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Signature of submitting official: Genna O'Berin

I. ACCOMPLISHMENTS

a. What are the major goals and objectives of the program?

Research

The overarching research objective of TIDC is to improve the durability and extend the life of transportation infrastructure, including roads, bridges, and rail facilities. This objective will be achieved through (1) fundamental and applied research that will broaden our overall knowledge base while providing practical solutions to the state and federal agencies responsible for constructing and maintaining the nation's transportation facilities; (2) educational offerings in various fields of transportation that include comprehensive course work and student participation in research; (3) workforce development activities and programs to expand the workforce of transportation professionals; and (4) a perpetual program of technology transfer to ensure TIDC research results are disseminated and applied as widely as feasible.

Specific research projects are selected through a combination of peer-review and state DOT/industry input and are expected to fall within TIDC's four research thrust areas identified in the table below.

Table 1: TIDC Research Thrusts Areas

Thrust Area Title	Description
Thrust Area 1: Transportation Infrastructure Monitoring and Assessment for Life	Managing aging civil infrastructure is a major challenge facing every country in the world. Research conducted under this theme tackles this issue through the development and implementation of novel strategies for the assessment and health monitoring of highway bridges, rail structures, pavements, slopes, embankments, and foundations. The ability to monitor the performance and health of these vital elements will provide the information required to prioritize the repair and replacement of our transportation infrastructure, while advanced assessment will justify extending the service life of these assets.
Thrust Area 2: New Materials for Longevity and Constructability	This thrust investigates new materials and technologies to improve durability and extend the life of transportation infrastructure. The materials and technologies investigated can apply to a range of transportation modes (vehicular, rail, etc.).
Thrust Area 3: New Systems for Longevity and Constructability	This research thrust focuses on evaluation, development, performance, reliability, and application of engineering systems to improve the durability and longevity of new and existing transportation infrastructure. New England's transit networks face challenges related to cold weather, changing climate, age-related deterioration, evolving load demands, construction efficiencies, and congestion, among others. In these times of economic austerity, innovative engineering systems are needed to alleviate existing and future financial strain on the region.
Thrust Area 4: Connectivity for Enhanced Asset and Performance Management	The system operational efficiency of transportation infrastructure can be improved by smart technologies that connect the infrastructure to information/management systems, vehicles, and roadway users. These emerging, connected technologies – coupled with appropriate and evolving management systems – can improve the durability of existing and new infrastructure. This is essential in the coming age of highly automated, connected vehicles and given the need to improve the performance of the existing infrastructure through more cost-effective and targeted assessments of asset vulnerabilities due to extreme weather events. This research theme applies to all forms of infrastructure including highway, railroad, marine ports, and airports.

TIDC will provide base funding to each member university contingent upon performance. The project proposals are reviewed and scored by the TIDC Advisory Board and other technical professionals. Upon completion of the review, the Advisory Board meets and provides their recommendation(s) for the selection of the proposal(s). The TIDC administrative team (Center Director, Senior Program Manager, Grant and Fiscal Manage, Education &

Outreach Manager, and Advisory Board Chair) then reviews the recommendation(s) and makes the final selection of the successful proposal(s).

Funding is contingent upon performance, and all funded activities must meet metrics defined in technology transfer, education and workforce development, and collaboration. Each member university will provide performance metrics information to UMaine through quarterly progress reports for each research project to ensure performance is adequately tracked. In order to ensure successful implementation of research findings, each project's funding is also contingent on the commitment of a Technical Champion in implementing the potential findings of the work. See the Collaboration section on page 4 for more details about the role of the Technical Champion. Funding for research projects is also contingent upon collaboration with transportation organizations, including the region's DOTs and transportation companies.

Formal metrics to measure program effectiveness includes the number of new research initiatives/projects funded, number of continued research projects funded at member universities, number of research projects completed during the reporting period, number of active industrial and DOT partners involved in TIDC projects, dollar amount invested in TIDC research, and number of times findings have been implemented. Formal metrics under the research section overlap with metrics in other subsections.

Education & Workforce Development

TIDC seeks to attract a more diverse pool of talented students into careers in science and engineering and ensure that these students receive the best education possible. Beyond providing students with a detailed knowledge of existing public transportation infrastructure and system challenges in the realm of durability and life extension, TIDC activities will (1) enhance student communication skills to ensure they can reach a variety of audiences including researchers, the public, and decision-makers; (2) create an inclusive multi-cultural and multi-disciplinary student body by recruiting underrepresented populations into our program; and (3) foster the development of leadership skills through vertically integrated research teams (faculty, post-docs when applicable, graduate students, and undergraduate students) and peer mentoring. Undergraduate and graduate students will be directly supported by TIDC research projects and make meaningful contributions under the mentoring and guidance of faculty that is essential to student success.

TIDC will strengthen diversity and STEAM education by sharing research with future members of the workforce in K-12 education settings. This will include both exposing young people to opportunities that exist within the field of transportation infrastructure and engaging them in transportation-related educational activities. TIDC will partner with industry members and non-profit education organizations like 4-H Cooperative Extensions and Jobs for Maine Grads (JMG), after-school programs, homeschooling cooperatives, and local libraries throughout New England to bridge transportation related activities into schools. TIDC will also create an online resource guide, portfolio, and transportation-related curriculum and activities for educators to utilize in their classrooms. TIDC will work with the College of Education and Engineering Colleges at the partner universities to create opportunities for professional development (continuing education requirements) for educators to create a better understanding of how to incorporate engineering activities into already existing curriculum at school districts.

TIDC will implement a series of webinars, workshops, conference sessions, and symposiums to provide opportunities for current transportation professionals to receive training on new technologies and outputs from TIDC funded research projects to help current professionals implement the findings into practice. Certificates of attendance will be offered to all attendees to be used toward professional development hours for all training opportunities.

Formal metrics to measure program effectiveness includes the number of undergraduate and graduate students participating in industrial internships; number of presentations and poster sessions led by students; number of papers published by students; number of seminars, workshops, and conferences hosted by TIDC researchers; number of presentations led by TIDC supported students; number of PDH certificate hours issues; number of K-12 students who participate in transportation-focused tours or activities at member institutions; and total number of K-12

classrooms reached by TIDC personnel, students, and/or researchers, including specifics on classrooms populated by under-represented groups of students.

Technology Transfer

As identified in the TIDC Technology Transfer Plan, the Center's mission is to develop innovative, sustainable, next-generation solutions to improve the durability and extend the lifespan of existing and new transportation assets in New England and beyond. TIDC is committed to making dramatic impacts in the cost-effectiveness of transportation infrastructure through transformative research, education, outreach, workforce development, and technology transfer through the four research thrust areas identified in Table 1.
TIDC's technology transfer objectives are:

- Ensure research developments and findings are accessible, disseminated, and transferred to a variety of users.
- Ensure research developments and findings are outputted consistently and in a scheduled manner to effectively reach a steady audience.
- Ensure research developments have long-term value and significant impact to the transportation industry through collaboration with government and industry organizations.

The technology transfer objectives of TIDC support the TIDC mission through their emphasis on research impact and dissemination. The TIDC goals and performance metrics reflect the full spectrum of research activities through technology concept inception and assessment to technology adoption. See Table 2: Technology Transfer Goals & Performance Measurers for the goals and performance metrics that TIDC-funded research projects are striving to meet during the course of their work.

Table 2: Technology Transfer Goals & Performance Measures

Goal	Performance Metrics	Annual Target
Output: Develop new technologies, techniques, or methodologies	Number of successfully demonstrated proof-of-concept activities for newly developed technologies, techniques, or methodologies	2
Output: Publish journal, conference, and/or policy papers that become references for practitioners for the modification of codes and standards for technology adoption	Number of technical reports, theses, dissertations, DOT reports, and other report types submitted and/or published	5
	Number of papers published in peer-reviewed journals	4
	Number of papers, abstracts, or posters published and/or presented in conferences, symposia, workshops, and/or meetings	12
Output: Post updates for technology transfer activities to TIDC virtual platforms	Number of posts to all TIDC platforms	350
Outcome: Deploy new technologies, techniques, or practices	Number of technologies deployed in transportation applications through pilot or demonstration studies	2
Outcome: Improve the processes, technologies, and techniques in addressing transportation issues	Number of licenses granted to industry or patent applications submitted	1
Impact: Workforce development	Number of webinars given to disseminate findings to industry professionals	6
	Number of seminar, workshop, and/or conference sessions delivered by researchers to present findings of research activities to industry professionals	45
Impact: Adoption of technologies, techniques, or practices	Number of instances of technology adoption by industry or transportation agencies and of commercialization	1

	Number of instances that TIDC supported findings were referenced, cited, or mentioned in journal articles, presentations given by others not active in the research project, newspaper or magazine articles, etc.	5
Impact: Development or modification of codes and standards to facilitate wider technology adoption	Number of instances of research changing industry or transportation agency practices, decision making, or policies	1

*To see how TIDC performed against these targets during this reporting period, see section I.b. – Technology Transfer.

A crucial outlet by which TIDC research is disseminated is through the use of social media platforms, YouTube, and the TIDC website. This serves to accomplish TIDC's technology transfer objectives by reporting TIDC technological findings and advances primarily to those who would not normally have exposure to TIDC operations. Our primary goal is to reach and inform as many people as possible from various demographics.

