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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 email exchanges 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, technical advisory committee (TAC) was established for research projects that were selected based on input of ABC-UTC Advisory committee, AASHTO T-4 and AASHTO T-3 Committees. The technical advisory committee 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. Meetings were held with TAC to discuss ABC-UTC research projects.

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

Project #	Research Project Title	TAC Members	Progress (October 1, 2016 – March 31, 2017)
FIU-1	Compilation of all ABC research that is ongoing and completed	Ahmad Abu-Hawash, Iowa DOT Ben Beerman, FHWA	The research database was populated with the research projects and ideas contained in the TRB ABC subcommittee Research Tracking Sheet.

Project #	Research Project Title	TAC Members	Progress (October 1, 2016 – March 31, 2017)
	Recommended by AASHTO T-4		
FIU-2	Compilation of ABC solutions	Ahmad Abu-Hawash, Iowa DOT Ben Beerman, FHWA	The ABC Project Database continues to be populated and advertised.
FIU-3	Extending the application of simple for dead continuous for live load (SDCL) to seismic regions- Part 1: Numerical Study	Tom Ostrom, Caltrans Reza Farimani, Thornton Tomasetti BijanKhaleghi, Washington DOT Elmer Marx, Alaska DOT Bruce Johnson and Hormoz Seraj, Oregon Department of Transportation, Ben Beerman, FHWA	Phase I of project completed. Test specimen for verifying the merits of envisioned detail to extend the application of SDCL to high seismic areas are completed and will be tested during next reporting cycle. This activity will then follow a shake table test at University of Nevada-Reno. The graduate student working on the project is in continuous communication with counterpart graduate student at UNR. This project is closely coordinated between FIU and UNR.
FIU-4	Estimating total cost of bridge construction using ABC and conventional methods of construction (Phase I)	Ben Beerman, FHWA Mary Lou Ralls Newman, Ralls Newman, LLC	This project has been completed.
FIU-5	Development of Manual for Enhanced Service Life of ABC Bridges	Bruce Johnson, Oregon DOT Ali Maher, Rutgers University Hamid Ghasemi, FHWA	The most common form of Accelerated Bridge Construction (ABC) is the use of pre-fabricated modular bridge systems. These systems require joints between elements. From the structural standpoint owners are concerned about the durability and service life of cast-in-place closure joints (longitudinal and/or transverse) in ABC projects. To address these concerns, an

Project #	Research Project Title	TAC Members	Progress (October 1, 2016 – March 31, 2017)
		Carlos Duart, CDR Maguire	<p>experimental program was conducted at Florida International University's ABC research facility (ABC-UTC, www.abc-utc.fiu.edu). As part of investigation a new closure joint detail is also developed that is economical and user friendly with respect to constructability. The new detail consists of a hooking the transverse reinforcement in the closure joint area. Combination of experimental, numerical and analytical investigation is being carried out to develop design provisions that could be adopted by governing design and construction specifications. The experimental program is investigating the optimal lap splice length and staggering space on existing ABC bridge closure joints. During the first phase, experimental test specimens were constructed with twelve different lap splice lengths using two inch and four inch staggering space respectively of closure joints using hooked bars. The closure joint specimens were constructed in two stages. The section modeling the precast concrete slab was casted first and left to cure for minimum of 28 days before the closure joint was placed to complete the test specimen. Some specimens were also cast monolithically to be used as reference specimen. All test specimens were subjected to two-point loading to obtain constant moment over the closure joint. Test results have shown that the longitudinal connection detailed with hooked bars provided adequate flexural capacity and ductility ratio.</p>
FIU-6	Alternative ABC Connections Utilizing UHPC	Bruce Johnson, Oregon Department of Transportation, Bijan Khaleghi, Washington DOT,	<p>The researchers continue to develop an ABC connection details between column and cap beam using UHPC and associated design provisions. A series of experimental tests were performed to evaluate the seismic performance of the proposed connection. The observed displacement ductility exceeds those implied by design specifications.</p>

