The Road Dust Institute: A New Partnership for Managing Dust at Transportation Facilities

by Billy Connor, Director,
Alaska University Transportation Center

AUTC has partnered with the Western Transportation Institute, the University of California, Davis, the University of Nevada, Las Vegas, and FHWA to form the Road Dust Institute. According to its mission statement, “The Road Dust Institute (RDI) provides tools to manage dust on transportation facilities through research, education, and technology transfer thereby supporting improvements in health, safety, mobility, environmental sustainability, and livability. RDI’s unique knowledge, experience, and capabilities provides for collaboration, partnering, and consolidation of resources to address the needs of industry, government, and other stakeholders to reduce the impacts of dust.”

Working with industry and interested stakeholders, the RDI is working to eliminate the adverse impacts of transportation-related dust. As part of its outreach program, the RDI is holding the 2nd Road Dust Best Management Practices Conference in Las Vegas, Nevada, November 7–9, 2011. The conference brings together researchers and federal, local, state, and county road practitioners to discuss dust-management practices. This year’s conference will feature presentations and training by national and international experts in dust management. Attendees will be given the opportunity to interact with the experts through poster sessions, round table dialogue, and training sessions.

Dust continues to be a serious concern in Alaska and the nation. The EPA estimated in 2005 that 10.5 tons of fine particulates (dust) were produced from the nation’s 1.3 million roads (Federal Register, 2006). This equates to a staggering 7.9 tons of dust per mile of unpaved road per year. Considering the in-place cost for base course material to be $25 per ton, the cost to federal, state, and local agencies for dust loss is estimated at $260 million per year. This cost only represents loss of fine particles and does not include the associated cost of aggregate loss. Before the ADOT&PF implemented a dust-management program on the Dalton Highway between Fairbanks and Prudhoe Bay, about an inch of surfacing was lost per year due to traffic. That inch translates to costs that exceed $24,000 per mile per year. In the 1980s, ADOT&PF began using calcium chloride to manage the dust. Presently, this application costs about $6,000 per mile.

There are numerous other reasons to control dust including safety. Dust from a vehicle can reduce visibility to nearly zero, and under certain conditions, several minutes can pass before full visibility is restored.

The Road Dust Institute will develop uniform dust-management standards, performance measures, and testing procedures.

To learn more about the 2nd Road Dust Best Management Practices Conference, visit http://roaddustinstitute.org/conference

Billy Connor and Clint Adler, P.E., Chief of Research Development and Technology Transfer, Alaska Department of Transportation & Public Facilities, have made improving dust management in Alaska a priority for the joint AUTC/ADOT&PF research program. Results from ongoing research projects will be presented at the 2011 RDI conference.
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 multimodal issues facing Alaska and the nation’s transportation community.

For more information about our research, please contact:

AUTC
P.O. Box 755900
Room 245 Duckering Building
Fairbanks, AK 99775-5900

Or visit our web site: ine.uaf.edu/AUTC

Director
Billy Connor
bgconnor@alaska.edu

Program Assistant
Jill Dewey-Davidson
autc@uaf.edu

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3 Director’s Notes

AUTC contributes to the production of an experienced and inquisitive future workforce.

4 Characterizing the Load Environment of Ferry Landings for the Washington State Ferries and the Alaska Marine Highway System

By teaming up to collect and share new information on structural tolerances at ferry landings, the Washington State DOT, the Alaska DOT, and the AUTC will help marine highway planners design more economical, more reliable, more robust ferry terminal structures.

6 Asphalt-treated Base Course Materials

The key to improving road construction is to get practical, current information into the hands of the right people. This project’s final results will contribute to the current Alaska Flexible Pavement Design Manual used by highway engineers. On a wider scale, Liu’s results will expand the national data base of asphalt treated base course materials, improving information on road construction world wide, especially regarding the resilient behavior of ATBs under low temperatures.

8 Congratulations to our Graduates

The UAF Graduate Certificate in Construction Management program will see its first three graduates this spring. The Program in Construction Management was designed to make relevant, top quality education available to employees at a cost and time commitment attractive to their employers.
We here at AUTC value our students, whether graduate or undergraduate, for not only their willingness to work hard, but for their desire to make a difference and for their desire to learn. We recognize that AUTC generates two equally important products. These are our students and research results. Most funding agencies recognize the value of the research, but not all recognize the value of the students. These students represent the of future transportation.

Universities have always been about teaching and learning. It follows that universities focus on their students, even in research. The notion that students are a source of cheap labor is a fallacy. The reality is that involving student researchers, undergraduate and graduate, requires time and energy. That said, I’m continuously amazed at their ability to challenge conventional wisdom successfully. Their ability to think freely, if managed correctly, is one of their best qualities. Any professor that has tried to answer a student’s “why not?” question only to find there is “no reason not to” can attest to that.

We all know that our students represent our future workforce. We also recognize that investments in our students secure our nation’s position in the world’s market place. Unfortunately, too many people apply this to only the classroom.

