# Alaska Department of Transportation & Public Facilities

## Research, Development & Technology Transfer


# Annual Report 2014

# Research Development and Technology Transfer
# 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 (ADOT&PF) provides research management, library, technical assistance, training, and technology deployment services to ADOT&PF, local transportation agencies, and their partners.

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

This is a report of the research, development, and technology transfer activities carried out by the ADOT&PF and its partners. This report covers federal fiscal year 2014, beginning October 1, 2013, and ending September 30, 2014.

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# Table of Contents



**Program Summaries**
Fiscal Summary……. 1
Research Funding Distribution & Acronyms…..……..... 2
Research Projects Programmed in FFY 2014…….. 3
Research Active Projects FFY 2008 – FFY 2013…… 4
Research Projects Completed During FFY 2014……. 7
Project Costs……. 9

**Research & T2 Projects…….** 14

**Administration & Policy**
T2-06-08 Optimizing Implementation of Civil Rights Requirements for Vessel Construction…….. 15
T2-12-20 Improving Engineering Education Delivery…… 16
T2-12-22 ADOT&PF Leadership Academy Development……. 16
T2-13-03 Transportation Asset Management Program…… 16
T2-13-20 Enhancing Research & Technology Deployment through Program Recording…….. 17
T2-13-21 Improving Excellence Workshop…… 17
T2-14-18 AASHTOWare Investigation…….. 17

**Alaska Marine Highway System**
T2-08-08 The Response of Pile-Guided Floats Subjected to Dynamic Loading…… 18
T2-09-03 Load Environment of Washington State Ferry and Alaska Marine Highway Landings…… 18
T2-10-13 Selecting Preservatives for Marine Structural Timbers in Herring Spawning Areas……. 19
T2-12-16 Cordova Sectional Barge Study……. 19

**Bridges & Structures**
T2-08-02 Plastic Strain Limits for Reinforced Concrete…… 20
T2-10-05 Ductility of Welded Steel Columns to Cap - Part II……... 20
T2-11-08 Structural Health Monitoring and Condition Assessment of Chulitna River Bridge……. 22
T2-12-12 Investigation of High-Mast Light Pole Anchor Bolts…….. 23
T2-13-11 Reinforced Concrete Filled Pipe Piles in Soils…… 23
T2-14-06 Experimental Feature – Spray Applied MMA Bridge Deck Waterproofing Membrane……. 24
T2-14-09 Seismic Load Path Effects in RC Bridge Columns……. 25
T2-14-17 Seismic Repair of Reinforced Concrete Bridge Structures……. 25

**Environmental**
T2-11-13 Alaska Bald Eagles and Highway Construction Projects…… 26
T2-12-23 Assessment of Implementation of SAFETEA-LU Section 6004…… 26
T2-14-13 Underwater Pile Driving Noise Study…… 26

# Table of Contents



**Geotechnical and Foundations**
T2-10-04 Phase II: Development of an Unstable Slope Management Program Research…….. 27
T2-12-01 FY 11 CTIP Unstable Slope Management Program (USMP), WFL……... 27
T2-12-15 Use of Lidar to Evaluate Slope Safety……. 28
T2-12-21 Geotechnical Asset Management Program…….. 28
T2-12-24 Geophysical Investigation at Mile 9 Dalton Highway…… 29
T2-13-07 Expedient Permafrost Resistivity Investigation…….. 29
T2-13-08 Unstable Slope Management - Phase II…….. 30
T2-13-12 Long Term Monitoring of Ice-Rich Cut Slopes at Dalton Highway MP 9……. 30
T2-13-18 Geotechnical Asset Management - Stage II…… 31
T2-14-11 GAM through Thermal Modeling of Highway Embankments for Dalton Highway Reconstruction Projects……... 31
T2-14-14 Haines Highway Debris Flow Source Study……... 32

**Hydraulics & Hydrology**
T2-12-11 Estimating Future Flood Frequency and Magnitude in Basins Affected by Glacier Wastage…… 33

**Maintenance & Operations**
T2-10-12 Performance of Dust Palliatives on Unpaved Roads in Rural Alaska……. 34
T2-11-06 Field-Evaluating of Crack Sealing of Asphalt Concrete Pavements in Alaska…… 34
T2-11-07 Develop Locally Sourced Salt Brine Additive for Anti-icing…….. 35
T2-12-07 Whittier Tunnel Signal System Investigation…….. 36
T2-12-13 Maintenance Decision Support System (MDSS)……. 37
T2-13-09 Testing & Screening Surfacing Materials for Alaska's Yukon River Bridge…….. 37

**Materials & Construction**
T2-06-04 Experimental Features: Sasobit And Foamed Warm Mix Asphalt Techniques…….. 38
T2-08-16 Application of a Nontraditional Soil Stabilization Technology: Lab Testing of Geofibers and Synthetic Fluid……... 39
T2-10-01 Foamed Warm Mix Asphalt Lab Testing: Experimental Features in Highway Construction…… 39
T2-10-11 Stabilization of Erodible and Thawing Permafrost Slopes with Geofibers and Synthetic Fluid……. 40
T2-11-02 Geosynthetic Design Guidelines and Construction Specifications Review & Update…… 41
T2-11-11 Economic Impact of Fines in the Unbound Pavement Layers……. 41
T2-12-05 Video Documenting Best Practices for Mitigating Frost Damage to Transportation Infrastructure…… 42
T2-13-02 Development of GPS Survey Data Management Protocols and Policy……... 43
T2-13-10 Tencati Wicking Fabric Design…… 43
T2-13-13 Evaluate Presawn Transverse Thermal Cracks…… 44
T2-13-14 Wicking Fabric Design Specification…….. 44
T2-13-17 Evaluation Low Temperature Pavement Cracking…….. 45

# Table of Contents



T2-13-19 Polyester Concrete For Approach Slabs……. 46
T2-14-05 Experimental Feature – Fiber Reinforced Ploymer Composites for Culvert Repair…….. 46
T2-14-08 Revisions to the Alaska Flexible Pavement Design Software…… 47
T2-14-12 Characterization of Alaska Hot-Mix Asphalt containing Reclaimed Asphalt Pavement (RAP)…… 47
T2-14-15 Fly Ash through Rapid Research…… 48

**Safety & Traffic**
T2-12-18 Review of Power Sources for Alaska DOT Road Weather Information Systems, Phase I……. 49
T2-12-19 A Design for an Interface Board between a MRC Thermistor Probe and a Personal Computer……. 49
T2-08-13 Frequency and Potential Severity of Red Light Running in Anchorage…….. 50
T2-12-10 Whittier Tunnel Operations Study…… 50
T2-12-14 Improving Passing Lane Safety and Efficiency for Alaska's Rural Non-Divided Highways…….. 51
T2-13-01 Flashing Yellow Arrow Public Information Campaign…… 51
T2-13-15 Value of Depressed Medians on Divided Highways in Alaska…… 52
T2-13-16 Optimizing Highway Patrol Investment Levels……... 53
T2-14-07 Experimental Feature – Wavetronix® Radar Traffic Detection……... 54
T2-14-16 Modeling Passing Lane Behavior on Two-Lane Highways……. 54

**Supplemental Research & Technology Program**
T2-11-17 Rapid Research Response FFY 2014……..….. 55
T2-11-18 Research & Deployment FFY 2014……..…… 56
T2-11-19 Experimental Features FFY 2014…….……. 57
Pooled Fund Studies FFY 2014……. 58

**Alaska Technology Transfer**
Local Technical Assistance Program……..…… 59
National Highway Institute……..…… 59
T2-13-06 Rapid Technology Transfer…… ……..……... 59

# Fiscal Summary

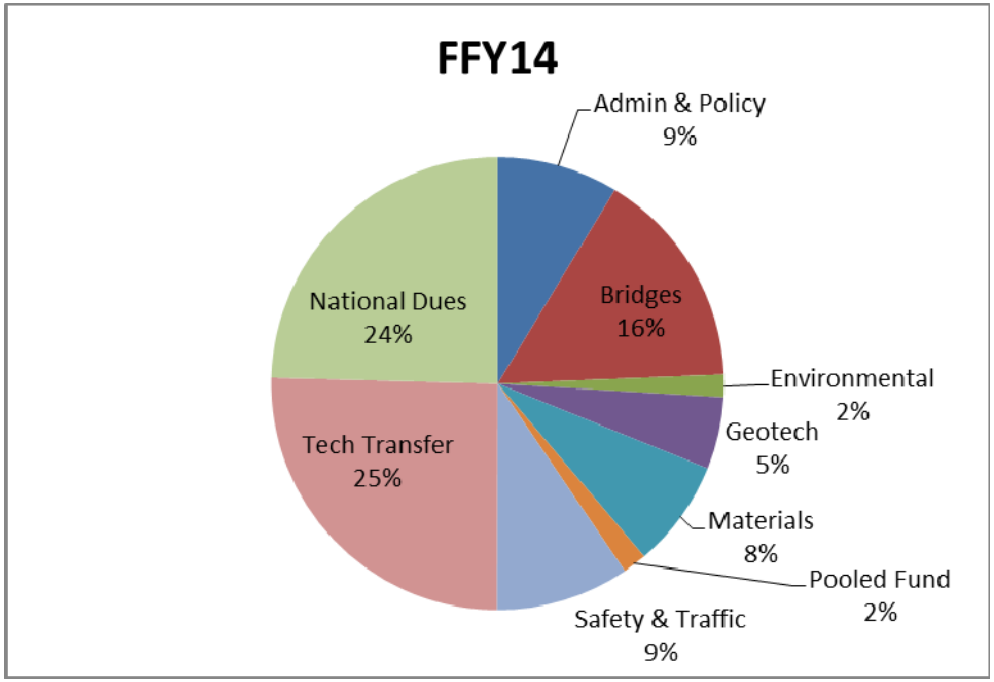


RD&T2 received funding from the Federal Highway Administration's (FHWA) State Planning and Research Program (SP&R), Local Technical Assistance Program (LTAP), Surface Transportation Program (STP), and state matching funds (SM). Additionally, RD&T2 leverages funding with the Alaska University Transportation 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

| FFY 2014 RD&T2 Fiscal Summary | | 2014 |
|---|---|---|
| **Revenues** | | |
| SP&R Program Funds (STIP ID#6451) | $ | 2,066,084 |
| USDOT IRT Program Grant | $ | 0 |
| SHRP2 Offset from Planning | $ | 750,000 |
| NHI Funds (STIP ID#6452) | $ | 350,000 |
| State Funds | $ | 105,000 |
| Local Technical Assistance Program (State$) | $ | 300,000 |
| Reinvested Project Closures | $ | 470,000 |
| **Total** | **$** | **4,041,084** |
| **Expenditures & Obligations** | | |
| NCHRP Dues | $ | 507,575 |
| TRB Core Services | $ | 100,983 |
| SHRP2 Contributions | $ | 384,526 |
| Pooled Fund Studies | $ | 69,000 |
| Technology Transfer / Training | $ | 1,025,000 |
| Research Project (old projects increases) | $ | 179,000 |
| Research Project Programming (New Obligations) | $ | 1,775,000 |
| **Total** | **$** | **4,041,084** |

## Research Funding Distribution in FFY14

| *Research Funding Distribution Category* | *Total* |
|---|---|
| Administration & Policy | $350,000 |
| Alaska Marine Highway System | $0 |
| Bridges & Structures | $634,000 |
| Environmental | $65,000 |
| Geotechnical & Foundations | $208,000 |
| Hydraulics & Hydrology | $0 |
| Maintenance & Operations | $0 |
| Materials & Construction | $311,000 |
| Pooled Fund Studies | $69,000 |
| Safety & Traffic | $386,000 |
| Technology Transfer Training (LTAP, Rapid Technology Transfer & NHI) | $1,025,000 |
| TRB, NCHRP & SHRP2 Contributions | $993,084 |
| Grand Total (17 Projects Programmed) | $4,041,084 |




### Acronyms

| | |
|---|---|
| ADOT&PF | Alaska State Department of Transportation & Public Facilities |
| AUTC | Alaska University Transportation Center |
| CRREL | Cold Regions Research & Engineering Laboratory |
| FHWA | Federal Highway Administration |
| GF | General Fund (State of Alaska) |
| LTAP | Local Technology Assistance Program |
| M&O | Maintenance & Operations |
| MSU | Montana State University |
| NCHRP | The National Cooperative Highway Research Program |
| NCSU | North Carolina State University |
| NHI | National Highway Institute |
| PacTrans | Pacific Northwest Transportation Consortium |
| RD&T2 | Research, Development & Technology Transfer |
| SHRP | Strategic Highway Research Program 2 |
| SP&R | (FHWA) State Planning & Research |
| STIP | Statewide Transportation Improvement Program |
| STP | (FHWA) Surface Transportation Program |
| TRB | Transportation Research Board |
| UAA | University of Alaska Anchorage |
| UAF | University of Alaska Fairbanks |
| UofI | University of Idaho |
| WTI | Western Transportation Institute |

# Fiscal Summary



**17 New Projects Starts in FFY2014 using SP&R Funds unless noted**
**Total = $1,775,000**

| Title | T2 Project # | AKSAS Project # | Category | Total Current Project Funding |
|---|---|---|---|---|
| Rapid Technology Transfer Program | T2-14-01 | 76550 | Training & TechTransfer | $375,000 |
| Technology Transfer Program CY2014 (LTAP) | T2-14-02 | 63993 | Training & TechTransfer | $300,000 |
| National Highway Institute (NHI) CY2014 | T2-14-03 | 63990 | Training & TechTransfer | $350,000 |
| Rapid Research Response FFY 2014-16<br>Behavioral Analysis of Existing Passing<br>(support for T2-14-16) | T2-14-04 | 64006 | Safety&Traffic | $11,000 |
| Fiber Reinforced Polymer Composites for Culvert Linings | T2-14-05 | 64315 | Materials & Construction | $ 25,000 |
| Spray Applied MMA Bridge Deck Waterproofing Membrane | T2-14-06 | 64317 | Bridges & Structures | $29,000 |
| Wavetronic Radar Detection through Experimental Features | T2-14-07 | 64321 | Safety & Traffic | $35,000 |
| Revisions to the Alaska Flexible Pavement Design Software | T2-14-08 | N/A | Materials & Construction | $105,000 (State) |
| Seismic Load Path Effects in RC Bridge Columns | T2-14-09 | 64203 | Bridges & Structures | $365,000 |
| Geotechnical Asset Management Thermal Modeling | T2-14-11 | 64230 | Geotech & Foundations | $145,000 |
| Characterization of Alaska Hot-Mix Asphalt containing Reclaimed Asphalt Pavement (RAP) | T2-14-12 | 64234 | Materials & Construction | $155,000 |
| Underwater Pile Driving Noise Study | T2-14-13 | 64236 | Environmental | $65,000 |
| Haines Debris Flow Source Study | T2-14-14 | 64238 | Geotech & Foundations | $63,000 |
| Rapid Research Response FFY 2014-16<br>Fly Ash Mix Design | T2-14-15 | 64006 | Materials & Construction | $26,000 |
| Modeling Passing Lane Behavior on Two Lane Highways | T2-14-16 | 83980 | Safety & Traffic | $340,000 |
| Seismic Repair of Reinforced Concrete Bridge Substructures | T2-14-17 | 83974 | Bridges & Structures | $240,000 |
| AASHTOWare Investigation | T2-14-18 | 83988 | Administration & Policy | $350,000 |

