TECHNOLOGY FOR
Alaskan Transportation
Local Technical Assistance Program

Winter 1999
November–December
Volume 24, Number 4

IN THIS ISSUE...

PLUS...

Anti-icing/Deicing & Winter Maintenance Practices in the Anchorage District

Plowing and sanding are tried and true, but anti-icing is the wave of the future. The application of a liquid chemical freezing-point depressant onto a highway at or before the beginning of precipitation can inhibit the formation of a bond between the snow or ice and the pavement surface. Periodically monitoring and reapplying product to weaken or prevent that bond is the core of a successful anti-icing program. Deicing is an operation where a chemical deicer is applied to an accumulation of snow, ice, or frost that is already bonded to the pavement surface. Deicing can, of course, be accomplished mechanically (hard way) or with chemicals. Prewetting traction sand is a technique aimed at melting the

photo: Jerry Reed

Anchorage District fleet

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FHWA Crash Tests Curb-Mounted Bridge Rail

(Adapted from Research and Technology Transporter, *Nov. 1999.)*

FHWA crash tested a pickup truck with a Massachusetts Type S3 Steel Bridge Railing system. This bridge rail, when mounted behind a 200-mm-high curb and a 1,525-mm-wide sidewalk, had been evaluated in a series of three crash tests and met the requirements of Test Level Four (TL-4) in National

Truck and bridge rail before test

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Crash Tests

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Cooperative Highway Research Program Report 350 (NCHRP 350). However, researchers wanted to see if the experiment could be conducted without the sidewalk and with the bridge rail mounted directly on a 200-mm-high curb.

To keep the railing geometrics the same with respect to impacting vehicles, the steel posts were shortened by 200 mm before mounting them on the curb.

The Massachusetts Type S3 Steel Bridge Railing system is a beam-and-post system consisting of three tubular steel rail elements bolted to wide-flange steel posts.

Vertical pickets consisting of 25 mm x 25 mm steel tubes are used to close the gaps between the rails in order to meet the AASHTO guidelines for pedestrian protection.

The pickup truck impacted the bridge rail at a nominal speed of 100 km/h and an impact angle of 25 degrees. The bridge rail contained and redirected the test vehicle upright. It came to rest 85.3 m down from the impact point and was in line with the bridge rail (see photo below). The bridge rail received minimal damage.

Tire marks were on the face of the curb at post number 5. To the right of post number 5, two pickets pulled out of the bottom bolts. Cracks radiated around post number 5 and under the concrete deck.

The test results met the evaluation criteria for Test No. 4-11 in NCHRP Report 350. The next crash test will be a strength test with the single unit truck.

Alaska DOT&PF tested the Alaska multistate bridge rail, using the same NCHRP report 350 test no. 4-11. The bridge rail meets the NCHRP requirements. The research report (research report 247 NCHRP 350-411) can be found at <ftp://ftp.dot.state.ak.us/pub/nres/Research%20Reports/>.

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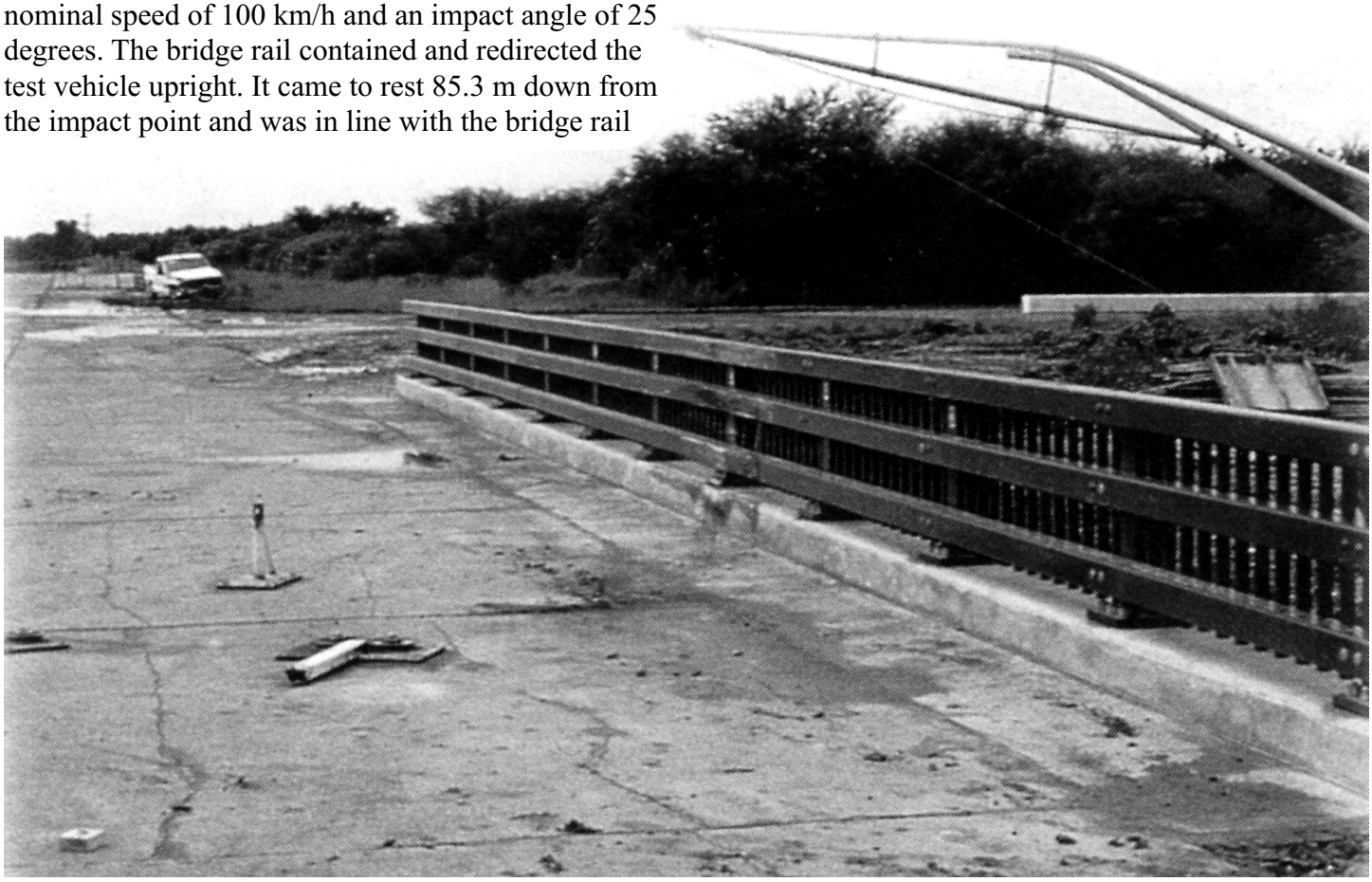

Bridge rail and truck after the crash test

Anti-icing/Deicing

continued from page 1

sand particles into the accumulated snow or ice to keep the sand from blowing off the road. This technology is not new anymore. It is being used in various forms all around Alaska and the rest of the country with various mixtures of products.

History

Bill Mowl, Alaska DOT&PF's Anchorage superintendent, was first introduced to liquid MgCl2 (magnesium chloride) at an equipment symposium he attended in the Pacific Northwest in 1995. Bill brought this idea back to Anchorage and we researched the literature for other commercially available anti-icing products. Bill knew that the Municipality of Anchorage was using liquid potassium acetate at $4 to $5/gallon and was convinced that the less expensive MgCl2 would work about as well. We concluded that it was worth a try and that liquid MgCl2 was the right product for the job. One of the first things to result from our research was that the Municipality of Anchorage switched products. They agreed that MgCl2 was much more cost-effective. Our current purchase price for liquid MgCl2 in Anchorage is $1.11 per gallon delivered to our storage tanks.

Current Practices

Anchorage DOT&PF Maintenance & Operations has a 6,000-gallon MgCl2 storage tank in Anchorage, a 10,000-gallon tank at Birchwood Airport, and a 10,000-gallon tank in Girdwood. All of the Anchorage and Girdwood sanders are equipped with twin 70-gallon saddle tanks for pre-wetting the traction sand with liquid MgCl2. Our application rate is set at about 9 gallons MgCl2 per cubic yard of sand, or 3.2% by weight. This allows the trucks to spread two loads of sand without having to refill their MgCl2 tanks. We have a couple of 2,000-gallon direct application trucks in Anchorage and a single 1,800-gallon truck in Girdwood. A typical application rate for anti-icing is 50 gallons per lane mile. All three of these vehicles have "ground speed controls" capable of maintaining a uniform predetermined application rate of MgCl2 over one, two, or three lanes of pavement at varying speeds from a dead stop to 50 mph. Getting traffic to cooperate is another issue!

photo: Jerry Reed

The 6,000-gallon MgCl2 storage tank.

photo: Jerry Reed

The winter maintenance strategies used in Anchorage are a mix of anti-icing, deicing, and applying traditional traction sand. Our traction sand contains about 5% salt, added mainly to prevent freezing and to keep the stockpile workable. This small amount of salt we use is enough to promote some melting when temperatures are above 15° F. During these warmer periods we sometimes mix extra salt with the sand to promote even more melting. On other rarer occasions, usually during a wet snowfall, we use straight salt to help prevent the pack from forming.

