Dipping into new materials - the 2013 ice arch went beyond frozen water

Engineering students experimented with a new kind of material to construct this year’s ice arch: Pykrete - a mixture of sawdust and water. The material was chosen for its durability and strength.

Pykrete is a composite material made from a mixture of saw dust and water that exhibits the structural strength and durability of concrete when frozen. First developed in the early 20th century, its use was once proposed as a candidate for making huge, unsinkable ships during WWII.

Civil Engineering student Ryan Cudo, co-captain of the ice arch team and the architectural brain behind this year’s structure, had initially been working on a design made out of pure ice but, inspired by the idea of classmate Pat Brandon, decided to give Pykrete a try instead. Tests determined that the perfect ratio of the Pykrete was 18% white spruce saw dust and 82% water by weight. (Continues on Page 3)
A Letter From The Dean

Welcome to the second edition of the CEM Newsletter. Now that the snow has finally melted and we have moved into high summer, we are reminded of how the world around UAF also constantly changes. At CEM, students and faculty have completed a year of interactive instruction, hands-on research, adventurous field work, and successful competition in an ever-changing environment.

Academic disciplines and research fields are constantly changing as well; every day new ideas are built up and broken down to incorporate new study results. CEM students have opportunities to explore their ideas and gain practical experience in hands-on applications. Although its deconstruction was out of students’ hands (it melted!), the ice arch featured in this newsletter exemplifies a learning style central to a UAF education. Students had the opportunity to combine classroom knowledge and practical skills while exploring the use of a new material (Pykrete).

On UAF’s main campus, along with student projects, we are literally building up the future of engineering through the construction of the new UAF Engineering Facility. On the site between the Duckering and Bunnell buildings, construction is well underway on a new facility for the engineering community. On May 21st, Gov. Sean Parnell signed the FY14 capital budget, which allotted $30 million in additional funding for UAA and UAF engineering facilities; this funding will help construction continue. The new facility will make it possible for CEM to increase our available course offerings in engineering as well as supplying students and other researchers with facilities equipped for meeting Alaska’s changing needs.

I hope you will see throughout this newsletter a sampling of the different ways we are enhancing and building on concepts to further student learning and the current knowledge base of practicing, professional engineers. Thank you for your ongoing support.

Douglas J. Goering
Dean

New Engineering Facility - Groundbreaking Ceremony and Construction Updates

An official groundbreaking ceremony took place March 30, 2013 to mark the start of construction for the New Engineering Facility. Construction of the building addition is now fully underway. Tanana Loop and the south access to Duckering have been closed since mid-April to make way for construction equipment. To follow the progress of building construction live via our outdoor webcam, please visit the CEM website at cem.uaf.edu/about/new-engineering-facility.

The FY14 capital budget that was signed by Governor Sean Parnell on May 21 includes $30 million in ‘bridge funding’ for both the UAA and UAF Engineering Facilities to keep the projects on track. To date, the University of Alaska has received a little over half of the funding for both facilities.

This has been a joint unified effort by UAA, UAF and UAS to garner support for these facilities. This funding was made possible due to the efforts of the Alaska State Legislature and overwhelming statewide support from UA advocates, engineers, students, and industry leaders who understand the importance of investing in the future.

The university system continues to prepare engineers to tackle chronic environmental and structural challenges and the demands of arctic climate conditions with innovative solutions.
While last year's ice arch was constructed using blocks of ice that were supported by a wooden frame until the arch could stand on its own, this year's structure was built using continuous molds. The intuitive design of these molds and their special feature, a ribbed support structure made out of 2x4 frames, can be attributed to ice arch team captain Will Riley. The multi-stage construction process, which involved assembling the molds, mixing and pouring the Pykrete and finally erecting the structure, began during the last part of Christmas break. Once the molds were assembled and put into place, the Pykrete was poured in small increments every 24 hours at outside air temperatures ranging from -5 to 10°F. Team members and volunteers spent about 2 hours each night mixing and pouring Pykrete to get the ice arch ready for completion.

The raising of the arch took place on February 20, 2013. Fairbanks-based company Ghemm Co. volunteered their time and equipment to help lift the pieces into place. Despite its frozen water content, the appearance of the final structure was certainly not what one would expect from an “ice” arch. The amount of sawdust in the Pykrete caused the arch to be completely opaque, brownish in color, and roughly textured. However, the Pykrete arch provided a unique sight along Cornerstone Plaza until the structure gave way to the blistering spring sun in early May.

Students involved in building the 2013 ice arch included:
Team Captain Will Riley (Mechanical Engineering/Chemistry), Co-Captain and Designer Ryan Cudo (Civil Engineering; ASCE President), Project Representative Katrina Monta (Civil Engineering), and Brett Wells (Civil Engineering); Volunteers: Daniel Hjortstrop, Justin Calkins, Martin Grey, Brett Martino, Tux Seims and Thomas Osterman.

