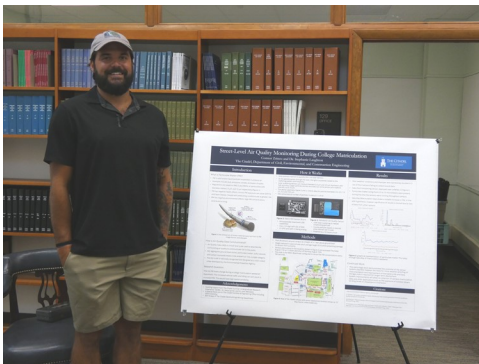


THE CITADEL- CIVIL, ENVIRONMENTAL, & CONSTRUCTION ENGINEERING NEWS



RESEARCH NEWSLETTER EDITION

Oct 2022– The Citadel is known for the cadet program which prepares principled leaders, many of whom go on to serve in the military. At the same time, faculty at The Citadel strive for academic success for our students in the classroom. Often overlooked is the research activity undertaken at The Citadel. This research not only allows faculty to stay connected and current in their respective fields, but also provides opportunities for students to build a resume to apply to graduate school and enhance their learning experience by having more hands on interactions with the content. Further, research brings additional resources to the department through external grants from federal, state, and corporate agencies. This Issue provides highlights from Civil and Construction Engineering.

The photographs (left) were taken at the student research poster session for The Citadel Summer Undergraduate Research Experience (SURE) in August 2022. This program provides funding and research mentoring for students from across The Citadel. CECE students have participated every year since the program began in Summer 2017. This summer, four students from Civil and Construction Engineering were accepted to participate:

- Cadet John Baker ('23) worked with Dr. Nandan Shetty to determine infiltration rates in two **rain garden** locations on the Charleston peninsula. While the locations and surrounding conditions varied, infiltration characteristics were surprisingly similar per field quantification.
- Transfer student Greer Hensley ('23) worked with Dr. Mostafa Batouli to update the **quality management** paradigm. Construction engineering quality management practices are based on those used in manufacturing, however through a literature review and two case studies, Greer was able to identify the main cause of non-compliance issues in two different Construction Engineering case studies.
- Veteran student Connor Zrinzo ('23) worked with Dr. Stephanie Laughton to assemble and deploy low-cost **air quality** sensors around The Citadel to assess changes in particulate matter concentrations during a college matriculation weekend. While the weather disrupted many of the sensors during the monitoring period, the process of tool assembly and programming was a valuable addition to Connor's education.
- Cadet Mary Coastal Watkins ('24) worked with Dr. Simon Ghanat to create a database of South Carolina **earthquake magnitudes** in order to create an algorithm to predict future earthquakes. While South Carolina's earthquakes may not get as much attention as those in California, the potential for infrastructure damage may be greater.

Newsletter Dedicated in Memory of John Morse ('89)

This edition of the CECE Department Newsletter is dedicated to Civil Engineering alumni John Morse, Class of 1989. Mr. Morse was the Vice President and owner of ATCS, a multidisciplinary engineering consulting service based in Virginia. He was an enthusiastic partner for our Construction Engineering faculty when conducting industry research. Mr. Morse passed suddenly in June 2022. He is survived by his wife and children, as well as his father and sister. His son is currently a sophomore at The Citadel.



INSIDE THIS ISSUE

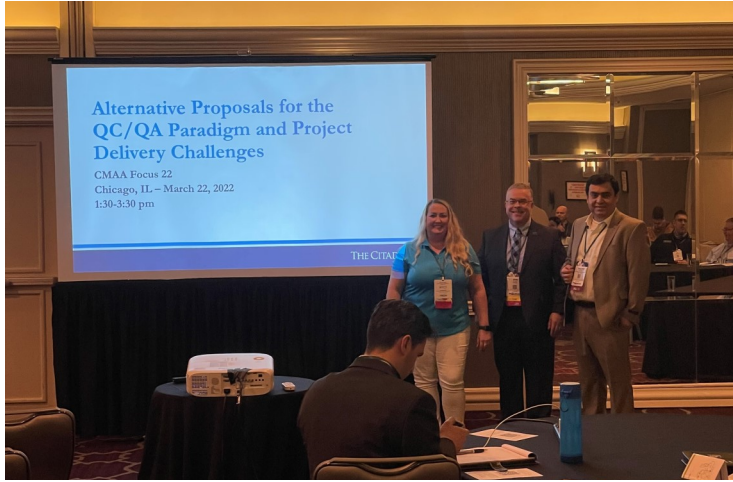
- 2 CONSTRUCTION ENGINEERING RESEARCH; DEPARTMENT HEAD MESSAGE
- 3 CAR CRASH RESEARCH; URBAN HEAT ISLAND RESEARCH
- 4 FACULTY NEWS; ENGINEERING EDUCATION RESEARCH



