Annual Report 2007

Research Development and Technology Transfer

SPREAD FOOTING SECTION

NOTE:
For design limits of walls see Section.

Use Refer.

For general drainage notes see Wall Details.

Optional Key

Construction joint

Batter Backface

2” Clear

Stop

H=8 to 22
1’-0’
2’-5’
H=24 to 30

3” Clear

W/4 for H
W/3 for H

H=16
35 dia.

W/4 for H
W/3 for H

42 dia.

Transportation & Public Facilities
State of Alaska

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For general drainage notes see Wall Details.

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Stop

H=8 to 22
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W/3 for H

H=16
35 dia.

W/4 for H
W/3 for H

42 dia.

Transportation & Public Facilities
State of Alaska
This is a report of research, development, and technology transfer activities carried out by the Alaska Department of Transportation & Public Facilities and its partners. These projects and services are funded through the State Planning and Research Program of the Federal Highway Administration, U.S. Department of Transportation. This report covers federal fiscal year 2007, beginning October 1, 2006, and ending September 30, 2007.

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Fiscal Summary: Suzanne Boyer
AKDOT&PF Research & Technology Transfer Section

Cover photo of Portage, Alaska, by Chuck Eldridge

Graphic design and layout: Sue and Russ Mitchell, Inkworks
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Federal fiscal year 2007 was a time of tremendous change for the Research Development & Technology Transfer (RDT2) Section of the Alaska Department of Transportation & Public Facilities (AKDOT&Pf). We began the year with three of our six positions newly vacated: the section chief, a research engineer, and our office administrative coordinator. During the year, we’ve hired two new research engineers, filled our administrative coordinator position twice, and I became the brand new section chief.

In many ways our experience is typical of the dramatic changes occurring throughout the department and throughout the nation as the transportation industry adjusts to the reality that the retiring baby boomers are leaving a significant gap in the senior ranks of the workforce and experienced successors are in short supply. State transportation agencies especially are finding many unfamiliar challenges as they try to replace their seasoned retirees with fewer, younger, and ambitious members of the 21st century workforce. These new recruits are resourceful, innovative, and eager to learn new skills and embrace new technologies. They are also willing to diversify their career experiences as they compete for personal and professional development and fulfillment. Gone are the days of the loyal, 30-year company employee. To succeed, our new transportation professionals need more and frequent training, mentoring, and opportunities to collaboratively test and develop their skills and talents.

I can’t imagine a richer array of opportunities to fully challenge 21st century transportation workforce: Our increasingly mobile society expects more than ever from the transportation system. They want fewer construction delays, less congestion, safer conditions in inclement weather, less environmental impact, and greater input into transportation and community planning and decision-making. Today’s transportation professionals must address all of these demands in an increasingly collaborative and interdisciplinary environment, often with fewer resources as costs escalate. In addition to enhancing workforce development efforts, innovation will be the key to success.

Recognizing the need to increase efforts in workforce development and innovation in transportation for the future, the United States Congress increased federal investment in transportation research, development, and technology transfer through the Safe, Accountable, Flexible, Efficient, and Transportation Equity Act: A Legacy for Users (SAFETEA-LU). We are especially fortunate that this legislation authorized a new national university transportation center in Alaska to help address present and future issues for transportation in Alaska and other cold regions. The University of Alaska seized this opportunity and created the Alaska University Transportation Center (AUTC) with federal approval of their strategic plan in late 2006. AUTC chose its theme, “Transportation Safety, Security, and Innovation in Cold Regions” with the needs of the Alaska and national transportation community in mind.

AKDOT&Pf has recognized the tremendous opportunities presented by the existence of AUTC and, through the RDT2 section, invested $625,000 in state matching funds following AUTC’s first request for research proposals in
FFY 2007. The resulting eight applied research projects promise to improve AKDOT’s practices related to bridge and pavement design, increase our understanding of frozen soil-structure interactions during earthquakes, and provide guidelines for risk analysis in construction contracting. In addition, we have partnered with AUTC to provide customized training opportunities to transportation practitioners throughout Alaska. I am optimistic that we can build upon and sustain these efforts well into the future.

Looking forward, I see that we have just begun what will be a long, challenging, but potentially very rewarding journey. I am convinced that the demand for quality research, development, technology transfer, and workforce development services will only increase. Our success in addressing these demands will depend upon our willingness to collaborate and commit to implement the continuing advances in transportation technology, meet the increasing demands from our customers (the travelling public), and position the changing workforce for success. The future of Alaska depends on our mutual efforts. We’re looking forward to the journey.

Clint Adler, P.E.
The Research, Development, and Technology (RDT2) Section is the department’s key resource for developing Alaska’s transportation workforce, and incorporating technology and innovation into the department’s practices. The RDT2 section helps the department achieve its mission and goals more efficiently, effectively, and economically through research, development, and technology transfer services.

The Research and Technology Transfer section’s services include:

- developing and maintaining the department’s research and training programs;
- identifying research needs;
- managing research projects;
- helping to implement research results;
- identifying, evaluating, developing, and promoting promising technologies and opportunities to improve transportation practices in Alaska;
- promotion of reciprocal awareness within the national and international transportation community of beneficial and promising technologies developed in Alaska;
- workforce development through:
  - training
  - technical Assistance
  - quarterly *Technology for Transportation* newsletters
- library and technical information services;
- developing and maintaining collaborative research, technology transfer, and funding partnerships, including (but not limited to):
  - Transportation Research Board
  - National Cooperative Highway Research Program
  - Alaska University Transportation Center (AUTC)
  - Northwest Transportation Consortium
  - Federal Highway Administration
  - American Association of State Highway Transportation Officials Standing Committee on Research and Research Advisory Committee

Transportation Pooled Fund Program
National Highway Institute
Local Technical Assistance Program
Border Technology Exchange Program
RDT2 staff from the left: Simon Howell, Dave Waldo, Suzanne Boyer, Steve Barney, Jim Sweeney, and Clint Adler.
Fiscal Summary

RDT2 receives funding from the Federal Highway Administration’s State Planning and Research Program (SP&R), Local Technical Assistance Program (LTAP), Surface Transportation Program (STP), Border Technology Exchange Program (BTEP), Alaska University Transportation Center (AUTC), and state matching funds (SM).

FFY 2007 State Planning and Research (SP&R) Budget

<table>
<thead>
<tr>
<th>FFY 2007 State Planning &amp; Research Budget</th>
<th>$1,586,100</th>
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<tr>
<td><strong>Revenues</strong></td>
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<tr>
<td>Federal Funds</td>
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<td>State Funds</td>
<td>$317,220</td>
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<tr>
<td>Total</td>
<td>$1,586,100</td>
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2007 Expenditures & Obligations (Includes 4.9% ICAP)

| 100% Federal Funds                       |           |
| NCHRP Dues                               | –$266,000 |
| TRB Dues                                 | –$100,000 |
| Pooled Fund Studies                      | –$35,000  |

| 80% Federal/20% State Funds             |           |
| Match for Local Technical Assistance Program | –$280,000 |
| Rapid Research Response Program*        | $0        |
| Innovative Features Program*            | $0        |
| Research Project Programming            | –$905,100 |
| Total                                   | –$1,586,100|

FFY 2008 State Planning & Research Budget $1,940,975

| Revenues                                |           |
| Federal Funds                           | $1,552,780|
| State Funds                             | $388,195  |
| Total                                   | $1,940,975|

Estimated Expenditures & Obligations (Includes 4.9% ICAP)

| 100% Federal Funds                       |           |
| NCHRP Dues                               | –$278,000 |
| TRB Dues                                 | –$100,000 |
| Pooled Fund Studies                      | –$100,000 |

| 80% Federal/20% State Funds             |           |
| Match for Local Technical Assistance Program | –$280,000 |
| Rapid Research Response Program          | $100,000  |
| Innovative Features Program             | $0        |
| Research Project Programming             | –$1,282,975|
| Total                                   | –$1,940,975|

ICAP = Indirect Cost Allocation Plan
* Project funded from previous years
### 2007 Technology Transfer Programs

<table>
<thead>
<tr>
<th>Project</th>
<th>Title</th>
<th>Calendar Year 2007 Funding</th>
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<tr>
<td>Training and Technical Transfer</td>
<td>Local Technical Assistance Program</td>
<td>$340,000 (LTAP and SP&amp;R)</td>
<td>Dave Waldo</td>
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<td>Training for AKDOT&amp;PF Personel</td>
<td>National Highway Institute</td>
<td>$450,000 (STP and SM)</td>
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<td>Training and Technical Transfer</td>
<td>Border Technology Exchange Program</td>
<td>$16,000 (BTEP)</td>
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<td>Training and Technical Transfer Supplement</td>
<td>Alaska University Transportation Center/Local Technical Assistance Program match</td>
<td>$125,000 (LTAP and AUTC)</td>
<td>Dave Waldo</td>
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### Programmed SP&R Funds, FFY 2006–2007

- LTAP 20%
- TRB & NCHRP 25%
- Supplemental Research Programs (4) 9%
- Environmental (2) 7%
- Hydraulics/Hydrology (2) 5%
- Preconstruction/Design (1) 3%
- Materials/Geotechnical (1) 3%
- Bridges/Structures (3) 12%
- AHMS (1) 2%
- Traffic & Safety (2) 3%
- Planning (1) 2%
- Maintenance & Operations (1) 2%
- Construction (2) 4%
- TRB & NCHRP 25%
- Supplemental Research Programs (4) 9%
- Environmental (2) 7%
- Hydraulics/Hydrology (2) 5%
- Preconstruction/Design (1) 3%
- Materials/Geotechnical (1) 3%
- Bridges/Structures (3) 12%
- AHMS (1) 2%
- Traffic & Safety (2) 3%
- Planning (1) 2%
- Maintenance & Operations (1) 2%
- Construction (2) 4%
## New Research Project Reports in FFY 2007

