The Alaska University Transportation Center (AUTC) theme, “Transportation Safety, Security, and Innovation in Cold Regions,” was selected to complement the mission and direction of the University of Alaska—to inspire learning and to advance and disseminate knowledge through teaching, research, and public service, emphasizing the North and its diverse peoples.

This theme also takes into account the needs of such stakeholder groups as the Alaska Department of Transportation & Public Facilities, the Alaska Railroad Commission, the oil and gas industry, and the broader transportation community that extends across the nation. Research at the University of Alaska fills a national need; AUTC is the only center with a specific, primary focus on transportation in cold regions.

AUTC directs its efforts to all modes of transportation. Like many northern regions, Alaska depends on multimodal transportation for part of its economic growth. A mix of highway, air, marine, rail, and pipeline infrastructure makes it possible to meet the needs for goods and transportation for its people.

Northern regions face special challenges, including varying population density, long distances between communities (often with no interconnecting roads), and high dependence on aviation and marine transportation. Diverse geographic features, along with complicating factors such as unstable soils and extremely cold temperatures, lead to high transportation costs. Pipelines for oil and other fuels dramatically impact the economic well-being and security of the nation. When such infrastructure traverses arctic and subarctic terrains, the challenges of planning, designing, constructing, and maintaining pipelines are unique.

Improvements in cold regions transportation engineering and dissemination of our innovative research to the national forum are AUTC’s primary goals.

The Center addresses issues related to those identified in the Highway Research and Technology report (a joint publication released by the Federal Highway Administration, the American Association of State Highway and Transportation Officials, and the Transportation Research Board) as key research and technology themes, including but certainly not limited to investigating the impact of climate change on permafrost, reducing construction and maintenance costs of transportation infrastructure, improving air quality during the winter months, and other measures that address multimodal issues facing Alaska and the nation’s transportation community.
# Alaska University Transportation Center

*Transportation safety, security, and innovation in cold regions.*

## Table of Contents

- Message from Billy Connor, Director 2
- Organization Chart 3
- AUTC Governing Board 4
- AUTC Staff 5
- CAN-AM Award 6
- Value of Research 7
- Students in Research 10
- Partnerships 12
- AUTC Outreach 14
- AUTC By the Numbers 15
- AUTC Completed Projects
  - Technical Asset Management 16
  - Structural Integrity 17
  - Materials and Geotechnical 19
  - Permafrost and Frozen Ground 21
  - Workforce Development 22
  - Environmental 23
- AUTC Ongoing Projects 24
- Photo Credits 29

---

AN ANNUAL REPORT OF RESEARCH, EDUCATION, AND TECHNOLOGY TRANSFER ACTIVITIES FOR **2013**
As I looked over this final annual report, a record of our last year as a National University Transportation Center, I can’t help but feel a sense of pride in what we have accomplished. It isn’t just the research, the primary product of any university research organization. Nor is it the funding we have garnered since 2005. Rather, my pride comes from the changes we have been able to foster as a result of our research and the growth of those who have participated in our program.

Our research, together with our partners, on soil-structure interaction during seismic events in cold regions, has yielded results that are now part of the AASHTO bridge design guides. There is no doubt that this process would have been much slower without the funding we received as a national center. While such advances may take longer in the future, we can be sure our bridges will withstand a seismic event even in frozen ground.

In our first annual report in 2007, we discussed the need to develop a reliable way to quantify dust production in rural areas. Rural Alaskans suffer from heavy concentrations of fugitive dust from roads and other infrastructure. As a result, they are seeing increases in dust-related health issues, including asthma and other respiratory problems. During a visit to the Village of Lower Kalskag near Bethel Alaska, the residents told me that the number one issue in the village was dust. Dust was a greater issue than health care, education and the economy. I saw evidence of this safety hazard myself. As we traveled toward the village on one of Alaska’s many dirt roads, I noted that the dust kicked up by one ATV hide a second until we were within a few feet of it.

AUTC researchers have developed new information and new strategies for addressing dust hazards. We are regular presenters at gatherings of rural Alaskans to discuss how they can reduce their dust problems. We now offer assistance to individual villages in developing dust reduction strategies that meet their needs. Again, our results are relevant beyond Alaska. I just returned from a trip where I was able to observe the dust issues Arizonans face. While many were similar to those of Alaska, the number of large mines and military training grounds offered another view of how our research may help.

AUTC has also worked with the Alaska Department of Transportation and Public Facilities to create stronger and more relevant workforce development programs. Together we have put in place an educational program which augments their existing training programs. Our philosophy of “education for the career” (see page 12) is based on recognizing that it is better to prepare employees for their futures than to simply train them for the current job.

These are but three of the many areas where we — and all our sister UTCs — are making a difference. As our term as a National UTC is coming to an end, AUTC is moving into the next phase of its existence. We are cultivating new partners and creating new opportunities as exciting as the ones depicted in this final annual report. Check our website to see the new contributions to transportation safety and security we will make.
University of Alaska Provost

College of Engineering & Mines Dean

Institute of Northern Engineering Director

AUTC Director

Labatory Manager
Grant Manager
Program Assistant
Communication Specialist

Governing Board
Defines research needs from industry and consumer perspectives

Executive Committee
(UAA, UAF, UAS)
Clarifies research directions and evaluates potential projects

Other Organizations & Partnerships
Share resources and expertise, contribute to active projects

Contributing Faculty
Provide research and expertise in Structures
Transportation Operations
Transportation Materials and Seismic Studies
Geotechnical Materials Modeling
AUTC Governing Board members represent both transportation and technology users and those who must manage infrastructure at national, state, and local levels. All transportation modes are represented in this dynamic group.

To learn more visit ine.uaf.edu/autc.
AUTC faculty and staff perform research, offer training, disseminate results and support a network of researchers all over the USA.

Each participating University of Alaska campus hosts an associate director, who works to engage faculty and local partners in that region of Alaska.
The CAN-AM Civil Engineering Amity Award recognizes a member of the American Society of Civil Engineers or the Canadian Society of Civil Engineers for either a specific instance that has sparked continuing benefit in understanding and goodwill, or a career of exemplary professional activity that has contributed to the amity between the United States and Canada. In the case of this award to Mr. Billy Connor, Director of the Alaska University Transportation Center, the Societies emphasize the latter — an entire career of professional contributions.

The objective of the CAN-AM Civil Engineering Amity Award is to give recognition to those civil engineers who have made outstanding and unusual contributions toward the advancement of professional relationships between the civil engineers of the United States of America and of Canada. In citing the work and contributions of Mr. Connor, the organization wrote:

In his 40 year career as an Alaskan professional engineer in Civil Engineering and Engineering Management, Mr. Connor has worked almost entirely on cold regions problems involving highways, airfields and permafrost foundations. During this career he has also been exemplary in the presentation, publication, and education of others based on the results of his work; thereby serving to educate the public and other professionals through Technology Transfer in state of the art considerations and solutions to the problems of building in the North.

Commencing in 1976 through 1991, Billy served as a Research Engineer for the Alaska Department of Transportation and Public Facilities, and in 1998 became the Research Manager for the Department, serving in that role through 2004. In the interim he also served as the Hydraulic Engineer and as a Construction Engineering Manager for the Department of Transportation, where he applied his research experience to improving pavement design methods and standards. He has continued to advance the science of building highways on permafrost by assisting in the development of design features and monitoring systems for experimental permafrost control roadway sections on the Al-Can highway in the Yukon Territory, in cooperation with Canadian engineers.

