



Program Progress Performance Report University Transportation Centers

Submitted to	U.S. Department of Transportation Research and Innovative Technology Administration
Federal Grant Number	DTRT13-G-UTC41
Project Title	ABC-UTC (Accelerated Bridge Construction - University Transportation Center)
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Submission Date	October 31, 2018
DUNS and EIN Numbers	DUNS: 07-129-8814, EIN: 237047106
Recipient Organization	Florida International University; 11200 SW 8th St, Miami, FL 33174
Account Number	800002954
Grant Period	September 30, 2013 to September 30, 2018
Reporting Period Start Date	April 1, 2018
Reporting Period End Date	September 30, 2018 (PPPR # 10)

ACCOMPLISHMENTS

What are the major goals and objectives of the program?

The broad goals and objectives of the Tier I 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; 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 design, repair and construction of the nation's aging bridge infrastructure in line with U.S. DOT's strategic focus on State of Good Repair.

Specific goals and objectives of the ABC-UTC can be broken into three general categories:

Research

- Extend principles of ABC to the repair, replacement and preservation of bridges, including multi-hazards and seismic issues.
- Enhance the service life of bridges constructed using principles of ABC by emphasizing design for service life (at the design stage), preservation, and timely maintenance.
- In collaboration with other UTCs develop traffic safety systems specifically for modular bridge construction for all traffic levels.
- Develop next generation bridge systems that are best suited for ABC applications.
- Building on existing knowledge, develop the next generation of decision-making tools for better communication among stakeholders, which should assess the merits of various construction processes and visualize the entire life span of bridges in a seamless manner from birth to recycling.
- Develop new and innovative ideas and applications for use of advanced materials, such as Ultra High-Performance Concrete in ABC.
- Investigate use of robotics in bridge construction
- Facilitate adaptation of high-speed rails, by developing ABC solutions specific to high speed rails
- Investigate ABC solutions for addressing challenges imposed by climate change
- Develop new knowledge to extend the application of ABC in seismic areas.

Education and Workforce Development

- Become the educational focal point for advancing principles of ABC.
- Develop and nationally distribute K-12 educational materials related to bridge engineering, and ABC in particular, for educating and attracting future generations of transportation and sustainability engineers.
- Develop educational materials that could be used in academia at both undergraduate and graduate levels for explaining fundamental and advanced topics in ABC.
- Develop and deliver continuing education opportunities on ABC for practicing engineers across the country.

- Train graduate students knowledgeable in implementation of ABC in practice
- Train high school teachers by providing them with tools that they can incorporate into their curriculum to teach bridge engineering with an especial focus on ABC.

Technology Transfer

- Become a national repository and focal point for assisting federal, state, and local agencies on matters related to ABC.
- Educate the current and next generation of engineers on when and how to effectively use ABC technologies.
- Lower the cost of utilizing ABC technologies by conducting outreach activities at the local, regional, and national levels that include the dissemination of research results.
- Develop implementable tools that follow the form and function of AASHTO-type publications.
- Conduct webinar and national conferences.

What was accomplished under these goals?

Meetings and correspondences among the partner universities were held during the reporting period to track progress in different tasks, using a matrix that included a list of planned tasks. Progress in different tasks related to research, education and workforce development, and technology transfer was discussed during these meetings between ABC-UTC directors, associate directors, graduate students and key researchers.

Following is a description of various tasks by three main categories that are research, workforce development, and technology transfer.

Research

ABC-UTC aims to carry out research in close association with federal and state agencies and bridge industry. During the reporting period, research advisory panel (RAP) was established for research projects that were selected based on input of ABC-UTC Research Advisory Board (RAB), AASHTO T-4 and AASHTO T-3 Committees. The research advisory panel consists of professionals from FHWA, state DOT and industry. These professionals were carefully selected for each research projects based on their experience that was closely related to the ABC-UTC research projects.

Following table provides a list of research projects, research advisory panel members for each project and progress made in the project during the reporting period.

Project #	Research Project Title	RAP Members	Progress (April 1, 2018 – September, 30 2018)
FIU-1	Compilation of all ABC research that is ongoing and completed	Ahmad Abu-Hawash, Iowa DOT	The ABC Research Database continues to be populated and advertised.

