Program Progress Performance Report for University Transportation Centers

Submitted to: Office of the Assistant Secretary for Research and Technology
            U.S. Department of Transportation
            1200 New Jersey Avenue, SE
            Washington, DC 20590

Project Title: Tier 1 University Transportation Center for Environmentally Sustainable Transportation in Cold Climates (CESTiCC)

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Project Grant Period: September 30, 2013- September 30, 2019

Reporting Period End Date: September 30, 2018

Report Term: Semi-annual PPPR #10

Signature: 
            Billy Connor, CESTiCC Director
Abbreviations

- ACI – American Concrete Institute
- AKDOTPF – Alaska Department of Transportation and Public Facilities
- APWA – American Public Works Association
- ASCE – American Society of Civil Engineers
- AS&G – Anchorage Sand & Gravel
- ASPE – Alaska Society of Professional Engineers
- CEM – College of Engineering and Mines
- CSET – Center for Safety Equity in Transportation
- EPA – Environmental Protection Agency
- FNSB – Fairbanks North Star Borough
- FNSBSD – Fairbanks North Star Borough School District
- GCI – General Communication Incorporated
- IACIP – International Association of Chinese Infrastructure Professionals
- ITE – Institute of Transportation Engineers
- MDOT – Montana Department of Transportation
- MnDOT – Minnesota Department of Transportation
- NDOT – Nevada Department of Transportation
- MST – Missouri University of Science and Technology
- MSU – Montana State University
- PC – Pervious Concrete
- PCP – Pervious Concrete Pavement
- RiP – Research in Progress
- RMC – Ready Mix Concrete
- STEM – Science, Technology, Engineering and Math
- TRB – Transportation Research Board
- WSU – Washington State University
- UAF – University of Alaska Fairbanks
- UAF OAR – University of Alaska Fairbanks, Office of Admission and the Registrar
- UH – University of Hawaii
- UTC – University Transportation Center
- WSDOT – Washington State Department of Transportation
- WSU – Washington State University
1. Accomplishments

What are the major goals and objectives of the program?

The major goals and objectives of the CESTiCC program are to systematically engineer environmentally sustainable transportation infrastructures in cold climates, considering the entire life cycle of transportation planning, design, materials selection, construction, maintenance and operations, preservation, and recycling through the collaboration of academia, industry and other stakeholders by cross-disciplinary research, education, and technology transfer activities.

What was accomplished under these goals?

During the past six months of the project:

- **Regular email announcements and website updates**
  A CESTiCC emailing contact list has been regularly updated. The Center announcements have been distributed through emails to professionals in the transportation and engineering communities. Activities have been posted to the website in a timely fashion as reflected by Research, News, Webinars, Publications, Workforce development, and other links on the CESTiCC website.

- **Monthly webinar series**
  Starting in September 2014, CESTiCC has hosted monthly webinar series that invites internationally recognized researchers to discuss Environmentally Sustainable Transportation in Cold Climates. The seminar series is free and open to all transportation professionals and engineering communities. Since the last reporting period, CESTiCC has hosted three webinars. Additionally, the webinars were recorded and posted on our website.

- **Research projects**
  Detailed project information is available on our website at [cem.uaf.edu/cesticc/research](http://cem.uaf.edu/cesticc/research). The research progress during this reporting period is summarized as follows.
  
  - There are currently 21 ongoing projects, and 29 completed projects. Of these, 5 were completed in this reporting period. Final project reports were reviewed, revised, and posted on [http://cem.uaf.edu/cesticc/research](http://cem.uaf.edu/cesticc/research), and sent to TRID.
  
  - Quarterly reports have been collected and reviewed in a timely fashion to keep track of progress, accomplishments and future goals.
  
  - Annual project progress meetings were held for ongoing projects during this reporting period.
  
  - PIs continue to conduct and disseminate research through professional meetings and other venues, and details can be found in the products section on pages 5-10 of the PPPR.

- **Sponsorship**
  No events were sponsored during this reporting period to promote the UTC program.
What opportunities for training and professional development has the program provided?


How have the results been disseminated? (Please provide links or examples for website use.)

CESTiCC staff and researchers have been actively involved in various professional meetings and outreach activities to promote the UTC program, enhance public understanding and increase interest in learning and transportation careers.

Research

- Research information through RiP, websites, quarterly reports, and Gotomeetings.
- Research project information was available at the TRB’s RiP database and the Center’s website. Research progress was updated to funding agencies through quarterly reports and Gotomeetings. Seven projects have been updated to “complete” in RiP during this period and final project reports were sent for review to TRID during this reporting period.

Professional Meetings

During this reporting period, CESTiCC members have given many presentations and invited talks at various professional venues all over the world such as:
1. The 7th Asian Pacific Conference on Unsaturated Soils. August, 2019, Tokyo, Japan

For more details please review the products section found on pages 4-6.

