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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 work force; 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 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 that will be funded, especially those that will concentrate on highway safety, 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.
- Develop new knowledge to extend 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.

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.

What was accomplished under these goals?

Monthly meetings among the partner universities, were held during the reporting period to track progress in different tasks, using a matrix that included 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 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 steering committee, AASHTO T-4 and AASHTO T-3 Committees. 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 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 (Oct-2015 Mar-2016)
FIU-1	Compilation of all ABC research that is ongoing and completed Recommended by AASHTO T-4	Ahmad Abu-Hawash, Iowa DOT Ben Beerman, FHWA	A functioning research database has been created based on the framework developed for the project database. The research database continues to undergo refinement and will be expanded to account for current needed, ongoing and completed research related to ABC.
FIU-2	Compilation of ABC solutions	Ahmad Abu-Hawash, Iowa DOT Ben Beerman,	The ABC Project Database was completed and opened to the public. The focus of this reporting period has been on presenting on the database at national and international venues.

Project #	Research Project Title	TAC Members	Progress (Oct-2015 Mar-2016)
		FHWA	<p>Presentations on the database have been made in person at the National ABC Conference and the TRB Convention. The work was also presented during the last graduate student seminar webcast hosted by the ABC-UTC to an audience of over 200.</p> <p>The other focus of this past period has been on verifying and cleaning up the data already contained in the database and helping bridge owners and other related parties to develop entries for the database.</p>
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	During the reporting period, a finite element model of the seismic detail of SDCL was investigated and load resistance mechanisms of the system were also studied. Earthquake loads were simulated by three different load conditions including push up, push down and inverse forces. A numerical study was conducted to provide a simple design formula which is suitable to use in design offices. Based on Phase II of this study, an experimental testing program, which is capable of verifying the finite element results, was developed. For this purpose, a column with girders on both sides will be constructed in the structure lab of FIU. The column and bent cap are designed based on CALTRANS specifications. The CALTRAN design provision is proved to be adequate for utilizing FIU's SDCL detail in practice. The purpose of component test is to verify the merits of FIU's SDCL detail before it is utilized on shake table test.
FIU-4	<p>Synthesis on calculating total public costs for short-term road closures to justify reasonable incentives/ disincentives</p> <p>Recommended by AASHTO T-4</p>	Ben Beerman, FHWA Mary Lou Ralls Newman, Ralls Newman, LLC	During the reporting period, a case study was conducted for the bridge located at the interchange of I-4 and Graves Avenue in Orlando, FL. The construction costs and user costs of using ABC methods were compared to those of convention methods. This case study demonstrates the benefits of using the total costs that incorporate both the construction and user costs in the decision making process. In addition, five bridge design and construction cases developed by Florida Department of Transportation were analyzed with respect to

Project #	Research Project Title	TAC Members	Progress (Oct-2015 Mar-2016)
			<p>total cost to identify the ABC cost elements. This aspect of the project is work in progress.</p> <p>Also, procedures to estimate additional road user costs including business impacts, and freight and commodity impacts using simulation-based tools have been identified. In addition, procedures to estimate diversion have been identified. A subarea network within Broward County, FL was imported into a mesoscopic dynamic traffic assignment (DTA) tool, DTALite. This DTA model is being calibrated and will be used in the estimation of road user cost during construction.</p>
FIU-5	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>Recent work on this manual has concentrated on developing complete arrays of reinforcement for closure pours. In order to achieve this goal the following steps have been undertaken:</p> <ul style="list-style-type: none"> • A study of the ABC project database was conducted, and all possible types of connections for ABC projects were categorized. • Different and dominant categories of ABC projects in service were then identified. • For each category, representative bridges were selected in different climates and under different traffic conditions and then inspected. Coordination of the inspection activities with the agency responsible for the bridges was necessary to acquire their assistance during the inspection. To date, site visits and a non-destructive testing program have been carried out at two bridge sites and the results have been reported in quarterly progress reports. • A test program was developed to investigate IR signatures on existing ABC bridge structures. Laboratory test specimens were constructed with three different types of closure pours. Three specimens have been constructed, each 15 feet long. The bridge girders are spaced 6 feet apart, and are WF 30x99 steel sections. Nelson studs were welded to the top flange. The girders were set on top of concrete jersey traffic

