



UTC Semi Annual Progress Report University Transportation Centers

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1. ACCOMPLISHMENTS: What was done? What was learned?

The information provided in this section allows the grants official to assess whether satisfactory progress has been made during the reporting period. The ABC-UTC 2016 grant was awarded in December 2016. In this period Cycle 3 projects have started. In the next period, we are planning to start the process of selection of topics for Cycle 4 projects.

1.1 What are the major objectives of the program?

The major goals of the ABC-UTC program fall into six different categories:

1.1.1 Research

The objectives of the Accelerated Bridge Construction University Transportation Center (ABC-UTC) are to advance the frontier of Accelerated Bridge Construction (ABC); develop new ABC knowledge; effectively transfer the state-of-the-art ABC knowledge to the profession; develop a next-generation ABC workforce; provide leadership in making contributions to solve national transportation issues; and collaborate with the Federal Highway Administration (FHWA), the American Association of State Highway and Transportation Officials (AASHTO), Departments of Transportation (DOTs), other UTCs, and the transportation profession to make ABC the best solution for the nation's aging bridge infrastructure, in line with ***Fixing America's Surface Transportation (FAST) Act research priority area: "Improving the Durability and Extending the Life of Transportation Infrastructure" and non-exclusive topic areas: "Construction Methodologies" and "Application of New Materials and Technologies."***

The ABC-UTC will also contribute to FAST Act's priority areas of "Reducing Congestion (Improve Operations)", "Promoting Safety (Transportation Worker Safety/ Construction Zones)," "Preserving the Environment (Environmentally Responsible Planning and Construction)," and "Preserving the Existing Transportation Systems (Retrofits and Multiple Uses of Infrastructure)".

1.1.2 Leadership

The proposed ABC-UTC consortium members have well-established, working relationships with one another that span decades. Collectively, the five institutions have the expertise and synergy to accomplish the Center's objectives. The ABC-UTC's research team, many of whom are recognized experts in the field and are

in leadership positions, is particularly well suited to solving the remaining barriers to widespread implementation of ABC practices and the construction of longer service-life bridges. The research team members will continue their leadership through professional publications, articles, media outputs, and conferences to extend their leadership beyond the academic arena. The program will also invest in young faculty to become future leaders in the area. We demonstrate our leadership in innovations in education, workforce development, deployment of research results and conducting research.

1.1.3 Education and Workforce Development

All ABC-UTC partners have well-established education and workforce development programs that will be further strengthened through the ABC-UTC. FIU, ISU, UNR, UW, and OU, each offer graduate degrees, leading to M.S. and Ph.D. degrees in all traditional fields of civil engineering, including transportation engineering, structural engineering, and construction engineering. The quality of these programs is best evidenced by the many awards and recognition their students have received in recent years.

The objectives of the Accelerated Bridge Construction University Transportation Center (ABC-UTC) are to develop successful programs in the areas of seminars, workshops, and training courses for graduate and undergraduate students.

1.1.4 Technology Transfer

One of the strongest aspects of the current ABC-UTC is the knowledge and leadership role that it has and will play in bridge engineering in terms of Technology Transfer. The keys to the FIU's ABC-UTC success in Technology Transfer are: a) a solid, extensive knowledge of ABC; b) a strong focus (ABC); c) coordination of its activities with AASHTO, FHWA, DOTs, and consultants; d) identification of the knowledge gaps, e) identification of the bridge community needs; f) teamwork; g) identification of the best means, methods, and format of transferring the knowledge, and most importantly; h) involvement of stakeholders and adopters early in the process, and continuously seeking and receiving feedback from the community and making necessary improvements and adjustments.

Some of the highlights of technology transfer will include:

- Partnerships across Sectors to Move Research into Practice
- Peer-reviewed Journals and Other Publications to Showcase Research Results
- Information Exchanges
- Academic and Continuing Education Programs
- Distance Learning
- Conferences, Webinars, and Workshops
- Assessment of Outreach and Progress Implementing Research Results

1.1.5 Collaboration

The ABC-UTC is a consortium of FIU (as lead university) located in Miami, Florida (Region 4); ISU located in Ames, Iowa (Region 7); UNR located in Reno, Nevada, (Region 9); OU located in Norman, Oklahoma (Region 6); and UW located in Seattle, Washington (Region 10). This structure will foster collaboration among experts in various areas of ABC and will result in the wider dissemination of results. In addition to the partnerships that occur through individual projects and the pooled-fund program, ABC UTC will facilitate external collaboration through the Advisory Board and Advisory Panels consisting of external industry and US and State Transportation members.

Partnership with Government Agencies:

The existing ABC-UTC already has a strong working relationship with AASHTO SCOBs T-4, T-3 and T-11, FHWA, TRB ABC Subcommittee, and NCHRP, and these relationships will expand and continue.

Communication capabilities already in place will allow for remote control and operation of experimental work conducted at any or all partner university facilities. Such real-time viewing, control, and data manipulation is just one example of how the partner universities will work collaboratively.

The requirements for all partner universities for effective collaboration include:

- Linkage among Research, Education, Workforce Development and Technology Transfer Activities
- Working with Minority-Serving Institutions
- Advisory Boards and Committees
- Metrics for Measuring Collaboration Success

1.1.6 Diversity

- The lead university is a Minority Serving Institution and Hispanic Serving Institution. With a current enrollment of approximately 55,000, FIU is among the top 10 largest public universities in the U.S. and ***annually grants more than 11,000 BS, MS, and PhDs to Hispanic students. FIU also has an R1 Carnegie Classification***, which is the highest research activity rating universities can achieve. FIU has an established national reputation for excellence in Accelerated Bridge Construction and has an excellent Transportation Engineering program. Additionally, the consortium of universities is diverse. Specifically, 1) the consortium is made up universities in large (Miami, Seattle), medium (Reno), and small (Ames and Norman) population areas; 2) the consortium encompasses the Eastern (FIU), Midwest (ISU and OU), and Western (UNR and UW) regions of the

United States; 3) The consortium covers both seismic (UNR, UW) and non-seismic regions (FIU, ISU, and OU) and 4) The consortium is multi-disciplinary, including both engineering (construction, structural, geotechnical, transportation and safety) and non-engineering (policy and management) disciplines. Further, FIU contributes to ABC, ITS, and construction engineering expertise.

- ABC-UTC activities, FIU will provide one of the best platforms for consortium member universities and **other anticipated UTCs** to attract qualified minority students to their graduate programs. OU has a large Native American student enrollment and provides opportunities for consortium members to attract Native American students also houses the Center for Diversity in Engineering and Computing (CDEC). The goals of the CDEC are to increase the overall number of students pursuing engineering careers and to increase the proportion of students from traditionally underrepresented populations in the overall number of students who pursue an engineering degree.
- ABC-UTC works closely with the CDEC and take full advantage of the CDEC's expertise and the various outreach programs it has developed. Currently, the CDEC has several ongoing programs targeting elementary, middle, and high school level students.

Over the last twelve years, the CDEC has been focused on increasing the flow of traditionally underrepresented ethnic/gender groups and students with disabilities into the engineering and computing pipeline. At the K-12 level, the Center implements programs such as summer and academic enrichment programs, tutoring services, teacher training, mentorships, career/college/financial awareness seminars, dual enrollment, counseling services, parental workshops, and physical fitness. Other programs such as the Florida-Georgia Louis Stokes' Alliance for Minority Participation (FGLSAMP) provide many FIU STEM students with the need/merit-based scholarships and opportunities to conduct research and receive faculty mentoring. These and other activities are supported by various grants from the U.S. Department of Education, NSF, Motorola Foundation, Miami-Dade County Public Schools, Miami Children's Trust, the Caterpillar Foundation, Office of Naval Research, and others.

