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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Reporting Period End Date: September 30, 2017

Report Term: Semi-annual PPPR #8

Signature:
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 seven webinars: *Converting Paved Roads to Unpaved Roads, Application of Life-Cycle Cost Analysis in Civil Engineering, Prediction of Thermal Behaviors of Pervious Concrete Pavements in Winter, the 2017 CESTiCC Summer Workshop presentation sessions 1-3*. Additionally, all webinars have been recorded and posted on our website.

- **E-newsletters**
  Starting in December 2014, CESTiCC has sent out E-newsletters. The newsletters give our subscribers the opportunity to see what we have been up to and any upcoming events. CESTiCC published one newsletters (spring) during this reporting period. PDF files of each newsletter can be found on the CESTiCC website under *Publications*.

- **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.

  - 2 new research projects officially started in this reporting period. Including these, there are currently 33 ongoing projects, and 17 completed projects. Of these, 6 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.

Outreach, technology transfer, and workforce development
A workshop was held on August 10, 2017 at the WSU Pullman Campus. The workshop featured a student poster competition as well as lectern sessions which were broadcast as webinars for remote viewers. The webinars, presentations, and posters were posted on the Center’s workforce development page, which continues to be maintained on the Center’s website to better disseminate presentations and posters from Center organized and sponsored workforce development programming. In addition, CESTiCC has actively participated in various outreach activities and technology transfer to promote environmental sustainability in transportation. Please see details in the “What opportunities for training and professional development . . .” section on page 3, “How have the results been disseminated . . .” section on pages 3-5 and the “Impact” section on pages 12-14.

Sponsorship
CESTiCC sponsored a number of events during this reporting period to promote the UTC program. The Center sponsored the following: The International Workshop on Research Frontier and Reviews, UAF Steel Bridge and Concrete Canoe teams, and the 2017 CESTiCC Summer Workshop.

What opportunities for training and professional development has the program provided?
- L. Fay, D. Jones, K. Skorseth, Converting Paved Roads to Unpaved Roads, CESTiCC webinar series, co-sponsored by The Safety Center and the Western Transportation Institute, April 4, 2017.
- Q. Huang, Application of Life-cycle Cost Analysis in Civil Engineering, CESTiCC webinar series, April 27, 2017.

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. Four 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 world such as:
  3. Project on Sustainable Development of Highway Engineering in Special Regions symposium, Chang’an, China, June 8, 2017.
  4. 2017 International Conference on Transportation Infrastructure and Materials, Qingdao, China, June 9-12, 2017.

For more details please review the products section found on pages 5-10.

Outreach

- Kids2College event, April 19, 2017
  Center Outreach Coordinator Joe Alloway and Research Coordinator Sheng Zhao presented two sessions for the 2017 Kids2College Event. Joe presented an interactive lecture on transportation and discussed ways future engineers might tackle Alaska’s challenges and Sheng Zhao led tours of pavement labs and taught students how we make asphalt pavement.

- Math Day on Campus, April 25, 2017
  Joe Alloway presented 6 short sessions on how we use math in our daily lives to solve various problems at this event.

- May the Fourth fund raiser, May 4, 2017
  Joe Alloway worked with the Institute of Northern Engineering to raise money and awareness at this Star Wars themed event. CESTiCC participation included donation of personal funds and an on-theme performance by Joe Alloway.

- 2017 Week of the Arctic, May 9-10, 2017
  Joe Alloway staffed a UAF research table during the 2017 International Week of the Arctic event in Fairbanks in May. The event brought experts in science, policy, education, and more to Fairbanks to discuss the various challenges facing northern communities. Joe highlighted the work being done by the Center alongside work by other university research centers.

- 2017 Tanana Valley State Fair, August 6-7, 2017
Joe Alloway staffed a table promoting UAF and CESTiCC at the 2017 Tanana Valley State Fair. The days that he volunteered were Alaska Mining Day and Alaska Heritage Day at the fair, respectively.

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: 26 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 and Facebook page with news, products and research. We will also continue producing E-newsletters, which will then be posted on our website in pdf format.

2. Products

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

Publications

- Journal Publications


• Reports
  
  


• **Conference Papers**
  
  
  

• **Presentations**
  
  
  
  
  
  
  
  
• K. Kappenman, D. Dockery, T. McMahon, & M. Blank, Swimming Performance of Sauger in Relation to Fish Passage, 42nd annual meeting of the Western Division of the American Fisheries Society, “Change and Continuity: Celebrating 50 years of Fisheries in the West”, Missoula, Montana, May 22-25, 2017.
• J. Liu, Recycling in Alaska’s Transportation Infrastructure, 2nd International Conference on Transportation Infrastructure and Materials, June 2017.
• E. Ryan, K, Kappenman, & M. Blank, A Baseline Swimming Assessment for Arctic Grayling: Characterizing the Volitional Swimming Performance of Arctic Grayling to Inform Passage Studies, 42nd annual meeting of the Western Division of the American Fisheries Society, “Change and Continuity: Celebrating 50 years of Fisheries in the West”, Missoula, Montana, May 22-25, 2017.
• X. Shi, & G. Xu, Graphene Oxide Modified Fly Ash Pervious Concrete, CESTiCC Summer Workshop, Pullman, Washington, August 11, 2017.
• X. Shi, & G. Xu, Fly Ash Binder Based Pervious Concrete, Webinar for the City of Spokane, WA, July 25, 2017.

• X. Shi, *Exploratory Study into the Use of Nanotechnology for Reinforcement of Weak Soils*, 1st World Transport Convention, Beijing, China, June 5, 2017.