Project #	Research Project Title	TAC Members	Progress (Oct-2015 Mar-2016)
			<p>barricades, and rest on elastomeric pads. Non-destructive testing (Impulse Response test) program have been carried out on all the three specimens.</p>
FIU-6	<p>Alternative ABC Connections Utilizing UHPC</p>		<p>This project has developed ideas for development of next generation of ABC connections that allows using large tolerance and having long service life. A feasibility study in the form of conducting detail non-linear finite element analysis and constructing a full scale test specimen is underway. The results obtained demonstrate the feasibility of the concept. Work is in progress and more detail information will be provided during next reporting cycle.</p>
ISU-1	<p>Development of Crash-Tested Prefabricated Bridge Railings</p> <p>Recommended by AASHTO T-4</p>	<p>Ahmad Abu-Hawash, Iowa DOT Tim Fields, Connecticut DOT</p>	<p>The two barrier connection systems have been tested in the laboratory with quasi-static testing. The loads were applied cyclically using a hydraulic actuator. The systems will be evaluated based upon how they impact their individual strengths and how they impacted the performance of the deck overhangs used to support the railing.</p> <p>The barrier segments were tested individually to test the barrier to deck connection. Then they were connected and tested again. The force was applied at the joint to measure the force distribution. A ponding test was also conducted on the connections to test for durability.</p> <p>The construction of the barrier rails was fabricated by a precast plant in Omaha. They were delivered to the Iowa State Lab February of 2016. The construction of the deck slab and the loading block were done in the Iowa State University Structures Lab.</p> <p>Laboratory testing began March of 2016. The first laboratory test was conducted on the precast barrier with the inclined rod connection, PBI. The push load was applied incrementally up to 54 kips. It was applied in six kip increments.</p>

Project #	Research Project Title	TAC Members	Progress (Oct-2015 Mar-2016)
			The barrier performed as expected. Cracks developed along the deck around 18 kips. It wasn't until the loading reached 48 kips that diagonal, hairline cracks began to form on the barrier near the barrier to barrier interface. The maximum deflection of the barrier was measured at 0.807 inches.
ISU-2	Extending the Application of ABC to Bridge Rehabilitation (synthesis first then developmental)	Ahmad Abu-Hawash, Iowa DOT Ben Beerman, FHWA	Not Applicable. This project has been completed.
ISU-3	Durability and strength of grouted sleeve couplers	Ahmad Abu-Hawash, Iowa DOT Elmer Marx, Alaska DOT	Not Applicable. This project has been completed.
ISU-4	Material Design and Structural Configuration of Link Slabs for ABC Applications		This project was initiated during the last reporting period.
ISU-5	Investigation of Macro-Defect Free Concrete for ABC including Robotic Construction		This project was initiated during the last reporting period.
ISU-6	An Integrated Project to Enterprise-Level Decision Making Framework for Prioritization of Accelerated Bridge Construction		This project was initiated during the last reporting period.
ISU-7	Rapid Bridge Demolition Plan Review Guidance		This project was initiated during the last reporting period.
UNR-1	Behavior and design of precast bridge cap beams with pocket connections	Bijan Khaleghi, Washington DOT Elmer Marx, Alaska DOT Tom Ostrom,	Not Applicable. This project has been completed.

Project #	Research Project Title	TAC Members	Progress (Oct-2015 Mar-2016)
		Caltrans	
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	Not Applicable. 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	A large-scale two-column pier test model with square columns, UHPC and ECC plastic hinges, and pocket connections was constructed, instrumented, and prepared for testing on a shake table. This model was tested in April to evaluate and generate information on the seismic performance of cap beam pocket connections for square columns and determine the relative merit of ECC and UHPC plastic hinges. Analysis of the test is in progress.
UNR-4	Shake Table Studies of a Bridge System with ABC Connections:		This project was initiated during the last reporting period. This project is being conducted in a close collaboration with FIU. One of the main objective of this project is to evaluate the merits of FIU's SDCL detail for seismic region. This project is closely tied to project FIU-3. The shake table test related activities will start after completion of the component test at FIU.