Project #	Research Project Title	TAC Members	Progress (October 1, 2016 – March 31, 2017)
		Tom Ostrom, Caltrans, Elmer Marx, Alaska DOT	Beside seismic detail, a none-seismic detail with one layer of UHPC is proposed. The experimental tests were performed to evaluate the behavior of the none-seismic connection as well. Moreover, numerical analyses by using a finite element (FE) software were done and the results showed a good agreement with the corresponding experimental data.
FIU-7	Extending Application of SDCL to ABC (Phase II – Experimental):	Bruce Johnson, Oregon Department of Transportation, Bijan Khaleghi, Washington DOT, Tom Ostrom, Caltrans, Elmer Marx, Alaska DOT	Construction of the test specimen is completed. The test set-up is currently being prepared and the test will be finished by end of June 2017.
FIU-8	Estimating total cost of bridge construction using ABC and conventional methods of construction (Phase II)	Ben Beerman, FHWA Mary Lou Ralls Newman, Ralls Newman, LLC	The research team has finalized the activities associated with this project and is currently writing the final report.
FIU-9	Demolition Requirements for Bridge Construction Projects – Best Practices Guideline	Ahmad Abu-Hawash, Iowa DOT; Benjamin Beerman, FHWA; Mike Culmo, CME; Tim Davis, PCL; Richard Dunn, Baker; Tim Keller, Ohio DOT; Mary Lou	The draft final report containing the demolition survey results was reviewed by the TAC. Comments were addressed and a final report was issued. An NCHRP Synthesis 20-05 project has been released for the next funding cycle based on the results of this survey and final report

Project #	Research Project Title	TAC Members	Progress (October 1, 2016 – March 31, 2017)
		Ralls, SBC Global; Corey Rogers, Michigan DOT; Carmen Swanwick, Utah DOT; Wayne Symonds, Vermont Agency of Transportation	
ISU-1	Development of Crash-Tested Prefabricated Bridge Railings Recommended by AASHTO T-4	Ahmad Abu-Hawash, Iowa DOT Tim Fields, Connecticut DOT	The completed experimental work consisted of six different tests with the first two on two isolated barriers before establishing the barrier-to-barrier connection. Data from the first four tests have been analyzed in detail, which confirm the preliminary findings. The barrier with the inclined bar connection performed well while U-bar connection needs improvement. The performance of the barrier-to-barrier connection was satisfactory. Several chapters of the final report have also been drafted and they will be reviewed next.
ISU-2	Extending the Application of ABC to Bridge Rehabilitation (synthesis first then developmental)	Ahmad Abu-Hawash, Iowa DOT Ben Beerman, FHWA	This project has been completed.
ISU-3	Durability and strength of grouted sleeve couplers	Ahmad Abu-Hawash, Iowa DOT Elmer Marx, Alaska DOT	This project has been completed.
ISU-4	Material Design and Structural Configuration of Link Slabs for ABC Applications		After completing a review of potential fiber choices for contractor friendly fiber reinforced concrete link slab materials, four synthetic macro fiber types were selected to be investigated for their concrete reinforcing potential. Four separate concrete fiber suppliers generously donated samples of fiber to the

Project #	Research Project Title	TAC Members	Progress (October 1, 2016 – March 31, 2017)
			<p>project for preliminary testing. The four fibers that were selected based on potential performance from literature and availability in the current market were High Strength Polyethylene (HSPE), Polyvinyl Alcohol (PVA), Polypropylene (PP), and Basalt. The mixes prepared with the four fibers were tested under 3rd point bending flexure and splitting tension to evaluate their reinforcing effectiveness. The research team is now in the process of summarizing the results for the next step of the project.</p>
ISU-5	Investigation of Macro-Defect Free Concrete for ABC including Robotic Construction		<p>A site visit to the laboratory at Caterpillar was completed to better understand the new mix iterations and its associated properties. To achieve better performance, fibers were considered. However, the limitations associated with toughness and mixability were evident due to the large numbers of fibers required to achieve the desired material properties. Possible applications for the material given these limitations are currently being explored.</p>
ISU-6	An Integrated Project to Enterprise-Level Decision Making Framework for Prioritization of Accelerated Bridge Construction		<p>The impact of bridge closures due to bridge maintenance or replacement is analyzed at the network level. For this purpose, the current state of the network is considered by partial or closure of the bridges based on the type of ABC techniques used. A dynamic traffic analysis is implemented to capture the duration of bridged closures. A simulation-based approach is utilized to prioritize bridges. The different ABC techniques that could be used are based on the type of bridges and their importance to the functionality of the network. Different measures such as social return on investment (SROI), traffic delay and opportunity loss are used to measure the functionality of the transportation network.</p>

