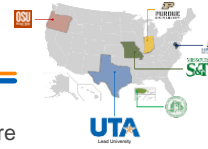




DuRe - Transp

Tier 1 University Transportation Center for
Durable and Resilient Transportation Infrastructure



Semi-Annual Progress Report for University Transportation Centers

Submitted to U.S. Department of Transportation
Office of the Assistant Secretary for Research and
Technology (OST-R)

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Project Title Tier 1 University Transportation Center for Durable and
Resilient Transportation Infrastructure (DuRe-Transp)

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Signature 

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1) ACCOMPLISHMENTS

1.A - What are the major goals and objectives of the program?

The Tier-1 UTC, Center for Durable and Resilient Transportation Infrastructure (DuRe-Transp), focuses on the statutory research priority area “Improving the durability and extending the life of transportation infrastructure”. The consortium driving the Center’s mission is comprised of a transdisciplinary team of prominent researchers from six universities in the U.S.: The University of Texas at Arlington (UTA-Lead), Howard University (HU), Missouri University of Science and Technology (S&T), Oregon State University (OSU), Purdue University (PU), and the University of Puerto Rico - Mayagüez (UPRM). By leveraging such collaboration, DuRe-Transp addresses critical scientific and technological advancements in the strategic topics of Durability, Construction and Finance.

Research Goals

DuRe-Transp Center’s overall goal is premised on Innovation, Durability, Life-cycle performance, Climate Change mitigation initiatives and Performance-based standards for revitalization of the nation’s infrastructure. DuRe-Transp addresses critical challenges in 7 Research Themes (RT):

- **Durability**
 1. RT-I: Inspection, Maintenance and Preservation (IMP)
 2. RT II: Sustainability and Longevity (SL)
 3. RT III: Health Monitoring (HM)
- **Construction**
 4. RT IV: Sustainable Materials and Structures for Climate Change Mitigation (CCM)
 5. RT V: Advanced Materials and Technologies for Construction and Retrofitting (CR)
 6. RT VI: Construction Methods and Management (CMM)
- **Finance**
 7. RT VII: Innovative Revenue and Finance (RF)

DuRe-Transp’s Research Themes identify and prioritize scientific and technological advancements that support U.S. DOT’s goals for inspecting, repairing, and rebuilding the transportation infrastructure, improving roadway safety for all users, and charting innovative cost-effective pathways for transition to net-zero emissions and climate change mitigation. Under the 7 Research Themes, the Center will lead cross-disciplinary research projects to develop and deploy the next generation of durable and sustainable concrete-based materials, with emphasis on mitigation of degradation mechanisms liable for diminishing the service life of transportation infrastructure. The performance of these materials will be rigorously tested in both laboratory and field conditions, evaluating the materials’ exposure to various environments (e.g., marine and frost). This research will support the development of standard guidelines for the formulation and deployment of the next generation of durable materials. The Center will also dedicate resources for comprehensive research on advanced structural retrofitting and repair solutions for existing infrastructure. Focus will be given on the development of carbon-neutral materials and renewable energy-related technologies for mitigating the greenhouse gas (GHG) emissions in transportation infrastructure and alleviating the urban heat island. The Center will develop and implement in-place and remote-sensing technologies for structural health monitoring (SHM) including unmanned aerial vehicles (UAVs). The SHM tools will provide the ability to detect damage – at its onset or at very-early stages – in the infrastructure elements. Such tools will be supplemented with advanced data-driven models to perform life-cycle analysis, asset management, and performance characterization. The models will employ state-of-the-art artificial intelligence and machine learning techniques, and deep learning

methods for data inference, prediction, and optimization. The Center will also deploy novel technologies and data-fusion frameworks to advance revenue and finance in transportation sector, with an emphasis on the design and implementation of data-driven blockchain-based smart contracts and commercial vehicle user fee models. Such finance systems will provide actionable managerial data that will ultimately increase return on investment while also reducing project risks.