<table>
<thead>
<tr>
<th>Title</th>
<th>Report Number</th>
<th>Date Published</th>
<th>Contact</th>
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<tr>
<td>Preliminary Study of Scour in Bottomless Culverts</td>
<td>FHWA-AK-RD-06-05</td>
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<td>Jim Sweeney</td>
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<tr>
<td>Bridge Seismic Retrofitting</td>
<td>FHWA-AK-RD-06-06</td>
<td>Pending</td>
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<td>Evaluation of Alternate Embankment Construction Methods</td>
<td>FHWA-AK-RD-07-01</td>
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<td>Jim Sweeney</td>
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<td>Theoretical Standard Density Determination with Troxler Gauge</td>
<td>FHWA-AK-RD-07-02</td>
<td>4/1/07</td>
<td>Steve Saboundjian</td>
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<td>Use of Rubber in Hot Asphalt to Reduce Rutting</td>
<td>FHWA-AK-RD-06-02</td>
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<td>Steve Saboundjian</td>
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<td>Vegetation Study of Alaska's Richardson Highway: Identification of Plant Communities and Assessment of Control Strategies</td>
<td>FHWA-AK-RD-06-04</td>
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<tr>
<td>Workflow Optimization</td>
<td>FHWA-AK-RD-06-03</td>
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<td>The Effects of a Winter Ice Jam Event on Bioengineered Bank Stabilization Along the Kenai River</td>
<td>FHWA-AK-RD-07-03</td>
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<td>Effects of Multiple Freeze Cycles and Deep Frost Penetration on Pavement Performance and Cost</td>
<td>FHWA-HRT-06-121</td>
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<td>Pavement Subgrade Performance Study</td>
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<td>Research on the Upstream Passage of Juvenile Salmon Through Culverts: Retrofit Baffles</td>
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<td>Electronic Appraisal Development Study</td>
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<td>Evaluation of Alternate Embankment Construction Methods</td>
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<td>Design Manual for Air-Cooled Embankments</td>
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<td>Influence of Low Temperatures on the Ductility of Bridge Structures in High Seismic Regions</td>
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<td>Alaska Bridge Design Synthesis &amp; Bridge Design Manual</td>
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<td>Yukon River Bridge Decking Research</td>
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<td>Optimizing Implementation of Civil Rights Requirements for Vessel Construction</td>
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<td>Aggregate Abrasion Using Nordic Ball Mill Test</td>
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<td>Development of a Rapid Wetland Assessment Model for Alaska</td>
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<td>Steel Column to Steel Cap Beam Bridge Pier Connection Improvements</td>
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<td>Documenting Best Management Practices for Ice-rich Soils &amp; Permafrost Sites</td>
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<td>Evaluation of Alternatives for Integrated Vegetation Management for AKDOT&amp;PF</td>
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<td>Evaluation of Risk Factors for Repeat DUI Offenses</td>
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<td>Review of Crash Reduction Factors for Use in the HSIP</td>
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* New projects are those with project numbers T2-07-XX.
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<tr>
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<td>Demonstration of Nonintrusive Traffic Data Collection Devices in Alaska</td>
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<td>Environmental Impact of Creosote-Treated Marine Piles</td>
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<td>Jim Sweeney</td>
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<td>Development of Design Criteria for Vegetated Riprap</td>
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<td>Jim Sweeney</td>
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<td>Analysis of DOT Pile Driving Testing</td>
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**Pooled Fund Studies**

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<td>Western Maintenance Partnership</td>
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### 2007 State-Funded AUTC Research Projects

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<tr>
<th>Research Category</th>
<th>AUTC Project ID</th>
<th>Title</th>
<th>State FY 2007 Match Funding</th>
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<tr>
<td>Bridge Design</td>
<td>107013</td>
<td>Alaska Bridge Bent Pushover Software Including Concrete Confinement Effects</td>
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<td>Impact of Fines Content on Resilient Modulus Reduction of Base Courses During Thawing</td>
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**FY 2007 State Funding**

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13
Developing GPS Survey Data Management Protocols and Policy

The benefits of global positioning system (GPS) technology can be summed up as cheaper, better, faster. When properly used, GPS can lower grading and earth-moving costs from 15 to 30%; reduce errors; provide instantaneous determination of position in X, Y, and Z axes; enable easy interim estimates for pay quantities; and result in less staking and more accurate grading.

In the last five years in the construction industry, Real Time Kinetic (RTK) GPS surveying has become the most common method of staking construction projects. Completion time and reduced manpower requirements have made the method more popular. Alaska contractors are increasingly equipping bulldozers, graders, and backhoes with automated grading technology to determine blade and bucket position, resulting in faster and more accurate grading, less rework, more efficient surveys, and less machine idle time.

Our project goal is to determine best practices for ADOT&PF in using GPS to stake out construction features and control earthmoving equipment equipped with automatic grading instrumentation. GPS surveying methods have been included in project contracts with approval of ADOT&PF Location Section surveyors in accordance with the draft Alaska Survey Manual. While this approval process was sufficient for ensuring project control was properly established and that GPS parameters were checked, other construction administration problems arose with the use of this “black box” technology. Unfamiliar with system capabilities, ADOT&PF construction inspectors had difficulty

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Displays measurements and guides the operator.

GPS records and maps the compaction results.

Accelerometer on drum measures soil stiffness as an indication of soil compaction.

GPS base station = centimeter accuracy.
This research project proposes to adapt to these technical advances by:

Rewriting the *Alaska Survey Manual* to require a written quality control plan for GPS surveys. The contractor would be required to submit a detailed narrative explaining how the GPS survey will be conducted, equipment calibrated, qualifications of personnel, etc. A registered land survey (RLS) will be required to approve any ground models produced during the work.

Surveying project engineers by questionnaire to assess problems encountered and solicit solutions.

Conducting training in automated machine grading and RTK stakeout methods.

Establishing one pilot project per region to obtain RTK GPS equipment and use it on projects in the 2008 construction season.

Conducting a literature search on solutions from other states and AASHTO's Technology Implementation Group.

Communicating with contractors and surveyors through their trade organizations.

Based on what is learned in the 2008 construction season, the research will:

Propose changes to Section 642, Construction Surveying, of the Standard Specifications.

Recommend changes to the design and construction manuals, especially as regards design information to be provided to the contractor.

Identify appropriate training, software, and computer equipment to enable the best use of GPS technology.
Research Project Summaries

T2-03-02 Experimental Study on Seismic Retrofit Techniques for Cap Beam, Columns, and their Connections of Highway Bridges

Status: Completed and implemented

This research developed seismic retrofit methods for cast-in-place steel shell (CISS) column foundation shaft-to-cap-beam connections. The research was conducted at the University of Missouri-Rolla Center for Infrastructure Engineering Studies.

Specific seismic improvements made to the column and the bent cap system were: (1) the moment capacity of the column was reduced by cutting a portion of the column longitudinal reinforcement at the connection to the bent cap to levels that can ensure a proper ductile seismic response; (2) a section of the steel shell was cut and removed, leaving a gap between the steel shell and the bent cap; and (3) the bent cap dimensions were increased to ensure proper reinforcement spacing and to install the additional flexure and joint shear reinforcement, which was designed according to well-established joint shear force transfer mechanism models.

At the conclusion of this research, recommendations were made for seismic retrofit of multicolumn bridge bents with circular CISS columns. These recommendations are being incorporated into the department’s bridge design procedures. The final report, Seismic Retrofit of CISS Pile Bent Cap Connections, is available.
The goal of this research was to develop recommendations for the future seismic design or assessment of reinforced concrete bridge bent structures in cold seismic regions. Ten large-scale circular columns were constructed and tested under cyclic reversal of loads inside an environmental chamber in the North Carolina State University Construction Facilities Laboratory (CFL). The columns were tested at below freezing (−40°C, −40°F) and ambient (23°C, 74°F) temperatures. In order to characterize every aspect of the seismic response at low temperatures, the columns’ design was governed by a desired behavior or geometry: shear dominated, flexural dominated, and reinforced concrete-filled steel tube columns.

Results obtained show that reinforced concrete members exposed to the combined effect of sub-freezing temperatures and cyclic loads undergo a gradual increase in strength and stiffness coupled with a reduction in displacement capacity. The experimental results were used to calibrate a fiber-based model, and a series of static and inelastic analyses were performed on typical Alaska DOT bent configurations. Based on the results obtained from the experimental tests, the nonlinear simulations, and a moment-curvature parametric analysis, a simple methodology was developed to account for the low-temperature flexural overstrength and reduction in ductility.
T2-06-06 Alaska Bridge Design Synthesis

This study has provided a comprehensive report comparing bridge design practice in Alaska to national practice and trends. Jorgensen and Associates has been under contract to perform this work. Their synthesis report was delivered in June 2007. This work will help DOT&PF implement a federal mandate requiring load reduction factor design (LRFD) of all highway bridges. Unclear portions of the LRFD specifications have been interpreted and clarified to help define bridge design policy and practice in Alaska. The synthesis report draws on research literature as well as technical subcommittee proceedings and suggests policy language and chapter headings to be used in writing a bridge design manual for Alaska.

In the next phase of this work, Jorgensen and Associates will write the bridge design manual for Alaska. This work will benefit the department by providing clear policies and procedures for implementing the new LRFD standard.