Collaboration

Institutional leads serve on the TIDC Management Team which ensures each institution has ownership in and is committed to the success of the program. Additionally, in an effort to ensure all TIDC research projects are relevant to Department of Transportation and/or Industry needs, each TIDC research project is required to have a Technical Champion. The Technical Champion has subject matter expertise and is actively involved in research activities, from the creation of the project proposal to assisting with the implementation of successful research findings as a result of the work. The Technical Champion acts as a resource, connecting the researchers to the industry and meeting with the researchers to continue to help the teams keep their research relevant. Technical Champions on each project provide in-kind support and are not monetarily compensated for the time they spend working with the principal investigators and research team. As more projects are added and advanced, the number of Technical Champions and their contributions will change. See Table 5 on page 11 for a complete list of Technical Champions.

To ensure the successful selection and implementation of relevant research projects, TIDC has assembled an Advisory Board. The role of the Advisory Board is to ensure TIDC continues to meet the needs and challenges of Region 1, as described within its designated Fast Act topic, in collaboration with New England Transportation Agencies. The Advisory Board evaluates and recommends the Selection of competitively funded research projects through an open RFP process that encourages collaboration and implementation of next-generation solutions. The Advisory Board also reviews TIDC's annual performance metrics from each member university to assess the status of base funded projects. Additionally, the goal is to have all Advisory Board Members work toward facilitating the engagement of researchers and students with Design and Maintenance Department members to encourage real-world solutions. The Advisory Board is currently comprised of members from each state DOT/AOT in Region 1. The Advisory Board meets two to three times annually to ensure effective partnership in achieving TIDC's research objectives and goals and add value to New England's Transportation Infrastructure.

Formal metrics to measure collaboration goals include presentations given at non-member universities, documented conversations regarding collaboration between TIDC and other UTCs, documented conversations/meetings between researchers, DOTs, industry partners, and technical champions, the number of industrial partners and state DOTs participating in TIDC research, dollar amount of state DOT and industry investments in TIDC research projects, number of technical champions actively involved in TIDC research projects, and number of outside attendees to the TIDC Annual Conference.

b. What was accomplished under these goals?

Research

In order to ensure TIDC is conducting relevant and transferable research projects, individual projects are required to submit periodic reports to ensure the approved goals and objectives of each research project are being met and are working toward TIDC's mission and research goals. During this reporting period, TIDC had 44 projects that were

active, 1 project that concluded, 3 projects that initiated during the reporting period, and 3 projects that were terminated. See Table 3 for a list of the 44 TIDC funded research projects that were active and/or selected/extended during the reporting period. (* indicates a newly selected/awarded project during the reporting period.)

Table 3: TIDC Projects Active During the Reporting Period

Project Number & Title Institution	Institution(s)	Start Date
Thrust Area 1: Transportation Infrastructure Monitoring and Assessment of Enhanced Life		
1.4 – Electromagnetic Detection and Identification of Concrete Cracking in Highway Bridges	University of Massachusetts Lowell	1/1/2019
1.5 – Distributed Fiber Optic Sensing System for Bridge Monitoring	University of Massachusetts Lowell	1/1/2019
1.12 – Improved UAV-Based Structural Inspection Techniques & Technologies for Northeast Bridges	University of Maine	10/1/2020
1.13 – Structural Integrity, Safety, and Durability of Critical Members and Connections of Old Railroad bridges Under Dynamic Service Loads and Conditions.	University of Connecticut	10/1/2021
1.14 – Exploring the Safety Impact of Rumble Strips on Prevention of Lane Departure Crashes in Maine	University of Maine	10/1/2021
1.15 – Non-Contact Intelligent Inspection of Infrastructure	University of Connecticut	10/1/2021
1.16 – Wireless Joint Monitoring (j-JMS) for Safety of Highway Bridges	University of Connecticut	10/1/2021
1.17 – Determining Layer Thickness and Understanding Moisture Related Damage of State-Owned Roads Using GPR and Capturing Such in a GIS-Based Inventory	University of Rhode Island	9/1/2021
1.18 - Vision-Based Detection of Bridge Damage Captured by Unmanned Aerial Vehicles	University of Rhode Island	11/9/2022
1.19 - Assessing Presence and Impact of REOB (Recycled Engine Oil Bottoms) on Asphalt*	University of Rhode Island	08/01/2023
C3.2018 – Condition Assessment of Corroded Prestressed Concrete Bridge Girders	University of Massachusetts Lowell & Western New England University	1/1/2019
C11.2019 – Development of System-Level Distributed Sensing Technique for Long-Term Monitoring of Concrete and Composite Bridges	University of Massachusetts Lowell, University of Vermont, University of Maine	1/1/2020
C19.2020 – Damage Modeling, Monitoring, and Assessment of Bridge Scour and Water Borne Debris Effect for Enhanced Structural Life	University of Connecticut	10/1/2020
C20.2020 – Advanced Sensing Technologies for Practical UAV-Based Condition Assessment	University of Maine	10/1/2020
Thrust Area 2: New Materials for Longevity and Constructability		
2.2 – Concrete Systems for a 100-Year Design Life	University of Maine	3/1/2020
2.7 – High Performance Concrete with Post-Tensioning Shrinking Fibers	University of Vermont	1/1/2019
2.9 – Carbonating Subgrade Materials for In Situ Soil Stabilization	University of Maine	9/1/2018
2.10 – Durability Evaluation of Carbon Fiber Composite Strands in Highway Bridges	University of Maine	6/1/2019
2.11 – Culvert Rehabilitation Using 3D Printed Diffusers	University of Maine	7/1/2020
2.12 – Evaluation of Processed Glass Aggregate for Utilization in Transportation Projects as a Sand Borrow	University of Vermont	10/1/2020
2.13 – Performance Structural Concrete Optimized for Cost, Durability, and Manufacturability	University of Vermont	10/1/2020

2.14 – Implementation of UHPC Technology into the New England Construction Industry	University of Connecticut	10/1/2021
2.15 – Incorporation of Pollinator Planning to Enhance Ecosystem Functions and Durability of Transportation Right-of-Way Infrastructure	University of Rhode Island	10/1/2021
2.16 – Enhancing the Durability of Bridge Decks by Incorporating Microencapsulated Phase Change Materials (PCMs) in Concrete	University of Rhode Island	1/1/2022
2.17 – Design and Development of High-Performance Composites for Improved Durability of Bridges in Rhode Island	University of Rhode Island	1/1/2022
2.18 – Recycling Large-Scale 3D-Printed Polymer Composite Precast Concrete Forms	University of Maine	1/1/2022
2.21 - Mineralogical Characterization of Pavement Aggregates in Maine	University of Maine	11/14/2022
2.22 - Large-scale 3D printed wedge-insert for creating camber in standardized molds for the GBeam Composite Bridge*	University of Maine	04/01/2023
Thrust Area 3: New Systems for Longevity and Constructability		
3.5 – Prevention of Stressed-Induced Failures of Prestressed Concrete Crossties of the Railroad Track Structure	Western New England University	9/1/2018
3.7 – Development of General Guidelines on the Effects of Bridge Span Range and Skew Angle Range on Integral Abutment Bridges (IAB's)	University of Massachusetts Lowell	7/1/2018
3.11 – Development of a Simplified Methodology to Evaluate the Factor of Safety and Link the Magnitude of Lateral Spreading for CSEs Supported on Rigid Inclusions	University of Maine	9/1/2019
3.12 – Flexural Strength and Durability of Micropile Threaded Connections	University of Maine	6/1/2019
3.13 – Investigating the Effectiveness of Enzymatic Stabilizers for Reclaimed Stabilized Base Products	University of Vermont	10/1/2020
3.15 – Nonstructural Approaches to Reduce Sediment and Pollutant Runoff from Transportation Infrastructure in Urbanized Areas	University of Rhode Island	9/1/2021
3.16 – CT Bridge Girder Sections with Precast Decks and FRP girder-deck Shear Connectors	University of Maine	1/1/2022
3.17 - Assessment of CT Girder Load Distribution and Web Buckling Through Field Load Testing and Finite-Element Analysis	University of Maine	6/1/2022
3.18 - Steel-free Concrete Bridge Decks	University of Maine	6/1/2022
3.19 - Detection and Monitoring of Material Aging and Structural Deterioration using Electromagnetic and Mechanical Sensors with Virtual Reality and Machine Learning Modeling	University of Massachusetts Lowell	6/1/2022
3.22 – Automated Manufacturing of GBeam Composite Bridge Girders*	University of Maine	04/01/2023
C17.2020 – Durability of Modified Helical Piles under Lateral and Torsional Loads: Embracing Efficient Foundation Alternative to Support Lightweight Transportation Structures	University of Maine & University of Rhode Island	10/1/2020
Thrust Area 4: Connectivity for Enhanced Asset and Performance Management		
4.1 – Highly Automated Vehicles and Bridge Infrastructure	University of Maine	9/1/2018
4.12 – Proactive and Intelligent Risk Management in Complex Civil Infrastructure Project Systems	University of Connecticut	10/1/2021
4.13 - Development and Application of Cost-Benefit Tool for Quantifying External Social Impacts of Small to Mid-Size Transportation Projects	University of Vermont	06/01/2022
4.15 - Travel Demand Survey to Inform Infrastructure Investments	University of Maine	3/1/2023

Project 4.11 completed work and submitted a final report during the reporting period. Project 4.12 was terminated due to the PI, Dr. Jin Zhu, leaving UConn to return to China. Projects 2.22 and 3.22 were terminated due to the reorganization of a key industry partner which prevented continuation of work.