| 42 Active Research Projects Started FFY2006 - FFY2013 Table 1/3 | | | | |
|---|---|---|---|---|
| Title | T2 Project # | AKSAS Project # | Category | Total Current Project Funding |
| Plastic Strain Limits for Reinforced Concrete | T2-08-02 | 60855 | Bridges & Structures | $300,000 (SP&R) |
| Application of a Nontraditional Soil Stabilization Technology: Lab Testing of Geofibers and Synthetic Fluid | T2-08-16 | 60932 | Materials & Construction | $200,000 (State) |
| Foamed Warm Mix Asphalt Lab Testing: Experimental Features in Highway Construction | T2-10-01 | 61072 | Materials & Construction | $29,986 (SP&R) |
| Phase II: Development of an Unstable Slope Management Program Research | T2-10-04 | 63440 | Geotechnical & Foundations | $1,150,000 (STIP) |
| Stabilization of Erodible and Thawing Permafrost Slopes with Geofibers and Synthetic Fluid | T2-10-11 | 63707 | Materials & Construction | $132,000 (SP&R) |
| Performance of Dust Palliatives on Unpaved Roads in Rural Alaska | T2-10-12 | 63701 | Maintenance & Operations | $40,000 (SP&R)<br>$40,000 (AUTC) |
| Geosynthetic Design Guidelines and Construction Specifications Review & Update | T2-11-02 | 76174 | Materials & Construction | $73,500 (GF) +<br>$16,000 (SP&R) |
| Structural Health Monitoring and Condition Assessment of Chulitna River Bridge | T2-11-08 | 60742 | Bridges & Structures | $ 203,000 (SP&R)<br>+280,000 (SP&R) |
| Financial Impact of Fines in the Unbound Pavement Layers | T2-11-11 | 60642 | Materials & Construction | $90,000 (SP&R) |
| Deployment FFY 2012-FFY 2014 | T2-11-18 | 61085 | Main Funding Categories-subprojects individually listed in table | $778,396 (SP&R)<br>$251,458 spent |
| Experimental Features FFY2012-FFY2014 | T2-11-19 | 61105 | | $500,000 (SP&R)<br>$231,000 Spent |
| FY 11 CTIP Unstable Slope Management Program (USMP), WFL | T2-12-01 | 54270 | Geotechnical & Foundations | $80,000 Western Federal Lands |
| Whittier Tunnel Signal System Investigation | T2-12-07 | 61862 | Maintenance & Operations | $150,000 (SP&R) |

| 42 Active Research Projects Started FFY2006 - FFY2013 Table 2/3 | | | | |
|---|---|---|---|---|
| Title | T2 Project # | AKSAS Project # | Category | Total Current Project Funding |
| Whittier Tunnel Operations Study | T2-12-10 | 61908 | Safety & Traffic | $150,000 (SP&R)<br>+50,000 (SP&R) |
| Estimating Future Flood Frequency and Magnitude in Basins Affected by Glacier Wastage | T2-12-11 | 61923 | Hydraulics & Hydrology | $80,000 (SP&R)<br>$15,000 (depl) |
| Investigation of High-Mast Anchor Bolts | T2-12-12 | 61925 | Safety & Traffic | $80,000(SP&R) |
| Maintenance Decision Support System (MDSS) | T2-12-13 | 80839 | Maintenance & Operations | $225,000 (SP&R) |
| Improving Passing Lane Safety and Efficiency for Alaska's Rural Non –Divided Highways | T2-12-14 | 61965 | Safety & Traffic | $60,000 (SP&R)<br>$60,000 (AUTC) |
| Use of LiDAR to Evaluate Slope Safety | T2-12-15 | 61972 | Planning & Design | $115,000 (SP&R) |
| Rapid Research: Cordova Section Barge Study | T2-12-16 | 60533<br>LC300830 | Alaska Marine Highway | $45,000 (SP&R) |
| Review of Power Sources for Alaska DOT RWIS, Phase 1 | T2-12-18 | 62084 | Safety & Traffic | $40,000 (SP&R) |
| Improving Engineering Education Delivery, Phase 1 | T2-12-20 | 62133 | Administration & Policy | $30,000 (SP&R)<br>$30,000 (AUTC) |
| Geotechnical Asset Management Program | T2-12-21 | 80900 | Geotechnical & Foundations | $1,933,055 (STIP) |
| DOT&PF Leadership Academy | T2-12-22 | 62131 | Administration & Policy | $80,000 (SP&R) |
| Development of GPS Survey Data Management Protocols and Policy | T2-13-02 | 61085 | Materials & Construction | $10,000 (SP&R) |
| Transportation Asset Management Program | T2-13-03 | 80880 | Administration & Policy | $1,333,078 (STIP) |
| LTAP Technology Transfer Program (LTAP) | T2-13-04 | 62407 | Training & TechTransfer | $300,000 (SP&R) |
| NHI National Highway Institute | T2-13-05 | 62404 | Training & TechTransfer | $350,000 (SP&R) |

| 42 Active Research Projects Started FFY2006 - FFY2013 Table 3/3 | | | | |
|---|---|---|---|---|
| Title | T2 Project # | AKSAS Project # | Category | Total Current Project Funding |
| Rapid Technology Transfer | T2-13-06 | 76550 | Technology Transfer Training | $100,000 (State) |
| Unstable Slope Management - Phase II | T2-13-08 | 62467 | Geotechnical and Foundations | $1,700,000 (STIP) |
| Testing & Screening Surfacing Materials for Alaska's Yukon River Bridge | T2-13-09 | 60533 | Bridges & Structures | $137,000 (SP&R)<br>$50,000 (M&0) |
| Tencati Wicking Fabric Design | T2-13-10 | 61105 | Materials & Construction | $35,000 (SP&R) |
| Reinforced Concrete Filled Pipe Piles in Soils | T2-13-11 | 62725 | Bridges & Structures | $330,000 (SP&R) |
| Long Term Monitoring of Ice-Rich Cut Slopes at Dalton Highway MP 9 | T2-13-12 | 61105 | Geotechnical and Foundations | $40,000 (SP&R) |
| Evaluate Presawn Transverse Thermal Cracks | T2-13-13 | 63031 | Materials & Construction | $75,000 (SP&R) |
| Wicking Fabric Design Specification | T2-13-14 | 63041 | Materials & Construction | $125,000 (SP&R) |
| Value of Depressed Medians on Divided Highways in Alaska | T2-13-15 | 63039 | Safety & Traffic | $150,000 (SP&R) |
| Optimizing Highway Patrol Investment Levels | T2-13-16 | 63068 | Safety & Traffic | $100,000(SP&R) |
| Evaluation Low Temperature Pavement Cracking | T2-13-17 | 60533 | Materials & Construction | $8,000 (SP&R) |
| Geotechnical Asset Management - Stage II | T2-13-18 | 63076 | Geotechnical and Foundations | $80,000 STIP |
| Experimental Feature: Polyester Concrete For Approach Slabs | T2-13-19 | 61105 | Materials & Construction | $51,000 (SP&R) |
| Enhancing Research & Technology Deployment through Program Recording | T2-13-20 | 61085 | Administration & Policy | $30,000 (SP&R)<br>Spent $5,000 |
| Improving Quality Workshop | T2-13-21 | 61085 | Administration & Policy | $30,000 (SP&R)<br>$30,000 (AUTC) |

| 18 Projects Started FFY2006 - FFY2013 and closed in FFY14 Table 1/2 | | | | |
|---|---|---|---|---|
| Title | T2 Project # | AKSAS Project # | Category | Total Current Project Funding |
| Experimental Feature: Sasobit and Foamed Warm Mix Asphalt Techniques | T2-06-04 | 61072 | Materials & Construction | $64,000(Const.)<br>$70,000(SP&R) |
| Optimizing Implementation of Civil Rights required for Vessel Construction | T2-06-08 | 62905 | Administration & Policy | $55,000 (SP&R) |
| The Response of Pile-Guided Floats Subjected to Dynamic Loading | T2-08-08 | 60945 | Alaska Marine Highway | $100,000 (SP&R) |
| Frequency and Potential Severity of Red Light Running in Anchorage | T2-08-13 | 60973 | Safety & Traffic | $ 200,000 (SP&R)<br>$ 22,947 Spent |
| Load Environmental of Washington State Ferry and Alaska Marine Highways Landings | T2-09-03 | 63280 | Alaska Marine Highway | $107,000 (SP&R) |
| Ductility of Welded Steel Column to Cap, Part II | T2-10-05 | 63695 | Bridge & Structures | $180,000(SP&R) |
| Selecting Preservatives for Marine Structural Timbers in Herring Spanning Areas | T2-10-13 | 63707 | Alaska Marine Highway | $77,534 (SP&R) |
| Field-Evaluating of Crack Sealing of Asphalt Concrete Pavements in Alaska | T2-11-06 | 60600 | Maintenance & Operations | $90,000 (SP&R) |
| Develop Locally Sourced Salt Brine Additive for Anti-icing | T2-11-07 | 60595 | Maintenance & Operations | $140,000 (SP&R) |
| Alaska Bald Eagles and Highway Construction Projects | T2-11-13 | 60579 | Environmental | $50,000 (SP&R) |
| Video Documenting Best Practices for Mitigating Frost Damage to Transportation Infrastructure | T2-12-05 | 61085 | Materials & Construction | $15,000 (SP&R) |
| Rapid Research Response: A Design for an Interface Board between a MRC Thermistor Probe and a Personal Computer | T2-12-19 | 60533 | Safety & Traffic | $30,000 (SP&R) |
| DOT&PF Leadership Academy | T2-12-22 | 62131 | Administration & Policy | $80,000 (SP&R) |
| Assessment of Implementation of SAFETEA-LU Section 6004 | T2-12-23 | 62129 | Administration & Policy | $80,000 (SP&R)<br>$0 Spent |

| 18 Projects Started FFY2006 - FFY2013 and closed in FFY14 Table 2/2 | | | | |
|---|---|---|---|---|
| Title | T2 Project # | AKSAS Project # | Category | Total Current Project Funding |
| Geophysical Investigation at Mile 9 Dalton Highway (Rapid Response FFY 12-14) | T2-12-24 | 60533 | Geotechnical & Foundations | $23,000 (SP&R) |
| Flashing Yellow Arrow Public Information Campaign | T2-13-01 | 61085 | Safety & Traffic | $25,000 (SP&R) |
| Expedient Permafrost Resistivity Investigation (Rapid Response FFY 12-14) | T2-13-07 | 60533 | Geotechnical & Foundations | $68,000 (SP&R) |
| Enhancing Research & Technology Deployment through Program Recording | T2-13-20 | 61085 | Administration & Policy | $30,000 (SP&R) |

Fiscal Year in Review

The Research & T2 section began 17 projects during FFY 14. This added to the already 60 active research and T2 projects started between FFY06 through FFY13. Eighteen of those 60 projects were closed in FFY14 for a total of 42 active projects. Sixteen of these 42 projects are in the final stage of publishing final report or financial closure with FHWA.

The following five tables include project names and costs and are included to show increases and decreases to the initial research projects.

| Project Cost Table 1/5 | | | | | |
|---|---|---|---|---|---|
| **T2#** | **AKSAS #** | **Current Projects** | **Initial Obligation** | **Program thruFFY14** | **Change** |
| T2-06-04 | 61072 | Experimental Feature: Sasobit and Foamed Warm Mix Asphalt Techniques | $70,000 | $70,000 | $0 |
| T2-06-08 | 62905 | Optimizing Implementation of Civil Rights Requirements for Vessel Construction | $55,000 | $55,000 | $0 |
| T2-08-02 | 60855 | Plastic Strain Limits for Reinforced Concrete | $300,000 | $300,000 | $0 |
| T2-08-08 | 60946 | The Response of Pile-Guided Floats Subjected to Dynamic Loading | $100,000 | $100,000 | $0 |
| T2-08-13 | 60973 | Frequency and Potential Severity of Red Light Running in Anchorage | $200,000 | $22,947 | ($177,053) |
| T2-08-16 | 60932 | Application of a Nontraditional Soil Stabilization Technology: Lab Testing of Geofibers and Synthetic Fluid* | $200,000 | $200,000 | $0 |
| T2-08-18 | 60932 | Lifecycle Bridge Costs* | $150,000 | $150,000 | $0 |
| T2-09-03 | 63280 | Load Environment of Washington State Ferry and Alaska Marine Highway Landings | $107,000 | $107,000 | $0 |
| T2-10-01 | 61072 | Experimental Feature: Sasobit and Foamed Warm Mix Asphalt Techniques | $70,000 | $70,000 | $0 |
| T2-10-04 | 63440 | Phase II: Development of an Unstable Slope Management Program Research | $600,000 | $600,000 | $0 |
| T2-10-05 | 60945 | Ductility of Welded Steel Column to Cap, Part II | $180,000 | $180,000 | $0 |
| T2-10-11 | 63707 | Stabilization of Erodible and Thawing Permafrost Slopes with Geofibers and Synthetic Fluid | $132,000 | $132,000 | $0 |
| T2-10-12 | 63701 | Performance of Dust Palliatives on Unpaved Roads in Rural Alaska | $40,000 | $40,000 | $0 |
| T2-10-13 | 63703 | Selecting Preservatives for Marine Structural Timbers in Herring Spawning Areas | $72,000 | $77,437 | $5,437 |

| Project Costs Table 2/5 | | | | | |
|---|---|---|---|---|---|
| **T2#** | **AKSAS #** | **Current Projects** | **Initial Obligation** | **Program thruFFY14** | **Change** |
| T2-11-02 | 76174 | Geosynthetic Design Guidelines and Construction Specifications Review & Update | $89,500 | $89,500 | $0 |
| T2-11-06 | 60600 | Field-Evaluating of Crack Sealing of Asphalt Concrete Pavements in Alaska | $90,000 | $90,000 | $0 |
| T2-11-07 | 60595 | Develop Locally Sourced Salt Brine Additive for Anti-icing | $153,000 | $153,000 | $0 |
| T2-11-08 | 60742 | Structural Health Monitoring and Condition Assessment of Chulitna River Bridge | $203,000 | $483,000 | $280,000 |
| T2-11-11 | 60642 | Economic Impact of Fines in the Unbound Pavement Layers | $90,000 | $90,000 | $0 |
| T2-11-13 | 60579 | Alaska Bald Eagles and Highway Construction Projects | $50,000 | $10,000 | ($40,000) |
| T2-12-01 | 54270 | FY 11 CTIP Unstable Slope Management Program (USMP), WFL | $80,000 | $60,000 | ($20,000) |
| T2-12-05 | 61085 | Video Documenting Best Practices for Mitigating Frost Damage to Transportation Infrastructure | $20,958 | $20,958 | $0 |
| T2-12-07 | 61862 | Whittier Tunnel Signal System Investigation | $150,000 | $150,000 | $0 |
| T2-12-10 | 61908 | Whittier Tunnel Operations Study | $150,000 | $200,000 | $50,000 |
| T2-12-11 | 61923 | Estimating Future Flood Frequency and Magnitude in Basins Affected by Glacier Wastage | $80,000 | $95,000 | $15,000 |
| T2-12-12 | 61925 | Investigation of High-Mast Anchor Bolts | $80,000 | $80,000 | $0 |
| T2-12-13 | 80839 | Maintenance Decision Support System (MDSS) | $225,000 | $225,000 | $0 |
| T2-12-14 | 61965 | Improving Passing Lane Safety and Efficiency for Alaska's Rural Non –Divided Highways | $60,000 | $60,000 | $0 |
| T2-12-15 | 61972 | Use of Lidar to Evaluate Slope Safety | $115,000 | $115,000 | $0 |

