A Successful and Growing Partnership

by Clint Adler, P.E., Chief of Research Development & Technology Transfer, Alaska Department of Transportation & Public Facilities.

The Alaska Department of Transportation & Public Facilities enhances its research, development, and technology transfer programs through a collaborative relationship with the Alaska University Transportation Center.

“Found it on trust” and “Make deals unabashedly” are two keys to building robust transportation research and technology programs. I am happy that these philosophies typify the blossoming relationship between the Alaska Department of Transportation & Public Facilities (ADOT&PF) and the Alaska University Transportation Center (AUTC). This relationship is founded on trust because AUTC’s researchers have repeatedly demonstrated sincere desire and willingness to meet with ADOT&PF staff and take the time to listen and learn about the unique challenges and constraints Alaska’s transportation practitioners face on a daily basis. Likewise, there has been tremendous ingenuity and dedication from all who have discovered the rewards of collaboration amongst diverse teams to develop unique solutions for to increasingly interdisciplinary transportation challenges.

Our maturing relationships are paying dividends in several ways. Chief among them:

► Workforce development — Students working on transportation research projects develop expertise and experience they’ll need in the workforce. The demand for well-prepared transportation professionals has never been higher. ADOT&PF and transportation agencies across the nation are facing the perfect storm as the baby boomers that make up the majority of mid- to senior managers retire, and delivering and financing transportation programs become increasingly complicated. This environment requires new approaches to educating the nation’s transportation professionals. AUTC has risen to the challenge by developing new course offerings for undergraduates and practicing professionals alike.

► Capacity & Expertise — As the wave of retirees take their knowledge with them, and public sector budgets tighten, ADOT&PF’s need to augment its capabilities with additional specialized knowledge and skills grows. AUTC’s availability to rapidly assist with planning, design, construction, and maintenance issues pays big dividends. For example, AUTC investigations into dust control methods at rural airports are resulting in more cost-effective management of hundreds of Alaska’s rural airport runways and roads.

Leveraging Resources — Federal and state transportation funding laws allow AUTC and ADOT&PF to match funding, typically on a 50%/50% basis. But AUTC and its faculty and staff have not stopped there. We have been very happy to partner on efforts involving pooled resources from multiple partners, such as the Alaska Railroad, other state DOTs and universities, and even other nations. AUTC has been instrumental in integrating these resources into our joint efforts.

On behalf of ADOT&PF, I thank all AUTC faculty and staff for their willingness and dedication to developing a successful partnership for improving transportation in Alaska and beyond.
The AUTC Newsletter is published semi-annually by the Alaska University Transportation Research Center, Institute of Northern Engineering, University of Alaska Fairbanks, to inform readers about our research and outreach activities.

AUTC addresses issues related to research and technology themes as identified in the Highway Research and Technology Report (April, 2002), including 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 to address multi-modal issues facing Alaska and the nation’s transportation community.

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You may have noticed that in the last two newsletters I’ve asked our partners to chime in on our projects. I’m doing this for two reasons. First, I want them (the people using our results) to explain how they are implementing our work. Second, I want to show that we are making a difference in the quality of our transportation network. As Elmer Marks states (see story on page 4), “The Bridge Design division is changing how the Alaska Department of Transportation and Public Facilities estimates the impact of earthquakes on its structures based in our work. That work is finding its way into the AASHTO codes.”

Our relationships with ADOT&PF, the Alaska Railroad, and our other partners continue to grow (see Clint Adler’s front page story). AUTC values these partnerships and will continue its collaboration to solve issues of importance to each of them. At the same time, AUTC must look for new opportunities with other transportation organizations.

One opportunity is an effect of climate change. As the ice cover in the Arctic Ocean diminishes, marine traffic is expected to increase along with the need for transportation infrastructure. The Coast Guard, the Department of Homeland Security and the Navy are looking at new or expanded missions in the Arctic Oceans. Resource extraction near the coastline is likely to increase. As a result, new ports and related transportation infrastructure are likely.

Unfortunately, our knowledge of planning, designing, constructing, and operating marine infrastructure in the North is quite limited, as is our ability to predict ice movement, ice strength, or sediment transport. Engineering design guidelines are essentially nonexistent. Coast Guard facilities for ship safety are thousands of miles away.