Our most widely used strategy is to plow and apply traction sand. Anchorage uses an average of approximately 19,000 tons of clean (less than 2% silt content) washed sand per year. We have held the line on sand purchases and hope to cut back on these numbers in the future. Part of the reason that our usage has stayed flat is that every year our lane miles to maintain go up! Our policy for snow removal is that we start plowing when at least 2" of snow has accumulated. The trucks sand as they plow and when they are done plowing they continue applying sand until adequate traction is obtained. We have had great success with prewetting. Our State Equipment Fleet partners (Dave Bryson in particular) worked with us to design a system that is both functional and inexpensive. We think that we are getting much better results in that more of the sand we apply is staying in the driving lane where it does its job. In my opinion anyone that uses traction sand as a winter strategy should be prewetting. Sand that migrates to the centerline and the shoulders of the road is not only wasted but is actually counter-productive. Traction sand has been found to add substantially to air quality problems. The direct application of MgCl2 in these urban areas can help to cut down on airborne dust pollution.

The Anchorage station is working with the Municipality of Anchorage Department of Health and Human Services using CMAQ (Congestion Mitigation / Air Quality) funds from the FHWA to demonstrate, by way of a test program, that using a liquid anti-icer/ deicer in lieu of traction sand can help alleviate air quality problems. We are in the second year of a three-year pilot program. During the winter of 1998/1999 we applied liquid MgCl2, and no sand, to a five lane-mile section of Gambell/Ingra Streets. This year we have enlarged the area to encompass 15 lane miles of urban streets to include portions of A and C Streets and Fireweed Lane. The evaluation of winter season usage of MgCl2 as a deicer and anti-icer on ambient PM-10 (particulate matter in the range of 5 microns) dust levels has so far been inconclusive. It's conceivable that the area-wide use of traction sand prewetted with MgCl2 is partially responsible for the lack of a conclusive relationship. Further testing is certainly warranted. We believe there is a logical connection between decreased sand usage and a decrease in airborne dust problems. The application of liquid MgCl2 was demonstrated to be an effective dust palliative. MgCl2 is hydroscopic, which means that it attracts and retains moisture. MgCl2 is similar to calcium chloride and can be used as a dust palliative on unpaved roads. Data showed that after an application of MgCl2 adjacent to the Gambell Street monitoring station, PM-10 concentrations were substantially lower than those near the untreated Tudor Road control section.

The use of MgCl2 is more expensive than sand alone but the extra cost is partially balanced by a savings in street sweeping and storm drain cleaning costs, and less wear and tear on street markings. Using MgCl2 can also provide a higher level of service to the motoring public by providing enhanced traction during the early portion of a snowstorm and by making the snow easier to plow. Another benefit is that the MgCl2 we use is specified to be 70% less corrosive than salt by way of a corrosion-inhibiting additive. Based on studies to date, the effects to the environment are minimal and acceptable. We are cognizant, though, of the need to balance further increases in usage against potential impacts to our streams and water bodies.

Municipality of Anchorage

The Municipality of Anchorage has an aggressive chemical anti-icing/deicing policy. They began using liquids the winter of 1993 with liquid potassium acetate, switching to MgCl2 in January 1996. They apply MgCl2 only in what is called the CBD (Central Business District), bounded by L Street to Ingra, and Third Avenue to Ninth Avenue. The Municipality of Anchorage has cut back on the use of traction sand in a big way. They quit using traditional sand altogether and are now using what they call an "aggregate." This aggregate is similar in composition to pea gravel only it has naturally fractured surfaces. This material contributes much less to the airborne dust problem. The State has opted not to use this material due to the high-speed nature of our routes. We are concerned that these "chips" would lead to many more broken windshields and chipped paint jobs. Another consideration is that in order to get a particle to stick to the road surface, approximately ⅓ of the particle

needs to be embedded into the snow or ice pack. The larger aggregate size that the Municipality of Anchorage uses would not stick very well on slick roads with little or no pack. The smaller particle size of our traditional traction sand works better in that regard.

The Municipality of Anchorage has cut back from 13,000 tons of sand used in 1995/1996 to about 5,000 tons in 1998/1999. Both the MOA and the State have been using MgCl2 in street sweepers to allow them to start sweeping earlier in the season. Street sweepers need to wet the pavement to keep the dust down and the MgCl2 keeps the water from freezing in the trucks and on the roads.

photo: Jerry Reed

Anti-icing tanker

Anti-icing

We too would like to do away with as much sand as possible in our urban areas. Anti-icing and liquid de-icing are well suited to routes with a higher level of service such as the high traffic routes in the Anchorage area. A successful program requires vigilance and timeliness to provide bare pavement throughout a storm or to return to bare pavement sooner after a storm ends. The biggest problem we have is trying to do more with less. Although the benefits are there to be had, it does cost more money to use MgCl2. In this age of declining budgets we can't afford to provide an increased level of service.

Our experience with anti-icing has been limited, mainly due to these budgetary constraints. To fully implement an anti-icing program would be very costly indeed. In the best of all worlds MgCl2 would be applied over the entire length and width of the roadway. The Anchorage maintenance station has approximately 1,100 lane miles of road, requiring an investment of approximately $55,000 for every major snow event to apply MgCl2 everywhere. When you consider that there are an average of 10 snow storms every year, that adds up to over half a million dollars. Timing is critical. If we misjudge the weather and the MgCl2 gets washed away by rain, the potential benefit is lost. Another problem is one of logistics. It would be impossible to cover all 1,100 lane-miles of road in a timely manner without having a whole fleet of direct application spray vehicles.

Our compromise solution is that we are now attempting to anti-ice only our major intersections. The rationale for this is that these areas typically develop a lot of snow pack. A plow team during a major snowfall generally consists of three or four plow trucks running together as a team. The need to overlap to pick up the snow berm without it spilling over the plow blade results in them clearing only about two or three driving lanes per pass. When these plows go through the larger intersections in Anchorage they only get the center through lanes, leaving the left and right turn pockets to get packed down by traffic. Using MgCl2 in these areas will help to keep this hard pack from forming, or at least make it easier to remove later. Due to our limited manpower we are generally not able to reapply MgCl2 throughout the duration of the snowstorm to prevent the pack from forming. Our anti-icing strategy is to spray these major intersections early on and then let them go to pack. The number one priority during a snowstorm is to plow the high-speed major highways. It may be many hours before we can get back to plow the urban intersections. The stratified layer of somewhat diluted MgCl2 will still be there when the snow is plowed away, helping to prevent a hard bond from forming. We have witnessed the benefits of anti-icing and the residual effects to be gained and hope to expand our efforts in the future.

Deicing

Deicing is another costly proposition. Hard packed snow or ice is very difficult and time consuming to remove mechanically. Deicing with chemicals is

costly and relatively inefficient. The ideal solution is to prevent the pack from forming in the first place. Melting snow takes heat. Adding MgCl2 deicing fluid adds no heat but simply lowers the melting temperature. Serrated cutting edges on belly blades or graders can be used to score the ice in an attempt to get the deicer fluid underneath where it can work to dislodge the accumulated pack; but only when the ambient temperatures are conducive to melting. An eye-opening statistic is that at our latitude in Anchorage (61° N) the amount of available energy from the sun to melt snow is 15 times less than in Denver, Colorado (40° N). On a sunny day in Denver the sun provides 870 Btu/sq. ft., compared to 60 Btu/sq. ft. in Anchorage. Here in Anchorage we must rely on heat solely from traffic or ambient temperatures with essentially no help from the sun to melt snow or ice. It should be noted that using MgCl2 does tend to darken the road surface. This darkened pavement contributes to a little more heat absorption from the sun than we would otherwise get. Another disadvantage that we have here in Alaska is that our range of temperatures is typically narrow in comparison to the lower 48. Our temperatures may range from 20 to 25° on a given winter day compared to 20 to 45° in Colorado.

photo: Jerry Reed

Coming Soon

A new development that has been some time in the making is our GPS data collection project. The State Equipment Fleet is managing the recently released RFP (request for proposals) to mount a GPS in one of our sanders to collect inventory information as to how much sand/liquid MgCl2 is applied and where. This information will be reported to the EPA as part of our NPDES (National Pollution Disposal Elimination System) permit process. Automating this procedure will be a welcome change for our sander operators who are now filling out written forms and estimating these amounts. The new system will be capable of logging on a daily basis how much granular sand and liquid magnesium chloride is applied (in pounds) and the location applied (by segments of not more than 500 meters of road length). The data will indicate the street receiving sand or deicer, export this data in an open format, and include an automated data upload via a wireless connection to a base station computer at the M&O office.