The following are a few examples of the accomplishments achieved under individual research projects:

- The UML Project 1.5 team conducted a field test at the Grist Mill Bridge in Hampden, Maine to ensure the sensor's four year functionality and collected one baseline and five dynamic datasets.
- The UConn Project C21.2022 team finished their accelerated corrosion testing in the lab with four chloride concentrations (1%, 2%, 3&, and 5% NaCl) up to 400 cycles. The testing on a wider range of samples with a wider range of chloride concentrations will provide data points for building prediction models. The team also collected a multitude field samples from bridges that represent a range of corrosion progression for comparison.
- The UMaine Project 2.2 team conducted tests on concrete sample casting with lightweight aggregate for curing purposes. The team optimized the MDOT-referred concrete mix design to have lower shrinkage, higher mechanical performance, and lower permeability. They found the shrinkage of concrete can be further mitigated with the addition of >10% lightweight fine aggregate.
- The URI Project 1.18 team has set up and tested a UAV for vision-based GPS-denied flight and have implemented a front-end back-end database system to allow cooperative remote creation of training and testing databases.
- The UVM Project 2.7 team fabricated a new set of chitosan fibers for testing, fabricated and prepared a small set of cement beams for testing, and collected and began processing data from previous tests on fiber laden beams with CAT scans, high resolution images, and Rapid Chloride Tests.

More TIDC research accomplishments can be found in sections III and IV of this report and on the TIDC website on each research project's individual page.

Education & Workforce Development

TIDC has continued their work to increase their outreach effort to the K-12 audience in order to encourage students to consider transportation as a profession. As part of this effort, researchers and the TIDC Education and Outreach Manager in collaboration with undergraduate students and TIDC staff and Researchers attended numerous events throughout the reporting period. The University of Maine team conducted numerous K-12 activities, reaching over 1,000 students, teachers, and parents. Some examples of these activities include:

- The Casco Bay / Portland Arts & Technology High School STEM Expo on April 6, 2023, where more than 150 students transitioned between multiple STEM related activity tables. The TIDC activity station had students building straw bridges and weight testing them. We saw a steady flow of diverse groups of elementary to high school students.
- On April 19, 2023, the TIDC outreach team partnered with the Maine Science Museum to provide a spring break activity. This activity was geared toward elementary aged students that were either present for the spring break camp hosted at the Museum, or members of the public that were visiting. The youth built straw bridges and weight tested them using toy cars and animals on them. This activity attracted more than 30 youth and parents.
- Owl's Head Transportation Museum hosted a STEMFest on April 29, 2023. The TIDC Education & Outreach Manager brought the straw bridge building activity to the event that attracted more than 50 youth in the surrounding area. The youth built bridges using compostable straws and tape. They were challenged to make the bridge span a length that was a little longer than a single straw and then weight test the bridge using washers in a dixie cup. One bridge was so well built that it easily held all of the washers and a couple of cell phones without collapsing.
- The 2023 Windstorm Challenge was held at the University of Maine on May 12, 2023. This event attracted over 800 middle and high school students from around Maine. TIDC had a bridge building

activity booth where students built bridges using popsicle sticks and hot glue. After they finished the bridges, they were weight tested on an Instron testing unit in the ASCC. While many student groups started bridges, we had 11 bridge they were fully completed and weight tested before the volunteer on the testing unit had to leave. We handed out awards for the top three bridges based on a weight to strength ratio.

- On June 14, 2023, 45 6th graders, with their teachers and chaperones, attended their annual bridge breaking contest. They begin the activity in their classrooms in Clinton and Albion elementary schools and then finish the unit out by bringing the bridges to the University of Maine to test them on the Instron testing unit at the ASCC. As part of the visit, students took a tour of the lab and saw examples of transportation related research, including the 3D-printed forms and culverts on display.
- In July, the TIDC Education & Outreach Manger worked with the Maine Summer Transportation Institute's Program Director, spending two weeks with the camp and 28 youth, to learn the ins and outs of running the camp in preparation for the program to transition to TIDC management. The Program Director retired on Sept 30th and TIDC will take over the running of the program for 2024. The youth participated in 12-14 activities, depending on the week and took field trips to the Maine Maritime Academy and the Bangor International Airport. The program is funded mostly by the MaineDOT through the FHWA.

The TIDC Annual Conference was held in August of this year. There were 25 presenters and 120 participants from around the country that came to the University of Maine to learn about transportation research innovation that has been implemented. Future collaborations on research were also an outcome of the Annual Conference.

Technology Transfer

TIDC research results have been disseminated through a variety of ways including the TIDC website and social media platforms. In December, TIDC launched a newly designed website aimed at engaging more users and providing a more streamlined method of technology transfer. The previous website is being maintained now solely to house the consistently growing catalog of our previous tech transfer events and provide information to the public on new tech transfer opportunities as they arise. TIDC continues to expand social media operations and have developed internal management systems to facilitate schedule consistency and higher volume of output. Since the last report, TIDC social platforms have continued to promote findings and opportunities for collaboration directly to the public and have promoted market-ready technology transfer opportunities. TIDC platforms have seen steady increase in a number of analytical categories with the goal of more consistently reaching a greater share of the general public. TIDC virtual platforms, links to which can be found in section II.e - Website(s) or other Internet site(s), have accumulated the following total results over the last semi-annual period:

- TIDC Website – 6,157 views, 3,674 sessions
- TIDC YouTube Channel – 4,253 views, 255.7 hours of watch time, 41 new subscribers
- TIDC LinkedIn – 27,560 impressions, 922 reactions, 138 new followers
- TIDC Facebook - 3,641 unique impressions, 297 reactions, 6 new followers
- TIDC Twitter - 3,525 impressions, 65 reactions, 1 new followers
- TIDC Instagram - 842 unique impressions, 127 reactions, 18 new followers

TIDC researchers gave 41 presentations at 17 conferences, workshops, and/or seminars during the reporting period. The following table indicates the conferences and workshops attended by TIDC researchers and the activity they conducted to disseminate information during this reporting period.

Table 4: Conferences, Workshops, and Seminars

Name of Conference/Workshop	Activity	Location	Dates
11th International Conference on FRP Composites in Civil Engineering	Conference Presentation	Rio de Janeiro, Brazil	July 2023
13th Advances in Cement-Based Materials	Conference Presentation	Columbia University	06.14-16.2023

14th International Workshop on Structural Health Monitoring	Conference Presentation	Stanford University	09.14.2023
15th International Workshop on Micropiles	Workshop Presentation	Vail, Colorado	June 2023
16th International Congress on the Chemistry of Cement 2023	Poster Presentations	Bangkok, Thailand	09.18-22.2023
2023 Joint Rail Conference	Conference Presentation	Baltimore, Maryland	04.11-13.2023
2023 MassDot Transportation Innovation Conference	Conference Presentation	Worcester, Mass.	05.02.2023
2023 Student Research Symposium	Poster Presentations	Orono, Maine	04.14.2023
2023 TIDC Conference	Conference and Poster Presentations	Orono, Maine	08.08-10.2023
ASC 38th Annual Technical Conference	Conference Presentation	Woburn, Mass.	09.19.2023
ASCE Engineering Mechanics Institute (EMI) 2023 Annual Conference	Conference and Poster Presentations	Atlanta, GA	06.06-09.2023
EVACES 2023	Conference Presentation	Italy	08.29.2023
ICTD ASCE 2023		Austin, Texas	June 2023
Industry and Deep Foundations Institute Partners Workshop	Research Presentation	Virtual	07.29.2023
New England Polytec Technology Seminar	Seminar Presentation	Cambridge, Mass.	05.10.2023
SPIE Smart Structures and Nondestructive Evaluation 2023	Conference Presentations	California	04.18-19.2023
Third International Interactive Symposium on Ultra-High-Performance Concrete (UHPC)	Conference Presentation	Wilmington, Del.	06.04-07.2023

Additionally, TIDC has published or submitted 11 journal papers/articles, 17 conference papers, and 3 other publications and presentations during the reporting period. For a complete list of the submitted papers, please see Section III, Outputs.

Collaboration

Critical to TIDC's success is the development of partnerships and collaborations with state DOTs, transportation industry executives, transportation professionals, and various stakeholders that assist in addressing the center goals. TIDC researchers regularly hold meetings with their partners across these fields to provide project updates and receive feedback. On June 30, 2023, the research team of Project 1.13 (UConn) held their quarterly meeting with the project's technical champion and advisors, including representatives from ConnDOT, Metro-North Railroad Co., Amtrak, Genesee & Wyoming Railroad Co., and Polytech Inc. The project 1.14 (UConn) team also met with their Maine DOT technical champion and discussed their results and study limitations. The team and their technical champion made the joint decision to focus on center rumble strips for rural two-lane roads and ignore edge rumble strips due to the lack of data.

TIDC researchers are actively working with industry partners during their research efforts to ensure their findings will be able to transition into practice more efficiently. For example, the research team for Project 2.12 (UVM) held a meeting on April 14, 2023 with personnel from the Vermont Department of Environmental Conservation and Chittenden Solid Waste Department to identify additional uses for processed glass aggregate (PGA), specifically as a sand mound material used in septic wastewater systems.

Also, during this reporting period, the TIDC Management Team met each month, with the exception of September (due to the time constraints at the start of the semester), for a total of five meetings. Four meetings were held via Zoom and one was held in person during the annual conference. The Advisory Board met once during the reporting period to

discuss research goals and future endeavors. Adding to our collaboration efforts and goals, TIDC Administration also met with 10 other UTCs via Zoom to discuss administrative best practices and attended the annual CUTC meeting in Miami.

All TIDC funded projects have met the goal of having a Technical Champion (as described in Section I a, Collaboration) assigned to each. Some research projects have additional Technical Champions and Advisors involved in their projects. Each PI is responsible for submitting their quarterly reports to their TC and working with them to ensure their research will have the greatest impact on the transportation industry. In addition to sending their reports to the TC, PIs from multiple projects are meeting with their TC to discuss and adapt their research. The following table identifies the 51 active Technical Champions and Advisors involved in TIDC research projects during this reporting period. (* Indicates newly added Technical Champions and Advisors during this reporting period.)