| Project Costs Table 3/5 | | | | | |
|---|---|---|---|---|---|
| **T2#** | **AKSAS #** | **Current Projects** | **Initial Obligation** | **Program thruFFY14** | **Change** |
| T2-12-16 | 60533 | Rapid Research: Cordova Section Barge Study | $45,000 | $45,000 | $0 |
| T2-12-18 | 62084 | Review of Power Sources for Alaska DOT RWIS, Phase 1 | $40,000 | $40,000 | $0 |
| T2-12-19 | 60533 | Rapid Research Response: A Design for an Interface Board between a MRC Thermistor Probe and a Personal Computer | $30,000 | $30,000 | $0 |
| T2-12-20 | 62133 | Improving Engineering Education Delivery, Phase 1 | $30,000 | $30,000 | $0 |
| T2-12-21 | 63076 | Geotechnical Asset Management - Stage II | $80,000 | $80,000 | $0 |
| T2-12-22 | 62131 | DOT&PF Leadership Academy Development | $50,000 | $50,000 | $0 |
| T2-12-23 | 62129 | Assessment of Implementation of SAFETEA-LU Section 6004 | $80,000 | $0 | ($80,000) |
| T2-12-24 | 60533 | Geophysical Investigation at Mile 9 Dalton Highway (Rapid Response FFY 12-14) | $23,000 | $23,000 | $0 |
| T2-13-01 | 61085 | Flashing Yellow Arrow Public Information Campaign | $25,000 | $25,000 | $0 |
| T2-13-02 | 61085 | Development of GPS Survey Data Management Protocols and Policy | $10,000 | $10,000 | $0 |
| T2-13-03 | 80880 | Transportation Asset Management Program | $1,333,078 | $1,333,078 | $0 |
| T2-13-04 | 62407 | LTAP Technology Transfer Program (LTAP) | $300,000 | $300,000 | $0 |
| T2-13-06 | 76550 | Rapid Technology Transfer* | $100,000 | $100,000 | $0 |
| T2-13-07 | 60533 | Expedient Permafrost Resistivity Investigation | $68,000 | $68,000 | $0 |
| T2-13-08 | 62467 | Unstable Slope Management - Phase II | $1,700,000 | $1,700,000 | $0 |

| Project Costs Table 4/5 | | | | | |
|---|---|---|---|---|---|
| **T2#** | **AKSAS #** | **Current Projects** | **Initial Obligation** | **Program thruFFY14** | **Change** |
| T2-13-09 | 60533 | Testing & Screening Surfacing Materials for Alaska's Yukon River Bridge | $112,000 | $112,000 | $0 |
| T2-13-10 | 61105 | Tencati Wicking Fabric Design | $30,000 | $30,000 | $0 |
| T2-13-11 | 62725 | Reinforced Concrete Filled Pipe Piles in Soils | $330,000 | $330,000 | $0 |
| T2-13-12 | 61105 | Long Term Monitoring of Ice-Rich Cut Slopes at Dalton Highway MP 9 | $30,000 | $40,000 | $10,000 |
| T2-13-13 | 63031 | Evaluate Presawn Transverse Thermal Cracks | $75,000 | $83,000 | $8,000 |
| T2-13-14 | 63041 | Wicking Fabric Design Specification | $125,000 | $125,000 | $0 |
| T2-13-15 | 63039 | Value of Depressed Medians on Divided Highways in Alaska | $150,000 | $150,000 | $0 |
| T2-13-16 | 63068 | Optimizing Highway Patrol Investment Levels | $100,000 | $100,000 | $0 |
| T2-13-17 | 60533 | Evaluation Low Temperature Pavement Cracking | $8,000 | $8,000 | $0 |
| T2-13-18 | 63076 | Geotechnical Asset Management - Stage II | $80,000 | $0 | ($80,000) |
| T2-13-19 | 61105 | Polyester Concrete For Approach Slabs | $51,000 | $51,000 | $0 |
| T2-13-20 | 61085 | Enhancing Research & Technology Deployment through Program Recording | $30,000 | $5,000 | ($25,000) |
| T2-13-21 | 61085 | Improving Quality Workshop | $40,000 | $40,000 | $0 |
| T2-14-01 | 76550 | Rapid Technology Transfer Program | $375,000 | $375,000 | $0 |
| T2-14-02 | 63993 | Technology Transfer Program CY2014 (LTAP) | $300,000 | $300,000 | $0 |
| T2-14-03 | 63990 | National Highway Institute (NHI) CY2014 | $350,000 | $350,000 | $0 |

| Project Costs Table 5/5 | | | | | |
|---|---|---|---|---|---|
| **T2#** | **AKSAS #** | **Current Projects** | **Initial Obligation** | **Program thruFFY14** | **Change** |
| T2-14-04 | 64006 | Rapid Research Response FFY 2014-16 Passing Behavior monitoring | $11,000 | $11,000 | $0 |
| T2-14-05 | 61105 | Fiber Reinforced Polymer Composites for Culvert Linings | $25,000 | $25,000 | $0 |
| T2-14-06 | 61105 | Spray Applied MMA Bridge Deck Waterproofing Membrane - Experimental Feature | $29,000 | $29,000 | $0 |
| T2-14-07 | 61105 | Wavetronic Radar Detection through Experimental Features | $35,000 | $35,000 | $0 |
| T2-14-08 | none | Revisions to the Alaska Flexible Pavement Design Software | $105,000 | $105,000 | $0 |
| T2-14-09 | 64203 | Seismic Load Path Effects in RC Bridge Columns | $365,000 | $365,000 | $0 |
| T2-14-11 | 64230 | Geotechnical Asset Management Thermal Modeling | $145,000 | $145,000 | $0 |
| T2-14-12 | 64234 | Characterization of Alaska Hot-Mix Asphalt containing Reclaimed Asphalt Pavement (RAP) | $155,000 | $155,000 | $0 |
| T2-14-13 | 64236 | Underwater Pile Driving Noise Study | $65,000 | $65,000 | $0 |
| T2-14-14 | 64238 | Haines Debris Flow Source Study | $63,000 | $63,000 | $0 |
| T2-14-15 | 64006 | Rapid Research Response FFY 2014-16 -Fly Ash Mixture | $26,000 | $26,000 | $0 |
| T2-14-16 | 64006 | Modeling Passing Lane Behavior on Two Lane Highways | $340,000 | $340,000 | $0 |
| T2-14-17 | 83974 | Seismic Repair of Reinforced Concrete Bridge Substructures | $240,000 | $240,000 | $0 |
| T2-14-18 | 83988 | AASHTOWare Investigation | $350,000 | $350,000 | $0 |

# FFY14 Projects

## T2-06-08 Optimizing Implementation of Civil Rights Requirements for Vessel Construction

Principal Investigator: E. W. Morris & Associates, Inc.
Funding: $55,000 (SP&R)
Project Manager: Lauren M. Little, P.E.
Report Published August 2014; Project Closed FFY14

This research examines practice in other states with ferry systems and how they implement the Disadvantaged Business Enterprise (DBE), On the Job Training (OJT) and Equal Opportunity Requirements for contracting using both FTA and FHWA funds. These contracts do not adapt well to out of state contractors using in-state goals.

**Benefits to the State:** The goal of the research is to develop improved bid and contract specifications and a plan to effectively implement DBE requirements of 49 CFR 26 and the ADOT&PF's federally approved DBE program.

## T2-12-20 Improving Engineering Education Delivery – Phase I

Principal Investigator: Dr. Robert A Perkins, P.E.
Funding: $30,000 (SP&R) + $30,000 (AUTC)
Project Manager: Carolyn Morehouse, P.E.
Report Published June 2014; Closed FFY15

Review academic literature on non-traditional teaching techniques and materials, evaluate these techniques in the classroom, and partner with universities and other state Departments of Transportation on academic curriculum development and delivery.

**Benefits to the State:** Study of alternative methods for learning including web based training, video conferencing, recorded training sessions and information packages for producing transportation engineering modules.

## T2-12-22 DOT&PF Leadership Academy Development

Principal Investigator: Dr. Robert A. Perkins, P.E., Dr. Lawrence Bennett, P.E.
Funding: $80,000 (SP&R)
Project Manager: Carolyn Morehouse, P.E.
Report Published June 2014; Closed FFY14

Investigate the feasibility of developing a cohesive series of training experiences for the Department of Transportation & Public Facilities personnel to prepare them for leadership roles appropriate to their level of responsibility. The research will include literature review, interviews with expert organizations, curriculum, development, assessment, and evaluation.

**Benefits to the State:** System for implementing a leadership development program for technical skills which includes mentoring, skills assessment, training and tracking progress.

## T2-13-03 Transportation Asset Management

Principal Investigator: Cambridge Systematics, Inc.
Funding: $1,333,078
Project Manager: Carolyn Morehouse, P.E.
Estimated completion date March 2015

This research project was established to have an outside entity make recommendations for planning and implementing a Transportation Asset Management System and Data Solution an Asset Management program in the Department.
The research project's scope consists of the following thirteen tasks: 1) Create Work Plan; 2) Document and Assess all Federal Requirements and Associated Research; 3) Research Other State Best Practices; 4) Stakeholder Coordination; 5) Evaluate Current Systems and Extent of Integration (Existing Condition); 6) Develop ADOT&PF TAMIS Framework (Desired Condition); 7) TAMIS Gap Analysis; 8) Research TAMIS System Model Alternatives; 9) Research Recommendations for TAMIS; 10) Develop and Conduct a Project Communication Plan; 11) Data Business Plan for TAMIS; 12) Develop a Proof of Concept for TAMIS Application; and 13) Draft a Data manual and data registry.

**Benefits to the State:** This project will result in improved data management for the department. The recommendations will lead the department toward creating a system that all employees can easily use and for the department to maintain. It will strengthen the ability of data programs to support core business functions of the department. It will improve the data quality throughout the organization and protect data by treating it as an asset of the agency and limit the risks associate with the loss of data and information or making decisions using poor quality data. Short term benefits include the drafting of a data and information technology policy and procedure and associated manuals. Cambridge will also do an asset management maturity assessment that will help in drafting our TAM Plan for FHWA.

## T2-13-20 Enhancing Research & Technology Deployment through Program Recording

Principal Investigator: Patrick Casey (CTC & Associates, LLC)
Funding: $30,000 SP&R (spent $5,000)
Project Manager: Carolyn Morehouse, P.E.
Completion Date: January 2014

RD&T2 section DOT&PF exists to facilitate the identification, development, and deployment of research results and beneficial technologies in order to improve the delivery of transportation systems and services in Alaska. Federal and state regulations require annual reporting of the activities of the RD&T2 section. This is a subproject of Deployment FFY12-14.

**Benefits to the State:** The ADOT&PF Research Advisory Board asked RD&T2 to identify improved reporting efforts to, if possible, increase effectiveness in promoting deployment and awareness of the section's activities within the ADOT&PF.

## T2-13-21 Improving Quality Workshop

Principal Investigator: Billy Connor (UAF – AUTC)
Funding: $40,000 SP&R + ($40,000 AUTC)
ADOT&PF Project Manager: Carolyn Morehouse, P.E.
Completion Date: June 2015

**Benefits to the State:** This collaborative project supports and promotes a partnership with the Alaska University Transportation Center (AUTC) to identify and promote additional opportunities for the partnership to support ADOT&PF's core value of Improving Quality as defined in its "Strategic Plan". Both agencies intend to use this project to enhance communication and coordination amongst stakeholders of the DOT&PF Research, Development & Technology Transfer Section and the Alaska University Transportation Center.


## 83988 AASHTOWare Investigation

Principal Investigator:
Funding: $350,000 SP&R
Project Manager: Carolyn Morehouse, P.E.
Completion Date: December 2016

AASHTOWare is software packaged designed for transportation agencies. The software allows for automating processes during the planning, design and construction of a project. Test and evaluate AASHTOWare modules to determine if DOT&PF should implement statewide. Use project information from each region to evaluate pros and cons for a transition to AASHTOWare from the 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 and it can replace BidTab which is the current historical prices database.

## T2-08-08 The Response of Pile-Guided Floats Subjected to Dynamic Loading

Principal Investigator: Dr. Andrew Metzger (UAA & AUTC)
Funding: $100,000 (SP&R)
Project Manager: Janelle White
Volume I&II Published August 2014; Closed FFY14

Pile-guided floats are docks that boats and other sea vessels attach to so both ship and dock can move as water levels vary. Pile-guided floats provide an alternative to stationary docks.

ADOT&PF is considering using floating piers at certain stops along the Alaska Marine Highway System (AMHS). These ocean ports are subject to daily tide height changes. The floats also undergo other forces, such as wind, waves and the weight of cargo and people as ships load and unload.

There is little design information available concerning how dynamic loading will affect the floats. This project will develop a rational basis for estimating the dynamic response of floating pile-guided structures.

Researchers will develop a model for two different systems. Both models will include functions that represent wave action and vessel loading over time. At the project's end, AMHS and ADOT&PF will have a validated and ready-to-implement model with good design criteria for both floats and guide-piles.

**Benefits to the State:** This detailed understanding of the forces acting on pile-guided floats will result in better designs which avoid under and overdesigning. The resulting designs will be more economical with increased longevity.

## T2-09-03 Load Environment of Washington State Ferry and Alaska Marine Highway Landings

Principal Investigator: Dr. Andrew Metzger (UAA & AUTC)
Funding: $107,000 (SP&R)
Project Manager: Lauren M. Little, P.E.
Report Published April 2014; Closed FFY14

As Pacific commerce and travel grow, docking structures become more important from both an economic and public safety standpoint—especially as new shipping lanes are created by melting trends in northern waters. This project's goal is to mitigate uncertainty about load demands on ferry landing structures. The lack of information about the magnitude of these loads or how they may be determined forces design engineers to make assumptions. These assumptions can lead to costly over-engineering.

While the structures used by AMHS and WSFS have fundamental differences, the metrics needed to determine appropriate design criteria are the same. The instruments used to monitor these facilities are also similar. This presents an opportunity for a cost-sharing project in which ADOT&PF and Washington State DOT are able to have a cooperative research project and benefit from a much more comprehensive project than either might be able to support individually. The project should hopefully strengthen ties in an already integrated system.

The project team acquired a robust statistical sample of the metrics needed to define the design criteria. The data collected resulted in updated design criteria for AMHS engineers.

**Benefits to the State:** This project will improve the design parameters for docking structures making them safer. It also promotes interstate cooperation, sharing resources and technology for mutual benefits.

## T2-10-13 Selecting Preservatives for Marine Structural Timbers in Herring Spawning Areas

Principal Investigator: Dr. Robert A. Perkins (UAF & AUTC)
Funding: $77,534 (SP&R)
Project Manager: Lauren M. Little, P.E.
Report Published April 2014; Closed FFY14

Marine harbors and docking facilities are a central piece of Alaska's commerce, trade, and tourism industries. They are key travel conduits in vast regions of the state that lack connected inland roads. Alaska marine harbors use wood for many structures that come in contact with salt water, including piles, floats, and docks. It is economical to buy and maintain.

The problem is that wood immersed in salt water is prone to attack by marine borers—various types of marine invertebrates that can destroy a wood structure in only a few years.
Only two wood preservatives are currently recommended for use in Alaska's waters—ACZA (ammoniacal copper zinc arsenate) and creosote; both have side-effects. ACZA is a water-based preservative that leaches copper, which is toxic to both marine invertebrates and other species, into the marine environment. Creosote, an oil-based preservative made from coal tar, leaches hydrocarbon chemicals into the water.