T2-06-10 Yukon River Bridge Deck Materials Research

Status: Under contract to Alaska University Transportation Center

Research is being conducted at the Alaska University Transportation Center to evaluate alternative decking materials for the E. L. Patton Bridge. This orthotropic steel deck bridge is on the haul route to the North Slope oil fields and carries heavy oilfield modules and the Trans-Alaska oil pipeline across the Yukon River on a 6 percent grade. The bridge was also designed to carry a gas pipeline.

After the bridge was constructed, it was surfaced with a temporary Douglas fir timber plank wearing surface. The timber decking has required periodic replacement due to the abrasion caused by truck tire chains as well as degradation from decay. With the increasing cost and decreasing quality of available timber, other decking materials are being considered. To be a viable option, the new decking material must be durable, light weight, skid resistant, cost effective, and be compatible with the flexible orthotropic steel bridge deck.

Several alternative decking materials have been considered, including high-density polyethylene and fiber-reinforced polymers. The Alaska University Transportation Center has constructed a traction testing machine to simulate truck tire loading conditions for testing these materials. Also, field test sections have been installed on the bridge to demonstrate actual performance. The objective of this research is to identify a material that can be used in the design of a durable wearing surface for the bridge.
T2-07-03 Steel Column to Steel Cap Beam Bridge Pier Connection Improvements

Status: Under contract to North Carolina State University

This research project is focused on testing the seismic performance of a connection detail used for bridges and docks. The structural system consists of steel pipe columns welded to a steel cap beam. The performance of the welded connection is critical to the development of sufficient ductile behavior in the system. The research is being conducted at North Carolina State University and is scheduled to be completed by June 2009.

The first phase of this research will test the structural system as it is currently designed and constructed. If the system exhibits adequate ductility, other variables will be introduced such as adverse welding conditions and poor joint locational accuracy. Depending on the outcome of the initial testing, improvements to the connection detail may be incorporated in subsequent tests. Alternative connection details will be proposed as appropriate. This research will provide recommendations for both the current load and reduction factor design (LRFD) method as well as for anticipated displacement-based design criteria.

TPF-5(068) Long-Term Maintenance of Load and Resistance Factor Design Specifications

Status: Ongoing. Last contribution in 2005

The objective of this pooled fund study is to provide timely assistance to the AASHTO Highway Subcommittee on Bridges and Structures in implementing, revising, and refining the ASHTO Bridge Load Resistance Factor (LRFD) documents.

In order to facilitate the shift to LRFD design methods, this pooled fund study is providing support needed for LRFD specifications maintenance. This work includes providing the technical assistance necessary for making corrections, clarifications, and additions. Specification formatting and documentation of revisions are also undertaken.

Many states have contributed to this effort. A total of $2,240,000 has been committed so far, with contributions from Alaska DOT&PF of $40,000. The Alaska DOT&PF Bridge Section relies on AASHTO LRFD specifications exclusively for new bridge design and sees significant value in supporting this effort.
T2-02-03 Effectiveness of Paving on Airborne Particulate Matter in Kotzebue, Alaska

Status: Alaska Department of Environmental Conservation will conclude post-paving dust monitoring during summer of 2008 and complete project reporting by December 2008. Interim reports available.

Kotzebue, one of the larger cities in northwest Alaska, has undergone a steady population growth over the past 20 years. This growth has resulted in a vast expansion in the local road network. This demand for new roads led to a substantial increase in the number of unpaved road surfaces as well as an increase in vehicular traffic and airborne particulate matter. This elevation in the level of particulate air pollution is causing Kotzebue residents to experience an increase in respiratory illnesses. When the air becomes dusty, the number of health problems and hospital visits increase.

The objective of this project is to determine if paving a portion of Kotzebue’s dirt roads will be effective in reducing the levels of particulate emissions from the road surface due to vehicle traffic and winds. The project will also assess the overall reduction in the concentration of airborne particulate matter in Kotzebue.

T2-04-03 Development of a Rapid Wetland Assessment Model for Alaska

Many AKDOT&PF projects involve unavoidable impacts to wetlands due to Alaska’s unique climate and ecosystems. To satisfy requirements of state and federal environmental laws and policies and to ensure environmentally responsible transportation planning and decision-making, AKDOT&PF must assess the functions and values of wetlands potentially affected by transportation project alternatives. No single or standard method exists for assessing wetlands specifically throughout Alaska.

Lack of a standardized wetland assessment method for highway projects in Alaska has resulted in inefficient environmental reviews. Objective, consistent, and efficient functional assessment techniques that reflect Alaska’s varied climates and ecosystems are needed. AKDOT&PF needs guidance for developing a rapid wetland functional assessment procedure for Alaska’s transportation projects.

Under Phase I of this research, researchers analyzed and synthesized rapid wetland functional assessment practices from other states and agencies potentially applicable to Alaska. Their task was to identify data and information needs necessary to develop an Alaskan statewide rapid wetland functional assessment protocol. The complete report is available at http://www.dot.state.ak.us/stwddes/research/assets/pdf/fhwa_ak_rd_05_09.

Phase II of this research effort will further examine and customize for Alaska the most suitable rapid wetland assessment techniques identified from Phase I, the Montana Wetland Assessment Method and the Washington State Wetland Rating System for Western Washington. In addition, the study will make an assessment of the feasibility of using GIS techniques for wetland delineation and assessment for large, corridor-scale projects.
T2-07-11 Environmental Impact of Creosote Marine Piles


The goal of this project is to identify and document the acceptable level of environmental impacts from creosote-treated wood piling in aquatic environments. ADOT&PF is responsible for many structures that incorporate wood pilings in Alaskan waters. Many of these are treated with creosote, which is generally the most economical method of wood preservative. However, creosote contains many toxic chemicals, and some governments and organizations are limiting creosote use. AKDOT&PF does not have a policy regarding use of creosoted wood, although it is responsible for the safe disposal of any creosoted wood removed for maintenance and new construction. The principal investigator, Dr. Robert Perkins, has presented a technical paper based on this research entitled “To Pull or Not to Pull: Risk Management of Creosote Piles in Marine Waters” to the spring meeting of the Arctic Marine Oilspill Program on Environmental Contamination and Response.

TPF-5(140) Structural Acoustic Analysis of Piles (Pooled Fund Study)

Status: The technical advisory committee is determining the scope and methods for the study.

Bridges, ferry terminals, and other structures constructed over water commonly have driven pile foundations. Driving piles in water may produce intense underwater sound that can negatively impact aquatic animals. State DOT’s, harbor districts and others must be able to reasonably predict the acoustical properties of sound generated by a project to forecast and mitigate the possible impacts to aquatic animals.

There is little scientific knowledge on noise characteristics produced in relation to variables in pile driving such as pile material, pile shape, hammer characteristics and so on. Understanding the acoustical properties of pile driving will help government and private entities select the proper materials and methods and noise reduction strategies for pile driving to economically ensure proper structural integrity while minimizing the adverse impacts of underwater noise.

The objectives of this study are:
1. To investigate how modifications in pile materials, pile shape, hammer characteristics, the nature of the substratum into which the pile is driven, water depth, the depth to which the pile is driven into the substratum, the load-bearing objective of the pile, and other variables influence the properties of noise generated during pile driving.
2. To develop and validate acoustical source models of pile driving based on pile materials, pile shape, hammer characteristics, and other variables.
3. To develop and validate sound field models of the effects of sound attenuation systems on the sound field close to piles. This includes defining the limits of the near field for different physical conditions (that is, size and shape of pile, depth of water, wavelengths of interest).
4. Develop guidance for DOT’s and other entities to select appropriate materials, methods, and noise reduction strategies for pile-driving projects.
5. To identify additional ranked research topics necessary to address regulatory and practical application solutions.
T2-01-04 Updating Geotechnical Procedures

Status: Completed and implemented

This project was an effort to revise and update AKDOT&PF’s manuals and guides for exploration, testing, and evaluation of geotechnical conditions at proposed project sites. The work was a collaborative effort between the department and the principal investigator Willard Slater, geological consultant.

While the department’s geotechnical personnel had kept pace with advances made in the subject area, the manuals and guides had become outdated and did not include the most modern standards for geotechnical procedures. The PI worked together with department staff to complete the following geotechnical guides and manuals:

- Alaska Field Guide for Soil Classification
- Alaska Field Rock Classification and Structural Mapping Guide
- Alaska Geotechnical Report Preparation Guidelines
- Alaska Geotechnical Field Investigations Guide
- Alaska Guide to Description and Classification of Peat and Organic Soil

The department staff is continuing implementation efforts to complete these additional guides:

- Alaska Material Site Investigations Guide
- Alaska Geotechnical Procedures Manual Checklists
- Guide to Liquefaction Analysis
- Foundations Investigation Guide
T2-02-04 Eliminating Longitudinal Cracking

Status: Completed and implemented

This research examined new techniques to cool embankment side slopes, with the goal of avoiding accelerated thaw and longitudinal cracking. The research was conducted by the UAF Department of Mechanical Engineering. The project involved the design and monitoring of an Air Convection Embankment (ACE) that was included as an experimental feature in the Parks/Chena Ridge interchange. The research also involved the use of insulation and horizontally embedded thermosyphons.

