Message from the Director

The sun is shining, the snow has melted, and the color green is all around us. The all too brief spring of Fairbanks has come and gone and the bright months of summer lie ahead. It's been a very busy semester for the Center, with students graduating, researchers traveling and presenting all over the world, papers published, and workshops held and attended. This spring saw the conclusion of several projects with final reports submitted, and summer will see even more. We are proud of the accomplishments of the Center, its PIs, students, and staff. Although we know it's a busy season, we hope summer will bring at least a little bit of rest for everyone!

I hope that you will continue to stay engaged with CESTiCC. I invite you to visit our website as well as our Facebook page to stay up-to-date with our many activities. Best wishes to you all for a wonderful summer.

Jenny Liu
Several research projects were completed this spring. In this newsletter we will highlight completed projects from our Material & Design and Environmental Impact Assessment research thrusts. For a complete list of our active and completed research projects, please visit our research site.

**Durability and smart condition assessment of ultra high performance concrete in cold climates**

PI: Pizhong Qiao, WSU

Ultra-high performance concrete (UHPC) is an advanced cementitious material of enhanced strength and durability compared with conventional concrete, qualities which are significant in a wide variety of structural applications. Developing locally and supplementary sourced UHPC mixtures provides great economic benefits. For cold climate applications, it is also necessary to establish its approximate service life and long-term durability, and its frost resistance.

This research tested twelve trials mixtures produced with locally sourced materials. It was found that the optimal UHPC mixture approximately exhibits compressive strength of 15 ksi, elastic modulus of 5,000 ksi, direct tensile strength of 1.27 ksi, and shrinkage of 630 at 28 days. This is comparable to commercial UHPC mixes, and superior to conventional concrete. The tensile strength and modulus of elasticity in tension, dynamic modulus, and wave modulus showed a slight increase from the virgin values after 300 freeze-thaw cycles, suggesting superior frost resistance for use in cold climates. Finally, no internal damage was detected through X-ray imaging analysis up to 300 cycles; however porosity deterioration was observed, indicating that internal damage will eventually occur in the freeze-thaw cycle.

UHPC structures are expected to have a longer service life than conventional concrete, so more severe conditioning protocols should be applied to UHPC. Once the degradation of material properties is experimentally evaluated, damage mechanics-based models may potentially evaluate damage accumulation and failure mechanisms of UHPC. The innovative and effective condition assessment technique using embedded smart
aggregates is capable of in situ monitoring of strength growth, assessing long-term durability, and detecting potential damage to UHPC materials and structures.

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**Life cycle sustainability assessment of highway winter maintenance**

**PIs: Xianming Shi, WSU & Na Cui, MSU**

Snow and Ice control products have a negative impact on the natural environment, transportation infrastructure and motor vehicles. Therefore, adopting sustainability principles for winter road maintenance (WRM) operations will insure that any cost savings resulting from new WRM practices are not created at the expense of infrastructure, the environment, or travelers.

The impetus for this research was a need to analyse the use of road salt, the most commonly used deicer used for winter maintenance in the USA. The research team considered not only economic savings and benefits from improved winter roadway safety and mobility, but also assessed the indirect costs of issues such as infrastructure degradation and vehicle corrosion. This study introduced the concept of Life Cycle Sustainability Assessment (LCSA) to winter roadway maintenance operations, and assessed the impacts of the use of road salt deicers to better understand its cradle-to-grave effects. Specifically, the LCSA looked at life cycle costs, environmental life cycle assessment, and social life cycle assessment. This reflects the current state of thinking regarding the LCSA of road salt.

Using this framework, it is possible to make more informed and balanced decisions regarding the use of salt for winter roadway maintenance operations, which account for indirect impacts and costs. This framework is a step in the right direction, but the PIs feel it will be improved and enriched by continuing research, and hope it may be used as a template for future LCSA reviews of products, technologies, and practices.
Outreach

Laura Fay's work featured in Stateline article
Associate Director Laura Fay's work on unpaving was featured in a stateline article this semester. The article covers the process of unpaving and cites a report on safety and maintenance which Fay co-authored for the National Cooperative Highway Research Program.