Project #	Research Project Title	TAC Members	Progress (October 1, 2016 – March 31, 2017)
UNR-1	Behavior and design of precast bridge cap beams with pocket connections	Bijan Khaleghi, Washington DOT Elmer Marx, Alaska DOT Tom Ostrom, Caltrans	This project has been completed.
UNR-2	Evaluation of Seismic Performance of Bridge Columns w/ Couplers and Development of Design Guidelines	Ahmad Abu-Hawash, Iowa DOT Bijan Khaleghi, Washington DOT Elmer Marx, Alaska DOT Tom Ostrom, Caltrans	This project has been completed.
UNR-3	Development and Seismic Evaluation of Pier Systems w/ Pocket Connections and Hollow PT/UHPC Columns	Bijan Khaleghi, Washington DOT Elmer Marx, Alaska DOT Tom Ostrom, Caltrans	Experimental and analytical studies of this project were completed. Development of design methods for ABC connections and examples began. Two journal papers, one on post-tensioned columns with pocket connections and the other on two-column piers with pocket connections were submitted.
UNR-4	Shake Table Studies of a Bridge System with ABC Connections:		Instrumentation plans for the bridge system model were developed. Components of the two column pier model supporting the bridge were constructed. Design and detailing of steel superstructure and precast deck panels were completed. NSBA donation was secured and a local steel fabricator was identified to fabricate the steel elements of the superstructure.

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 (Apr-2016 Sept-2016)
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 24 graduate students are working on ABC-UTC related research projects. Twelve at FIU, seven at ISU and five at UNR.
WD-2	Increasing the number of research assistantship opportunities for graduate students.	ALL (FIU, ISU, UNR)	In this period, a total of five graduate research assistants worked on different aspects of seismic design of ABC bridges. ISU and FIU had no additional students in this reporting period.
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	FIU and ISU continue to develop materials to move some courses online.
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. • Nathan Johnson, Kleinfelder Engineering • Claudia Pulido, Kiewit Infrastructure Engineers • Mark Reno, Quincy Engineering • Ashkan Vosooghi, AECOM

Task #	Brief Description of Task	Lead Institution	Progress (Apr-2016 Sept-2016)
			All three center partners are actively encouraging productive mentorship relationships between graduate students and former graduate students and professionals.
WD-6	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.	ISU	These seminars continue to be offered quarterly, but are now under a new name: “Research Seminars”. Seminars were delivered in October 2016 and January 2017 and were attended by over 400 sites each from across the world (with multiple attendees at many sites). These seminars are recorded and archived on the ABC-UTC website for future viewing. These seminars are recorded and archived on the ABC-UTC website for future viewing.
WD-7	Encourage one-on-one interaction with industry.	ISU Lead; ALL (FIU, ISU, UNR)	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.
WD-8	Internship Program- All three consortium members will develop an undergraduate research internship program.	UNR Lead; ALL (FIU, ISU, UNR)	All three partner universities have hired undergraduate students as interns on ABC-UTC research projects. Fourteen undergraduate students are supported through internships and are actively involved in research during the past reporting period.
WD-9	Educational Modules- Develop three educational modules, in the form of print and videos, for K-12 with focus on developing age-appropriate programs.	UNR	Preparation were made to present an ABC seismic module at three middle-school summer camps to be held at UNR in June 2017. The PowerPoint presentation has been posted on the project 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	FIU, ISU, UNR	A parent-student bridge engineering camp is being organized for June 2017. This camp will introduce 20 low-socio economic families to bridge engineering. Details on the camp are being closely documented so that a similar model can be used at other low socioeconomic communities around the country.