Table 5: Active Technical Champions & Advisors

Name and Title of Technical Champion or Advisor	Organization
August Arles, Geotechnical Engineer	Vermont Agency of Transportation
Warren Best, Assistant Deputy Director, Structures	Metro-North Railroad Company
Tanner Blackburn, Chief Geotechnical Engineer	Hayward Baker
Robert Blunt, Project Manager	VHB
Chad Boutet, P.E., Asst. Vice President	Genesse & Wyoming Co.
Andy Cardinali, Principal Engineer of Bridge Design	Connecticut Department of Transportation
David Cist, Chief Technology Officer	Geophysical Survey Systems, Inc. (GSSI)
Bao Chuong, Supervising Engineer of Bridge Design	Connecticut Department of Transportation
Taylor Clark, Assistant Engineer	Maine Department of Transportation
Rusty Croley, Senior Vice President of Operations and Engineering	Vossloh Tie Technologies
Jeff DeGraff, P.E., Hydraulics Project Engineer	Vermont Agency of Transportation
Paul DelSignore, Deputy Chief Engineer, Structures	Amtrak
Haresh Dholakia, Transportation Engineering Supervisor	Connecticut Department of Transportation
Anthony Diba, Engineer	AIT Bridges
Manesh Dodia, Transportation Engineer	Connecticut Department of Transportation
Todd Dragland, Vice President	Hayward Baker
Dennis Emidy, State Safety Engineer	Maine Department of Transportation
Jonathan Ehrlich, Developer	T2D2
Callie Ewald, P.E., Geotechnical Engineering Manager	Vermont Agency of Transportation
Benjamin Foster, P.E., Deputy Chief Engineer	Maine Department of Transportation
Greg Goyette, Principal Transportation Practice Leader *	Stantec Consulting
Peggy Hagerty Duffy	ADSC-IAFD; Hagerty Engineering
Peter Healey, Pavement Engineer	Rhode Island Department of Transportation
Badri Hiriyur, Developer	T2D2
Dr. Mark Jen, P.E., S.E., Technical Manager	Michael Baker Engineering, Inc.
Gregory Krikoris, Area Bridge Engineer	Massachusetts Department of Transportation
John Kocur, Director of Engineering	Sperry Rail Service
Laura Krusinski, Senior Geotechnical Engineer	Maine Department of Transportation
James Lacroix, P.E., State Bridge Design Engineer	Vermont Agency of Transportation
Alexander Mann, Hydrologist	Maine Department of Transportation
Tanya Miller, Research Engineer	Vermont Agency of Transportation
Andrew Mrockowski, Transportation Engineer	Connecticut Department of Transportation
Deirdre Nash, Assistant Research Engineer	New Hampshire Department of Transportation
Dr. Emily Parkany, P.E., Research Manager	Vermont Agency of Transportation
Dale Peabody, Director, Transportation Research	Maine Department of Transportation
Mario Pineda, Territory Manager	Polytec, Inc.

John Preiss, Bridge Engineer	Rhode Island Department of Transportation
Michael Redmond, Business Systems Manager, Concrete Quality Control Specialist, Bridge Program	Maine Department of Transportation
Gary Seider, Engineering Manager	Hubbell
Rita L. Seraderian, P.E., FPCI, LEED AP, Executive Director	Precast/Prestressed Concrete Institute Northeast
Robert Skehan, Director, Office of Safety	Maine Department of Transportation
Joseph Stilwell, Fabrication Engineer	Maine Department of Transportation
Craig Stratton, Director of Sensing Sales	Luna Incorporated
Ken Sweeney, President	AIT Bridges
Josh Tyler, Director of Operations	Chittenden Solid Waste District (CSWD)
Stephen Tartre, Director of Engineering *	Maine Turnpike Authority
Nicholas Van Den Berg, Materials & Certification Manager	Vermont Agency of Transportation
Susan Votta	Rhode Island Department of Transportation
James Wild, Concrete Materials Manager	Vermont Agency of Transportation
Christos Xenophontos, Assistant Director	Rhode Island Department of Transportation
Hailing Yu, Civil Engineer	U.S. DOT Volpe Center

The following table identifies the 47 active collaborators and stakeholders and their contributions during the reporting period. (* indicates new project collaborators during this period)

Table 6: Research Project Collaborators

Organization	Location	Contribution
AIT Bridges, a division of Advanced Infrastructure Technologies	Brewer, ME	In-kind, collaborative research, personnel, facilities
American Concrete	Auburn, ME	Financial support, facilities, collaborative research
Amtrak	Philadelphia, PA	In-kind, collaborative research, personnel
Carrol Concrete *	Berlin, VT	In-Kind
Chittenden Solid Waste District (CSWD)	Williston, VT	Financial support, facilities, personnel
City of Lowell	Lowell, MA	Collaborative research, facilities, personnel
Connecticut Department of Transportation	Newington, CT	Collaborative research, personnel, facilities, in-kind support
Deep Foundations Institute	Hawthorne, NJ	Financial
ENSOFT Inc.	Austin, TX	In-kind, Personnel
Genesee & Wyoming, Inc	Darien, CT	In-kind, collaborative research
Geophysical Survey Systems, Inc. (GSSI)	Lowell, MA	Collaborative research, personnel, in-kind, facilities
GMS	Pennsylvania	In-kind
Helix Mooring Systems, Inc.	Cumberland, ME	Financial, in-kind,
Hexagon PPM	Madison, AL	In-kind, personnel
Hubbell Power Systems, Inc.	Centralia, MO	Financial, in-kind, facilities, personnel
Jacobs Engineering	Herndon, VA	Personnel
J.P Carrera & Sons *	Middlebury, VT	In-kind
Luna Innovation	Roanoke, VA	In-kind, collaborative research, personnel
Maine Department of Transportation	Augusta, ME	In-kind, collaborative research, financial, personnel, equipment

Massachusetts Department of Transportation	Boston, MA	Collaborative research, personnel, facilities, in-kind
Metro-North Railroad Company	Bridgeport, CT	Collaborative research, facilities, personnel, in-kind
New Hampshire Department of Transportation	Concord, NH	Personnel
Norchem *	Ft. Pierce, FL	In-kind
Nucor	Pennsylvania	In-kind
Oak Ridge National Laboratory	Oak Ridge, TN	Financial, collaborative research
OCI	Pennsylvania	In-kind
Polytec, Inc.	Hudson, MA	In-kind, collaborative research, personnel, equipment, facilities
Rhode Island Department of Transportation	Providence, RI	In-kind, facilities, personnel
Saint-Gobain	Northborough, MA	In-kind, collaborative research, personnel, facilities
Santec, Consulting Services, Inc.	South Burlington, VT	In-kind, personnel
SD Ireland Concrete *	Williston, VT	In-kind
T2D2	New York, NY	In-kind, collaborative research
The International Association of Foundation Drilling (ADSC-IAFD)	Pennsylvania	Financial
U.S. DOT Volpe Center	Cambridge, MA	Personnel
Unistress Corporation	Pittsfield, MA	In-kind, collaborative research
University of Connecticut	Storrs, CT	In-kind, collaborative research, personnel, facilities, financial
University of Maine	Orono, ME	In-kind, collaborative research, personnel, facilities, financial
University of Massachusetts Lowell	Lowell, MA	In-kind, collaborative research, personnel, facilities, financial
University of Rhode Island	Kingston, RI	In-kind, collaborative research, personnel, facilities, financial
University of Vermont	Burlington, VT	In-kind, collaborative research, personnel, facilities, financial
Urban Mining Northeast *	New Rocelle, NY	In-kind
Vermont Agency of Transportation	Montpelier, VT	In-kind, collaborative research, personnel, financial
Vermont Department of Environmental Conservation	Montpelier, VT	Personnel, in-kind
Vermont Technical College	Randolph Center, VT	Facilities, collaborative research, personnel
VHB	Augusta, ME	Collaborative research, in-kind, personnel
Voestalpine Nortrak Inc. *	Pueblo, CO	In-kind
Western New England University	Springfield, MA	In-kind, collaborative research, personnel, facilities, financial

c. How have the results been disseminated?

Research results have been disseminated in a variety of ways throughout this reporting period. Research results are provided on each project's page on the TIDC Website at https://tidc.umaine.edu/research/project-search/. Further results were disseminated through journal articles, professional magazines, and meetings with New England State DOTs. Additionally, research findings are being disseminated in undergraduate and graduate courses at each university. Lastly, presentations from webinars, the 2020, 2021, 2022, and 2023 Annual Conferences, and the 2021 and 2023 New England Railroad Symposium are available on the TIDC YouTube page and the TIDC website.

d. What do you plan to do during the next reporting period to accomplish the goals?

Research

TIDC will continue to achieve high impact, relevant, and innovative research projects, and the performance of current research projects will continue to be evaluated against the mission, goals, and objectives of TIDC. During the next reporting period, TIDC will continue preparing for the close of the grant program by working with researchers to set guidelines and expectations for completion of their active projects and by facilitating engagement with Technical Champions and industry partners to develop opportunities for high impact deployments. Additionally, TIDC will pursue further funding and collaborations in order to provide for new research opportunities.