Project #	Research Project Title	RAP Members	Progress (April 1, 2018 – September, 30 2018)
	Recommended by AASHTO T-4		
FIU-2	Development of Manual for Enhanced Service Life of ABC Bridges	Bruce Johnson, Oregon DOT; Ali Maher, Rutgers University; Hamid Ghasemi, FHWA; Carlos Duart, CDR Maguire	<p>In previous period, a study of the ABC project database was conducted, and all possible types of closure pour for ABC projects were categorized.</p> <p>In this period, the testing of the first 48 specimens are completed. Data to date indicates that for number 4 reinforcement very short overlap is needed, while additional tests need to be conducted to establish lap splice length for number 6 bars and larger.</p>
FIU-3	Alternative ABC Connections Utilizing UHPC	Bruce Johnson, Oregon DOT; Bijan Khaleghi, Washington DOT; Tom Ostrom, Caltrans; Elmer Marx, Alaska DOT	This project has been completed..
FIU-4	Extending Application of SDCL to ABC (Phase II – Experimental):	Bruce Johnson, Oregon DOT; Bijan Khaleghi, Washington DOT; Tom Ostrom, Caltrans; Elmer Marx, Alaska DOT	This project has been completed..
FIU-5	A Predictive Computer Program for Proactive Demolition Planning	James Corney, Utah DOT	The team has been working on various numerical components required to simulate the demolition. In particular, balancing between simulation fidelity and computational efficiency is pursued as the computational framework in this study targets solving a field scale problem for use in the engineering practice, which is different from a conventional fracture mechanics solver that focuses on the precise crack propagation at a relatively small scale. The team is at the same time trying to numerically reproduce some field demolition scenarios.
FIU-6	Corrosion Durability of Reinforced Concrete Utilizing	FDOT	A relevant literature review has been performed.

Project #	Research Project Title	RAP Members	Progress (April 1, 2018 – September, 30 2018)
	UHPC for ABC Applications	Bijan Khaleghi, Washington DOT; Tom Ostrom, Caltrans; Elmer Marx, Alaska DOT; Bruce Johnson, Oregon DOT; William Oliva, Wisconsin DOT	The second phase of the experiment, with ponding the previous samples, has been done. durability projections have been done to identify the applicability of UHPC for repair of damaged concrete for marine conditions, and estimate the service lives of UHPC repair applied to concrete bridge piers exposed to the severity range of chloride-laden environments.
FIU-7	Extending Maximum Length of the Folded Steel Plate Girder Bridge System (FSPGBS), exceeding 100 ft. with capability to Incorporate Camber	NSBA	Two test specimens have been fabricated and we plan to test the system. A patent was developed based on this project. Many in the industry are waiting to apply the result of this project once it has concluded.
FIU-8	NDT Methods Applicable to Health Monitoring of ABC Closure Joints	Ahmad Abu-Hawash, Iowa DOT; Steve Womble, FDOT, D7	At the first stage of the project, categorization and identification of ABC joints focused on indexing different types of closure joints and compositions, critical details, types of damage including causes and thresholds was reviewed. Accordingly, for investigating the defects associated with ABC closure joints, some attempts have conducted to make the connection between various common damages of ABC joints and their main causes as the defect etiology. Concurrently, a comprehensive literature review concentrated on NDT techniques applicable to health monitoring of ABC closure joints was carried out, and the most promising NDT methods were evaluated according to criteria including test speed, data analyzing speed, ability for surface scanning and internal damage detection, cost, ease of use, operator and public safety, required knowledge, and repeatability of results for each type of joint. The top five were recognized as the most applicable to health monitoring of closure joints. These are Impact Echo, Ground

Project #	Research Project Title	RAP Members	Progress (April 1, 2018 – September, 30 2018)
			Penetrating Radar, Ultrasonic, Infrared Thermal Imaging and Impulse Response methods.
FIU-9	Performance Comparison of In-Service, Full-Depth Precast Concrete Deck Panels to Cast-in-Place Decks	Ahmad Abu-Hawash, Iowa DOT; James Corney, Utah DOT; Bruce Johnson, Oregon DOT	Results from a national survey were compiled and analyzed. An interim report was developed containing the results from the literature review and the survey. Inspection information is being compiled on the FDPC deck panel bridge and CIP comparison projects.
FIU-10	Use of Drones in ABC	Atorod Azizinamini, FIU; Armin Mehrabi, FIU; Ibrahim Tansel, FIU	<p>Relevant literature review has been performed.</p> <p>Search and request for fund to buy appropriate drone has been submitted.</p> <p>Experiment with student's drone for magnetic sensor has been performed.</p>
ISU-1	Development of Prefabricated Bridge Railings Recommended by AASHTO T-4	Ahmad Abu-Hawash, Iowa DOT; Tim Fields, Connecticut DOT	Project has been completed and final draft report is under review with the RAP members.
ISU-2	Material Design and Structural Configuration of Link Slabs for ABC Applications	Ahmad Abu-Hawash, Iowa DOT; Michael Nop, Iowa DOT; Wisconsin DOT; and Michael P. Culmo, CME Associate	Project has been completed and final draft report is under review with the RAP members.
ISU-3	An Integrated Project to Enterprise-Level Decision Making Framework for Prioritization of Accelerated Bridge Construction	Ahmad Abu-Hawash, Iowa DOT	This project has been completed.
ISU-4	Inspection and QA/QC for ABC Projects	Ahmad Abu-Hawash, Iowa DOT; Hoda Azari, FHWA; Shane Boone, BDI)	Project has been completed, the draft final report is under review.