Looking ahead, we are also anxious to take advantage of a new Road and Weather Information System (RWIS) slated for our area. This program is moving right along. A bidder has been selected to develop a strategic deployment strategy and we anticipate the prototype system will cover Anchorage and the Cook Inlet Basin. Application rates of anti-icing/deicing chemical vary with pavement temperature and the expected amount of precipitation. An RWIS system can help us make intelligent decisions by providing real-time pavement and weather data. This is particularly important in areas with a great variance in temperatures and precipitation such as we experience. The FHWA recognizes the value of anti-icing/deicing, as evidenced in publication No. FHWA-RD-95-202, June 1996, the "Manual of Practice for an Effective Anti-icing Program."

by Jerry Reed,
Central Region Maintenance and Operations,
Alaska DOT&PF

Editor's Note: For more information on RWIS, go to www.fhwa.dot.gov, choose "search," then type in "road weather information systems."

FHWA Rewrites Manual on Uniform Traffic Control Devices

Reprinted from Research and Technology Transporter, Nov. 1999.

FHWA's Office of Transportation Operations is rewriting the Manual on Uniform Traffic Control Devices (MUTCD). The MUTCD contains standards and guidance for the design and use of signs, pavement markings, traffic signals, and other traffic control devices. It's been more than 20 years since the last MUTCD was rewritten in its entirety. The evolution of innovative technologies, roadway developments, and new applications of traffic control devices caused FHWA to reexamine the information in the most recent edition of the MUTCD. A major rewriting and reformatting effort of this manual has been underway since 1995. The MUTCD is listed in Volume 23 of the Code of Federal Regulations (CFR), part 655. All changes to the MUTCD must be made using the Federal Register rulemaking process. This process allows the public to offer commentary on the proposed changes. FHWA has published notices of proposed amendments in the Federal Register for the following parts of the MUTCD:

- Part 1—General Provisions
- Part 2—Signs
- Part 3—Markings
- Part 4—Signals
- Part 7—Traffic Control in School Areas
- Part 8—Traffic Control at Highway–Rail Grade Crossings
- Part 9—Traffic Control for Bicycle Facilities
- Part 10—Traffic Control for Light-Rail Transit (New)

FHWA plans to publish all notices of proposed amendments for the remaining parts of the MUTCD by March 2000. The remaining parts include a new Part 5—Traffic Control for Low-Volume Rural Roads, and Part 6—Traffic Control for Work Zones. FHWA also plans to publish a notice of proposed update information for Parts 1, 3, 4, and 8. Comments from the public for all parts of the MUTCD must be received by June 2000. FHWA will review and summarize the comments and prepare a final rule position, which will

be published in the Federal Register in December 2000. In an effort to increase public awareness of the MUTCD, FHWA is publishing the Millennium MUTCD in both hard copy and electronic format (CD-ROM and Internet). The Federal Register notices and the proposed text are available at the following Internet locations:

- Federal Register home page: http://www.nara.gov/fedreg
- MUTCD home page: http://www.fhwa.dot.gov/operations/mutcd

FHWA will expand the website to include electronic briefing presentations, which will provide changes to the MUTCD, and an overview of the proposed database management program that can be used to research various requests for changes in the MUTCD. FHWA will preview the new and expanded website at the upcoming Transportation Research Board Conference scheduled for January 2000.

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A Millennium Edition of the MUTCD will be under construction throughout 2000.

HITEC Releases ICE BAN® Evaluation Report

WASHINGTON, D.C., October 25, 1999—The Highway Innovative Technology Evaluation Center (HITEC), a service center of the Civil Engineering Research Foundation (CERF), has released the final technical evaluation report for Ice Ban® snow and ice control agents. Ice Ban® is made from corn processing residues and can be mixed with liquid salts for both anti-icing and deicing. Ice Ban America, Inc., a business unit of Natural Solutions Corporation of North Palm Beach, Florida Beach, manufactures it.

The HITEC evaluation was planned and overseen by an expert panel of user agencies across the country. The goals of the evaluation were fourfold: to determine the effectiveness of Ice Ban products in melting snow and ice; to determine the effects of Ice Ban products on highway structures such as reinforcing steel, concrete, and asphalt; to characterize the fundamental chemical properties of Ice Ban products; and to collect more information on operational performance of the products, including rate and timing of application, ease of use, use limitations, and cost-effectiveness.

To accomplish these goals, the panel recommended a comprehensive program of laboratory and field testing. More than 15 tests were performed by independent laboratories on Ice Ban products, and field trials of Ice Ban products—including Ice Ban Plus™ or "M50," the most widely used formula—were conducted by eight highway agencies over the past three winter seasons.

The HITEC findings confirm that Ice Ban products can indeed be an effective aid to snow and ice control operations by melting snow and ice faster and at lower temperatures than traditional ice control agents, with little or no adverse effects on roads, infrastructure, or vehicles.

Summary of Evaluation Findings for the Testing of Ice Ban® (CERF Report #40410) may be purchased by calling (800) 548-2723 or (703) 295-6300, or via Marketing@asce.org. For further details about the HITEC evaluation, please contact Peter Kissinger, CERF senior vice president at pkissinger@cerf.org. For more information on the Ice Ban product, please call Joseph Kroll at (561) 625-4232 or (888) 423-2261.

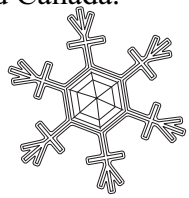
CERF is an independent, nonprofit 501(c)(3) organization created by the American Society of Civil Engineers (ASCE) and headquartered in Washington, D.C. CERF began operation in 1989 to bring together diverse groups within the civil engineering community to "facilitate, integrate, and coordinate" common solutions to complex research challenges facing the civil engineering profession.

2000 North American Snow Conference!

Announcing the 2000 North American Snow Conference!

The American Public Works Association (APWA) is holding the 2000 North American Snow Conference at the Grand Traverse Resort in Acme, Michigan, from April 9 through April 12, 2000. The conference will be attended by public works officials from throughout the United States and Canada.

For more information contact Diana Forbes, APWA meetings coordinator, (816) 472-6100, ext. 3520 or by e-mail at dforbes@apwa.net, or (soon) www.pubworks.org/conferences/ and click on 2000 North American Snow Conference.



HITEC Releases SSL MSE PLUS™ Retaining Wall System Report

WASHINGTON, D.C., October 26, 1999—The Highway Innovative Technology Evaluation Center (HITEC), a service center of the Civil Engineering Research Foundation (CERF), has released a technical evaluation report for the SSL MSE PLUS™ Retaining Wall System (MSE Plus System). This report was prepared as part of the HITEC evaluation for earth retaining systems (ERS) and describes the performance attributes, capabilities, and limitations of the MSE Plus System. The MSE Plus System is a mechanically stabilized earth (MSE) structure developed, designed, and supplied by SSL, LLC, Scotts Valley, California. The evaluation was conducted based on material, design, construction, performance, and quality assurance information provided by SSL. The information was evaluated for conformance with the state-of-practice criteria as outlined in the HITEC Technical Protocol. As of April 1999, three projects have been completed using this system. By developing up-to-date evaluation criteria and performance information for ERS technologies, such technologies can quickly be tested against established national standards, substantially decreasing the time needed to move them into practice. ERS evaluations are based on an evaluation plan developed by an expert technical panel and tailored for the specific attributes of each technology. HITEC is accepting applications for this program on an ongoing basis and will publish the results of each evaluation in a series of reports, such as the SSL MSE PLUS™ Retaining Wall System. Evaluation of the SSL MSE PLUS™ Retaining Wall System (#40441) may be purchased by calling (800) 548-2723 or (703) 295-6300 or send an e-mail to marketing@asce.org. For additional information concerning the MSE Plus System or HITEC, please contact Scott Edwards, HITEC senior program manager, at (202) 842-0555 or sedwards@cerf.org, or contact SSL directly by calling Steve Ruel at (408) 430-9300.