I’ve noticed that undergraduate students who become involved in research are far more likely to go on to graduate school. Here at the University of Alaska Fairbanks, undergraduate students who do go on to graduate school can often reduce the time required to earn a Master’s degree by a year, because they are already pursuing a research subject, and their projects are already in progress.

Students involved in research enter the workforce with a slightly different approach to their daily tasks. They tend to be more inquisitive and better equipped to adapt to change. In addition, they are more willing, often eager, to take on assignments that require pushing the envelope of knowledge or current practice.

All of us at AUTC value our students and the future they represent. We take our responsibility of preparing them for their futures, and yours, very seriously. When you assess the worth of university-conducted research, be sure to appreciate the dual roles — teaching and knowledge production — that research represents.
Marine highways provide a necessary service for coastal communities in a number of areas within the United States. In Alaska, the Alaska Marine Highway System (AMHS) is a vital part of the transportation system; it connects over 33 ports, most of which are only accessible by air or sea. Ferries operate year-round and are a critical component of Alaska’s highway system. Similarly, in Washington State the ferry system is vital to public transportation within Puget Sound and the surrounding area. Washington State Ferries (WSF) provides service to over 24 million passengers each year and is the largest ferry system in the U.S. A vital component of the region’s multi-model transportation infrastructure, WSF operates 23 vessels and 20 ferry terminals, requiring some terminals to service multiple vessels simultaneously. For both marine highway systems, passenger demand is expected to increase considerably over the coming decades. This projection and the age of existing facilities — many of which are over 25 years old — have prompted plans for renovation of a number of ferry terminals.

An Overlooked System of Highways

Although they are often overlooked in transportation studies, ferry systems (also known as marine highways) are actually part of the U.S. highway system. Consequently, the knowledge base for this type of infrastructure is less developed than for other modes of transportation. When information is lacking, engineers and planners of marine highway facilities must make assumptions on how best to finance, design, build, operate, and maintain these significant transportation systems — often with considerable uncertainty.

Measuring Activity and Impact for Better Design

Because marine highway transportation has been mostly overlooked by the research community, technology pertaining to its infrastructure has not developed significantly in several decades. This project to help fill this existing knowledge gap. Specifically, this project will study the forces from ferry vessels on ferry landings, the shore structures that accept ferry vessels. This information, which is critical for designs that are economical yet reliable, with inherent longevity, is based on measuring movements and internal structural forces at ferry landing structures. Measurements are taken each time a vessel docks. Statistics of this data, taken over numerous dockings, are used to identify forces from the vessel that have a low probability of being exceeded. Using criteria in this format will result in a design with a quantifiable degree of reliability and safety. This methodology is the same as that used in building and bridge design in the U.S. The results of this project will represent a significant advancement in the design of ferry terminal structures, as well as marine structures in general.
Partnerships Promote More and Better Research

In addition to its technical merit, this project represents a successful partnership in transportation research. Because both the AMHS and WSF have similar needs but limited research funds, AUTC orchestrated a tripartite funding plan that provides cost sharing for both the ADOT&PF and Washington State Department of Transportation (WSDOT). By jointly participating in the project, the WSDOT and ADOT&PF are realizing significant cost savings over what would be expected if each entity funded its own separate project. Furthermore, it is unlikely that either project would have been funded on a stand-alone basis due to cost. The partnership fostered by AUTC made fulfillment of AMHS and WSF needs feasible.

**Below:** A closer view of a “dolphin” at the Auke Bay Ferry Terminal. Dolphin structures absorb the impact during vessel berthing. They also provide a platform to tie-up and secure the vessels when docked. The structure must be strong enough to support the vessel during impact; but not so stiff that it (the dolphin) damages the vessel. Having adequate knowledge of berthing parameters is critical when engineers design these structures. Photo by A. Metzger.

**Left:** The research team instrumented the rubber fenders, piling and bollards to monitor displacements and strains from both berthing events and mooring lines. This figure shows the work platform used to install strain gauges on the pile “tripod”. Photo by A. Metzger.

**Inset:** Project Principle Investigator, Andrew Metzger, ascends the ladder after installation of strain gauges. Photo by AUTC staff.
Increasing Knowledge of Asphalt-treated Base Course Materials

by Juanyu Liu, UAF Civil and Environmental Engineering professor and AUTC researcher. For more information on Liu’s work, visit civil.uaf.edu/people/juanyu-liu/

Asphalt-treated base (ATB) course material is commonly used for pavement construction in Alaska due to material availability and relatively low cost. Builders can use lower-quality materials that have been stabilized as a base course to produce stronger pavements, extending a road’s life span and saving the state money over time. At present, there is little data on the engineering characteristics (or properties) of base materials commonly available in Alaska. The need for such data has become more critical recently, since ADOT&PF adopted mechanistic pavement design methods.

This study, headed by Jenny Liu of UAF’s Civil & Environmental Engineering Department, investigated four ATB types (hot asphalt, emulsion, foamed asphalt, and reclaimed asphalt pavement) that are popular for treating base course materials in Alaska. Liu and Ph.D. student Peng Li conducted a detailed literature review, including information from ongoing research projects, to compile the latest information on ATB characterization. The literature search provided the basis for selecting materials and designing a series of tests to demonstrate what mixes might work best in Alaska’s three very different regions (Northern, Central, and Southeast).