Previous research indicates that copper leaching from ACZA is slight after a year or so, while creosote leaches polycyclic aromatic hydrocarbons (PAH) at a declining rate over time, but is still measurable after many years. Previous researchers had difficulty narrowing their searches to these two preservatives because harbors are frequently contaminated with many other chemicals. Determining how these wood preservatives alone impact marine life over time is difficult.

This study tested the toxicity of marine structural preservatives to herring eggs under a variety of conditions common in Alaska marine waters, focusing on Southeast Alaska. It also compared the durability of creosote-versus ACZA-treated marine timbers under comparable climatic and service conditions. Results indicated that there is no significant difference between ACZA and creosote with regard to herring egg toxicity. ACZA should not be used for submerged glulam however.

**Benefits to the State:** Research results will help structural engineers and other marine specialists make better-informed choices about wood preservatives that are both economical and environmentally sound.

## T2-12-16 Rapid Research Response: Cordova Sectional Barge Study

Principal Investigator: Dr. Andrew Metzger, (UAA & AUTC)
Funding: $45,000 (SP&R)
Project Manager: Carolyn Morehouse, P.E.
Completion Date: *Waiting for final report from AUTC*

This project will assist ADOT&PF's engineers evaluate the effectiveness & accuracy of the structural design for pile-guided floats for the ferry landing in Cordova.

**Benefits to the State:** This research will improve or validate structural designs and plans for ferry landings on the Alaska Marine Highway System.

## T2-08-02 Plastic Strain Limits for Reinforced Concrete

Principal Investigator: Dr. Mervyn J. Kowalsky (NCSU)
Funding: $300,000 (SP&R)
Project Manager: Janelle White
Waiting for final report

ADOT&PF's bridge design engineers are challenged by many unknowns when designing reinforced concrete transportation structures to withstand Alaska's seismic loads. They must utilize concrete and steel strain limit states that have minimal experimental or theoretical basis. And while the strain limits that are typically utilized attempt to account for cyclic loading, there is no current basis for their selection. Furthermore, the strain limits typically proposed do not consider the effects of temperature. Lastly, while strain limits that occur early in the non-linear range are well established, the strain limits which define maximum structural capacity are less well defined.

The objectives of this research project are to propose strain limit states that account for low temperature effects and regional seismic load histories, and to develop an approach to allow ADOT&PF bridge design engineers to easily relate proposed strain limits to target displacements for design.

This project involves the use of analytical, numerical, and physical modeling to investigate plastic strain limits used for designing reinforced concrete structures. For typical ADOT&PF reinforced concrete circular column sections, the researchers are studying the role that load history plays on the selection of strain limits for key performance limit states such as serviceability, damage control, maximum load, and collapse. A determination will then be made if the strain limits are affected by seismic load history and temperature. Consideration of these criteria will be made in order to recommend strain limits and how the limits can be utilized for displacement-based seismic design of bridges to achieve pre-defined levels of seismic performance under pre-defined levels of seismic hazard typical for Alaska.

**Benefits to the State:** The researchers will provide design recommendations and examples of application for both a force-based approach (current practice) and a displacement-based approach. It is anticipated that a workshop will also be conducted at the conclusion of this project that will transfer knowledge and assist the ADOT&PF to improve the safety and reliability of Alaskan bridges.

## T2-10-05 Ductility of Welded Steel Columns to Cap, Part II

Principal Investigator: Dr. Mervyn J. Kowalsky (NCSU, UAF & AUTC)
Funding: $180,000 (SP&R)
Project Manager: Angela Parsons, P.E.
Report Published Dec 2013: Closed FFY14

This research was a continuation of a project that investigated bridge and marine structure design practices, aiming to identify improved connection design approaches to produce the necessary ductility and energy absorbing capacities required for satisfactory designs in Alaska.

Through earlier testing, the researchers not only proved what methods were inadequate (such as the current practice of fillet-

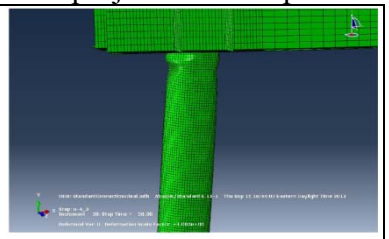
welding the cap beam to the pile as well as alternative welding methods) but also confirmed that a new method of using a plastic hinge-relocating concept was more successful. This method utilized a round steel column capital in which the top portion welded to the cap beam is thicker than the bottom thinner portion welded to the pile. The approach successfully reduced the inelastic demands of the cap beam weld, and forced the inelastic action to occur in the pile itself.

This second phase of the research involved optimizing the new design to improve displacement capacity and ductility, and investigated additional connection designs proposed by ADOT&PF engineers. To do so, the concept of modified weld protected connections was developed based on capacity design principles. The concept was aimed at developing connection configurations that would improve the seismic capacity of steel pier systems by relocating damage in the pile elements away from critical welded regions in addition to strengthening critical welded regions to remain in the elastic range of response. Three such connection configurations were developed with two being shown to fulfill both key criteria.

**Benefits to the State:** The research result in design recommendations in regards to standard welded connections, modified weld protected connections, and the ductility capacity of systems utilizing a composite connection configuration. The results of this research are anticipated to lead to design methods for piles that will make them more durable and resistant to damage from shaking. These design improvements are targeted at improving the performance of steel bridges and marine structures containing these connections while achieving improved lifespan and less maintenance.

**Photos:** In order to recommend improvements to ADOT&PF's design of standard welded connections for bridge and marine structures, NCSU researchers used a variety of experimental methods including large-scale quasi – static experimental testing, scaled dynamic shake table experimental testing, and analytical (computer simulation) investigations.
Illustrations extracted from the research project's final report.

Figure 6.216 Scaled Steel Pier with Mass Block System on Shake Table



## T2-11-08 Structural Health Monitoring and Condition Assessment of Chulitna River Bridge

Principal Investigator: Dr. J. Leroy Hulsey (UAF & AUTC)
Funding: $483,000 (SP&R)
Project Manager: Angela Parsons, P.E.
Phase 1 published August 2014; Waiting for Phase 2 report

Bridge safety and performance are national transportation priorities. The purpose of this research project is to select and test an innovative structural health monitoring (SHM) technology and protocol for bridges in cold, remote locations. The project is intended to help the ADOT&PF improve the maintenance and repair of bridge structures, and to extend their service lives.

The research team is studying the Chulitna River Bridge which is located near Milepost 133 on the Parks Highway. This bridge is regularly used by heavy overload vehicles, and is an essential link in the safe and efficient movement of people and commerce within Alaska. In 2011 a load rating and structural assessment of this bridge found that although the bridge inspected well, it rated more poorly than expected and recommended it for further analysis using a SHM system.

The first phase of this research involved selecting, configuring, installing, and testing an optimal SHM instrumentation and protocol for use on this bridge, with an eye toward extending this approach to bridges throughout Alaska. The data provides reliable information to improve decision-making about timely maintenance, repair, and closure needs.

The second phase of the project includes collaboration between structural engineering faculty at the University of Alaska (AUTC) and Washington State University (PacTrans) with the aim to use the SHM system to better understand the bridge's response to known loads, and predict future performance.

The research tasks in this phase include continuing monitoring of the sensors to determine if the girders are over stressed under standard highway loads and permit vehicles, monitoring critical members and providing real-time alerts when sensing systems approach or exceed established limits, and creation of Finite Element models for estimating and evaluating the current condition and condition changes of the bridge structure response to static and dynamic loading.

**Benefits to the State:** More effective bridge structural health monitoring (SHM) systems can provide structural response data, enable development of improved decision-making tools, conform and augment visual assessment, improve inspection credibility and subsequent load rating, assist transportation asset management efforts in assessing long-term bridge performance, optimize inspection schedules, maintenance schedules and dollars, and increase structure reliability. Improving safety performance by providing more reliable information quickly on the structural health of any monitored bridge, the system will provide a new safety and management tool along with monitoring capabilities that complement traditional bridge inspection methods

**Photos:** *Load testing of the Chulitna River Bridge's newly installed SHM system. Photo credit AUTC.*

## T2-12-12 Investigation of High-Mast Light Pole Anchor Bolts

Principal Investigator: Dr. Scott Hamel
Funding: $80,000 (SP&R)
Project Manager: Anna Bosin, P.E.
Final Report Published October 2014; Closed FFY15

The goal of this project is to reduce the risk of a high-mast light pole failure due to the inability to maintain proper tightness of the anchor bolt nuts at the base of ADOT&PF's high-mast light poles. Research tasks include observing, measuring, and modeling the structural behavior of these fastening systems. The researchers will characterize the potential failure modes and recommend implementable actions to correct current installations and properly design future installations.

Two high-mast light poles on the Glenn Highway near Anchorage are being studied. The researchers modified standard anchor rods by drilling out and bonding strain gages into the center, and then connected them to a computer controlled data acquisition system to monitor during standard tightening procedure and for longer term ambient conditions. Preliminary findings show that several of the anchor rods yielded during the FHWA tightening procedure including establishing a snug-tight condition followed by 60 degrees of turn-of-the-nut method. The researchers note that the snug tightened fasteners for large diameter fasteners with short grip lengths are likely to exceed the recommended snug tight pretension range. However, if the degree of rotation in the turn-of-nut method was varied with the grip length/bolt diameter ratio, in addition to the existing recommendations about bolt diameter and grade, then final bolt pretensions may be more likely to fall within the desired range.

**Benefits to the State:** Increased safety and reliability of high-mast lighting structures in Alaska and reduced maintenance costs associated with currently necessary monitoring and tightening procedures.

## T2-13-11 Reinforced Concrete Filled Pipes in Soils

Principal Investigator: Billy Connor, P.E. & Dr. Mervyn J. Kowalsky (NCSU, UAF & AUTC)
Funding: $330,000 (SP&R)
Project Manager: Janelle White
Completion Date: December 2015

The use of reinforced concrete filled steel pipe piles is common in Alaska and is gaining acceptance across the nation. It is often a preferred support system for bridges as these piles provide good seismic performance and can be driven rather than drilled in resulting in reduced construction cost and environmental impacts. This project will supplement the research conducted under T2-08-02 Plastic Strain Limits by conducting large scale testing of reinforced concrete filled pipe piles in soil media and structural analysis. The project will evaluate the impact of relative soil-pile stiffness on pipe pile strain limits, plastic hinge length and deformation characteristics, proposed analysis methods, and damping.

**Benefits to the State:** This research will provide experimental validation of proposed models for concrete filled steel tubes forming pipe-soil systems, allowing Bridge engineers in Alaska

and nationwide improved confidence in the structural analysis and use of these cost effective bridge support systems.

## T2-14-06 Experimental Feature: Spray Applied MMA Bridge Deck Waterproofing Membrane

Principal Investigator: Richard Pratt, P.E., Chief Bridge Engineer, Statewide
Funding: $29,000 (SP&R)
Project Manager: Lauren M. Little, P.E.
Estimated Completion Date: December 2017

This experimental feature will evaluate spray applied methyl methacrylate (MMA) waterproofing membrane on the new bridge deck of the Phelan Creek Bridge under the Richardson Highway MP 201 Phelan Creek Bridge Replacement project. As bid cost, constructability, and effectiveness of the MMA membrane system will be evaluated as compared to the currently used mastic asphalt membrane.

The MMA system provides a seamless membrane that readily accommodates variations in surface profile. It can be applied with temperatures as low as 32°F. The resins do not react with moisture. Consequently, it can be applied as long as the surface is “surface dry” and above the dew point. The system is applied in two contrasting color coded coats, which reduces flaws and improves quality control. The system features rapid installation. It is cured and load resistant within 1 hour. The MMA system has been successfully incorporated on many bridge decks around the world. Many locations have similar conditions and climates as Alaska. The durability of the system is further evidenced through its use on railway bridges where the ballast directly bears on the MMA membrane without failure.

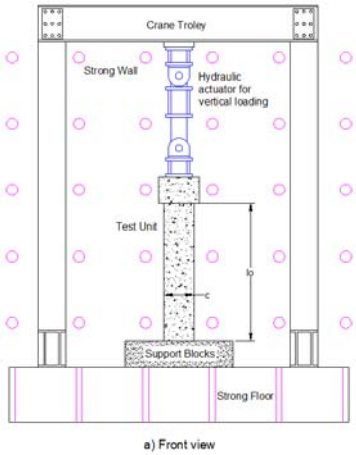
**Benefits to the State:** If the MMA membrane performs as planned, it could save millions in traffic control costs and impacts to the traveling public on future bridge deck projects due to its shortened cure time, even when compared to the higher unit cost for the membrane. It also has potential to significantly save on bridge life cycle costs if it provides better deck coverage and longer lasting waterproofing than current methods.

## T2-14-09 Seismic Load Path Effects in RC Bridge Columns

Principal Investigator: Billy Connor, P.E., Dr. Mervyn J. Kowalsky & Dr. James M Nau (NCSU, UAF & AUTC)
Funding: $365,000 (SP&R)
Project Manager: Janelle White
Completion Date: April 2017

The project studies the impact of multi-directional loading which could lead to adjustments in unidirectional strain limits proposed for seismic design on reinforced concrete bridge columns. The project will include a literature research, load path testing and analysis, model calibration and investigation of load path effects of wall piers.

**Benefits to the State:** Revisions to wall pier design for the existing model. The research will account for out of plane displacement which can be used to determine minimum wall pier thickness requirements for given in plane and out of plane deformation demands.




Proposed wall prism test setup.

## T2-14-17 Seismic Repair of Reinforced Concrete Bridge Substructures

Principal Investigator: Rudolf Seracino, Mervyn Kowalsky, and James M. Nau
Funding: $240,000 (SP&R)
Project Manager: Janelle White
Estimated Completion Date: December 2017

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 truly needed, and when repair is truly 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. The cost savings to the State of Alaska will be significant when bridges that would 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.

## T2-11-13 Alaska Bald Eagles and Highway Construction Projects

Principal Investigator: Taylor Horne, Statewide Environmental Manager
Funding: $50,000 (SP&R) Spent $10,000
Project Manager: Janelle White
Completion Date: Project cancelled June 2014

In May 2007 the USFWS established new National Bald Eagle Management Guidelines as a result of the Bald Eagle being de-listed from the Threatened and Endangered Species list. On September 11, 2009 the USFWS published new regulations which included a new Bald Eagle permit process and two permits that could be applied for prior to construction projects that may impact Bald Eagle nests. These 2007 regulations and permits have been difficult to follow and the permits are very difficult to obtain.

Alaska has a very high population of Bald Eagles and managing these stocks based on National Guidelines does not work well here. The Southeast (SE) Region has been working closely with the USFWS on developing a monitoring effort to establish impacts associated with chip-seal maintenance of roads in SE. This research project collected the monitoring reports on several paving projects but we were unable to develop any programmatic agreement since the regulations have changed.

## T2-12-23 Assessment of Implementation of SAFETEA-LU Section 6004

Funding: $80,000 (SP&R)
Project Canceled June 2014

This project was not scope and the project went inactive and had to be closed. This is still a need to assess the effectiveness of the ADOT&PF implementation of the SAFETEA-LU Section 6004 provisions and identify improvements. The research will include interviews with other states and a literature review to identify and evaluate best practices and make recommendations and any opportunities to streamline transportation project delivery.