Through his efforts as noted above, Billy has become an authority on Northern design and construction. He has contributed numerous engineering publications as primary or coauthor, including 6 in the last 10 years. From 2004 to the present time he has served as Program Director of the University of Alaska’s University Transportation Center in Fairbanks, managing a multi-million dollar program of innovative engineering research. For these reasons, we consider Billy Connor to be the best candidate for the Can-Am Amity award for 2013.

On behalf of Alaska DOT&PF’s RD&T, we wish to congratulate Mr. Connor on this well-deserved award, and thank him for his innovative service to the Department and to Alaska.
To produce valuable research findings, AUTC works at both the project and program level. For some issues, one or two research projects may offer valuable results that can be implemented. For larger, more complex issues, sometimes an entire program of research projects must be coordinated to produce meaningful results. Indeed, many of Alaska’s transportation problems are among the most unique and severe in the nation, often requiring a robust program supported by versatile research partnerships to adequately serve the State’s needs. When it comes to preserving pavement, bridges, and unpaved roads and runways, Alaska poses unusual challenges that few beside our partners at the Alaska Department of Transportation and Public Facilities (DOT&PF) truly understand.

Pavement Preservation

Governments around the circumpolar north struggle to preserve pavement. The State of Alaska is no different, as a multitude of climatic, environmental, and subsurface factors are constantly working to reduce the lifespan of pavement and to dramatically increase the costs of maintaining it. Addressing these challenges has long been the pillar of AUTC’s relationship with Alaska DOT&PF.

Together, the partnership has managed a robust portfolio of pavement preservation research encompassing 14 projects and a $2.4 million budget. Yielding far greater dividends in increased infrastructure lifespan and reduced maintenance, this program’s dual goals are to extend the life and reduce the costs of pavement. AUTC has worked closely with Alaska DOT&PF to improve pavement material properties, design procedures, and maintenance and preservation techniques.

By improving the properties of pavement materials, AUTC research aims to increase pavement durability and reduce maintenance costs. This research has enhanced asphalt concrete performance with synthetic fabric reinforcement and advancements in asphalt-treated base course. Lab studies have further developed testing methods for stronger cold region aggregates and the economic use of fines in unbound pavement layers. Warm mix asphalt has also been a topic of interest for Alaska DOT&PF, as AUTC has worked to increase the performance of WMA in cold regions.

Improving design procedures is another way to extend pavement life and lower its expenses. AUTC research projects developed pavement design and performance testing to enhance the use of fines in base course materials during cold region thawing. In other studies, researchers have found ways to enhance flexible pavement and hot mix asphalt design standards and performance testing, as well as improving the cost effectiveness of Alaska’s flexible pavement design software. Another project tested the use of cost effective, environmentally friendly, anti-corrosive de-icing technologies such as carbon fiber tape heating panels built within a pavement surface.

Maintenance and preservation improvements are yet another important area of AUTC’s cold region pavement research. Projects have investigated cost-effective uses of crack sealing for asphalt concrete pavements in Alaska. Researchers have also collaborated with Alaska DOT&PF stakeholder to develop and publish an interactive treatment strategy selection guide and online database for pavement treatments specific to Alaska.

Seismic Bridge Design

With 24,000 seismic events each year, Alaska is North America’s most seismic state. Compounding this concern for structural engineers, consider that the frozen, thawing and thawed soils common to Alaska result in more serious seismic impacts to structures, boosting the likelihood of unanticipated seismic bridge damage. In addition to these naturally-occurring stresses, bridges are also few and far between, spreading the burden of commercial-weight truckloads across a relatively small collection of bridges. In this state, compromising even one key bridge is not an option.

Addressing these challenges, AUTC has managed a broad program of bridge seismic
AUTC Value of Research

design and structural health monitoring research. Through improved design standards and innovative structural health monitoring technologies, this work has improved Alaska’s ability to cost-effectively manage its vital bridge assets across the state.

AUTC has overseen a more comprehensive multi-project program of research examining the seismic performance of steel bridge piers, bridge pier analysis software, and, for the first time, climate effects on seismic bridge response in cold regions. To do this, AUTC summoned the best and brightest from within the UA system as well as outside, with leading researchers and seismic testing facilities from North Carolina State University, Oregon State University, and the University of Science and Technology, Beijing, PRC.

Through this work, we now realize there is a significant difference in how soils respond to seismic activity on frozen ground and thawed ground. We also understand the potential for liquefaction of thawing ground is high. From Northeast China to North Carolina, we have partnered with other facilities and research institutions to leverage geographical and lab-based resources to produce more relevant results for our stakeholders. The results of this work have been integrated into Chapter 8 of the AASHTO National Seismic Bridge Design Codes, as well as in updated standards for the State of Alaska. In addition, this program of research has led to valuable spin-off studies.

More recently, AUTC and Alaska DOT&PF installed a first-of-its-kind structural health monitoring (SHM) system on the Chulitna River Bridge near Healy, Alaska. Concerned about the bridge’s structural integrity, Alaska DOT&PF commissioned the study to determine whether the bridge required special posting for weight limits. The decisions could significantly limit traffic and heavy-load vehicle use on what is one of only two corridors linking South Central Alaska to the Interior and to North Slope oil fields.

The study’s results indicated the bridge did not require posting. In addition, researchers developed a unique remote monitoring system that drastically reduced the bridge’s maintenance and checkup needs. The system, able to function independently in severe climate and weather, allows crews to remotely assess structural performance data without the time, expense, and labor of regular in-person checkups.

Reducing Rural Dust

Alaska DOT&PF and AUTC have partnered since 2006 to reduce dust on Alaska’s roads and airports. To date, the partnership is wrapping up a multi-project research program that has:

• Tested and compared non-corrosive palliatives in 21 different regional sites,
• Developed cost-effective options for Alaska DOT&PF and local governments,
• Created and deployed a portable testing instrument and a repeatable testing method,
• Tested palliative solutions that reduce 90% of dust for 1-2 years after application,
• Implemented results into new state dust-reduction requirements and FAA airport bidding specs, and
• Developed new dust management guidelines for state and local governments.

Fugitive Dust (defined by the U.S. Environmental Protection Agency as PM10 and PM2.5) poses threats to public health in Alaska’s rural communities and costly infrastructure repair for Alaska DOT&PF. It also creates a significant hazard by limiting driver visibility.

More than 50% of Alaska’s state-owned roads are unpaved — as are nearly all other private and local roads in the state. Traffic on gravel roads can remove as much as 750 tons of material per mile in a single year. At this rate, if gravel costs $20 per ton, expenses for replacing lost road surfaces can reach $15,000 per mile annually. Dust reduction palliatives such as Calcium Chloride cost roughly
$8,000 per mile, yielding significant savings of $7,000 per mile.

Dust is a problem for Alaska’s rural communities that depend upon hunting, fishing, and food gathering/processing. Roughly 82% of Alaska’s communities are outside the statewide road system and rely on local unpaved roads and 255 state-owned rural airports as a lifeline to the outside world. Dust brings health risks, impairs quality of life, and imposes costly maintenance needs on limited local budgets.