Education & Workforce Development

During the next reporting period, the TIDC Education & Outreach Manager will continue to expand TIDC presence in K-12 classrooms by reaching out to educators to introduce the bridge building curriculum into classrooms throughout New England. This will be done in collaboration with researchers at member universities. Another big part of the outreach efforts will include updating the K-12 section of the TIDC Website to include an easily accessible, digital version of the bridge building curriculum. Additionally, the Education & Outreach Manager will work with the College of Education at the University of Maine, in addition to other stakeholders at the Department of Education, to create a micro-credential for Middle School Teachers. The micro-credential will be a certified continuing education credit course and will provide educators with an outline of how to incorporate teaching engineering throughout their curriculum and how to identify how they are already teaching engineering. Lastly, the Education & Outreach Manager will be working to transition the Maine Summer Transportation Institute for the 2024 summer session to an overnight to attract more rural students to attend the camp.

In the realm of Higher Education and Workforce Development, the TIDC Annual Student Recognition Night and Poster Contest will be held through the months of October to December. Additionally, Certificates of Attendance will be made available to attendees of the conference to be used for professional development hours (PDHs).

Technology Transfer

To accomplish TIDC's technology transfer objectives identified in Section I. a., Technology Transfer, the following venues and mechanisms will be and/or continue to be employed: (1) a TIDC website and social media accounts that promote findings and opportunities for collaboration directly to the public; (2) the expansion of the 2023 TIDC Annual Conference at the University of Maine, August 6-8, through early advertising and outreach activities in New England; (3) continued participation/presentation in regional/national transportation conferences and industry webinars; (4) The 2023 TIDC Student Poster Session taking place December 13, 2023; (5) involvement and planning in the 2024 Maine Summer Transportation Institute at the University of Maine, July 11-15 and July 18-22; and (6) promotion of all market-ready technology transfer opportunities through industry/trade publications, the TIDC website, and social media accounts.

TIDC will continue to output consistent technology transfer centered posts to virtual platforms. During the next reporting period, TIDC will organically increase total social media impressions by 20%, follower count by 5%, and reactions by 30%. TIDC will increase YouTube viewership, watch time, and subscribers all by 25%. Additionally, TIDC will increase website views by 50% and unique viewership by 50%

TIDC will also use the webinars and symposiums mentioned in the above section as a form of Technology Transfer. Not only will these provide opportunities for professionals to receive professional development hours (PDH), but it will allow TIDC research findings to be presented to the public.

Collaboration

Principal Investigators and TIDC Management team members will continue to collaborate with state DOT/AOT representatives. All TIDC projects will continue to be supported by at least one Technical Champion (as described in Section I c – collaboration). Projects are encouraged to seek support from additional technical advisors in DOTs, government agencies, and industry leaders. These additional partnerships will increase the applicability of TIDC's

research findings and create more opportunities for the adoption of findings in the region and beyond. Monthly management team meetings will continue and the Program Manager will visit each member university on an annual basis. Also, in a continued effort to help with the goal of expanding the next TIDC Annual Conference for more collaboration opportunities, TIDC is currently reaching out to industry partners to develop a varied and engaging selection of topics and presenters to participate in the conference.

II. PARTICIPANTS & COLLABORATING ORGANIZATIONS

a. What individuals have worked on the project?

In total, 59 principal investigators, faculty, administrators, and management team members and 103 students participated in TIDC research projects during the reporting period. As the projects progress, more student researchers will be added. All TIDC participants who were active during the reporting period are listed in the table below. (* Indicates students who graduated and received their degree during the reporting period.)

Table 7: Active Principal Investigators, faculty, administrators, students, and Management Team Members

Institution	Principal Investigators, Faculty, Administrators, and Management Team Members	Students
University of Maine	Dr. Habib Dagher, Dr. Keith Berube, Dr. Sunil Bhandari, James R. Bryce, Amanda Collamore, Dr. Bill Davids, Dr. Wilhelm Friess, Dr. Aaron Gallant, Dr. Per Garder, Dr. Douglas Gardner, Dr. Andrew Goupee, Kathryn Grond, Dr. Eric Landis, Dr. Linfei Li, Dr. Roberto Lopez-Anido, Genna O'Berin, Vu Phan, Dr. Jonathan Rubin, Brianne Sales, Aaron Schanck, Dr. Andrew Schanck and Dr. Ali Shirazi.	Arnav Acharya, George Akandinge, Zahra Ameli, Jake Bear, Danilo Botero-Lopez, Camilo Fernandez, Jacob Clark, Andre Espinosa, Eyan Fennelly, Jhan Kevin Gil-Marin, SK Belal Hossen, Prabhat Khanal, Thomas Korstanje, Piper Kramer, Izaak Krause, Sebastian Montoya, Erfan Najaf, Temitope Omokinde, Maedeh Orouji, Jon Pinkham, Katie Schweizer, and Emma White*.
University of Connecticut	Dr. Lesley Frame, Dr. Alexandra Hain, Dr. Song Han, Dr. Shinae Jang, Dr. Ramesh Malla, Dr. Nalini Ravishanker, Dr. Jiong Tang, Dr. Kay Wille, and Dr. Wei Zhang	Rahul Anand, Sreeram Anantharaman , Prakash Bhandari, Indrani Chattopadhyay, Nathan Comment, Guoqiang Cui, Mandip Dahal, Celso De Oliviera*, Pierredens Fils, Gavin Foley, William Hughes, Harley Jeanty, Donghyun Kim, Cameron Larkin, Brian Lassey, Steven Matile, Krupa Mekala, Ivan Panchyshyn, Dominic Parciasepe, Bijaya Rai, Daisy Ren, Alok Sharma, Sean Small, Alexa Torres, Sachin Tripathi, Jiachen Wang, Ting Wang, Zelin Yun, and Yang Zhang.
University of Massachusetts Lowell	Dr. Susan Faraji, Dr. Xingwei Wang, Dr. Jianqiang Wei, and Dr. Tzuyang Yu	Maryam Abazarsa, Sabrina Abedin, Ritham Batchu, Andres M. Biondi Vaccariello, Lidan Cao, GuoQiang Cui, Harsh Gandhi, Amirhossein Madadi, Koosha Raisi, Eion Stack, Rui Wu, Tyler Yesu.
University of Rhode Island	Dr. Christopher Baxter, Dr. Aaron Bradshaw, Dr. Rebecca Brown, Dr. Sumanta Das, Dr. Mayrai Gindy, Dr. Joseph Goodwill, Dr. Abdelttawab Hendawi, Dr. Stephen Licht, Nicole Martino, Dr. Vinka Oyanedel-Craver, and Dr. Paolo Stegagno	Pamela Franco, Mason Jacobs, Chan Young Koh, Hewenxuan Li, Sophia Lopardo, Bolaji Oladipo, Andrew Pariseault, Rakesh Paswam, Jenna Salem, Andrew Sheerin, Sinna Vaughan, and Brandon Yeh.
University of Vermont	Dr. Mandar Dewoolkar, Jeff Frolik, Dr. Ehsan Ghazanfari, Dr. Dryver Huston, Mitchell Robinson, Dr. Dana Rowangould,	Agusten Hoen, Ben Kopacki, Richard Laverty, Mohammad Qader, Lauren Snow*, Neha Subedi, Ryan van der Heijden, and Bismark Yeboah

	Dr. Gregory Rowangould, Dr. Matthew Scarborough, James Sullivan, and Tian Xia	
Western New England University	Dr. Moochul Shin and Dr. ChangHoon Lee	Simon Banas, Evan Blake, Robert Brea, Christa-Elizabeth Cicerone, Kaitlyn Correia, Adam Garstka, Spencer Laframboise, Brian Leclair, Charles Maloy, Conner McLeod, Keara Mooney, Archer Parker, Thomas Schreiber, William Shtefan, Dante Talamini, and Christopher Spinazola.
Total	**59**	**88**

b. What organizations have been involved as partners?

TIDC has received continued commitments of support and matching funds from 47 collaborators during this reporting period. The type of support provided by the collaborators varies from in-kind, financial, equipment, personnel, to supplies. In addition, many collaborators provide direct personnel links in research through Technical Champions. See Table 5 on page 10 and Table 6 on page 11 for an overview of the collaborators on TIDC research projects and what they have contributed.

c. Have other collaborators or contacts been involved?

In addition to the collaborators and Technical Champions listed above, TIDC researchers have partnered with 50 individual transportation industry professionals over the reporting period.

III. OUTPUTS

a. Publications, conference papers, and presentations:

The following table includes a list of some of the 73 accepted, submitted, and published papers, reports, and presentations given during the reporting period. For the full list, see Appendix I Table I:

Table 8: Publications, Conference Papers, and Presentations

Type	Title	Citation/Event	Date	Status
Conference Paper	Estimating Dynamic Response and Characteristics of Steel Truss Railroad Bridges Under Service Train Excitation Using Laser Vibrometer and Accelerometers	de Oliveira, C., Dhakal, S., and Malla, R. B., "Estimating Dynamic Response and Characteristics of Steel Truss Railroad Bridges Under Service Train Excitation Using Laser Vibrometer and Accelerometers", Proceedings of the Joint Rail Conference (JRC), ASME, New York, NY, April 2023	04.13.2023	Published
Conference paper	Smart Textile Embedded with Distributed Fiber Optic Sensors for Railway Bridge Long Term Monitoring	Andres M. Biondi, Xu Guo, Rui Wu, Lidan Cao, Jingcheng Zhou, Qixiang Tang, T. Yu, Balaji Goplan, Thomas Hanna, Jackson Ivey, Xingwei Wang, Optical Fiber Technology, 80, 103382, doi:10.1016/j.yofte.2023.103382	06.19.2023	Published
Poster Presentation	Transfer Responses from Global and Local Finite Element Analysis of Two Old Truss Railroad Bridges	2023 TIDC Conference	08.08-10.2023	Presented
Conference Presentation	Phase and Property Evolutions of Alkali-Silica	ASCE Engineering Mechanics Institute (EMI) 2023 Annual Conference	06.07.2023	Presented

