UTC Semi Annual Progress Report
University Transportation Centers

Submitted to	U.S. Department of Transportation Research and Innovative Technology Administration
Federal Grant Number	69A3551747121
Project Title	ABC-UTC (Accelerated Bridge Construction – University Transportation Center)
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Submitting Official	Same as above
Submission Date	10/31/2018
DUNS and EIN Numbers	DUNS: EIN: 237047106
Recipient Organization	Florida International University; 11200 SW 8th St, Miami, FL 33174
Grant Period	11/30/2016-12/1/2022
Reporting Period Start Date	**4/01/2019**
Reporting Period End Date	**9/30/2019**
Report Frequency	Semi-annual (Report #5)
Submitting Official	Dr. Atorod Azizinamini

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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. Two cycles of research projects are being conducted and the center is in the process of topic selection for the third cycle.

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 proposed consortium is diverse in ways beyond the call of the RFP. 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 update of the Operation Manual. We continue to update the Operation manual as needed to best fit our goals and objectives.

- Selection of Research Topics for Cycle 3 (Starting January 2020). All partner universities have submitted idea proposals for the advisory committee to review. The PI's will be informed in November regarding the selection of topics chosen and will need to submit full proposals by the end of November.

- 2019 Research Day 1 was held on May 7th, 2019 and presented to the public via GoToWebinar. We had a total of 14 presentations which were based on Cycle 1 projects. We are planning to host the next Research Day sometime in November.

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	80% complete
FIU-2016-1-2	Field Demonstration-Instrumentation and monitoring of Accelerated Repair Using UHPC Shell	Kingsley Lau	50% 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	40% complete
FIU-2016-1-4	Innovative Foundation Alternative for High-Speed	Seung Jae Lee	25% complete

Project #	Project Title	Principal Investigator	Status
	Rail Application (Joint project with UNR)		
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	50% complete
FIU-2016-2-1	Development of Non-Proprietary UHPC Mix (Joint project with all partner universities)	David Garber	20% complete
FIU-2016-2-2	Performance of Existing ABC Projects - Inspection Case Studies (Joint project with all partner universities)	Armin Mehrabi	5% complete
FIU-2016-2-3	Development of ABC Course Module- Available ABC Bridge Systems for Short Span Bridges	Armin Mehrabi	50% complete
FIU-2016-2-4	Optimization of Advanced Cementitious Material for Bridge Deck Overlays and Upgrade, Including Shotcrete	Islam Mantawy	20% complete
FIU-2016-2-5	Robotics and Automation in ABC Projects	Islam Mantawy	25% complete
FIU-2016-2-6	Laminated Wood Deck System for Folded Plate Girder	Atorod Azizinamini	10% complete
ISU-2017-1-1	Contracting Methods for Accelerated Bridge Construction Projects: Case Studies and Consensus Building	Katelyn Freeseman	95% complete
ISU-2017-1-2	Bidding of Accelerated Bridge Construction	Katelyn Freeseman	95% complete

Project #	Project Title	Principal Investigator	Status
	Projects: Case Studies and Consensus Building		
ISU-2017-1-3	Accelerated Repair and Replacement of Expansion Joints	Brent Phares	75% complete
ISU-2016-2-1	Development of Non-Proprietary UHPC Mix (Joint project with all partner universities)	Behrouz Shafei	55% complete
ISU-2016-2-2	Performance of Existing ABC Projects- Inspection Case Studies (Joint project with all partner universities)	Katelyn Freeseman	35% complete
ISU-2016-2-3	Synthesis of available contracting methods	Jennifer S. Shane,	30% complete
ISU-2016-2-4	Development of ABC Course Module- Design of Link Slabs	Behrouz Shafei	45% complete
UNR-2016-1-1	Innovative Foundation Alternative for High-Speed Rail Application (Joint project with FIU)	Mohamed Moustafa	15% 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	50% complete
UNR-2016-1-3	More Choices for Connecting Prefabricated Bridge Elements and Systems (PBES)	Mohamed Moustafa	90% complete
UNR-2016-2-1	Development of Non-Proprietary UHPC Mix - Application to Deck Panel Joints (Joint project with all partner universities)	Mohamed Moustafa	30% complete
UNR-2016-2-2	Synthesis of available methods for repair of prestress girder ends	Mohamed Moustafa	15% complete