The Center's Summer Transportation Program recruits 40 middle school students and engages them in a five-week summer program consisting of a host of activities designed to prepare and inspire them to pursue careers in the design, operation, safety, and optimization of modern land, sea, space, and air transportation systems.

Specific activities proposed for the proposed ABC-UTC will include: 1) adapting and modifying the outreach materials from CDEC for transportation careers and targeting the materials to K-12 and undergraduate student groups via websites and social media such as Facebook and Twitter; 2) offering fellowships that specifically target traditionally underrepresented students; 3) providing funding to support campus visits of prospective minority students; and 4) making presentations on transportation careers at major minority institutions and conferences.

OU highly values diversity and inclusion, and the university's Gallogly College of Engineering has full-time staff to organize and engage in activities targeted toward attracting and retaining minority students. Located in the heart of the Native American Country, Native American outreach is one of OU's strengths. The outreach activities include summer camps and summer bridge and site visits.

- One of the measures of success in ABC-UTC diversity activities will be the number of minority students admitted from FIU into the undergraduate and graduate programs of ABC-UTC consortium member universities.

1.2 What was accomplished under these goals?

1.2.1 Research

- Ongoing updates to the Operation Manual. We continue to update the Operation manual as needed to best fit our goals and objectives.
- Review of proposals and commencement of Cycle 3 projects.
- 2019 Research Day 2 was held on Novemberth, 2019 and PI's made a total of 21 online presentations on Cycle-2 projects to the public . The next Research Day will be held on April 27th, 2020.
- The following Research Seminars were presented during the previous reporting period with the number of independent sites attending also highlighted. Many sites have multiple attendees, so the actual number of attendees is higher. Research Seminars continue to give exposure to our students to the industry.

	Date	Research Seminar Title	Student(s) Presenter	# sites attending
1	10/25/2019	Performance Comparison of In-Service, Full-Depth Precast Concrete Deck Panels to Cast-in-Place Decks	Esmail Shahrokhinasab, (Ph.D., FIU)	622
2	1/31/2020	Extending Maximum Length of the Folded Steel Plate Girder Bridge System (FSPGBS), exceeding 100 ft. with Capability to Incorporate Camber	Faheem Afzal (Ph.D., FIU)	405

The following table provides a list of the research projects, with PI and the status of the project.

Project #	Project Title	Principal Investigator	Status
FIU-2016-1-1	Development Of Guide For Selection Of Substructure For ABC Projects (Joint project with OU)	Armin Mehrabi & Hesham Ali	95% complete Final deliverable to be posted soon.
FIU-2016-1-2	Field Demonstration-Instrumentation and monitoring of Accelerated Repair Using UHPC Shell	Kingsley Lau	75% complete (Experimental)
FIU-2016-1-3	Envisioning Connection Detail for Connecting Concrete Filled Tube (CFT) Columns to Cap Beam for High-Speed Rail Application (Joint project with UW)	Atorod Azizinamini	90% complete
FIU-2016-1-4	Innovative Foundation Alternative for High-Speed Rail Application (Joint project with UNR)	Seung Jae Lee	60% complete
FIU-2016-1-5	Eliminating Column Formwork Using Prefabricated UHPC Shells: (Originally a subproject of "Envisioning Connection Detail for Connecting Concrete Filled Tube (CFT) Columns to Cap Beam for High-Speed Rail Application")	Atorod Azizinamini	90% complete
FIU-2016-2-1	Development of Non-Proprietary UHPC Mix (Joint project with all partner universities)	David Garber	45% complete
FIU-2016-2-2	Performance of Existing ABC Projects - Inspection Case Studies (Joint project with all partner universities)	Armin Mehrabi	60% complete
FIU-2016-2-3	Development of ABC Course Module- Available ABC Bridge Systems for Short Span Bridges	Armin Mehrabi	95% complete Final deliverable to be posted soon.
FIU-2016-2-4	Optimization of Advanced Cementitious Material for	Islam Mantawy	45% complete

Project #	Project Title	Principal Investigator	Status
	Bridge Deck Overlays and Upgrade, Including Shotcrete		
FIU-2016-2-5	Robotics and Automation in ABC Projects	Islam Mantawy	65% complete
FIU-2016-2-6	Laminated Wood Deck System for Folded Plate Girder	Atorod Azizinamini	25% complete
FIU-2016-2-7	Understanding Critical Impacting Factors and Trends on Bridge Design, Construction, and Maintenance for Future Planning	Lu Zhang	40% complete
FIU-2016-2-8	Complex Networks Perspectives Towards Accelerated Bridge Construction (ABC)	Arif Mohaimin Sadri	35% Complete
FIU-2016-3-1	Alternative Materials and Configurations for Prestressed-precast Concrete Pile Splice Connection	Armin Mehrabi	New Project
FIU-2016-3-2	Alternative Technical Concepts for Contract Delivery Methods in Accelerated Bridge Construction	Mohamed ElZomor	New Project
FIU-2016-3-3	Work Zone Safety Analysis, Investigating Benefits from Accelerated Bridge Construction (ABC) on Roadway Safety	Islam Mantawy	New Project
FIU-2016-3-4	Use of UHPC in Conjection with Pneumatic Spray Application and Robotic for Repair and Strengthening of Culverts-Phase I	Atorod Azizinamini	New Project
FIU-2016-3-5	Prefabricated Barrier System Utilizing UHPC Connections	Islam Mantawy	New Project

Project #	Project Title	Principal Investigator	Status
FIU-2016-3-6	Robotic Bridge Construction: Experimental Phase I	Atorod Azizinamini	New Project
FIU-2016-3-7	Rapid Repair and Retrofit of Timber Piles Using UHPC	Islam Mantawy	New Project
FIU-2016-3-8	Automated MFL System for Corrosion Detection	Atorod Azizinamini	New Project
FIU-2016-3-9	UHPC connection for SDCL steel bridge system	Atorod Azizinamini	New Project
ISU-2016-1-1	Delivery Methods for Accelerated Bridge Construction Projects: Case Studies and Consensus Building	Katelyn Freeseaman	99% Completed Final Deliverable to be posted soon
ISU-2016-1-2	Bidding of Accelerated Bridge Construction Projects: Case Studies and Consensus Building	Katelyn Freeseaman	99% Completed Final Deliverable to be posted soon
ISU-2016-1-3	Accelerated Repair and Replacement of Expansion Joints	Brent Phares	95% Completed Final Deliverable to be posted soon
ISU-2016-2-1	Development of Non-Proprietary UHPC Mix (Joint project with all partner universities)	Behrouz Shafei	80% Completed
ISU-2016-2-2	Performance of Existing ABC Projects- Inspection Case Studies (Joint project with all partner universities)	Katelyn Freeseaman	50% Completed
ISU-2016-2-3	Synthesis of available contracting methods	Jennifer S. Shane,	95% Completed Final Deliverable to be posted soon
ISU-2016-2-4	Development of ABC Course Module- Design of Link Slabs	Behrouz Shafei	65% Completed
ISU-2016-3-1	Investigation of The Efficacy Of Helical Pile Foundation Implementation In Accelerated Bridge	Justin Dahlberg	New Project

