perform well structurally and economically will be first identified. Alternatives will be screened based on practical considerations to identify one new cross-section shape.

Benefits to the State:
Potential benefits to the department include the ability to span longer distances, reduced construction time, and more efficient use of resources.

BRIDGES & STRUCTURES CONT.

4000197 LOW TEMPERATURE PERFORMANCE FRICTION PENDULUM BEARING INUNDATED WITH ICE

Principal Investigator: Keri Ryan (UNR)
Funding: $300,000
Project Manager: Shane Moller
Estimated Completion: December 2022

Friction pendulum bridge bearings at certain locations in Alaska are known to fill with water and freeze during the winter months. The presence of ice in the cavity of the isolator could obstruct the movement of the bearing during an earthquake. This would result in increased base shear in the bearing which is potentially damaging to the bridge superstructure and foundation. The objective of this study will be to determine, experimentally, the lateral force required to displace a base isolator that is replete with ice produced from rainwater or roadway runoff. The lateral force may be correlated to the expected seismic base shear of an in-service bridge.

Benefits to the State:
The results will allow engineers to gauge the severity of this problem and if it can be accounted for in engineering analysis; can be mitigated with maintenance practices; or will require repair or replacement of bridge components.

4000206 UAV BRIDGES AND STRUCTURES CONDITION INSPECTION

Principal Investigator: Anand Puppala, Surya Sarat Chandra Congress, (Texas A&M Transportation Institute)
Funding: $186,319
Project Manager: Shane Moller.
Estimated Completion: June 2023

Research tasks to address the safe and effective use of Unmanned Aerial Vehicle platform for performing routine bridge, tower, and public facility inspections. Tasks included are to develop UAV test protocols, supplement ten bridges, one high mast tower, and two public facility buildings inspections and rating surveys, determine what size or types of structures warrant the use of UAVs, and create a minimum specification for the hardware, software, UAV, and associated accessories that needed for inspections.

Benefits to the State: This research could minimize the risk and danger associated with manually inspecting structures and allow for response inspection on structures in emergency situations such as earthquakes, floods, or slope failures that would otherwise be unsafe. This research could also allow for the ability to identify defects in large structures that might otherwise not be seen until the defect has grown or become problematic.

4000205 SEISMIC BEHAVIOR OF HIGH STRENGTH REINFORCING STEEL AT LOW TEMPERATURES

Principal Investigator: Dr. Mervyn Kowalsky, Lina Espinosa, (NC State)
Funding: $368,720
Project Manager: Shane Moller
Estimated Completion: December 2024

This research is to study the impact of low temperatures on the seismic behavior of columns reinforced with A706 Grade 80 and 100 steel. This will be accomplished through the use of the Buckled Bar Tension test and large scale column tests, both conducted at low temperatures at the NC State Constructed Facilities Laboratory, as well as computational modelling of columns (and bridge systems) using stress-strain models and section hysteretic behavior observed during the conduct of the experiments.

Benefits to the State: Application of high strength steel can potentially reduce the steel content in structures which results in more easily and quickly built structures and can also reduce overall costs.

Jesse Escamilla testing out autonomous 3D Scan software with Skydio X2 in Juneau/ Ryan Marlow, DOT&PF

ENVIRONMENTAL

4000198 FISH PASSAGE CULVERT SLIP LINER RESEARCH

Principle Investigator: Department of Fish and Game
Funding: $130,000
Project Manager: Shane Moller
Estimated Completion: December 2022

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.

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.

GEOTECHNICAL

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

Principal Investigator: UAF
Funding: $141,425
DOT&PF Project Manager: Anna Bosin, P.E.
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 thermosiphon cooling features.

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

4000186 EVALUATION OF LIGHT POLE FOUNDATION EMBEDMENT

Principal Investigator: Joshua Steelman, University Nebraska Lincoln
Funding: $250,000
DOT&PF Project Manager: Anna Bosin, P.E.
Estimated Completion: December 2023

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.

HFHWY00151 MONITORING AND ANALYSIS OF FROZEN DEBRIS LOBES PHASE II

Principal Investigator: Margaret Darrow (UAF)
Funding: $339,650
Project Manager: Shane Moller
Estimated Completion: December 2022

Frozen debris lobes (FDLs) are landslides in permafrost located along the Dalton Highway corridor. The closest to the highway, FDL-A, has demonstrated a steadily increasing rate of movement which resulted in the realignment of the Dalton Highway in 2016. Based on movement trends, it is anticipated that FDL-A will impact the old embankment by 2021.