Seeking a mobile dust monitoring system with the versatility to work in remote, rural areas, AUTC created the DUSTM. Mounted to the back of an ATV, the system entails an air intake, opacity measurement, and data logging — all in a portable device that has proven to be the first repeatable methodology of its size for loftable dust measurement. AUTC has deployed this versatile monitoring system on unpaved roads and runways in 23 communities across rural Alaska.

Expanding this work, AUTC also partnered with research counterparts in Montana, Nevada, and California to form the Road Dust Institute. RDI works with government and industry to develop uniform dust-management standards, performance measures, and testing procedures.

This program of research continues, as the team expanded its monitoring and testing activities to 11 more rural Alaska airports through 2014.

Moving New Programs Forward

AUTC’s research is driven by a desire to serve the unique needs of Alaska and other cold regions. This dedication to the real-world problems of the North means that while many other major research programs wind down or transition into implementation, a new batch of complex challenges arise for AUTC. The center is already expanding research into broad areas of future transportation development in Alaska.

As Alaska plans new transportation corridors, AUTC is working with its partners at the Water and Environmental Research Center (WERC) to manage a broad program of stream gauging and river flow studies along the North Slope and areas south of the Brooks Range, where new road corridors advance into the permitting phase. Stream data is vital to this process, and providing independent research to inform the planning process remains an important objective for AUTC.

Since Alaska has become an important player in new aerospace and aviation developments, NASA, INE, AUTC, and Alaska DOT&PF have worked together to hold high level discussions about the feasibility of using airship technology to serve a variety of roles — from commercial transport to scientific research and coastal security. For the past three years, the partnership has convened the widely-attended Cargo Airships for Northern Operations Workshop, bringing together state, federal, international, and private industry stakeholders to discuss the future of Airships in Alaska.

In addition, as the Arctic emerges as a new arena for geopolitical competition, the question of locating and building arctic port infrastructure remains a central question for federal and state agencies. Beyond ports, a variety of on- and off-shore marine infrastructure questions drive state transportation planning, from the use of pile-guided floats and creosote-treated timber to higher level planning issues within the Alaska Marine Highway System. AUTC has worked to meet these needs in recent years, managing multiple research projects and even introducing the Marine North research program—a one-of-a-kind initiative aiming to answer significant technical questions about arctic marine infrastructure in Alaska.

In sum, AUTC is driven to keep pace with Alaska’s evolving transportation challenges as we enter a new era in which climate change, system expansion, and arctic development bring new kinds of questions for engineers and planners. AUTC will continue listening closely to its stakeholders and assembling specialized interdisciplinary teams to provide meaningful research of high value to Alaska and beyond.
Jason Zottola, as a Master’s student, worked on an international project with Dr. Margaret Darrow and Canadian colleagues. The research focused on the interaction of heat and groundwater flow through an embankment built over permafrost, a complex interaction of phenomena. The work required coordinating and evaluating data from the field, laboratory, and computer thermal modeling to gain an understanding of the processes at work. Last year Zottola presented a paper he coauthored at the 15th International Conference on Cold Regions Engineering in Quebec City to a standing room only audience. Jason served as Secretary of the Alaska Alpha chapter of Tau Beta Pi, a good arena for his leadership skills. As the father of a young family, Jason proved his ability to juggle many tasks and complete them all. All his colleagues were impressed with Zottola’s ability to maintain his high academic performance, to conduct solid research, and to demonstrate leadership and professionalism, all while participating fully in his family life.

Zottola now lives in Anchorage and works at Arctic Foundations, Inc. as an engineer’s assistant. He currently works on modeling and design of various thermosyphon projects.

Travis graduated Fall 2012 with a MS in Environmental Engineering. His research focused on developing a methodology to assess the performance of dust control palliatives and apply that methodology to several sites where palliatives had been applied to roads and runways around Alaska. Dust control has become a key topic in Alaska, where excessively dusty conditions in some rural villages have resulted in poor air quality and other issues. ADOT&PF and the Alaska Department of Environmental Conservation funded these projects, and with Travis’s contributions, a draft version of a testing methodology has been used throughout rural Alaska, providing much-needed knowledge on determining how well palliatives perform and which work best in specific locations.

Travis, a professional and dependable researcher, traveled in often harsh conditions in remote areas, coordinating fieldwork and arranging supply and equipment needs on short notice.

Travis now lives in Juneau and works for ADOT&PF as an Engineering Assistant in Preconstruction. He is working on various transportation projects.

Jason Kwiatkowski graduated this past spring with a MS in Civil Engineering. His research and thesis were integral parts of Dr. Metzger’s project: Load Environments of Washington State Ferry and AK Marine Highway Landings. Jason was instrumental in executing a novel approach to determining statistically-based engineering design criteria for ferry berthing structures. This approach required extensive field work and substantial data collection over an entire calendar year. Using the Python platform, Jason developed a custom computer algorithm designed to distill the massive amount of data into metrics needed for new engineering design criteria which will be adopted by the Washington State Ferry system. Preliminary results of Jason’s work are already being implemented.

Jason exhibits professionalism and leadership in all tasks. He maintained an exceptional gpa throughout his graduate studies, showing his drive and outstanding understanding of his studies and research.

Jason is now living in Anchorage and working at Reid Middleton, Inc. as a designer, working on structural modeling and framing for different buildings in the area.
YUKON RIVER BRIDGE: WEARING SURFACE ALTERNATIVES

AUTC researchers have been evaluating the current wearing surface on the Yukon River Bridge since 2006, and they are conducting research to find an alternative surface material. Currently the bridge is topped with 3”x12” fir planks, which have an average lifespan of only seven years.

Last summer AUTC developed a unique idea to lengthen the service life of the wearing surface: applying a sealer/epoxy/grit mixture to provide traction on the bridge surface.

Undergraduate students are performing testing and analysis for each field-tested product as well as overseeing field application of the test samples.

This bridge, part of the only road connecting the oil fields on the North Slope with Alaska ports and harbors, presents challenges to truckers and engineers alike. This two-lane bridge is 2,900 feet long and includes an unusually steep 6% grade.

The structure is subjected to extremely cold temperatures which result in fatigue-related challenges. In addition, truckers use tire chains to cross the bridge, which causes heavy damage to the wearing surface and quickly wears down the surfacing typically used to provide traction. The structure was designed with limited provisions for added dead weight, which means any alternative wearing surface has a weight restriction of no more than 30 pounds per square foot.

AUTC is evaluating three wearing surfaces submitted by the private sector for field performance and flexural behavior at -50°F. Students are also instrumental in developing a tractable epoxy coating product that can be applied to the bridge timbers. This product must stand up to the harsh temperature differentials common to interior Alaska.

In this new process, the fir planking is first covered with a thin sealer, then coated with epoxy. Another coat adds a ½” thick mixture of epoxy and aggregate to the top surface of the boards. This coating adds toughness and strength. This process has never been tried on a bridge wearing surface before.

Typical epoxy is vastly affected by temperature changes; it becomes brittle under extremely cold temperatures. The research team has experimented in adding different solvents to the uncured epoxy mixtures, in hopes of designing a cured material that can respond to stress more elastically in subzero temperatures. At this point, they have developed a prototype of a new wearing surface, and several new test sections will be installed on the Yukon River Bridge in 2014.

