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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Submission Date: April 30, 2019

DUNS Number: 615245164

EIN Number: 92-6000147

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

Reporting Period End Date: March 31, 2019

Report Term: Semi-annual PPPR #11

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 four 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. The research progress during this reporting period is summarized as follows.

  - There are currently 17 ongoing projects, and 34 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, 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?

- F. Tang, *Chloride-Induced Rebar Corrosion in Concrete: Mechanism, Prevention, Monitoring and Assessment*, CESTiCC webinar series, October 4, 2018.
- A. Mizumori and D. Wilson, *WSDOT’s Bridge Deck Construction and Bridge Rehabilitation Program*, CESTiCC webinar series, October 24, 2018.
- J. Han, General Guides to Publish Well-Written Technical Papers, CESTiCC webinar series, March 22, 2019.

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 world such as:

1. TRB 97th Annual Meeting, Washington D.C., January 13-17, 2019

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

Outreach

- *Pearl Creek Elementary STEM Night*, January 31, 2019
  
CESTiCC staffed a table on road construction and design for elementary school students at Pearl Creek Elementary School’s annual STEM night.
- *UAF Engineering Day*, February 23, 2019
  
CESTiCC presented a materials science activity at UAF CEM’s Engineering Open House on the UAF campus. Participants learned about the materials that go into roadways and deicing solutions. They also learned basic scientific measuring and mixing skills while making their own roadway material, playdough.
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: 16 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
• S. Aggarwal, A. Kadir & N. Belz. *Near-Roadway Air Pollution: Evaluation of Fine Particulate Matter (PM$_{2.5}$) and Ultrafine Particulate Matter (PM$_{0.1}$) in Interior Alaska*, CESTiCC Project Reports, January 2019.

• *Conference Papers*
  • None this reporting period

• *Presentations*

• *Other Products*
  • None

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

• *Lectures/Seminars/Workshops/Invited Talks*
  • None.
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:
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, *Evaluating Potential Effects of Deicing Salts on Roadside Carbon Sequestration*, completed during this period. This project sought to document patterns of road deicing salts and potential effects of these salts on the amount of carbon passively being sequestered along the Montana Department of Transportation's (MDT) roads; this project was designed collaboratively with a related roadside project that tested three different highway right-of-way (ROW) management techniques (mowing height, shrub planting, disturbance) to determine whether they have the capacity to increase soil organic carbon (SOC). Our sampling did not reveal elevated salt levels at any of the nine locations sampled at each of the three I-90 sites, with the greatest saline concentrations found at the sample locations furthest from the road. This pattern was consistent across all three sites. Soil organic matter (SOM) showed a broad range from ~1 to >10%. SOM values were generally lowest adjacent to the road and greatest furthest from the road. We found no or weak evidence of a relationship between our indices of soil salinity and SOM levels, with
EC, exchangeable calcium, and cation exchange capacity. Results imply that if road deicing salts are altering patterns of roadside SOM and potential carbon sequestration, this effect was not captured by our experimental design nor did it appear to have affected roadside vegetation during our most recent sampling effort.

The findings highlight the value of experimentally separating the multiple potentially confounding effects of winter maintenance operations on roadside soils: roads could focus the flow of water, salts, and sands to roadside soils. How these types of mass inputs to roadside soils might influence medium- or long-term carbon dynamics remains an open question, but a fuller characterization of these types of mass inputs and their potential flow paths will be essential to clarifying the potential roles of roadside soils in Terrestrial Soil Organic Carbon Sequestration strategies.

The project Environmentally Friendly Pervious Concrete for Treating Deicer Laden Stormwater (Phase II Final Report), completed this period. In Phase I of this project, graphene oxide (GO)-modified pervious concrete was developed using coal fly ash as the sole binder. The primary objectives of Phase II of this project were (1) to evaluate the stormwater infiltration capacity of GO-modified fly ash pervious concrete; (2) to evaluate the durability performance of GO-modified fly ash pervious concrete using freeze/thaw and salt resistance testing methods; and (3) to use advanced analytical tools to fully characterize the GO-modified fly ash binder. Test results indicate different degrees of reduction in concentrations of possible pollutants in stormwater—copper, zinc, sulphate, chloride, ammonia, nitrate, and total phosphate. The incorporation of GO significantly improved the resistance of pervious concrete to freeze/thaw cycles and ambient-temperature salt attack. The specimens were examined using X-ray diffraction, which revealed that the mineralogy and the chemical composition of fly ash pastes differ considerably from those of cement pastes. Nuclear magnetic resonance was used to study the chemical structure and ordering of different hydrates, and provided enhanced understanding of the freeze/thaw and salt scaling resistance of fly ash pervious concrete and the role of GO.

- **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 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 16 ongoing research projects and CESTiCC PIs have completed 35 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 3 journal publications, 7 conference presentations, and 5 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 3-4.

5. **Changes**

No changes during this reporting period.