The study concluded that the ACE produced a sustained trend of reduced temperatures at the base of the embankment and that settlement and longitudinal cracking was reduced. These findings support the use of ACE in subsequent construction and justify further research to refine the technology. The following reports on this research have been published:

- ACE and Thermosyphon Design Features: Loftus Road Extension Project
- Loftus Road Extension Project: Final Report

T2-08-01 Analysis of DOT&PF Pile Driving and Dynamic Pile Testing Results

Status: Project start-up

Correctly estimating pile lengths is critical for the economic design and construction of pile foundations. The methods used currently to estimate driven pile capacity are based on pile sizes smaller than 24 inches in diameter. Alaska DOT&PF routinely uses piles up to 48 inches in diameter.

Alaska DOT&PF Statewide Materials has gathered a significant amount of pile driving and dynamic pile testing data from projects throughout the state. This project will incorporate the past 15 years of pile driving data into a useable procedure for accurately predicting pile capacity as a function of depth. The department’s foundation and geotechnical engineers hope to use this data to improve static pile capacity estimations and plan to incorporate the results of this research into the department’s pile foundation design procedures.

SPR-3(072) Strength and Deformation Analysis of MSE Walls at Working Loads

Status: Ongoing

An improved method for the design of mechanically stabilized earth (MSE) walls is being developed under this pooled fund study. This effort is being lead by the Washington State Department of Transportation.

It has been demonstrated that the AASHTO simplified method is sufficiently accurate for steel strip reinforced soil walls. This research is investigating the K-stiffness method of wall design and validating results with various soil types in a series of full-scale field tests. A database of case studies has been created which now contains 42 entries. Current research activities have been focused on the influence of reinforcement stiffness, facing batter, and surcharging on wall performance.

Improving MSE wall technology has many potential benefits to the department, such as improved safety and reliability and more economical designs.
T2-99-02 Verification of Roughness Coefficients

Status: Completed. USGS published two scientific investigations reports.


This project provided matching funding to support a U.S. Geological Survey effort to collect hydrologic data on numerous Alaska streams. Southeast Alaska produced valuable data, with higher than normal stream flows. This allowed stream flow modeling researchers to perform calibration and verification of channel roughness. Stream flow modeling indicated that hydraulic engineers need higher estimates of roughness coefficients on steep Alaska streams.

Historically, nationally published roughness coefficients tend to lead designers to underestimate roughness and underestimate flood heights on many of Alaska’s mountain streams. Stream channel roughness estimates in Alaska are critical to effective stream crossing designs.

T2-02-08 Bed Material Retention in Buried Invert Culverts

Status: Completed. Project report, “Preliminary Study of Scour in Bottomless Culverts” is available at http://www.dot.state.ak.us/stwddes/research/assets/pdf/fhwa_ak_rd_06_05.pdf

A common permit stipulation for buried invert culverts is that the bed material within the culvert barrel remains stable up to the 50-year design flood. However, ADOT&PF hydraulic engineers lack design criteria for providing and installing stable bed material in fish passage culverts, including the stability of the streambed material near the culvert inlet and outlet. Existing design methods and criteria do not address streambed material stability in a buried culvert. Also, existing gradation specifications allow sub-bed flow during low flow conditions, which may preclude fish passage.

The Utah Water Research Laboratory undertook a research contract to perform flume studies into common riprap sizing design guides to provide reference hydraulic parameters and bed material properties for designing stable bed material that allows for fish passage in culverts. This study evaluated the scour potential of four substrate materials and the accuracy of six riprap sizing methods.
T2-03-04 Design of Pipe Attachments for Precast Culvert Headwalls

Status: Completed. No research report is available. The effort resulted in proposed standard drawings to be approved by DOT&PF’s Bridge Section.

Precast culvert headwalls are a practical alternative to cast-in-place headwalls (Standard Drawing D-30.03) and have many advantages for both the contractor and AKDOT&PF. Precasting concrete allows better control of curing temperatures, use of better quality concrete from concrete batch plants instead of job mixed concrete, faster construction time at the jobsite, less traffic control expense and less environmental impacts. However, the completed headwalls or headwall parts must be of a size which can be easily transported and must be placed by a crane on site. Under this project, the bridge design section proposed new standard drawings for cast-in-place type I and type II headwalls and precast type I and type II headwalls. These proposed precast headwall designs are limited to single barrel installations; however, contractors may propose alternate precast designs for multibarrel installations in lieu of cast-in-place construction. Also, design has independently developed a new turnbuckle attachment method.

T2-05-05 Vegetated Riprap Survey


AKDOT&PF engineers commonly use riprap to stabilize streambanks at roadways and bridges; however, state and federal natural resource agencies prefer the use of vegetation on stream banks to provide and enhance fish habitat. A potential solution is to produce a hybrid revetment system using rock to stabilize the stream in concert with vegetation to provide and enhance fish habitat. Researchers conducted a site survey of riprap armored stream banks along Alaska highways. The study’s intent was to evaluate and determine the governing parameters of a successful hybrid environment using rock to stabilize the stream banks in concert with vegetation to maintain healthy riparian habitat.
T2-07-01 Ice Forces on Bioengineered Bank Stabilization


The purpose of this cursory research effort was to gather field data and other relevant information necessary to supplement existing knowledge of ice forces on bioengineered bank stabilization structures such as root wads, willow brush layering, and coir logs. The impetus for this study was an ice-jam and flood on the Kenai River in January 2007. The unique winter flood and ice jams were caused by a glacially dammed lake outburst.

The findings of this study and others on bioengineered structures in Alaska suggest that some sacrificial damage may be expected to occur if root wads are subjected to direct impacts from large ice floes. Well-established willow brushlayers appear to work well in protecting the upper bank from ice damage on steep banks and are resilient in recovering from ice jam damage.

T2-07-10 Evaluation of Ecological Benefits of Revegetated Riprap and Bioengineering and T2-07-12 Development of Design Criteria for Vegetated Riprap

Status: Projects in scoping phase

These research projects will identify, evaluate, and document the biological impacts of vegetated streambank protection and develop criteria for facilitating design, construction, and maintenance of vegetated riprap streambank protection. Modifications will be incorporated into Chapter 17 of the DOT&PF Highway Drainage Manual.

The Technical Advisory Committee (TAC) for these projects is composed of state and federal employees familiar with streambank protection issues and includes experts from the Alaska Departments of Transportation & Public Facilities, Natural Resources, Fish and Game, and Environmental Conservation as well as the U.S. Fish & Wildlife Service and Environmental Protection Agency. The TAC chose to combine these two research projects and developed a draft request for proposals. This draft received many contentious comments. The state agency personnel then held a separate teleconference to better define the state’s position and to determine an appropriate course of action. They proposed a meeting moderated by an expert nationally recognized as understanding both hydraulic design of riprap and streambank restoration techniques. The ultimate goal of this effort is to support interagency memorandums of agreement on such treatments. These research projects are included in the negotiations between EPA and ADOT&PF over violations resulting from the Kenai Peninsula flooding in 2004.
TPF-5(164) Fish Passage in Large Culverts with Low Flows

Status: Project start. FHWA will lead this pooled-fund study.

The research will quantify low flow hydraulics in large culverts. National attention is now focused on modifying traditional design methods, which emphasize culvert efficiency, in such a way that the objective of fish passage is also achieved. To prepare successful designs for fish passage, there is an immediate need to develop more information about the hydraulics of low flows in large culverts. Because of the availability of advanced instrumentation, FHWA is now able to obtain more precise measurements than were possible in the past to address concerns about low flow hydraulics. The study will be conducted by the FHWA at the Turner-Fairbank Highway Research Center’s J. Sterling Jones Hydraulic Research Laboratory in McLean, Virginia. The study results can be incorporated in FHWA Hydraulic Engineering Circulars (Future HEC-26, etc.) for nationwide distribution and implementation. The report will include a practical design method for estimating average and local velocities in culverts and will describe how the results can be used to develop improved methods for designing culverts to facilitate fish passage.

Maintenance and Operations

T2-03-07 Mitigation of Drifting Snow at Trans-Alaska Pipeline Crossing

Status: Terminated

This research was focused on mitigating chronic traffic-blocking snow drifts caused by high guardrail at Trans-Alaska Pipeline crossings of the Dalton Highway. The research sought to identify cost-effective measures to control drifting. This work was being conducted as a collaborative effort with Alyeska Pipeline Service Company.

Several possibilities were considered, including snow fences, guardrail types, and vortex generators. This project was terminated due to a lack of adequate guidance in developing a sound work plan. No conclusive results were obtained.
T2-05-03 Richardson Highway Vegetation Survey and Assessment


To support the department’s initial efforts to develop an integrated right-of-way vegetation management program, agronomists from the Alaska Plant Materials Center conducted a vegetation survey of the Richardson Highway from Valdez to Delta Junction to assess native and invasive plant communities in the highway right-of-way. The department will use the information gathered in vegetation management planning.

T2-07-06 Integrated Vegetation Management Along Alaska’s Highways

This project is evaluating new strategies for managing tall, woody species and non-native invasive species within state highway right-of-ways. The research is being conducted at the Alaska University Transport Center. Two different field sites have been selected for conducting the research that represent the range of climate conditions in the subarctic.

Strategies include combining mechanical brush cutting and the application of herbicides. Herbicide application methods include broadcast spraying and wetblade mowing. Wetblade mowing is a practice where the herbicide is applied from the blade to the cut stems during the mowing operation. One objective of this research is to determine the quantity of herbicide being lost to the soil during wetblade mowing. Another focus is to quantify the attenuation rates of herbicides in northern soils. One challenge is to distinguish between the mass fraction of herbicide that is degraded versus that which leaches to an underlying aquifer.