Project #	Project Title	Principal Investigator	Status
UNR-2016-2-3	Performance of Existing ABC Projects - Inspection Case Studies	Mohamed Moustafa	20% complete
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)	70% complete
OU-2016-1-2	Rapid Retrofitting Techniques for Induced Earthquakes	Philip Scott Harvey Jr.	95% complete
OU-2016-2-1	Development of Non-Proprietary UHPC Mix (Joint project with all partner universities)	Royce W. Floyd	45% complete
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	43.75% complete
OU-2016-2-3	Performance of Existing ABC Projects - Inspection Case Studies (Joint project with all partner universities)	Musharraf Zaman	30% complete
UW-2017-1-1	Performance Evaluation of Structural Systems for High-Speed Rail In Seismic Regions	John Stanton	80% complete
UW-2017-1-2	New Seismic-Resisting Connections or Concrete-Filled Tube Components In High-Speed Rail Systems (Joint Project with FIU)	Dawn Lehman	80% complete
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	35% complete

Project #	Project Title	Principal Investigator	Status
UW-2016-2-2	Development of ABC Course Module- Seismic Connections	John Stanton	10% complete
UW-2016-2-3	Development of ABC Course Module - Design of CFST Components and Connections for Transportation Structures	Dawn Lehman	70% complete
UW-2016-2-4	Performance of Existing ABC Projects - Inspection Case Studies (Joint project with all partner universities)	John Stanton	5% complete
UW-2016-2-5	UW-2016-2-5- Tsunami Design Forces for ABC Retrofit	Marc Eberhard	5% complete

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	10/1/18 to 3/31/19
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.	31 (FIU,UNR, ISU, OU) 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.	3 (FIU) 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.	24 publications (sumitted, accepted, or published)
		44 conference presentations (presented)

Task #	Brief Description of Task	10/1/18 to 3/31/19
WD-4	**Travel Scholarships:** Each ABC-UTC consortium member will be expected to support students who travel to conferences to present their work.	5 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
		1314 sites attended the seminars

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	7/26/2019	Durable UHPC Columns with High-Strength Steel	Mahmoud Aboukifa, (Ph.D., UNR)	575
2	4/26/2019	Integral Abutment Details for ABC Projects, Phase II	Austin DeJong (M.S., ISU)	739

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

	Student Name	Conference Name	Date	Location
1	Amir Sadeghnejad	Second International Interactive Symposium on Ultra-High-Performance Concrete	June 2019	Albany, NY
2	Nerma Caluk	Second International Interactive Symposium on Ultra-High-Performance Concrete	June 2019	Albany, NY
3	Mahsa Farzad	Second International Interactive Symposium on Ultra-High-Performance Concrete	June 2019	Albany, NY
4	Negar Naeimi	Second International Interactive Symposium on Ultra-High-Performance Concrete	June 2019	Albany, NY
5	Mahmoud Aboukifa	Second International Interactive Symposium on Ultra-High-Performance Concrete	June 2019	Albany, NY

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

- Mentorship activities continue to take place.

- A four-day parent/child bridge engineering summer camp was hosted and led by FIU on June 10-13. The camp introduced 3rd to 6th-grade students and their parents to bridge engineering and ABC through several activities developed by FIU. Participants were all given a bridge-building toy to encourage the continuation of these activities at home. Details on all activities are available on the ABC-UTC website.
- A 3D model of a fully prefabricated bridge was developed by FIU and posted on the ABC-UTC website. This model can be printed on typical 3D printers and used to help teach students about different bridge components in a fully prefabricated bridge.
- Two-day teacher workshops were hosted by UNR (August 1-2) and UW (August 8-9) and led by ISU. These workshops introduced teachers to "Engineering First!", a four-week engineering module with daily one-hour lessons for K-5 classrooms developed by ISU. Attendees were also given supplies to complete the module in their classrooms.