Task #	Brief Description of Task	Lead Institution	Progress (Apr-2016 Sept-2016)
	general and principles of bridge engineering and ABC in particular.		
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	One article was published during this reporting period: The ABC advantage: Time, safety, and quality make ABC a bridge construction hero (http://go-explore-trans.org/post.cfm?ID=19007)
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 TRB.
WD-13	Make presentations on transportation careers at major minority institutions and conferences.	All (FIU, ISU, UNR)	Video presentations were prepared featuring UNR faculty and graduate students working on ABC projects. These will be used in future recruitment effort starting in Fall 2017. Presentations were made by FIU students at the 2017 TRB in Washington, DC.

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 (Apr-2016 Sept-2016)
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)	ISU- The 2017 AASHTO SCOBS meeting will be held in June with several members of the ABC-UTC will be in attendance. Preparations are underway for PIs to attend and give presentations at the Meeting in Spokane, WA
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	An ABC-UTC workshop was held at the January 2017 TRB Annual Meeting in Washington, DC; a total of six presentations were given by FIU, ISU, and UNR researchers. Technical presentations and key note speaker presentations were given by FIU at the following conferences/meetings: 1. U.S.-Europe Research Collaboration, "Future of Bridge Design and Construction: Accelerated Bridge Construction", Nov, 3, 2016, Miami, FL 2- Keynote speaker, University of Missouri, Annual Bridge Conference, "Accelerated Bridge Construction", Nov 17, 2016 3- AISI Steel Bridge Task force and AASHTO SCOBS, T-14 meeting, "Update on summary of research studies in ABC at FIU", Jan 25, 2017, Orlando, FL 4- Keynote talk, Miami, ASCE Chapter, "Accelerated Bridge Construction", May, 9, 2017 Technical presentations were given at the following conferences/meetings:

Task #	Brief Description of Task	Lead Institution	Progress (Apr-2016 Sept-2016)
			<ol style="list-style-type: none"> 1. "Accelerated Bridge Construction in High Seismic Zones – Pocket Connections for Conventional and Novel Materials," 11th US-Taiwan Bridge Engineering Workshop, Taipei, Taiwan, October 2016. 2. "Advanced Materials for Accelerated Bridge Construction w/ Pocket Connections in High Seismic Zones," Keynote Presentation, 1st International Conference on Modern Materials and Structures in Civil Engineering, Tehran, Iran, October 2016 (Via Skype).
T2-3	<p>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.</p>	All	<p>Several papers were prepared and submitted by FIU, UNR and ISU, based on first and second-year research projects, being carried out, to TRB and other journals.</p> <p>TRB papers related to ABC were prepared and submitted by FIU, ISU and UNR. Publication notifications on papers is still pending.</p>
T2-4	<p>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.</p>	FIU, ISU and UNR	<p>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 keynote talks on ABC at national gatherings and more are planned.</p> <p>UNR researchers gave 8 presentations at national and international venues in the form of keynote speeches, invited workshop presentations, and other invited seminars.</p>

Task #	Brief Description of Task	Lead Institution	Progress (Apr-2016 Sept-2016)
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 that was originally transferred from FHWA.
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	An initiative has begun to further promote proven advanced technologies including proprietary products to bridge owners; a web page has been developed and a process to vet technologies is under development.
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 evaluates the products (similar to HITEC).	All	Nothing new to report.
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. NEES program is completed.
T2-10	Offices of technology transfer: As appropriate, cooperative agreements will be developed with industries for eventual marketing of products developed through research studies	All	New patent is submitted to extend the maximum length of folded plate bridge system beyond 100ft. New patent is being developed for a precast concrete system

Task #	Brief Description of Task	Lead Institution	Progress (Apr-2016 Sept-2016)
	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.		for short to medium-span bridges for ABC applications. A new patent was submitted for retrofitting existing concrete bridges using UHPC in accelerated manner
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	Papers on ABC were prepared for upcoming conferences and journals. 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 Center has a website (www.abc.fiu.edu). With enhancements, this website will become the official site of the ABC-UTC.	All	The dedicated ABC-UTC website (http://www.abc-utc.fiu.edu) continues to be improved and refined.
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 2016 Highlights Report is under development.