	Reaction Gels Under Carbonation			
Workshop Presentation	Four Point Bending Test on Micropile Threaded Connections	15th International Workshop on Micropiles	06.2023	Presented

b. Journal publications:

The following table includes a list of TIDC journal publications and their status during the reporting period:

Table 9: Journal Articles and Publications

Title	Citation	Date	Status
Composite Bridge Girders Structure Health Monitoring Based on the Distributed Fiber Sensing Textile	Wu, Rui, Andres Biondi, Lidan Cao, Harsh Gandhi, Sabrina Abedin, Guoqiang Cui, Tzuyang Yu, and Xingwei Wang. "Composite Bridge Girders Structure Health Monitoring Based on the Distributed Fiber Sensing Textile." Sensors 23, no. 10 (2023): 4856.	05.18.2023	Published
Smart Textile Embedded with Distributed Fiber Optic Sensors for Railway Bridge Long-term Monitoring	Biondi, Andres M., Xu Guo, Rui Wu, Lidan Cao, Jingcheng Zhou, Qixiang Tang, Tzuyang Yu et al. "Smart textile embedded with distributed fiber optic sensors for railway bridge long term monitoring." Optical Fiber Technology 80 (2023): 103382.	06.16.2023	Published
Assessment of Web Shear Stresses and Shear Capacity of FRP Composite Tub Girders for Highway Bridges	A. Schanck, W. Davids, J. Pinkham and K. Berube. "Assessment of web shear stresses and shear capacity of FRP composite tub girders for highway bridges," Structures, vol. 51, pp. 880-894, 2023	5.2023	Published
Phase Evolution and Mechanical Hydroscopic Properties of Alkali-Silica Reaction Gels Modified by Magnesium Nitrate	Arkabrata Sinha, Jianqiang Wei*, Phase Evolution and Mechanical-Hydroscopic Properties of Alkali-Silica Reaction Gels Modified by Magnesium Nitrate, Cement and Concrete Composites, 2023, 144: 105283	09.04.2023	Published
Hydration and Phase Evolution of Blended Cement Composites Containing Lithium and Saturated Metakaolin	Dayou Luo, Jianqiang Wei*, Hydration and Phase Evolution of Blended Cement Composites Containing Lithium and Saturated Metakaolin, Cement and Concrete Composites, 2023, 144: 105268.	08.22.2023	Published
The Efficacy of Functionalized Sodium-Montmorillonite in Mitigating Alkali-Silica Reaction	Dayou Luo, Jianqiang Wei*, The Efficacy of Functionalized Sodium-Montmorillonite in Mitigating Alkali-Silica Reaction, Applied Clay Science, 2023, 245: 107-139.	09.09.2023	Published
Elucidating the Role of Magnesium Nitrate in Alkali-	Dayou Luo, Jianqiang Wei*, Elucidating the role of magnesium nitrate in alkali-silica reaction: performance and	09.25.2023	Submitted

Silica Reaction; Performance and Multiscale Mechanisms	multiscale mechanisms (submitted to Cement and Concrete Research)		
Estimating Dynamic Response and Characteristics of Steel Truss Railroad Bridges Under Service Train Excitation Using Laser Vibrometer and Accelerometers	de Oliveira, C., Dhakal, S., and Malla, R. B., "Estimating Dynamic Response and Characteristics of Two Steel Trusses Open-deck Railroad Bridges under Passenger Train Excitation using Laser Doppler Vibrometer", Transportation Research Record, 2023	6.2023	Draft Completed
Machine Learning Guided Design of Microencapsulated Phase Change Materials Incorporated Concretes for Enhanced Freeze-Thaw Durability	Li, H.W.X., Lyngdoh, G., Krishnan, N. M. A. & Das, S. Machine learning guided design of microencapsulated phase change materials-incorporated concretes for enhanced freeze-thaw durability. Cement and Concrete Composites 140, 105090 (2023) https://doi.org/10.1016/j.cemconcomp.2023.105090	4.2023	Accepted and Published Online
Integrating Experiments, Finite Element Analysis, and Interpretable Machine Learning to Evaluate the Auxetic Response of 3D Printed Re-Entrant Metamaterials	Oladipo, B., Matos, H., Krishnan, N.M.A, Das, S. Integrating Experiments, Finite Element Analysis, and Interpretable Machine Learning to Evaluate the Auxetic Response of 3D Printed Re-entrant Metamaterials, Journal of Materials Research and Technology. (2023) Volume 25, July–August 2023, Pages 1612-1625.	6.2023	Accepted and Published Online
Covid-19 and Transportation Safety	Marshall, E., Shirazi, M., Ivan, J.N. (2023), Transport Review.	09.30.2023	Published

c. Books or other non-periodical, one-time publications:

The following table includes a list of TIDC publications in books or other non-periodical media during the reporting period and their status:

Table 10: Books and Non-periodical Publications

Title	Citation	Date	Status
N/A	N/A	N/A	N/A

d. Other publications, conference papers, and presentations:

The following table includes a list of the articles and presentations that falls within the other publications, conference papers, and presentations section during the reporting period:

Table 10: Other Publications, Presentations, and Meetings

Type	Title	Citation/Description	Date	Status
Meeting Presentation	Industry and Deep Foundations Institute Partners Meeting	Global Stability App for Column Supported Systems	07.29.2023	Presented
Seminar Presentation	Response Monitoring of Long-Span Open Deck Truss	Seminar Presentation	05.10.2023	Presented

	Train Bridge from Field Test and FE Modeling			
Thesis	Structural Health Monitoring of Civil Field Structures Considering Uncertainty	Citation Pending	08.30.2023	Published
Thesis	Performance of Helical Piles Retrofitted with Novel Collar Vane Under Lateral and Torsional Loads	Carvajal-Munos, J.S. (2023). "Performance of helical piles retrofitted with a novel collar vane under lateral and torsional loads." University of Maine, M.S. Thesis, p. 309.	5.052023	Submitted
Thesis	Integrated Physic-Based and Data-Driven Models for Community Resilience Assessment Under Wind Storms	W. Hughes. "Integrated Physics-Based and Data-Driven Models for Community Resilience Assessment under Wind Storms"; Ph.D. Dissertation, University of Connecticut Department of Civil and Environmental Engineering.	04.19.2023	Accepted

e. Website(s) or other Internet site(s):

The following websites and social media sites are used to disseminate information about TIDC findings.
TIDC website: https://tidc.umaine.edu/
YouTube: https://www.youtube.com/channel/UCimTO-44wrniqXx4_AXnLGA
Instagram: https://www.instagram.com/tidcatumaine/
Twitter: https://twitter.com/TIDCatUMaine
Facebook: https://www.facebook.com/TIDCatUMaine/
LinkedIn: https://www.linkedin.com/company/transportation-infrastructure-durability-center/
UMass Lowell's TIDC research page: https://www.uml.edu/Research/tidc/

f. Technologies or techniques:

A number of technologies and/or technical innovations were developed during the reporting period:

- UML Project 1.5: Developed and new textile design that was submitted to Saint-Gobain for sensing textile fabrication.
- UConn Project 1.15: Established and validated multi-level structural health monitoring framework utilizing machine learning and actual experimental data of impedance measurement. The machine learning algorithm can provide high-level classification between structural fault and bolt joint loosening.
- UMaine Project 3.12: Created an executable code to compute the factor of safety for basal stability for any column geometry, subsoil layering, and filling properties.
- UML Project 3.19: M improvements to their VR chamber for training transportation professionals.
- UMaine Project 4.11: finalized the crash models for the project. These models help to understand the crash trend in 2021 and 2022 compared to pre-pandemic Maine.
- UConn Project 1.13: Developed a 3D finite element model of the Cos Cob bridge in Connecticut and the Tilton Belmont bridge.
- UML Project C11.2020: Developed two structural models with reduced orders for data fitting which improved the structural health monitoring algorithm.

g. Inventions, patent applications, and/or licenses:

One project is currently pursing patent opportunities:

- UMaine Project 2.9 filed a provisional patent titled, "Compositions and Methods of Accelerated Soil Stabilization" on May 5, 2023.

IV. OUTCOMES

The TIDC has an outcome to report as a result of the outputs from TIDC-funded research:

- The UMaine project 2.11 team, in coordination with NHDOT, installed a 3D printed culvert diffuser and three witness plates in Exter, NH at NH Route 85 to rehabilitate the culvert carrying Rocky Hill Brook in August. The diffuser and witness plates were inspected after one month in September. The witness plates will be brought back for testing after one year in the field to determine the change in material properties due to environmental exposure.

V. IMPACTS

a. What is the impact on the effectiveness of the transportation system?

As a result of the successful implementation of the structural health monitoring system at the Penobscot-Narrows Bridge, will improve the operation and safety of the bridge by identifying events that affect the response of the carbon fiber composite strands and the anchor system.

b. What is the impact on the adoption of new practices, or instances where research outcomes have led to the initiation of a start-up company?

Nothing to report.

c. What is the impact on the body of scientific knowledge?

TIDC researchers have contributed to the body of scientific knowledge by publishing journal articles and presenting findings at conferences, webinars, seminars, and symposiums to transportation professionals.

d. What is the impact on transportation workforce development?

TIDC research findings have impacted workforce development through trainings and updates offered to transportation professionals at the city and state department/agency of transportations and industry organizations. Additionally, TIDC has issued a total of 134 certificates of attendance totaling 615.75 Professional Development Hours to date.