Streambank Stabilization Handbook

"New one-of-a-kind compendium" is how Veri-Tech, Incorporated is describing their *Streambank stabilization Handbook,* published on CD-ROM. The features advertised include:

- Compendium of basic concepts of geomorphology, geology, hydrology/hydrodynamics, and geotechnical engineering.
- Step-by-step descriptions of analysis methods to help readers apply and understand techniques.
- Advantages and disadvantages of techniques are discussed.
- Presents information from the authors' extensive professional experience, in addition to having an extensive compilation of literature and unpublished research and large numbers of tables, figures, and color photographs.
- Provides information about actual projects—successes and failures.
- Large number of color photographs of existing projects and field situations.
- Presents project planning concepts and activities.
- Technical design guidance and procedures are described.
- Mouse "hotlink" cross-referencing—phrase/word search capability.
- Requires Windows 95/98/NT.

Pricing:
U.S. Federal Government and U.S. universities—$149
All Others (including state and local governments and international orders)—$199. A demo download is available at http://www.veritechinc.com.

Editor's Note: Also see "Stream Revegetation and Protection: A Guide for Alaska," Technical Report No. 93-3, March 1998 by Alaska Department of Fish and Game. For a copy contact your regional Fish and Game office.

2000 AWRA National Spring Specialty Meeting

The Alaska Section, AWRA, is hosting its Spring Specialty conference in Anchorage on April 30–May 4, 2000, which is a national meeting of its parent organization, the American Water Resources Association. The theme/title of the conference is "Water Resources in Extreme Environments." Extensive areas of the world regularly experience extremes in hydrology and climate. These areas include deserts, polar regions, high plateaus and mountains, rain forests, and subarctic. Common characteristics of these areas are generally low population density, minimal hydrologic and meteorological databases, and a wide range of water resource management problems. Anchorage, Alaska, will be the convening site for an international symposium on Water Resources in Extreme Environments. Extremes, both high and low, in air temperature, rainfall, snowfall, wind relative humidity, soil moisture, runoff, and combinations of many of these are reflected in the hydrologic response of watersheds.

General information about the meeting can be found at http://awra.org/meetings/alaska2000/index.html

America Traffic Safety Services Foundation Encourages Scholarship Applicants

The American Traffic Safety Services Foundation was developed as a result of ATSSA (American Traffic Safety Services Association) members' desire to promote safety through education. Since 1988, the ATSS Foundation has provided scholarships to public officials pursuing educational goals that support highway safety. Since 1991, the Mid-Career Scholarship Program has provided individuals who currently work for a federal, state, or local agency an opportunity to obtain a bachelors, masters or doctoral degree or certification in traffic or transportation engineering or related field. The scholarships are designed to be partnerships between the foundation and governmental agencies that assist individuals who might otherwise be unable to pursue continuing education. Since its origin, the foundation has awarded over $300,000 in scholarship. This is an outstanding opportunity for personal and professional advancement. For complete details or to apply, contact:

Ms. Melanie Myers, Foundation Director
15 Riverside Parkway, Suite 100
Fredericksburg, Virginia 22406-1022
(540) 368-1701 or (800) 272-8772, ext. 112
foundation@atssa.com
or go to ATSSA's website at www.atssa.com.

Asphalt Research Projects

High Temperatures for Alaskan Asphalt Pavements (99-02)

While *Low Temperature Cracking of Modified Asphalt Concrete Mixes in Alaska* (see next project synopsis) dealt with low temperature asphalt issues, this study develops design pavement surface temperatures on the high end of the temperature spectrum. The goal is to satisfy the Superpave design method requirements to develop accurate asphalt binder specifications. Existing computer database files for high temperatures will be processed. This requires plotting air and pavement temperatures for approximately 20 sites around the state. The mathematical relationships between air and pavement surface temperatures will be used to derive the design pavement temperatures.

DOT&PF developed a database of air temperatures around the state under a previous research study, which investigated low temperature effects of polymer asphalt concrete pavements. The high temperature data still needs to be processed to develop mathematical relationships between air and pavement surface temperatures on the high end. The Superpave design system, developed as part of the Strategic Highway Research Progam's asphalt research, requires that these high-end temperatures be known to satisfy given performance requirements. Processing the existing high temperature data allows the designer to confidently specify the correct Superpave asphalt binder. This should lead to better pavement performance and reduced maintenance costs.

Low Temperature Cracking of Modified Asphalt Mixes in Alaska, Executive Summary (Research Report 876 SPR-95-1)

Low temperature cracking is a major distress mode in Alaskan pavements. The cracking occurs due to extreme temperatures that range, in some instances, from about –50° C in winter to 40° C in summer. Using asphalt modifiers in Alaskan pavements has occurred over the past fifteen years. These modifiers include SOR polymers, SBS polymers, ULTRAPAVE, and CRM (the dry process, PlusRide, and the wet process). Field observations and laboratory studies in Alaska and elsewhere indicate that using these modifiers might improve the cracking resistance of pavements at low temperatures. Research focused on:

Low temperature cracking is a major distress mode in Alaskan pavements.

- characterizing asphalt and polymer modified asphalt mixes from a number of selected sites using several tests:
  - SHRP Superpave PG grading system
  - thermal stress restrained specimen test (TSRST)
  - Superpave IDT laboratory tests on field specimens,
- comparing low-temperature cracking performance using field surveys,
- verifying the applicability of SHRP Superpave thermal cracking, and
- assessing the preliminary economic benefits of using polymer modified asphalts.

Study results indicate general significant improvement in the low-temperature cracking resistance when polymer modifiers are used. Researchers estimate the corresponding reduced crack

sealing costs to be between 30% and 40%. They developed minimum air and pavement temperature correlations using field data covering Alaska's climatic zones. From this information, they developed contour maps for Alaskan roads corresponding to 50% and 98% reliability of minimum pavement temperature. The study resulted in establishing design recommendations to minimize low-temperature cracking and estimate crack progression with age.

Polymer Modified Asphalt Emissions from Alaskan Hot Plants (99-03)

Polymer modified asphalt has proven cost effective for controlling asphalt rutting, cracking, and premature aging. The problem is, the Clean Air Act caused EPA and DEC to scrutinize asphalt plant emissions. Several Associated General Contractors paving contractors indicate that their asphalt plants cannot meet air quality emissions requirements when they manufacture polymer modified asphalt (PMA). A recent laboratory study indicates that emissions may be a function of one or many items:

- including elevated PMA mixing temperatures
- the type of polymer used
- the amount of volatiles in the base asphalts

DOT&PF will not be able to use PMAs if the asphalt plant emissions do not remain in compliance. This study is to provide enough information on PMAs to determine which combinations of polymers and base asphalts should be used to meet the requirements of the Clean Air Act. The information will be obtained through literature search and manufacturer survey. If this information proves adequate, a final report will include specification recommendations. We expect this study to be complete by December 31, 1999.

Implementation of Successful Asphalt Mix Designs (99-04)

High-cost asphalt-paving decisions are made based on short-term contractor risk analysis during the bidding phase of projects. These decisions often result in less than optimum asphalt performance and occasional pavement failures. We need to compile a library of past asphalt mix designs that have produced good pavement performance. The successful mix designs for a given route or locale could then be used to define future project specifications.

Correlating mix designs to existing pavement performance data and to material source location would show which pavement aggregate gradations are likely to result in the most successful pavement for each locale. Pavement engineers could then implement the most cost-effective asphalt aggregate gradations. This would result in higher quality pavement, a more uniform bidding platform, and lower maintenance costs.

Pavement Software Announcement

An updated version of FHWA's LTPPBind software, Version 2.1, is now available. The software helps pavement engineers select the correct performance graded (PG) binder to use when implementing the Superpave mix design system, based on climatic data. The new version includes more data, as well as enhancements to the data summary reports. The software is available on CD-ROM or can be downloaded from the LTPP Web site (www.tfhrc.gov/pavement/ltpp/bind/ltppbind.htm). To obtain a copy on CD-ROM, contact the LTPP customer service line at (423) 481-2967 (email: ltppinfo@fhwa.dot.gov).

A Cedar Bridge for Skagway

written by Frank Muchmore
artilcle excerpted from: *Public Roads,* September/October 1999, U.S.D.O.T.

courtesy Muchmore Engineering International

This Alaska yellow cedar bridge crossing the Nelson Slough prvides access to Dyea Flats at all tidal stages.

The U.S. Department of Agriculture (USDA) Forest Service administers the Wood in Transportation (WIT) cost-sharing demonstration grant program to promote cost-effective, structurally sound bridges, preferably using local timber as well as local businesses and employees. The city of Skagway received a grant from the Forest Service for assistance in design and construction of a timber bridge. The grant specified that the bridge must be constructed from untreated Alaska yellow cedar, a naturally decay-resistant wood species, using recently developed stressed-deck technology. For the project, the Forest Service provided monetary assistance and made Alaska yellow cedar trees available from Forest Service land.