This research has the potential to reduce moose/vehicle collisions by improving sight distance and reducing moose browsing near highways.
TPF-5(009) Computer-Based, Self-Operating Training System on Anti-Icing/Road Weather Information Systems (AI/RWIS)

Status: Ongoing

The focus of this research is to improve safety by increasing the efficiency of winter storm maintenance. The project is developing a computer-based training program on RWIS, anti-icing strategies, snow and ice control materials, equipment and procedures, and level of service policies. This research was given high priority by AASHTO’s Winter Maintenance Policy Coordinating Committee (WMPCC). Most of the snow-belt states have joined this Pooled Fund Study, with Iowa Department of Transportation leading.

Five computer-based training modules have been identified: Equipment Maintenance; Proper Plowing Techniques; Blowing Snow Mitigation; Deicing; and Winger Maintenance Management. The first three of these modules have been completed and delivered. These modules will be used to train personnel not familiar with the new RWIS systems by using a series of realistic scenario-based exercises.

TPF-5(145) Western Maintenance Partnership

The Western Maintenance Partnership (WMP) is an alliance of participating states pooling efforts to focus on highway maintenance. The purpose of the WMP is to provide a forum for promoting effective maintenance strategies. The program facilitates workshops for discussion and exchange of information and knowledge.

In August 2007, the second annual WASHTO maintenance scan was hosted by Alaska DOT&PF as part of this pooled fund study. Representatives from Colorado, Oklahoma, Washington, Utah, Texas, Arizona, Nebraska, Wyoming, and Montana attended. Alaska DOT&PF gave presentations on the Alaska Maintenance Management System and the Pavement Management System. Alaska issues and features were discussed, including winter aggregate requirements, the Knik River Bridge anti-icing system, the bridge overweight detection system, and the Alaska Marine Highway System. Climate, flooding, avalanche control, and permafrost considerations were also discussed.

Maintenance issues included policies, practices, specifications, field investigations, applied research, materials, and training. In recent years there has been increasing emphasis on cost effectiveness, asset management, and infrastructure preservation in maintenance programs. This pooled fund study seeks to develop innovation, expertise, and solutions to the complex management of highway assets by providing a forum for sharing field experience and hands-on demonstrations.
The research goal is to determine how to effectively implement the Disadvantaged Business Enterprise (DBE), On the Job Training (OJT), and Equal Employment Opportunity (EEO) requirements for contracting on Alaska Marine Highway System (AMHS) ship projects. These contracts do not adapt well to out-of-state shipyards when let with in-state DBE goals and OJT and EEO requirements. In addition, shipyards have difficulty understanding FHWA Civil Rights implementation requirements. The research will examine practices in other states with ferry systems such as Washington, California, and New York. AMHS and AKDOT&PF Civil Rights Office personnel explained the problems they have encountered in meeting federal civil rights contacting requirements in contracts for AMHS refurbishment and new vessel construction contracts. A draft RFP developed from the interviews has been circulated for comments at this time and is ready for advertising.

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

The research goal is to determine how to effectively implement the Disadvantaged Business Enterprise (DBE), On the Job Training (OJT), and Equal Employment Opportunity (EEO) requirements for contracting on Alaska Marine Highway System (AMHS) ship projects. These contracts do not adapt well to out-of-state shipyards when let with in-state DBE goals and OJT and EEO requirements. In addition, shipyards have difficulty understanding FHWA Civil Rights implementation requirements. The research will examine practices in other states with ferry systems such as Washington, California, and New York. AMHS and AKDOT&PF Civil Rights Office personnel explained the problems they have encountered in meeting federal civil rights contacting requirements in contracts for AMHS refurbishment and new vessel construction contracts. A draft RFP developed from the interviews has been circulated for comments at this time and is ready for advertising.

Materials and Construction

T2-99-07 High Temperatures of Alaska Pavements

Status: Project cancelled due to related policy developments in pavement specifications.

The objectives of the research were to develop design pavement surface temperatures on the high end to satisfy the Superpave design method requirements for developing accurate asphalt binder specifications. Under a previous research study, DOT&PF developed a database of air temperatures around the state to investigate low temperature effects on polymer AC pavements. The Superpave design system, developed as part of the SHRP asphalt research program, requires that high-end temperatures be known to satisfy given performance requirements. Analysis of the high-temperature data will allow design engineers to confidently specify the correct Superpave asphalt binder, which will lead to improved pavement performance and reduced maintenance costs. Summer air and pavement surface temperature data for past years were analyzed to develop correlations between high air and pavement temperature for about 20 sites around the state. These were compared to the Superpave average seven-day pavement high temperature to decide if they were appropriate for Alaska conditions.
**T2-02-05 Design Manual for Air-Cooled Embankment**

Status: Final report pending

Roadway embankments constructed in areas of warm permafrost (interior Alaska) experience high rates of failure due to thaw-induced settlement of the foundation soils. This problem is most pronounced beneath the embankment shoulders where additional snow cover in winter, due to snow plowing operations, and hot dry conditions during summer produce mean annual surface temperatures that are several degrees higher than their preconstruction values. Thaw settlement beneath embankment shoulders often causes side-slope instability and the formation of large longitudinal cracks in the asphalt pavement surface with consequent maintenance requirements. To reduce maintenance costs and improve roadway safety, a new type of thermal treatment that uses an open, highly porous rock cover on the shoulder side slope was investigated. Modeling studies and field measurements will be used to understand the thermal behavior of these ventilated shoulder features and formulate design procedures. The aim of this study is to produce a design manual to be used by DOT&PF and private contractors. Data generated with advanced models will be combined with field measurements and synthesized into a set of design guidelines. These guidelines will be incorporated into the design manual.

The data collected for this study on the Loftus Road/Thompson Drive project shows that the ventilated shoulder berms of porous rock have the effect of causing freezing at the embankment shoulders, a very promising result. These study results are now being compiled into a report and new design guidelines.

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**T2-02-18 Fatigue Characterization of Alaska’s Polymer-Modified Asphalt Mixes (formerly Use of Modified Asphalts)**

Status: Completed. The research report is available at [http://www.dot.state.ak.us/stwddes/research/assets/pdf/fhwa_ak_rd_05_05.pdf](http://www.dot.state.ak.us/stwddes/research/assets/pdf/fhwa_ak_rd_05_05.pdf)

Use of polymer-modified asphalt cement in Alaska's asphalt concrete pavements continues to increase in the belief that modified asphalt improves the performance of the pavement and that polymer use is therefore economically justifiable. Recent increases in asphalt costs caused DOT&PF to question the cost-effectiveness of modified asphalts, especially where traffic volumes are low. Laboratory fatigue testing for this project led to: (1) regression equations that predict the fatigue life of polymer modified vs. nonmodified asphalt concrete, and (2) a regression equation relating asphalt concrete mix flexural stiffness to temperature. A new design concept was developed based on the ratio of modified asphalt fatigue life to nonmodified fatigue life. The ratio represents the fatigue life advantage of polymer modification. The ratio, termed the modified asphalt performance multiplier (MAPM), accounts for temperature, air voids, tensile strain, and asphalt concrete stiffness. The MAPM concept can be incorporated into Alaska’s flexible pavement design method to allow life cycle costs analysis to determine when modified asphalts are cost effective. Alaska’s computer program for flexible pavement design can be modified to incorporate the new MAPM concept. Future studies are needed to develop performance models for polymer-modified mixes with respect to rutting and thermal cracking.
T2-03-11 Evaluation of Alternate Embankment Construction Methods

Status: Draft report available

This study researched alternative materials and construction methods that could be practical alternatives to imported gravel. Many bush communities have poor material resources and must import gravel by barge, which is very expensive. A literature search identified alternate materials and methods that could possibly be successfully used in western Alaska. The draft report developed in 2006 was formatted and edited for content under a task order. Upon completion, the finished document will be circulated for comment to design managers to determine if a further effort is desired to estimate the economic cost/benefit and practicality of these techniques.

T2-03-12 Theoretical Standard Density Determination with Nuclear Gauge

Status: Completed. The research report entitled “Evaluating a Simplified Method to Estimate Compaction of Soils and Aggregates” is available at http://www.dot.state.ak.us/stwddes/research/assets/pdf/fhwa_ak_rd_07_02.pdf

The Proctor and Vibratory standard methods for determining the degree of field compaction for soils and aggregates require obtaining a field sample (by digging the compacted layer) for screening/sieving. This is done to correct the values obtained from these tests. Field materials technicians in the Southeast Region observed that a simple calculation could replace this time-consuming procedure. The same was observed for asphalt mixes. It is speculated that by knowing the coarse aggregate specific gravity, the percent voids and air void ratio (through nuclear densometer), one can calculate the maximum density of the material and subsequently its percent compaction.

The objective of the study was to check the validity, applicability, and limits of the simple method described above. This was achieved by compiling and organizing the data collected by the Southeast technicians for soils, aggregates, and asphalt mixes; applying the simple calculation method to obtain maximum density values; then comparing these values to those obtained by using the standard tests. Values from projects in other regions were also analyzed to check the universality of the suggested method.

T2-03-13 Implementation of Asphalt Mix Designs

Status: Terminated

The department has made high-cost asphalt-paving decisions based on short-term contractor risk analysis during the project bidding phase. These decisions often result in less-than-optimum asphalt performance and occasional pavement failures. The project sponsors identified a need to compile a library of past asphalt mix designs, and if possible, correlate them to pavement performance attributes. The successful mix designs for a given route or locale could then be used to define future project specifications. Correlating mix designs with performance would allow the pavement engineers to implement the most cost-effective asphalt aggregate gradations. The intent of the research was to determine and recommend which pavement aggregate gradations will result in the most successful pavement for each locality. ADOT&PF’s intent is to implement the most cost-effective asphalt aggregate gradations, which will result in higher quality pavement, a more uniform bidding platform, and lower maintenance costs.