Education and Workforce Development

The educational, training and professional development activities of the project are closely integrated with the research objectives with the aim to contribute to the successful training of students at all levels of education, graduate, undergraduate and pre-college/K-12, focused on women and underrepresented groups. The DuRe-Transp Center will also contribute to enhancing the potential of postdoctoral fellows and early career researchers to flourish as scholars and become the nation's front-line engineers, allowing them to acquire new scientific knowledge, technological know-how and professional skills in engineering practices that can extend the durability and service life of our TI. This goal will be facilitated by specific education and workforce development activities:

- New Certificate program with cross-disciplinary courses in the strategic focus area “Improving the durability and extending the life of transportation infrastructure”. The courses will be delivered blended/hybrid (face-to-face and on-line), and in live webcasts and self-paced on-line. To complete the certificate, students will select 4 courses from the following list: Inspection and Preservation of Concrete Structures; Durability and Long-term Performance of Sustainable Infrastructure; Structural Health Monitoring (SHM) of Existing Superstructures and Substructures; Carbon Neutral Construction Materials and Structures; Advanced Materials for Construction and Retrofit; Additive Manufacturing in Transportation Infrastructure; Assets Management and Risk Assessment of Concrete Infrastructure; Digital Financing for Transportation Infrastructure.
- Special education modules, aligned with the Center’s research activities, to reinforce existing academic programs and support the development of new skill sets in upper-level undergraduate and graduate courses.
- New learning opportunities, i.e., development of new materials, technologies and tools, that can be used for senior undergraduate design and capstone projects.
- Educational seminars/webinars with invited plenary lectures from scientists and engineers from the academia and industry.
- DuRe-Transp Outstanding Student of the Year. DuRe-Transp will select an outstanding student of the year, annually, starting the AY 24-25 based on accomplishments in one or more Research Themes of DuRe-Transp, academic performance, professionalism, and leadership.
- Research Scholarships to Community College Students. DuRe-Transp will provide scholarships to students from community colleges through existing partnerships, such as the Tarrant County College to The University of Texas at Arlington (TCC-to-UTA) admission program, and TCC-UTA-Dallas College partnerships supported by the North Central Texas Council of Governments (NCTCOG). The scholarship awardees will participate in undergraduate research activities and attend courses at the consortium’s universities, e.g., UTA’s Department of Civil Engineering.
- Pre-college/K-12 summer camps to deliver age-appropriate presentations and research showcases to pre-college/K-12 students with focus on students from underserved communities.

- Webinars and Educational Modules to K-12 teachers about innovative construction technologies, novel infrastructure materials and smart structure through existing education programs in the consortium’s universities, i.e., STEM Education program of the Kummer Center at S&T.

Technology Transfer Activities

A primary objective of the DuRe-Transp Center is the transition of research into practice by developing hands-on technologies for engineers and transportation practitioners. Specific plans for technology transfer and collaboration activities to accelerate the development and deployment of research findings will be designed.