Design

In the spring of 1997, the city of Skagway retained Muchmore Engineering International of Juneau, Alaska, to design the bridge across Nelson Slough. Criteria for bridge aspects relating to stress laminating were based on Chapter 9, "Design of Longitudinal Stress-Laminated Deck Superstructures" of *Timber Bridges—Design, Construction, Inspection and Maintenance* (USDA Forest Service Publication No. EM 7700-8, August 1992) and on *Guide Specifications for the Design of Stress-Laminated Wood Decks,* published by the American Association of State Highway and Transportation Officials (AASHTO). All other aspects of the bridge design were based on the *Standard Specifications for Highway Bridges,* also published by AASHTO (1996).

The bridge is designed for AASHTO H520-44 loading—a bridge length of slightly more than 23 meters, a width of almost 5 meters outside-to-outside (4.36-meter roadway width), and a skew of 0 degrees.

The bridge has three continuous spans of 7.62 meters each, center-to-center of bearing. The stress-laminated deck is about one-third meter deep and consists of 7.62-cm (3-inch) by 33.02-cm (13-in) rough-sawn Alaska yellow cedar laminations and is continuous for the full length of the bridge. Individual laminations are 4.9 meters in length with 3.65-meter, 2.4-meter, and 1.2-meter laminations staggered so that no joints are closer than 1.2 meters in adjacent lines of laminations (per AASHTO *Guide* specifications).

The stressing system is designed for 1.6-cm- (0.62-in.) diameter high-strength galvanized steel thread-bars, conforming to the requirements of ASTM A722

(American Society for Testing and Materials, 1988). The 5.5-meter-long stressing bars are spaced at 0.6-meter centers through holes drilled at mid-depth of the deck laminations with heavy galvanized steel bearing plates at each end. Prestressing tension is applied with a center-hole hydraulic jack, one rod at a time. Rods are sequentially tensioned several times until each rod is "squeezing" the laminations together with about 129 kilonewtons of force.The result is one huge slab of wood that is much like a big butcher block.

The two piers are bents consisting of three pressure-treated Class A Douglas fir piles (ASTM D25-91) driven to a minimum bearing capacity of 18 metric tons with a 30.48-cm (12-in) by 30.48-cm cap and a 7.62-cm (3-in) by 33.02-cm (13-in) cross bracing. Because of environmental constraints in Alaska, the normal creosote or pentachlorophenol treatments are not allowed over streams in the state, so the piles are treated with copper naphthenate in heavy oil by Perma Post Products of Hillsboro, Ore.

Timber running planks were used because there are no paved roads in the immediate area.

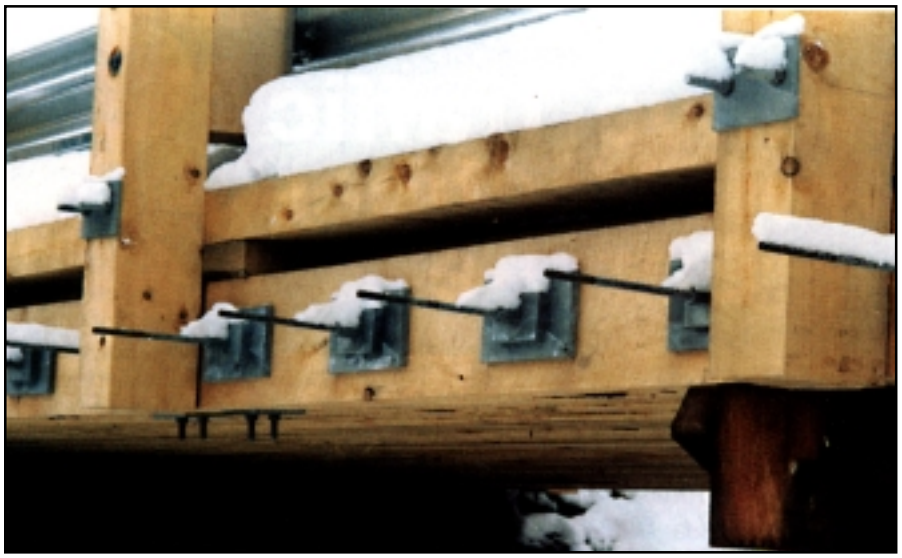
The abutments are U-shaped retaining walls consisting of rock-filled gabion baskets, topped with 30.48-cm by 30.48-cm cedar sills to support the bridge ends. Curbs and rail posts, including approach rail posts, are also of Alaska yellow cedar. Bridge rail posts are spaced at 2.4-meter centers. Bridge railing is thriebeam galvanized steel; approach railing is W-beam galvanized steel; and there is a galvanized transition rail between.

The new bridge over the Nelson Slough is simple, strong, aesthetic, and aromatic. "It is a terrific-looking bridge, smelling of fresh-cut cedar," said Skagway city manager Bob Ward. It's probably the best-smelling bridge in Alaska.The bridge is strong enough to handle any vehicle legally allowed on the road and as many well-fed tourists as can fit on a bus. Built exactly a century after Dyea sprang to life during the great Yukon Gold Rush, this "new technology" timber bridge will serve visitors to this historic area for many years to come.

Important features of this stress-laminated timber bridge include:

- Use of locally logged and milled decay-resistant timber.
- Fabrication and construction that requires only readily available materials, normal carpentry and construction skills, and commonly used construction equipment.
- The longest piece in the stress-laminated deck is 4.88 meters.

Frank Muchmore is a bridge engineer for the Alaska Department of Transportation and Public Facilities, and he is also the owner and chief engineer of Muchmore Engineering International. Before returning to Alaska in 1993, he served as a structural engineer for the USDA Forest Service in Alaska and Montana for 29 years. During his tenure in the Forest Service, he helped to develop and validate the timber stressed-deck technology. He also developed the servicewide Oracle-based Bridge and Major Culvert Information System still used by the Forest Service. He has a bachelor's degree in civil engineering from Montana State University. Muchmore is a registered professional engineer in Alaska and Montana.



coutesy of Muchmore Engineering International

The tension rods were restressed in the sping of 1999, and no further stressing will be necessary.

UAF'S AISES Student Chapter Participates at National Conference by AISES students

The University of Alaska Fairbanks Chapter of the American Indian Science and Engineering Society (AISES) sent five students to the 1999 National Conference in Minneapolis, Minnesota, on November 18–20. The UAF AISES delegates were Lee DeWilde, a junior in engineering; Delores Huffman, a junior in anthropology; Kim Ivie, a senior in Alaska Native studies and education; Calvin Moses, a sophomore in computer science; and Wily Splain, a junior in engineering. Sue McHenry, chapter advisor, accompanied the group. Jeff Davis and Shane Derendoff, UAF graduates who work for IBM in Rochester, Minnesota, also attended. The theme for the event was "Setting the Pace in Bridging Tradition and Technology" and the conference showcased a variety of speakers, workshops, and a career fair, all of which were very motivating for participants. Featured speakers Billy Mills, 1964 Olympic gold medalist in the 10,000-meter race, and John Harrington, the first Native American astronaut, provided inspiration to continue striving toward our academic and professional goals.

IBM visit, back: Todd Kelsey, Sue McHenry, Wily Splain, Shane Derendoff. Front: Calvin Moses, Delores Huffman, Kim Ivie, Jeff Davis, Lee DeWilde.

Each UAF student attended a variety of concurrent sessions and their comments offered the following insights about their experiences.