A one-day Summer Camp Symposium was hosted by the University of Oklahoma where participants can actively engage ideas related to transportation engineering. This symposium served as a forum to network, gain presentation experience, and to discuss topics relating to bridges, pavement, planning, and construction with colleagues from Oklahoma and throughout the entire region. Some of the topics included were bridge construction and repair, Accelerated Bridge Construction using Large-Block GRS Abutments, Performance Monitoring of GRS Bridges in Oklahoma, and Development of ABC-UTC Non-Proprietary UHPC to name a few. Participants received 6 professional development hours for attending this event.

The center continues to work with the Workforce Development Advisory Board (WDAB) to ensure efforts are best aligned to achieve its central mission and have the largest impact.

1.2.4 Technology Transfer

During this reporting period, work continued to sponsor and host the International ABC Conference to be held in December of 2019 in Miami, Florida. During this reporting period, the Preliminary Program was developed and distributed. The conference program includes 108 thirty-minute technical podium presentations, a special poster research presentation session, and four technical keynote talks in addition to the general session keynote talk by the USDOT Deputy Assistant Secretary for Research and Technology, Diana Furchtgott-Roth. Seven 4-hour pre-conference workshops were also finalized and included in the Preliminary Program. In addition, nominations were received for ABC project awards and the ABC person of the year award, and the submission deadline closed; awards will be announced during the conference general session.

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 700 to over 1,900 with multiple participants at many of the sites. One presentation featured a precast deck that accelerated tunnel construction and was given by a state DOT and industry partner. The remaining five presentations were given by bridge owners and their partners, featuring design and construction details and lessons learned on state-of-the-art ABC technologies incorporated in completed bridge projects in states across the U.S.

The 2019 In-Depth Web Training was conducted during this reporting period. Over 800 sites registered for the free 4-hour training. The eleven presenters in the six 40-minute modules showcased the latest ABC applications in seismic regions.

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 April and July Research Seminars reported in the Workforce Development section of this report. Also, work continued 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	4/1/19-9/30/19
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 **All research projects are in progress**.	0
	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	12
	***Presentations* –** Research projects presented at conferences and other events	Number and quality of conferences and events during which results of the research are presented	44
	***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 5 short courses, work currently in progress. (See Research Section, project #'s FIU-2016-2-3; ISU-2016-2-4; OU-2016-2-2; UW-2016-2-2; UW-2016-2-3)**	0
Outcomes	***Separate Financial Contributions for 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	0
	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 5/7/2019 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 3 Research and presenting it at the ABC-UTC Advisory Board Meeting in December.
- Implementation of Education and Workforce Development activities
- International ABC Conference, December 2019. We are expecting large participation, as for the first-time conference it has an International Scope and covers three frontiers influencing ABC.
- Monthly webinars and other related technology transfer activities
- The quarterly research seminar and semi-annual research day
- Continuation of Research Projects and other activities.