- Technical webinars to highlight new technological advances from the Center’s research projects. The webinars will provide Professional Development Hours to professional, engineers and practitioners.
- Training sessions to students from Technical Trade Schools, i.e., Edge Tech Academy in Arlington, TX and the Rolla Technical Institute in Rolla, MO, in new areas such as bridge inspection, Structural Health Monitoring (SHM) and 3D printing of concrete.
- Online training webinars in collaboration with Local Technical Assistance Programs (LTAP). DuRe-Transp will collaborate with LTAPs in Texas (TxLTAP), Missouri (MoLTAP) and Puerto Rico (PRLTAP) to integrate new research findings and robust technologies developed by the Center’s projects into practice. Topics of the quality training webinars will cover, but not limited to, the use of non-metallic reinforcement, inspection, maintenance and preservation of concrete pavements and bridges, structural health monitoring, and repair and rehabilitation of concrete infrastructure using novel materials, such as Ultra High Performance Concrete (UHPC).
- Annual half-day seminar to highlight research outcomes/products, starting the AY 24-25. Target audiences are consortium members, transportation professionals from state and local governments, and transportation agencies/enterprises.
- DuRe-Transp faculty will disseminate knowledge and develop guidelines and standards through numerous technical committees in Transportation Research Board (TRB), American Concrete Institute (ACI), American Society of Civil Engineers (ASCE), and International Union of Laboratories and Experts in Construction Materials, Systems and Structures (RILEM).
- The Center’s faculty members will also organize sessions at the technical conventions, e.g., TRB Annual Meeting and ACI Fall and Spring Conventions to disseminate the research findings from the Center’s projects.
- The Center’s research teams will publish the research findings in joint publications in peer-reviewed journals actively involving postdoctoral fellows and Ph.D. students.
- The Center’s website will be created and utilized to publicize on-going research, educational activities, technology transfer events, and project reports.
- Research outcomes of the DuRe-Transp Center will be uploaded into the U.S. DOT Research Hub in a timely manner.

1.B - What was accomplished under these goals?

- 16 Interdisciplinary research projects for the 1st year of the DuRe-Transp Center (06/01/2023 – 05/31/2024) were developed involving multiple partners. The research projects are aligned with the U.S. DOT mission to repair, rebuild, and modernize the nation’s TI, with a particular focus on climate change mitigation, resilience, and safety for all users (U.S. DOT Strategic Plan FY 2022-2026). The research projects are categorized within the Center’s 7 research themes as follows:

Durability

1. RT-I: Inspection, Maintenance and Preservation (IMP)
 - IMP-1 Smart Diagnostics and Prognostics of TI Using UAVs and ML-based Systems
 - IMP-2 Best Practices for Application of Sealers/Coatings for Extending Service Life of Bridges
2. RT II: Sustainability and Longevity (SL)
 - SL-1 Multi-physics Model to Predict Degradation and Service-life of Concrete
 - SL-2 AI Framework to Design and Discover Durable Binders for Infrastructure
 - SL-3 Extending the Lifespan of Concrete Superstructures via Alkali-Silica Reaction Mitigation
3. RT III: Health Monitoring (HM)
 - HM-1 Smart Wireless Sensors and Monitoring System
 - HM-2 Comprehensive Diagnostic System for Corrosion Assessment of Concrete Infrastructure
 - HM-3 AI/video-driven SHM and Lifespan Estimation of In-service Bridges

Construction

1. RT IV: Sustainable Materials and Structures for Climate Change Mitigation (CCM)
 - CCM-1 Carbon Neutral Concrete Pavements for Decarbonizing Transportation Sector
 - CCM-2 Reducing Embodied Carbon by Optimizing Cementitious Systems for Alternative Cement Use via Thermodynamic Modeling- Carbonation and Corrosion in Low Clinker Cement Concretes
2. RT V: Advanced Materials and Technologies for Construction and Retrofitting (CR)
 - CR-1 Performance of Fiber-reinforced Concrete for Bridge Construction and Rehabilitation
 - CR-2 Seismic Performance of Corroded H-piles Retrofitted Using Advanced Construction Materials
3. RT VI: Construction Methods and Management (CMM)
 - CMM-1 Design and Performance of Eco-friendly UHPFRC for 3D Printing
 - CMM-2 Quantitative Risk Assessment of Concrete Infrastructure Assets