Liu and Li evaluated the engineering properties of ATB course materials, including resilient modulus ($M_R$), permanent deformation, fatigue life, and rutting performance. They conducted tests at three temperatures, -10 °C, 0 °C and 20 °C, which represented typical temperatures at different seasons. They used repeated triaxial tests (Figure 1) to evaluate the $M_R$ and permanent deformation of the ATB samples. The tests were conducted according to AASHTO T307 at various stress states; designers all over the state will have confidence in these results.

In addition, rutting and fatigue tests were also conducted on the most commonly used base course, hot asphalt treated base (HATB). HATB is popular because hot asphalt can be used for both the base course and the surface layer, which makes construction easier. HATB tends to remain more viscous and elastic, even long after application, than other base courses. To identify what HATB mix might work best in Alaska, especially on high-traffic roads, the team performed rutting tests using a Georgia Loaded Wheel Tester (Figure 2), which simulated repeated wheel loads on the pavement. Test results indicated how well the materials could resist rutting. Fatigue tests were carried out on a repeated flexural bending system (Figure 3). This testing system simulated the bending motion that occurs at the bottom of the asphalt pavement. Statistical analyses were performed based on collected data, and the $M_R$ testing results showed that asphalt treatment effectively increases the moduli of the tested base course materials.

Among three treatment techniques, hot asphalt treatment resulted in the most significant improvement, followed by emulsified asphalt treatment and foamed asphalt treatment. All the treated base course materials exhibited stress state dependent properties. This dependency varied for different types of materials. As expected, the $M_R$ of ATBs increased with a decrease in temperature.

Aggregate source plays an important role in the stiffness of ATBs as well. Of Alaska’s three regions, the aggregate found in the Northern region was softer, because the rocks tend to be more round. Results also found that hot asphalt treated base material with 3.5% binder content has the best rutting resistance, and increasing binder content further also improves fatigue resistance.

To make these lab studies most useful to future designers, Liu developed comprehensive regression models for all four of the treated base course materials commonly used in Alaska. These new formulas will allow Alaskan designers to select the appropriate mixture based on treatment technique, ambient temperature, aggregate properties, and binder content.
Dust also negatively affects the quality of life for those who live along gravel roads. Delucchi (1998) calculated the unaccounted cost of mortality and morbidity due to road dust at between $3 billion and $153.5 billion (1990–91 dollars).

Dried salmon is a major source of food in the diet of rural Alaskans. Dust from village streets forces villagers to dry their fish miles from their homes and risk the loss of fish to hungry animals looking for an easy meal. Calcium chloride is not an acceptable palliative due to the bitter taste it imparts to the drying fish.

Over the past four years, AUTC has been working to find an inexpensive solution to Alaska’s dust problem. Unfortunately, we quickly found that there is no standard for measuring the effectiveness of palliatives. As a result, suppliers were left to define the effectiveness of their products. While most suppliers are trying to be honest in their evaluations, the lack of standards makes it nearly impossible to compare products or to compare results from one location to another. In most cases, the effectiveness of a product is subjective.

Through the RDI, we will be developing uniform dust-management standards, performance measures, and testing procedures.

Join us in Las Vegas, dust off your boots, and learn to manage your dust.
Congratulations to our 2011 Graduates

The UAF Graduate Certificate in Construction Management program will see its first three graduates this spring.

Jeff Russell and Andrew Schultz, of the Alaska Department of Transportation & Public Facilities, and Scott Shopa, of the US Army Medical Service Corps, will take a new level of expertise back to their professional communities.

With dedication and hard work, all three completed 15 graduate-level credits in construction project management while performing at their existing jobs. All three will be better equipped to take on large projects and to mentor the new professional staff who join their organizations. With new skills and increasing confidence, these professionals will be better placed for promotion opportunities and more challenging projects.

The Graduate Certificate Program in Construction Management was designed to make relevant, top quality education available to employees at a cost and time commitment attractive to their employers.

Bob Perkins, professor of Engineering Management at UAF, notes that “about a third of our Civil Engineering graduates go into the field with very little management training. Our goal was to offer a program that would offer advanced training to practicing engineers. We found that there was also a group of technical professionals who could use the same training.” Many professionals also saw a need for more training in communications — the “human side” of their construction projects.

As the program has grown, UAF tapped Keith Whitaker, an engineer with expertise in design construction and litigation, to run the program.

“These are the best type of students,” said Whitaker, “hard-working, focused, enjoyable to have in class. I think they’re already seeing the benefits of this program.” Whitaker’s goal for the coming years is to attract more students from a wider range of employers, including the private sector.

“One great thing about this program is that the students come in with this large body of knowledge that they share with each other and with their instructors,” said Perkins.

The new graduate program is supported by a group of organizations, including the AKDOT&PF and the Alaska University Transportation Center.