While these issues could appear overwhelming, we have the opportunity to be on the ground floor of developing the tools for marine transportation in the North. To that end, I have asked Andrew Metzger, P.E., Ph.D, to take the lead for AUTC in developing a Marine North Research Program. He will be working with engineers, scientists, planners, and administrators to fill the knowledge gaps and find solutions for developing marine infrastructure. Dr. Metzger has a strong marine structures background and a keen interest in working in the Arctic. All of us here at AUTC are excited about the opportunities afforded us by this new endeavor.
AUTC Benefits the Alaska Department of Transportation & Public Facilities Bridge Section

by Elmer Marx, ADOT&PF Bridge Engineer

Alaska is one of the most seismically active regions in the world and is where three of the world’s ten largest earthquakes have been recorded. The intense ground shaking of these earthquakes has caused extensive damage to structures; however, the hardship created by a large earthquake does not end with the ground shaking. Weeks, months, or even years can pass before life returns to “normal.” As recently demonstrated in China, Haiti, and Chile, access in and out of earthquake-stricken regions is particularly important for minimizing loss of life.

The Alaska Department of Transportation and Public Facilities (ADOT&PF) is responsible for “Providing for the safe movement of people and goods and the delivery of state services.” Considering the size of the state and its limited and non-redundant roadways, this objective can be particularly difficult to satisfy after a large earthquake has occurred. One approach to ensuring the functionality of Alaska’s transportation system is to provide durable bridges that are capable of withstanding large earthquake forces. With that objective in mind, the Alaska University Transportation Center (AUTC) has coordinated with ADOT&PF to deliver the tools needed to provide safer, more reliable bridges.

Seismic Performance of Steel Bridge Piers

Limited material availability and a short construction season have driven ADOT&PF to consider non-traditional bridge structures. The use of an all-steel bridge pier is particularly attractive, because it eliminates the need for cast-in-place concrete that is difficult and expensive to produce in remote locations.

Unfortunately, all-steel bridge piers have not performed well in past earthquakes, and ADOT&PF is suspicious of their seismic performance.

Working with North Carolina State University, ADOT&PF and AUTC tested connection details typically used for steel bridge piers. Full-scale model tests demonstrated the vulnerabilities of steel bridge piers using standard connection details. Research results provided ADOT&PF with the basis for restricting these structures to low seismic hazard regions.

Laboratory data collected during the first phase of the project allowed the research team to develop connection details capable of better resisting seismic demands. Full-scale testing of revised connection details is ongoing. The objective of this phase of the research is to develop connection details capable of resisting moderate seismic hazards without eliminating the attractive features of the system.
Automated Bridge Pier Analysis Software

The large movement that occurs in bridge piers because of ground shaking during earthquakes has led to failure of bridges in the past. In fact, most earthquake damage is concentrated in bridge piers. Consequently, it is important that bridge piers have the ability to resist considerable ground movement without failing.

Over the past twenty years, research has helped engineers create analysis tools to better predict the ability of bridge piers to accommodate earthquake movements. Although reliable, these tools are complex and rely on computerization. Furthermore, several different computer programs are required to provide the full structural response of a bridge pier.

Working with Oregon State University, ADOT&PF and AUTC have developed new computer software that provides accurate predictions of a bridge pier’s capacity to resist earthquake loads. Although this software performs very complicated analysis, it is easy to use and provides reliable results in a fraction of the time previously required. This improved analysis tool allows bridge engineers to provide safer, more cost-effective bridges in less time.

Climate Effects on Seismic Bridge Response

In addition to experiencing a large number of earthquakes, Alaska is subjected to extremely cold weather. During prolonged periods of cold, the ground freezes, and concrete and steel become more brittle. These effects are detrimental to bridges when combined with an earthquake.

Working with universities throughout the nation, ADOT&PF and AUTC have examined the effects of cold climate on bridge seismic response. For example, the University of Alaska Anchorage has provided design guidelines for the effects of frozen soil on shaking ground during earthquakes. The University of Alaska Fairbanks has preformed large-scale testing of bridge piles in frozen soil. This research combined with that from North Carolina State University and Iowa State University has led to the development of bridge design guidelines that, for the first time, include the effects of cold climate environments.

With the assistance of the Alaska University Transportation Center, the Alaska Department of Transportation and Public Facilities is “Providing for the safe movement of people and goods and the delivery of state services.” Together, we are building a better Alaska.
Rodney Collins, graduate student in Civil Engineering is AUTC’s Student of the Year for 2010. Collins’ stellar academic performance, the quality of his research, and his leadership in student professional activities made him an obvious choice for this award.

Starting in 2008, Collins participated in various research projects, developing an interest in the use of geofibers and synthetic fluid for stabilizing marginal soils, which became the subject of his Master’s thesis. His research — part of a larger project jointly funded by the ADOT&PF and AUTC — involves lab testing of non-traditional soil stabilization technology. The project goal is to find new techniques to stabilize loose sandy and silty soils, improving their performance as foundations for such structures as buildings, airstrips, and roads.