2. PRODUCTS

2.1 PUBLICATIONS, CONFERENCE PAPERS, AND PRESENTATION

2.1.1 Journal Articles Submitted

Citation for Article	**Peer-Reviewed?**
Author(s). "Article Title". *Journal Title*, Submitted <Month>, <year>.	Yes or No
Jaberi, A., Valikhani, A., Mantawy, I.M Azizinamini, A., "Service Life Design of Deck Closure Joints in ABC Bridges: Guidelines and Practical Implementation" Frontiers in Built Environment-Bridge Engineering (Under Review)	Yes
Valikhani, A., Jaberi, A., Mantawy, I.M Azizinamini, A., "Evaluation of Bond Strength between Concrete Substrate and Ultra-High-Performance Concrete as Repair Material" Construction and Building Materials (Under Review)	Yes
Sadeghnejad, A; Rehmat, S.; Mantawy, I.M; Azizinamini, "SDCL in Seismic Areas: A comparative Study of Cyclic and Shake Table Tests" Transportation Research Record Journal 2020. (Under Review).	Yes
Caluk, N.; Mantawy, I.M; Azizinamini, "Cyclic Test of Concrete Bridge Column Utilizing UHPC Shell" Transportation Research Record Journal 2020. (Under Review).	Yes
Mokhtarimousavi, Seyedmirsajad, Jason C. Anderson, Atorod Azizinamini, and Mohammed Hadi. "Factors Affecting Injury Severity in Auto-Pedestrian Crashes: A Time of Week Analysis Using Random Parameter Ordered Response Models and Artificial Neural Network" Transportation Research Record Journal 2020. (Under Review).	Yes
Farhangdoust, Saman, Mehrabi, Armin "A New Approach to Structural Health Monitoring of Closure Joints in Accelerated Bridge Construction. Journal of Performance of Constructed Facilities.	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." *Transportation Research Record: Journal of the Transportation Research Board,* Submitted August 2019.	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) Containing RAP." *Transportation Research Record: Journal of the Transportation Research Board,* Submitted August 2019.	Yes
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." *Construction & Building Materials,* Submitted September 2019.	Yes

Ghabchi, R., Rani, S., Zaman, M. and Ali, S.A. “Effect of WMA Additive on Properties of PPA-modified Asphalt Binders Containing Anti-Stripping Agent.” *International Journal of Pavement Engineering*, DOI: 10.1080/10298436.2019.1614584	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*	Yes

2.1.2 Journal Articles Published (TT Plan Output)

Citation for Article	**Peer-Reviewed?**
Author(s). “Article Title”. *Journal Title,* vol.*,* pp*,* date.	Yes or No
Farzad, M., Shafieifar, M., & Azizinamini, A. (2019). Retrofitting of Bridge Columns Using UHPC. Journal of Bridge Engineering, 24(12), 04019121.	Yes
Farzad, Mahsa, Siavash Rastkar, Amir Sadeghnejad, and Atorod Azizinamini. "Simplified Method to Estimate the Moment Capacity of Circular Columns Repaired with UHPC." Infrastructures 4, no. 3 (2019): 45.	Yes
Farzad, Mahsa, Saiada Fuadi Fancy, Kingsley Lau, and Atorod Azizinamini. "Chloride Penetration at Cold Joints of Structural Members with Dissimilar Concrete Incorporating UHPC." Infrastructures 4, no. 2 (2019): 18. (1 Citation as of July 15, 2019)	Yes
Sadeghnejad, Amir, Ramin Taghinezhadbilondy, and Atorod Azizinamini. "Seismic Performance of a New Connection Detail in an SDCL Steel Bridge System." *Journal of Bridge Engineering* 24, no. 10 (2019): 04019094.	Yes
Mokhtarimousavi, Seyedmirsajad, Jason C. Anderson, Atorod Azizinamini, and Mohammed Hadi. "Improved Support Vector Machine Models for Work Zone Crash Injury Severity Prediction and Analysis." *Transportation Research Record* (2019): 0361198119845899.	Yes
Caluk, Nerma, Islam Mantawy, and Atorod Azizinamini. "Durable Bridge Columns using Stay-In-Place UHPC Shells for Accelerated Bridge Construction." *Infrastructures* 4, no. 2 (2019): 25.	Yes
Farzad, Mahsa, Saiada Fuadi Fancy, Kingsley Lau, and Atorod Azizinamini. "Chloride Penetration at Cold Joints of Structural Members with Dissimilar Concrete Incorporating UHPC." *Infrastructures* 4, no. 2 (2019): 18.	Yes