## T2-14-13 Underwater Pile Driving Noise Study

Principal Investigator:
Funding: $65,000 FFY 2014 & $130,000 FFY 2015
Manager: Janelle White
Champion: Taylor Horne

Pile installation activities can exceed levels deemed harmful to species protected under the Endangered Species Act and the Marine Mammal Protection Act. For FFY14 Conduct literature review, develop an auditory test pile program approved by NOAA, NMFS and DOT&PF. For FFY15 conduct acoustic monitoring for pile installation to determine the hazard area for behavioral harassment. Date gathered from the auditory program will provide scientifically based observations pertinent to DOT&PF pile installation projects.

**Benefits to the State:** Coordination of DOT&PF, NOAA and NMFS to collect actual underwater pile driving and background noise levels which are applicable to current and future marine mammal protection requirements.

## T2-10-04 Phase II: Development of an Unstable Slope Management Program

Principal Investigator: Lawrence Pierson, Landslide Technology, Inc., & Peter Hardcastle, R&M Consultants, Inc.
Funding: $1,150,000 (STP) total funding $4,000,000
Project Manager: Barry Benko, C.P.G.
Completion Date: December 2017

Collect and assess necessary data to develop and deploy a new DOT&PF Unstable Slope Management Program.

**Benefits to the State:** The USMP is part of the overall Geotechnical Asset Management Program and focuses on one class of geotechnical assets: soil and rock slopes. This project is still in its initial stages for two areas: (1) inventory and condition survey to identify, assess, and rate our unstable slopes for hazard and risk; and (2) developing a knowledge base about our slopes, their condition over time, and how to manage the slopes on a lifecycle cost basis to optimize performance in support of our transportation system.

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

## T2-12-01 FY 11 CTIP Unstable Slope Management Program (USMP), WFL

Principal Investigator: Dave Stanley, C.P.G (ADOT&PF) with Landslide Technology, Inc. (Portland, OR)
Funding: $80,000 (Western Federal Lands Coordinated Technology Implementation Program)
Project Manager: Barry Benko, C.P.G.
Completion Date: December 2014

Provide support to FHWA - Federal Lands Highway Division by adapting and demonstrating ADOT&PF's Unstable Slope Management Program (USMP) for use by several federal lands agencies (Bureau of Indian Affairs, National Park Service, Federal Lands Highways, U.S. Forest Service and U.S. Fish & Wildlife Service) associated with the Coordinated Technology Implementation Program.

In 2013, Landslide Technology began development of the database structure and produced a demonstration video for database use training. The principle investigators also collaborated with the partner federal agencies to create customized unstable slope rating criteria and a field rating form. The systems will be field tested in demonstrations planned for December 2014.

**Benefits to the State:** Further development of the USMP by adapting and deploying USMP to federal agencies for implementation of asset management for slopes and further refinement of the hazard and risk management aspects of the USMP along with more advanced aspects of geotechnical asset management including estimates of service life and development of condition indices, service levels and performance measures

## T2-12-15 Use of Lidar to Evaluate Slope Safety

Principal Investigators: Dr. Andrew Metzger & Keith Cunningham (UAF & AUTC)
Funding: $115,000 (SP&R) + $50,000 (PACTrans)
Project Manager: Anna Bosin, P.E.
Completion Date: December 2014

Evaluate the potential for light detection and ranging (LiDAR) technology for mapping and managing unstable slopes. Mobile vehicle-mounted laser-scanning equipment will be used to collect data on two unstable slopes along Alaska's highway system. The researchers will analyze the data and prepare analytical geospatial based tools and/or models useful for developing unstable slope management program.

**Benefits to the State:**
This project will produce improved tools for managing unstable highway slopes. When implemented, this will create cost-effective and proactive slope remediation which will increase traveler safety and reliability of highway corridors.

## T2-12-21 Geotechnical Asset Management

Principal Investigator: Dave Stanley, C.P.G.
Funding: $1,933,055 Research out of $2,700,000 (STIP)
Project Manager: Barry Benko, C.P.G.
Completion Date: September 2015

This effort will create Geotechnical Asset Management (GAM) program architecture, research and develop: performance measures, methods for predicting future performance of assets, and analysis methods. Create inventory and condition survey for assets. Monitor performance of assets over time and compare to performance measures. Provide decision-making support to agency management on maintenance, repair and rehabilitation alternatives.

Significant progress was made in 2013, including continuing development of a formal development plan, inventory data compilation for material site, retaining wall, and unstable slope assets, risk evaluations, and pilot GAM implementation in high-risk transportation corridors.

**Benefits to the State:** The GAM program is an important element of the overall implementation of best transportation asset management (TAM) practices for AKDOT&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.

## T2-12-24 Rapid Research Response: Geophysical Investigation at Mile 9 Dalton Highway

Principal Investigator: Kevin Bjella, PhD., Cold Regions Research & Engineering Laboratory (CRREL)
Funding: $23,000 (SP&R)
Project Manager: Carolyn Morehouse, P.E.
Project completed June 2014

The US Army Cold Regions Research & Engineering Laboratory (CRREL) will conduct a geophysical survey on the Dalton MP 9-11 Construction Project. The geophysical survey results will immediately be made available to ADOT&PF design and construction staff for consideration in design revisions. CRREL will produce a report relating the geophysical survey to the Dalton MP 9-11 Materials Report.

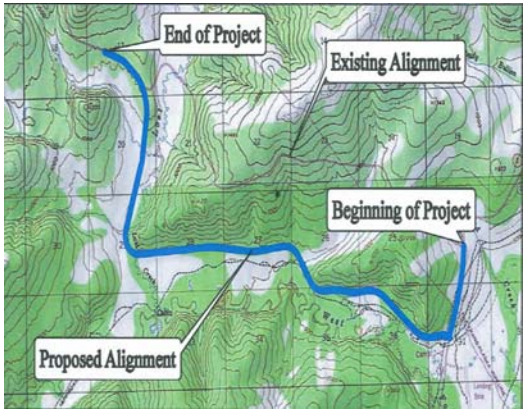
**Benefits to the State:** The research will evaluate the Ohm Mapper geophysical survey instrument as a predictive tool for detection of permafrost extent and severity. The use of continuous geophysical surveys is expected to be an inexpensive preliminary evaluation tool for alignments in permafrost areas. The department will use Geophysical surveys as a supplement to borehole drilling programs.

## T2-13-07 Rapid Research Response: Expedient Resistivity Investigation (Ohm Mapper)

Principal Investigator: Kevin Bjella, PhD., Cold Regions Research & Engineering Laboratory (CRREL)
Funding: $68,000 (SP&R)
Project Manager: Angela Parsons, P.E.
Project Completed July 2014

The US Army Cold Regions Research & Engineering Laboratory (CRREL) will conduct a geophysical survey using the OhmMapper instrument for the Dalton Highway MP 0-9 Reconstruction project in conjunction with the centerline drilling program. The OhmMapper results will be correlated with the drilling to determine the optimum alignment for the realignment project.

**Benefits to the State:** The research will evaluate the Ohm Mapper results in conjunction with the drilling program to determine the extent and locations of ice-rich vs. ice-poor permafrost. This method will result in greater coverage of the project subsurface condition, resulting in an optimized centerline alignment with reduced construction and maintenance costs over the life of the highway.




*Proposed realignment Dalton Highway MP 0-9 Reconstruction.*

## T2-13-08 Unstable Slope Management – Phase II

Principal Investigator: Darren Beckstrand Landslide Technology
Funding: $1,700,000 (STIP)
Project Manager: Barry Benko, C.P.G.
Completion Date: December 2015

This effort continues the development of the Unstable Slope Management Program (USMP), initiated in 2009. In Stage I of program development, the investigators compiled a database of the "Top 200" unstable slopes, refined the slope rating system, and created a web page portal to the data.

Under the scope for this research project, the investigators will finish the architecture of the database system and continue populating the inventory by adding the remaining unstable slopes in the road network, with key transportation corridors receiving priority in the work sequencing. Asset management elements will be incorporated into the USMP in the areas of service life prediction, establishing services levels and performance measures and initiating development of analysis tools to determine life cycle cost of slopes in support of decision-making for transportation corridors. Ultimately the database and webpage will be migrated to Department servers, and the website will be made available to the public.

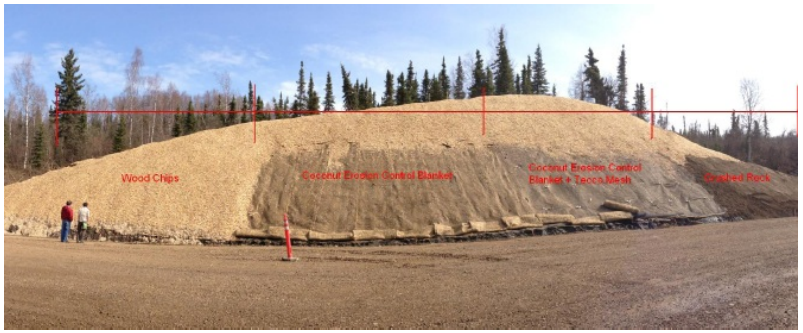
**Benefits to the State:** Unstable slopes along the State's routes present critical risks to safety and mobility in the transportation system. This research effort will enable the realization of sound asset management, resulting in the most economic allocation of resources to unstable slopes.

## T2-13-12 Experimental Feature: Long Term Monitoring of Ice-Rich Cut Slopes at Dalton Highway MP 9

Principal Investigator: Dr. Xiong Zhang (UAF & AUTC)
Funding: $40,000 (SP&R)
Project Manager: Lauren M. Little, P.E. & Carolyn Morehouse, P.E.
Completion Date: December 2014

This project is a follow on to project T2-11-05 Experimental Study of Various Techniques to Protect Ice-Rich Cut Slopes. Researchers will monitor the performance of the test section and techniques used on the Dalton Highway 9 Mile Hill construction project for a year.

**Benefits to the State:** This research will result in recommendations and guidelines for design and construction. This will ensure proper application of successfully tested mitigation approaches on future construction projects which require cuts in ice-rich permafrost.




*Test sections constructed on the Dalton Highway 9 Mile Hill North project. Photo credit AUTC.*

## T2-13-18 Geotechnical Asset Management - Stage II

Principal Investigator: Various
Funding: $80,000, (Other STIP project)
Project Manager: Barry Benko, C.P.G
Completion Date: December 2014

The project supports four research contracts for developing Geotechnical Asset Management (GAM) concepts for state Departments of Transportation: 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.

The Federal Highway Administration (FHWA) is participating in funding these GAM-related research projects 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 these deliverables is that they are created specifically for a broader audience than Alaska transportation agencies.

**Benefits to the State:** Deliverables will include:

- An executive level summary,
- Individual graphics suitable for use in FHWA publications and pamphlets,
- PowerPoint presentation slides,
- Other deliverables that may be developed during the course of the work and the execution of the project's Communication Plan.

The final content of the additional deliverables will vary from project to project. Each project will include a communication plan based on NCHRP Report 610, "Communicating the Value of Transportation Research" and will address these deliverables tailored to the subject or the individual contracts.

## 64230 GAM through Thermal Modeling of Highway Embankments for Dalton Highway Reconstruction Projects

Principal Investigator: Steve McGroarty and Jeff Currey
Funding: $145,000
Manager: Dave Waldo
Estimated Completion Date: December 2018

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 parameter 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.

Leverage two upcoming reconstruction projects on the Dalton Hwy to design thermally stable embankments with thermal monitoring instrumentation to study performance of insulation board. 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 constructed, or existing embankments reconstructed, on permafrost to facilitate design of the least expensive thermally stable embankment. This will reduce maintenance.

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**T2-14-14 Haines Highway Debris Flow Source Study**
Principal Investigator: Drs. Ronald Daanen and Gabriel Wolken, DGGS
Funding: $63,000 FFY 2014 & $80,000 FFY 2015
Manager: Anna Bosin, P.E.
Estimated Completion Date: December 2015

Debris flow events are occurring with increasing frequency within the Haines Highway Debris Flow Corridor (MP 16- 24). M&O expended approximately $335,000 on equipment and labor responding to debris flow events in this highway segment in 2013 alone. DOT lacks baseline data characterizing the upslope source areas. Produce high resolution orthophoto and detailed DSM of the two most active sites (MP 19 and 23). Deploy and ground temp sensors. Conduct a repeat aerial survey, creation of orthophoto and DSM, which will enable researchers to quantify and map the total amount of debris movement and to portray source material origination. Results will be crucial to design of future mitigation of debris flow hazards.

**Benefits to the State:** Reduction of hazard to the travelling public, reduction of risk to the Department, maintaining consistent mobility.

## T2-12-11 Estimating Future Flood Frequency and Magnitude in Basins Affected by Glacier Wastage

Principal Investigator: Anna Liljedahl, (UAF & AUTC)
Funding: $80,000 (SP&R) + Deployment $15,000
Project Manager: Angela Parsons, P.E.
Completion Date: December 2014

The research will collect field measurements of weather and temperature to develop hydraulic models which characterize contemporary changes and trends in hydraulic flows from glacial streams. The Final Report will recommend engineering criteria and parameters for use in the design of bridges and culverts located in drainage basins with a component of glacial runoff.

**Benefits to the State:** The research is expected to result in better predictions of peak flows from streams affected by melting glaciers. Analyzing this component of flow along with rainfall data will result in more reliable designs for hydraulic structures.

*Sagavanirktok River showing stream barbs near Deadhorse, June 2009. Photo: Dr. Horacio Toniolo.*

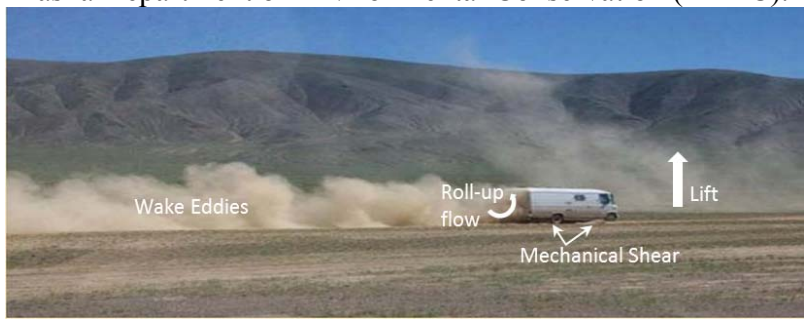
## T2-10-12 Performance of Dust Palliatives on Unpaved Roads in Rural Alaska

Principal Investigator: Dr. David L. Barnes (UAF & AUTC)
Funding: $40,000 (SP&R) + $40,000 (AUTC)
Project Manager: Dave Waldo
Report Published October 2014, working on field manual

More than 80% of Alaska's communities can only be accessed by air or off-road vehicles, and rely on 255 state-owned airports—many unpaved—and local unpaved roads for access and supplies. These unpaved roads and runways generate fugitive dust, leading to impaired quality of life, and costly maintenance.

Annually, traffic can remove up to 750 tons of gravel per mile, amounting in roughly $15,000 in annual maintenance costs. The use of dust palliatives such as calcium chloride can save around $7,000 per mile per year over untreated roads.

The research team will apply and monitor dust control agents in three sections of Alaska's roads: two in rural villages and one in North Pole. This project is co-funded by AUTC and the Alaska Department of Environmental Conservation (ADEC).




Both for public health and cost-effectiveness considerations, researchers want to know how much fugitive dust must be suppressed to meet regulatory standards. Researchers will use this information to help local communities plan the use of dust-control agents.

**Benefits to the State:** The research will assess the longevity and success of different palliatives to determine life cycle costs, assisting engineers with decision making and potentially providing significant life cycle cost savings. The results from this research along with other dust related research is being combined into a recommended ADOT&PF Dust Manual with associated training materials.