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 (Oct-2015 Mar-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 total, 22 graduate students are working on ABC-UTC related research projects. Thirteen at FIU, seven at ISU, and two at UNR.
WD-2	Increasing the number of research assistantship opportunities for graduate students.	ALL (FIU, ISU, UNR)	Research assistantships were increased by seven from the previous reporting cycle.
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	The UNR course module was updated and preparation for adding audio to the Power Point files began. Additional educational modules are also being developed in rural bridges and ABC (ISU) and connection details (FIU).
WD-4	Developing online courses and making progress towards the development of fully online degree programs.	FIU	FIU and ISU have begun 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	<p>The following professionals from industry have been mentoring ABC-UTC students on research during this reporting period:</p> <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. <p>UNR added the following new four members to provide mentoring opportunities in ABC-seismic:</p> <ul style="list-style-type: none"> • Nathan Johnson, Kleinfelder Engineering • Claudia Pulido, Kiewit Infrastructure Engineers

Task #	Brief Description of Task	Lead Institution	Progress (Oct-2015 Mar-2016)
			<ul style="list-style-type: none"> • 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>The format and other details related to the seminar were finalized and the speakers for the first and second seminars were invited. The first graduate student seminar was delivered in January 2016 and was attended by over 130 sites across the world. These seminars will occur quarterly and will feature two graduate student speakers who worked on ABC-UTC related research projects.</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)	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 from the technical community.
WD-8	<p>Internship Program- All three consortium members will develop an undergraduate research internship program.</p>	UNR Lead; ALL (FIU, ISU, UNR)	All three partner universities have hired undergraduate students as interns on ABC-UTC research projects. Thirteen undergraduate students were supported through internships and were actively involved in research during the past reporting period. UNR hired a new undergraduate research intern in Jan. 2016.
WD-9	<p>Educational Modules- Develop three educational modules, in the form of print and videos, for K-12 with focus on</p>	UNR	Preparation of an ABC-seismic module began for presentation at three middle-school summer camps

Task #	Brief Description of Task	Lead Institution	Progress (Oct-2015 Mar-2016)
	developing age-appropriate programs.		to be held at UNR in June 2016 and future years
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.	ISU	Nothing new to report. Teacher camps are planned at ISU and FIU for summer 2016.
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	Two articles were published during this reporting period: <ul style="list-style-type: none"> • “ABC: bridge in a ‘pocket’” (UNR) • “The importance of ABC today: a commentary” (ISU) These articles were published on the ISU In-Trans website and the ABC-UTC 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, AISC, National ABC Conference, TRB, and ASCE.
WD-13	Make presentations on transportation careers at major minority institutions and conferences.	All (FIU, ISU, UNR)	Presentations were made by students at ACI, AISC, National ABC Conference, TRB, and ASCE. Many of these presentations were made by students from FIU, which is designated a minority university.

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 (Oct-2015 Mar-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)	All researchers involved in ABC-UTC research projects attended and presented at T-4 subcommittee meeting in December 2015. In addition, presentations were given at the Int. Bridge Conference, Caltrans, and TRB with some of the SCOBS members in attendance.
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	All partner universities presented at the following meetings during the reporting period: <ul style="list-style-type: none"> • Workshops at the National ABC Conference, Dec. 2015 • Papers at the National ABC Conference, Dec. 2015 • Presentations at TRB 2016
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	Preparation of several Journal papers are in progress.
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.	UNR	UNR presented ABC-related seminars at the University of Virginia, three seminars at Caltrans, a talk at TRB 2016, and a talk at ACI Spring convention, 2016. FIU, continues to provide assistance to local and national agencies in ABC area, through active participation and presentations and providing assistance where asked. Several ABC keynote talks were made at different gatherings.
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	All	ABC-UTC is in close communication with AASHTO T-4 and TRB ABC committee and FHWA. Through these activities, activities of ABC-UTC are complementary to other national programs.

	the use of ABC across the U.S.		
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	Efforts have continued to develop a working relation with FHWA LTBP Program. U.S. DOT help might be needed to establish this relation.
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 implementation of ABC as a standard practice.	FIU	Nothing new to report.
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	Not applicable.
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 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	A new concept in the form of thin Ultra High Performance Concrete (UHPC) in shell form is envisioned for retrofitting bridges in coastal area, especially as related to sea level rise issues. A provisional patent was prepared for patenting the concept by FIU.
T2-11	Three forms of publication: ABC-UTC publications will be of three forms, each serving a different purpose: (1) journal articles, (2) conference	All	Conference papers on ABC were prepared for upcoming conferences and journals.