In a workshop titled "Career Opportunities: Bridging Tradition and Technology," presenters "spoke about their experiences in college, their experiences when they first started looking for work and their stuggles to find their niche in their jobs. I thought they all gave very good presentations on the trials and tribulations of college and the job market. They were all very strong believers in honoring their respective Native cultures and tribes." (Moses)

"'Recognizing Elders as the First Teachers in AISES Science Camps and Fairs,' presented by Claudette Bradley and Alan Dick, was a very encouraging session for me. Some day, when I have kids of my own, I want them to have a program available to them similar to the program described in the session. Bradley and Dick described the learning environment experienced by young kids at the Howard Luke's Camp where the focus is on learning science in their own environment (not just from a text book). The presenters stated that the top three student science projects presented at their annual science fair were alumni from the Howard Luke Camp!" (Splain)

"'Teaching Aeronautics, Global Awareness, and Space' was presented by three teachers who received training through NASA and were successfully teaching aeronautics in their classrooms. As a student close to finishing my degree in education, I found this session to be especially motivating and helpful. I was exposed to creative strategies for teaching this type of material and I gathered some resources to use in my own classroom in the future. These teachers were excited about what their students had accomplished and they were willing to share some great ideas. Overall, the conference was very inspiring and I notice that each year I gather something different from my participation in AISES conferences. This year the messages relayed really hit home with me and gave me motivation and raised my confidence." (Ivie)

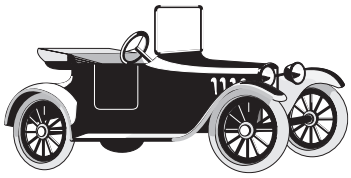
"There was such an array of sessions to select from that it was difficult to make a choice, but I finally focused on Intel's Mock Interviews. This proved to be a good choice as I learned a lot about what an interview entails. I was given a hypothetical situation and asked how I would respond. The appropriate steps are to identify the problem, confront it, develop a resolution and then follow up on the outcome. I learned that emphasis on safety is very important and that it's good to ask follow-up questions at the conclusion of the interview. I felt the mock interview was a very valuable learning tool for me, as was the entire AISES conference experience." (DeWilde)

Captain D. J. Vanus, an officer in the U.S. Air Force, presented a session titled "Walking the Warrior Path." Captain Vanus shared his experiences as a warrior with an overflow group of high school and college students, elders, and children. He spoke to us as a First Nations person, instilling a sense of pride for our heritage, and motivating us to acheive our academic goals. It is important for Native Americans to get an education in order to survive the changes we face today. It is also our responsibility to preserve the traditions of our people. Captain Vanus helped us realize we can do both. We can walk our chosen paths as warriors, both in the traditional sense as well as the contemporary." (Huffman)

At the conclusion of the AISES conference in Minneapolis, the UAF AISES delegation traveled south to Rochester, Minnesota, where the group had a special opportunity to visit IBM's Executive Briefing Center. IBM representatives Todd Kelsey and Maggie Blaley provided an overview of IBM and their latest developments in technology for the new millennium. Davis and Derendoff gave us insight into their jobs and their experiences as recent UAF graduates and young professional employees of IBM.

We are very grateful to the generous donors who contributed funds to assist the UAF chapter of AISES in all our endeavors this year. Our donors include Alaska Department of Transportation and Public Facilities T^2 program, UAF's Newnet program, College of Rural Alaska, Lawrence Livermore Labs, Koniag Inc, ABR Inc. Environmental Research and Services, Karen Owens, British Petroleum, Stephanie Place Dobson, Design Alaska, Sasha Atuk Dixon, PDC Inc, Paul Reichardt, and Crisenbery Engineering.

Billy Mills, 1964 Olympic champion, keynote speaker at AISES conference.



Age and Driving

Reprinted with permission from Mass Interchange, *Vol. 12, No. 3, summer 1998.*

Older motorists on roadways are increasing in number. Nationally, the percentage of motorists over 55 is steadily growing to the point, that by the year 2010, one half of the U.S. population will be 55 years of age or older.

In 1993, licensed motorists comprised 8.8% of the total population over 70. Advances in medicine, better lifestyles, and other factors mean more of these older motorists will remain independent and continue to drive. Due to the large representation of motorists age 55 and over in automobile accidents, studies have been performed to identify errors among older motorists which lead to such accidents. The most common errors are:

- Failure to yield to right-of-way
- Failure to obey signs, signals, and markings
- Improper turns

All of these factors are compounded by high-speed traffic and high-density intersections. By understanding motorists, guidelines emerge for the traffic engineer to design the roadway elements to optimize use for older motorists. These same improvements also help the fatigued, preoccupied, or impaired motorist. The result is better and safer highways for all motorists.

How Well Do You See?

Older motorists don't see as well as they did when they were younger, especially at night . . .

Reprinted with permission from Mass Interchange, *Vol. 12, No. 3, summer 1998.*

Research on the older motorist has been increasing in recent years. Although there are a number of aspects of human performance related to driving which change with the passage of years, such as response time and information processing, more of these are extremely variable, i.e., age is a poor predictor of performance. Not so for visual perception. Although there are exceptions, for the most part visual performance becomes progressively poorer with age, a process which accelerates somewhere in the late 40s or early 50s.

Some of these changes are attributable to optical and physiological conditions in the aging eye, while others relate to changes in neural processing of the image formed on the retina. The abilities related to optical and physiological processes in the eye are:

- Ability to see detail ("visual acuity")
- Ability to see contrast
- Ability to see dim objects and objects in a cluttered background ("target detection")
- Ability to see object in glare
- Ability to see objects outside the line of sight ("peripheral vision")

These are the seeing abilities that decline with age, usually so slowly that the person doesn't realize for some years that they don't see as well as they used to. These ability declines affect the importance of traffic control device design and placement.

The *Manual on Uniform Traffic Control Devices* (MUTCD) that forms the basis for sign design and placement for all states and almost all local jurisdictions makes a fundamental assumption: that motorists can be expected to score at least 20/23 (slightly worse than 20/20). If you do a little trigonometry, the 1 inch letter height for 50 feet rule of thumb works out to
20/23. Studies have shown that 15 percent of the general driving population cannot read letters of that size at 50 feet, and 40 percent of motorists over 65 cannot see that well, even under the very best visual conditions.

There is also some evidence that the night vision system ages faster than the day vision system does. The bottom line is that only 30 percent of the light under daytime conditions that is recovered by the retina in a 20-year-old gets to the retina of a 60-year-old. Because of these changes, the brightness of an object (such as a curb) has to be increased by twice or more for a 70-year-old to see it at the same distance as a 30-year-old.

Training (www.dot.state.ak.us, click on "training opportunities."

Date	Event	Sponsor/Contact	Location
January 19–20	Geotechnical Integrator (gINT®)	Simon Howell, (907) 451-5482	Anchorage
March 8–10	NHI 13132: Hot Mix Asphalt Constr.	Sharon McLeod-Everette, (907) 451-5323	Anchorage
March 13–15	NHI 13132: Hot Mix Asphalt Constr.	Sharon McLeod-Everette, (907) 451-5323	Juneau
March 16–17	ASCE Construction Project Claims Administration and Avoidance	Sharon McLeod-Everette, (907) 451-5323	Juneau
March 20–24	ASCE Construction Project Claims Administration and Avoidance	Sharon McLeod-Everette, (907) 451-5323	Fairbanks/ Anchorage
April 12–14	NHI 13132: Hot Mix Asphalt Constr.	Sharon McLeod-Everette, (907) 451-5323	Fairbanks
May 18–19	NHI 35005: Highway Program Financing	Sharon McLeod-Everette, (907) 451-5323	Fairbanks
May 22–23	NHI 35005: Highway Program Financing	Sharon McLeod-Everette, (907) 451-5323	Anchorage
May 23–25	NTI Transportation and Land Use	Sharon McLeod-Everette, (907) 451-5323	Anchorage
May 25–26	NHI 35005: Highway Program Financing	Sharon McLeod-Everette, (907) 451-5323	Juneau

Meetings Around Alaska

Society	Chapter	Meeting Days	Location
ASCE	Anchorage	Monthly, 3rd Tues., noon	Northern Lights Inn
	Fairbanks	Monthly, 3rd Wed., noon	Captain Bartlett Inn
	Juneau	Monthly, 2nd Wed., noon*	Westmark Hotel * except June–Aug.
ASPE	Anchorage	Monthly, 2nd Thurs., noon	West Coast International Inn
	Fairbanks	Monthly, 1st Fri., noon	Captain Bartlett Inn
	Juneau	Monthly, 2nd Wed., noon*	Westmark Hotel * except June–Aug.
ASPLS	Anchorage	Monthly, 3rd Tues., noon	Executive Cafeteria, Federal Building
	Fairbanks	Monthly, 4th Fri., noon	Ethel's Sunset Inn
	Mat-Su Valley	Monthly, last Wed., noon	Windbreak Cafe; George Strother, 745-9810
ITE	Anchorage	Monthly, 4th Thurs., noon**	Sourdough Mining Co. ** except July & Dec.
IRWA	Sourdoughs Ch. 49	Monthly, 3rd Tues., noon**	West Coast International Inn
	Arctic Trails Ch. 71	Monthly, 2nd Thurs., noon**	Oriental House
	Totem Ch. 59	Monthly, 1st Wed., noon	Mike's Place, Douglas ** except July & Dec.
ICBO	Northern Chapter	Monthly, 1st Wed., noon brown bag lunch	Rm. 531 Duckering Bldg, Univ. of AK Fairbanks Larry Hinzman, 474-7331
PE in Government	Anchorage	Monthly, last Fri., 7 a.m.	Elmer's Restaurant

Metrication and Enhancement of MicroBENCOST Software Package

This is an NCHRP digest of NCHRP Project 7-12(2), "Metrication and Enhancements of MicroBENCOST Software Package." The project updated a software package originally developed under NCHRP Project 7-12, "Microcomputer Evaluation of Highway User Benefits," distributed by Mc Trans since 1993. Both research projects were conducted by the Texas Transportation Institute (TTI) and were administered by the Texas A&M Research Foundation. This digest was drafted by TTI personnel under the direction of Dr. Katherine F. Turnbull.