Task #	Brief Description of Task	Lead Institution	Progress (Apr-2016 Sept-2016)
T2-15a	Webcasting and video Clips: Selected tests will be webcast, and video clips of critical parts of selected tests will be developed.	All	Nothing new to report for this period.
T2-16	Social media: Researchers will actively participate in professional social media such as Facebook, Twitter, and LinkedIn.	All	FIU is utilizing Hootsuite to coordinate social media activity to promote ABC-UTC activities. All archived webinars, seminars, and web trainings are uploaded on the ABC-UTC YouTube channel.
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 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.	FIU	FIU, ISU and UNR gave number of presentations at various gatherings. The ISU "ABC for Secondary Road System" short course is available on the ABC-UTC website at http://abc-utc.fiu.edu/technology-transfer/continuing-education-courses/ . Nothing new to report on two planned short courses.
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	An In-Depth web training was conducted on October 4, 2016. Similar to the 2014 and 2015 inaugural training, the 2015 in-depth web training was four hours long and consists of six modules, each a 30-minute presentation by an expert in the focus area of the module followed by a 10-minute Q&A session. This year's in-depth web training featured the Tennessee DOT's "Fast Fix 8" Project in Downtown Nashville.
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	FIU has continued to organize and successfully conduct monthly free webinars, with six conducted in this time period. These webinars are being attended by about 3000 to 4000 bridge professionals

Task #	Brief Description of Task	Lead Institution	Progress (Apr-2016 Sept-2016)
			from across the country. Almost all State DOTs listen to these monthly webinars. These monthly webinars have become the most listened bridge webinar in the country.
T2-20	Annual national conference: In coordination with FHWA, state DOTs, and industry, a national ABC conference will be organized each year.	FIU	The preliminary program for the 2017 National ABC Conference, to be held December 6-8 in Miami, was under development during this reporting period.
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 such ABC workshop in December 2012 with more than 40 attendees. There will be a registration fee and the event will be self-supporting.	FIU	Half-day workshops will be held on December 6 in conjunction with the National ABC Conference. Workshop topics and organizers were identified during this reporting period.
T2-23	Assessment and Evaluation Tool: Initially develop the tool, determine the goal of the activity, and identify the criteria. For each activity, populate the tool. See EDC “National and State Implementation Goals” and SHRP2 “Evaluation of Benefits.”	FIU	The progress of different activities is being monitored using evaluation matrices.

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

Please see the tables above for more details. Following are highlights of information provided in the tables listed above

- 2017 National ABC Conference plans are in progress with several held day pre-conference workshops being planned.
- Educational modules were developed and used in graduate courses to train students.
- Monthly webinars were continued
- ABC-UTC web-based graduate student seminars were held in October 2016 and January 2017. All of our past research seminars are archived and available on our website.
- In-depth webinar series were initiated and held in November 2014, November 2015 and October 2016

- ABC sessions are organized at several major conferences
- Ph.D. students, post-doctoral fellows, and undergraduate students involved in ABC-UTC projects have been trained on ABC topics.
- Travel scholarships offered to students to attend TRB Annual Meeting.

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?

During next reporting period, the following tasks will be emphasized:

- Continuing with conduct of in-progress research projects and research selected for the third incremental funding
- Briefing the ABC-UTC steering committee members on the progress of research projects.
- Development of more ABC educational modules
- Continuing with monthly free webinars
- Continue to disseminate research results through various outlets.
- Continuing with organization of the 2017 National ABC conference
- UNR to specifically, give presentations and organize an earthquake lab tour for three different groups of middle school students in June 2017.
- Post new video clips of tests and other ABC promotional materials on web.
- Conduct summer camps.