	papers; and (3) research reports.		
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 web site. www.abc-utc.fiu.edu
T2-13	Dedicated website: Currently the FIU ABC Center has a website (www.abc.fiu.edu). With enhancements, this web site will become the official site of the ABC-UTC.	All	A dedicated web site for the ABC-UTC is developed and is fully active (http://www.abc-utc.fiu.edu). A new website was created during the last reporting period to increase functionality, organization, and make it more user-friendly.
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	FIU, UNR and ISU contributed to the annual highlights.
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	FIU, UNR and ISU contributed to the annual highlight report.
T2-15a	Webcasting and video Clips: Selected tests will be webcast, and video clips of critical parts of selected tests will be developed.	All	The UNR shake table testing of April 2016 is scheduled to be webcast.
T2-16	Social media: Researchers will actively participate in professional social media such as Facebook, Twitter and LinkedIn.	All	FIU has created and is actively maintaining ABC-UTC accounts following social media website. <ul style="list-style-type: none"> • LinkedIn • Twitter • YouTube UNR is preparing a YouTube channel to post video clips of ABC shake table tests.
T2-17	Statewide or region-wide continuing education courses: Three short	FIU	FIU, ISU and UNR gave number of presentations at various gathering

	<p>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.</p>		
T2-18	<p>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 trainings to assist practitioners in developing a better understanding of the specific topics.</p>	FIU	<p>An In-Depth web training was conducted on November 10, 2015. Similar to the 2014 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 Milton-Madison Bridge lateral slide replacement project.</p>
T2-19	<p>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.</p>	FIU	<p>FIU has continued to organize and successfully conduct monthly free webinars, without any interruption. These webinars are being attended by about 3000 to 4000 bridge professionals 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.</p>
T2-20	<p>Annual national conference: In coordination with FHWA, state DOTs, and industry, a national ABC conference will be organized each year.</p>	FIU	<p>The 2015 National Accelerated Bridge Construction Conference was held during December of 2015. More than 650 bridge professionals attended the conference. Ten workshops, each four or eight hours long were conducted on Sunday December 6, 2015 at the conference locations. On Monday and Tuesday, December 7 and 8, 2015, 115, thirty minutes long technical presentations were made during the conference. The first annual ABC</p>

			<p>conference was held in December of 2014. These two annual conferences have become among most important bridge engineering events of the year. Following are two videos capturing the highlights of 2014 and 2015 National ABC Conferences.</p> <p>https://abc-utc.fiu.edu/technology-transfer/conferences/</p> <p>The next conference is scheduled for December 6, 7 and 8, 2017 (www.2017abc.fiu.edu)</p>
T2-21	<p>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.</p>	FIU	<p>Ten workshops, covering different ABC topic, were held during 2015 National ABC conference. For details of these nine workshops, please visit https://abc-utc.fiu.edu/conference/2015-national-accelerated-bridge-construction-conference/</p>
T2-23	<p>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.”</p>	FIU	<p>Progress of different activities is being monitored using evaluation matrices.</p>

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

- 2014 and 2015 National ABC conference
- Educational modules were developed and used in graduate courses to train students.
- Nine, four-hour long, workshops were held in conjunction with 2014 National ABC Conference. Ten, four hour long workshops were held during 2015 National ABC conference
- Monthly webinars were continued
- In-depth webinar series were initiated and held in November 2014 and 2015
- ABC sessions are organized at several major conferences
- PhD students, post-doctoral fellows, and undergraduate students involved in ABC-UTC projects have been trained on ABC topics.

How have the results been disseminated?

The results will be disseminated by followings:

- 2014 and 2015 National ABC conference
- Educational modules
- Nine, four-hour long, workshops were held in conjunction with 2014 National ABC Conference. Ten, four hour long workshops were held during 2015 National ABC conference
- Monthly webinars
- In-depth webinars
- Various presentations to AASHTO, TRB, other national and international conferences, website, and conference publications.