Project #	Research Project Title	RAP Members	Progress (April 1, 2018 – September, 30 2018)
ISU-5	Integral Abutment Details for ABC Projects, Phase II	<p>Brent Phares, ISU; Travis Hosteng; ISU; Behrouz Shafei; ISU; Jim Nelson, Iowa DOT</p> <p>Ahmad Abu-Hawash, Iowa DOT; Mike Nop, Iowa DOT; Logan Wells, Iowa DOT; Mike LaVoilette; HDR; Elmer Marx, Alaska DOT; Mike Culmo, CME; William Oliva, Wisconsin DOT; James Corney, Utah DOT; Atorod Azizinamini, FIU</p>	<p>Constructability of each specimen was documented in the final report, specifically any issues encountered. Construction and laboratory testing of connection details was successfully completed by the end of July, and data analysis and conclusions were presented in the final report. Final report completed, including TAC review, and was submitted by September 30.</p>
ISU-6	Development of Guidelines to Establish Effective and Efficient Timelines and Incentives for ABC	Ahmad Abu-Hawash, Iowa DOT; Mathew Haubrich, Iowa DOT	This project has been completed.
UNR-1	Shake Table Studies of a Bridge System with ABC Connections:	Bijan Khaleghi, Washington DOT; Elmer Marx, Alaska DOT; Tom Ostrom, Caltrans	The shake table loading protocol was finalized. The 70-ft long 2-span bridge model was tested to failure and data was collected over approximately 300 channels. Data reduction and processing of data began. An ABC-UTC research webinar was given. Also a journal paper was prepared and submitted for possible publication.
UNR-2	Analytical Investigations and Design Implications of Seismic Response of a Two-Span ABC Bridge System	Bijan Khaleghi, Washington DOT; Elmer Marx, Alaska DOT; Tom Ostrom, Caltrans	The analytical model of the two-span bridge was refined. Work on developing the parametric study matrix began. A journal paper on modeling and parametric studies was submitted for possible publication.
UNR-3	Durable UHPC Columns with High-Strength Steel	Elmer Marx, Alaska DOT; Tarek Masrour, Caltrans	This project has two goals: understanding confinement behavior of UHPC; and testing 4 UHPC columns. More than 70 UHPC cylinders with different confinement were tested, and

Project #	Research Project Title	RAP Members	Progress (April 1, 2018 – September, 30 2018)
			construction of the 4 columns is completed and ready for testing in the next month or two.

Education and Workforce Development

The following table lists different tasks related to workforce development provides a brief description of each task, identifies the lead institution for each task, and states the progress made in each task during the reporting period.

Task #	Brief Description of Task	Lead Institution	Progress (October 1, 2017 – March, 2018)
WD-1	Student Education: Each ABC-UTC consortium member will be expected to mentor a minimum of one graduate student for each \$50,000 to \$75,000 in project work.	ALL (FIU, ISU, UNR)	In this period, a total of 36 graduate students are working on ABC-UTC related research projects.
WD-2	Increasing the number of research assistantship opportunities for graduate students.	ALL (FIU, ISU, UNR)	In this period ISU added 2 students, UNR added 3 students, and FIU had 6 additional students.
WD-3	Upgrading course content in the areas of structural engineering and construction engineering/management to include modules on the use of ABC topics.	UNR	In this period, ABC seminars previously posted and the related video clips were maintained.
WD-4	Developing online courses and making progress towards the development of fully online degree programs.	FIU	Nothing new to report.
WD-5	Mentorship Program – Development of a mentoring program where students are put in direct contact with industry representatives who are active in the field of accelerated bridge construction.	FIU, ISU, UNR	The following professionals from industry have been mentoring ABC-UTC students on research during this reporting period: <ul style="list-style-type: none"> • Michael LaViolette, HDR • Mike Culmo, CME • Finn Hubbard, Fish & Associates • Dr. Reza Farimani, Thornton Tomasetti • Dr. Francesco Russo, Michael Baker Jr., Inc. • Dr. Jawad Gull, HDR • Dr. Ardalan Sherafati, BlueScope Construction.