Project #	Project Title	Principal Investigator	Status
	Construction Projects – Phase I		
ISU-2016-3-1	Multi-Span Lateral Slide Laboratory Investigation: Phase 1	Katelyn Freeseaman	New Project
UNR-2016-1-1	Innovative Foundation Alternative for High-Speed Rail Application (Joint project with FIU)	Mohamed Moustafa	25% complete
UNR-2016-1-2	Identify the Risk Factors That Contribute to Fatalities and Serious Injuries and Implement Evidence-Based Risk Elimination and Mitigation Strategies	Mohamed Moustafa	70% complete
UNR-2016-1-3	More Choices for Connecting Prefabricated Bridge Elements and Systems (PBES)	Mohamed Moustafa	99% complete Final Deliverable to be posted soon
UNR-2016-2-1	Development of Non-Proprietary UHPC Mix - Application to Deck Panel Joints (Joint project with all partner universities)	Mohamed Moustafa	60% complete
UNR-2016-2-2	Synthesis of available methods for repair of prestress girder ends	Mohamed Moustafa	95% complete Final Deliverable to be posted soon
UNR-2016-2-3	Performance of Existing ABC Projects - Inspection Case Studies	Mohamed Moustafa	30% complete
UNR-2016-3-1	Quantitative assessment of soil-structure interaction effects on seismic performance of bridges with ABC connections	Elnaz Seylabi	New Project
UNR-2016-3-2	Investigating the Potential Applications of Elastomeric Polymers (Such As Polyuria And Polyurethane) For Accelerated Bridge Construction And Retrofit	Hamed Ebrahimian	New Project

Project #	Project Title	Principal Investigator	Status
UNR-2016-3-3	Application of Methacrylate Polymers for Seismic ABC Connections	Mohamed Moustafa	New Project
OU-2016-1-1	Development of Guide For Selection Of Substructure For ABC Projects (Joint project with all partner universities)	Musharraf Zaman (Joint project with FIU)	95% complete Final Deliverable to be posted soon
OU-2016-1-2	Rapid Retrofitting Techniques for Induced Earthquakes	Philip Scott Harvey Jr.	100 % Completed
OU-2016-2-1	Development of Non-Proprietary UHPC Mix (Joint project with all partner universities)	Royce W. Floyd	90% Completed
OU-2016-2-2	Development of ABC Course Module - The risk due to Induced Earthquakes and Accelerated Solution (under technology transfer activity)	Philip Scott Harvey Jr	93.75% Completed
OU-2016-2-3	Performance of Existing ABC Projects - Inspection Case Studies (Joint project with all partner universities)	Musharraf Zaman	50% Completed
OU-2016-3-1	Service Life Design Guidance for UHPC Link Slabs	Royce Floyd	New Project
OU-2016-3-2	Development of User-friendly Tools and Decision-making Algorithms for Service Life Design of ABC Bridges	Shima Mohebbi	New Project
UW-2017-1-1	Performance Evaluation of Structural Systems for High-Speed Rail In Seismic Regions	John Stanton	85% Completed
UW-2017-1-2	New Seismic-Resisting Connections or Concrete-Filled Tube Components In High-Speed Rail	Dawn Lehman	95% Completed Final Deliverable to be posted soon

Project #	Project Title	Principal Investigator	Status
	Systems (Joint Project with FIU)		
UW-2016-2-1	Development of Non-Proprietary UHPC Mix - Evaluation of the Shear Strength of UHPC (Joint project with all partner universities)	Paolo Calvi	40% Completed
UW-2016-2-2	Development of ABC Course Module- Seismic Connections	John Stanton	30% Completed
UW-2016-2-3	Development of ABC Course Module - Design of CFST Components and Connections for Transportation Structures	Dawn Lehman	88% Completed
UW-2016-2-4	Performance of Existing ABC Projects - Inspection Case Studies (Joint project with all partner universities)	John Stanton	15% Completd
UW-2016-2-5	UW-2016-2-5- Tsunami Design Forces for ABC Retrofit	Marc Eberhard	10% Completd
UW-2016-3-1	Design Guidelines for ABC Column-to-Drilled-Shaft Foundation Connections in High Seismic Zones	Marc Eberhard	New Project
UW-2016-3-2	Economic Pier-to-Pile Connections for Permanently Cased Shaft (CFST) Piles	Dawn Lehman	New Project

1.2.2 Leadership

Several of the partner universities faculty members and students serve on national committees, panels, and other volunteer positions.

1.2.3 Education and Workforce Development

The core Education and Workforce Development tasks continued during the past reporting period. These are summarized in the below table.

Task #	Brief Description of Task	10/1/19 to 3/31/20
WD-1	Student Education and Research Assistantships: Each ABC-UTC consortium member will be expected to mentor a minimum of one graduate student for approximately each \$75,000 in project work and provide research assistantship opportunities for graduate students.	52 (FIU, UNR, ISU, OU, UW) MS/Ph.D. students have been supported
WD-2	Undergraduate Internships: Each ABC-UTC consortium member will be expected to support undergraduate students on research projects.	12 (FIU, UNR, ISU, OU) undergraduate students have been supported
WD-3	Student Publications: Each ABC-UTC consortium member will be expected to support students to publish and present their work.	35 publications (submitted, accepted, or published)
		25 conference presentations (presented)
WD-4	Travel Scholarships: Each ABC-UTC consortium member will be expected to support students who travel to conferences to present their work.	26 travel scholarships provided
WD-5	Research Seminars – Each graduate student will be required to give a technical presentation at the conclusion of their research study. These presentations will be delivered electronically as part of the ABC-UTC technology transfer activities.	Total of 2 students presented in 2 research seminars
		1027 sites attended the seminars

The following students were supported to travel during the previous reporting period.

	Student Name	Conference Name	Date	Location
1	Rehmat, Sheharyar	TRB Annual Meeting	01/2020	Washington, DC
2	Sadegnejad, Amir	TRB Annual Meeting	1/2020	Washington, DC
3	Mokhtarimousavi, Seyedmirsajad	TRB Annual Meeting	1/2020	Washington, DC
4	Javed, Ali	TRB Annual Meeting	1/2020	Washington, DC
5	Caluk, Nerma	TRB Annual Meeting	1/2020	Washington, DC
6	Valikhani, Alireza	TRB Annual Meeting	1/2020	Washington, DC
7	Chang, Michelle	TRB Annual Meeting	1/2020	Washington, DC
8	Volk, Michael	2019 ABC Conference	12/2019	Miami, FL
9	Rehmat, Sheharyar	2019 ABC Conference	12/2019	Miami, FL
10	Sadegnejad, Amir	2019 ABC Conference	12/2019	Miami, FL