VI. CHANGES/PROBLEMS

a. Changes in approach and reasons for change:

Nothing to report.

b. Actual or anticipated problems or delays and actions or plans to resolve them:

We have encountered some unexpected Project PI and early returns to home countries as referenced in section b. above, as well in delays in identifying and recruiting replacement students this past year. Although student recruiting is now nearly at required staffing levels, we are evaluating how this student staffing will scheduled completion dates.

Nothing to report.

c. Changes that have a significant impact on expenditures:

Nothing to report.

d. Significant changes in use or care of human subjects, vertebrate animals, and/or biohazards:

Nothing to report.

e. Change of primary performance site location from that originally proposed:

Nothing to report.

VII. SPECIAL REPORTING REQUIREMENTS

All TIDC projects are in compliance with Research Project Requirements (located in the Grant Deliverables and Reporting Requirements for 2016 and 2018 UTC Grants (Nov 2016, revised June 2018)) in regards to new research projects.

Appendix I

Table 1: Full List of Publications, Conference Papers, and Presentations				
Type	**Title**	**Citation/Event**	**Date**	**Status**
Poster Presentation	Recycling of Polymer Extrusion-Based Large-Scale Additive Manufacturing Formwork	2023 Student Research Symposium	4.2023	Presented
Conference Presentation	Assessing the Impact of Rumble Strips Installations on Prevention of Lane Departure Crashes in Maine	ICTD ASCE 2023	6.2023	Presented
Workshop Presentation	Four Point Bending Test on Micropile Threaded Connections	15th International Workshop on Micropiles	6.2023	Presented
Conference Presentation	Recycling of Large-Scale3D Printed Polymer Composite Precast Concrete Forms	11th International Conference on FRP Composites in Civil Engineering	7.2023	Presented
Conference Presentation	Estimating Dynamic Response and Characteristics of Steel Truss Railroad Bridges Under Service Train Excitation Using Laser Vibrometer and Accelerometers	2023 Joint Rail Conference	4/13/2023	Presented
Conference Presentation	Real Time Traffic Monitoring of Pedestrian Bridge Using Distributed Fiber Optic Sensing Textile	SPIE Smart Structures and Nondestructive Evaluation 2023	4/18/2023	Presented
Conference Presentation	Distributed Fiber Optic Sensing Textile Installation on a Novel Composite Girder Bridge	SPIE Smart Structures and Nondestructive Evaluation 2024	4/18/2023	Presented
Conference Presentation	Smart Finger Posture Real Time Monitoring System	SPIE Smart Structures and Nondestructive Evaluation 2025	4/19/2023	Presented
Seminar Presentation	Response Monitoring of Long-Span Open Deck Truss Train Bridge from Field Test and FE Modeling	New England Polytec Technology Seminar	5/10/2023	Presented
Conference Presentation	Experimental Study on the Impact Resistance of High-Performance Cementitious Materials with Non-Metallic Fibers for Prestressed Concrete Crossties	2023 Joint Rail Conference	04.11-13.2023	Presented
Poster Presentation	Modeling the Effectiveness of Using Heater and Thermal Insulation to Reduce Cracks on Concrete Bridge Decks	2023 Student Research Symposium	04.14.2023	Presented
Conference Presentation	Enhanced Alkali-Silica Reaction Mitigation by Functionalized Montmorillonite	2023 MassDot Transportation Innovation Conference	05.02.2023	Presented

Conference Presentation	Non-Proprietary Ultra-High Performance Concrete with Glass Recycled Powder	Third International Interactive Symposium on Ultra-High-Performance Concrete (UHPC)	06.04-07.2023	Presented
Conference Presentation	Influence of Carbonation on Alkali-Silica Reaction	ASCE Engineering Mechanics Institute (EMI) 2023 Annual Conference	06.07.2023	Presented
Conference Presentation	Phase and Property Evolutions of Alkali-Silica Reaction Gels Under Carbonation	ASCE Engineering Mechanics Institute (EMI) 2023 Annual Conference	06.07.2024	Presented
Conference Presentation	Bridge Deck Underside Evaluation with Contacting and Non-Contacting UAS-Mounted Sensors	ASCE Engineering Mechanics Institute (EMI) 2023 Annual Conference	06.09.2025	Presented
Conference Presentation	Development of Non-Proprietary Ultra-High Performance Concrete	13th Advances in Cement-Based Materials	06.14-16.2023	Presented
Poster Presentation	Deep Learning-Based Steel Bridge Corrosion Detection	EMI2023 Conference	06/06-09/2023	Presented
Meeting Presentation	Global Stability App for Column Supported Systems	Industry and Deep Foundations Institute Partners Meeting	07.29.2023	Presented
Poster Presentation	Deep Learning-Based Steel Bridge Corrosion Detection and Quantification Using YOLOv8	2023 TIDC Conference	08.08-10.2023	Presented
Poster Presentation	Transfer Responses from Global and Local Finite Element Analysis of Two Old Truss Railroad Bridges	2023 TIDC Conference	08.08-10.2023	Presented
Poster Presentation	Finite Element (FE) Modeling of Tilton-Belmont Railroad Bridge in New Hampshire Under Typical Train Loading	2023 TIDC Conference	08.08-10.2023	Presented
Poster Presentation	Wireless Expansion Joint Monitoring System for Highway Bridges	2023 TIDC Conference	08.08-10.2023	Presented
Poster Presentation	Long Term Structural Health Monitoring on Grist Mill Bridge	2023 TIDC Conference	08.08-10.2023	Presented
Poster Presentation	Development of Protocols for Determining the Overall Deleterious Material Content in Processed Glass Aggregate	2023 TIDC Conference	08.08-10.2023	Presented
Poster Presentation	Fiber Attrition of Short Carbon Fibers Due to One Cycle of Thermo-Mechanical Material Recycling	2023 TIDC Conference	08.08-10.2023	Presented
Poster Presentation	Crack Mitigation Strategies for Concrete Bridge Decks	2023 TIDC Conference	08.08-10.2023	Presented
Poster Presentation	Shrinkage Resistant Chitosan Fiber to Improve Long Term Concrete Durability	2023 TIDC Conference	08.08-10.2023	Presented

Poster Presentation	Performance Concrete Optimized for Cost, Durability, and Manufacturability	2023 TIDC Conference	08.08-10.2024	Presented
Poster Presentation	The Impact of the Abutment Wall Height and the Backfill Soil on the Behavior of Steel Piles in IABs	2023 TIDC Conference	08.08-10.2024	Presented
Poster Presentation	Development of Live Load Distribution factors for GBeam Highway Bridges	2023 TIDC Conference	08.08-10.2024	Presented
Poster Presentation	Steel-Free Concrete Bridge Decks - Material Study	2023 TIDC Conference	08.08-10.2024	Presented
Poster Presentation	Electromagnetic Detection and Identification of Concrete Cracking in Highway Bridges	2023 TIDC Conference	08.08-10.2024	Presented
Presentation	Ai-Based Advances in UAV-Based Bridge Inspection	2023 TIDC Conference	08.09.2023	Presented
Conference Presentation	Unique Challenges for Developing Civil Engineering Infrastructure on the Moon	2023 TIDC Conference	08.09.2023	Presented
Conference Presentation	A Textile Embedded with Distributed Fiber Optic Sensors for Pedestrian Bridge Monitoring	EVACES 2023	08.29.2023	Presented
Presentation	GBeam Composite Bridge Girders: Results of Recent Research and New Developments	2023 TIDC Conference	08.08.2023	Presented
Conference Presentation	Structural Monitoring with Robot and Augmented Reality Teams	14th International Workshop on Structural Health Monitoring	09.14.2023	Presented
Poster Presentation	Phase Evolution and Property Development of Alkali-Silica Reaction Gel in Carbonation	16th International Congress on the Chemistry of Cement 2023	09.18-22.2023	Presented
Poster Presentation	Functionalization of Merkoalin with Non-ionic Surfactants: Swelling and Pozzolanic Reactivity	16th International Congress on the Chemistry of Cement 2023	09.18-22.2023	Presented
Conference Presentation	Efficient Residual Stress Modeling for Large-Format Polymer Composite Extrusion-Based Additive Manufacturing	ASC 38th Annual Technical Conference	09.19.2023	Presented
Peer-Reviewed Journal	Machine Learning Guided Design of Microencapsulated Phase Change Materials Incorporated Concretes for Enhanced Freeze-Thaw Durability	Li, H.W.X., Lyngdoh, G., Krishnan, N. M. A. & Das, S. Machine learning guided design of microencapsulated phase change materials-incorporated concretes for enhanced freeze-thaw durability. Cement and Concrete Composites 140, 105090 (2023)	4.2023	Accepted and Published Online

		https://doi.org/10.1016/j.cemconcomp.2023.105090		
Journal Article	Assessment of Web Shear Stresses and Shear Capacity of FRP Composite Tub Girders for Highway Bridges	A. Schanck, W. Davids, J. Pinkham and K. Berube. "Assessment of web shear stresses and shear capacity of FRP composite tub girders for highway bridges," Structures, vol. 51, pp. 880-894, 2023	5.2023	Published
Journal Manuscript	Estimating Dynamic Response and Characteristics of Steel Truss Railroad Bridges Under Service Train Excitation Using Laser Vibrometer and Accelerometers	de Oliveira, C., Dhakal, S., and Malla, R. B., "Estimating Dynamic Response and Characteristics of Two Steel Trusses Open-deck Railroad Bridges under Passenger Train Excitation using Laser Doppler Vibrometer", Transportation Research Record, 2023	6.2023	Draft Completed
Peer-Reviewed Journal	Integrating Experiments, Finite Element Analysis, and Interpretable Machine Learning to Evaluate the Auxetic Response of 3D Printed Re-Entrant Metamaterials	Oladipo, B., Matos, H., Krishnan, N.M.A, Das, S. Integrating Experiments, Finite Element Analysis, and Interpretable Machine Learning to Evaluate the Auxetic Response of 3D Printed Re-entrant Metamaterials, Journal of Materials Research and Technology. (2023) Volume 25, July–August 2023, Pages 1612-1625.	6.2023	Accepted and Published Online
Conference Paper	Recycling of Large-Scale3D Printed Polymer Composite Precast Concrete Forms	Schweizer, K., Bhandari, S., Lopez-Anido, R., and Wang, L. "Recycling Large-Scale 3D Printed Polymer Composite Precast Concrete Forms", 11 th International Conference on FRP Composites in Civil Engineering, Rio de Janeiro, Brazil, 23-26 July 2023	7.2023	Published
Conference Paper	Efficient Residual Stress Modeling for Large-Format Polymer Composite Extrusion-Based Additive Manufacturing	Bhandari S., Lopez-Anido R. A., "Efficient residual stress modeling for large-format polymer composite extrusion-based additive manufacturing", American Society for Composites (ASC) 38th Annual Technical	9.2023	Published