This digest provides details and concepts about a software package consisting of two independent programs on separate disks—an English units version (C:/MBE) and a metric units version (C:/MBM)—that update and enhance the original English unit program (C:/MB). All programs are written in the FORTRAN programming language and use the DOS operating system. The DOS operating system is accessable through the MS-DOS prompt in the Windows Programs listings.

Analyzing the benefits and costs of alternative highway investments and conducting economic assessments of various transportation options is important to transportation professionals, policy makers, and researchers. The financial analysis requirements of the Intermodal Surface Transportation Efficiency Act (ISTEA) and the Transportation Equity Act for the 21st Century (TEA-21), as well as rules promulgated by federal and state agencies, support the need for improved techniques for conducting benefit-cost assessments.

The MicroBENCOST software represents one of these techniques. MicroBENCOST provides a planning-level economic analysis tool that can be used to analyze a variety of transportation projects. MicroBENCOST was initially developed under NCHRP Project 7-12, "Microcomputer Evaluation of Highway User Benefits," and has been available since 1993. A follow-up study, NCHRP Project 7-12(2), "Metrication and Enhancement of MicroBENCOST Software Package," was undertaken to improve the initial program and to develop a metric version.

Alaska-Based Pavement Design Software Now Available

Billy Connor and Bob McHattie, researchers and long-time highway experts for Alaska Department of Transportation and Public Facilities, recently taught "Selecting and Designing Pavements for Alaska," a class based on three pieces of software for pavement designers. They taught in Whitehorse, Yukon Territory; Anchorage; and twice in Fairbanks. The developers (all employees of Alaska DOT&PF) address conditions which affect construction of roads and airports in Alaska in the three pieces of software:

- AKOD98—mechanistic design procedure for overlays and new construction, developed by Eric Johnson, Joey Veazey, Billy Connor, Scott Gartin, Bob McHattie, and Nelson McCullough
- AKPave99—excess fines method of pavement design used by the Department, developed by Billy Connor, Joey Veazey, Eric Johnson, Bob McHattie, and Scott Gartin
- PaveInfo—calculates the number of cycles to failure for pavement rutting, fatigue life, and base course failure, developed by Billy Connor and Phil Kvapil.

The software is available on CD-ROM by contacting Connor at 907-451-5479 or billy_connor@dot.state.ak.us. The same CD also has BERG2, MUT1D, and FishPass programs. Software can also be downloaded from the DOT&PF website at http://www.dot.state.ak.us/external/state_wide/t2/software.html; read the disclaimer in order to download.

Structural Steel

From The Construction Metrication Newsletter, *National Institute of Building Sciences*

The following has been prepared by the American Institute of Steel Construction, Inc. (AISC). It updates the May-June 1995 issue of this newsletter on the same subject.

Metric versions of most structural steel products are no different in size than their inch-pound equivalents. Rather, they are simply relabeled ("soft converted") in metric units. Because few steel products are produced in even, round, inch-pound sizes now, there is no need to convert them to even, round metric sizes.

Types of Steel. The common ASTM specifications for structural steel products—A992/A992M, A36/A36M, A572/A572M, A529/A529M, A242/242M, A588/-A588M, A852/A852M, and A514/514M—include both inch-pound and metric units. Where multiple grades exist within a specification, the metric yield stress is used. For example, A572 Grade 50 (50 ksi) becomes ASTM A572/572M Grade 345 (345 MPa). The table below shows the equivalence of several common metric yield stresses to their inch-part counterparts.

Yield Stress (MPa)	Approx. Yield Stress (ksi)
250	36
290	42
345	50
415	60
450	65

Linear Dimensions. Linear dimensions are converted to millimeters (mm) and mass is converted to kilograms (kg). Yield and tensile stresses are expressed in megapascals (MPa), where 1 MPa = 1 N/mm^2 and 1 ksi = 6.895 MPa. Note that mass must be multiplied by the acceleration of gravity, 9.81 m/s^2, to determine force in newtons (N).

Structural Shapes (Series W, M, 5, HP, C, and MC). The metric nomenclature for hot-rolled structural shapes is defined in ASTM A6/A6M. In general, structural shapes are soft converted with actual dimensions rounded to the nearest millimeter.

Depending on the shape, masses are rounded to the nearest kilogram per meter or tenth of a kilogram per meter. The nominal depth of each shape, however, is always rounded to the nearest 10 mm. For example, a W14x90 shape is expressed in metric units as W360x134. The nominal depth of 14 inches is converted to a nominal 360 mm and the mass of 90 lb/ft is converted to 134 kg/in.

Some U.S. mills have implemented a dual unit marking system whereby each piece is marked with both inch-pound and metric designations regardless of the type of order. No mill has established stock metric lengths, however. Consult each mill to determine length, cuffing, and shipping practices.

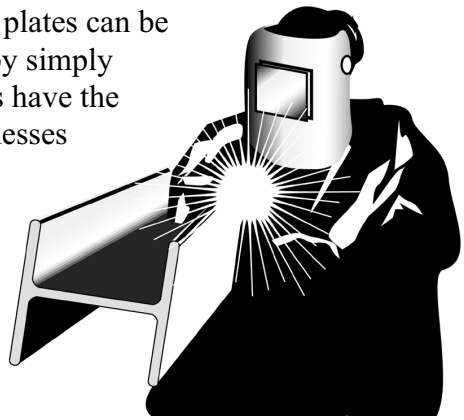
Angles. Angles are soft converted as designated in ASTM A6/A6M. Leg sizes are rounded to the nearest millimeter and thicknesses are rounded to the nearest tenth of a millimeter.

Hollow Structural Sections (HSS). HSS are soft converted. For rectangular or square HSS, side dimensions and wall thicknesses are converted and rounded to the nearest tenth of a millimeter. For example, an HSS6x6x¼ would be designated HSS 152.4x152.4x 6.4. For round HSS, the diameter and wall thickness are converted and rounded to the nearest tenth of a millimeter.

Steel Pipe. Pipe is soft converted with new designations based on ISO DN (diameter nominal) sizes where 1 inch=25 mm (see the 2nd Quarter 1999 issue of *Construction Metrication*). Existing pipe strength identifiers remain unchanged. Thus, a 6-inch standard pipe will be relabeled as DN150 pipe, a 6-inch extra-strong pipe as DNX150 pipe, and a 6-inch double-extra-strong pipe as DNXX150 pipe.

Alternatively, the DN size may be used with the identifiers "standard," "extra strong," and "double-extra-strong." A foolproof identification includes the DN size, the wall thickness in millimeters, and the mass in kilograms per meter. Most standard pipe sizes are also available as round HSS shapes, manufactured from typical HSS steels.

Bar and Plate Products. Since plates can be rolled to any thickness and width by simply adjusting the plate rolls, most mills have the capability to produce metric thicknesses should an order be large enough to warrant it. Locating small quantities of bars in metric thicknesses, however, may be difficult for some time.



When a project calls for metric bar material, reasonable solutions may be to: (1) order a plate product of the required metric thickness and burn or shear the plate to the required width (plate nesting will minimize scrap loss); (2) order bars to the closest available inch-pound thickness and width; and (3) use soft-converted metric bar dimensions.

High-Strength Bolts, Nuts, and Washers. The metric series of high-strength bolts, nuts, and washers is a true ("hard") metric series designated by an "M" prefix followed by the actual diameter in millimeters: M16, M20, M22, M24, M27, M30, and M36. See ASTM specifications A325M and A490M for high-strength bolts, A563M for nuts, and F436M for washers. The next *LRFD Specification for Structural Joints Using ASTM A325 or A490 Bolts,* currently under ballot by the Research Council on Structural Connections is planned to be a dual-unit specification.