Anthony Clevenger’s wolverine research featured in Canadian Geographic
Dr. Anthony Clevenger’s work on his current CESTiCC project was featured in Canadian Geographic. The article, “In Search of the Wolverine”, discusses how intrusion into habitats by way of roads and highways affects wolverine populations.
**Pearl Creek STEM Night and Engineering Open House**

CESTiCC staff and student volunteers attended the 2017 STEM Night at Pearl Creek Elementary and the CEM Engineering Open House at UAF. They introduced the students and community members to the complexities of roads and invited them to build roads of their own using special tracks and cars.

**Academic and professional careers in transportation features at Major Mania**

Outreach Coordinator Joe Alloway introduced prospective and current students to the myriad career options in the field of transportation at Major Mania in conjunction with UAF’s *Inside Out*.

**Transportation Engineering sessions for Kids2College**

Center staff presented on transportation to 5th grade classes at the annual *Kids2College* event. The lesson started by introducing some of the challenges civil engineers face in cold climates, and finished with a tour of UAF's pavement lab.

**Math Day on campus**

CESTiCC presented at the annual Math Day on Campus, sponsored by the Space Grant program. The presentation discussed how math is used in everyday activities in ways that might surprise young students.

**2017 Week of the Arctic in Fairbanks, Alaska**

CESTiCC attended the 2017 *Week of the Arctic* events at UAF during the week of May 8-14. Staff hosted a table to discuss Center research with academics, policy makers, and professionals from throughout the circumpolar north.
Technology Transfer

CESTiCC researchers presided and presented at TRB

The TRB 96th Annual Meeting was held January 8-12, 2017 in Washington, D.C. Center researchers gave about 20 presentations covering a wide range of topics related to environmentally sustainable transportation at TRB. Some CESTiCC Presentations focused on reducing environmental impacts from construction, operation, and preservation through effective, practical approaches. Researchers Xianming Shi and Zhengxian Yang presented Snow Removal Performance Metrics: Past, Present, and Future; Xiong Zhang’s Rapid Characterization of Seasonally Affected Soils Using Simple Equipment; and Rob Ament’s Native Plants for Roadside Revegetation in Idaho.

Several posters were presented, primarily focused on material design. Some examples included Low Temperature Cracking Analysis of Asphalt Binders and Mixtures, Hot Weather Impacts on Thermal Profiles in Pervious Concrete, and Winter Temperature Prediction at Near Surface Depth of Pervious Concrete Pavement. CESTiCC’s young researchers also had the opportunity to showcase their research at TRB. Mehdi Honarvar Nazari, our 2016 Student of the year, presented Corrosion Behavior of C1010 Carbon Steel in the Presence of an Apple Pomace Derived Green Inhibitor. PhD student
Sen Du made his TRB lectern session debut with *Snow Fences for Reducing the Impacts of Snow Drifts on Highways: Renewed Perspective.*

Srijan Aggarwal presented at Fairbanks ASCE monthly meeting
Center PI Dr. Srijan Aggarwal recently presented at the monthly meeting of ASCE Fairbanks Chapter. Stemming from his [current CESTiCC project](#), the presentation, “Air Quality Issues in Interior Alaska” focused on local air quality issues, fundamentals, current research, and research directions. He particularly discussed ultrafine particulate matter (PM 0.1) and its potential effects on human health. It was well attended and well received.

Horacio Toniolo held a 2-D modeling workshop in March
Horacio Toniolo and post-doctoral researcher Joel Homan held a workshop entitled “Two-Dimensional Modeling Using HEC-RAS and SRH-2D” in March, which built on Dr. Toniolo’s current project, “Developing Guidelines for 2-dimensional Hydraulic Model Review and Acceptance”. The workshop was co-sponsored by CESTiCC and the Alaska Department of Transportation and Public Facilities. Materials can be downloaded [here](#).