Finance

1. RT VII: Innovative Revenue and Finance (RF)
 - RF-1 Blockchain-based Smart Contracts for Allocating Resources and Automating Contract Payments
 - RF-2 Commercial Vehicle Life Cycle Use Fees Based on Pavement Impact
 - RF-3 Machine Learning Maintenance Cost Forecasts for Better Infrastructure LCCA
- Individual Semi-Annual Reports for each research project were developed in accordance with the Research Project Requirements Template in Exhibit D of the “UTC – Grant Deliverables and Reporting Requirements”.
- The 1st Kickoff meeting was organized by the DuRe-Transp Director *Konsta-Gdoutos* online through Microsoft Teams. 32 attendees from the UTA, HU, S&T, OSU, PU, and UPRM participated, including the Center’s Associate Directors *Khayat*, *Marin* and *Weiss*, Theme Leaders of the 7 Research Themes, Principal Investigators of the projects, faculty and staff members. The Center’s research, workforce development and technology transfer objectives were presented. A timeline with immediate tasks and actions items including research, workforce development and technology transfer activities with specific performance metrics were discussed.
- The 1st Grant Kickoff meeting between the Office of the Assistant Secretary for Research and Technology and the DuRe-Transp Team was held in Washington DC on May 19, 2023. The meeting was focused on the organization, planning and research, workforce development and technology transfer activities of the new Center for the 1st year of the Tier 1 UTC grant.
- Official Press Conference about the new University Transportation Center DuRe-Transp by the Deputy Assistant Secretary for Research and Technology of U.S. DOT, *Robert Hampshire*. The Press Conference was held in UTA’s Center for Advanced Construction Materials on Thursday April 27, 2023. The agenda of the press conference included official announcements about the DuRe-Transp Center by OST-R’s Deputy Assistant Secretary for Research and Technology *Robert Hampshire*, The Dean of the College of Engineering of UTA, *Peter Crouch* and the Director of DuRe-Transp *Maria Konsta-Gdoutos*. The press event included media interviews and a lab tour at the research facilities of UTA’s Center for Advanced Construction Materials. News release to media:
<https://www.fox4news.com/news/ut-arlington-receives-10-million-grant-to-develop-energy-efficient-roads>
<https://www.cbsnews.com/texas/news/ut-arlington-gets-10m-grant-to-create-energy-efficient-concrete/>
<https://spectrumlocalnews.com/tx/south-texas-el-paso/news/2023/05/03/ut-arlington-granted-10-million-to-improve-texas-roadways->
- Director *Konsta-Gdoutos* and Program Coordinator *Danoglidis* of the DuRe-Transp Center participated in the 2023 Council of University Transportation Centers (CUTC) Summer Meeting in Miami, FL, on June 20 - 22, 2023. Following the 2023 CUTC meeting, DuRe-Transp’s Director *Konsta-Gdoutos* organized a teleconference between the Assistant Director, Theme Leaders, and key staff for discussing important updates about deliverables and reporting requirements for the 1st year of the DuRe-Transp Center.
- The Data Management Plan of the DuRe-Transp Center was submitted and approved by the Grant Manager and the National Transportation Library Team, on October 05, 2023.

1.C - What opportunities for training and professional development has the program provided?

- Director *Konsta-Gdoutos* organized a live webinar entitled “CO₂ Sequestration and Renewable Energy Efficient Concrete” on August 01, 2023. The topic of the webinar is relevant to the Research Theme IV “Sustainable Materials and Structures for Climate Change Mitigation (CCM)” of the DuRe-Transp Center. The webinar was offered to undergraduate and graduate students, young researchers, faculty in the U.S. institutions. Two key presentations were included.
 - 1) Title: “Realizing Electrical-to-Thermal Energy Conversion Efficiency in Nanoengineered Concrete to Empower Low-Emission Heating Technologies”
Speaker: Panagiotis Danoglidis
Assistant Professor of Research, Center for Advanced Construction Materials
The University of Texas at Arlington, USA
 - 2) Title: “Geopolymer based composites - Resource-efficient materials with multifunctional properties”
Speaker: Marco Liebscher
Institute of Construction Materials, Technische Universität Dresden, Germany

The video recording of the webinar is available in the link below.