Researchers used historical asphalt mix designs to identify four candidate aggregate gradations. The ADOT&PF Statewide Materials lab completed mix designs and obtained pertinent mix data. However, the project advisory committee chose to cancel this project before completion.
T2-04-01 Aggregate Abrasion Using Nordic Ball Mill Test

Status: Final report pending

Aggregate durability, hardness and abrasion resistance can be measured using tests such as the degradation value test (Deg), the Los Angeles test (LA) and the Nordic ball mill test (NB). However, the repeatability and reproducibility of the Deg test have been questionable. In addition, when compared to the NB test, the Deg and LA tests do not seem to distinguish among varying levels of aggregate wear susceptibility. Therefore, there was a need to study the NB test results in comparison to the conventional Deg and LA results, and to assess its repeatability and reproducibility.

The objectives are to test aggregates from different projects and from the three regions of the state using the Nordic Ball Mill test, then compare results to the Deg and LA test results. Repeatability and reproducibility of the Nordic test will be assessed. Maximum Nordic abrasion specification values will be established for the different aggregate materials depending on their location in a pavement structure—wearing, binder, or base course—and the traffic level based on AADT. The aggregate testing is now complete and the report is being written.

T2-04-02 Use of Rubber in Hot Asphalt to Reduce Rutting

Status: Final report pending

Pavement performance data records from the Pavement Management System (PMS) indicate that the life of asphalt pavements is less than eight years on highways having high traffic volumes in the central and southeastern regions of Alaska. These roads typically have AADT volumes over 5,000 ADT per lane. The observed failure modes are rutting from studded tires in winter and plastic deformation in summer. The objective of this research is to reevaluate the use of crumb rubber in hot mix asphalt used in projects constructed in the 1980s. Hot mix asphalt (HMA) made using the PlusRide method (dry process) has demonstrated excellent resistance to studded tires. Although this mix is initially more costly, the superior qualities of this mix are expected to have a much lower life cycle cost, based on the known performance of the similar PlusRide mix placed on the A-C couplet in 1986. The mix design will use the Marshall method, then the Prall test to simulate studded tire wear on asphalt mixes, and the loaded wheel rut tester to evaluate resistance to plastic deformation. This technology will add dry crumb rubber into the mixing chamber of a hot plant with hot aggregate and asphalt cement.

This research is an effort to improve on the A-C couplet design and reduce the risk of failure of rubberized asphalt mixes by using highly crushed aggregate, coarse crumb rubber, and polymer modified asphalt cement. The deliverable from this research is new construction specifications for hot mix asphalt with crumb rubber.

The researchers are now writing the final report based on the recently completed Elmore Road project in Anchorage.
T2-06-09 Characterization of Asphalt Treated Base Material

Status: Collaborative research project underway with the Alaska University Transportation Center

Asphalt-treated bases are the most commonly used type of stabilized layers in Alaska because of material availability and relative cost. The Alaska Flexible Pavement Design Manual and the statewide policy on stabilized base courses stipulate the use of stabilized layers for the majority of roadway pavements. The inclusion of asphalt, either hot or in the form of emulsion, is one of the options mentioned to construct asphalt-treated bases. However, at present there is a lack of data on engineering material properties for typical Alaska base materials. These data are necessary for pavement design. This study will systematically investigate three types of Alaska asphalt-treated bases: hot asphalt treated, emulsion treated, and foamed asphalt-treated base course materials. The study will collect data on their properties, including stiffness, fatigue, and permanent deformation characteristics at different asphalt contents and temperatures. The thorough study of asphalt-treated bases in this project will directly benefit current pavement design systems in Alaska. Improved design equations and moduli values will be incorporated in a new edition of the Flexible Pavement Design Software and Manual. Designers will then be able to use this tool to design improved pavement structures. This study will also enhance the use of marginal or locally available materials by detailing the beneficial effects of asphalt-treated bases on pavement life and its economic advantages.

AUTC researchers are presently testing the material properties of sample mixes in this two-year project. These lab test results will be compared with core samples and falling weight deflectometer data from finished projects.

T2-07-04 Documenting Best Management Practices for Ice-rich Soils and Permafrost Sites

Status: In progress

The goal of this project is to synthesize best management practices for mitigation of problems resulting from ice-rich permafrost exposed during road construction, including disposal and incorporation of the ice-rich permafrost in parts of the embankment. This research will also develop design, construction, and environmental criteria, guidelines, and specifications related to the best management practices identified. The report will address a potential need for on-site testing and treatment of thaw-generated water.

The research is under contract to Ted S. Vinson, professor emeritus from Oregon State University. He is conducting an extensive literature review under Task I, including applicable sources from the ADOT&PF library and the Cold Regions Research and Engineering Laboratory (CRREL) library. One interview was initiated with a permafrost construction and engineering expert. He submitted a paper entitled “Managing Ice-Rich Permafrost Encountered During Construction,” based on initial work conducted on the project, which was accepted for presentation at the Ninth International Conference on Permafrost (NICOP) in Fairbanks June 30–July 3, 2008. The paper presentation will hopefully attract the attention of permafrost engineers from other countries and facilitate discussion of project issues.
T2-07-05 Development of Construction Dust Control Protocols

Status: Project start up

The research will establish clear criteria for temporary dust control methods on construction projects where water is not effective because of the length of the project or extended dry conditions. The Technical Advisory Committee, consisting of Northern Region engineers, met to determine the needs of the Construction Section with regards to dust control on their projects. Construction needs a specification for a contingent sum item to be used in situations where the Item 643(18) Watering is not sufficient. The dust control measures are needed for only a one to six week interval and must not have an adverse effect on the pavement structure or the environment. The specification must also be written to account for variances in soil conditions, environmental effects, corrosivity, cost, application equipment, storage considerations, and logistics. Alaska University Transportation Center researcher Prof. David Barnes is conducting a similar but larger study on dust control needs of the ADOT&PF and has familiarity with the topic. The TAC will contract directly with him on this project. Dr. Barnes, assisted by Dr. Ron Johnson, will prepare a research proposal by July 2008.

SPR-2(208) Pavement Subgrade Performance Study

Status: In progress

The objectives of this FHWA-led pooled-fund study are to develop improved mechanistic subgrade failure criteria for pavements and to evaluate the effect of seasonal variability on resilient material properties. Mechanistic design of pavements requires fundamental material properties and material failure criteria as a function of load and environmental effects such as temperature and moisture content. The strength or weakness of a pavement structure is based on the performance of the subgrade. The current subgrade failure criteria used in many mechanistic design/evaluation methodologies were surmised mainly from tests that did not consider the effects of subgrade soil type or moisture content. Because of these limitations, the current FHWA-sponsored subgrade performance study was designed to investigate and upgrade the failure criteria of subgrade materials. The project will study the effect of subgrade type and moisture content on failure criteria. This international study includes testing at the U.S. Army Cold Regions Research and Engineering Laboratory, where test sections are being constructed using four subgrade types and three moisture contents and are subjected to accelerated loading. The sections are instrumented with stress, strain, moisture, and temperature sensors. In this study the ambient temperature is held at around 20°C.

Heavy vehicle simulation testing on all twelve test sections has been completed. To complement the heavy vehicle simulation testing, Cornell University will conduct additional laboratory tests to characterize subgrade soils tested by this coming fall. A complete database with raw data, processed data, and laboratory data will be available in late 2008. FHWA and pooled fund states will conduct additional analysis as needed at that time. The data will also be available for states and researchers for future analyses.

A report that provides an overview of the test program and testing procedure is available at http://www.pooledfund.org/documents/SPR-2_208/ProjectOverview_TR03-5.pdf

Subsequent reports will detail the construction of each test section, the data acquired, and the results.
TPF-5(013) Effects of Multiple Freeze-Thaw Cycles vs Deep Frost Penetration on Pavement Performance


The objectives of this study are to: (1) quantify the effects of frost penetration on pavement performance in climates with deep sustained frost as compared to environments with multiple freeze-thaw cycles, (2) investigate the effect that local adaptations have on mitigating frost penetration damage, and (3) estimate the associated cost of constructing and maintaining pavements in freezing climates. The approach consisted of modeling various pavement performance measures using both climatic and nonclimatic input variables and performance data collected as part of the Long-Term Pavement Performance program. Five climatic scenarios are defined in terms of climatic input variables for the models. Predicted performance measures are presented for each of the climatic scenarios and compared at a 95 percent confidence interval to determine statistically significant performance differences.

Participating pooled fund states were asked about standard specifications, standard designs, average life expectancies, and construction costs specific to each state highway agency. These data and information acquired through literature review of SHA standard practices are summarized with consideration given to the mitigation of frost-related damage. The report also discusses and compares life cycle cost analysis for each climatic scenario using predicted performance to determine average life and average agency construction costs for standard pavement sections. The use of the performance models for local calibration as required in the National Cooperative Highway Research Program Guide for Mechanistic-Empirical Design of New and Rehabilitated Pavement Structures is explored, along with possible application of the performance models in pavement management systems.