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			<ul style="list-style-type: none"> • Nathan Johnson, Kleinfelder Engineering • Claudia Pulido, Kiewit Infrastructure Engineers • Mark Reno, Quincy Engineering • Ashkan Vosooghi, AECOM <p>All three center partners are actively encouraging productive mentorship relationships between graduate students and former graduate students and professionals.</p>
WD-6	<p>Graduate Student 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.</p>	ISU	<p>These seminars continue to be offered quarterly as “Research Seminars”. Seminars were delivered in April 2018 and July 2018 and were attended by 934 and 527 sites from around the world, respectively, with multiple attendees at many of the sites.</p> <p>These seminars are recorded and archived on the ABC-UTC website for future viewing.</p>
WD-7	Encourage one-on-one interaction with industry.	ISU Lead; ALL (FIU, ISU, UNR)	<p>Opportunities for graduate and undergraduate students is being encouraged through the mentorship program, the internship program, and the graduate student seminar program. Additionally, all project technical advisory committees include numerous members of the technical community.</p>
WD-8	<p>Internship Program- All three consortium members will develop an undergraduate research internship program.</p>	UNR Lead; ALL (FIU, ISU, UNR)	<p>All three partner universities have hired undergraduate students as interns on ABC-UTC research projects. UNR 1, FIU 2, ISU 0 undergraduate students are supported through internships and are actively involved in research during the past reporting period.</p>
WD-9	<p>Educational Modules- Develop three educational modules, in the form of print and videos, for K-12 with focus on developing age-appropriate programs.</p>	UNR	<p>ISU developed a four-week K-5 curriculum focused on bridge engineering and ABC. The curriculum was used in one classroom as a pilot program and was introduced to additional teachers and librarians in Miami during the summer teacher workshop. FIU developed ABC, bridge engineering, and structural engineering modules and introduced them to teachers and librarians at the summer teacher workshop. FIU also</p>

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			used the developed activities to lead several single-day K-8 events at local libraries, schools, and at another FIU campus. FIU also used the developed activities to lead a three-day parent-child camp for children (K-8) and one of their parents. All developed modules are available on the ABC-UTC website.
WD-10	Summer Teacher Program- Each consortium member will develop a two-day-long summer camp for elementary, middle and high school teachers to familiarize them with basics of transportation engineering in general and principles of bridge engineering and ABC in particular.	FIU, ISU, UNR	A summer teacher workshop was held in June 2018 to introduce 15 teachers and 4 librarians to ABC and bridge engineering curriculum developed at ISU and FIU.
WD-11	Online e-Zine Go- ISU will publish quarterly articles in the online “e-zine Go!” related to the ABC-UTC’s mission.	ISU	No additional articles were published in the previous reporting period. All previously posted articles are archived on the e-Zine Go! website.
WD-12	Offer travel scholarship with emphasis on traditionally underrepresented students	All (FIU, ISU, UNR)	Travel scholarships were offered for students to attend and present at ACI and the American Iron and Steel Institute Task Force Meeting
WD-13	Make presentations on transportation careers at major minority institutions and conferences.	All (FIU, ISU, UNR)	Previously prepared video presentations are housed on the ABC-UTC website.

Technology Transfer

The following table lists different tasks related to technology transfer provides a brief description of each task, identifies the lead institution for each task, and states the progress made in each task.

Task #	Brief Description of Task	Lead Institution	Progress (October 1, 2017 – March, 2018)
T2-1	AASHTO Subcommittee on Bridges and Structures (SCOBS) Meeting: ABC-UTC Director and key research team members will be attending the annual AASHTO meetings and, where needed and possible, will brief the related committees on research findings by giving technical presentations.	All (FIU, ISU, UNR)	The 2018 AASHTO SCOBS meeting was held June 2018 in Burlington, Vermont and attended by ABC-UTC Director and UNR Co-Director Dr. Saiidi. Dr. Saiidi made a presentation on “NCHRP 12-105, Proposed AASHTO Seismic Specifications for ABC Column Connections- Analytical and Experimental Investigations,”
T2-2	National Committee Meetings: Each ABC-UTC consortium member will be expected to attend at least 3 meetings of national committees each year (other than annual AASHTO meetings) and give technical presentations.	All	The ABC-UTC director attended the following national meetings, CUTC 2018 Summer meeting,
T2-3	Journal Publications: Each ABC-UTC consortium member will be expected to prepare and submit a minimum of two journal publications, in high impact journals, for each research project as lead.	All	<p>Farhangdoust, S. & Mehrabi, A. B. (2018). Health Monitoring of Accelerated Bridge Construction Closure Joints – Review of Non-destructive Testing Methods. Engineering Structures</p> <p>Farhangdoust, S. & Mehrabi, A. B. (2018). Damage Detection of Deck Joints in Accelerated Bridge Construction. Journal of Civil Structural Health Monitoring</p> <p>Baqersad, M., Farhangdoust, S. & Mehrabi, A. B. (2018). Development of Guide for Selection of Substructure for ABC Projects.</p> <p>Shahrokhinasab, E., Farhangdoust, S., Garber, D., & Mehrabi, A. B. (2018). Performance of Full-Depth Precast Concrete</p>