https://drive.google.com/file/d/1n-U_15go4LHZ2sM3DXHN-CmhIkGSITuu/view

- Theme Leader *Acosta* delivered a seminar during the 2023 Summer Transportation Institute Program organized by UPRM. The 4-week program is a transportation focused career awareness initiative specifically designed for high school students entering the junior (11th grade) and senior years (12th grade). The purpose is to provide academic experiences such as hands-on STEM activities organized in UPRM’s facilities, and invited seminars in transportation related topics, to encourage high school students to pursue transportation-related course work at the college and university level.
 - 1) Title: “Common Materials used in Civil Engineering”
Speaker: Felipe J. Acosta
Date: July 10, 2023
Objective: The 1.5-hour seminar includes an introduction to fundamental physical and mechanical properties of construction materials such as Portland cement and concrete, steel, aggregates and wood; a tour in the Construction Materials Laboratory at UPRM; and live demonstrations of mechanical property tests on 2 in. x 4 in. cement mortar cylinders with several water-to-cement ratios

1.D - How have the results been disseminated?

- Research findings of DuRe-Transp’s research projects are being compiled to prepare scientific papers and technical presentations at conventions, e.g., ACI Fall 2023 Convention, TRB 2024 Annual Meeting.

1.E - What do you plan to do during the next reporting period to accomplish the goals and objectives?

The following tasks are planned for the 2nd Semi-Annual period of 10/01/2023 – 03/31/2024 to accomplish the goals and objectives of DuRe-Transp.

- Bi-monthly seminar series within the framework of the DuRe-Transp Center. The seminars will include research topics in the research themes Inspection, Maintenance and Preservation; Sustainability and Longevity; Health Monitoring; Sustainable Materials and Structures for Climate Change Mitigation; Advanced Materials and Technologies for Construction and Retrofitting; Construction Methods and Management; and Innovative Revenue and Finance. The seminars will be live streamed followed by a Q&A session. The video presentations will be uploaded in DuRe-Transp Center’s website.

Tentative Program:

- 1) 1-hour Seminar on November 21, 2023
Presentations from the research members of the Oregon State University and Howard University
 - 2) 1-hour Seminar on December 12, 2023
Presentations from the research members of the Purdue University and University of Puerto Rico at Mayagüez
 - 3) 1-hour Seminar on January 16, 2023
Presentations from the research members of the University of Texas at Arlington and Missouri University of Science and Technology
- A new session entitled “Measuring, Monitoring and Modeling Concrete’s Electrical and Thermal Properties” is organized by the DuRe-Transp’s Director Konsta-Gdoutos in the ACI Fall Convention 2023 in Boston, MA. The program of the session was upload in ACI 2023 Fall Convention’s website.
<https://www.concrete.org/events/conventions/currentconvention/sessionsandevents.aspx?m=p&schedule&EventId=ZSESS327>
<https://www.concrete.org/events/conventions/currentconvention/sessionsandevents.aspx?m=p&schedule&EventId=ZSESS328>
 - A call for proposals for the 2nd year of DuRe-Transp (06/01/2024 – 05/31/2025) will be published. Director *Konsta-Gdoutos*, Associate Director for Education and Workforce Development *Khayat*, Director of Scientific Committee *Shah* and Theme Leaders of the 7 Research Themes will evaluate the research proposals based on specific intellectual merit and broader impact criteria. The selected project will be sent to the Grant Manager for review.
 - The DuRe-Transp will provide scholarships to two students from the Tarrant County College to participate in the research activities of UTA’s research projects and take courses in the Department of Civil Engineering of UTA, through the TCC-to-UTA admission program.
 - UTA and S&T will contact Edge Tech Academy and Rolla Technical Institute, respectively, to initiate discussions for organizing training sessions to the Technical Trade School students.

2) PARTICIPANTS & COLLABORATING ORGANIZATIONS

2.A What organizations have been involved as partners?