TPF-5(064) Western Alliance for Quality Transportation Construction

Status: In progress

In the mid 1990s, several western state and federal highway agencies recognized the need to have qualified materials test technicians and laboratories conducting acceptance testing on materials purchased and incorporated into transportation facilities. This loose organization of highway agencies formed the Northwest Alliance for Quality Transportation Construction (NAQTC), which produced five technician training and qualification modules for use within their organizations. Since materials testing procedures vary little from state to state, the NAQTC determined that all highway agencies in the western United States would benefit from a united effort. The NAQTC invited all WASHTO states to join their organization. Eventually, seven additional state highway agencies joined the NAQTC to form the Western Alliance for Quality Transportation Construction, or WAQTC. The WAQTC is actively seeking to expand beyond the current member agencies consisting of state departments of transportation and FHWA agencies. The Alaska, Arizona, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and FHWA Western and Central Federal Lands highway departments are currently members. The WAQTC is dedicated to improving the quality of transportation products and services through a comprehensive Technician Training and Qualification Program (TTQP).

The goal of this pooled fund study is to support the development and refinement of a training and qualification program for construction inspection and materials testing technicians by the WAQTC, a cooperative technology transfer effort of multiple western states and FHWA.

Work on this study has stalled due to issues with the funding controlled by FHWA Resource Center in response to an audit for the FHWA Pooled Fund Program. Once all available money is accounted for, contracting efforts can proceed to obtain a consultant WAQTC program manager. The contract will be a multiyear effort to support the WAQTC Executive Committee, maintain existing materials, develop new training and testing modules, and update of WAQTC and AASHTO test methods annually. The management of the study has been transferred to Utah DOT.
T2-07-02 Development of GPS Survey Data Management Protocols and Policy

Status: Project start

The goal of this research is to develop policy and criteria for collecting, analyzing, and managing global positioning system (GPS) survey data. The research project will determine the needs of the department in adopting the GPS real time kinetic (GPS RTK) stakeout and automated machine grading (AMG) construction techniques. The project will result in reformatting and editing of the Alaska Survey Manual, proposed revisions to the Construction Manual, the Design Manual, and to Standard Specification 642, Construction Surveying. The project will result in reformatting and editing of the Alaska Survey Manual, proposed revisions to the Construction Manual, the Design Manual, and to Standard Specification 642, Construction Surveying. The Technical Advisory Committee consists of experienced AKDOT&PF surveyors, designers, and construction engineers who meet monthly to form and direct the research. TAC members are from the three regions of the ADOT&PF. The TAC distributed a comprehensive questionnaire to construction engineers in the three regions to determine the use and state of knowledge of these technologies among ADOT&PF construction personnel. Also, the State of Montana Research Section provided the results of a survey of state practices in GPS and machine control, as did AASHTO-TIG and Wisconsin DOT. Other literature searches of state DOT websites produced relevant studies and specifications.

The Technical Advisory Committee formulated a training plan and has proposed that a pilot project be conducted for each region, which will involve the use of GPS RTK rovers and will explore AMG and computer and data issues commonly encountered in the use of this technology. An overview of this research was presented at the statewide construction managers meeting in March, and managers were asked to suggest pilot projects and to detail their training needs. To date one training session has been held and one pilot project has begun. One more pilot project has been proposed and candidates for the third are being considered. Input from the pilot projects, contractors, and state project engineers will be used to develop the proposed specifications and electronic exchange procedures. The expected completion date of this project is October 31, 2008.
T2-07-09 Demonstration of Nonintrusive Traffic Data Collection Devices in Alaska

Status: Under contract to SRF Consulting Group

Until recently, the available traffic data collection methods, such as inductive loops and pneumatic road tubes, required intrusion into the roadway to install. More advanced devices are now available for traffic data collection. This project will evaluate the use of portable acoustic and radar sensors to collect volume, speed, and classification data at temporary data collection sites.

As phase 1 of this project, SRF Consulting Group conducted a meeting of the project’s technical advisory panel on November 1, 2007. The advisory panel decided that the traffic data collection systems should be self-contained and portable. The panel decided to test two types of equipment: (1) for performing high-volume, multilane traffic counts, and (2) for obtaining axle counts and classifying vehicle type. Wavetronix (for traffic count) and Axle Light (for axle count) traffic monitoring sensors were selected for field trials in Alaska’s three DOT&PF regions. This meeting resolved general project scope issues. The panel decided that all additional work on this project would be done under a separate proposal/contract based on consensus items developed at this meeting.

Phase 2, a contract for equipment acquisition, training, field work, analysis, and report writing, remains to be negotiated. A detailed work plan for field testing the equipment will be formulated during the first equipment training session. Completion of Phase 2 is tentatively March 2009. This work is expected to provide safer methods for traffic data collection, improve traffic data quality, and increase data collection efficiency.

SPR-3(042) Aurora Program

Status: Perpetual pooled fund program. AKDOT&PF provides continuing support through the Division of Program Development.

The Aurora Program is an international collaborative pooled-fund program of research, development, and deployment with the goal of improving dissemination of road weather information to transportation providers and end users, ultimately reducing potential weather-related incidents and delays in both urban and rural areas. The Aurora vision is to deploy RWIS to integrate state-of-the-art road and weather forecasting technologies with coordinated, multiagency weather monitoring infrastructures. It is hoped this will facilitate advanced road conditions and weather monitoring and forecasting capabilities for efficient highway maintenance and provide real-time information to travelers. The study is ongoing and will continue for the foreseeable future. Members contribute funds annually, propose research projects on RWIS-related projects, manage contracts for the research, prepare reports, and submit results for publication. One of Aurora's goals is to provide guidelines for RWIS implementation and usage. Twenty-three projects are ongoing and three new projects have been selected for 2007–2008. To date, 25 projects have been completed. Complete information on all projects is available at the project website at http://www.aurora-program.org/
TPF-5(087) Electronic Appraisal Development Study: Phase 1

Status: Completed. The project report can be found at http://www.utexas.edu/research/ctr/pdf_reports/9_1523_1.pdf

The objectives of this research project were: (1) to gather and analyze requirements for, and document a plan for, a prototype design of an electronic appraisal system (EAS) that would effectively support the transmission, analysis, and storage of appraisal information; and (2) to build a prototype EAS, demonstrating its salient features.

Currently most state DOTs use a paper-based appraisal system. These systems can be arguably ineffective, laborious, and are subject to divergences in appraised values. Based on the testing process and the subsequent analysis of the results obtained, researchers found that the use of a web-based system for an EAS resulted in a more efficient, flexible, sustainable, and user-friendly system for acquiring rights-of-way. Researchers were also able to establish data clustering as the preferred method for implementing an SPC mechanism. It was discovered that data clustering could be effectively used as a statistical analysis tool to create a benchmark to test the accuracy of a subject appraisal. The proposed EAS system demonstrated the applicability of the latest technologies in right-of-way acquisition, providing a safe archiving feature to maintain proper documentation. Lastly, the EAS was able to provide a secure and prompt communication channel that will allow appraisers and DOT right-of-way personnel to interact with one another, accelerating and simplifying the entire right-of-way evaluation process.

ADMINISTRATION AND POLICY

T2-06-01 Workflow Optimization Study

Status: Completed. The report, published in October 2006, is available at http://www.dot.state.ak.us/stwddes/research/assets/pdf/fhwa_ak_rd_06_03.pdf

At ADOT&PF, work production begins when a project is established. Drawings, plans, and data are shared between Planning, Surveying, Right-of-way, Pre-Construction, Bridge Design, Materials, Environmental, Construction, and Maintenance & Operations during the development of a project. Because different software is often used for specific tasks, the products are not always compatible from one task to the next. This imposes inefficiencies on the development process and, in some extreme cases, loss of data. Workflow optimization and better use of available technology could save considerable costs and time throughout the development process.

The objective of this research was to evaluate currently existing ADOT&PF workflow by identifying, documenting, and reporting similarity, disparity, and bottlenecks in the flow. Specific tasks included:

- comprehensive review of current software use in the three ADOT&PF regions to identify workflow similarities, disparities, problems, barriers, gaps, chokepoints, and bottlenecks
- evaluation of the efficiency of the current ADOT&PF workflow, including determining what types and formats of information are being transferred between various sections.
- identifying potential vendors that might visit ADOT&PF with the aim of pinpointing areas of change and how to proceed with these changes.
- recommendations for ADOT&PF workflow change.

The department’s leadership is considering options for implementing the recommendations of this study.
T2-07-07 Evaluation of Risk Factors for Repeat DUI Offenses

This research, under contract to C&S Management Associates, is investigating the relationship between underage drinking and subsequent driving under the influence (DUI) offenses. The study is intended to provide information to be used in decisions regarding prevention and treatment methods.

The principal investigator (Hamilton) conducted a literature review on the topic, drawing from formal research and government publication sources. The research bears up the solid correlation between early onset of alcohol use and problem behavior (including driving under the influence) in later life. Hamilton expresses several caveats regarding his research findings so far, which cannot be fully explained as part of this brief summary. He is approaching this subject with reasonable caution regarding data sources and statistical analyses. Hamilton found relatively little hard data in the literature that scientifically examined the link between underage drinking behavior and the occurrence of problem behavior later in life. Therefore, he believes that this project may add new information to the general body of knowledge about repeat DUIs. Hamilton is examining actual court cases that occurred for minor consuming and connecting these, by name, with individuals who had drunk driving incidents for which a court case exists.

Hamilton has obtained half of the data needed to complete the project. Additional DUI data will be obtained from the Alaska Court System. The study is expected to be completed by September 2008.

T2-07-08 Review of Crash Reduction Factors for Use in the HSIP

The Alaska Highway Safety Improvement Plan (HSIP) is a program aimed at reducing fatalities and major injuries on our highways. The program evaluates specific safety-related improvements and ranks them in terms of cost effectiveness. Each type of safety feature has an associated crash reduction factor (CRF), which is used to assess the performance of the safety measure.