PRODUCTS

Publications, conference papers, and presentations

- ❖ Several papers were prepared and submitted to TRB
- ❖ Final report for completed projects are posted on ABC-UTC website.

- ❖ Organized a special session at 2017 TRB meeting to provide a summary of ABC-UTC research product. The workshop was held on Sunday and is organized by ABC-UTC and TRB ABC committee.
- ❖ Several final reports as reported on ABC-UTC website

FIU

- ❖ Garber D, “Overview of the ABC Project and Research Databases,” Presentation, TRB 96th Annual Meeting (2017), Latest Accelerated Bridge Construction Innovations from Research.
- ❖ Garber D (2016), *Compilation of Results from Bridge Demolition DOT Survey*, Technical Report, Miami: Florida International University.
- ❖ Garber D (2016), *Compilation of Accelerated Bridge Construction (ABC) Bridges*, Miami: Florida International University.
- ❖ Garber D and Ralls M, “Accelerated bridge construction project and research databases,” New York City Bridge Conference, New York, 2017.
- ❖ Aziznamini, A, U.S.-Europe Research Collaboration, “Future of Bridge Design and Construction: Accelerated Bridge Construction”, Nov, 3, 2016, Miami, FL
- ❖ Aziznamini, A, Keynote speaker, University of Missouri, Annual Bridge Conference, “Accelerated Bridge Construction”, Nov 17, 2016
- ❖ Aziznamini, A, AISI Steel Bridge Task force and AASHTO SCOBS, T-14 meeting, “Update on summary of research studies in ABC at FIU”, Jan 25, 2017, Orlando, FL
- ❖ Aziznamini, A, Keynote talk, Miami, ASCE Chapter, “Accelerated Bridge Construction”, May, 9, 2017

FIU’s ABC related Presentations at 2017 TRB in Washington DC

- ❖ Aziznamini, A, “Alternative ABC Connection Utilizing UHP”
- ❖ Farad, Mahsa, “Development of Innovative Bridge Systems Utilizing Steel-Concrete-Steel Sandwich System”
- ❖ Aziznamini, A, “Closure Joint Alternatives for ABC Projects”
- ❖ Aziznamini, A, “Bridge Elements Using Various Forms of Concrete Filled Tubes”
- ❖ Aziznamini, A, “Retrofitting Damaged Bridge Elements Using Thin Ultra-High-Performance Shell Elements”

UNR

- ❖ Many presentations in various forms are given. The updated list is posted at the following sites:
- ❖ <http://wolfweb.unr.edu/homepage/saiidi/USDOT/workforce.html>
- ❖ <http://wolfweb.unr.edu/homepage/saiidi/USDOT/technology.html>
- ❖ <http://wolfweb.unr.edu/homepage/saiidi/USDOT/presentations.html>

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 will be filed:

- Sandwich Folded Girder System
- Innovative connection for ABC Bridges.
- THIN UHPC shell for rapid retrofitting
- Extending the maximum length of Folded Plate Steel Bridge System to 110 ft. using an innovative connection detail.

Other products

UNR prepared promotional video clips for engineering recruitment events.

PARTICIPANTS & COLLABORATING ORGANIZATIONS

ABC-UTC Participants at FIU

Name	Atorod Azizinamini, Ph.D.
Program/Project Role	ABC-UTC Director
Number of hours worked during the	Approximately 400 hrs.

reporting period	
Contribution to Program/Project	Responsible for oversight and governance of ABC-UTC
Funding Support	FIU, FDOT, UTC
Collaborated with individual in foreign country	N.A.
Country(ies) of foreign collaborator	N.A.
Traveled to foreign country	N.A.
If traveled to foreign country(ies), duration of stay	N.A.