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 second incremental funding
- Conducting 3rd graduate student seminar
- Development of more ABC educational modules
- Identifying more workforce development tasks and activities
- Continuing with monthly free webinars
- Continue with the research tasks as envisioned in the proposals. Continue with training of researchers, outreach to the ABC stakeholders, other engineers, and researchers. Continue to disseminate research results through various outlets.
- Continuing with organization of the 2017 National ABC conference

PRODUCTS

Publications, conference papers, and presentations

❖ FIU

- Garber D., "Overview of the ABC Project and Research Databases", In *Transportation Research Board 95th Annual Meeting*, January 10-14, 2016, Washington D.C.
- Garber D., "Database of All Available ABC Projects and Research Information", In *National Accelerated Bridge Construction Conference*, December 7, 8, 2015, Miami, Florida.

- Azizinamini A., “Innovative and new UHPC products and details for accelerating bridge retrofit”, In *National Accelerated Bridge Construction Conference*, December 7, 8, 2015, Miami, Florida.
- Taghinezhad R., “Extending application of Simple for Dead Load and Continuous for Live Load (SDCL) steel bridge system to high seismic areas”, In *National Accelerated Bridge Construction Conference*, December 7, 8, 2015, Miami, Florida.
- Hadi M., “Tools to estimate the total cost of ABC projects versus conventional methods of construction”, In *National Accelerated Bridge Construction Conference*, December 7, 8, 2015, Miami, Florida.
- Shafieifar M., “Innovative ABC solutions using UHPC”, In *National Accelerated Bridge Construction Conference*, December 7, 8, 2015, Miami, Florida.
- Valikhani A., “Robotic Construction in ABC Projects,” In *National Accelerated Bridge Construction Conference*, December 7, 8, 2015, Miami, Florida.
- Jaberi A., “Customized Manual for Design of ABC Projects for Service Life,” In *National Accelerated Bridge Construction Conference*, December 7, 8, 2015, Miami, Florida.
- Azizinamini, A. “ABC-UTC status report” TRB ABC sub-committee”, TRB 95th Annual Meeting, 10-14 January, 2016, Washington D.C
- Azizinamini A., “ABC-UTC status report” AASHTO, SCOBS T-4 committee
- Azizinamini A. Workshop Speaker, Transportation research Board (TRB), “Ultra-High-Performance Concrete Connections for Precast Bridge Elements”, Jan 10, 2016
- Azizinamini, A., “ABC”, Keynote speaker, 2016 Annual Structural Engineers Association of Illinois - Bridge Symposium, Thursday, April 28, 2016.
- Azizinamini, A. “Economical steel bridge systems for ABC applications,” Washington State Department of Transportation, June 22, 2015
- Azizinamini A., “Economical steel bridge systems for ABC applications,” Oregon State Department of Transportation, June 23, 2015
- Azizinamini A., “Accelerated Bridge Construction: State of Knowledge in U.S.,” Brazilian Bridge Engineering Conference, Sao Paulo, Brazil, May, 2015
- Azizinamini, A., “Economical steel bridge systems for ABC applications,” ASCE Structures Congress, April 2015, Portland Oregon

- Azizinamini, A., “Development of Innovative ABC connection for seismic regions for ABC applications,” AASHTO SCOB T-3 meeting, April 2015, New York
- Azizinamini A., “Development of Customized manual for service life design of ABC bridges,” 2015 AASHTO SCOB T-9 meeting, April 2015, New York

❖ ISU

- Hosteng, T., “Strength, Durability, and Application of Grouted Couplers for Integral Abutments in ABC Projects”, In *National Accelerated Bridge Construction Conference*, December 7, 8, 2015, Miami, Florida.
- Hosteng, T., “Strength, Durability, and Application of Grouted Couplers for Integral Abutments in ABC Projects”, In *2015 International Bridge Conference*, June 7-11, 2015, Pittsburg, PA