Jenny Liu and Xianming Shi served as panelists at CI Summit
Jenny Liu and Xianming Shi attended the [Construction Institute 2017](#) summit in Anaheim, California. Jenny Liu chaired a panel session entitled “Life Cycle Sustainability of Asphalt Concrete Pavements”. The panel shared recent developments for sustainability throughout the life cycle of asphalt pavements, including planning, design, material selection, construction, maintenance & operations, preservation, recycling, and life cycle environmental assessment.

Rob Ament's work on wool featured in IECA newsletter
Rob Ament's CESTiCC Project, “[Evaluation of Effectiveness and Cost-Benefits of Woolen](#)"
“Roadside Reclamation Products” was featured in an International Erosion Control Association (IECA) newsletter. The story highlighted progress the project has made in evaluating wool’s effectiveness in erosion control blankets, silt fences, and as a compost additive, noting that the material shows particular promise in erosion control blankets.

Mehdi Honarvar Nazari at Agriculture Symposium
PhD student researcher and 2016 Student of the Year Mehdi Honarvar Nazari gave a poster presentation at the Pioneering Ideas in Agriculture Symposium at Washington State University. His poster was called “Corrosion Behavior of C1010 Carbon Steel in the Presence of an Apple Pomace Derived Green Inhibitor”.

Mahmoud Shehata at GPSA Research Exposition
Student researcher Mahmoud Shehata presented a poster at the GPSA Research Exposition at Washington State University. The poster, “Numerical Simulations of Aerodynamics and Snow Drift around Living Snow Fences” was co-authored by Center PI John Petrie.

Laura Fay presented at APWA conference
The APWA North American Snow Conference was held in April in Des Moines, Iowa, and was an opportunity for snow control experts and educators to share their research and regional approaches to snow management. Laura Fay presented “Salty Water & Brown Trees – Current Strategies to Mitigate Impacts” at the conference.

Rob Ament spoke on Wildlife Connectivity in Gabon
Rob Ament spent a week in the nation of Gabon on invitation of the World Bank Group in April. Rob served as an expert speaker for a special meeting of its Global Wildlife Program. He presented on wildlife connectivity and how transportation effects it, and discussed several specific efforts in which he is engaged.

Webinar Series
Seven webinars were hosted by CESTiCC this spring. The presentations for each were recorded and are available on the CESTiCC website.
**Turning Waste Peony Leaves into Green Chemicals: an Exploratory Study**
This webinar discusses an exploratory study that demonstrates the feasibility of deriving renewable chemicals from waste flower leaves and thus adding value to such agro-based waste materials. The study derived a liquid corrosion inhibitor through a zero-waste chemical and biological process that readily degrades the waste peony leaves.

**A Bio-Wicking System to Mitigate Capillary Water in Base Course**
Available laboratory tests and field applications have clearly indicated that a newly developed H2Ri wicking fabric has the ability to remove capillary water from pavement layers, improve pavement performance, eliminate the frost heave problem, and result in significant cost savings. This webinar discusses an improved bio-wicking system to mitigate the shortfalls of current design for wicking fabric.

**Toward Performance Specifications for Concrete Durability**
This presentation discusses developing conceptual framework for the specification for concrete durability using performance modeling concepts. Specifically, the approach will relate acceptance tests, material properties, degradation models, limit states, and reliability. When implemented, this approach can be used for a variety of distress mechanisms. Examples are provided for three specific distresses.

**Converting Paved Roads to Unpaved Roads**
This webinar was co-sponsored by the Safety Center and CESTiCC, and provided an overview of the National Cooperative Highway Research Program (NCHRP) Synthesis 485, Converting Paved Roads to Unpaved.

**Application of Life-Cycle Analysis in Civil Engineering**
There are three components to life-cycle cost analysis: initial/construction cost, operation/maintenance cost, and life-cycle loss, where the last two cost components involve time-dependent performance predictions. Two application projects were assessed to demonstrate long-term serviceability, integrity, and accounting for prevailing uncertainties were considered in the life-cycle cost assessment.