Outreach

- *Kids2College Event*, April 18, 2018
- CESTiCC Director Billy Connor engaged 5th and 6th grade students from the Alaska Gateway School District and the Nordale Elementary School during the annual Kids2College event hosted by UAF. The students were introduced to the concepts of friction and safe stopping distances on different road surfaces.

What do you plan to do during the next reporting period to accomplish the goals and objectives?

We will follow the implementation plan to ensure that all the CESTiCC funded research, education, and outreach activities move forward as scheduled.
• Project updates: 21 projects are set to conclude in the next reporting period. Final reports and products will be posted on the Center’s research page and in TRID. Project close-up meetings will also be held.
• Researchers will continue to get students involved in research and disseminate results in a timely manner.
• Will endeavor to continue monthly webinar series to promote the Center’s research.
• Will continue to participate in various activities on outreach, technology transfer and other activities to publicize the Center.
• Will continue to update the website with news, products and research.

2. Products

Publications, conference papers, presentations, websites, lectures, seminars, workshops, invited talks

Publications
• Journal Publications

• Reports
  • L. Fay, M. Akin & A.Muthumani. *Estimating the Application Rate of Liquid Chloride Products Based on Residual Salt Concentration on Pavement*, CESTiCC Project Reports, April 2018.
  • L. Fay & M. Akin. *Investigation of Alternative Deicers for Snow and Ice Control*, CESTiCC Project Reports, April 2018.


• M. Huijser. *Outreach and Technology Transfer on the Effectiveness of Wildlife Fences and Wildlife Crossing Structures in a Multifunctional Landscape*, CESTiCC Project Reports, April 2018.

• **Conference Papers**
  • None this reporting period

• **Presentations**

  • Shi, X. Smart and Green Infrastructure Enabled by Materials. Presentation for the 3rd Simpson Strong-Tie Annual Building Connections Student Symposium, October 6, 2018, Pullman, WA.

  • Shi, X., Liu, K. Mechanical Performance of Asphalt Binder Modified with Graphene Oxide and Warm Mix Additives. Transportation Research Board ADC 60 (*Committee on Resource Conservation and Recovery*) Summer 2018 Workshop, July 16, 2018, Spokane, WA.


• Du, S., Shi, X. Abrasion Resistance of High Volume Fly Ash Concrete as Influenced by Inclusion of Graphene Oxide. Transportation Research Board ADC 60 (Committee on Resource Conservation and Recovery) Summer 2018 Workshop, July 16, 2018, Spokane, WA.

• Xu, G., Shi, X. Stormwater Infiltration Test and NMR Study on Salt Scaling Resistance of Fly Ash Based Pervious Concrete. Transportation Research Board ADC 60 (Committee on Resource Conservation and Recovery) Summer 2018 Workshop, July 16, 2018, Spokane, WA.

• Other Products

• Website Updates
  • CESTiCC Website: cem.uaf.edu/cesticc/ (new content)
  • CESTiCC Webinar page: cem.uaf.edu/webinars (new content)
  • CESTiCC Workforce Development: cem.uaf.edu/cesticc/workforce-development.aspx (new content)
  • CESTiCC Publications Page: http://cem.uaf.edu/cesticc/publications.aspx (new content)

• Lectures/Seminars/Workshops/Invited Talks
  • Invited Talk. Shi, X. Application of Graphene Oxide in Civil Engineering Materials: Exploratory Studies. Presentation invited by the State Key Laboratory of Silicate Materials for Architectures, June 8, 2018, Wuhan, China.
  • Invited Talk. Shi, X. Graphene Oxide Enables Ambiently Cured Fly Ash Geopolymer. Presentation invited by the School of Naval Architecture, Ocean & Civil Engineering, Shanghai Jiaotong University, June 14, 2018, Shanghai, China.

3. Participants & Collaborating Organizations

What organizations have been involved as partners?

• Collaborative research and financial support
  26 ongoing research projects are funded by CESTiCC and the following agencies:
    • AKDOTPF
    • ADEC
    • AS&G
• Aurora Consortium
• BP Exploration Alaska
• Emulsion Product Co.
• Midwest Industrial Supply, Inc.
• Local Roads Research Board
• MnDOT
• MDOT
• MSU Department of Land Resources and Environmental Sciences
• RMC Research and Education Foundation
• TenCate Geosynthetics
• UH Manoa
• The Wilburforce Foundation
• WSDOT

**Have other collaborators or contacts been involved?**
Tele-conferences and Gotomeetings were held during the reporting period to discuss research ideas and broad collaborations on research, education, workforce development, and outreach activities between CESTiCC and various collaborators:

- Research collaborators:
  - Apun LLC, Anchorage, AK
  - Alaskans for Litter Prevention and Recycling (ALPAR)
  - Brookings Institute
  - Brookside Woolen Mill
  - Central Environmental Inc.
  - Insulfoam
  - Missouri University of Science and Technology
  - MnDOT
  - Ramy Turf Products, LLC
  - Sugarloaf Wool Mill
  - University of Tennessee, Knoxville
  - University of Idaho
  - University of New Hampshire
  - 13 Mile Lamb and Wool Company