Task #	Brief Description of Task	Lead Institution	Progress (October 1, 2017 – March, 2018)
			<p>(FDPC) Deck Panels. Transportation Research Board (TRB)</p> <p>Mokhtarimousavi, S., Anderson, J.C., Azizinamini, A., Hadi, M., "Improved Support Vector Machine Models for Work Zone Crash Injury Severity Prediction and Analysis," Submitted to be presented at the 98th Annual Meeting of the Transportation Research Board and considered for publication at the Transportation Research Record: Journal of the Transportation Research Board, 2019.</p> <p>Mokhtarimousavi, S., Azizinamini, A., Hadi, M., "Evolutionary Algorithms Approach for Performance Enhancement of Machine Learning Techniques to Predict Work Zone Crash Severity," In preparation, to be submitted for publication in Journal of Accident Analysis & Prevention.</p> <p>Azizinamini, A., S. Rehmat, A. Sadeghnejad. "Enhancing resiliency and delivery of bridge elements using ultra high performance concrete as formwork". Transportation Research Board Annual Meeting 2019. August 2018</p> <p>Sadeghnejad, A, R. Taghinezhad, A. Azizinamini, "Extending Use of an Economical Steel Bridge System through Introduction of a New Detail", ASCE Journal of Bridge Engineering, Submitted May, 2018.</p> <p>Shafieifar, Mohamadreza, Mahsa Farzad, and Atorod Azizinamini. "A comparison of existing analytical methods to predict the flexural capacity of Ultra High Performance Concrete (UHPC) beams."</p>

Task #	Brief Description of Task	Lead Institution	Progress (October 1, 2017 – March, 2018)
			<p>Construction and Building Materials 172 (2018): 10-18.</p> <p>Shafieifar, Mohamadreza, Mahsa Farzad, and Atorod Azizinamini. "New Connection Detail to Connect Precast Column to Cap Beam Using UHPC in ABC Applications". Journal of the Transportation Research Board, 2018.</p> <p>Rezaei N, Klein G, and Garber D, "Effect of Development and Geometry on Behavior of Concrete Deep Beams," accepted by ACI Structural Journal, 2018.</p> <p>Rezaei N, Klein G, and Garber D, "Strut Strength and Failure in Full-Scale Concrete Deep Beams," accepted by ACI Structural Journal, 2018.</p> <p>Klein, G, Rezaei N, Garber D, and Tureyen A.K., "Shear in Discontinuity Regions," accepted by Concrete International, 2019.</p> <p>Shoushtari, E., M. Saiidi, A. Itani, and M. Moustafa, "Design, Construction, and Shake Table Testing of a Steel Girder Bridge System with ABC Connections," Journal of Bridge Engineering, ASCE, Special Issue: Accelerated Bridge Construction, Submitted</p> <p>Shoushtari, E., M. Saiidi, A. Itani, and M. Moustafa, "Pretest Analysis of Shake Table Response of a Two-Span Steel Girder Bridge Incorporating ABC Connections," Chinese Academy of Engineering, Journal of Frontiers of Structural and Civil Engineering, Special Issue: High Performance Structures–</p>

Task #	Brief Description of Task	Lead Institution	Progress (October 1, 2017 – March, 2018)
			Building Structures and Materials, Submitted.
T2-4	Outreach: Each ABC-UTC consortium member will be expected to participate in a minimum of two outreach activities each year. Ideally, one outreach activity would be geared toward a national audience and one would be geared toward regional audiences.	FIU, ISU and UNR	All universities have been active in outreach and assisting local and national agencies to learn about ABC. Key researchers at all three institutions routinely give presentations at national conferences. Dr. Azizinamini has given several presentations on ABC at national gatherings and more are planned.
T2-5	ABC strategic plan: In collaboration with AASHTO T-4 Technical Committee on Construction, a strategic implementation plan will be developed to promote and support the use of ABC across the U.S.	All	The ABC-UTC continues to collaborate with the AASHTO SCOBS Technical Committee for Construction (T-4) in support of the T-4 strategic plan.
T2-6	Collaboration with bridge groups: The research team will work with other bridge groups such as the FHWA Long-Term Bridge Performance Program.	All	The ABC-UTC continues to coordinate with bridge owners on project submissions to the ABC Project Database, with eight projects in AZ, MN, OH, and PA added during this reporting period.
T2-7	Provide bridge owners with tools to implement ABC as a standard practice: Research team will convene meetings of select practicing engineers and bridge owners to assist them in the implementation of ABC as a standard practice.	FIU	The Implemented Advanced initiative proposal continues to be evaluated. Technologies.
T2-8	Supplier input: Suppliers that specialize in products suitable for making ABC more efficient will be consulted on their products and systems; as appropriate, ABC-UTC will assist suppliers in assembling and/or acting as an independent body that	All	The ABC-UTC continues its development of a process to provide an independent perspective on the recently renamed Implemented Advanced Technologies.