The collision of FDL-A with the old embankment represents a unique opportunity to observe a landslide impacting infrastructure in a safe and controlled way and on a predictable schedule.
The objective of this study is to measure the pressure this moving landmass imparts to the embankment, and how the FDL deforms the existing embankment.

Benefits to the State:
The results of this study will help DOT&PF to develop mitigation measures that may slow or stop the movement of landslides in permafrost that threaten critical infrastructure.

Installing sensor equipment- Dalton Highway- Shane Moller, DOT&PF

HYDROLOGY & HYDRAULICS

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: Anna Bosin, P.E.
Estimated Completion: December 2022

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.

4000937 FRAMEWORK FOR CULVERT ASSET MANAGEMENT IN ALASKA

Principal Investigator: Ken Karle (Hydraulics Mapping and Modeling)
Funding: $145,000
Project Manager: Anna Bosin, P.E.
Estimated Completion: December 2022

Hydraulics engineers collect culvert data on a project by project basis. The information collected is stored in different formats, and in different locations which is not available for program planning or project design. This project will develop a framework for an Alaska specific culvert asset management program and calculate a return on that investment. The goal of this project is to provide tools to engineers to assist in program planning, including options for condition rating, deterioration modeling, and life cycle planning to be established in the new Maintenance Management System.

Benefits to the State: Develop a template for culvert inventory, work activities, and cost in the Maintenance Management Systems. Establish life cycles for culverts from different regions and a deterioration model for each region.

MATERIALS & CONSTRUCTION

4000174 NHS INNOVATIVE PAVEMENT DESIGN RESEARCH FOR PAVEMENT MANAGEMENT SYSTEM

Principal Investigator: DOT&PF
Funding: $150,000
Project Manager: Andrew Pavey
Completed December 2021

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.

4000181 EXPERIMENTAL FEATURE MINNESOTA DRIVE RAMP MICROSURFACING MONITORING

Principal Investigator: DOT&PF
Funding: $125,000
Project Manager: Andrew Pavey
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.

SAFETY & TRAFFIC

4000203 LED TRAFFIC SIGNAL LUMINOSITY STUDY

Principal Investigator: Vinod Vasudevan
Funding: $254,569
Project Manager: Anna Bosin, P.E.
Estimated Completion Date: October 20222

Light-emitting diodes (LEDs) started replacing incandescent lamps in traffic signal heads approximately 15 years ago. Incandescent lamps normally provide the amount of light required by regulations until they burn out. In contrast, LEDs degrade over time and may appear working by having color output while the luminosity may fall below regulations. The objective of this research is to carry out a life-cycle analysis and reconnaissance of the "degradation rate" of LED traffic lights in Alaska.

Benefits to the State: Based on the findings, create new recommended re-lamping schedule eligible for FHWA participation. Evaluate LED performance at first re-lamping interval.

000S944 EQUIPMENT VISIBILITY IN SUB-ARCTIC WINTER CONDITIONS

Principal Investigator: John Clendenin
Funding: $50,000
Project Manager: Anna Bosin, P.E.
Estimated Completion Date: October 2022

Sub-arctic winter conditions create a series of variables making snow removal equipment very difficult for motorists to see in the active roadway. The combination of long duration low-light levels, near white-on-white contrast of ground and sky, and routine inversion causing vehicle emissions to remain at ground level make it very difficult for motorists to see lighting and beacons on heavy equipment. There are many rear-end accidents every year where privately owned vehicles run into the back of DOT&PF heavy equipment performing snow removal.

Benefits to the State: Improved equipment lighting can increase visibility for operators to perform operations while also increasing visibility to motorists. Improved equipment lighting may also reduce collisions, resulting in a reduced loss of State assets, less equipment down time, higher productivity, and fewer third party tort claims.

000S949 LEFT-SIDE DELINEATION FOR BLOWING SNOW

Principal Investigator: Shane Moller
Funding: $125,700
Project Manager: Anna Bosin, P.E.
Estimated Completion Date: June 2023

Alaska's mainline highways traverse long distances with varying terrain between communities. In areas dominated by tundra, ground blizzards can pop up with no warning as there is no vegetation to block blowing snow. Communities in these areas are few and far between and communications are often limited to CB radio between vehicles. The Dalton Highway is most prevalent location where ground blizzards occur.

Using white delineators on both the right a left side of two lane rural roadways is a requirement of the Manual on Uniform Traffic Control Devices. However, in areas that experience ground blizzards and other blowing snow events as well as dense fog, it can be difficult for drivers to discern the right side from the left side white delineators.