Seyedmirsajad Mokhtarimousavi, 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, *Institute of Transportation Engineers. ITE Journal*, 89(10), p.25-33.	Yes
Rezaei N* and Garber D, "Study of Bridge Demolition DOT Survey and Available Standard Specifications," *Advances in Civil Engineering*, https://doi.org/10.1155/2019/4896717, 2019.	Yes
Farhangdoust, Saman, Mehrabi, Armin "Health Monitoring of Accelerated Bridge Construction Closure Joints – Review of Nondestructive Testing Methods. Journal of Advanced Concrete Technology.	Yes
Dopko, M., Najimi, M., Shafei, B., Wang, X., Taylor, P., and Phares, B. (2019) Carbon microfiber reinforced concrete with binary chemical admixtures, ACI Materials Journal [In Press].	Yes
Zhang, Ning, and Alice Alipour. "A two-level mixed-integer programming model for bridge replacement prioritization." Computer-Aided Civil and Infrastructure Engineering (2019). [Journal information: 6/106 (Computer Science, Interdisciplinary Applications) 1/63 (Construction & Building Technology)1/132 (Engineering, Civil)1/37 (Transportation Science & Technology) with impact factor of 6.208	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–UTC Research Day, online, 05/19	Lee, S. J., "Innovative Foundation Alternative for High-Speed Rail Application"
ABC–UTC Research Day, online, 05/19	Azizinamini, A., "Envisioning Connection Detail for Connecting Concrete Filled Tube (CFT) Columns to Cap Beam for High-Speed Rail Application"
ABC–UTC Research Day, online, 05/19	Mehrabi, A; Ali, H., "Development of Guide For Selection Of Substructure For ABC Projects"
ABC–UTC Research Day, online, 05/19	Lau, K., "Field Demonstration-Instrumentation and monitoring of Accelerated Repair Using UHPC Shell"

Second International Interactive Symposium on Ultra-High-Performance Concrete, Albany, June/2019	Sheharyar Rehmat, Amir Sadeghnejad, Atorod Azizinamini Prefabricated UHPC Structural Formwork for Cap Beams
Second International Interactive Symposium on Ultra-High-Performance Concrete, Albany, June/2019	Sheharyar Rehmat, Amir Sadeghnejad, Atorod Azizinamini, “Connection between Concrete Filled Tube (CFT) Columns and Prefabricated elements using UHPC”
Second International Interactive Symposium on Ultra-High-Performance Concrete, Albany, June/2019	Caluk et. al “Development of UHPC Shell Formwork Concept and Associated Connections”
Second International Interactive Symposium on Ultra-High-Performance Concrete, Albany, June/2019	Mohamedreza Shafiefar et al, “A Comparison of Existing Analytical Methods to Predict the Flexural Capacity of Ultra-High-Performance Concrete (UHPC) Beams”
Second International Interactive Symposium on Ultra-High-Performance Concrete, Albany, June/2019	Amir Sadeghnejad and Atorod Azizinamini, “Development of Innovative Short-Span Bridge System Using UHPC Formworks”
Second International Interactive Symposium on Ultra-High-Performance Concrete, Albany, June/2019	Masha Farzad and Atorod Azizinamini, “Effect of Concrete Moisture on Macrocell Development in Repair of Reinforced Concrete Substructure with UHPC”
Second International Interactive Symposium on Ultra-High-Performance Concrete, Albany, June/2019	Masha Farzad and Atorod Azizinamini, “Retrofitting of Bridge Columns Using UHPC”
Second International Interactive Symposium on Ultra-High-Performance Concrete, Albany, June/2019	Alireza Valikhani and Atorod Azizinamini, “Development of Rapid Retrofit UHPC Based Solution to Repair Damaged Flexural Members”