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	evaluates the products (similar to HITEC).		
T2-9	Data dissemination through partnership: Several existing resources will be utilized for data dissemination, such as a) DOT/RITA research clusters and b) NEEShub, which is established by the NSF George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES).	All	Nothing new to report.
T2-10	Offices of technology transfer: As appropriate, cooperative agreements will be developed with industries for eventual marketing of products developed through research studies conducted by the ABC-UTC. At the request from an individual researcher, industry partner or the ABC-UTC Director, it will be determined if there is a merit to develop a patent based on research outcomes.	All	Several patents have been developed based on research outcomes.
T2-11	Three forms of publication: ABC-UTC publications will be of three forms, each serving a different purpose: (1) journal articles, (2) conference papers; and (3) research reports.	All	A new journal papers were submitted and preparation of other papers began.
T2-12	Technical briefs: Every ABC research project will have a one-page (front and back) technical brief of the pertinent details that will be sent out via e-news to a larger transportation community.	All	Description of each ABC-UTC research project has been posted on ABC-UTC website. www.abc-utc.fiu.edu
T2-13	Dedicated website: Currently the FIU ABC	All	The dedicated ABC-UTC website (http://www.abc-utc.fiu.edu) continues to

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	Center has a website (www.abc.fiu.edu). With enhancements, this website will become the official site of the ABC-UTC.		be updated with the latest research, workforce development, and technology transfer activity.
T2-14	Periodic e-newsletter (ABC Talk): An online newsletter (ABC Talk) will be published to present the highlights of ABC-UTC activities. The availability of the newsletter will be communicated through resources available to AASHTO, FHWA, and TRB.	All	Nothing new to report.
T2-15	Printed newsletter: Annually, a hard copy version of the select articles from e-newsletter (ABC Talk), summarizing the highlights of ABC-UTC activities, will be published	All	The ABC-UTC has decided to change the Annual Highlights report to a Bi-annual Highlights report. Our next report will cover 2017 and 2018 and will be published in 2019.
T2-15a	Webcasting and video Clips: Selected tests will be webcast, and video clips of critical parts of selected tests will be developed.	All	We continue to webcast select tests.
T2-16	Social media: Researchers will actively participate in professional social media such as Facebook, Twitter, and LinkedIn.	All	ABC-UTC have continued using Hootsuite to coordinate and market all webinars, seminars, events, and any other large events hosted by ABC-UTC via Facebook, Instagram, Twitter, and LinkedIn.
T2-17	Statewide or region-wide continuing education courses: Three short courses, each four hours long, will be developed: a short course on basic principles of ABC and overview (FIU), a short course on issues related to seismic (UNR), and a short course on use of principles	FIU	Efforts are underway to systematically educate state DOT's on the implementation of ABC.

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	of ABC in small communities (ISU). The materials for each course will be developed for presentation on the web to DOTs and consulting engineers across the country. The course materials will be archived for future use.		
T2-18	In-depth web conference training: Specific featured presentation topics from the planned monthly webinars will be expanded to 3- to 4-hour in-depth web conference training to assist practitioners in developing a better understanding of the specific topics.	FIU	The archive for the 2018 In-Depth Web Training was completed (https://abc-utc.fiu.edu/technology-transfer/in-depth-web-training-archive/). Plans are underway for the 2019 In-Depth Web Training, currently scheduled for fall 2019.
T2-19	Monthly ABC webinars: The current FIU ABC center monthly webinars, attracting 3000 to 5000 participants, will be continued. Webinars will be archived for subsequent viewing.	FIU	The ABC-UTC conducted a monthly webinar with featured presentation in each of the six months of this reporting period, with registered sites ranging from 750 to 900. Details are available on the Monthly Webinar Archives at https://abc-utc.fiu.edu/events/webinar-archives/ .
T2-20	ABC Conferences: In coordination with FHWA, state DOTs, and industry, a national ABC conference will be organized each year.	FIU	The ABC-UTC is sponsoring the 2019 International ABC Conference: Including Automation, Service Lie and UHPC to be held December 11-13 in Miami. We have started advertising the conference, on various media outlets, both online and in print. More information on the upcoming conference can be found at https://abc-utc.fiu.edu/conference/accelerated-bridge-construction-conference/ .
T2-21	Annual workshop: An annual 1.5-day technical workshop on ABC topics of current concern will be held at FIU. FIU held its first	FIU	The ABC-UTC plans again to sponsor 11 half-day pre-conference workshops on December 11, 2019 in Miami, prior to the start of the 2019 Conference.

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	such ABC workshop in December 2012 with more than 40 attendees. There will be a registration fee and the event will be self-supporting.		

What opportunities for training and professional development has the program provided?

- Educational modules
- Monthly webinars
- In-depth webinars
- Web-based research seminars
- Various presentations to AASHTO, TRB, other national and international conferences, website, and conference publications.
- Youtube channel for video clips of the tests was maintained and updated.
- Youtube posting of general aspects of ABC seismic connections was maintained and updated.