❖ UNR

- Mehrsoroush, A., M. Mehraein, M. Saiidi, “Seismic Behavior of Pipe Pin Connections for Accelerated Bridge Construction,” ACI Fall Convention, Denver, Colorado, November 2015.
- Varela, S. and Saiidi, M. “Innovative ABC columns with copper-based SMA and ECC for seismically active regions”, *Proceedings, National Accelerated Bridge Construction Conference*, December 7, 8, 2015, Miami, Florida.
- Mohebbi, A., M. Saiidi, and A. Itani, “Seismic Evaluation of a Precast PT/UHPC Bridge Column with Pocket Connection and Precast Footing”, *Proceedings, National Accelerated Bridge Construction Conference*, December 7, 8, 2015, Miami, Florida.
- Saiidi, M., M. Tazarv, B. Nakashoji, S. Varela, and F. Kavianipour, “A New Generation of Earthquake-Resistant Bridges w/ SMA,” Invited seminar, University of Virginia, Charlottesville, Virginia, October 2015.
- Saiidi, M., “Highlights of Recent and Current Bridge Earthquake Engineering Research at UNR with ABC Flavor- A Few Examples,” Workshop No. W-5, Design Criteria and Connections for Application of ABC in Seismic Regions,” National ABC Conference, Miami, Florida, December 2015.
- Saiidi, M., “ABC-UTC-Seismic Findings on Studies of CFRP-PT Square Columns and Piers, Mechanical Splices, and Pocket Connections,” Mid-Year AASHTO Bridge Meetings, Sub-Committee T-4: Bridge Construction, Miami, Florida, December 2015.
- Saiidi, M., “Lessons from Recent Seismic Studies of ABC Bridges and Connections at UNR,” TRB Committee AFF50 Technical Presentation, Transportation Research Board 95th Annual Meeting, Washington, DC, January 2016.
- Saiidi, M., “Resilient Earthquake-Resistant Bridges- Going beyond ABC,” California Department of Transportation Educational Seminar Series, Presented twice, Headquarters, Sacramento, California, February 2016.

- Saiidi, M., “Resilient Earthquake-Resistant Bridges- Going beyond ABC,” California Department of Transportation Educational Seminar Series, TransLab, Caltrans, Sacramento, California, February 2016.

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 trainings, 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 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 allows for 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

Other products

Nothing to Report

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 reporting period	Approximately 400 hrs.
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.
Travelled 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.
Travelled to foreign country	N.A.
If traveled to foreign country(ies), duration of stay	N.A.

Name	Ali Mostafavi
Program/Project Role	ABC-UTC – Co-PI on a research project
Number of hours worked during the reporting period	Approximately 120 hours
Contribution to Program/Project	Co-PI on the Public Cost Estimation Project
Funding Support	ABC-UTC
Collaborated with individual in foreign country	N.A
Country(ies) of foreign collaborator	N.A
Travelled 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 80 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
Travelled to foreign country	N.A
If traveled to foreign country(ies), duration of stay	N.A

Name	Wallied Orabi
Program/Project Role	ABC-UTC – Co-PI on a research project
Number of hours worked during the reporting period	Approximately 110 hours
Contribution to Program/Project	Co-PI on the Public Cost Estimation Project
Funding Support	ABC-UTC
Collaborated with individual in foreign country	N.A
Country(ies) of foreign collaborator	N.A
Travelled to foreign country	N.A
If traveled to foreign country(ies), duration of stay	N.A

Name	Albert Gan
Program/Project Role	ABC-UTC – Co-PI on a research project
Number of hours worked during the reporting period	50 hours
Contribution to Program/Project	Design of ABC-UTC Homepage, 2014 ABC-UTC Conference Website, and ABC Seminar Certification Process Automation.
Funding Support	Volunteer
Collaborated with individual in foreign country	N.A
Country(ies) of foreign collaborator	N.A
Travelled to foreign country	N.A
If traveled to foreign country(ies), duration of stay	N.A

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, ABC-UTC website, technology training certificate delivery, 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
Travelled 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	350 hours
Contribution to Program/Project	Overall leadership
Funding Support	-
Collaborated with individual in foreign country	No
Country(ies) of foreign collaborator	NA
Travelled 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
Collaborated with individual in foreign country	No
Country(ies) of foreign collaborator	NA
Travelled to foreign country	Yes, but not w/ ABC-UTC funding
If traveled to foreign country(ies), duration of stay	NA

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
Travelled to foreign country	No
If traveled to foreign country(ies), duration of stay	NA

Industry Partners and Collaborators

ABC Center Executive Board

- Atorod Azizinamini, Florida International University
- Mary Lou Ralls, Ralls Newman, LLC, Former State Bridge Engineer, State of Texas
- Kevin Thompson, URS, Former State Bridge Engineer California
- Jugesh Kapur, Burns & McDonnell, Former State Bridge Engineer, Washington State
- Ben Beerman, Federal Highway Administration
- Paul Liles, Former State Bridge Engineer, Georgia