ASCE-SEI Conference 2019, Orlando, April 2019	S. Farhangdoust and AB Mehrabi, NDT Inspection of Critical ABC Details to Assure Life-Cycle Performance and Avoid Future Unforeseen Excessive Repairs
8th Smart Materials and Structures, Dublin, August 2019	AB Mehrabi, "Development of Smart Materials and Structures should Anticipate Evolution of Structural Systems and Construction Methods
ASCE Florida, Orlando, July 2019	AB Mehrabi, Development of a Guideline for Selection of Substructures for ABC Projects
SEI Structures Congress, Orlando FL, April 2019	A. Azizinamini, UHPC shell technologies to reduce the life cycle cost of ABC projects
SEI Structures Congress, Orlando FL, April 2019	A. Azizinamini, New ABC connection detail for connecting precast cap beam to precast columns with well-defined plastic hinges
SEI Structures Congress, Orlando FL, April 2019	A. Azizinamini, Extending simple for dead and continuous for live load steel bridge system for ABC application in high seismic areas
UTC Spotlight Congress, Washington, DC, May 2019	Presenting a poster: ABC-UTC Developing Economical, Innovative and Implementable, Transportation Infrastructure Solutions
2nd International Bridges Workshop, Mexico 2019	Atorod Azizinamini, "Accelerated Bridge Construction: Past, Present and Future, and ABC-UTC Activities:
FHWA Webinar, Denver, Colorado, July 2019	Atorod Azizinamini, "Simple-Made Continuous Rolled Steel Girder Bridges". Link to the recording: https://connectdot.connectsolutions.com/pwgjts4154bj/
In-Depth Web Training, Miami, FL, September 2019	"ABC in moderate-to-high seismic regions" Bijan Khaleghi, Ph.D., P.E., S.E., State Bridge Design Engineer, Washington State DOT; Khashayar Nikzad, Ph.D., P.E., Principal Engineer, TranTech; Lee Marsh, Ph.D., P.E., Deputy Director, America's Technical Excellence Center, WSP; Greg Banks, P.E., S.E., Senior Bridge Engineer, WSP; Atorod Azizinamini, Ph.D., P.E., Professor and Chair, Civil and Environmental Engineering Department, Florida International University; Toorak Zokaie, Ph.D., P.E., Earthquake Engineering Specialist, California Department of Transportation (Caltrans); Dorie Mellon, P.E., Senior Bridge Engineer, Caltrans; Dawn Lehman, Ph.D., P.E., Professor, University of Washington; Amy Leland, P.E., S.E., Seismic and Foundation Specialist, Washington State DOT; John Stanton, Ph.D., P.E., Professor, University of Washington; and Timothy Peruchini, EIT, Structural Design Engineer, Reid Middleton

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)
ABC–UTC Research Day, online, 05/19	Freeseman, Katelyn, “Contracting Methods for Accelerated Bridge Construction Projects: Case Studies and Consensus Building”
ABC–UTC Research Day, online, 05/19	Freeseman, Katelyn, “Bidding of Accelerated Bridge Construction Projects: Case Studies and Consensus Building”
ABC–UTC Research Day, online, 05/19	Chen, An, “Accelerated Repair and Replacement Of Expansion Joints”
AASHTO Committee on Bridges and Structures, Montgomery, AL, June 2019	Freeseman, Katelyn, General session, discussed multi-span lateral slides with state bridge engineers, as well as bidding/contracting and delivery methods (National Meeting)
46th Annual Review of Progress in Quantitative Nondestructive Evaluation, Portland OR, July 2019	Freeseman, Katelyn, General session, discussed NDT for ABC projects (National Meeting)
2019 SPTC Summer Symposium, organized by Southern Plain Transportation Center, held at National Cowboy and Western Heritage Museum, Oklahoma City. Date: August 8th, 2019.	Ali, S.A., Ghabchi, R., Zaman, M., Rahman, M.A., and Rani, S. “Evaluation of Moisture-Induced Damage Potential of Asphalt Mixes Using Performance-based Laboratory Tests”.
2019 SPTC Summer Symposium, organized by Southern Plain Transportation Center, held at National Cowboy and Western Heritage Museum, Oklahoma City. Date: August 8th, 2019.	Rahman M.A., Zaman, M., Ghabchi, R., Ali, S.A., Arshadi, A., and Barman, M. “Evaluation of Cracking Resistance of Warm Mix Asphalt (WMA) Containing RAP.”
CUTC Summer Meeting, held in Norman, Oklahoma, June 2019	Lead organizer of Conference, Musharraf Zaman (National Meeting)