This research will review current CRF values for accuracy to improve the prioritization of HSIP projects. The research project will also propose CRF values for safety features that have no established CRF values. The research is being conducted by Kinney Engineering and is scheduled to be completed by December 2008. The work plan includes literature research, synthesis of other state practices, analysis of current countermeasures, and a review of the HSIP project evaluation process. Specific countermeasures to be investigated include cable barrier median barriers, concrete median barriers, traction enhancement, and signalization features.

The research is expected to provide an updated list of CRF values as well as recommended CRF values for countermeasures that currently do not have CRF values established. The results would be implemented by including the new CRF values in the HSIP Handbook.
SPR-3(094) Pavement Marking Life Cycle

Status: Ongoing

The objective of this research is to develop service life curves for the reflectivity performance of durable pavement markings. The researchers are collecting, compiling, and analyzing retro-reflectivity data for the following durable pavement marking materials: thermoplastic, epoxy, tape, and methyl methacrylate. Nine states are participating in this research, with Utah as the lead state.

The progress made has been to develop a management plan and preliminary procedures for data collection. Recommendations have been made for the number and locations of data collection sites. The separate states have begun collecting field data. The Texas Transportation Institute is compiling and analyzing the data and will be responsible for the final report.

TPF-5(114) Roadside Safety Pooled Fund Research Program

The purpose of this research is to improve roadside safety through the development of crashworthy roadside structures. The research program is being facilitated by Washington State DOT with California, Alaska, Louisiana, Texas, Minnesota, and Tennessee participating. The pooled fund study is a cost effective means for states to crash test roadside features in accordance with FHWA standards. A committee selects and prioritizes specific research efforts.

This study includes bridge rails, guardrails, transitions, barriers, end treatments, crash cushions, and breakaway supports. The specific areas of interest identified are long-span guardrail, guardrail on slopes, guardrail post installation in rock, anchored concrete barrier, box culvert guardrail, and curved guardrail. The study will examine the influence of driveways, slopes, ditches, shoulders, medians, and curbs on single-vehicle collisions. It will involve computer simulations, full-scale crash testing, analysis, in-service performance data, and benefit cost analysis.

This research will improve safety for the traveling public by providing new innovative and economical options for crashworthy roadside features.
Housed within DOT&PF’s Research Section, Technology Transfer (T2) provides support to Alaska DOT&PF, local governments, and other transportation personnel. T2 is comprised of four programs, integrated to provide a seamless training and technology transfer service.

**Local Technical Assistance Program**

LTAP is a national network of centers funded by FHWA. The LTAP 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. T2’s primary focus is on:

- training events and programs,
- quarterly newsletter, and
- library services.

**National Highway Institute**

NHI funding provides transportation-related education programs to 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, maintenance, and rehabilitation personnel working for Alaska’s transportation infrastructure.
Border Technology Exchange Program

BTEP is an FHWA-funded technology transfer program between the Government of Yukon Highway and Public Works in Canada and the State of Alaska DOT.

BTEP formalizes and funds several unofficial information exchanges on design, construction, and mitigation techniques for asphalts, permafrost issues, new structure, designs, and other cold-region engineering problems.

Funds are used primarily to pay for travel for subject matter experts from respective locations. Since we share the Alaska Highway, and the Yukon receives federal aid funds for that stretch of highway, the benefits of technology transfer activities become obvious to motorists from the Lower 48, Alaska, and Canada.

New for 2008: Rapid Technology Transfer Program

Designed to rapidly respond to high-value, unprogrammed ad hoc needs, RTTP is related to training and technology transfer. Funds are limited to courses, projects, programs, or equipment with a regional or statewide emphasis that will benefit the maximum number of stakeholders. The fund’s use should result in cost savings, leveraging of external resources, or enhancement of partnerships.
**T2 Highlights for 2007**

- Offered 81 training sessions to over 1,700 participants from state and local governments for a total of nearly 27,000 participant hours.
- Awarded contract for on-line environmental training program to be recognized by regulatory agencies: to be launched early to mid 2008.
- Developed construction management certificate with UAF, DOT, and industry. Pilot program currently being offered.
- Through our first year as a corporate partner with ATSSA, increased our outreach by 50% while maintaining similar costs as when we used ATSSA instructors.
- Continue our partnership with Alaska University Transportation Center. Continue to get about $125,000 per year to enhance our LTAP program.
- Did extensive planning for our first Construction Career Day scheduled in April 2008.
- Cosponsored development of *Building Rural Alaska* video

**T2 Tasks for 2008**

- Increase training attendance by local governments.
- Work to complete and implement road scholar program with TTAP and AUTC partnership.
- Combine Training and Research advisory committees.
- Reorganize website.
- Circulate newsletter electronically on listserve and increase research focus.
- Attend peer group meetings to facilitate establishment of core courses for our new training management system.
- Fully implement on-line environmental training program to be recognized by regulatory agencies, to be launched early to mid 2008.
- Convert VHS library to DVD and store on networked CD/DVD server.
- Enhance distance-delivery options and continue evaluation of video conference classrooms.
Learning in a Roundabout Way

This summer marked the fifth year of Research & Technology Transfer’s participation in the Alaska Summer Research Academy (ASRA), an intensive two-week residential math, science, and engineering camp sponsored by the UAF College of Natural Science and Mathematics. The camp is geared towards grades 8–12 and consists of over a dozen modules, ranging from Aviation to Wildlife Ecology. Research & T2 sponsors the Civil Engineering module. A special thanks to WSDOT and their State Traffic Engineer’s Office for sharing their expertise in the traffic design area and to the Washington State LTAP Center’s network to make the collaboration happen.

When the high school students from the ASRA civil engineering group presented their design project for “dysfunction junction,” many in the room chuckled and knew the intersection in question. While working in the intersection, the students were approached by several pedestrians who asked: “Is someone going to finally fix this intersection?” It is unlikely to be built, but the kids learned about the design and construction process and came up with a great design model!

THE DESIGN STUDY

After an introduction to survey equipment from Alaska DOT Larry Durfee and Scotty Sexton, the group tackled a design survey of the intersection. The objective was to determine the available footprint for other intersection options.

Brian Walsh of Washington DOT led the group through the design process and was instrumental in providing the information the group needed to select and design an alternative intersection.
Looking for options to improve “dysfunction junction,” the group spent some time observing its traffic flow and at the roundabout down the road. By mapping traffic flow in 15-minute increments, they were able to gather empirical data that indicated roundabout capacity surpassed “dysfunction junction.” They also noted fewer miscues and generally a high level of service from the roundabout for both traffic and pedestrians. Time was also spent at a busy signalized intersection, and that option was considered.

After weighing safety, capacity, cost, and aesthetics, the ASRA students determined a roundabout was an ideal option, receiving high marks in safety, capacity, and esthetics. The initial cost would be higher, but over the course of several years they determined it could be competitive with a signal. But would it fit? After going back to their design survey they determined they needed about a 140-foot circle to match the diameter of a single-lane roundabout—they had plenty.

Mike Lund, Alaska DOT construction engineer, leads a tour of the North Pole roundabout project. This was an excellent opportunity for the ASRA group to see live application of what they’ve been learning.

“What a great opportunity to work with such intelligent and motivated high school students on transportation issues. The ASRA experience gave me insight into the importance of sharing our profession with students searching for their place in the career world. I am so impressed with the creative and thoughtful energy the students put into problem solving at the chosen intersection. Even if they don’t choose to become transportation engineers, they’ll no doubt be better drivers on our roadways.”— Brian Walsh, WSDOT

Emily Koenig and Erin Dickson get technical support from Brian Walsh while they work on their conceptual design for a roundabout. Brian is a traffic engineer for Washington DOT and is considered one of the lead subject matter experts in Washington state for roundabouts.
The Design

Having decided on a roundabout design, the students conducted preliminary scale drawings to get a feel for what a roundabout would look like. Using the data from the design survey, they were able to use the old intersection and overlay conceptual drawings—this they did in small groups. With four design options to choose from, they decided a four-leg roundabout best fit the needs of the location and could be easily adapted to the current intersection without major realignment.

From their preliminary drawings the group created their final design and started to develop a scale model for use in demonstrating their concept.

Evan Mathers and Jeffrey Danielson work on the scale roundabout model to determine the correct roundabout diameter.

Their design fits nicely into a similar footprint as the current intersection. The lines in red represent the roundabout and the blue lines show the current intersection, often referred to as “dysfunction junction.”

The ASRA civil engineering group poses behind the final model they built based on their conceptual design for a four-leg roundabout. The model is currently on display at the Alaska University Transportation Center at UAF. Left to right: Evan Mathers, Erin Dickson, Emily Koenig, Jeffrey Danielson, Scott Weis, Laura Frame, and Keith Hoza. Not pictured: Ben Symons.
The surveyors came back to help the group in construction staking to give them an idea of how a project is marked out for construction. First the kids reestablished their survey control point from their design survey. Their design was based on the same survey coordinate control system, enabling them to transfer plan data onto the intersection with the total station.

Evan Mathers works to convert some last-minute points from conceptual design for use in the construction survey. Keith Hoza assists with these calculations.

The ASRA 2007 civil engineering group stands at the center stake of the proposed roundabout. Standing left to right: Ben Symons, Scotty Sexton of Alaska DOT, Scott Weis, Evan Mathers, Jeffrey Danielson, Larry Durfee of Alaska DOT, Keith Hoza. Sitting: Laura Frame, Emily Koenig. Not pictured: Erin Dickson, Dave Waldo of Alaska DOT, and Lisa Minnear of UAF (ASRA civil engineering co-instructors).