## T2-11-06 Field-Evaluating Crack Sealing of Asphalt Concrete Pavements in Alaska

Principal Investigator: Dr. Juanyu "Jenny" Liu
Funding: $90,000 (SP&R)
Project Manager: Anna Bosin, P.E.
Final Report Published August 2014; Project Closed FFY14

Routine sealing of cracks in asphalt concrete costs the state of Alaska millions of dollars annually. Without new technology to eliminate the cracking, sealing and minor patching will continue to be a major expense for ADOT&PF.

This project aims to find possible cost-effective improvements to existing crack-sealing methods. Some research suggests it may be possible to ignore cracks entirely, under certain circumstances, with no negative effects. Liu is working with field researchers to determine where sealing is necessary and where it is not in order to devise more economically sound

approaches to road repair. The team will also determine the effectiveness of several different repair treatments for major transverse cracks.

The team will provide recommendations for saving a significant portion of the maintenance and operations funds now spent on crack sealing and minor patching of major transverse cracks. The research will provide ADOT&PF with research findings that the agency can easily integrate into its Departmental Guidelines for Pavement Preservation Treatments in Alaska.

**Benefits to the State:** This project will help ADOT&PF achieve its goal of managing its infrastructure efficiently and effectively. This project will provide insight on how to save on repair costs while maintaining quality roads.

## T2-11-07 Develop Locally Sourced Salt Brine Additive for Anti-icing

Principal Investigators: Xianming Shi (MSU-WTI) and Dr. Juanyu "Jenny" Liu (UAF & AUTC)
Funding: $140,000 (SP&R)
Project Manager: Carolyn Morehouse, P.E.
Final Report Published September 2014; Closed FFY14

ADOT&PF, MSU's Western Transportation Institute (WTI) and AUTC are investigating whether local agricultural or distillery by-products can replace high-cost proprietary products for anti-icing operations on winter roads. The partnership hopes to bring considerable cost savings and safety improvements to Alaska's roads.

Researchers developed and lab tested locally sourced salt brine additives. The preliminary results show some promising combinations including distillery by-products. The results will help improve traveler and commercial safety and mobility while reducing corrosion and environmental impacts.

The project will give ADOT&PF more options for snow and ice control while promoting sustainable, cost-effective winter road service. In a time of fiscal belt-tightening, this work allows state winter road maintenance budgets to cover more roads or more frequent anti-icing activities.

**Benefits to the State:** Beyond reducing Alaska's winter road maintenance costs, this research may also boost local economic growth by providing a market for salt brine production using local materials.

## T2-12-07 Whittier Tunnel Signal System Investigation

Principal Investigator: DOWL HKM, Thomas L. Moses, Jr., P.E.
Funding: $150,000 (SP&R)
Project Manager: Mike San Angelo, P.E.
Report Published September 2014 called *"Evaluation of the Train Signal and Rail Systems for the Anton Anderson Memorial Tunnel"*; Contract needs to be closed

Investigate the causes and recommend technical and operational solutions for the Whittier Access Tunnel for the traffic signal system. This project coupled with T2-12-10 will give operational recommendations to improve vehicle and freight operations scheduling of this unique multi-modal facility.

**Benefits to the State:** The results of this study will help ADOT&PF and the Alaska Railroad improve operations and maintenance of the Whittier Tunnel multimodal facility.

## T2-12-13 Maintenance Decision Support System (MDSS)

Principal Investigator: Billy Connor, P.E. (UAF & AUTC) in Partnership with the National Center for Atmospheric Research (NCAR)
Funding: $225,000 (M&O)
Project Manager: Ocie Adams
Completion Date: December 2015

The project will evaluate and refine a software system to help roadway maintenance personnel optimize their snow and ice control operations. The system will analyze historical weather conditions and forecast data to prescribe optimal strategies for plowing snow and applying anti-icing treatments to roadways based on weather and pavement condition observation and forecasts. The ADOT&PF's Fairbanks maintenance district will pilot the technology along roadway corridors with various weather microclimates in an effort to fine tune the predictive capabilities of the software and data collection system.

**Benefits to the State:** By improving weather and roadway condition assessment during winter storms and then optimizing snow and ice control efforts, ADOT&PF and local transportation agencies should be able to provide safer road conditions while minimizing costs. Additionally, minimizing the use of deicing and anti-icing agents promises environmental benefits and reduced impacts to roadway users.

## T2-13-09 Rapid Research Response: Testing and Screening Surface Materials for the Yukon River Bridge – Phase II

Principal Investigator: Dr. J. Leroy Hulsey (UAF & AUTC)
Funding: $137,000 (Rapid Research SP&R) & $50,000 (M&O)
ADOT&PF Project Manager: Carolyn Morehouse, P.E.
Project Completion Date May 2015

This research project is the second stage of T2-10-07 Testing and Screening Surface Materials for Alaska's Yukon River Bridge-($51,000SP&R Final Report Published June 2014; Closed FFY14). The purpose is to find a more durable material to replace the timber decking. The timber used for the deck is going up in cost due to reduced logging in quality old growth forests. Each time the deck is replaced it costs tax-payers millions of dollars. If the time between replacements could be extended, money and human power could be saved or directed toward other projects.

**Benefits to the State:** Finding a more durable and cost effective bridge decking solution for this critical route will save the State millions of dollars over the long term through reduced road closures and maintenance costs.

*Yukon River Bridge*

## T2-06-04 Experimental Features: Sasobit and Foamed Warm Mix Asphalt Features

Principal Investigator: Alaska Highway Experimental Feature: Leo Woster, Northern Region Materials Engineer; Petersburg Mitkof Highway Experimental Feature: Bruce Brunette, Southeast Region Materials Engineer, Steve Saboundjian, State Pavement Engineer
Funding: $64,000Petersburg Mitkof Highway $70,000 (SP&R)
Project Manager: Angela Parsons, P.E.
Project completed and closed

Two experimental feature projects were initiated to study longterm performance and constructability of warm mix asphalt (WMA) technologies in Alaska's cold weather environment. WMA reduces the high mixing temperatures of conventional hot-mix asphalt, which has the effect of reducing fuel consumption and emissions during asphalt concrete production and placement. The use of WMA can increase the time between production and final compaction, which allows increased haul distances and extension of the paving season. WMA decreases binder viscosity, which improves mix workability and helps compaction. EPA will likely mandate the use of WMA in the future because emissions are greatly reduced by this technology. This research assessed two commonly used WMA methods:

Sasobit, a synthetic wax additive, is mixed into the binder and does not require plant modifications. This method was studied as part of the Petersburg Mitkof Highway Upgrade Project, Phase II.

Foamed warm mix asphalt using the Astec double-barrel green system, which injects steam into the binder to lower its viscosity. This method, favored by contractors, was studied as part of the Alaska Highway milepost 1267–1314 project. These projects studied the field placement and handling characteristics of WMA, included Superpave testing (see T2-10-01), and allow for three years of monitoring including visual inspection, measurement of rutting, and falling weight deflectometer testing if available.

**Benefits to the State:** These studies will ensure successful construction practices on projects that use WMA technology. Long-term monitoring should reveal potential problems and the necessary adjustment needed for success. Developmed Warm Mix specification that is in use.

*Sasobit® flakes (left) and prills (right). Photo: Graham Hurley, Brian Prowell.*

## T2-08-16 Application of a Non-Traditional Soil Stabilization Technology: Lab Testing of Geofibers and Synthetic Fluid

Principal Investigator: Billy Connor, P.E. (AUTC)
Funding: $200,000 (State Funds)
Project Manager: Steve Saboundjian, P.E.
Waiting for the final manual from AUTC
Estimated Completion Dec 2014

Gravel is practically nonexistent in western Alaska. The cost of importing gravel exceeds $200 per cubic yard in some areas of the west. Gravel is often needed to build infrastructure such as roads or runways. These costs can be dramatically reduced if local soils can be made usable in place of imported gravel.

This project is investigating a new technique for using geofibers and a synthetic fluid to stabilize the loose, sandy, and silty soils typical of western Alaska. Lab tests measured how well these new materials might improve poor foundation soils.

Results showed that fibers can double or triple the strength of the soil. Addition of synthetic fluids adds some strength as well. Their primary function is to reduce moisture sensitivity of the fine-grained material. A two-part chemical additive has proven to increase the strength of sands, silts, and clays at a lower cost than imported gravel. This project is the basis for a field application of these new materials. Testing of soil to determine the indirect tensile and resilient modulus tests on Tanana silt, Horse Shoe Lake Sand, and Fairbanks silt. Describe the use of fibers, synthetic fluids and two-part soil stabilizers for base stabilization.

**Benefits to the State:** Synthetic fluids and geofibers proved to strengthen weak soils. The research findings from this study will directly benefit a wide range of transportation construction projects by enabling the use of locally available materials, providing significant reduction in overall construction costs. This project will update the stabilization manual to include the findings of this research.

## T2-10-01 Foamed Warm Mix Asphalt Lab Testing: Experimental Features in Highway Construction

Principal Investigator: Dr. Juanyu Lui and ADOT&PF NR Construction/Materials
Funding: $29,986 (SP&R)
ADOT&PF Project Manager: Anna Bosin, P.E.
Estimated Completion Date: December 2014

One way to reduce the cost of paving is to find ways to reduce the amount of energy it takes to apply asphalt to a surface. Hot mix asphalt (HMA), used predominantly on paving projects, is typically spread at temperatures between 280° and 320°F. When road crews use warm mix asphalt (WMA), applied at significantly lower temperatures (250° to around 270°F), they reduce the energy requirements and costs of highway paving.

Researchers wanted to see if WMA could be applied without adversely impacting pavement performance in Alaska. They worked with ADOT&PF on a paving project near Tok, Alaska. The team experimented with one form of WMA that involves adding small amounts of water (as steam) to the asphalt mixer system. The investigators collected samples on site. They conducted laboratory tests to assess how this WMA technique works and to determine if there is any significant difference between how HMA and WMA pavements performed.

Tests included material characterization, rutting potential, resistance to fatigue, moisture susceptibility, and performance under low temperatures. Results show that the engineering properties of the asphalt mixture are not significantly affected by adding steam during production. Liu recommended that tests on field-collected, field-compacted specimens for foaming WMA could provide more representative and definitive results.

**Benefits to the State:** If found to be comparable in strength and durability, warm mix asphalt could dramatically reduce the cost of paving by saving energy that it takes to heat the asphalt to mixing and application temperatures.

## T2-10-11 Stabilization of Erodible and Thawing Permafrost Slopes with Geofibers and Synthetic Fluid

Principal Investigator: Dr. J. Leroy Hulsey and Dr. Xiong Zhang (UAF & AUTC)
Funding: $132,000 (SP&R)
ADOT&PF Project Manager: Angela Parsons, P.E.
Report Published June 2014; Waiting for final invoice from AUTC in order to close.

Thawing, unstable, and eroding permafrost slopes pose serious challenges for road maintenance crews and transportation engineers in Alaska. Frozen soils can heave or sink with temperature change. For slopes, this can result in significant erosion and stability issues with the roadway embankment.

Recent research on synthetic fluids and geofibers has shown that these materials can reinforce the volatile frozen soils in pavement bases and mitigate these problems. Traditional interim slope stabilization techniques are costly and require specialized skills and equipment to ensure adequate performance. They also are only marginally effective in the cold climates of Alaska and other northern regions in stabilizing the slope until vegetation can establish.

This project constructed a test slope to study the feasibility of stabilizing erodible and thawing permafrost slopes with geofibers and synthetic fluid. Geofibers and synthetic fluids can improve very loose, sandy soils—the material often left behind after permafrost thaws. These types of soils are very common in Alaska, especially in northern and western areas.

Results of the research indicated promise for some synthetic fluid and geofiber combinations for interim slope stabilization; however one product tested inhibited grass growth, making it impractical for slope stabilization in terms of erosion control.

**Benefits to the State:** The outcomes of this research will provide engineers and contractors with additional options for short term (1-3 years) stabilization of erodible slopes. Use of some of the products tested could result in shorter time periods for CGP and project closeout, providing significant savings to the Department.

## T2-11-02 Geosynthetic Design Guidelines & Construction Specifications Review & Update

Principal Investigator: Eli Cuelho (MSU-WTI)
Funding: $16,000 (SP&R) + $73,500 (State GF)
ADOT&PF Project Manager: Anna Bosin, P.E.
Completion Date: December 2014

Engineers strive to provide safe and effective transportation corridors and facilities that are economic to construct and maintain. ADOT&PF routinely uses geosynthetics (planar products manufactured from polymeric material) to create innovative design solutions for soil stabilization, soil reinforcement, separation, mechanically stabilized earthen structures, embankments, drainage, erosion control, pavement, and silt fences. However, the department's specifications and design practices are over five years old and do not account for the rapidly evolving world of geosynthetics technologies and design practices.

The main objective of this project is to provide recommendations that will assist the ADOT&PF to update Alaska's geosynthetic design guidelines and construction specifications to provide for the most economical geosynthetic selection while minimizing conflicts and promoting competition. The research team includes nationally recognized experts in the field of geosynthetics for transportation engineering applications, will conduct a reviews of current geosynthetic design and construction practices in Alaska, historic and future uses of geosynthetics within the state, design and construction practices from other state and federal sources, and will synthesize this information to adequately update Alaska's geosynthetic design and construction practices. The researchers will also conduct a training course in Alaska to transfer the results of this project and assist ADOT&PF engineers to effectively and efficiently utilize geosynthetics in design and construction.

**Benefits to the State:** The products of this research include updated design and construction specifications materials that will be suitable for direct implementation by ADOT&PF staff. The specifications will be reviewed and updated in consideration of specific local concerns identified through the review of current and anticipated geosynthetic use throughout Alaska.

## T2-11-11 Financial Impact of Fines in Unbound Pavement Layers

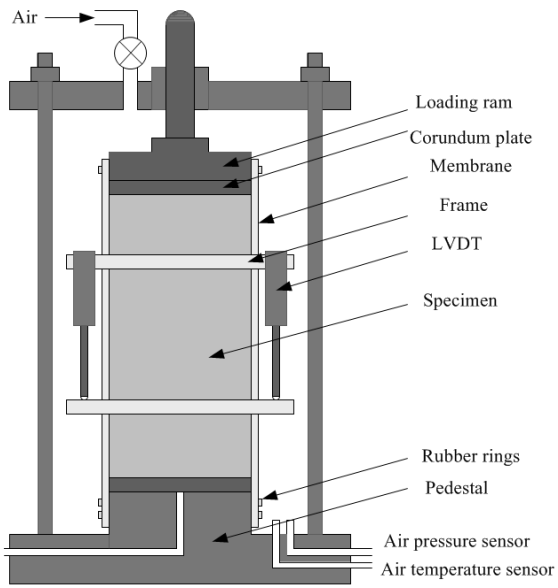
Principal Investigator: Dr. Juanyu "Jenny" Liu
Funding: $90,000 (SP&R)
ADOT&PF Project Manager: Anna Bosin, P.E.
Report Published November 2014. Need final AUTC invoice

In Alaska's spring months, ice thawing underneath road pavement weakens roads and other transportation infrastructure. This causes great expense to the state and inconvenience and safety hazards for private and commercial motorists. This project examines how the fines in the base materials that a road is built on affects susceptibility to frost heaving and support for loads during the spring thaw.