Working in AUTC engineering research offers many opportunities in addition to a strong academic background. As part of his work on this project, Collins has traveled to communities like Barter Island, to study the effects of melting permafrost; to Unalakleet, to test soil bearing capacity; Emmonak, to test dust-control measures; and Kwigillingok, to investigate the use of geofibers and synthetic fluid on clay subgrade.

“Throughout my studies,” Collins noted, “the most important thing I have gained is the opportunity to interact with people from different cultures and understand engineering problems through the eyes of the people that live there.”

Collins has coauthored two published papers on cutting-edge use of geofibers and synthetic fluid to stabilize Fairbanks silt. Two other papers are in progress: one involving large-scale direct shear tests of Ottawa sand mixed with geofibers; the other is a case study describing the use of geofibers and synthetic fluid to stabilize a road.

After graduation from UAF with his Master’s degree, Collins plans to complete a Ph.D. at another university.

“I look forward to sharing my experiences at a new university and also gaining a new perspective on engineering,” he said.

After a PhD, and some time in the private sector — perhaps a consulting business — Collins hopes to return to UAF, where, as he described it, “I can continue conducting research and also educating new students.”
Autc Creates Learning Opportunities

One of AUTC’s strategic goals is to involve undergraduate and graduate students in research related to transportation safety, security, and innovation in cold regions. This practice helps build a capable and experienced future workforce and creates opportunity for two-way sharing of insights between knowledgeable engineers with years of experience and students with fresh ideas and enthusiasm.

One project, “Application of a Non-traditional Soil Stabilization Technology,” led by AUTC director Billy Connor, involved students in two stages: lab testing the use of geofibers and synthetic fluid for soil stabilization (funded by ADOT&PF and AUTC) and field application of geofibers and synthetic fluid to stabilize loose sandy and silty soils typical of Western Alaska (funded by the Federal Highway Administration).

Rodney Collins, graduate student in civil engineering and recipient of the 2010 AUTC Student of the Year award, performed the majority of the laboratory testing, measuring to what degree these new materials improve poor foundation soils. Tests have shown that fibers can double or triple the strength of the soil. Synthetic fluids reduce moisture sensitivity in fine-grained material, encouraging poor, silty soils to stay drier, which increases their strength and reduces rutting.

Two students gained hands-on field experience in field application of these geofibers and synthetic fluid as part of a new road bed. They helped apply these materials at a site in Alaska’s Matanuska-Susitna Borough, near Horseshoe Lake.

Along with Collins, UAF undergraduate Peter Jackson participated in the field application and will help monitor the site. Researchers worked with FHWA, gathering data from this site as well as from other active test sites. New sites in the state of Washington are being identified.

In addition to providing a powerful learning environment for students, this research directly benefits a wide range of transportation construction projects by presenting engineers with soil preparation strategies that make use of locally available materials, which can significantly reduce overall construction costs. Likely projects include highway embankment construction and unstable slope management in addition to construction of roads and airports in remote areas.

Above, undergraduate Peter Jackson helped spread geofibers and shot video for the “Non-traditional Soil Stabilization Technology: Use of Geofibers and Synthetic Fluid in the Field” project. To see Jackson’s video of the road building process at this field site, visit http://www.youtube.com/watch?v=Nzh-xNW4Ows.
Captain Bob Pawlowski joins the AUTC Governing Board

AUTC welcomes Captain Bob Pawlowski to our Governing Board.

Pawlowski is the Legislative Liaison to the Denali Commission. In this position he represents the Alaska State Legislature on common program interests with the Denali Commission.

Pawlowski has spent the past 36 years in fishery science, environmental management, business development and public policy. As a NOAA Corps Officer, he commanded two NOAA research vessels; served as Navigation Advisor for Alaska to the Office of Coast Survey; Regional Planning Officer, Northeast Regional Office, NMFS; and Director, Alaska Ocean Service Center. After completing a career with the NOAA Corps, he worked in port development for Port MacKenzie, Survey Project Manager for Thales GeoSolutions, General Manager, St. George Chadux Corporation and Executive Director, Alaska Fisheries Development Foundation.

Outside of his work responsibilities, he teaches coastal engineering at the University of Alaska and served as an advisor to the Alaska Legislature and the Governors Sub-cabinet on climate change. Pawlowski has a Masters in Engineering Management and an MBA from UAA and a USCG Masters License.

AUTC Web Site Launches New Look

Visit the new AUTC web site (http://ine.uaf.edu/autc/) for current news, detailed information on our research and outreach projects, and easy access to our publications. If you’ve got a story you’d like to share with the UTC and Alaska communities, contact sboatwright@alaska.edu.