How have the results been disseminated?

The results will be disseminated by followings:

- Educational modules
- Monthly webinars
- In-depth webinars
- Web-based research seminars
- Various presentations to AASHTO, TRB, other national and international conferences, website, and conference publications.
- Youtube channel for video clips of the tests was maintained and updated.
- Youtube posting of general aspects of ABC seismic connections was maintained and updated.

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

Several summer camps and workshops are being planned for the summer 2019. These activities will target K-12 teachers, students, and families.

Publications, conference papers, and Presentations

Mehrabi, A. B., & Farhangdoust, S. (2018). A Laser-Based NonconRAPt Vibration Technique for Health Monitoring of Structural Cables: Background, Success, and New Developments. *Advances in Acoustics and Vibration*, 2018

Shafieifar, Mohamadreza, Mahsa Farzad, and Atorod Azizinamini. "Experimental and numerical study on mechanical properties of Ultra High Performance Concrete (UHPC)." *Construction and Building Materials* 156 (2017): 402-411.

Shafieifar, Mohamadreza, Mahsa Farzad, and Atorod Azizinamini. "A comparison of existing analytical methods to predict the flexural capacity of Ultra High Performance Concrete (UHPC) beams." *Construction and Building Materials* 172 (2018): 10-18.

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NACE, Phoenix, 04/2018: Mahsa Farzad, David Garber, Atorod Azizinamini, Kingsley Lau.
"Mahsa Farzad, David Garber, Atorod Azizinamini, Kingsley Lau" Mahsa Farzad, David Garber, Atorod Azizinamini, Kingsley Lau

2018 PCI Convention and National Bridge Conference: Chitty F, Freeman C, and Garber D, "Development of UHPC Joint Detail for Florida Slab Beam Bridge," 2018 PCI Convention and National Bridge Conference, Student Research I (EDU2), Denver (CO), February 2018.

TRB: Chitty F, Freeman C, and Garber D, "Analysis of efficient prestressed concrete superstructures for short-span bridges for accelerated construction," TRB 97th Annual Meeting, Concrete Bridge Topics, Part 3 (Part 1, Session 346; Part 2, Session 413), Washington, D.C., January 2018.

TRB: Chitty F, Freeman C, and Garber D, "Development of longitudinal joint details for Florida Slab Beam incorporating Ultra-High-Performance Concrete," TRB 97th Annual Meeting, Longitudinal Deck-Level Connections for Accelerated Bridge Construction, Washington, D.C., January 2018.

Saiidi, M., "ABC Seismic Issues and Concepts," Alaska Department of Transportation Workshop, Juneau, Alaska, April 2018

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Shoushtari, E., and M. Saiidi, “Shake Table Studies of A Two-Span Steel Girder Bridge System with ABC Connections,” Accelerated Bridge Construction University Transportation Center Webinar, July 2018.

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Saiidi, M., “NCHRP 12-105, Proposed AASHTO Seismic Specifications for ABC Column Connections- Analytical and Experimental Investigations,” Annual AASHTO Bridge Meetings, Sub-Committee T-3: Bridge Seismic Session, Burlington, Vermont, June 2018

Lee, Seung Jae, ABC–UTC Research Day, Miami, FL, 05/18 (Webinar) “A Predictive Computer Program for Proactive Demolition Planning” A Predictive Computer Program for Proactive Demolition Planning

Lee, Seung Jae, ABC–UTC Research Day, Miami, FL, 05/18 (Webinar) “Innovative Foundation Alternative for High Speed Rail Application” Innovative Foundation Alternative for High Speed Rail Application

Website(s) or other Internet site(s)

- **ABC-UTC Website (<https://abc-utc.fiu.edu/>)**: The ABC-UTC website was redesigned and recreated to create a more functional and user-friendly site to house all ABC-related materials. The website is host to all of the webinars, in-depth web training, student seminars, and short courses that have been hosted by the center. These videos are all available for free to users. The site also has all information, progress reports, final reports, and other resources related to all of the ABC-UTC research projects.
- **ABC Project and Research Database (<http://utcdb.fiu.edu/>)**: As part of two separate ABC-UTC research projects, an ABC Project and Research Database website and the online database was created. This database contains information related to ABC-related projects and research. The website interface allows users to easily search and access this information and also gives users the ability to propose enter in new projects and research for consideration in the official database.
- **Technical Training Certificate Delivery System (<https://abc-utccerts.fiu.edu/>)**: This site and system allow for the webinar, graduate student seminar, and other technical training event certificates of participation to be created and delivered to attendees and

participants. The system also creates an online database of all user certificates, which allows participants to access all past certificates of attendance.