- All the participating institutions of DuRe-Transp are actively involved by providing support to the Center.
 - 1) The University of Texas at Arlington, Arlington, TX – LEAD, financial and in-kind support, supply facilities and equipment, and research collaborations
 - 2) Howard University, Washington, DC, in-kind support, supply facilities and equipment, and research collaborations
 - 3) University of Puerto Rico at Mayagüez, Mayagüez, Puerto Rico, in-kind support, supply facilities and equipment, and research collaborations
 - 4) Missouri University of Science and Technology, Rolla, MO, financial and in-kind support, supply facilities and equipment, and research collaborations
 - 5) Oregon State University, Corvallis, OR, in-kind support, supply facilities and equipment, and research collaborations
 - 6) Purdue University, West Lafayette, IN, in-kind support, supply facilities and equipment, and research collaborations
- Several state governments and industrial partners are in the process of partnering with DuRe-Transp to provide financial and in-kind support and facilities to the Center:
 - 1) Texas Department of Transportation, Austin, TX, financial and/or in-kind support
 - 2) Missouri Department of Transportation, Jefferson City, MO, financial and/or in-kind support
 - 3) Oregon Department of Transportation, Salem, OR, financial and/or in-kind support
 - 4) City of Dallas, Dallas, TX, financial and/or in-kind support

2.B Have other collaborators or contacts been involved?

- During the 1st semi-annual reporting period, the DuRe-Transp Center has contacted several potential collaborators to establish the External Advisory Committee (EAC), indicatively:
 - 1) Alireza Hatefi, Director, Public Works Department, City of Dallas, Dallas, TX
 - 2) Kenneth Drake, Professor of Chemistry, Department of Physical Science, Tarrant County College, Hurst, TX
 - 3) Jen Harper, Research Director, Missouri Department of Transportation, Jefferson City, MO

The objective of the EAC is to oversee and help advance the Center's strategic goals including research, education, outreach and diversity, partnership, workforce development, and technology transfer. The EAC will meet twice a year. The feedback and recommendations by the EAC will be disseminated and discussed with all partners in a follow up meeting to ensure successful progression of all activities and implementation of the DuRe-Transp vision/goals.

3) OUTPUTS

3.A - Publications, conference papers, and presentations

Publications:

- 1) Jaberizadeh, M.M., Danoglidis, P.A., Shah, S.P. and Konsta-Gdoutos, M.S., 2023. Eco-efficient cementitious composites using waste cellulose fibers: Effects on autogenous shrinkage, strength and energy absorption capacity. *Construction and Building Materials*, 408, p.133504.
- 2) Aghaee, K., Khayat, K.H., 2023. Design and performance of fiber-reinforced shrinkage compensating eco-friendly concrete, *Construction and Building Materials*, 408, p.133803
- 3) Wei, J., Farzadnia, N., Addai-Nimoh, A. and Khayat, K.H., 2023. Evaluation of residual flexural behavior of corroded fiber-reinforced super workable concrete beams. *Cement and Concrete Composites*, 144, p.105278.
- 4) Aghaee, K., Han, T., Kumar, A. and Khayat, K.H., 2023. Mechanism underlying effect of expansive agent and shrinkage reducing admixture on mechanical properties and fiber-matrix bonding of fiber-reinforced mortar. *Cement and Concrete Research*, 172, p.107247.
- 5) Weiss, W.J., Isgor, B.O., and Bharadwaj, K. 2023. Effect of Limestone on Electrical Properties of Cementitious Systems. (*Submitted for publication to a peer-reviewed journal*)

Presentations:

- 1) Maria Konsta-Gdoutos, Panagiotis A. Danoglidis. Enhancing the Tensile Strain Capacity of Cement-based Composites Using Fibrillar Waste Byproducts, 15th International Conference on Fracture, Atlanta, GA, June 11-16, 2023.
- 2) Panagiotis A. Danoglidis, Maria Konsta-Gdoutos. Multiscale Toughening Mechanism in Hybrid Fiber Reinforced Cement-Based Nanocomposites, 15th International Conference on Fracture, Atlanta, GA, June 11-16, 2023.
- 3) Jason Weiss, Burkan Isgor. Optimizing PLCs and other Blended Cements, Roadmap to Carbon Neutrality, Virtual Concrete Sustainability Summit, August 22-24, 2023.