		Conference, Woburn, MA, Sep 18-20, 2023		
Conference Paper	Estimating Dynamic Response and Characteristics of Steel Truss Railroad Bridges Under Service Train Excitation Using Laser Vibrometer and Accelerometers	de Oliveira, C., Dhakal, S., and Malla, R. B., "Estimating Dynamic Response and Characteristics of Steel Truss Railroad Bridges Under Service Train Excitation Using Laser Vibrometer and Accelerometers", Proceedings of the Joint Rail Conference (JRC), ASME, New York, NY, April 2023	04.13.2023	Published
Thesis	Integrated Physic-Based and Data-Driven Models for Community Resilience Assessment Under Wind Storms	W. Hughes. "Integrated Physics-Based and Data-Driven Models for Community Resilience Assessment under Wind Storms"; Ph.D. Dissertation, University of Connecticut Department of Civil and Environmental Engineering.	04.19.2023	Accepted
Conference paper	Structural Health Monitoring (SHM) of a Train Model under Traffic Loading	Batchu, R., K. Raisi, T. Yu, Structural health monitoring (SHM) of a train model under traffic loading, In: Proc SPIE Smart Structures/NDE, vol. 12486, March 15, doi: 10.1117/12.2658173.	05.02.2023	Published
Conference paper	Distributed Optic Fiber Sensing Textile Installation Inside a Novel Composite Girder Bridge	Abedin, S., A.M. Biondi Vaccariello, L. Cao, R. Wu, T. Yu, X. Wang, Real time traffic monitoring of pedestrian bridge using distributed fiber optic sensing textile, In: Proc SPIE Smart Structures/NDE, vol. 12487, March 15, doi:10.1117/12.2658097.	05.02.2023	Published
Conference paper	Real Time Traffic Monitoring of Pedestrian Bridge Using Distributed Fiber Optic Sensing Textile	Wu, R., A. M. Biondi Vaccariello, L. Cao, G. Cui, S. Abedin, X. Wang, H.N. Gandhi, T. Yu, Distributed optic fiber sensing textile installation inside a novel composite girder bridge, In: Proc SPIE Smart Structures/NDE, vol. 12487, March 14, doi:10.1117/12.2662371.	05.02.2023	Published
Conference paper	Detection of Steel Rebar Corrosion in Bridge Piers Using 1.6GHz ground Penetrating Radar	Raisi, K., R. Batchu, T. Yu, Detection of steel rebar corrosion in bridge piers using 1.6GHz ground penetrating radar, In: Proc SPIE Smart Structures/NDE, vol. 12487, March 15, doi: 10.1117/12.2657731.	05.02.2023	Published
Conference Paper	Denoising of GPR B-Scan Images using Discrete Wavelet Transform	doi:10.1117/12.2657741	05.09.2023	Published

Conference Paper	Detection of Steel Rebar Corrosion in Bridge Piers Using 1.6GHz Ground Penetrating Radar	doi:10.1117/12.2657731	05.09.2023	Published
Conference Paper	Remote Detection of Chloride Ion Content Using SAR	doi: 10.1117/10.2661309	05.09.2023	Published
Conference paper	Composite Bridge Girders Structure Health Monitoring Based on the Distributed Fiber Sensing Textile	Wu, R., A. Biondi, L. Cao, H. Gandhi, S. Abedin, G. Cui, T. Yu, X. Wang, Sensors, 23(10), 4856; doi.org/10.3390/s23104856	05.17.2023	Published
Journal Article	Composite Bridge Girders Structure Health Monitoring Based on the Distributed Fiber Sensing Textile	Wu, Rui, Andres Biondi, Lidan Cao, Harsh Gandhi, Sabrina Abedin, Guoqiang Cui, Tzuyang Yu, and Xingwei Wang. "Composite Bridge Girders Structure Health Monitoring Based on the Distributed Fiber Sensing Textile." Sensors 23, no. 10 (2023): 4856.	05.18.2023	Published
Conference paper	Development of Non-proprietary UHPC using Recycled Glass Powder	Citation Pending	06.04.2023	Published
Journal Article	Smart Textile Embedded with Distributed Fiber Optic Sensors for Railway Bridge Long-term Monitoring	Biondi, Andres M., Xu Guo, Rui Wu, Lidan Cao, Jingcheng Zhou, Qixiang Tang, Tzuyang Yu et al. "Smart textile embedded with distributed fiber optic sensors for railway bridge long term monitoring." Optical Fiber Technology 80 (2023): 103382.	06.16.2023	Published
Conference paper	Smart Textile Embedded with Distributed Fiber Optic Sensors for Railway Bridge Long Term Monitoring	Andres M. Biondi, Xu Guo, Rui Wu, Lidan Cao, Jingcheng Zhou, Qixiang Tang, T. Yu, Balaji Goplan, Thomas Hanna, Jackson Ivey, Xingwei Wang, Optical Fiber Technology, 80, 103382, doi:10.1016/j.yofte.2023.103382	06.19.2023	Published
Conference Paper	Deep Learning-Based Steel Bridge Corrosion Segmentation and Condition Rating Using Mask RCNN and YOLOv8	Citation Pending	06.25.2023	Submitted
Journal Article	Hydration and Phase Evolution of Blended Cement Composites Containing Lithium and Saturated Metakaolin	Dayou Luo, Jianqiang Wei*, Hydration and Phase Evolution of Blended Cement Composites Containing Lithium and Saturated Metakaolin, Cement and Concrete Composites, 2023, 144: 105268.	08.22.2023	Published

Thesis	Structural Health Monitoring of Civil Field Structures Considering Uncertainty	Citation Pending	08.30.2023	Published
Journal Article	Phase Evolution and Mechanical Hydroscopic Properties of Alkali-Silica Reaction Gels Modified by Magnesium Nitrate	Arkabrata Sinha, Jianqiang Wei*, Phase Evolution and Mechanical-Hydroscopic Properties of Alkali-Silica Reaction Gels Modified by Magnesium Nitrate, Cement and Concrete Composites, 2023, 144: 105283	09.04.2023	Published
Journal Article	The Efficacy of Functionalized Sodium-Montmorillonite in Mitigating Alkali-Silica Reaction	Dayou Luo, Jianqiang Wei*, The Efficacy of Functionalized Sodium-Montmorillonite in Mitigating Alkali-Silica Reaction, Applied Clay Science, 2023, 245: 107-139.	09.09.2023	Published
Conference Paper	Structural Monitoring with Robot and Augmented Reality Teams	Fath A, Liu Y, Tanch S, Hanna N, Xia T, Huston D. (2023) "Structural Monitoring with Robot and Augmented Reality Teams" Proceedings of the 14th International Workshop on Structural Health Monitoring, Stanford University, Stanford, CA, S Farhangdoust, A. Guemes, FK Chang, eds.	09.14.2023	Published
Conference Paper	Functionalization of Merkoalin with Non-ionic Surfactants: Swelling and Pozzolanic Reactivity	Dayou Luo, Jianqiang Wei*, Functionalization of Metakaolin with Non-Ionic Surfactants: Swelling and Pozzolanic Reactivity, 16th International Congress on the Chemistry of Cement 2023 (ICCC2023), "Further Reduction of CO2-Emissions and Circularity in the Cement and Concrete Industry", Bangkok, Thailand, Sep. 18–22, 2023.	09.18-22.2023	Published
Conference Paper	Phase Evolution and Property Development of Alkali-Silica Reaction Gel in Carbonation	Arkabrata Sinha, Jianqiang Wei*, Phase Evolution and Property Development of Alkali-Silica Reaction Gel in Carbonation, 16th International Congress on the Chemistry of Cement 2023 (ICCC2023), "Further Reduction of CO2-Emissions and Circularity in the Cement and Concrete Industry", Bangkok, Thailand, Sep. 18–22, 2023.	09.18-22.2023	Published

Journal Article	Elucidating the Role of Magnesium Nitrate in Alkali-Silica Reaction; Performance and Multiscale Mechanisms	Dayou Luo, Jianqiang Wei*, Elucidating the role of magnesium nitrate in alkali-silica reaction: performance and multiscale mechanisms (submitted to Cement and Concrete Research)	09.25.2023	Submitted
Peer-Reviewed Journal	Covid-19 and Transportation Safety	Marshall, E., Shirazi, M., Ivan, J.N. (2023), Transport Review.	09.30.2023	Published

** Note that no TIDC funds were utilized for travel to international conferences.*