	Student Name	Conference Name	Date	Location
11	Mokhtarimousavi, Seyedmirsajad	2019 ABC Conference	12/2019	Miami, FL
12	Javed, Ali	2019 ABC Conference	12/2019	Miami, FL
13	Caluk, Nerma	2019 ABC Conference	12/2019	Miami, FL
14	Valikhani, Alireza	2019 ABC Conference	12/2019	Miami, FL
15	Muhammad Faheem	2019 ABC Conference	12/2019	Miami, FL
16	Mohamadtaqi Baqersad	2019 ABC Conference	12/2019	Miami, FL
17	Saman Farhangdoust	2019 ABC Conference	12/2019	Miami, FL
18	Abbas Khodayari	2019 ABC Conference	12/2019	Miami, FL
19	Esmail Shahrokhinasab	2019 ABC Conference	12/2019	Miami, FL
20	Carlos Sosa	2019 ABC Conference	12/2019	Miami, FL
21	Ali, Syed Ashik	99th Annual Meeting of Transportation Research Board (TRB)	1/2020	Washington, DC
22	Looney, Trevor	2019 International ABC Conference	12/2019	Miami, FL
23	Aboukifa, Mahmoud	2019 International ABC Conference	12/2019	Miami, FL
24	Abokifa, Mohamed	2019 International ABC Conference	12/2019	Miami, FL
25	Naeimi, Negar	2019 International ABC Conference	12/2019	Miami, FL
26	Ghaffary, Azin	2019 International ABC Conference	12/2019	Miami, FL

In addition to these core Education and Workforce Development activities, the following activities were conducted:

- Mentorship activities continue to take place.
 - K-12 activities were developed with the ACI Student Chapter at FIU for STEM-fair events, where participants walk around to different tables with STEM activities. These activities and demonstrations were designed to have different levels of complexity for different age students.
 - Students from the ACI Student Chapter at FIU hosted demonstration tables at FIU's Engineering Expo (2/21/20), which saw more than 1,600 K-12 students from Miami-Dade and Broward County schools.
 - Students from the ACI Student Chapter at FIU hosted demonstration tables at Miami-Dade Public Library System's STEAMFest (2/22/20), which saw several hundred K-12 students and parents from Miami-Dade County.

- Planning for additional WD activities in 2020 was done at the annual meeting in December 2019. These activities included the following:
 - Parent-Child Camp (K-8) – multi-day camp designed for parents and their children (K-8) to learn about bridge engineering
 - Public Library Outreach – partner with libraries to develop and run extracurricular activities related to bridge engineering
 - Edutainment Learning – partnering with Digital Innovations and Pinecrest Academy of Nevada (Edutainment); K-12 teachers request interview with expert in specific field and expert uses video communications to interact with class
 - 3D Printing Workshops and Model Development – partnering with Miami Beach Urban Studios on 3d printing and model development
 - Teacher Workshops – two-day teacher workshops hosted by different partner universities to introduce teachers to bridge engineering curriculum developed by ABC-UTC researchers

Future 2020 WD are being reevaluated based on the current situation with COVID-19. The ABC-UTC continues to host all their digital K-12 resources at <https://abc-utc.fiu.edu/education/k-12-resources/>.

1.2.4 Technology Transfer

During this reporting period, The 2019 International Accelerated Bridge Construction Conference, including Automation, Service Life and Ultra High-Performance Concrete was held. It was sponsored by the ABC-UTC and co-sponsored by 30 State Departments of Transportation, the Transportation Research Board, and the Federal Highway Administration. Over 600 attended the 2019 International Accelerated Bridge Construction Conference, including over 120 bridge engineers from state departments of transportation, 20 bridge engineers from the Federal Highway Administration, and various consultants and other bridge professionals. Seven half-day workshops were held on Wednesday, December 11. The Conference began on Thursday, December 12 with a general session followed by 30 technical sessions with 108 thirty-minute presentations. The conference concluded on Friday, December 13. A total of 52 companies exhibited ABC-related products and services to attendees during the 2019 Conference.

Coordination with state DOT bridge engineers occurred this reporting period to host the American Association of Highway and Transportation Officials (AASHTO) Committee on Bridges and Structures (COB) Technical Committee for Construction (T-4) mid-year meeting on December 9 in conjunction with the International ABC Conference in Miami.

Six Monthly Webinars were conducted during the reporting period. For these free webinars, the number of registered sites ranged from 800 to over 1,100 with multiple participants at many of the sites. Three presentations were given by bridge owners (Colorado DOT, Connecticut DOT, and Tennessee DOT) and their industry partners, featuring design and construction details and lessons learned on state-of-the-art ABC technologies incorporated in recently completed bridge projects in their states. One presentation was given by a Canadian bridge owner and industry partner on ABC aspects of one of their recent signature bridge projects. The remaining two presentations focused on (1) FHWA's Bridge Bundling Guidebook, an ABC planning and programming tool, and (2) the rescission of FHWA's patented and proprietary product regulation and Maine DOT's incorporation of proprietary products in projects in their state after the rescission.

During this period one Research Day Seminar was held with over 135 sites registered for the free 5-hour online seminar.

The ABC-UTC website (<https://abc-utc.fiu.edu/>) was updated with the latest ABC-UTC research and workforce development activities. Also posted were the Monthly Webinar and In-Depth Web Training recordings and other documents. Archives were similarly posted for the October and January Research Seminars reported in the Workforce Development section of this report. Also, work continued on data entry of completed ABC construction projects in the ABC Project Database, working with bridge owners to complete these submissions for posting on the open web. In addition, various other ABC events, news items, and details were posted.

Research	Goals	Research Performance Measures	10/1/19-3/31/20
Outputs	ABC-UTC Guides documents – Short documents that provide essential information needed to put results of research into practice; note that projects with similar topics may have a combined document	Number of documents submitted	1
	Research Seminar – Principal Investigator(s) and graduate student(s) will co-present project findings in quarterly Research Seminar series; products of the research project, at completion, will be presented	Number of seminars	2
	Publications – Peer-reviewed publications on research products	Number of peer-reviewed publications on research products	14
	Presentations – Research projects presented at conferences and other events	Number and quality of conferences and events during which results of the research are presented	60

Research	Goals	Research Performance Measures	10/1/19-3/31/20
	Development of Educational Materials – Continuing education courses, web-based training, part of conference workshops, or modules for college courses	Number of developed educational materials We are currently working on developing 4 short courses, work currently in progress. (See Research Section, project #'s FIU-2016-2-3; ISU-2016-2-4; UW-2016-2-2; UW-2016-2-3)	1
Outcomes	Separate Financial Contributions for Research Projects or Follow-on Research Projects – The impact of the research projects will be assessed by the level of interest expressed by state DOTs and/or industry	Number of separate financial contributions for research projects, including follow-on research projects	2
	Use in ABC Projects – Product(s) used in an ABC construction project	Number of times research products are incorporated in bridge construction projects, as identified by the PIs in collaboration with the bridge owners	0
Impacts	Governing State, Local, and National Specifications	Number of changes, to incorporate products, that are made to the state, local, or national (e.g., AASHTO) bridge design and/or construction specifications or guidelines.	1
	Standard Use of Products in ABC Projects	Number of states using the products in their bridge construction as a standard practice, as identified by the PIs in collaboration with the bridge owners	0

1.2.5 Collaboration

Collaboration among partner universities and advisory board members continues an ongoing basis for the areas of research, technology transfer and education and workforce development.

1.2.6 Diversity

Nothing to report.