3.B - Policy papers

Nothing to report.

3.C - Website(s) or other Internet site(s)

A website was created for the DuRe-Transp Center <https://duretransp.uta.edu/>. The website will be used for publishing all the research, education and workforce development and technology transfer activities organized within the framework of the Center. In this reporting period, the following information/tabs have been added: The Center, Research Team, Directory, News.

3.D - New methodologies, technologies or techniques

- The research team from HU worked jointly with the District Department of Transportation (DDOT) for the identification of two in-service bridges for detailed monitoring: New Frederick Douglass Memorial Bridge in Washington, DC; and Anacostia Riverwalk Trail Bridge in Washington DC. The primary focus of monitoring the New Frederick Douglass Memorial Bridge is to understand the behavior and progression of its laterally independent arches and structural connections. The objective of monitoring the Anacostia Riverwalk Trail

Bridge is to analyze its vibrational behaviors to confirm their alignment with anticipated operational benchmarks.

3.E - Inventions, patents, and/or licenses

Nothing to report.

3.F - Other products, such as data or databases, physical collections, audio or video products application software, analytical models, educational aids, courses or curricula, instruments, equipment, or research material.

- Application software:
 - 1) 2D Pixel Tracking Software. The research team of the HU developed a specialized 2D pixel tracking code in the preliminary stages of software development. This program is designed to capture displacement responses at points of interest within video data of specific infrastructures. This application will be instrumental in monitoring the chosen operational bridges.
- Courses or curricula
 - 1) A new course was developed in the department of Civil Engineering at OSU: CCE 321-Ecampus – Civil and Construction Engineering Materials Course, W Jason Weiss, Burkan Isgor, Completed and offered Online (Live Streaming) Winter 2024.

4) OUTCOMES

The research activities of the Center’s partners have been reported in the national media, increasing the public awareness of novel technological developments:

- 1) AZO Build: New Partnership to Manufacture Concrete that Captures Carbon Emissions
<https://www.azobuild.com/news.aspx?newsID=23287>
- 2) UTA News: UTA to develop concrete that costs less, lasts longer and is better for environment
<https://www.uta.edu/news/news-releases/2023/04/27/dot-coe-utc-grant>
- 3) OSU News: Looking down the road to better transportation infrastructure
<https://engineering.oregonstate.edu/all-stories/looking-down-road-better-transportation-infrastructure>
- 4) S&T News: S&T researchers on cutting edge of 3D concrete printing developments
<https://news.mst.edu/2023/02/st-researchers-on-cutting-edge-of-3d-concrete-printing-developments/>
- 5) Purdue News: Purdue panels to address US semiconductor needs, ‘Next Big Things in Tech’ at Fast Company Innovation Festival
<https://www.purdue.edu/newsroom/releases/2023/Q3/purdue-panels-to-address-us-semiconductor-needs-next-big-things-in-tech-at-fast-company-innovation-festival.html>
- 6) Purdue News: Purdue’s ‘talking concrete’ embedded into new I-465 and I-69 interchange in Indianapolis
<https://www.purdue.edu/newsroom/releases/2023/Q3/purdue-talking-concrete-embedded-into-new-i-465-and-i-69-interchange-in-indianapolis.html>

5) IMPACTS

5.A - What is the impact on the effectiveness of the transportation system?

- The pilot demonstrations designed for many projects of the 1st year of the DuRe-Transp Center, such as the project “CCM-1: Carbon Neutral Concrete Pavements for Decarbonizing Transportation Sector” and “CR-1: Performance of Fiber-reinforced Concrete for Bridge Construction and Rehabilitation”, can be used as case studies to show the implementation and commercialization potential of advanced materials and technologies developed by the Center for the construction of durable and sustainable concrete pavements and bridge decks using sustainable, eco-efficient concrete materials.
- The Center’s research teams will deliver new sensor, monitoring and diagnostic systems that support Structural Health Monitoring of transportation infrastructure, i.e., “HM-1: Smart Wireless Sensors and Monitoring System”, “HM-2: Comprehensive Diagnostic System for Corrosion Assessment of Concrete Infrastructure” and “HM-3: AI/video-driven SHM and Lifespan Estimation of In-service Bridges”. These systems can allow better prediction of service life and enable better management of the infrastructure.