Welding. AWS nomenclature for metric electrodes uses the first two digits of the strength of the electrode. For example, an electrode with a 480 MPa strength level (70 ksi) would be designated as an E48 electrode. The inch-pound equivalents of common metric electrode strengths are presented in the following table:

Electrode	Strength in MPa	Approximate stength in Ksi
E43	430	60
E48	480	70
E55	550	80
E62	620	90
E69	690	100

Fillet weld sizes are easily expressed in millimeters and should be designated in one-millimeter increments up to 8 mm, two-millimeter increments from 8 to 20 mm, five-millimeter increments from 20 to 40 mm, and ten-millimeter increments beyond 40 mm. Welding nomenclature does not change.

AISC Metric Publications and Software.

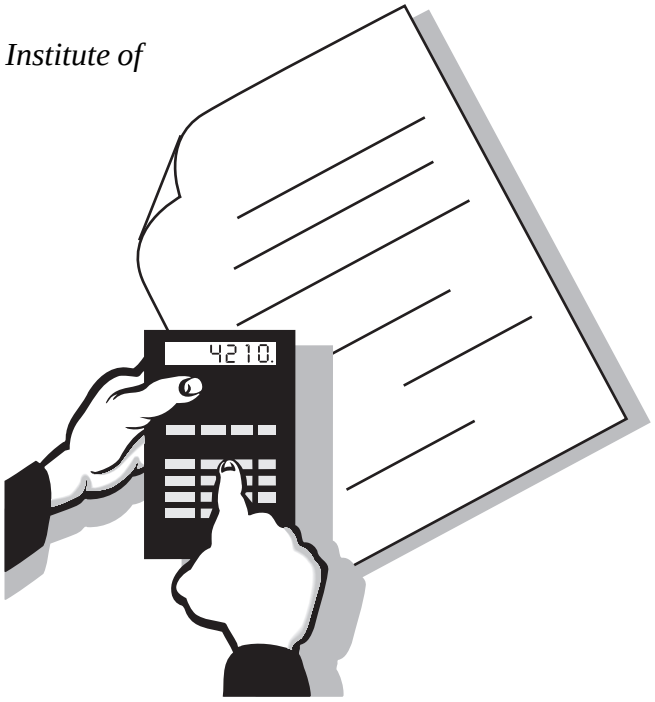
The following are available from AISC:

- *Metric LRFD Specification for Structural Steel Buildings* (AISC, 1994), $20.
- *Metric LRFD Specification Supplement No. 1* (AISC, 1998), no charge.
- *LRFD Manual of Steel Construction, Metric Conversion of the 2nd Edition* (AISC, 1999), Volumes I and II, $132 for the set or $72 each.
- *Fundamentals of (Metric) Structural Shop Drafting* (Canadian Institute of Steel Construction, 1988), $35.
- *AISC Database, Version 2.0, Metric Units,* an ASCII data file that gives programmers electronic access to the metric designations, dimensions, and properties for structural shapes—W, M, 5, HP, C, MC, WT, MT, ST, L, LL, HSS, P, PX, PXX, $60.

To order AISC publications, call (800) 644-2400. To order software, call (312) 670-2400. Publications and software also can be ordered from AISC's web site, www.aisc.org.

Metric Calculation Pitfalls

Richard McConnell, PB.
From The Construction Metrication Newsletter, *National Institute of Building Sciences*



When performing engineering calculations, converting technical texts, or reprogramming software in metric units, be especially careful to avoid the following kinds of errors:

1. Casually rounding **converted numbers.** The usual tendency in converting from inch-pound to metric units is to be overly precise. But when dealing with engineering calculations, precision is a virtue. Casual rounding can result in significant errors. **Round carefully**.
2. **Using the wrong decimal prefix.** It is easy to substitute N/m^2 for kN/m^2 or kPa for MPa, thereby changing numerical values by multiples of 1000. **Check the decimal prefix.**
3. **Using the wrong empirical coefficients in equations.** Empirical coefficients are based on the measurement units used in the balance of the equation. **Make sure empirical coefficients match the measurement units used.**

An example is the equation $v = c\ (2.17 - e)(\sigma)^{0.25}$ where v is velocity in ft/s, e is provided and dimensionless, u is pressure in lb/fl^2, and c is 78.2, the coefficient provided.

When $v = m/s$ and:

σ is provided in kgf/cm^2, c becomes 160.4;
σ is provided in N/cm^2, c becomes 90.6;
σ is provided in kPa (kN/m^2), c becomes 51.

All three values for c are correct *for the units used.* Note, however, that the first value for c is based on kgf/cm^2 (sometimes wriffen simply as kg/cm^2), an obsolete kilogram-force measure still found in some texts but internationally deprecated (see ASTM E380, ASTM E621, ANSI/IEEE 268, and Federal Standard 376B). The pascal (Pa), as used to derive the third value for c, is the proper unit of measure for pressure and stress. But regardless of the units used, the point is that the value for c must match the other units in the equation.

Videos for Loan

_____**Roadway Design: Balancing Safety, Environment, and Cost,** Minnesota Local Roads Research Board, Sept. 1995, 13:12 min.
_____**Innovative Pavement Maintenace Technology**, SHRP Video Report, Colorado DOT, April 1998, 5 min.
_____**Torts are Everybody's Business,** Pennsylvania DOT, May 1992, 5 min.
_____**How to Give a Deposition,** Pennsylvania DOT, July 1991, 17 min.
_____**Local Government on Trial, Part 1—The Background;** Pennsylvania Local Roads, April 1995, 41 min.
_____**Local Government on Trial, Part 2—The Trial,** Pennsylvania Local Roads, April 1995, 90 min.
_____**Planting Methods for Minnesota DOT,** Minnesota DOT, March 1994, 14:30 min. (includes size plans and specs)
_____**Keeping Soil on Construction Sites: Best Management Practices,** Ohio Department of Natural Resources, Soil and Water Conservation, 52 min.
_____**Getting Our Message Out: Elevating Public Awareness of Transportation Issues,** USDOT, Dec. 1998, 18:50 min.
_____**Workzone Safety for Roadway Maintenace Operations, Parts 1 – 7,** USDOT/FHWA, 1995, 108 min.
_____**Shooting Good Video,** USDOT/Federal Lands Highways – Coordinated Technology Implementation Program, August 1996, 7:36 min.
_____**Tribal Transportation Planning—A Vision of a Better Tribal Transportation Plan,** 15 min.
_____**Prefabricated Timber Bridge Deck Panels,** USDA Forest Service, Wood in Transportation Program, WIT-97-0026, November 1998

These materials may be borrowed for three weeks. However, if you need them longer, contact our office for an extension. Contact **Christel Kennedy** at (907) 451-5320 or TDD: (907) 451-2363.

Please print your name and address below, and mail, fax, or E-mail to:

Alaska Transportation Technology Transfer Center
Local Technical Assistance Program (LTAP)
Department of Transportation and Public Facilities
2301Peger Road M/S 2550
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CD-ROMs for Loan

_____**Geosynthetics: Use in Streets and Highways,** Minnesota Local Road Research Board, Jan. 1999

_____**Introduction to Work Zone Basics and Flagging,** Arizona LTAP, June 1999

_____**Work Zone Traffic Control—Guidelines,** Kentucky Transportation Center, University of Kentucky, August 1998

_____**Pavement Recycling Guidelines for State and Local Governments,** National Center for Asphalt Technology, USDOT/FHWA, March 1998

_____**Hot Mix Asphalt for the Undergraduate, Including the Superpave Mix Design System,** AASHTO/FHWA/Industry/ Superpave 2000, Summer 1999

_____**Intelligent Transportation Systems Awareness,** USDOT, FHWA-SA-99-016, Version 1.0, 1999

_____**An Evaluation of 3D/4D Visualization—North and South Roosevelt Blvds.,** Key West, Florida, Interactive CD-ROM, USDOT/ FHWA, FHWA-RD-98-173, 1998

_____**Resource Guide on the Implementation of Linear Referencing Systems in Geographic Information Systems: A Comprehensive Collection of Documents Pertaining to Linear Referencing and its Implementation in Geographic Information Systems,** USDOT/ Bureau of Transportation Statistics, BTS-CD-22

_____**77th Annual Meeting—Transportation Research Board,** Preprint CD-ROM, Washington D.C., January 11–15, 1998

_____**78th Annual Meeting—Transportation Research Board,** Preprint CD-ROM, Washington D.C., January 10–14, 1999

_____**Transportation Research Records 1472–1516,** National Research Council, Washington D.C., 1995

_____**Transportation Research Records 1516–1566,** National Research Council, Washington D.C., 1996

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This newsletter is funded by the Federal Highway Administration and the Alaska Department of Transportation and Public Facilities. The material contained herein does not necessarily reflect the views of the Alaska Department of Transportation, Federal Highway Adminstration, or the T² staff. Any reference to a commercial product or organization in this newsletter is only for informational purposes and is not intended as an endorsement.

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