CUTC Summer Meeting, held in Norman, Oklahoma, June 2019	Ali, Syed Ashik and Mohammad Ashiqur Rahman - Transportation Leadership Council participant (National Meeting)
ABC–UTC Research Day, online, 05/19	Harvey, Scott, Jr., “r. Rapid Retrofitting Techniques For Induced Earthquakes”
ABC–UTC Research Day, online, 05/19	Zaman, Musharraf, “Development Of Guide For Selection Of Substructure For ABC Projects”
CUTC Summer Meeting, held in Norman, Oklahoma, June 2019	Azizinamini, Atorod; Mehrabi, Armin and Baksh, Raheel (National Meeting)
2nd Int. Symposium on Ultra-High Performance Concrete, June 2-4, 2019, Albany, NY	Aboukifa, M.*, M.A. Moustafa, A. Itani, (2019). “Behavior of UHPC Columns Subjected to Combined Axial and Lateral Loading”
2nd Int. Symposium on Ultra-High Performance Concrete, June 2-4, 2019, Albany, NY	Naeimi, N.*, M.A. Moustafa, (2019). “Uniaxial compression behavior of confined UHPC cylinders by steel spirals”
ABC–UTC Research Day, online, 05/19	Moustafa, M., “Identify the Risk Factors That Contribute To Fatalities and Serious Injuries and Implement Evidence-Based Risk Elimination and Mitigation Strategies”
ABC–UTC Research Day, online, 05/19	Moustafa, M., “More Choices For Connecting Prefabricated Bridge Elements and Systems (PBES)”
ABC–UTC Research Day, online, 05/19	Moustafa, M., “innovative Foundation Alternative for High-Speed Rail Application”
ABC–UTC Research Day, online, 05/19	Lehman, D.” New Seismic-Resisting Connections or Concrete-Filled Tube Components In High-Speed Rail Systems”
ABC–UTC Research Day, online, 05/19	Stanton, J. “Performance Evaluation of Structural Systems For High-Speed Rail In Seismic Regions”
TRB ABC Subcommittee, 2019 TRB Annual Meeting, Washington, D.C., January 14, 2019.	Floyd, R. W. (presenter), Volz, J. S., Zaman, M., “Development of Non-Proprietary UHPC” (National Meeting)
Superpile May 2019 (Seattle)	Lehman. “Use of CFTs for seismic resistance”.
ADSC (Portland May 2019)	Lehman. “Use of CFTs for seismic resistance”.

PEER (Berkeley 2019)	Lehman. “Use of CFTs for seismic resistance”.

2.1.4 Conference Proceedings (TT Plan Output)

Citation for Conference Proceedings	Peer-Reviewed?
Author(s). “Article Title”. *Conference proceedings*, year, pp.	Yes or No
S. Farhangdoust and AB Mehrabi, NDT Inspection of Critical ABC Details to Assure Life-Cycle Performance and Avoid Future Unforeseen Excessive Repairs, Proceedings of ASCE-SEI Conference 2019	Yes
Aboukifa, M., M.A. Moustafa, A. Itani, (2019). “Behavior of UHPC Columns Subjected to Combined Axial and Lateral Loading”, 2nd Int. Symposium on Ultra-High-Performance Concrete, June 2-4, 2019, Albany, NY	Yes
Naeimi, N., M.A. Moustafa, (2019). “Uniaxial compression behavior of confined UHPC cylinders by steel spirals”, 2nd Int. Symposium on Ultra-High-Performance Concrete, June 2-4, 2019, Albany, NY	Yes
Moustafa, Mohamed, “ACI Committee 239 Ultra-High-Performance Concrete (UHPC), Quebec City, Canada, March 2019” (National Meeting)	Yes
Lehman. “Use of CFTs for seismic resistance”. Superpile 2019	Yes

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

ABC-UTC Website (https://abc-utc.fiu.edu/): The ABC-UTC website will continue to be upgraded and 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 newxt frontier in bridge engineering, specifically the application of automation in bridge construction an 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 taking a national lead in the ABC area and has established a very good working relation 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 to be held in December of 2019 at Hyatt Regency Hotel in Miami, FL. The State DOT engineers of sponsoring State DOTs work very closely with 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 result of US DOT supporting ABC-UTC at FIU, similar to other partner universities, they are 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 US DOT to dedicate a Tier One 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.

Nothing to report.

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.