1.2.7 How have the results been disseminated?

- Research Day was held on 11/8/2019 where the progress of each research project was presented by PI's to a general audience (comprising of State DOTs, Industry, FHWA, and other affiliates).
- Quarterly Progress Reports posted on the website.
- Publications
- Presentations
- Conference Proceedings
- Webinars, Research Seminars, In-depth Web Training

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

Expected highlights of the next reporting period include:

- Identification of project topics for Cycle 4 Research
- Implementation of Education and Workforce Development activities pending COVID-19
- Planning of the 2022 CUTC Meeting
- The planning of the next ABC-UTC Conference to be held in December 2021.
- Monthly webinars and other related technology transfer activities
- The quarterly research seminar and semi-annual research day
- Continuation of Research Projects and other activities.
- Working with bridge owners to implement the results of research projects developed by ABC-UTC
- Commercialization of patented products developed by ABC-UTC
- Assisting State DOT engineers to identify funds available through demonstration projects for implementing ABC-UTC developed products and bridge solutions.
- Develop a cooperative working relationship with PEER (Pacific Earthquake Engineering Research Center at the University of California at Berkeley California).
- Develop a cooperative working relationship with US Forest Service
- Develop small companies for marketing products and solutions developed by ABC-UTC
- Work with State DOTs, FHWA and bridge owners to organize workshops across the U.S. for educating bridge professionals with latest in the ABC area. Specifically, we are attempting to organize a day-long ABC workshop at different locations.
- Work with State DOT engineers and other entities who have developed Non-Proprietary Ultra-High Performance Concrete (UHPC) mixes to organize a daylong workshop that will include hands-on activities to promote the use of UHPC which is an advanced cementitious material.

2. PRODUCTS

2.1 PUBLICATIONS, CONFERENCE PAPERS, AND PRESENTATION

2.1.1 Journal Articles Submitted

Citation for Article	Peer-Reviewed?
Author(s). "Article Title". <i>Journal Title</i> , Submitted <Month>, <year>.	Yes or No
Valikhani, Alireza, Azadeh Jaber Jahromi, Islam M. Mantawy, and Atorod Azizinamini. "Numerical Modelling of Concrete-to-UHPC Bond Strength." <i>Materials</i> 13, no. 6 (2020): 1379.	Yes
Valikhani, Alireza, Azadeh Jaber Jahromi, Islam M. Mantawy, and Atorod Azizinamini. "Experimental evaluation of concrete-to-UHPC bond strength with correlation to surface roughness for repair application." <i>Construction and Building Materials</i> 238 (2020): 117753.	Yes
Valikhani, A.; Pouyanfar, S.; Jaber, A.; Mantawy, I.M; Azizinamini, A., "A Robust machine learning and image processing approaches to estimate concrete surface roughness using basic cameras" To be submitted to <i>Computer Aided Civil and Infrastructure Engineering</i>	Yes
Jaber Jahromi, Azadeh, Alireza Valikhani, Islam M. Mantawy, and Atorod Azizinamini. "Service Life Design of Deck Closure Joints in ABC Bridges: Guidelines and Practical Implementation." <i>Frontiers in Built Environment</i> 5 (2019): 152.	Yes
Sadeghnejad, Amir, Sheharyar Rehmad, Islam M. Mantawy, and Atorod Azizinamini . "SDCL in Seismic Areas: A comparative Study of Cyclic and Shake Table Tests". <i>Transportation Research Record</i>	Yes
Mokhtarimousavi, S., Anderson, J.C., Azizinamini, A., Hadi, M., "A Temporal Investigation of Crash Severity in Worker-Involved Work Zone Crashes: Investigating the Contributing Factors, Logistic Regression and Machine Learning Approaches," Submitted for publication in <i>International Journal of Transportation Science and Technology</i> .	Yes
Caluk, N., Mantawy, I. M., & Azizinamini, A. (2020). Cyclic Test of Concrete Bridge Column Utilizing Ultra-High Performance Concrete Shell. <i>Transportation Research Record</i> , 0361198120906088.	Yes
Farhangdoust, S, and Mehrabi, A.B., "Non-Destructive Evaluation of Closure Joints in Accelerated Bridge Construction using a Damage Etiology Approach," <i>MDPI- Applied Sciences</i> , February 2020.	Yes
Looney, T., Coleman, R., Funderburg, C., Volz, J., and Floyd, R. "Concrete Bond and Behavior of Non-Proprietary Ultra-High Performance Concrete Bridge Slab Joints," <i>ASCE Journal of Bridge Engineering</i> , Submitted October 31, 2019, Revision Submitted February 28, 2020.	Yes
Rahman M.A., Ghabchi, R., Zaman, M., Ali, S.A., and Arshadi, A. "Laboratory Characterization of Rutting and Moisture-Induced Damage Potential of Foamed Warm Mix Asphalt (WMA)	Yes

Containing RAP." <i>International Journal of Pavement Research and Technology</i> , Submitted March, 2020.	
Sumter, C.R., Dugan, C.R., Zaman, M., Rani, S., and Ali, S.A. "Rheology of Asphalt Binder with High Percentages of RAP Binder Rejuvenated with Waste Vegetable Oil." American Chemical Society Omega, Submitted January, 2020.	Yes

2.1.2 Journal Articles Published (TT Plan Output)

Citation for Article	Peer-Reviewed?
Author(s). "Article Title". <i>Journal Title</i> , vol., pp, date.	Yes or No
Farzad, Mahsa, Siavash Rastkar, Amir Sadeghnejad, and Atorod Azizinamini. "Simplified method to estimate the moment capacity of circular columns repaired with UHPC." <i>Infrastructures</i> 4, no. 3 (2019): 45.	Yes
Farzad, Mahsa, Amir Sadeghnejad, Siavash Rastkar, Arash Moshkforoush, and Atorod Azizinamini. "A theoretical analysis of mechanical and durability enhancement of circular reinforced concrete columns repaired with UHPC." <i>Engineering Structures</i> 209 (2020): 109928.	Yes
Mokhtarimousavi, S., Anderson, J.C., Azizinamini, A. and Hadi, M., 2020. Factors affecting injury severity in vehicle-pedestrian crashes: A day-of-week analysis using random parameter ordered response models and Artificial Neural Networks. <i>International Journal of Transportation Science and Technology</i> . (In Press)	Yes
Mokhtarimousavi, S., 2019. A time of day analysis of pedestrian-involved crashes in California: Investigation of injury severity, a logistic regression and machine learning approach using HSIS data. <i>Institute of Transportation Engineers. ITE Journal</i> , 89(10), pp.25-33.	Yes
Valikhani, Alireza, Azadeh Jaber Jahromi, Islam M. Mantawy, and Atorod Azizinamini. "Numerical Modelling of Concrete-to-UHPC Bond Strength." <i>Materials</i> 13, no. 6 (2020): 1379.	Yes
Valikhani, Alireza, Azadeh Jaber Jahromi, Islam M. Mantawy, and Atorod Azizinamini. "Experimental evaluation of concrete-to-UHPC bond strength with correlation to surface roughness for repair application." <i>Construction and Building Materials</i> 238 (2020): 117753.	Yes
Jaber Jahromi, Azadeh, Alireza Valikhani, Islam M. Mantawy, and Atorod Azizinamini. "Service Life Design of Deck Closure Joints in ABC Bridges: Guidelines and Practical Implementation." <i>Frontiers in Built Environment</i> 5 (2019): 152.	Yes
Caluk, N., Mantawy, I. M., & Azizinamini, A. (2020). Cyclic Test of Concrete Bridge Column Utilizing Ultra-High Performance Concrete Shell. <i>Transportation Research Record</i> , 0361198120906088.	Yes