Undergraduate researchers Richard Ward, Pat Brandon, Elliot Andersen, and Justin Stewart have all contributed to this project.
Partnerships are a defining characteristic of AUTC’s work, allowing the center to deliver versatile, interdisciplinary research on multimodal transportation topics. Partnerships allow AUTC to leverage the most effective balance of expertise, methodology, and knowledge for its stakeholders. In the past year, AUTC has seen positive developments both in its generally broad project partnerships, including a new regional university consortium, and its more specific interest areas of maritime and rural transportation and asset management.

Workforce development continues to be a critical element of AUTC’s program.

A recent study by the Alaska DOT&PF shows that 40% of their workforce have worked for the department for seven years or less. Twenty-five percent have worked for the department for less than one year. These statistics show that the knowledge base for the department is lacking. DOT&PF demographics also indicate that entry level positions are readily filled, but midlevel and upper management positions are nearly impossible to fill from outside the department. AUTC continues to work with DOT to develop educational and training programs that can accelerate promotional opportunities for its employees.

AUTC is exploring use of more digital training aids, including online and hybrid courses (which combine online courses with traditional classroom or video classroom education). The goal is to make education more friendly by allowing the student the freedom to schedule the training time.

Permafrost and seismic studies are important to everyone working on infrastructure in Alaska.

Our partners — including ADOT&PF, USDOT, FHWA, Alyeska Pipeline, and North Carolina State University — are focusing on how climate impacts infrastructure built on permafrost, and on soil structure interaction in frozen ground during seismic events. Ongoing research includes work on the (now infamous) Frozen Debris Lobes which are threatening the Dalton Highway and the Trans-Alaska Pipeline, improvements in slope protection in permafrost, and development of new foundation designs.

Dust management continues to be an
important focus area for AUTC and its partners.

Over the last year, researchers Dave Barnes and Billy Connor have developed a laboratory method to estimate the performance of palliatives before they are applied in the field. Our partners at Alaska DOT&PF, Midwest Industries, and SoilWorks have been supportive in this development. Each of our partners see this laboratory procedure as a way to evaluate products before they are applied; they also see the methodology as a move toward standardization in the dust management industry.

Over the past year, a Dust Working Group has been established to address the growing need to reduce dust in rural Alaska. The group is comprised of members from the EPA, Alaska Department of Environmental Conservation, FHWA, Alaska Native Tribal Health Consortium, Alaska DOT&PF, Polar Supply, the Alaska Tribal Technical Assistance Program, and AUTC. The focus of the group is to work with rural communities to improve quality of life through the reduction of dust, particularly near unpaved roads and airstrips. The group not only focuses on technical solutions, but also on behavioral solutions, including a program to reduce driving speeds in villages or by walking instead of riding. Education activities include production and distribution of brochures and manuals and holding community workshops.
AUTC Outreach

AUTC works with its stakeholders to provide technology transfer and technical assistance through conferences, workshops, training and educational activities, and one-on-one mentorship.

AUTC and the Alaska Department of Transportation and Public Facilities sponsored a track in the UAF Alaska Science and Research Academy; ASRA brings students from all over the US to explore science for ten days. Keith Whitaker, UAF, and Dave Waldo, ADOT&PF, worked with students to design and build a portable all-terrain vehicle bridge for the Alaska Department of Natural Resources. The program introduced the students to engineering principles and construction techniques. Since the bridge was given to the ADNR for use in maintaining their trail system, the students know they have produced something valuable.

AUTC director Billy Connor and professor David Barnes regularly give presentations to groups such as American Society for Civil Engineers, the Alaska Native Federation, and state and federal agencies, disseminating new information on dust management and the stabilization of silts and sands (these stabilized materials can be used to replace gravel that can cost in excess of $800 a cubic yard. Interest in these techniques in rural Alaskan communities continues to increase because they offer better quality of life. Public agencies are also interested in the savings that result from the reduction in maintenance costs.

AUTC continues to work with the UAF Department of Civil and Environmental Engineering to provide classes in Project Management. These one-credit classes are offered in a time-friendly format using video conferencing which reaches students throughout the state. Students can complete a Graduate Certificate after earning 15 credit hours from a wide range of courses. Examples include Project Management Boot Camp, Risk Management, Scheduling, Claims Avoidance and Dispute Resolution, Managing Quality in the Construction Project, Organizational Theory, and many others.

Through a partnership with Alaska DOT&PF, AUTC has focused on workforce development. Our philosophy can be summarized by the phrase “Train for the job and educate for the career.” Through education, the employee is better prepared for promotion. As part of the workforce development program, AUTC worked with the DOT&PF to create a Leadership Academy that helps prepare employees for upward mobility in their careers.

Each year the College of Engineering and Mines hosts an open house which has become quite popular with the community. This venue has a strong focus on the youth — our future workforce. AUTC sponsors a transportation-related activity called the “Sand Lego RC Derby.” Kids learn about the challenges of driving on soft soils and why it is important to build hard durable roads. They also learn about the difficulties of building roads over soft ground.

Working with North Pole High School, Billy Connor hosted two students as interns in AUTC. These two students developed a history of UAF’s steel bridge competition and the annual ice arch event. A poster was created, framed and hung in the main hall of the engineering building. As a result of the internship, the high school students interacted with university students, learning about how to succeed at college life. One student has decided to pursue a career in engineering.
As the USDOT funding for this national center winds down, AUTC’s partnerships with Pacific Region UTCs (Region 10) and Alaska DOT&PF are growing stronger. More studies supported by pooled funds are underway, and communication is stronger with neighboring universities and state agencies. Learning where to focus our resources, specifically time and effort, has been a process that has lead to great partnerships and collaborations nationally and internationally.

As the farthest north UTC, AUTC has found advantages in working globally with other international agencies and universities that share the same cold weather conditions and problems. International collaborations build awareness of AUTC’s unique expertise and allow the center to access world-class partners. Researchers also have more opportunities to share unique laboratory facilities, cutting-edge software and technology, and other research tools.

Following is a chart of AUTC annual expenditures. We remain heavily federally funded; 67% of our center activities are supported by federal entities. The State of Alaska is our next largest funder, supplying 23% of expenditures. The remaining support is made up of private, local, and university funding.

Alaska Transportation Facts

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Road Miles</td>
<td>16,675</td>
</tr>
<tr>
<td>Miles of inland waterway</td>
<td>5,500</td>
</tr>
<tr>
<td>Number of road bridges</td>
<td>1,173</td>
</tr>
<tr>
<td>Miles of rail used for freight</td>
<td>506</td>
</tr>
<tr>
<td>Ban on hand held devices</td>
<td>no</td>
</tr>
<tr>
<td>Ban on texting</td>
<td>yes</td>
</tr>
</tbody>
</table>

[gis.rita.dot.gov/StateFacts]
Updated Projects - Technical Asset Management

Geotechnical Asset Management (AUTC #510016), Andrew Metzger (University of Alaska Fairbanks) - Terminated

Information Gathering Infrastructure: Toward Intelligent Transportation (AUTC #510018), Jeffrey Miller (University of Alaska Anchorage)

New 2012 Precipitation Frequency Estimation Analysis for Alaska: Musings on Data Used and Final Product (AUTC #207119), Douglas L. Kane, Svetlana Stuefer, and Amy Tidwell (UAF)