**Prediction of Thermal Behaviors of Pervious Concrete Pavements in Winter**
In-field thermal performance of pervious concrete pavements during the winter were investigated in this webinar. The amount of heat conducted through pervious concrete is affected by the highly voided structure of pervious concrete. In a combined field-laboratory investigation, this project analyzed the field temperature data from an instrumented pervious concrete pavement (PCP) sidewalk in Pullman, WA.

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**Achievements and Accolades**

CESTiCC researchers and students joined the Order of the Engineer
Jenny Liu and Srijan Aggarwal joined fellow researchers Robert Perkins and Il-Sang Ahn in February in an induction ceremony for the American Order of the
Engineer. It is an oath taken by professional in the field of engineering to always remember to serve the public and repay the trust placed in engineers by society.

Anthony Mullin received his PhD from UAF
Center student researcher Anthony Mullin received his PhD from UAF on May 6, 2017 at UAF's 95th commencement ceremony. Jenny Liu was his major advisor. Dr. Mullin has worked with CESTiCC since its inception, and the Center is proud of his achievement.

Pizhong Qiao named Engineering Mechanics Institute Fellow
Center PI Pizhong Qiao was named a fellow of the American Society of Civil Engineers’ Engineering Mechanics Institute (EMI). Qiao was recognized for his contributions to civil engineering research, particularly in structural composites and mechanics, and his commitment and participation within the EMI. Qiao will be recognized as a fellow at the upcoming EMI 2017 conference, in June in San Diego.

CESTiCC student researchers receive fellowships and scholarships
Several CESTiCC student researchers were recently honored with fellowships and scholarships to support their academic and research efforts. Mehdi Honarvar Nazari and Jialuo He received the 2017 Perteet Graduate Fellowship in Civil Engineering.

Yan Zhang and Junluang Wu received the 2017 Washington Asphalt Pavement Association (WAPA) scholarship.
PhD student Gang Xu received the 2nd Year Russ and Anne Fuller Fellowship for Interdisciplinary Research for the 2017-18 academic year and the David C. Goss Scholarship from the American Coal Ash Association Educational Foundation. Gang Xu and Jialuo He also received the 3rd place best poster award at the 7th Annual Workshop of the International Association of Chinese Infrastructure Professionals (IACIP).

Student research assistant Addison Yang recently received the 2017 Haneman Travel Scholarship from the Alaska Society of Professional Engineers. The award will support his travel to a conference and present his research in May.

**Upcoming Events**

**2017 Transportation Research Congress - May 23-25**
The 2017 Transportation Research Congress (TRC) will be held in Beijing, China on May 23-25, 2017. This is the second annual TRC, and its theme will be "Next Generation" Transportation Technologies, including those on highways, railways, bridges, and more.

**International Conference on Transportation Infrastructure and Materials 2017 - June 9-12**
The 2017 ICTIM, which will be held in Qingdao, China on June 9-12. The conference will cover a broad range of topics related to transportation infrastructure and materials.

**CUTC Annual Meeting - June 19-21**
CESTiCC will be attending the 2017 Council of University Transportation Centers annual meeting in Buffalo, New York June 19-21.

**International Workshop on Frozen Ground Engineering and Climate Effects (FGECE2017) - August 1-10, 2017**
This workshop will be held in Anchorage Alaska, on August 1-10. This international workshop aims to provide a platform for professionals to exchange research results, strategies, and projects on frozen ground engineering, specifically related to civil infrastructure and engineering issues.
CESTiCC Summer Workshop - August 10

CESTiCC’s annual summer workshop will be held on Thursday, August 10 at Washington State University’s Pullman campus. The workshop will highlight and showcase Center research on environmental sustainability in transportation. Researchers, sponsors, collaborators, students, and other transportation professionals are welcome and encouraged to attend.

Registration: free, and currently open
Deadline for abstract submission: June 23rd
Deadline for workshop hotel reservations: July 25

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