Too much fines in base material can cause serious road problems. In the winter, the freezing horizon moves down through a road into the base material. Fines act like a wick, drawing moisture up, which conglomerates in lenses of ice that expand. During the expansion, material gets pushed around to make room for the ice. This can lead to heaves in the road. In

spring, when the ice melts, these spots will be weakened and become sunken.
The current policy on allowable fines in base material is at a set percentage. While this is good for keeping fines at low levels, research shows this may not be necessary. A recent study done at UAF shows that the type of material and the setting it's in may have an effect on the susceptibility of the road to frost heaving.
This is important. Replacing material to build a road can add large costs to a project. This project will examine the way content of fines affects frost heaving in materials with different moisture content and temperature gradients.

**Benefits to the State:** Knowing what acceptable fines content is for different materials in different settings will allow for less hauled material, saving the state money, without affecting road performance.




## T2-12-05 Video Documenting Best Practices for Mitigating Frost Damage to Transportation Infrastructure

Principal Investigator: Billy Conner, P.E. (UAF& AUTC)
Funding: $15,000 (SP&R)
ADOT&PF Project Manager: Clint Adler, P.E.
Completion Date: December 2013

Northern tier states and provinces are influenced by frost action and have collaboratively developed ways to minimize its effect on our transportation infrastructure. This project will update an existing frost video from the early 1980's, produced by US Army Corps of Engineers, Cold Regions Research & Engineering Laboratory (CRREL), to show how to design for preventing frost heaves, show examples of frost heaves, demonstrate how frost actions take place, and explain what fixes are available.

**Benefits to the State:** The material from this project will educate transportation professionals on the impacts Alaska's climate has on roads. This improved understanding is essential to ensure cost effective, reliable, and resilient transportation infrastructure in Alaska.
**Completed video:**
Full Length: http://www.youtube.com/watch?v=qnI7T5wbNjc
Executive Summary:
http://www.youtube.com/watch?v=fkrrSys03qQ

## T2-13-02 Research & Technology Deployment: GPS Protocols Survey

Principal Investigator: ADOT&PF staff
Funding: $10,000 (SP&R)
ADOT&PF Project Manager: Carolyn Morehouse, P.E.
Completion Date: December 2014

This project is a follow up to T2-07-02 Development of GPS Survey Data Management Protocols and Policy. The Alaska Survey Manual was updated in 2010 under that project and a Section 642 construction Specification drafted. This project will evaluate how the manual has been received by internal and external stakeholders and if any updates are needed as well as work towards full implementation of the 642 Specification.

**Benefits to the State:** Modern GPS survey methods are typically more cost effective for construction surveyors; however quality control must be assured to protect the Department's infrastructure investments. Evaluating current best practices versus our internal requirements will allow for development of effective Statewide policy.

**Photo:** Former Northern Region Survey Chief Scott Sexton works with GPS survey equipment.

## T2-13-10 Experimental Feature: Tencate Mirafi® H2Ri Wicking Fabric

Principal Investigator: Jeff Currey, NR Materials Engineer
Funding: $30,000 (SP&R)
ADOT&PF Project Manager: Dave Waldo
Completion Date: December 2016

The freezing of moisture in the ground can cause heaving. Under roads this can cause damage that leads to increased maintenance costs. ADOT&PF partnered with AUTC to research a possible solution. The use of the building fabric, Mirafi Nylon Wicking Fabric, could help prevent saturation of the ground that causes frost heave damage. The fabric is an impermeable much like a rain jacket. When installed properly it keeps much of the moisture out of the material that the road is built on. No moisture, no problem.

The fabric was installed by the Department's Contractor on the Dalton Highway MP 197-206 Reconstruction project. This section of road will be monitored by ADOT&PF and AUTC for three years. The results will help engineers design safer roads that require less maintenance. Preliminary field results show this fabric is promising for removing water from the embankment.

**Benefits to the State:** The use of construction fabric in building roads in Alaska should extend road life, especially in areas particularly susceptible to frost heaving.

*Wicking fabric installation location on the Dalton Highway MP 197-209 Rehabilitation project.*

## T2-13-13 Evaluate Presawn Transverse Thermal Cracks

Principal Investigator: Juanyu "Jenny" Liu (UAF – AUTC)
Funding: $75,000 SP&R
ADOT&PF Project Manager: Anna Bosin, P.E.
Completion Date: December 2015

Road-width thermal cracks (major transverse cracks) are perhaps the most noticeable form of distress on asphalt concrete pavements throughout the colder regions of Alaska. In these cold areas it has as not yet been possible to prevent this crack type from forming. To date, this appears to remain true regardless of paving material, embankment material, or construction method. A review of research and testing conducted in the Fairbanks area about 30 years ago shows that the technique of precutting thermal cracks in the pavement during construction has real potential for minimizing pavement distress associated with transverse cracking.

This research project will monitor and evaluate the recently reconstructed Richardson Highway project (Mile 340-346, near North Pole) which included sections with presawn cracks and a control section without presawn cracks. The researchers will use visual inspections, laboratory evaluations of asphalt core samples, and numerical simulation studies to make recommendations for future effective design and construction practices to control thermal cracking in asphalt concrete pavements.

**Benefits to the State:** The ADOT&PF spends a significant amount of money each year crack-sealing pavements. If a successful pre-cutting method can be determined it could provide significant savings in pavement preservation dollars each year and contribute to better performance of Alaska's valuable pavement assets.

***Photo:*** *Pre-cut pavement section on the Richardson Highway near Moose Creek. Photo credit Bob McHattie and Dr. Jenny Liu.*

## T2-13-14 Wicking Fabric Design Specification

Principal Investigator: Dr. Xiong Zhang (UAF & AUTC)
Funding: $125,000 (SP&R)
ADOT&PF Project Manager: Dave Waldo
Completion Date: June 2015

H2Ri wicking fabric is a new geotextile manufactured by TenCate Geosynthetics. Which is the same product used in T2-13-10. It contains both a high modulus polypropylene yarn for reinforcement and a nylon wicking yarn which can absorb and transport water for drainage under unsaturated conditions. Therefore the fabric can serve as reinforcement it has the

potential to dehydrate the subgrade and base course and consequently improve the performance of pavements.

This research will build on the ongoing monitoring of the Dalton 9 Mile test section (project T2-13-10). It will develop design guidance, determine product limitations, and cost benefit values for engineers to use in deciding when and how to use the fabric.

**Benefits to the State:** Use of this fabric may allow use of low quality, locally available materials to build roads and airport. It has the potential to bring significant savings in construction, maintenance and repair cost for roads in wet, swampy areas and areas of thawing permafrost. When properly used, it has proven to have the ability to wicking the water out of the pavement structure and eliminate the frost have and subsequent thaw weakening.


*Photo: Wicking fabric installation at Dalton Highway MP 110.5 Beaver Slide. Photo credit AUTC.*

## T2-13-17 Evaluation Low Temperature Pavement Cracking

Principal Investigator: Tonya Burrit (AK DOT&PF - Central Region Materials)
Funding: $8,000 SP&R
Project Manager: Anna Bosin, P.E.
Project Completed October 2014; PowerPoint Deliverable

The purpose of this research is to assess the actual performance of recently constructed highway projects that used asphalt pavements that were specially modified to reduce low temperature cracking. Modified asphalts add to the cost of paving projects, so it is important to determine if their use has actually resulted in reduced cracking.

This research involves conducting field measurements to evaluate and characterize pavement cracking on representative roadway segments. This analysis will also involve consideration of existing lab tests and mix designs. Deliverables from this project will include an interim compilation of the work done to date under previously funded research, and a final report and presentation to ADOT&PF materials, M&O, and construction staff.

**Benefits to the State:** The knowledge gained through this research effort is expected to be used by ADOT&PF materials engineers when designing future projects to achieve better performing asphalt pavements with reduced maintenance costs for crack sealing and patching which will help lower the life-cycle costs of Alaska's valuable highway pavement assets.

## T2-13-19 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.
Completion Date: December 2017

This experimental feature will evaluate polyester concrete for approach slabs on the Parks Highway MP 239-252 Rehabilitation construction project. The experimental feature will compare 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 would be allowed to drive on the slab in about 4 hours which would be 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.

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 will determine if polyester concrete may be a practical, cost saving alternative to traditional concrete methods for approach slab and deck construction. If the polyester concrete performs as planned, it could save millions in traffic control costs and impacts to the traveling public on future bridge retrofit and deck projects.

## T2-14-05 Experimental Feature: Fiber Reinforced Polymer Composites for Culvert Repair

Principal Investigator: Jeff Stutzke, P.E., Northern Region Hydraulics Engineer
Funding: $25,000 (SP&R)
Project Manager: Dave Waldo.
Estimated Completion Date: December 2017

This experimental feature will test the effectiveness of fiber reinforced polymer (FRP) composite liners (panels) in traditional corrugated metal culverts on the Parks Highway MP 239-252 Rehabilitation project near Healy. FRP panels will be compared to traditional repair methods such as cement inverts and slip-lining that have been used on previous projects. The FRP panels show promise for culvert repairs due to their abrasion and corrosion resistance, minimal installation requirements, and minimal increase to culvert invert elevation and hydraulic capacity.

FRP panel use has been limited to New England states with the oldest installation being a little over 3 years in the state of Maine. Preliminary results show the panels are performing as expected with no signs of wear. The FRP panel system is used on culverts 36” and larger as access for installation on anything smaller would be difficult. The panels are usable on any

surface of the culvert. Areas where culvert damage is overhead, panels are suitable for top surface repairs, and can be used to cover and support weaknesses in the culvert. Weirs and baffles may also be included if needed for fish pass purposes, however, the culverts being used for this Experimental Feature are not fish pass. The process of installing the FRP panels will allow both travel lanes to remain open with minimal interference to traffic. Expected life of the FRP panels is expected to outlast the service life of concrete which is approximately only a few decades.

**Benefits to the State:** If the use of FRP panels is successful, their use could provide the State with significant life cycle cost savings on culvert repairs.

## T2-14-08 Revisions to the Alaska Flexible Pavement Design Software & Manual

Principal Investigator:
Funding: $105,000 (State Funds)
Manager: Stephen Saboundjian, PE
Estimated Completion Date: December 2014

Update the Alaska Flexible Pavement Design (AFPD) software and incorporate WesLEA, a software developed by the US Corps of Engineers. Review, test and evaluate the software. Update the pavement design manual.

**Benefits to the State:** Updated AFPD software will be able to operate in a Windows 7 or Windows 8 operating system, currently ADOT&PF and its consultants have been using Windows XP machines or virtual XP machines to perform pavement design on Windows 7 machines. This is not an option under Windows 8

## T2-14-12 Characterization of Alaska Hot-Mix Asphalt containing Reclaimed Asphalt Pavement (RAP)

Principal Investigator: Dr. Jenny Liu
Funding: $155,000
Manager: Anna Bosin, P.E.
Estimated Completion Date: June 2016

DOT&PF highway construction specification now allows up to 15% RAP in the wearing course of a roadway pavement, and up to 25% RAP in the binder or base course layer(s). The materials engineering properties of these HMA mixes specific to Alaskan materials containing RAP will be properly characterized for use in pavement design software. This project will prepare representative laboratory-mixed specimens using local materials and conduct laboratory performance test to determine the engineering properties of the mixtures. It will update the database of material properties in the “AK Flexible Pavement Design Manual” for use in the pavement design software, and a potential revision of the HMA specification to increase the limit of RAP in HMA.

**Benefits to the State:** A better understanding of RAP’s engineering properties will improve pavement design and produce more reliable value engineering and life-cycle cost analysis. Increased use of RAP material will decrease construction costs, preserve virgin aggregate resources, and divert materials from the waste stream.

## T2-14-15 Mix Design – Fly Ash Rapid Response Project

Principal Investigator: Cole Sonafrank, CEO Suitable Alaskan Materials, LLC
Funding: $26,000
Manager: Anna Bosin, P.E.
Estimated Completion Date: December 2015

Materials available for embankment construction in remote areas of Alaska are often highly frost-susceptible and are subject to rutting and pumping during spring break-up either wet or dry conditions. Geopolymer concretes and soil cements using coal fly ashes have been investigated and the chemistry proven. Field testing is needed to demonstrate value. Conduct optimization of mix design with alkali and fly ash materials with the local borrow sources in a Fairbank area laboratory.

**Benefits to the State:** Utilize a waste product to improve poor quality local embankment material.

## T2-12-18 Review of Power Sources for Alaska DOT Road Weather Information Systems, Phase I

Principal Investigator: Richard Wies, Jr., (UAF & AUTC)
Funding: $40,000 (SP&R)
Manager: Angela Parsons, P.E.
Final Report Published September 2014; Closed FFY15

This research project involves studying the ADOT&PF Road Weather Information Systems (RWIS) sites that are currently installed off the power grid. The first generation of RWIS power generation units have outlived their economic lives – they are failing and are not cost effective to repair. The researchers will evaluate the state-of-the art in alternative power sources such as wind, solar, and fuel cells along with the latest in weather monitoring systems, and recommend improved equipment and power configurations and operating scenarios for each of the subject RWIS sites. In the next phase of the project, the researchers will work with DOT&PF to develop and test the most promising prototype system to install and test at one of these sites.

**Benefits to the State:** The results from this project will help the ADOT&PF provide for the safe and efficient movement of people and goods on Alaskan highways by investigating and recommending innovative remote off-grid power systems to improve the efficiency and reliability of the Road Weather Information System.

## T2-12-19 Rapid Research Response: A Design for an Interface Board between a MRC Thermistor Probe and a Personal Computer

Principal Investigator: Dejan Raskovic, (UAF & AUTC)
Funding: $30,000 (SP&R)
Project Manager: Lauren M. Little, P.E.
Report Published September 2014

The project developed a prototype for a new handheld device for reading and testing in-pavement temperature sensors maintained by ADOT&PF's Highway Data Section. Existing readers are no longer manufactured and only one remains functional. Technicians manually record pavement temperature data to assist with the commercial truck weight restriction compliance, usually in the spring months while the roads a still going through the spring thaw. The Highway Data Section maintains about 100 Temperature Data Probe (TDP) sites statewide. Properly maintaining and collecting TDP is critical to data driven decisions for the pavement design group and Truck Weight restriction enforcement.

**Benefits to the State:** The new interface device improves on the reliability and accuracy of pavement temperature data, thereby improving the effectiveness of Alaska's springtime pavement load restriction program.

## T2-08-13 Frequency and Potential Severity of Red Light Running in Anchorage

Principal Investigator: Not yet assigned
Funding: $200,000 (SP&R)
Project Manager: Angela Parsons, P.E.
Completion Date: Project Canceled; $23,000 spent

At the time that this project was approved, there were around 5 fatal and 60 major injury crashes per year at signalized intersections in Alaska. The majority of these involve red light running. The 2008 Alaska Strategic Highway Safety Plan identified this research as a priority.

This study aimed to quantify red light violations, determine how far into the red cycle the violations were occurring, and correlate this data to the severity and frequency of collisions involving red light violations. The information was expected to be used to assist decision makers in developing policy regarding red light violations.

Implementation of the expected results from this research would require the involvement of policy makers, traffic & safety engineers, and enforcement officials. During the course of the project, it became clear that not all of the required implementation entities were actively part of the research team, and did not have sufficient time or resources to dedicate to the effort.