- Education and outreach collaborators:
  - ASCE Construction Institute
  - ASCE Fairbanks Chapter
  - ACI Alaska Chapter
  - ASPE
  - Alaska Concrete Alliance
  - Alaska Asphalt Alliance
  - Alaska Space Grant Program
  - Alaska Tribal Technical Assistance Program Center
  - Alaska Local Technical Assistance Program Center
  - Environmental UTCs Network
4. Impact

- *What is the impact on the development of the principal discipline(s) of the program?*

Through our research, CESTiCC has made great impacts in the areas of advancing innovative sustainable materials and design, managing stormwater runoff, reducing environmental impacts during construction, operations and preservation, and improving the sustainability and conservation of ecosystems to maximize environmental sustainability in transportation. A couple of examples are highlighted as follows.

The project, *Estimating the Application Rate of Liquid Chloride Products Based on Residual Salt Concentration on Pavement*, completed during this period. The project focused on laboratory testing of asphalt and concrete pavement for deicing products. A known quantity of salt brine was applied as an anti-icer, followed by snow application, traffic simulation, and mechanical snow removal via simulated plowing. Using a sample from this plowed snow, researchers measured the chloride concentration to determine the amount of salt brine (as chloride) that remained on the pavement surface. Under the investigated scenarios, the asphalt samples showed higher concentrations of chloride in the plowed-off snow, and therefore lower concentrations of chlorides remaining on the pavement surface. In comparison, the concrete samples had much lower chloride concentrations in the plowed-off snow, and much higher chloride concentrations remaining on the pavement surface. An interesting pattern revealed by the testing was the variation in the percentage of residual chloride on the pavement surface with changes in temperature. When pavement type was not considered, more residual chloride was present at warmer temperatures and less residual chloride was present at colder temperatures. This observation warrants additional testing to determine if the pattern is in fact a statistically valid trend. The findings from the study will help winter maintenance agencies reduce salt usage while meeting the defined Level of Service. In addition, findings will contribute to environmentally sustainable policies and reduce the level of salt usage (from snow- and ice-control products) introduced into the environment.

The project *Transportation Life Cycle Assessment (LCA) Synthesis Phase II*, which completed this period, developed a set of narrated slideshows on topics related to
environmental LCA. The modules are available for download on the CESTiCC website, http://cem.uaf.edu/cesticc/publications/lca.aspx. The modules are around 20 minutes long and may be used for various purposes such as for class lectures or part thereof, and for background learning in research or application. The modules are organized into four topical areas, each containing overview and detailed modules. The A and α groups cover the international standards that define environmental LCA. The B and β groups summarize some of the typical environmental impact categories in LCA. The G and γ groups include software tools for LCA. The T and τ groups focus on the growing field of transportation with respect to LCA, a complex area of importance. The analytics section provides data on downloads of the modules from the websites and summary survey results from course implementation.

- **Other Disciplines** –
  Nothing to report this period.

- **What is the impact on the development of transportation workforce development?**
  CESTiCC has impacted the development of transportation workforce development through many interactions with agencies, the transportation professional community and broad general communities. The Center has given 12 presentations at professional meetings during this reporting period, and continues to offer regular webinars. Presentations from these workforce development events are available on the Center website for transportation professionals and broad communities. Additionally, we have continued to contribute to the development of the future transportation workforce through educational and community outreach events as highlighted above.

- **What is the impact on physical, institutional, and information resources at the university or other partner institutions?**
  CESTiCC currently has 21 ongoing research projects and CESTiCC PIs have completed 30 research projects, 5 of which were in this reporting period. The projects continue to produce innovative and valuable results, which can be used as physical, institutional, and information resources at universities and our partner institutions.

- **What is the impact on technology transfer?**
  CESTiCC actively engages the public with its research through various means such as free monthly webinars, presentations, newsletters, seminars, workshops, and symposiums as mentioned in earlier sections. During this reporting period, CESTiCC has produced 7 journal publications, 12 conference presentations, 4 invited talks/lectures/workshops/keynote presentations, and 5 reports, and hosted 3 webinars. The Center also updates its website in a timely manner with news, publications, webinar announcements and current research information.

CESTiCC strives to make its research accessible to the public. Project information, including project update presentations, reports, news, webinars, and workforce development information are available on our website to share with anyone who is interested.
• *What is the impact on society beyond science and technology?*
CESTiCC has made it a Center priority to go beyond science and technology by continuously participating in educational outreach opportunities, specifically with K-12 ages, professional societies, and the broad public community. CESTiCC has hosted many student groups, camps, and classes to expose them to the positive impacts civil engineers can have in the world. Examples can be referred from previous ‘outreach’ section on pg 3-4.

5. *Changes*

CESTiCC received a 1 year no-cost extension from U.S. DOT.