Gathering Vehicular Parameters through a Vehicle-to-Infrastructure Intelligent Transportation System (AUTC #410024), Jeffery Miller (UAA)

Fairbanks North Star Borough Road Upgrading Process (AUTC #309020), Billy Connor (UAF)

Including Life Cycle Cost Analysis in Alaska Flexible Pavement Design Software (AUTC #309023), Juanyu “Jenny” Liu (UAF)

Analysis of Alaska Transportation Sectors to Assess Energy Use and Impacts of Price Shocks and Climate Change Legislation (AUTC #309002), Virginia Fay (UAA)

Life Cycle Cost Analysis for Alaska Bridge Components (AUTC #207083), J. Leroy Hulsey (UAF)

Developing Guidelines for Pavement Preservation Treatments and for Building a Pavement Preservation Platform in Alaska (AUTC #410038), Gary Hicks (California Pavement Preservation Center) Juanyu “Jenny” Liu (UAF), Hannele Zubeck (UAA)

Alaska Marine Highway Systems Analysis (AUTC #RR07.04, AUTC #207105, AUTC #309018), Paul Metz (UAF)

Performance Analysis of the Dowling Multi-Lane Roundabouts in Anchorage, Alaska (AUTC #RR08.08), Ming Lee (UAF)

LED Street Lights in Alaska (AUTC #RR10.01), Richard Wies (UAF)

Economical Analysis of Using Light-emitting Diode Technology for Alaska Streetlights (AUTC #207099), Hsueh-Ming Wang (UAA)
Overheight Vehicle Collision Protection and Detection System for Cold Region Highway Bridges (AUTC #510024), Pizhong Qiao (WSU) and J. Leroy Hulsey (UAF)

Structural Health Monitoring and Condition Assessment of the Chulitna River Bridge (AUTC # 510015), J. Leroy Hulsey (UAF)

Identification and Laboratory Assessment of Best Practices to Protect DOT Equipment from the Corrosive Effect of Chemical Deicers (AUTC #510003), Xianming Shi (Montana State University) and Billy Connor (UAF)

Strain Limits for Concrete-filled Steel Tubes in AASHTO Seismic Provisions (AUTC #510001), Mervyn J. Kowalsky (North Carolina State University) and Billy Connor (UAF)

Seismic Performance of Steel Pipe Pile to Cap Beam Moment Resisting Connections (AUTC #410001), Mervyn J. Kowalsky (NCSU) and Andrew Metzger (UAF)

The Effect of Load History on Reinforced Concrete Bridge Column Behavior (AUTC #410002), Mervyn J. Kowalsky (NCSU), Utpal Dutta (UAA), and Andrew Metzger (UAF)

Frozen Soil Lateral Resistance for the Seismic Design of Highway Bridge Foundations (AUTC #510021), Zhaohui “Joey” Yang (UAA)

Seismic Performance and Design of Bridge Foundation in Liquefiable Ground with a Frozen Crust (AUTC #410015, AUTC #309010), Zhaohui “Joey” Yang (UAA)

Response of Pile-guided Floats Subjected to Dynamic Loading (MISC2), Andrew Metzger (UAF)

Characterizing the Load Environments of Ferry Landings for Washington State Ferries and the Alaska Marine Highway System (AUTC #309001), Andrew Metzger (UAF)

Selection of Preservatives for Marine Structural Timbers in Herring Spawning Areas (AUTC #410037), Robert A. Perkins (UAF)

Seasonally Frozen Soil Effects on the Seismic Performance of Highway Bridges (AUTC #107014), J. Leroy Hulsey (UAF)
Completed Projects - Structural Integrity (Cont.)

Bridge Structural Health Monitoring and Deterioration Detection — Synthesis of Knowledge and Technology (AUTC #309036), Yongtao Dong (UAF) and He Liu (UAA)

Smart FRP Composite Sandwich Bridge Decks in Cold Regions (AUTC #107018), Pizhong Qiao (Washington State University)

Wearing Surface Testing and Screening: Yukon River Bridge (AUTC #410008), J. Leroy Hulsey (UAF)

Chloride Deicer Exposure on Concrete (AUTC #510000), Xianming Shi (MSU) and Billy Connor (UAF)

Utilization of Screw Piles in High Seismicity Areas of Cold and Warm Permafrost (AUTC #309031), Kenan Hazirbaba (UAF)

Alaska DOT&PF Pile Extension Pier Pushover Software Version 1.0: Installation Instructions and Theory Documentation (AUTC #107013), Michael Scott (Oregon State University)

Study of Concrete Maturity Methods in Very Cold Weather (AUTC #107052), Yongtao Dong (UAF)

Evaluating the Overheight Detection System at the Eklutna River/Glenn Highway Bridge (AUTC #RR08.09), Ming Lee (UAF)
Impact of the Embedded Carbon Fiber Heating Panel on the Structural/Mechanical Performance of Roadway Pavement (AUTC #510022), Zhaohui “Joey” Yang (UAA)

Experimental Study on an Electrical Deicing Technology Utilizing Carbon Fiber Tape (AUTC #410014), Zhaohui “Joey” Yang (UAA)

Rapid Determination of Unsaturated Moisture Diffusivity for Soils during Frost Heave (AUTC #510017), Xiong Zhang, Gang Cheng (UAF), and Rifat Bulut (OSU)

Using the Micro-Deval Test to Assess Alaska Aggregates (AUTC #410009), Juanyu “Jenny” Liu (UAF)

Accelerated Degradation and Durability of Concrete in Cold Climates (AUTC #410029), Pizhong Qiao (WSU) and Juanyu “Jenny” Liu (UAF)

Characterization of Alaska Hot Mix Asphalt Mixtures with a Simple Performance Tester (410020), Juanyu “Jenny” Liu (UAF)

Alaska Hot Mix Asphalt Job Mix Formula Verification (AUTC #309024), Juanyu “Jenny” Liu (UAF)

Application of a Nontraditional Soil Stabilization Technology: Lab Testing of Geofibers and Synthetic Fluid (AUTC #207117), Billy Connor (UAF)

Application of a Nontraditional Soil Stabilization Technology: Use of Geofibers and Synthetic Fluid in the Field (AUTC affiliated project), Billy Connor (UAF)

Attenuation of Herbicides in Subarctic Environments Across Alaska (AUTC#207110, Seward test site; AUTC #309026, Fairbanks test site), David L. Barnes (UAF)

Evaluation of Warm Mix Asphalt for Alaska Conditions (AUTC #207086), Juanyu “Jenny” Liu (UAF)

Characterization of Asphalt Treated Base Course Material (AUTC #107049), Juanyu “Jenny” Liu (UAF)

Resilient Modulus Characterization of Alaskan Granular Base Materials (AUTC #107045), Juanyu “Jenny” Liu (UAF)
The Use of Geofibers and Synthetic Fluids at Kwigillingok Airport (RR11.01), Billy Connor (UAF)

Warm Mix Asphalt: Experimental Features in Highway Construction (AUTC #MISC5), Juanyu “Jenny” Liu

Feasibility Study of RFID Technology for Construction Load Tracking (AUTC #RR08.12), Morgan Henrie and Mike Ronchetti (UAA)

Geotechnical Investigations for the Dalton Highway Innovation Project as a Case Study of Ice-Rich Syngenetic Permafrost (AUTC #207122), Yuri Shur and Mikhail Kanevskiy (UAF)