Farzad, Mahsa, Mohamadreza Shafieifar, and Atorod Azizinamini. "Retrofitting of Bridge Columns Using UHPC." Journal of Bridge Engineering 24, no. 12 (2019): 04019121.	Yes
Shafieifar, Mohamadreza, Mahsa Farzad, and Atorod Azizinamini. "Investigation of a Detail for Connecting Precast Columns to Precast Cap Beams Using Ultrahigh-Performance Concrete." Journal of Bridge Engineering 25, no. 3 (2020): 04020001.	Yes
Farhangdoust, S, and Mehrabi, A.B., "Non-Destructive Evaluation of Closure Joints in Accelerated Bridge Construction using a Damage Etiology Approach," MDPI- Applied Sciences, February 2020.	Yes
Looney, T., McDaniel, A., Volz, J., and Floyd, R., "Development and Characterization of Ultra-High Performance Concrete with Slag Cement for Use as Bridge Joint Material", British Journal of Civil and Architecture Engineering, Vol. 1, No. 2, 2019, pp. 1-14.	Yes
Ali, S.A., Zaman, M, Ghabchi, R., Rahman, M.A., Ghos, S., and Rani, S. "Effect of Additives and Aging on Moisture-induced Damage Potential of Asphalt Mixes Using Surface Free Energy and Laboratory-Based Performance Tests." International Journal of Pavement Engineering, DOI: 10.1080/10298436.2020.1742335, March 2020.	Yes
Aboukifa, M., M.A. Moustafa, A. Itani. "Comparative Structural Response of UHPC and Normal Strength Concrete Columns under Combined Axial and Lateral Cyclic Loading", ACI Special Publication (in-press)	Yes

2.1.3 Meeting/Conference Presentations/Posters Made By key researchers & Students (TT Plan Output)

Meeting / Conference Name	Citation for Presentation
Meeting/Conference name, location, mo/yr	Author(s). "Presentation Title"
ABC International Conference Dec 2019	Rehmat, S., Sadehnejad, A., Mantawy, I., Azizinamini. Connection Details for Concrete Filled Tubes to Precast Footing and Cap Beam using Ultra-High Performance Concrete (Poster)
2019 International Accelerated Bridge Construction, Miami, 2019	Carlos Sosa, Mantawy, I., Azizinamini. "Repair and retrofit of timber piles using UHPC – preliminary tests" (Poster)
Transportation Research Board 99th Annual Meeting, Washington DC Jan/2020.	Sadeghnejad, Amir, Sheharyar Rehmat, Islam M. Mantawy, Atorod Azizinamini. "SDCL in Seismic Areas: A Comparative Study of Cyclic and Shake Table Tests"
International ABC Conference, Pre-	Sadeghnejad, Amir, Atorod Azizinamini. "Simple for Dead load and Continuous for Live load (SDCL) steel bridge system: Seismic Application." (Workshop)

conference Workshops, Miami, FL, Dec/2019	
International ABC Conference, Miami, FL 12/2019	Abbas Khodayari, Islam Mantawy, and Atorod Azizinamini. "Connection of Concrete Bridge Barrier and Deck using Ultra-High Performance Concrete"
ABC Conference, Miami, FL, 12/2019	Dickinson, Mantawy; Mantawy, I., Azizinamini Poster entitled "Optimization of Cementitious Overlays and Upgrades including Shotcrete"
2019 ABC Conference, Miami, December 2019	Caluk, Nerma; Mantawy, I., Azizinamini. "Eliminating the Need for Formwork using UHPC Shells"
2020 TRB Annual Meeting, Washington D.C., January, 2020	Caluk, Nerma and Mantawy, I., "Cyclic Test of Concrete Bridge Column Utilizing UHPC Shell"
2019 ABC Conference, Miami, December 2019	Azizinamini, Atorod. "Next Generation of Folded Steel Plate Girder Systems for Short Span Bridges"
2019 ABC Conference, Miami, December 2019	Azizinamini, Atorod. "Robotics & Automation in Construction (Technical Key Note)"
2019 ABC Conference, Miami, December 2019	Islam Mantawy. "Exploring Polymer Concrete for Bridge Deck Closures in ABC"
2019 - Research Day 2 November 8 th , 2020 (Online)	21 key researchers presented. Click on link below for list and toipcs/projects: https://abc-utc.fiu.edu/mc-events/2019-research-day-2/?mc_id=513
Research Seminar 10/25/2019	David Garber, Ph.D., P.E., Principal Investigator; and Esmail Shahrokhinasab, Ph.D. student. "Performance Comparison of In-Service, Full-Depth Precast Concrete Deck Panels to Cast-in-Place Decks".
Research Seminar 1/31/2020	Atorod Azizinamini, Ph.D., P.E., Principal Investigator; and Faheem Afzal, Ph.D. student. "Extending Maximum Length of the Folded Steel Plate Girder Bridge System (FSPGBS), exceeding 100 ft. with Capability to Incorporate Camber".
1 st International Conf. on 3D Printing and Transportation, Washington, DC, November 20-21, 2019	Atorod Azizinamini. "3D Printing of UHPC Formwork for ABC"
Bridge Taskforce Meeting, Orlando FL Jan. 29-31, 2020	Presentation at meeting on, ABC Research on Folded Steel Plate Girder. (National Meeting)
PCI Bridge Committee Meeting, Rosemont, Chicago, September 2019	Atorod Azizinamini, "UHPC Based ABC Solutions for Existing and New Bridges: ABC-UTC Research Activities"

	(National Meeting)
The Transportation Research Board (TRB) 99th Annual Meeting, Washington D.C., Jan 2020	Construction Management Committee AFH10, - National Meeting Attended Attended by Lu Zhang
The Transportation Research Board (TRB) 99th Annual Meeting, Washington D.C., Jan 2020	Information Systems in Construction Management Subcommittee, -National Meeting Attended by Lu Zhang
2019 ABC Conference, Miami, FL December 2019	Lu Zhang, Conducted more than 20 interviews with bridge experts related to Understanding critical impacting factors and trends on bridge design, construction, and maintenance for future planning
TRB 99 th Annual Meeting, Washington, D.C., January 2020	Shahrokhinasab E* and Garber D, "Long-Term Performance of Full-Depth Precast Concrete (FDPC) Deck Panels," TRB 99th Annual Meeting, Precast Concrete Bridge Deck Systems (Lectern Session 1175), Washington, D.C., January 2020.
TRB 99 th Annual Meeting, Washington, D.C., January 2020	Garber D, "ABC Research Database," TRB 99th Annual Meeting, ABC Joint Subcommittee – AFF00(2), Washington D.C., January 2020.
2019 International ABC Conference, Miami, FL, December 2019	Garber D and Shahrokhinasab E*, "Effect of Regional Materials on ABC-UTC Non-Proprietary UHPC Mix," 2019 International ABC Conference, Workshop #3: Non-Proprietary UHPC for ABC, Miami, FL, December 2019
2019 International ABC Conference, Miami, FL, December 2019	Shahrokhinasab E* and Garber D, "Performance Comparison of In-Service, Full-Depth Precast Concrete Deck Panels to Cast-in-Place Decks," 2019 International ABC Conference, ABC-Research, Miami, FL, December 2019.
The 7th Annual UTC Conference for the Southeastern Region, March 26-27, 2020, Florida Atlantic University, Boca Raton, FL	Bakhtiari, A. & Lee, S. J. (Accepted but the conference has been postponed due to the coronavirus pandemic) Predictive Bridge Demolition via Computer Simulation,
The International Accelerated Bridge Construction Conference, Miami, FL, December 11-13	Bakhtiari, A. & Lee, S. J. (2019) Enhanced Demolition Prediction via Computer Simulation, A Predictive Computer Program for Proactive Demolition Planning
2019 International Accelerated Bridge Construction Conference,	Floyd, R., Volz, J., Zaman, M., Walker, C., Roswurm, S., Dyachkova, Y., Looney, T. (presenter), "Development of ABC-UTC Non-Proprietary UHPC Mix," (poster)