5.B - What is the impact of technology transfer on industry and government entities, on the adoption of new practices, or on research outcomes which have led to initiating a start-up company?

- The technical specifications of new concrete mixes and products, i.e., carbon negative concrete mixes (CCM-1: Carbon Neutral Concrete Pavements for Decarbonizing Transportation Sector), ultrathin/film nanoengineered concrete coatings (IMP-2: Best Practices for Application of Sealers/Coatings for Extending Service Life of Bridges), and ASR-resistive nanoconcrete mixes (SL-3: Extending the Lifespan of Concrete Superstructures via Alkali-Silica Reaction Mitigation), will facilitate the design of new mixing protocols, materials and technologies to the contractors in the cement and concrete industry.
- New specifications for off-spec alternative cements will be developed, such as the performance based specification of new supplementary cementitious materials (SCMs) and Portland limestone cements (PLC) in the project “CCM-2: Reducing Embodied Carbon by Optimizing Cementitious Systems for Alternative Cement Use via Thermodynamic Modeling- Carbonation and Corrosion in Low Clinker Cement Concretes”. The specifications will be shared with the standardization bodies, i.e., “American Society for Testing and Materials” and “American Association of State Highway and Transportation Officials” for the development of new test and evaluation protocols and guidelines that can be used in construction.

5.C - What is the impact on the body of scientific knowledge?

The interdisciplinary research activities and methodologies followed for the successful execution of the Center’s projects exhibit a strong potential for the study and assessment of yet unexplored properties of advanced concrete materials. The research tasks of the project “CCM-1: Carbon Neutral Concrete Pavements for Decarbonizing Transportation Sector” include the first-time evaluation of the chemical, mechanical and electrical properties of concrete interfaces at the atomic- and nano- scale. This scientific direction will significantly contribute to the development of a nano-to-macro scale research pipeline for tailoring and tuning the properties of complex cementitious and concrete materials targeting new functionalities, i.e., CO₂ capture and mineralization ability, thermal to electrical energy conversion efficiency, electrical energy storage capacity. The concept

of developing new functional concrete materials, such as thermoelectric concrete, by performing atomic- and nano-scale experimental realization and characterization fosters research activities from all STEM disciplines including Civil and Environmental Engineering, Materials Science and Engineering, Chemistry, Computational Mechanics and Modelling, Prototyping (Technology) and Data/Mathematical Science.

5.D - What is the impact on transportation workforce development?

Several postdoctoral fellows, graduate and undergraduate students have been recruited through the DuRe-Transp Center’s projects for the 1st year of the grant. The cross-disciplinary research activities of the DuRe-Transp projects are specifically designed to enrich the academic portfolio of the postdocs and students with scientific and technological know-how in major transportation related topics as they move towards an independent research career and reach scientific maturity. The collaboration activities between universities for the projects also contribute to advancing the professional skills of the early career researchers including, but not limited to, research method planning and development, research-specific critical thinking and decision making, and professional network build-up.

6) CHANGES/PROBLEMS

6.A - Changes in approach and reasons for change

Nothing to report

6.B - Actual or anticipated problems or delays and actions or plans to resolve them

Nothing to report

6.C - Changes that have a significant impact on expenditures

Nothing to report

6.D - Significant changes in use or care of human subjects, vertebrate animals, and/or biohazards

Nothing to report

6.E - Change of primary performance site location from that originally proposed

Nothing to report

7) SPECIAL REPORTING REQUIREMENTS

Nothing to report