Stabilization of Horseshoe Lake Road using Geofibers and Soil-Sement (AUTC-G5806), Billy Connor (UAF)

Field Study to Compare the Performance of Two Designs to Prevent River Bend Erosion in Arctic Environments (AUTC #309009), Horacio Toniolo (UAF)

Converting the Fairbanks Metropolitan Area Transportation System (FMATS) Travel-demand Forecasting Model from QRS II to TransCAD (AUTC MISC7), Ming Lee (UAF)

Impact of Freeze-Thaw on Liquefaction Potential and Dynamic Properties of Mabel Creek Silt (AUTC #107041), H. Zhang, Kenan Hazirbaba, Leroy Hulsey (UAF)
Impact of Groundwater Flow on Permafrost Degradation and Transportation Infrastructure Stability (AUTC #510011), Margaret Darrow (UAF)

Experimental Study of Various Techniques to Protect Ice-rich Cut Slopes (AUTC #510010), Xiong Zhang (UAF)

Supplemental Study to “Using Mirafi Nylon Wicking Fabric to Prevent Frost Boils in the Dalton Highway Beaver Slide Area, Alaska” (AUTC 510020), Xiong Zhang (UAF) and Michael R. Lilly (Geo-Watersheds Scientific)

Stabilization of Erodible and Thawing Permafrost Slopes with Geofibers and Synthetic Fluid (AUTC #410028), J. Leroy Hulsey and Xiong Zhang (UAF)

Geophysical Applications for Arctic/Subarctic Transportation Planning (AUTC #410018), William E. Schnabel (UAF)

Fast Determination of Soil Behavior in the Capillary Zone Using Simple Laboratory Tests (AUTC #410025), Robert L. Lytton (Texas A&M University) and Xiong Zhang (UAF)

Evaluation of MEMS-based In-place Inclinometers in Cold Regions (AUTC #309022), Margaret Darrow (UAF)

Using Shallow Anchors and an Anchored Mesh System for Cut Slope Protection in Ice-Rich Soils (AUTC #207121), Xiong Zhang (UAF)

Monitoring and Analysis of Frozen Debris Lobes, Phase I (AUTC #12.03), Margaret Darrow and Ronald Daanen (UAF)

A Study of Unstable Slopes in Permafrost Areas: Alaskan Case Studies Used as a Training Tool (AUTC #309032), Margaret Darrow and Scott Huang (UAF)

Unstable Slope Management Program (AUTC #RR08.10), Margaret Darrow and Scott Huang (UAF)

Measurement of Temperature and Soil Properties for Finite Element Model Verification (AUTC #RR08.11), Margaret Darrow (UAF)

Preservation of the Alaska Highway, Phase 1 (AUTC #107054), Daniel Fortier (UAF)

Preservation of the Alaska Highway, Phase 2 (AUTC #309035), Daniel Fortier (Laval University) and Yuri Shur (UAF)

Effects of Permafrost and Seasonally Frozen Ground on Seismic Response of Transportation Infrastructure Sites (AUTC #107017), Zhaohui “Joey” Yang and Utpal Dutta (UAA)

Seismic Design of Deep Bridge Pier Foundations in Frozen Ground (AUTC #107033), Sri Sritharan (Iowa State University)
Completed Projects- Workforce Development

Knowledge Transfer Needs and Methods (AUTC #510009), Robert A. Perkins (UAF)

Serving Future Transportation Needs: Succession Planning for the State Department of Transportation Organization, Its People & Mission (AUTC #309038), Robert A. Perkins (UAF)

Development, Deployment, and Assessment of Activity-based Transportation Courses (AUTC- Idaho), Michael Kyte (University of Idaho) and Ming Lee (UAF)
Completed Projects - Environmental

Eagle Dust Project (AUTC #MISC3), David L. Barnes (UAF)

Dust Palliative Performance Measurements on Nine Rural Airports (AUTC # MISC4), David L. Barnes (UAF)

Construction Dust Amelioration (AUTC #RR10.03), Robert A. Perkins (UAF)

Naturally Occurring Asbestos in Alaska and Experiences and Policy of Other States Regarding its Use (AUTC #RR08.14), Robert A. Perkins (UAF)

Creosote-treated Timber in the Alaska Marine Environment (AUTC MISC8), Robert A. Perkins (UAF)

Development of Ambient PM2.5 Management Strategies (AUTC #107004), Ron Johnson and Tom Marsik (UAF)

Attenuation and Effectiveness of Triclopyr and 2,4-D Along Alaska Highway Rights-of-Way in a Continental and a Coastal Subarctic Environment (AUTC #107024), David L. Barnes (UAF) and Steve Seefeldt (USDA)

Impacts of Climate Variability and Change on Flood Frequency Analysis for Transportation Design (AUTC #207120), Amy Tidwell (UAF)

Feasibility Study of Electric Cars in the Cold Regions (AUTC #RR08.05), Jing Zhang (UAF)

Assessment of the Contribution of Traffic Emissions to Mobile Vehicle Measured PM2.5 Concentration by Means of WRF-CMAQ Simulations (AUTC #410003), Nicole Mölders (UAF)

Climate Change Impact Assessment for Surface Transportation in the Pacific Northwest and Alaska (AUTC #RR10.40), Ming Lee (UAF)

Bridge Deck Runoff: Water Quality Analysis and BMP Effectiveness (AUTC #RR08.13), Robert A. Perkins (UAF)

Long-range Transportation Forecasting for Greenhouse Gas Emission Estimation (AUTC #309042), Ming Lee (UAF)
As the use of dust-control palliatives in northern Alaska increases, state transportation professionals are looking for specifications to ensure effective performance of palliatives and to ensure the right palliatives are used in the right circumstances. For the past seven years, Alaska DOT&PF has applied dust-control palliatives to rural airport runways based only on recommendations from the manufacturers, who tend to have little experience with practical use. State engineers were unable to determine whether these products met specific standards, or which were the most effective at specific locations.

This project is using an innovative dust-monitoring instrument (DUSTM) to collect data and compare the effectiveness of newly applied palliatives and older (1 to 3 years) applications. Researchers are developing performance-based specifications for applying dust-control palliatives to unpaved transportation surfaces. These specifications will enable Alaska DOT&PF to choose the best palliative for a specific community's needs.

Dusty, unpaved roads and airports affect quality of life for many communities in cold regions; roughly 60% of Alaska’s roads are unpaved. Alaska is not alone. Of America’s 4.2 million miles of roads, 1.7 million are unpaved. Dust reduces road visibility, causes respiratory ailments, and affects fruit and plant harvesting activities. In addition, loss of fines material reduces road surface quality, increasing maintenance costs as well as wear and tear on vehicles.

Extending AUTC’s expertise in road dust reduction, project researchers are conducting one of several studies to improve rural dust control. Simply paving roads is often unworkable; costs are high, local materials are often unsuitable, and long-term maintenance may be unavailable. Possibilities for dust control abound, but which will fit best with the subsistence lifestyle practiced in rural areas, and what can the state’s thinly stretched budget afford?

To help address these questions, this project is developing a dust control research map that prioritizes critical areas. Researchers are designing instrumentation and methodology to accurately monitor road dust production. These tools will be used to support Alaska DOT&PF in field-testing various dust control measures in several locations.