- UNR YouTube channel to host shake table testing of bridges

Technologies or techniques

FIU has envisioned an innovative approach for rapid retrofit of bridges, exhibiting corrosion activities using thin shells of UHPC and robotic construction. A provisional patent is prepared for submission.

Inventions, patent applications, licenses

FIU is working on following innovative ideas for which patent application has been filed:

- Sandwich Folded Girder System.
- THIN UHPC shell for rapid retrofitting substandard bridges
- Extending the maximum length of Folded Plate Steel Bridge System to 105 ft. using an innovative connection detail.

Other products

UNR prepared promotional video clips for engineering recruitment events.

PARTICIPANTS & COLLABORATING ORGANIZATIONS

What organizations have been involved as partners?

- Atorod Azizinamini, Florida International University
- Saidi Saiidi, University of Nevada, Reno
- Brent Phares, Iowa State University
- Terry Wipf, Iowa State University

Industry Partners and Collaborators

ABC-UTC Advisory Committee Members

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. The members of the Advisory board can be found by visiting <https://abc-utc.fiu.edu/about-us/advisory-members/>

IMPACT

What is the impact on the development of the principal discipline(s) of the program?

The ABC-UTC has now become the focal point for ABC at national level. Many designers are contacting ABC-UTC for help and getting started in use of ABC. ABC-UTC is continuing providing

an excellent service to bridge profession and assisting U.S. DOT through its research, education and workforce development and technology transfer activities. ABC-UTC is taking a national lead in 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 liaison between the TRB ABC committee and ABC-UTC. These connections and activities are allowing ABC-UTC to better fill the knowledge gap, especially in the research, technology transfer 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 31 state DOTs 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.

About 25% of the 607,000 bridges in our inventory are substandard and need repair or replacement. This fact continues to elevate the impact ABC-UTC is having on bridge profession.

What is the impact on other disciplines?

Delivering transportation programs in a safe and economical manner is at the heart of any public agencies' mission. ABC-UTC's activities go beyond just building bridges that are constructed quickly. The introduction of time element into construction activities result in significantly enhancing the public and worker safety. It enhances the mobility and therefore help save energy and be environmentally responsible. Assisting the U.S. DOT, ABC-UTC is playing a role in helping to deliver a high quality transportation program to society.

What is the impact on physical, institutional, and information resources at the university or other partner institutions?

The establishment of ABC-UTC has allowed obtaining many additional resources for the faculties, active in ABC areas at FIU and partner universities. In 2015, FIU's Provost provided ABC-UTC a faculty line. As a result ABC-UTC hired Dr. Armin Mehrabi, who is a specialist in long span bridges. He joined the ABC-UTC on January of 2017. More importantly, on October 13, 2016, President and Provost at FIU, after a yearlong intensive evaluation of all major research activities at FIU, selected five research areas within FIU to be designated as preeminent programs. It is with great pleasure to state that Bridge Engineering and ABC-UTC was selected as one of the five research preeminent areas. Greater resources will be available to ABC-UTC as a result of being named preeminent program.

In summary, the establishment of ABC-UTC at FIU by U.S. DOT has provided this great institution with an excellent platform to better educate our students and help the profession while working shoulder to shoulder with U.S. DOT. The impact of the ABC-UTC on our students are enormous.

What is the impact on technology transfer?

The ABC-UTC monthly webinars are proving to be the most effective means of transferring the knowledge to the profession. Having 3000 to 4000 bridge professional participate in each monthly

webinar are unparalleled. The 2014 National ABC conference was co-sponsored by 26 states who actively participated in this event. The 2015 National ABC Conference was Co-Sponsored by 30 states and 2017 Conference sponsored by 32 states. The 2019 upcoming ABC conference thus far, has been co-sponsored by 31 states. ABC-UTC was successful in developing major travel scholarship program that allowed more than 200 state bridge engineers to attend each National ABC Conferences (2014, 2015 and 2017). These activities are providing opportunities for effective communications with State DOTs and bridge professionals, making the task of Technology transfer much easier.

Many State DOTs seek our help in organizing a workshop that is aimed at educating consultants and contractors in their areas about ABC.

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 the ABC the method of choice for bridge replacement and retrofit and in future to call it BC. This, in turn, will improve the mobility and save the 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 the safety. A single accident could cost taxpayers millions in litigation and legal expenses.

CHANGES/PROBLEMS

Changes that have a significant impact on expenditures

No Cost extension has been granted though 5/31/2019.

Actual or anticipated problems or delays and actions or plans to resolve them

No changes

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

No changes

Change of primary performance site location from that originally proposed

No changes

SPECIAL REPORTING REQUIREMENTS

Financial report and documents will be sent by Department of Research at Florida International University.

Completed by:

Florida International University: Atorod Azizinamini

Iowa State University: Brent Phares, Terry Wipf

University of Nevada, Reno: Saiid Saiidi, A. Itani