Miami, FL, December 12-13, 2019.	
Oklahoma Transportation Research Day, Oklahoma City, OK, November 5, 2019	Floyd, R., Volz, J., Zaman, M., Walker, C. (presenter), Roswurm, S., and Dyachkova, Y., "Development of ABC-UTC Non-Proprietary UHPC Mix," (poster)
2019 International Accelerated Bridge Construction Conference	P.S. Harvey, K.K. Muraleetharan, S. Sivakumaran. "A Framework to Quantify the Cumulative Damage due to Induced Seismicity"
Transportation Research Board 99th Annual Meeting, Washington, D.C. Date: January 12-16, 2020	Ali, S.A., Zaman, M, Ghabchi, R., Rahman, M.A., Ghos, S., and Rani, S. "Effect of Additives and Aging on Moisture-induced Damage Potential of Asphalt Mixes Using Surface Free Energy and Laboratory-Based Performance Tests."
Transportation Research Board 99th Annual Meeting, Washington, D.C. Date: January 12-16, 2020	Rahman M.A., Ghabchi, R., Zaman, M., Ali, S.A., and Arshadi, A. "Laboratory Characterization of Rutting and Moisture-Induced Damage Potential of Foamed Warm Mix Asphalt (WMA) Containing RAP."
2019 International ABC Conference, December 12–13, 2019, Miami, FL	Shoushtari, E., M.S. Saiidi, A. Itani, M.A. Moustafa, "Assessment of the Seismic Performance of an ABC Steel Girder Bridge through Shake Table Studies", [oral]
2019 International ABC Conference, December 12–13, 2019, Miami, FL	Naeimi, N., M. A. Moustafa, "Uniaxial Compression Behavior of Ultra-High Performance Concrete Confined by Steel Spirals", [poster]
2019 International ABC Conference, December 12–13, 2019, Miami, FL	Ghaffary, A., M. A. Moustafa, "Synthesis of Repair Methods for RC Bridge Girders", [poster]
2019 International ABC Conference, December 12–13, 2019, Miami, FL	Abokifa, M., M.A. Moustafa, A. Itani, "Connecting Prefabricated Bridge Decks using Poly Methyl Methacrylate Polymer Concrete", [poster]
2019 International ABC Conference, December 12–13, 2019, Miami, FL	Aboukifa, M., M.A. Moustafa, A. Itani, "Behavior of UHPC Columns Subjected to Combined Axial and Lateral Loading", [oral]
Caltrans Earthquake Research Seminar, September 26, 2019, Sacramento, CA	Moustafa, M. A. "Two Applications of UHPC for Bridge Columns: Full columns and Seismic Connections", [oral]
ACI Committee 239 Ultra-High Performance Concrete (UHPC), Cincinnati, OH, October 2019	Moustafa, M.A. Presented work on ABC-UTC related UHPC work.
FIU webinar series 2020.01.29	Stanton, John, "Use of UHPC for Longitudinal Joints in Deck Bulb Tee Bridge Girders"

2019 International ABC Conference, December 12–13, 2019, Miami, FL	Eberhard, M.O. “Application of Accelerated Bridge Construction Strategies and Innovative Structural Systems to High-Speed Rail”, 2019 International Accelerated Bridge Construction Conference, 12/2019.
Superpile 2019 (Seattle)	Lehman. “Use of CFTs for seismic resistance”.
PEER (Berkeley 2019)	Lehman. “Use of CFTs for seismic resistance”.
2019 International ABC Conference, December 12–13, 2019, Miami, FL	Eberhard, M.O. “Application of Accelerated Bridge Construction Strategies and Innovative Structural Systems to High-Speed Rail”, 2019 International Accelerated Bridge Construction Conference, 12/2019.

2.1.4 Conference Proceedings (TT Plan Output)

Citation for Conference Proceedings	Peer-Reviewed?
Author(s). “Article Title”. <i>Conference proceedings</i> , year, pp.	Yes or No
P.S. Harvey, K.K. Muraleetharan, S. Sivakumaran. “A Framework to Quantify the Cumulative Damage due to Induced Seismicity”. Proc. of the 2019 International Accelerated Bridge Construction Conference.	No
Sadeghnejad, Amir, Sheharyar Rehmat, Islam M. Mantawy, Atorod Azizinamini. “SDCL in Seismic Areas: A Comparative Study of Cyclic and Shake Table Tests” . Proc. of the 2019 International Accelerated Bridge Construction Conference.	No
Abbas Khodayari, Islam Mantawy, and Atorod Azizinamini. “Connection of Concrete Bridge Barrier and Deck using Ultra-High Performance Concrete”. Proc. of the 2019 International Accelerated Bridge Construction Conference.	No
Caluk, Nerma; Mantawy, I., Azizinamini. “Eliminating the Need for Formwork using UHPC Shells”. Proc. of the 2019 International Accelerated Bridge Construction Conference.	No
Azizinamini, Atorod. “Next Generation of Folded Steel Plate Girder Systems for Short Span Bridges”. Proc. of the 2019 International Accelerated Bridge Construction Conference.	No
Islam Mantawy. “Exploring Polymer Concrete for Bridge Deck Closures in ABC”. Proc. of the 2019 International Accelerated Bridge Construction Conference.	No
Shahrokhinasab E* and Garber D, “Performance Comparison of In-Service, Full-Depth Precast Concrete Deck Panels to Cast-in-Place Decks,”. Proc. of the 2019 International Accelerated Bridge Construction Conference.	No
Bakhtiari, A. & Lee, S. J. (2019) Enhanced Demolition Prediction via Computer Simulation, A Predictive Computer Program for Proactive Demolition Planning. Proc. of the 2019 International Accelerated Bridge Construction Conference.	No

P.S. Harvey, K.K. Muraleetharan, S. Sivakumaran. "A Framework to Quantify the Cumulative Damage due to Induced Seismicity". Proc. of the 2019 International Accelerated Bridge Construction Conference.	No
Shoushtari, E., M.S. Saiidi, A. Itani, M.A. Moustafa, "Assessment of the Seismic Performance of an ABC Steel Girder Bridge through Shake Table Studies", [oral]. Proc. of the 2019 International Accelerated Bridge Construction Conference.	No
Aboukifa, M., M.A. Moustafa, A. Itani, "Behavior of UHPC Columns Subjected to Combined Axial and Lateral Loading" , [oral]. Proc. of the 2019 International Accelerated Bridge Construction Conference.	No
Lehman. "Use of CFTs for seismic resistance". Superpile 2019	No
Eberhard, M.O. "Application of Accelerated Bridge Construction Strategies and Innovative Structural Systems to High-Speed Rail". Proc. of the 2019 International Accelerated Bridge Construction Conference.	No

2.2 WEBSITE AND OTHER INTERNET SITES (TWITTER, FACEBOOK,)

ABC-UTC Website (<https://abc-utc.fiu.edu/>): The ABC-UTC website will continues to be updated on an ongoing basis.