So far, researchers have qualitatively assessed dust control performance on unpaved runways, tested new instrumentation, and measured palliative performance at one rural road site with this prototype instrument. Data continues to be collected at new sites and analyzed. With each new data set, the State of Alaska gains a better understanding of how dust control products work.
Performance of Dust Palliatives on Unpaved Roads in Rural Alaska (AUTC #410036) David L. Barnes (UAF)

This project is one of a series assessing the longevity of different palliatives applied to rural Alaska roads over two summer seasons. Researchers continue collecting data using a custom-made dust-monitoring system (DUSTM). Created and assembled by the research team, the DUSTM is a portable device that can be attached to the rear of an ATV, and is compact enough to be transported in a small airplane. It measures the amount of airborne or loftable dust that rises from an unpaved roadway (sometimes called “fugitive dust”) during vehicle use. Researchers can use the data it yields to calculate reductions or increases in dust over time. The research team is applying and monitoring palliatives on multiple sections of Alaska roads in rural villages and towns across the state. Recent testing took place in Central, Circle, Tetlin, Eagle, and Hughes, Alaska. The team applied two new palliatives with no previous use in Alaska to a surface in Summit, a community along the Richardson Highway.

A partnership between AUTC and the Alaska Department of Environmental Conservation, this project compares associated dust concentration measurements taken by DUSTM with those collected by ADEC stationary monitors. Data correlations between the two sources will determine how much of the measured fugitive dust is from a controllable emission source and how much is from uncontrollable sources. Both for public health and cost-effectiveness considerations, researchers want to know how much fugitive dust must be suppressed to meet regulatory standards. The results will help local communities plan the use of dust-control palliatives.

Longevity Analysis of Dust Control Palliatives (AUTC #510019) David L. Barnes (UAF)

Communities and government stakeholders in rural Alaska need cost-effective methods to reduce road and airfield dust. Before applying dust-control products, however, they must consider the longevity and performance of the different commercial palliatives currently available.

This project has helped develop new instruments and methods for field-based measurements of dust-control palliative performance and longevity. Supported by Midwest Industrial Supply Inc., manufacturer of EK35 — one of two palliatives tested in the study (Durosoil is the other, manufactured by Soilworks® LLC) — Alaska DOT&PF and the research team applied and monitored these products at several airfields and roads in rural Alaska. The team is using laboratory tests as well to better understand differences in product performance. By correlating these tests with field-based measurements, researchers can predict a palliative’s possible performance prior to its application, enabling cost-effective implementation.

The data suggests that the proper fines content in the soil is an extremely important parameter to the performance of all palliatives. Increases above or below the optimum fines content will significantly alter the performance of commonly used palliatives.
In Alaska’s spring months, excess water underneath road pavement due to thawing weakens roads and other transportation infrastructure, causing great expense and inconvenience for private and commercial motorists. This project examines how the fines (P200) used in base materials affect frost susceptibility and support for vehicular loads during the spring thaw.

Realizing the variation in critical excess fines content, Liu’s team is also evaluating the financial impact of increasing the fines content in the unbound pavement layers. They will identify the most effective critical excess fines content (that is, threshold fines content) allowed in the typical Alaska unbound base courses. Allowing as little as 2% increase in fines could significantly reduce gravel costs for a construction project.

Expanding upon a recent UAF study, Liu is investigating the impact of fines content on resilient modulus reduction of base courses during thawing when the base course material is frozen. Testing will be conducted under different temperature gradients and with limited water access. Liu and her team will simulate a closed-water system by collecting soil specimens with different initial moisture and fines content and freezing them in a frost-heave cell with no access to water. Researchers will then test the resilient moduli of soil specimens under different subfreezing temperatures and after a freeze-thaw cycle under both undrained and drained conditions. The testing will provide the data for drafting recommendations that will help Alaska DOT&PF determine the situations when designers can relax stabilized base policies and when builders might reduce costs by allowing excess fines in the base layers for highway construction.

Recently, researchers have continued laboratory performance tests and evaluated specimen heaving susceptibility. The team also has reconfigured a frost-heave chamber to enable larger testing groups with more specimens. The team finalized two data processing scripts and updated an entire data set for completed specimens.
Field-Evaluating Crack Sealing of Asphalt Concrete Pavements in Alaska (AUTC #510005) Juanyu “Jenny” Liu (UAF)

For years, routine sealing of cracks in asphalt concrete (AC) has cost the state of Alaska millions of dollars annually. Without new technology to eliminate the cracking, sealing and minor patching will continue to be a major expense for Alaska DOT&PF.

This project aims to find cost-effective improvements to existing crack-sealing methods. Past research suggests that, under some circumstances, it is possible to ignore cracks entirely with no negative effects. Liu is working with field researchers to determine where sealing is necessary and where it is not, leading to a cost effective crack sealing program.

The team will also determine the effectiveness of several different repair treatments for major transverse cracks including routing, heat lance and “band-aid patching.” Each of these methods are routinely used with varying success. Ultimately, the research team will provide recommendations which should lead to significant savings in the maintenance and operations funds now spent on crack sealing and minor patching of major transverse cracks. The research will provide Alaska DOT&PF with information that the agency can easily integrate into its Departmental Guidelines for Pavement Preservation Treatments in Alaska.

In recent work, researchers have integrated numerous articles and reports on thermal crack propagation, deterioration, numeric modeling, sealing materials and methods, and cost-effectiveness into their ongoing literature review. This process has helped the team identify a literature gap on asphalts, base layers, soil interfaces, and computer modeling that pertains to this work. In the next phase, researchers will complete their draft literature review and finish six section evaluations and data documentation. At this point, the field work is complete and the final report is being written.
A research partnership between Montana and Alaska may bring considerable cost savings and safety improvements to Alaska’s roads. It may also allow certain commercial suppliers to transform a waste stream into a revenue source.

Xianming Shi from MSU’s Western Transportation Institute (WTI) and Jenny Liu (UAF AUTC) are investigating whether local agricultural or distillery by-products can replace high-cost proprietary products that enhance anti-icing operations on Alaska roads. Counterparts at the Montana DOT have already found success with a similar effort, and Alaska hopes to realize this same potential.

Using a literature review, agency surveys, laboratory investigation, and follow-up field tests, researchers are developing and testing locally sourced salt brine additives to determine whether they are suitable for anti-icing during winter maintenance in Alaska. This determination will help improve traveler and commercial safety and mobility while reducing corrosion and environmental impacts. Results will also give Alaska DOT&PF more options for snow and ice control in its effort to provide sustainable, cost-effective winter road service. Moreover, in a time of widespread fiscal belt-tightening, this project offers more effective options in winter road maintenance, allowing Alaska DOT&PF to do more with the same budget.

Beyond reducing Alaska’s winter road maintenance costs, this research may boost local economic growth by helping build a new market for glycerol—the principal by-product of biodiesel production. This bio-based local material may be useful for dust suppression and soil stabilization as well, adding to the potential benefits of this research.

In recent work, the project team has surveyed locally available materials and conducted significant outreach with commercial producers of seafood, beer, biodiesel, and timber throughout Alaska. While developing a literature review and patent examinations, researchers will integrate new databases into the existing review and will complete screening tests of commercial additives and several byproducts available in Alaska. This work will culminate in a statistical design experiment and full-scale testing of multiple anti-icing formulas for performance and impact.