Name	Mary Lou Ralls, P.E.
Program/Project Role	ABC-UTC Technology Transfer Director
Number of hours worked during the reporting period	Approximately 240 hrs.
Contribution to Program/Project	Responsible for oversight of ABC-UTC technology transfer and assistance to ABC-UTC Director as needed
Funding Support	UTC, AASHTO, TTI
Collaborated with individual in foreign country	N.A.
Country(ies) of foreign collaborator	N.A.
Traveled to foreign country	N.A.
If traveled to foreign country(ies), duration of stay	N.A.

Name	Mohammad Hadi
Program/Project Role	ABC-UTC – Co-PI on a research project
Number of hours worked during the reporting period	Approximately 20 hours
Contribution to Program/Project	PI on the Public Cost Estimation Project (FIU-4)
Funding Support	ABC-UTC
Collaborated with individual in foreign country	N.A
Country(ies) of foreign collaborator	N.A
Traveled to foreign country	N.A
If traveled to foreign country(ies), duration of stay	N.A

Name	Armin Mehrabi
Program/Project Role	ABC-UTC Co-Director of Research
Number of hours worked during the reporting period	Approximately 120 (Between January 1 2017 to March 31st 2017)

Contribution to Program/Project	Preparation of Proposal for Cycle 3. Coordination of Research activities, meetings, teleconferences, reviews, and updates
Funding Support	ABC-UTC at FIU
Collaborated with individual in foreign country	NA
Country(ies) of foreign collaborator	NA
Traveled to foreign country	NA
If traveled to foreign country(ies), duration of stay	NA

Name	David Garber
Program/Project Role	ABC-UTC Co-Director of WD activities and PI on research projects
Number of hours worked during the reporting period	Approximately 500 hours
Contribution to Program/Project	Responsible for Project #FIU-1, #FIU-2, #FIU-9 ABC-UTC website, technology training certificate delivery, workforce development activities, and assisting with other center activities.
Funding Support	ABC-UTC and FIU
Collaborated with individual in foreign country	N.A
Country(ies) of foreign collaborator	N.A
Traveled to foreign country	N.A
If traveled to foreign country(ies), duration of stay	N.A

ABC-UTC Participants at ISU

Name	Brent Phares
Program/Project Role	ABC-UTC Co-Director
Number of hours worked during the reporting period	250 hours
Contribution to Program/Project	Overall leadership
Funding Support	-
Collaborated with individual in foreign country	No
Country(ies) of foreign collaborator	NA
Traveled to foreign country	No
If traveled to foreign country(ies), duration of stay	NA

ABC-UTC Participants at UNR

Name	M. Saiid Saiidi
Program/Project Role	ABC-UTC Co-Director
Number of hours worked during the reporting period	200 hours
Contribution to Program/Project	Management of ABC-UTC-Seismic projects and workforce development/outreach at UNR.
Funding Support	ABC-UTC, Caltrans, WashDOT, NCHRP, NDOT
Collaborated with individual in foreign country	No
Country(ies) of foreign collaborator	N/A
Traveled to foreign country	Yes, but not w/ ABC-UTC funding
If traveled to foreign country(ies), duration of stay	N/A

Name	Ahmad Itani
Program/Project Role	ABC-UTC-Seismic Co-PI at UNR
Number of hours worked during the reporting period	130 hours
Contribution to Program/Project	Help manage ABC-UTC-Seismic projects and workforce development/outreach at UNR.
Funding Support	ABC-UTC, Caltrans
Collaborated with individual in foreign country	No
Country(ies) of foreign collaborator	NA
Traveled to foreign country	No
If traveled to foreign country(ies), duration of stay	NA

Name	Mohamed Moustafa
Program/Project Role	Senior personnel on ABC-UTC-Seismic ABC System Project
Number of hours worked during the reporting period	70 hours
Contribution to Program/Project	Help advice research assistant on ABC-UTC-Seismic project at UNR.
Funding Support	ABC-UTC, USDOT
Collaborated with individual in foreign country	No
Country(ies) of foreign collaborator	NA
Traveled to foreign country	No
If traveled to foreign country(ies), duration of stay	NA