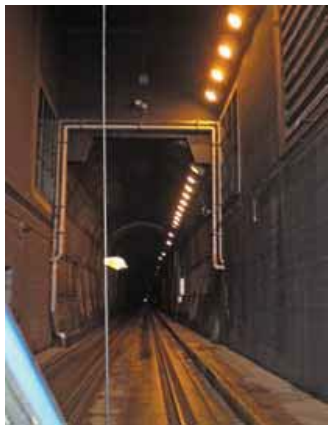
There was some benefit to the state for the research efforts that did occur. UAA and MOA were able to work together to use existing video detection to quantify red light running. There was a review an update to a 2005 red light running study that helped UAA develop methodology and protocols.

## T2-12-10 Whittier Tunnel Operations Study

Principal Investigator: DOWL HKM, Thomas L. Moses, Jr., P.E.
Funding: $150,000 (SP&R) +$50,000 (SP&R)
Project Manager: Robert Wright & Mike San Angelo, P.E.
Report Published August 2014; Contract needs to be closed.

Conduct operational research on the Whittier Access Tunnel with the objective of improving vehicle and freight operations scheduling of this unique multimodal facility.

**Benefits to the State:** The Whittier Access Tunnel was opened to the public in 2000 and is maintained and operated by ADOT&PF and the Alaska Railroad Corporation. This research project will investigate the existing scheduling matrix that blends vehicle traffic with railroad usage to understand if there are opportunities to improve peak traffic flows and increase efficiencies. The consultant and contractor will also review the initial assumptions that created the schedules and investigate how those assumptions have changed by identifying the current stakeholders that rely on this transportation asset.



*The Whittier Access Tunnel supports both vehicle and railroad traffic. Photo: Russ Mitchell.*

## T2-12-14 Passing Lanes Study

Principal Investigator: Billy Connor, P.E. (UAF & AUTC); Ahmed Abdel-Rahim & Brian Dyre, (UofI)
Funding: $60,000 (SP&R) + $60,000 (AUTC)
Project Manager: Anna Bosin, P.E.
Report Published July 2014

This study will develop novel highway lane markings and signage based on a scientific understanding of human perception and decision making (i.e., human factors) and will assess the potential of these safety interventions for reducing speed and risky passing behavior by conducting a series of driving simulation experiments.

**Benefits to the State:** Reduce the number of crashes that occur relative to passing lanes on Alaska's non-divided rural highways.

***From report***

## T2-13-01 Flashing Yellow Arrow Public Information Campaign

Principal Investigator: Meadow Bailey
Funding: $25,000 (SP&R) Deployment FFY12-14
Project Manager: Meadow Bailey & Hannah Blankenship
Project Complete

The public education campaign will encompass several communication media elements - including print, radio, television, and social media. Assess effectiveness of media campaign through surveys, monitoring coverage, interviews, and data and information analysis.

**Benefit to the State:** Information was provided to the public regarding flashing yellow arrows at intersections.


*Image from publication*

## T2-13-15 Value of Depressed Medians on Divided Highways in Alaska

Principal Investigator: Dr. Ghulam Bahm & Dr. Osama Abaza (UAA – AUTC)
Funding: $150,000 SP&R
Project Manager: Anna Bosin, P.E.
Completion Date: June 2015

The population of Alaska is steadily increasing, especially in the city of Anchorage. As a result, traffic volume is higher, and the demand to add lanes to existing highways in order to relieve congestion is increasing. In Alaska, an expressway or freeway is a high-speed (≥ 50 mph), multilane, divided highway with partial access control. These divided highways typically utilize wide medians.

During the Alaskan winter, where snow accumulates in medians from October to April, drivers can lose control of their vehicles in slippery road conditions. Wide medians with heavy snow serve as a refuge to absorb the impact of a crash. However, in order to provide additional through lanes, cater to the needs of higher traffic, and keep traffic congestion to a minimum, these wide medians could be replaced with narrow ones which may reduce the median's ability to function as a safety cushion. These depressed wide medians also act as snow storage areas, allowing snow to be plowed on both sides of the road. Eliminating these medians will reduce the available snow storage space and require plowing all of the snow to the right, increasing the snow load to one side of the road.

The main objective of this project is to compare the benefits of depressed wide medians (vee ditch) with other types of medians (narrow medians and no snow storage) in terms of safety, operations and maintenance. This will include analysis of historical crash data along with snow storage observations and vehicle tracking observations after snowfall to evaluate non-crash reported run off the road type incidents. The researchers will compare known high speed urban arterials with narrow medians (no vee-ditches) and no snow storage and additional lanes to improve traffic flow.

**Benefits to the State:** The results of this research will be valuable in helping Alaska's highway designers to determining appropriate engineering alternatives to deal with increasing traffic volumes in Anchorage and the surround areas.

***Photo:*** *The research team is compiling photos from car mounted GPS equipped video cameras to analyze runoff the road events. Photo taken on the Glenn Highway near Eklutna in December 2013 by Scott Thomas, ADOT&PF Traffic and Safety Engineer.*

## T2-13-16 Optimizing Highway Patrol Investment Levels

Principal Investigator: Billy Connor (UAF – AUTC)
Funding: $100,000 SP&R
Project Manager: Anna Bosin, P.E.
Completion Date: June 2015

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.

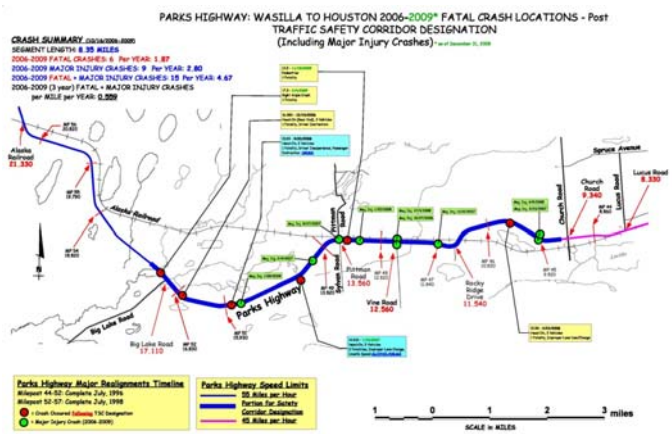
How can enforcement be directly linked to road safety when officers provide multiple duties away from roads? Reductions in citations or arrests could falsely indicate staffing reductions are possible when they may actually be needed to continue the trend.

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 in the Matanuska-Susitna area safety corridors. 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

**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 ).



## T2-14-07 Experimental Feature: Wavetronix© Radar Traffic Detection

Principal Investigator: Daniel Adamczak, P.E., Northern Region Preconstruction
Funding: $35,000 (SP&R)
Project Manager: Dave Waldo
Estimated Completion Date: December 2015

This experimental feature will test 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. The product is expected to be installed in the summer of 2014.

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.

**Benefits to the State:** If the Wavetronix© system proves to be constructible and cost-effective, it could 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

## T2-14-16 Modeling Passing Lane Behavior on Two-Lane Highways

Principal Investigator:
Funding: $340,000 (SP&R)
Project Manager: Anna Bosin, P.E.
Estimated Completion Date: December 2015

The researchers will conduct a driver-simulator-based study 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 high-fidelity driver simulation in a laboratory environment. Participants in the study will complete a driving simulator session and a questionnaire to further documenting the characteristics of their behavior. In addition to the driver simulator study, the researchers will use AASHTO SHRP2 naturalistic driver study data to validate the driver simulator study and model the passing maneuver based on this rich set of field data.

**Benefits to the State:** The outcome of the project will provide the ADOT&PF's with models that can be used to predict the risk level on two-lane rural highway and will contribute to a more efficient and safe traffic operations in two-lane rural highways, a major part of the transportation network infrastructure in Alaska.

## T2-14-04 Rapid Research Response FFY 2014-16

Principal Investigator: Various
Project Manager: Carolyn Morehouse, P.E.
Completion Date: Varies by project but all must be completed by December 2016

The Rapid Research Response program supports a portfolio of research projects, technology transfer, and workforce development activities to rapidly respond to opportunities to improve practices, procedures, and processes within the department as they arise and on an ad hoc basis. The account is funded through a revolving line item in the section's work program entitled "Rapid Research Response".

The research response project funds the following types of research activities:

•Generally short term, high priority research projects to provide or address urgently needed information and or problems.

•Augment existing research projects to take advantage of unforeseen opportunities where timing is of the essence. During the course of a research project, the researchers may identify a previously unforeseen opportunity or method worthy of exploration to enhance the research and provide more useful results. The "Rapid Response" funds allow timely response to such opportunities.

•Research coordination and advisory services with national, university, and other state research programs.

•Unique and timely research and technology demonstration efforts.

•Policy-related research to address the immediate needs of decision-makers.

**Benefits to the State:** DOT&PF can conduct research in a short period of time with quick results for immediate implementation.

| Project Title | Project # | Amount | Contact |
|---|---|---|---|
| Fly Ash Mix Design | T2-14-15 | $26,000 | Anna Bosin, P.E. |
| Driver Behavior Analysis | T2-14-16 | $11,000 | Anna Bosin, P.E. |

## 61085 Research & Technology Deployment FFY 2012-2014

T2-11-18
Project Manager: Carolyn Morehouse, P.E.
Completion Date: Varies by project but all must be completed by December 2014

The Research & Technology Deployment program augments the ADOT&PF portfolio of research projects, technology transfer, and workforce development activities to rapidly respond to opportunities to **implement** practices, procedures, and processes within the department as staff become aware of such opportunities. Emphasis is on research and technology transfer products from other states or research programs. The account is funded through a revolving line item in the section's work program entitled "Research & Technology Deployment".

**Benefits to the State:** The benefits of this program are enhanced implementation and deployment of research and technologies as they become known to the ADOT&PF. Examples of externally developed research and technologies include products of the Transportation Research Board's cooperative research programs, other state DOTs, international transportation programs, and professional organizations. The "Research & Technology Deployment Program" supports the following types of activities necessary for implementation and deployment of research and technology products developed external to the RD&TT program of ADOT&PF:

•Scans of international, national, and state research and technology products for potential deployment within the department.
•Communication, outreach, marketing, and education activities, products, and tools necessary to raise awareness and promote deployment of external research results within the department and other stakeholder agencies.
•Facilitation of workshops, technical and policy meetings, social networking, partnerships and other necessary promotion of research and technology products and activities to maximize their deployment.
•Professional technical communications and publication services and activities.
•Professional services needed for deployment.

| Project Title | Project # | Project Amount | Status |
|---|---|---|---|
| Video Documenting Best Practices for Mitigating Frost Damage | T2-12-05 | $20,958 | Complete |
| Development of TAMP | T2-12-08 | Canceled | Canceled |
| Flashing Yellow Arrows Public Info Campaign | T2 | $25,000 | Complete |
| Development of GPS Survey Data Management Protocols/Policy | T2-13-02 | $10,000 | Complete. |
| Expedient Permafrost Resistivity Investigation (Ohm Mapper) | T2-13-07 | $68,000 | Complete |
| Enhancing Research & Technology Deployment Through Program Recording | T2-13-20 | $30,000 | Complete |
| Improving Quality Workshop | T2-13-21 | $40,000 | Ongoing |
| Bridge Seismic Training | No # | $30,000 | Complete |
| Communications Specialist AUTC | No # | $27,500 | Complete |

## T2-11-19 Experimental Features FFY 2012-2014

Principal Investigator: Varies
Funding: $126,000 (Federal)
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, the FHWA will pay for its repair or replacement. Experimental features are often physical objects, however, can also be a new technique for using conventional materials.

The RD&T2 Program maintains an account to support evaluations of Experimental Features.

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

**FFY14 Experimental Features**

| Project Title (construction project) | Research Project # | Amount | Contact |
|---|---|---|---|
| Fiber Reinforced Panels (Parks MP 239-252) | T2-14-05 | $25,000 | Anna Bosin, P.E. |
| Spray Applied MMA Bridge Deck Waterproofing (Rich MP 201 Phelan Cr Bridge) | 64317 | $29,000 | Janelle White |
| Wavetronix Radar Detection (Johansen & Airport Way PM) | 64321 | $35,000 | Anna Bosin, P.E. |

**FY12&13 Experimental Features**

| Project Title (construction project) | Research Project # | Amount | Contact |
|---|---|---|---|
| Polyester Concrete Approach Slabs (Parks MP 239-252) | T2-13-19 | $51,000 | Janelle White |
| Tencate Mirafi Wicking Fabric (Dalton 197-200) | T2-13-10 | $30,000 | David Waldo |
| Long Term Monitoring Ice Rich Cut Slopes (Dalton) | T2-13-12 | $40,000 | Complete |
| Site Manage (2012) | No # | $21,000 | Complete |

**Pooled Fund Studies FFY 2014**
Principal Investigator: Varies
Funding: $72,600 (SP&R)
Completion Date: various

**Benefits to the State:** When significant or widespread interest is shown in solving transportation-related problems, research, planning, and technology transfer activities 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. ADOT&PF participates in the following pooled fund studies. Details and status are available at http://www.pooledfund.org/.

| Title | Study ID | Lead Agency | ADOT&PF FFY 2014 Funding | Project Website/ADOT&PF Technical Lead |
|---|---|---|---|---|
| **FFY 2014 Funding** | | | | |
| Assessing Roadway Traffic Count Duration and Frequency Impacts on AADT Estimations. | TPF-5(292) | FHWA | $6,000 | http://www.pooledfund.org/Details/Study/534 Jennifer Anderson |
| Simplified SPT Performance-Based Assessment of Liquefaction and Effects | TPF-5(296) | Utah Department of Transportation | $13,000 | http://www.pooledfund.org/Details/Study/538 David Hemstreet |
| Aurora Program | SPR-3(042) | Iowa Department of Transportation | $25,000 | www.pooledfund.org/Details/Study/189 Jack Stickel |
| Validation of Tsunami Design Guidelines for Coastal Bridges | Solicitation # 1332 | Oregon Department of Transportation | $25,000 | www.pooledfund.org/Details/Solicitation/1332 Rich Pratt |

# Alaska Technology Transfer



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

**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. Each LTAP center adapts its program to address the unique challenges faced by the customers it serves. LTAP's primary focus is on:

- training events and programs
- newsletters and tech briefs
- library services.

**National Highway Institute: $350,000**
Provides transportation-related education programs to AK DOT&PF employees to help improve the quality of the state's highway system by enhancing economic growth, improving public safety and quality of life, and promoting environmental stewardship. This is accomplished by technology transfer to the planning, design, construction, and maintenance personnel working for Alaska's transportation infrastructure.

**T2-13-06 Rapid Technology Transfer: $100,000**
State of Alaska program designed to respond to high-value, unprogrammed needs related to training and technology transfer. Funds are limited to courses, projects, programs, or equipment that will benefit the maximum number of stakeholders. Use of funds should result in cost savings, leveraging of external resources, or enhancement of partnerships.

**CY 2012 Program Dashboard**
Total number of training sessions: **89**
Total number of participants: **1,342**
Total number of participant hours: **13,022**

**CY 2013 Program Dashboard**
Total number of training sessions: **80**
Total number of participants: **1601**
Total number of participant hours: **17,839**

**T2 Highlights**

- Specialized training on gravel road inspection and maintenance planning to Fairbanks North Star Borough and Mat-Su area road commissioners to help them inspect and manage their service areas.
- Continuing participation in Alaska Summer Research Academy by delivering the civil engineering module to high-school students.
- Continuation and expansion of Construction Management Program with UAF's Institute of Northern Engineering.
- Developed and deployed an on-line version of the OSHA Hazard Communication (HAZCOM) workshop that has allowed 1700 employees to complete this required training on demand.
- Developed and deployed a rural airport maintenance video for airport contractors in cooperation with M&O.
- On-going management/delivery of the ATSSA and Alaska CESCL training programs.