• G. Xu, & X. Shi, *Influence of Graphene Oxide in a Chemically Activated Fly Ash Binder*, The 10th International Conference on Road and Airfield Pavement Technology (ICPT), Hong Kong, China, August 8-10, 2017.


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)

• CESTiCC Facebook Page: https://www.facebook.com/cesticc (new content)

Lectures/Seminars/Workshops/Invited Talks


• **Lecture.** X. Shi, *Innovations in Sustainable Transportation Infrastructure*, School of Civil Engineering, Harbin Institute of Technology, Harbin, China, July 6, 2017.


3. **Participants & Collaborating Organizations**

**What organizations have been involved as partners?**

- Collaborative research and financial support
- 34 ongoing research projects are funded by CESTiCC and the following agencies:
  - AKDOTPF
  - ACPA Northwest Chapter
  - ADEC
  - Alyeska
  - AS&G
  - Aurora Consortium
  - BP Exploration Alaska
  - The City of Spokane, Washington
  - Clear Roads
  - Decagon Devices Inc.
  - Emulsion Product Co.
  - Global Fiberglass Solutions
  - Idaho DOT
  - Integrated Capital Management
  - KVRI
  - Midwest Industrial Supply, Inc.
  - Local Roads Research Board
  - MnDOT
  - MDOT
  - MSU Department of Land Resources and Environmental Sciences
  - NDOT
  - PreMix of Pullman, Washington
  - RMC Research and Education Foundation
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
  - 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
  - Explore Fairbanks
  - Frontiers of Structural and Civil Engineering
  - FNSB
  - FNSBSD
  - GCI
  - Infrastructure & Climate Network (ICNet)
  - IACIP
  - Louisiana Transportation Research Center
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.

A noticeable knowledge gap in sustainable winter road operation is a lack of a comprehensive text addressing recent advances and best practices in this field. The recently completed project, Recent Advances in Sustainable Winter Road Operations – A Book Proposal, sought to address this issue. The result of the project was a book aiming to bridge the knowledge gap and address the need for information in this subject. The research team gathered experts from a variety of areas and invited them to share their expertise in chapters dedicated to their fields. The chapters were diverse, ranging from topics such as life cycle assessment, historical approaches to winter maintenance, and economic benefits to environmental risks, development of “greener” materials, and societal considerations. The book will be in print soon and will fulfill its purpose of increasing knowledge for academics and professionals alike.

The project Prediction of Thermal Behavior of Pervious Concrete Pavements in Winter was completed during this period, and aimed to determine the thermal properties of PCP during winter and to develop a theoretical model to predict PCP surface temperature to facilitate winter maintenance policies. The project included a laboratory and a field component. In the laboratory, thermal conductivity (k) of PC in wet and dry conditions was determined by two methods: 1) the heat flow meter and 2) the sensor probe. A linear relationship was established between thermal conductivity and porosity for PC specimens. This model agreed well with the measured k of the dry PC samples, while the prediction for wet samples was not as good as dry samples, as water wets the air pockets and fills the various pores of the aggregate and paste in the PC. In the field, the pavement temperature in a PCP sidewalk installation at Washington State University was monitored via in-pavement instrumentation. Based on the field data, the Enhanced Integrated Climatic Model (EICM) was developed and validated for the site, using PCP thermal properties and local climatic data, including ambient temperature, wind speed, 2 radiation of the sky, relative humidity, and precipitation. Overall, the EICM-predicted number of days that the pavement surface fell below 32°F agreed well with the number based on field data for 85% of the days. Therefore, the developed model is useful in identifying when to apply deicer agents.

- Other Disciplines –
The Center completed an outreach video project that briefly introduces and explains various challenges and approaches to improving environmental sustainability in transportation infrastructure. The video consists of 16 short sections and used examples from several Center projects. It also included brief interviews with several PIs. CESTiCC and the UAF Film and Theatre Arts department produced the video with permission from various public and private organizations who granted permission for the use of photographic and video resources. The final product was distributed to center PIs, the advisory board, and to various other Center contacts in the field of STEM education. It has also been shared on the Center’s website and YouTube. The video can be viewed at [http://cem.uaf.edu/cesticc/publications.aspx](http://cem.uaf.edu/cesticc/publications.aspx)

- **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 7 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 33 ongoing research projects and CESTiCC PIs have completed 17 research projects, 6 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.

  In addition, CESTiCC researchers have been active in research disseminations, collaboration, and exchange through numerous professional outlets. For example, CESTiCC held the 2017 Summer Workshop on August 10, 2017 in Pullman, Washington. More than 30 researchers, professionals, and students attended the workshop. 12 lectern presentations and 7 student posters were presented at the workshop. All presentation materials were recorded and shared on the Center’s Workforce Development page. Through various outreach, technology transfer, and workforce development activities, CESTiCC has provided information and resources on environmental sustainability in transportation to professional societies, K-12 students, and the public community.

- **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 18 journal publications, 3 conference papers, 30 conference presentations, 10 invited talks/lectures/workshops/keynote presentations, 6 reports and hosted 4 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 4-5.

5. **Changes**

Center Director Jenny Liu has accepted a full time professorship at Missouri University of Science and Technology. She will continue to serve as PI for her active research projects. Billy Connor, P.E., current director of UTC Tier 1 Center, CSET, will serve as Director of CESTiCC for the duration of the grant.

Center Outreach Coordinator Joe Alloway has resigned from his position. A new outreach coordinator will be hired in the next reporting period.

Center Research Coordinator Sheng Zhao has resigned from his position to pursue new professional goals.

Center Research Associate Lin Li has resigned from his position to pursue new research activities.