A byproduct of vodka production has been identified and tested in the laboratory. The results are encouraging. In a future phase of the project the product will be added to salt brine used by the Alaska DOT&PF to field test the product.
Cover: Winter traffic at -30°F contributes to air quality issues in Fairbanks. Photo by INE Staff (top). Ferry docked at an Alaska port by A. Metzger (bottom right). Floods in southcentral Alaska are a frequent threat to infrastructure. Photo courtesy: B. Connor. Table of Contents: (from left) Students conduct seismic testing of structures at a North Carolina State University facility. Photo courtesy M. Kowalsky, NCSU. Contract changes can be a source of risk and cost for all parties. Photo: INE Staff. Dust in rural Alaska. Photo: D. Witmer. NCSU structures testing lab conducting tests on bridge piers, photo courtesy M. Kowalsky, NCSU. Warming temperatures and river erosion expose a massive ice wedge near Kaktovik, AK. Photo courtesy Y. Shur, UAF. Dr. Jeff Miller, AUTC/UAA, shows off his work in developing and testing a Vehicle-to-Infrastructure Intelligent Transportation System. Photo courtesy: J. Miller. (Page 2) Photo of Billy Connor, AUTC Director, by INE Staff. (4) A. Armstrong (courtesy Armstrong). R. Kessler (courtesy Kessler). Bob Pawlowski (courtesy Pawlowski). All other board member photos by INE Staff. (5) R. Harper by J. Dewey-Davidson. Zhaohui Yang courtesy UAA. All other photos by INE Staff. (6) Billy Connor speaks at the 2013 International Symposium of Climatic Effects on Pavement and Geotechnical Infrastructure at UAF. Photo by INE Staff. (7) Warm Mix Asphalt Application photo courtesy ADOT. (10) Photo of J. Zottola by INE staff. Photo of J. Kwiatkowski courtesy Kwiatkowski. Photo of T. Eckhoff courtesy Eckhoff. (11) AKDOT crews applying test surfaces to the deck of the Yukon River bridge as part of AUTC research on light, durable wearing surfaces. Photos by student researcher Richard Ward. (12) As part of the Alaska Summer Research Academy, middle school students build a bridge on the UAF campus. AUTC instructor Keith Whitaker and AKDOT partner Clint Adler taught the class. Photo courtesy of AUTC staff. (13) A research team works together to install instrumentation for a study on groundwater interaction with embankments over permafrost. Photo courtesy M. Darrow. (14) The 2013 UAF College of Engineering & Mines Student Steelbridge Team took 1st place at the regional competition, held in Seattle, WA; they were one of only 49 teams to advance to the national competition, where they placed 3rd in efficiency and bridge stiffness, and 18th overall. AUTC Assoc. Director J.L. Hulsey is the team’s advisor. Photo by UAF’s T. Paris. (16) Top: Photo of field station collecting data for the Precipitation Frequency Estimation Analysis project, courtesy by S. Stuefer. Bottom: Aerial photo of roundabout on UAF by T. Paris. (17) Top: PhD student Lin Li conducts triaxial tests on soil samples. Photo courtesy INE Staff. Middle: Students conduct tests on frozen soil samples in support of better seismic designs for bridges. Photo courtesy J. Yang, UAA. Bottom: Student J. Kwiatkoski installs sensors for monitoring impact and movement on a ferry terminal. Photo by A. Metzger, UAF. (18) Top: AKDOT crews applying test surfaces to the deck of the Yukon River bridge as part of AUTC research on light, durable wearing surfaces. Photos by AUTC student researcher Richard Ward. Middle: Field instrumentation collecting data on chemicals present in the vicinity of creosote-treated pier supports. Photo courtesy R. Perkins, UAF. Bottom: Students at Washington State University work in the Smart Structures Lab, conducting tests on FRP sandwich bridge deck for damage identification. Photo courtesy Pizhong Qiao, WSU. Right: Chulitna River bridge, photo courtesy M. Fischer. (19) Top: Spreading Geofibers for soil stabilization as part of an experimental road bed in south-central Alaska. Photo courtesy B. Connor. Bottom: Applying warm mix asphalt as part of a project to develop asphalt specifications tailored to different regions in Alaska. Photo courtesy J. Liu, UAF. (20) Top and middle: Ph.D. student tests asphalt samples in AUTC’s materials testing lab. Photo: INE Staff. Bottom left & right: AKDOT road crew spreading warm mix asphalt, part of a project to develop asphalt specifications tailored to different regions in Alaska. Photo courtesy J. Liu. (21) Top: field crew applies stabilizing materials to a slope cut in ice-rich soils, photo courtesy X. Zhang, UAF. Middle: Student research assistants collect data as part of permafrost stabilization project. Bottom: Core sample of ice-rich soil. Both photos courtesy M. Darrow. (22) Left: A UAA research team performs fieldwork as part of the High-mast Light Pole Anchor Bolt Investigation. Photo courtesy Scott Hamel, UAA. Right: AUTC Director Billy Connor discusses threats posed by Frozen Debris Lobes to Alaska’s infrastructure at the International climate and Infrastructure Symposium, August 4-7 2013. Photo by AUTC staff. (23) Top: Dr. D. Barnes meets with ADOT maintenance engineers and community members as part of a dust palliative application project. Middle and Bottom: ADOT staff apply a selective vegetation control herbicide along an Alaska railway, part of a project jointly funded by AUTC, the Alaska Railroad, and the USDA. Photos courtesy D. Barnes, UAF. Lower left: UAF researchers in the field, gathering spring hydrology data which contributed to an AUTC-supported flood frequency study. (24) Starting bottom left: Dr. David Barnes has been instrumental in establishing a statewide dust-control research program jointly supported by AUTC and ADOT&PF. Photo courtesy INE Staff. ATV with UAF’s rugged and portable DUSTM attached; this UAF-designed instrument measures dust loftability on infrastructure such as remote aerial airstrips. Photo courtesy S. Young, AUTC student. A student researcher drives across an unpaved airstrip, collecting data on the effectiveness and durability of commercial dust palliatives. Photo courtesy S. Young, AUTC student. As part of an extensive dust control program, ADOT applied various dust palliative and AUTC research teams monitored and measured palliative performance. Photo courtesy T. Eckhoff, AUTC student. (26) Left: Graduate student David Jensen shows a core of ice-rich soil, collected as part of a thermal modeling and in-place inclinometer study. Photo courtesy M. Darrow, UAF. Right: Ph.D. student Lin Li shows lab storage of soil fines samples. Photo courtesy INE Staff. (27) Left and Middle: Examples of asphalt concrete cracking on Alaska’s Parks Highway, part of a project that conducted field evaluation of various crack-sealing strategies. Photos courtesy of Paul Eckman, AUTC undergraduate student. Ph.D. student Tony Mullins at a Transportation Research Board Conference poster session, presenting results from the “Field Evaluation of Crack-sealing in Asphalt Concrete Pavements” project. Photo courtesy J. Liu, UAF. (28) Dr. Jenny Liu presents her work at the International climate and Infrastructure Symposium, August 4-7 2013.
Alaska University Transportation Center

Transportation, Safety, Security, and Innovation in Cold Regions

AUTC is part of the
Institute of Northern Engineering
College of Engineering and Mines
University of Alaska Fairbanks
http://ine.uaf.edu/autc/