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Student awardees of the Chancellor's and Dean's lists at CEM were hosted by many corporate sponsors at the 34th Annual CEM Annual Awards Dinner on Saturday, April 27 at the Princess Hotel. During the presentations, word was received that the CEM students again won the regional steel bridge competition! Over 130 people attended the banquet.

State Senator Johnny Ellis was presented with the 2013 Distinguished Service Award for his unwavering support of the UA Engineering facilities as well as his support of K-U education in the state.

Pete Stokes, PE, UAF '07, was the recipient of the 2013 Distinguished Alumni Award due to his active involvement in promoting CEM, as well as his achievements in the engineering industry in Alaska. Along with giving a presentation on the future of engineering in Alaska, Mr. Stokes announced the creation of a new ‘Student Enhancement Fund’ by donating $1,000 to provide tutoring, support for national and international competitions, and other education assistance for engineering students. He also announced that his employer, Petrotechnical Resources of Alaska, would be matching his contribution with an additional $4,000 to create this new fund.

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Photo top left: Ice arch molds filled with Pykrete line up in the center of Cornerstone Plaza. The molds are supported by “ribs” made out of 2x4 frames.
Photo bottom left: Student team members closely inspect a section of the arch.
Photo arch left: Close up of the finished ice arch.
Photo arch right: Aerial view of ice arch being assembled at Cornerstone Plaza on the UAF campus.
The Institute of Northern Engineering continues to grow to meet state needs. During the past 12 months, new research faculty have joined INE to work in the collaborative and challenging environment offered by engineering and related disciplines. Three Centers in INE were particularly active in bringing in faculty to develop new programs with state relevance. The Mineral Industry Research Laboratory hired Guven Akdogan, a professor with expertise in mineral preparation. As Alaska gears up to meet the nations needs for critical and strategic minerals, Dr. Akdogan is a key piece. Dr. Akdogan was working in South Africa at the time of his hire, but is currently working in Finland with the world’s best in this area before he will join the Fairbanks faculty in December. We were able to hire Dr. Akdogan at a senior level due to his length and breadth of worldwide experience in the mining industry.

The Alaska Center for Energy and Power continues to grow in areas of critical state need. During the last month, ACEP hired two new faculty, Dr. Mark Mueller-Stoffels and Mr. George Roe. Both have experience with ACEP, but come from very different perspectives. Dr. Mueller-Stoffels started in ACEP as a post-doctoral research associate and has been instrumental in the design and creation of the electrical grid simulator. Mr. Roe, on the other hand, recently retired from Boeing, where he was a program developer and project manager for energy systems research. Both bring different perspectives and special skills to the table to solve Alaska’s energy needs.

In the ever-interdisciplinary Water and Environmental Research Center, Dr. Ken Tape, a landscape ecologist, has joined the ranks to conduct research on climate change, hydrology, and landscape modification, among other relevant topics. The WERC also added Dr. Lorrie Rea to the roster. Dr. Rea has developed a career in marine mammal research. While Dr. Rea seems, at first glance, a surprising fit with the Institute of Northern Engineering, it is no surprise to the many who have followed the WERC and its growth to meet state needs. Dr. Rea was attracted to WERC by the Alaska Stable Isotope Facility, a unit within WERC directed by Dr. Matthew Wooller, who has a joint appointment between INE and the School of Fisheries and Ocean Sciences. Dr. Wooller is himself a marine scientist. The WERC, while currently being directed by engineer Dr. William Schnabel, has had hydrologists and biologists as directors. Faculty from many disciplines are attracted to WERC to engage in its multidisciplinary environment. The breadth of research in WERC spans the breadth of Alaska’s science and engineering problems.

In INE, researchers conduct applied and basic research for state and federal agencies, private companies, and commercial interests. Anywhere that needs match expertise you may find INE researchers solving problems. If you have a project that needs doing, contact the Institute and let’s see if there is a match. If there isn’t, it may be that INE can attract the faculty capacity to get the work done. Research faculty in INE work on grants and contracts. Let’s discuss a scope of work and a budget and get to work solving Alaska’s challenges.

Dan M. White
Director, INE

2013 Steel Bridge

After capturing 1st place at the 2013 ASCE Pacific Northwest Regional Competition as well as receiving an Award of Excellence, the 2013 Steel Bridge Team competed at the national level where the team received 3rd place in the stiffness and efficiency categories and ranked 18th place overall.

Photo top left: The Steel Bridge team was awarded 1st place at the 2013 NW Regional Competition.
Photo bottom left: The Steel Bridge Team during the timed event at the 2013 Student National Steel Bridge Competition in Seattle.
To see more photos of the Steel Bridge team, please visit cem.uaf.edu/news.