All social media outlets have been created and are updated on an ongoing basis, such as:

- Twitter
- Facebook:
- Instagram
- YouTube
- LinkedIn

2.3 TECHNOLOGIES OR TECHNIQUES

We have initiated joint projects with all partner universities to develop a non-proprietary UHPC mix that will be available at the end of the year, promising low cost and availability to all users.

2.4 INVENTIONS, PATENT APPLICATIONS, AND/OR LICENSES

Azizinamini, Atorod. "Composite construct and methods and devices for manufacturing the same." U.S. Patent Application 16/202,318, filed June 6, 2019.

We have initiated preliminary work to develop the next frontier in bridge engineering, specifically the application of automation in bridge construction inspection with an emphasis on accelerated field procedures.

2.5 OTHER PRODUCTS

Nothing to report.

3. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS: Who has been involved?

3.1 WHAT ORGANIZATIONS HAVE BEEN INVOLVED AS PARTNERS?

- Atorod Azizinamini, Florida International University
- Ahmad Itani, University of Nevada, Reno
- Mohamed A. Moustafa, University of Nevada, Reno
- Terry Wipf, Iowa State University
- Brent Pahres, Iowa State University
- John Stanton, University of Washington
- Musharraf Zaman, The University of Oklahoma University

3.2 HAVE OTHER COLLABORATORS OR CONTACTS BEEN INVOLVED?

The ABC-UTC has an Advisory Committee that provides recommendations on ABC-UTC operations. The ABC-UTC also has advisory boards that provide recommendations under each of its focus areas of Research, Workforce Development, and Technology Transfer. Additionally, advisory panels and committees make recommendations on specific projects or activities.

4. IMPACT: What is the impact of the program? How has it contributed to transportation, education, research, and technology transfer?

4.1 WHAT IS THE IMPACT ON THE DEVELOPMENT OF THE PRINCIPAL DISCIPLINE(S) OF THE PROGRAM?

The ABC-UTC is now recognized as the focal point at the national level for acquiring the entire spectrum of information in ABC area. The USDOT's support of ABC-UTC and having a Tier-1 UTC devoted to ABC has created impactful activities at the national and international level and State DOTs and AASHTO look to ABC-UTC when it comes to ABC. The ABC-UTC is taking a national lead in the ABC area and continues to have an excellent working relationship with FHWA and AASHTO T-4 that is responsible for developing the national roadmap for State DOTs for implementing ABC. The Director of ABC-UTC was also elected to be a liaison between the newly formed TRB ABC committee and ABC-UTC. These connections and activities are allowing ABC-UTC to better fill the knowledge gap, especially in the research and workforce development areas. ABC-UTC has also made major accomplishments in developing a close working relationship with State DOTs Twenty-six state DOTs Co-sponsored the 2014 National ABC Conference, thirty State DOTs co-sponsored the 2015 National ABC Conference, 32 state DOTs co-sponsored the 2017 National ABC Conference and to date 30 state

DOTs, FHWA and TRB have co-sponsored the 2019 International ABC Conference Including Automation, Service Life and UHPC which was held in December of 2019 at the Hyatt Regency Hotel in Miami, FL. The State DOT engineers of sponsoring State DOTs work very closely with the ABC-UTC director to develop the conference program. The connection created with State DOT bridge engineers will greatly facilitate the implementation of ABC-UTC work.

4.2 WHAT IS THE IMPACT ON OTHER DISCIPLINES?

ABC-UTC has identified research areas that will help the ABC cause and that falls outside the mission of ABC-UTC. Bridge engineering is a multi-disciplinary field and ABC-UTC research activities are having an influence on several other disciplines, such as robotics, automation, computer science and development of the new field in damage assessment that is related to service life design of bridges.

4.3 WHAT IS THE IMPACT ON PHYSICAL, INSTITUTIONAL, AND INFORMATION RESOURCES AT THE UNIVERSITY OR OTHER PARTNER INSTITUTIONS?

As a direct result of having USDOT's support for ABC-UTC at FIU, FIU has provided several faculty lines to the Civil and Environmental Engineering Department. These additional new faculties are allowing to diversify the scope of research mission and conduct high-quality, multi-disciplinary research. Similar to FIU, other partner universities are also receiving many new resources that otherwise would not be provided to the group. As an example, Alumni and state are helping FIU to build a state of the testing facility capable of testing a very large bridge segment.

4.4 WHAT IS THE IMPACT ON TECHNOLOGY TRANSFER?

ABC technologies are increasingly being specified on bridge replacement projects as state DOTs and other bridge owners and their partners gain understanding and expertise in ABC. The ABC knowledge is expanding in part due to the large numbers of participants in the ABC-UTC conferences and the various ABC-UTC web activities, in addition to stakeholders' use of resources on the ABC-UTC website. Also, the close involvement of state DOT, FHWA, and industry partners in the ABC-UTC's Advisory Committee, Research Advisory Board, Workforce Development Advisory Board, and Technology Transfer Advisory Board is providing the exposure needed to understand the benefits of implementing ABC in their projects.

4.5 WHAT IS THE IMPACT ON SOCIETY BEYOND SCIENCE AND TECHNOLOGY?

Increasing safety, enhancing mobility, being environmentally responsible, building bridges that are resilient and sustainable are important consequences of using ABC. The major goal of ABC-UTC is to make ABC the method of choice for bridge replacement and retrofit and in future to call it BC. This, in turn, will improve mobility and save society in many different ways. One of the most important contributions of ABC to society is reducing the number of accidents and therefore significantly enhancing safety. A single accident could cost taxpayers millions in litigation and legal expenses. ABC is the future of bridge engineering and FHWA is very actively promoting ABC. Thanks to USDOT to

dedicate a Tier-1 UTC to this very timely area. We are hearing many comments from our stakeholders, indicating that they are looking at ABC-UTC, its web site, research products, webinars, and conferences, as a single point where they can go to get an answer to their questions. We are expanding our activities on a daily basis and adjusting our activities based on feedback we are receiving from stakeholders, to better achieve our mission and goals and fulfill what we promised in our proposal.

5. CHANGES/PROBLEMS

5.1 CHANGES IN APPROACH AND REASONS FOR CHANGE

Nothing to report.

5.2 ACTUAL OR ANTICIPATED PROBLEMS OR DELAYS AND ACTIONS OR PLANS TO RESOLVE THEM.

Since Mid March 2020, because of COVID-19, all partner universities have stopped the experimental work, which is a significant part of ABC-UTC research activity. During this period, all other tasks, including conducting numerical and analytical investigations, technology transfer activities and anything that could be done remotely are progressing and have increased. During this time period, detail plans are also being developed to re-start the experimental work, with higher efficiency, once permissions are given to return to testing laboratories.

5.3 CHANGES THAT HAVE A SIGNIFICANT IMPACT ON EXPENDITURES

Nothing to report.

5.4 SIGNIFICANT CHANGES IN USE OR CARE OF HUMAN SUBJECTS, VERTEBRATE ANIMALS, AND/OR BIOHAZARDS

Nothing to report.

5.5 CHANGE OF PRIMARY PERFORMANCE SITE LOCATION FROM THAT ORIGINALLY PROPOSED

Nothing to report.

6. Additional information regarding Products and Impacts

Nothing to report.