CONSTRUCTION ENGINEERING RESEARCH: CAN WE PREVENT PROJECT FAILURE FROM QUALITY ISSUES?

Sometimes research is motivated by collaborations among department alumni. **Dr. Burke and Dr. Batouli** hosted a workshop at the **Construction Management Association of America's** "CMAA Focus 22" Conference with **John Morse ('89)**. This workshop, intended for current construction management professionals, addressed industry QC/QA paradigms and opened discussion of how higher education can better prepare students for this task.

QC/QA, or quality control/quality assurance, is a set of practices used to ensure that the product created for the client meets the intended specifications. However, recent history yields a number of failures of QC/QA during the construction process, some of which resulted in fatalities: MWA Silver Line, Salesforce Transit Center, FIU Pedestrian Bridge, and Edmonton Arch Bridge.



The workshop posited that workmanship quality, rather than material quality, is often the root of failures. Current quality management practices focus on prevention of failure via documentation of quality issues, inspection methods for possible problems and guidelines on how to address problems. These practices focus mostly on the material goods rather than on the human workmanship factors that have been found to contribute to the industry problems.

Participants were encouraged to continue conversations from the workshop both with other practitioners in the field as well as academia. The academic ties have already borne fruit through the summer research of transfer student Greer Hensley (see cover story).

DEPARTMENT HEAD'S MESSAGE: WILLIAM J. DAVIS, PH.D., P.E. (AL)

Greetings from LeTellier Hall! Our students, faculty, and staff are working enthusiastically to maximize their learning experiences and striving for engineering excellence in the 2022 Fall semester. Highlights include:

- **National Award:** The Citadel was one of eight-colleges/universities to receive the 2022 Engineering Education Award from National Council of Examiners for Engineers and Surveyors (NCEES) for capstone design-build project "Designing Advanced Air Mobility Infrastructure: Multidisciplinary Capstone Project," <https://ncees.org/education/engineering-award/>. A Citadel project profile was published on the NCEES website: <https://ncees.org/the-citadel-2022/>. The award includes a \$10,000 cash prize.
- **100 years on The Ashley:** The Citadel celebrated 100-years at our current campus location, which officially opened Sept. 20, 1922. Over 180-years and 4,000 civil/construction engineering graduates; it is impossible to retell any chapter of The Citadel's history without including the significant contributions of legendary Citadel engineers such as William States Lee, Louis LeTellier, Carrol LeTellier, Jack McCormac, Loring Himelright, Gene Figg, Jr, Gus Bell, and many, many others.
- **Scholarly Research:** This newsletter features ongoing research conducted by students and faculty, including external grants from NSF, USDOT, SCDOT, NOAA, SC Sea Grant, PCI and Fuller Pile. Funded research furthers The Citadel's academic reputation, offers unique learning experiences for students, prepares students for graduate school, and provides additional resources to advance high-impact student enrichment activities.
- **2023 ASCE Carolinas Conference:** Students and faculty will host the annual ASCE Carolinas Conference, Apr. 13-15, 2023 for over 200-civil engineering students from North and South Carolina; with 10-academic competitions: Concrete Canoe, Steel Bridge, Blue Sky Innovation, Surveying, Mead Paper, Quizbowl, Geotechnical, Transportation, Lightest Bridge, and Freshmore Challenge.



Our student-centered teaching and learning community includes 238 civil and construction engineering students, 16-faculty/staff and eight student employees. Through teamwork, synergy and collaboration, we strive to honor the legacy of our collegiate forefathers and build upon the rich traditions of our storied engineering program at The Citadel. We are dedicated to our central mission of developing and graduating principled engineering leaders. Please visit us on campus, or reach out, if you would like more information about our students or academic programs. Contact: <jeff.davis@citadel.edu>



TRANSPORTATION RESEARCH: WHAT INFLUENCES FATAL CAR CRASHES IN SC?