Welcome

New Faculty Appointments
- Dan Walsh
  Professor of Mineral Preparation
  Engineering, Emeritus
- Jonah Lee
  Professor of Mechanical Engineering, Emeritus

New Staff Appointments
- Amy Arkwright
  ACEP Program Assistant
- Kyungcheol Choy
  WERC Post Doc
- Max Frey
  ACEP Program Assistant
- Leanne Isaacson
  Office Manager, Petroleum Engineering
- Judy Johnson
  Office Manager, Electrical Engineering
- Julene Lowdermilk
  Office Manager, Mining & Geological Engineering
- Heike Merkel
  ACEP Research Professional
- Derek Miller
  INE Business Office Manager
- Ashley Rodgers
  INE HR Coordinator
- Armando Sepulveda-Jauregui
  WERC Post Doc
- Ana Thayer
  INE Proposal Coordinator

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Research Spotlight: Jarvis Creek  (PI: Anna Liljedahl, WERC)

Hydrology research often focuses on the Arctic and the northern regions of Alaska, but WERC researcher Anna Liljedahl’s keeps one eye on Alaska’s Interior. After all, watersheds in the sub-arctic Interior include the same features as their cousins in the Arctic do: permafrost, glaciers and a semi-arid tundra and taiga.

Liljedahl’s Jarvis Creek project investigates the relationship between glaciers, frozen ground, groundwater and river hydrology and how the study area’s water cycle affects surrounding communities in terms of infrastructure and agriculture. This project originally started in 2011 and is a collaborative effort between WERC, Cold Regions Research Engineering Laboratory, Salcha-Delta Soil and Water Conservation District, US Army, the UAF Alaska University Transportation Center (AUTC), the Alaska Department of Transportation and Public Facilities (AKDOT&PF). The project also received funding from the National Institutes for Water Resources (NIWR) and the Pacific Northwest Transportation Consortium (PacTrans).

As a sub-basin of the Tanana and Yukon Rivers, the Jarvis Creek watershed covers an area of about 634 km². It serves as an excellent proxy watershed because its characteristics are typical for other large watersheds draining the north-facing Alaska Range: snowcapped mountains, glaciers, discontinuous permafrost, moraine in the foothills and permeable gravels in the lowlands. Like other glacierized basins in Interior Alaska, Jarvis carries water all year round and does not dry up in the summer months. One major advantage of Jarvis Creek is its close proximity to roadways and the community of Delta Junction, which grants relatively easy access to the study area and a direct linkage to water resource issues.

The goal of Liljedahl's study is to build a comprehensive hydrological model from both meteorological and hydrological data collections. Hydrology measurements include runoff, groundwater levels, snow accumulation, glacier melt and water geochemistry. Hollow pipes that are drilled into the glacier ice provide a reference point when measuring glacier melt while an attached air temperature sensor provides additional meteorological data. The meteorological station that is housed on a ridge between Jarvis Creek and the Delta River (aka Coal Mine Ridge, elevation 1021 m) has been supplying information since September 2012 and is connected to a real-time network. Additional stations located at 840 m to 1650 m elevation gather further information on air temperature, relative humidity and rainfall. The meteorological stations in Jarvis Creek provide rare insights into high elevation weather conditions, which will serve to refine flooding forecasts for communities and road infrastructure located in the lowlands.

Nearly 6% of the Tanana Basin of Interior Alaska is currently glacierized while permafrost is more abundant. The Tanana River basin has seen an increase in mean annual discharge attributed to increased flow between October and April (Brabets and Walwoord, 2009), while both summer precipitation (Wendler and Schulski, 2009) and glacier coverage (-17%) (Arendt, Hock and Herreid, unpublished) has decreased since the 1950s. Liljedahl and her collaborators hypothesize that the increased winter runoff in the Tanana River may be due to increased summer glacier melt, which promotes aquifer recharge and therefore increased river baseflow. To test the above hypothesis and shed more light on the source of the stream runoff, e.g. rainfall versus glacier melt, water chemistry including stable isotopes are being analyzed by CRREL. By measuring the runoff at two locations along Jarvis Creek, one upstream site representing the end of the relatively impermeable moraine and one location 15 miles downstream, the researchers hope to put a more precise value on the amount of runoff that is being diverted into the aquifer.

To find out more about the Jarvis Creek project, please visit in.e.uaf.edu/werc/projects/jarvis

For more information:

Photo top left: The meteorological station located around 15 miles from Jarvis Glacier at an elevation of 1650 m.

Photo top left: Anna Liljedahl sets up a precipitation gauge at the meteorological station located around 15 miles from Jarvis Glacier.

Photo middle left: Anna Liljedahl and her colleague Will Wright from the Salcha-Delta Soil and Water Conservation District measure snow accumulation on the Jarvis Glacier in mid-April 2013.

Photo middle right: Anna Liljedahl installs a wind guard for a precipitation gauge at one of the meteorological stations.
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