Benefits to the State: Easy to perceive delineation is imperative to getting people, goods, and services safely to their destinations as well as protecting the environment from spills associated with trucks running off the road.

000S948 URBAN WORK ZONE USER IMPACTS

Principal Investigator: Kinney Engineering LLC
Funding: $125,000
Project Manager: Anna Bosin, P.E.
Estimated Completion Date: December 2023

Projects in urban settings need an easy to use, repeatable, and unbiased decision making tool to assist in the evaluation of road closures and lane restrictions to balance impacts to drivers (delay and safety), local access, work zone safety and construction schedules.

Benefits to the State: potential to be applied to make roadway construction and work zones more efficient to safe construction costs and improve network efficiency for the traveling public.

INNOVATION

000S936 MINI ROAD WEATHER INFORMATION SYSTEMS PILOT PROJECT

Principal Investigator: Billy Connor
Funding: $112,484
Project Manager: Alicia Stevens
Estimated Completion Date: June 2022

This pilot project will test small, lower cost "mini-RWIS" stations using alternative power options: low-power cameras and sensors, solar panels, battery banks, and cell or satellite communications technologies. DOT&PF M&O has identified 5 sites in each of the Northern and Central regions and will choose 4 of the 5 locations in each region to test the equipment. Campbell Scientific will install the equipment above ground on signposts within DOT&PF ROW.

Benefits to the State: Mini-RWIS data and equipment will be analyzed by UAF over two winter seasons to determine if the technology is successful for northern winter applications used by DOT&PF M&O.

000S938 UNMANNED AERIAL SYSTEMS BUSINESS MODEL ASSESSMENT FOR DOT&PF

Principal Investigator:
Funding: $150,000
Project Manager: Anna Bosin, P.E.
Estimated Completion Date: September 2022

Imagery and Survey data collection through small unmanned aerial systems (SUAS) is becoming increasingly efficient and accurate in the planning, design, construction, and maintenance of transportation infrastructure. The technology is advancing rapidly, and current efforts to augment surveying activities have demonstrated significant potential to reduce survey timeframes and costs while acquiring accurate and useful data. The majority of the survey work utilizing SUAS has been project specific demonstrations. This project will evaluate current state-of-practice SUAS camera data processing methods, conduct a formal analysis of ground control and air control methods to determine best practices for quality control and assurance of datasets, research and verify accuracy of using artificial light from unmanned platform for nighttime photogrammetry, and develop training materials to document data processing work flows.

Benefits to the State: Leveraging SUAS and imagery processing technologies has added the ability to do small site remote sensing on state interests such as highways, airports, and material sites. Time is saved by gaining valuable data that gets used by various users for land survey, civil design, and planning. To optimize the benefit of this it is important to both use time as efficiently as possible while also gaining the best possible information.

000S946 ALASKA CONNECTED AND AUTONOMOUS VEHICLE STRATEGIC PLAN

Principal Investigator: Kittelson & Associates, Inc.
Funding: $99,983.88
Project Manager: Anna Bosin, P.E.
Completed: November 2021

Literature review of other state DOT's connected and autonomous vehicle (CAV) planning progress, and produce an Alaska customized CAV research roadmap and business plan (strategic plan) for DOT&PF. The project provided presentations to the CAV working group to gather input on the plans. Final deliverable is final report with CAV strategic plan.

Benefits to the State: CAV is developing at a fast pace among industry leaders and researchers. A final report with a strategic plan and roadmap would identify pilot studies, technological needs, and funding options that may address the cost/benefit of advancing vs. status quo. Readiness is known to reduce costs by optimizing time and solutions over political decisions made in haste.

4000113 EXPERIMENTAL FEATURES

Principal Investigator: Varies
Funding: $207,800
Project Manager: Carolyn Morehouse
Completion Date: 12/31/2022