Crashes are one of the leading causes of death and injury in many countries globally. According to the Fatality Analysis Reporting System database, there were approximately 33,650 fatal motor vehicle crashes in the United States in 2018. Contributing crash factors can be categorized into three main groups: human factors, vehicle factors, and environmental factors. Essential aspects of the environmental factors include the roadway design and crash site characteristics. Crash site characteristic analysis is essential for understanding crash causes and devising effective countermeasures.

Dr. Brown, Dr. Davis, and Dr. Michalak have been working in conjunction with Clemson University and SC DOT to develop a thorough site characterization of fatal crashes in SC. Their report for the **National Academies of Science: Transportation Research Board** focuses on determining which site characteristics have increased odds of involvement in fatal crashes.

The results of the analysis indicate that fixed objects, two-lane, rural, dark conditions, undivided roadways, non-junctions, and curve sections all indicate increased odds of fatalities in South Carolina. When compared against seven adjacent southeastern states and the U.S. as a whole, South Carolina has higher odds of fatal crashes. Better planning for safer roadway design, including clear zone reclamation, driver cognizance of design factors (e.g. curves), and enhanced intersection designs, is suggested to mitigate these severe crashes.

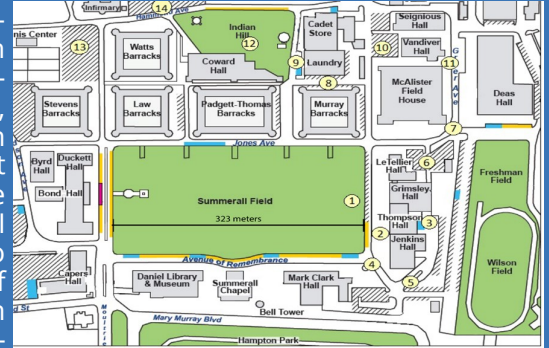
You can read the **full report** in the proceedings of the 101st Annual Transportation Research Board under the title "TRBAM-22-04907 - Site Characterization for Fatal Crashes in South Carolina."

CLIMATE RESEARCH: IS CAMPUS HOTTER?

On 31 July 2021, **Cadet Emma Larsen ('22)** and her mentors, **Dr. Simon Ghanat** and **Dr. Scott Curtis** collected temperature and humidity data as a part of the national **NOAA Heatwatch program**. This inspired continued research by Emma into urban heat island effects around The Citadel.

The urban heat island (UHI) effect is the occurrence of an overall higher temperature being documented in urban areas compared to their rural counterparts within the surface and canopy layers. Much of this temperature difference is a result of infrastructure factors such as materials including asphalt and concrete absorbing and re-emitting the sun's rays, urban geometry trapping the energy within the confines of the urban boundary, and roadways causing an abundance of heat waste.

While preparing to participate in HeatWatch through The Citadel Summer Undergraduate Research Experience, Emma became interested in how the intra-urban heat effect has manifested on her college campus. Although the UHI effect predominately refers to the ambient temperature of the entire city, a phenomenon associated with it is the intra-urban heat island effect that describes how smaller areas of a city or landscape become warmer due to the specific structure layout, sunlight exposure, and material. To quantify the difference, Emma conducted a smaller-scale heat mapping survey of her own on July 25, 2021, from 2:00-3:40pm EST. Using a handheld sensor that records wind speed, temperature, humidity, and heat index, she walked to different locations around campus (indicated on the map) and recorded the data for that point. She started in a central location to create a reference point and while analyzing the data, she based her values on whether the temperature was higher or lower from the reference point. In additional notes, she recorded the time, GPS coordinates, type of surface material, and how the surrounding landscape was structured.



Emma found the UHI effect is complex as temperatures around campus depend on the land cover type, with asphalt being related to higher temperatures compared to grass, but she also learned that the nearby Ashley River has a moderating impact on temperatures.

This work has been **published** in *Advances in Environmental and Engineering Research* under the title "Experience with Active Learning: The Charleston, SC, USA Urban Heat Island Effect".