Industry Partners and Collaborators

ABC-UTC Advisory Committee Members

State Transportation Agencies

- Atorod Azizinamini, Florida International University
- Mary Lou Ralls, Ralls Newman, LLC, Former State Bridge Engineer, State of Texas
- Carmen Swanwick, AASHTO SCOBS T-4 Chair, Utah DOT
- Wayne Symonds, AASHTO SCOBS T-4 Vice-Chair, Vermont Agency of Transportation
- Ahmad Abu-Hawash, Iowa DOT
- Nancy Daubenberger, Minnesota DOT
- Tom Donald, Massachusetts DOT
- Shoukry Elnahal, Delaware River & Bay Authority
- Bruce Johnson, Oregon DOT
- Jugesh Kapur, Burns & McDonnell; former State Bridge Engineer, Washington State
- Bijan Khaleghi, Washington State DOT
- Paul Liles, former State Bridge Engineer, Georgia
- Elmer Marx, Alaska DOT&PF
- Tom Ostrom, California DOT
- Robert Robertson, Florida DOT
- Kevin Thompson, former State Bridge Engineer, California
- Monica Starnes, Transportation Research Board
- Sam Fallaha, FDOT

Federal Highway Administration

- Ben Beerman, Resource Center

Industry Partners

- Riad Asfahani, U.S. Steel Corporation
- John Busel, American Composites Manufacturers Association (ACMA)
- Reid Castrodale, Lightweight concrete rep.
- Randy Cox, American Segmental Bridge Institute (ASBI)
- Mike Culmo, CME Associates, Inc.
- Jerry DiMaggio, Applied Research Associates, Inc.
- Carlos Duarte, CDR Maguire
- Bill Duguay, Associated General Contractors of America (AGC), rep.; J.D. Abrams, LP
- Mal Kerley, NXL Construction Services, Inc.
- Danielle Kleinhans, National Steel Bridge Alliance (NSBA)
- Bill McEleney, National Steel Bridge Alliance (NSBA), consultant
- William Nickas, Precast/Prestressed Concrete Institute (PCI)
- Eliza Partington, FIGG
- Maury Tayarani, Pennoni Associates Inc.

International Members

- Taek-Ryong Seong, RIST – South Korea
- Chan-Hee Park, RIST - South Korea

Collaborators Partner Universities

- Saiid Saiid, University of Nevada, Reno
- Brent Phares, Iowa State
- Ahmad Itani, University of Nevada, Reno
- Terry Wipf, Iowa State University

Center Administration, Faculty and Staff at Florida International University

- Atorod Azizinamini, ABC-UTC Director
- Mary Lou Ralls, Director of Technology Transfer
- Armin Mehrabi, ABC-UTC Director of Research and Associate Professor
- David Garber, ABC-UTC Director of Education & Workforce Development and Assistant Professor
- Mohammed Hadi, Co-Director and Professor Seung Jae Lee, Assistant Professor
- Seung Jae Lee, Assistant Professor
- Xia Jin, Assistant professor
- Hesham Ali, Professor of Practice
- Alireza Mohammadi, Graduate Student
- Huy Pham, Graduate Student
- Ramin Taghinezhad, Graduate Student Research Assistant
- Alireza Valikhani, Graduate Student Research Assistant
- Azade Jaber, Graduate Student Research Assistant
- Mahsa Farzad, Graduate Student Research Assistant
- Mohamadreza Shafieifar, Graduate Student Research Assistant
- Amir Sadeghnejad, Graduate Student Research Assistant
- Shereyar e Rehmat, Graduate Student Research Assistant

IMPACT

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

The ABC-UTC is fast becoming the focal point for ABC. 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 States have Co-sponsored the 2014 National ABC Conference, thirty State DOTs have sponsored the 2015 National ABC Conference and to date 31 state DOTs have co-sponsored the 2017 National ABC Conference to be held on December of 2017 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 pf 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.

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 webinars 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. 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 and 2015). 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 changes

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

No changes

Changes that have a significant impact on expenditures

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