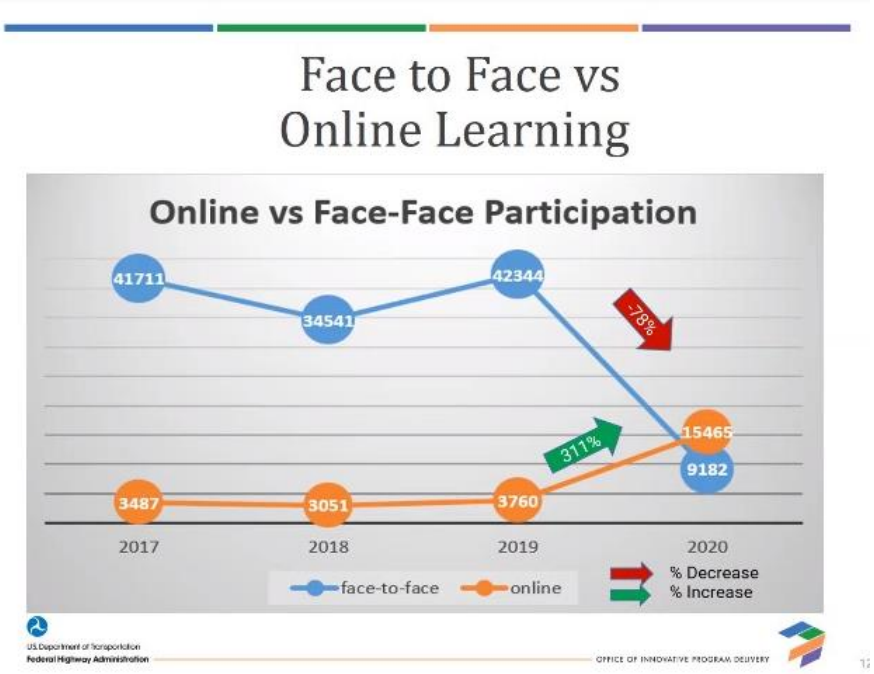
Experimental features incorporated into highway projects under this program are eligible for federal funding participation, which is normally limited to more proven and conventional items. Another advantage of the program is that if an experimental feature fails, FHWA will financially participate for 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 stand-alone projects.

ALASKA TECHNOLOGY TRANSFER

Housed within DOT&PF's RD&T2 Section, the Technology Transfer training staff (T2) provide resources and 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 for Alaska's transportation workforce development.
COVID-19 remained a safety concern for training delivery in FFY21. Instead of in-person classroom trainings, DOT&PF focused on virtual instruction as well as field trainings.

FFY 2021 PROGRAM DASHBOARD

- Total number of classroom training sessions: 0 **(COVID restrictions still in place)**
- Total number of on-line courses completed: **15**
- Total number of LTAP students who participated in trainings: **52**

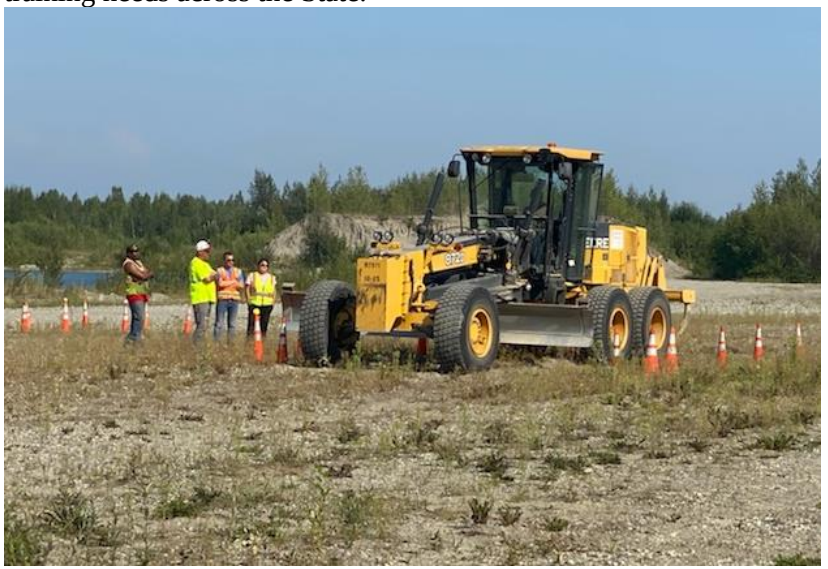


LOCAL TECHNICAL ASSISTANCE PROGRAM

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, outreach among agencies and governments
- Newsletters, tech briefs, online library
- Bring national trainings to Alaska

In fall 2021, DOT&PF reclassified the Training Specialist II to the LTAP Coordinator position located in Anchorage. A new LTAP Coordinator was hired in December 2020 to emphasize the LTAP training needs across the State.



LTAP Grader Operator Training. Summer, 2021 Photo:DOT&PF

NATIONAL HIGHWAY INSTITUTE

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: planning, design, construction, and maintenance personnel working for Alaska's transportation infrastructure.

T2 HIGHLIGHTS FFY2021

- On-going management/delivery of the ATSSA and Alaska CESCL training programs.
- Participation and outreach related to STIC & EDC program.
- Heavy Equipment Operator Training held in 5 locations across state: trained 25 LTAP students