CECE FACULTY FIRST AT CITADEL TO RECEIVE NSF MCA AWARD



Dr. Mary Katherine Watson was awarded a Mid-Career Advancement (MCA) Award from the National Science Foundation (NSF) in July 2022. This award is given to faculty at the associate professor rank in order to continue their research career growth through synergistic partnerships. For faculty at teaching-centered institutions, like The Citadel, this award allows them to continue productive research efforts that enhance student opportunities. Dr. Watson's project is titled "Exploring Algal Carbon Capture Potential in High pH Laboratory and Field-Scale Systems."

FACULTY & STAFF NEWS

Welcome New Adjunct Faculty

This fall, Nicholas Lacour, P.E. joined the department as an adjunct faculty. Mr. Lacour graduated from The Citadel in 2010 with a BS in Civil Engineering. He continued on to complete a MS in 2012 at Virginia Tech in Civil Engineering. In addition to his work as an adjunct faculty, Mr. Lacour works as a Geotechnical Consultant for Insight Group, LLC in North Charleston.



Welcome Back Sabbatical Faculty

During Academic Year 2021-2022, Dr. Mary Katherine Watson and Dr. Ron Welch were both out of the department on their one year sabbaticals. Both have returned to regular duty for Fall 2022. We are happy to see both on campus again.



Faculty Awards and Recognitions

Dr. Tim Mays was promoted to Colonel in the Unorganized Militia of South Carolina. This rank is given in recognition of his 20 years of service at The Citadel. We were lucky to be able to have Dr. Mays' father (USA Ret.) on hand for our informal promotion ceremony.



Giving To the CEE Department

Sustaining the levels of student success highlighted in this newsletter is greatly aided by support from our benefactors. You can contribute by making a donation **designated for Civil & Environmental Engineering** through The Citadel Foundation at <http://foundation.citadel.edu/> or call CEE at 843-953-5083.

ENGINEERING EDUCATION RESEARCH: COVID COGNITIVE OVER-LOAD?

Standard educational methods were disrupted in Spring 2020. **Dr. Mary Katherine Watson, assisted by Cadets Benjamin Kicklighter ('22) and Aidan Puzio ('22)**, sprang into action to see how new demands on students' cognition may affect their ability to learn and retain information. Through a series of surveys and focus groups, the team was able to begin to understand potential long-term educational effects of the COVID-19 pandemic.

Prior to the pandemic, all Citadel undergraduate engineering courses were administered in a face-to-face format. At the midterm of the Spring 2020 semester, all courses were converted to an emergency online format. The hypothesis was that shifting course modality could cause cognitive load changes among engineering students which could impact learning and development. Cognitive load refers to the burden placed on one's working memory when engaging in a task. In the context of undergraduate education, cognitive load is an important consideration because overload can disrupt the transfer of knowledge to long-term memory (i.e., learning). This work was supported by a **National Science Foundation (NSF) RAPID** grant, which allow for an expedited review process to fund high urgency projects. Also, DfX Consulting, LLC collaborated to conduct focus groups with Citadel students to learn more about their learning experiences during the pandemic.

Cognitive load, measured as perceived workload using the NASA Task Load Index (TLX), increased significantly during emergency online instruction during the Spring 2020 semester. In fact, we observed increases in numerous workload sources beyond what was previously found in the literature for undergraduate engineering students, including: mental demand, effort, temporal demand, and frustration. Further, cognitive load experiences may have been unique among demographic subgroups, especially middle-years students.

Table 11. Summary of changes in perceived workload and sources of demand experienced within academic classes as a result of the shift from face-to-face to emergency online instruction.

	Freshmen	Sophomores	Juniors	Seniors
Mental	*		***	
Physical				
Temporal		***	**	
Effort		*	*	*
Frustration	***	***	***	***
Performance				
Raw TLX	***	***	***	*

Green = small effect size; Yellow = medium effect size; Orange = large effect size

This work has been **published** in proceedings of the Research in Engineering Education Symposium 2021 and the American Society of Engineering Education National Conference 2021. The findings are an ongoing point of discussion among faculty in the department when planning changes to course curriculum and teaching modality.

Get Involved with the CEE Department

CEE faculty strive to provide quality lectures and assignments to support student learning, but many of the most impactful experiences occur due to the generosity of our alumni community. They help us provide student experiences such as guest speaker visits, field trips, and internships. If you are interested in volunteering your time, please reach out to Dr. Davis <jeff.davis@citadel.edu>.