ABC-UTC Steering Committee Members

- Atorod Azizinamini, Florida International University
- Mary Lou Ralls, Ralls Newman, LLC, Former State Bridge Engineer, State of Texas
- Kevin Thompson, URS, Former State Bridge Engineer California
- Jugesh Kapur, Burns & McDonnell, Former State Bridge Engineer, Washington State

- Ben Beerman, Federal Highway Administration
- Carmen Swanwick, AASHTO SCOBS T-4, Chair, Utah DOT
- Paul Liles, AASHTO SCOBS T-4 Vice Chair, Georgia DOT
- Ahmad Abu-Hawash, Iowa DOT
- Nancy Daubenberger, Minnesota DOT
- Shoukry Elnahal, Delaware River & Bay Authority
- Bruce Johnson, Oregon DOT
- Bijan Khaleghi, Washington State DOT
- Elmer Marx, Alaska DOT&PF
- Tom Ostrom, California DOT
- Robert Robertson, Florida DOT **(New)**
- Monica Starnes, Transportation Research Board
- Wayne Symonds, Vermont Agency of Transportation
- Maury Tayarani, MassDOT

Federal Highway Administration

- Ben Beerman, Resource Center
- Phil Yen, Office of Infrastructure

Industrial and Government partners

- John Busel, American Composites Manufacturers Association (ACMA)
- Reid Castrodale, Lightweight concrete rep.
- Randy Cox, American Segmental Bridge Institute (ASBI)
- Jerry DiMaggio, Applied Research Associates, Inc.
- Bill Duguay, Associated General Contractors of America (AGC), rep.; J.D. Abrams, LP
- Mike Engestrom, Small Span Steel Bridge Alliance (SSSBA)
- Mal Kerley, NXL Construction Services, Inc.
- Danielle Kleinhans, National Concrete Bridge Council (NCBC), rep.
- Bill McEleney, National Steel Bridge Alliance (NSBA)
- William Nickas, Precast/Prestressed Concrete Institute (PCI)
- Eliza Partington, FIGG

Collaborators from Partner Universities

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

Faculty and Staff at Florida International University

- Mohammad Hadi, Associate Professor
- Albert Gan, Professor
- Seung Jae Lee, Assistant Professor

- David Garber, Assistant Professor
- Xia Jin, Assistant professor
- Hesham Ali, Professor of Practice
- Ali Mostafavi, Assistant Professor
- Wallied Orabi, Assistant Professor
- Jawad Gull, Research Associate
- Alireza Mohammadi, Graduate Student
- Huy Pham, Graduate Student
- Ramin Taghinezhad, Graduate Student
- Alireza Valikhani, Graduate Student
- Azade Jaber, Graduate Student
- Mahsa Farzad, Graduate Student
- Mohamadreza Shafieifar, Graduate Student
- Haifeng Wang, Senior Software Engineer
- Atiosis Blanco, Specialist Computer Research International Members of the ABC Center
- Taek-RyongSeong, RIST - South Korea
- Chan-Hee Park, RIST - South Korea

IMPACT

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

The 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 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 are sponsoring 2015 National ABC Conference and plans are for having the next conference in 2017. The State DOT engineers of sponsoring State DOTs work very closely with ABC-UTC. The connection created with State DOT bridge engineers will greatly facilitate the implementation of ABC-UTC work.

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. The provost at FIU recently provided a faculty lime to ABC-UTC. The interview process is completed and offer is made to top candidate who is an expert in long span bridges. This new faculty is expected to start Fall 2016. The three institutions work closely on many activities and this is proving to be a great opportunity for the students to collaborate.

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 more than 4000 bridge professional participate in these monthly webinars are unparalleled. The 2014 National ABC conference was co-sponsored by 26 state who actively participated in this event. The 2015 National ABC Conference was Co-Sponsored by 30 State. ABC-UTC was successful in developing travel scholarship program that allowed more than 200 state bridge engineers at attend 2014 and 2015 National ABC Conferences. These activities are providing

opportunities for effective communications with State DOTs and bridge professionals, making the task of Technology transfer much easier.

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 consequence 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 tax payers 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