



Program Progress Performance Report University Transportation Centers

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

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

Research

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

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

Project #	Research Project Title	Research Advisory Panel Members	Progress (October 1, 2018 – May 31, 2019)
FIU-1	Compilation of all ABC research that is ongoing and completed	Ahmad Abu-Hawash, Iowa DOT	This project has been completed and final report has been submitted.

Project #	Research Project Title	Research Advisory Panel Members	Progress (October 1, 2018 – May 31, 2019)
	Recommended by AASHTO T-4		
FIU-2	Development of Manual for Enhanced Service Life of ABC Bridges	Ahmad Abu-Hawash, Iowa DOT; Mike Culmo, CME Associates; Romeo Garcia, FHWA	This project has been completed and final report has been submitted.
FIU-5	A Predictive Computer Program for Proactive Demolition Planning	Benjamin Beerman, FHWA; James Corney, Utah DOT	This project has been completed and final report has been submitted.
FIU-6	Corrosion Durability of Reinforced Concrete Utilizing UHPC for ABC Applications	FDOT Bijan Khaleghi, Washington DOT; Tom Ostrom, Caltrans; Elmer Marx, Alaska DOT; Bruce Johnson, Oregon DOT; William Oliva, Wisconsin DOT	This project has been completed and final report has been submitted.
FIU-7	Extending Maximum Length of the Folded Steel Plate Girder Bridge System (FSPGBS), exceeding 100 ft. with capability to Incorporate Camber	NSBA	This project has been completed and final report has been submitted.
FIU-8	NDT Methods Applicable to Health Monitoring of ABC Closure Joints	Ahmad Abu-Hawash, Iowa DOT; Steve Womble, FDOT, D7	This project has been completed and final report has been submitted.
FIU-9	Performance Comparison of In-Service, Full-Depth Precast Concrete Deck Panels to Cast-in-Place Decks	Ahmad Abu-Hawash, Iowa DOT; James Corney, Utah DOT; Bruce Johnson, Oregon DOT	This project has been completed and final report has been submitted.

Project #	Research Project Title	Research Advisory Panel Members	Progress (October 1, 2018 – May 31, 2019)
FIU-10	Use of Drones in ABC	Atorod Azizinamini, FIU; Armin Mehrabi, FIU; Ibrahim Tansel, FIU	This project has been completed and final report has been submitted.
UNR-1	Shake Table Studies of a Bridge System with ABC Connections:	Bijan Khaleghi, Washington DOT; Elmer Marx, Alaska DOT; Tom Ostrom, Caltrans	This project has been completed and final report has been submitted.
UNR-2	Analytical Investigations and Design Implications of Seismic Response of a Two-Span ABC Bridge System	Bijan Khaleghi, Washington DOT; Elmer Marx, Alaska DOT; Tom Ostrom, Caltrans	This project has been completed and final report has been submitted.
UNR-3	Durable UHPC Columns with High-Strength Steel	Elmer Marx, Alaska DOT; Tarek Masrour, California DOT	This project has been completed and final report has been submitted.
ISU-1	Development of Prefabricated Bridge Railings Recommended by AASHTO T-4	Ahmad Abu-Hawash, Iowa DOT; Tim Fields, Connecticut DOT	This project has been completed and final report has been submitted.
ISU-2	Material Design and Structural Configuration of Link Slabs for ABC Applications	Ahmad Abu-Hawash, Iowa DOT; Michael Nop, Iowa DOT; Wisconsin DOT; and Michael P. Culmo, CME Associate	This project has been completed and final report has been submitted.
ISU-3	An Integrated Project to Enterprise-Level Decision Making Framework for Prioritization of Accelerated Bridge Construction	Ahmad Abu-Hawash, Iowa DOT	This project has been completed and final report has been submitted.
ISU-4	Inspection and QA/QC for ABC Projects	Ahmad Abu-Hawash, Iowa DOT; Hoda Azari,	This project has been completed and final report has been submitted.

Project #	Research Project Title	Research Advisory Panel Members	Progress (October 1, 2018 – May 31, 2019)
		FHWA; Shane Boone, BDI)	
ISU-5	Integral Abutment Details for ABC Projects, Phase II	Brent Phares, ISU; Travis Hosteng; ISU; Behrouz Shafei; ISU; Jim Nelson, Iowa DOT Ahmad Abu-Hawash, Iowa DOT; Mike Nop, Iowa DOT; Logan Wells, Iowa DOT; Mike LaVoilette; HDR; Elmer Marx, Alaska DOT; Mike Culmo, CME; William Oliva, Wisconsin DOT; James Corney, Utah DOT; Atorod Azizinamini, FIU	This project has been completed and final report has been submitted.
ISU-6	Development of Guidelines to Establish Effective and Efficient Timelines and Incentives for ABC	Ahmad Abu-Hawash, Iowa DOT; Mathew Haubrich, Iowa DOT	This project has been completed and final report has been submitted.

Education and Workforce Development

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

Task #	Brief Description of Task	Lead Institution	Progress (October 1, 2018 – May 31, 2019)
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 29 graduate students were working on ABC-UTC related research projects.

Task #	Brief Description of Task	Lead Institution	Progress (October 1, 2018 – May 31, 2019)
WD-2	Increasing the number of research assistantship opportunities for graduate students.	ALL (FIU, ISU, UNR)	In this period no student were added as the projects are all coming to completion
WD-3	Upgrading course content in the areas of structural engineering and construction engineering/management to include modules on the use of ABC topics.	UNR	In this period, ABC seminars previously posted and the related video clips were maintained.
WD-4	Developing online courses and making progress towards the development of fully online degree programs.	FIU	Nothing new to report.
WD-5	Mentorship Program – Development of a mentoring program where students are put in direct contact with industry representatives who are active in the field of accelerated bridge construction.	FIU, ISU, UNR	<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. Ardan Sherafati, BlueScope Construction. • Nathan Johnson, Kleinfelder Engineering • Claudia Pulido, Kiewit Infrastructure Engineers • Mark Reno, Quincy Engineering • Ashkan Vosooghi, AECOM <p>All three center partners are actively encouraging productive mentorship relationships between graduate students and former graduate students and professionals.</p>
WD-6	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	ISU, FIU	These seminars continue to be offered quarterly as “Research Seminars”. Seminars were delivered in November 2018 and January 2019 and were attended by 530 and 744 sites from around the world, respectively, with multiple attendees at many of the sites.

Task #	Brief Description of Task	Lead Institution	Progress (October 1, 2018 – May 31, 2019)
	ABC-UTC technology transfer activities.		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 a total of 3 undergraduate students as interns on ABC-UTC research projects.
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.		Educational modules are being developed by ISU in cooperation with local Iowa elementary school. The four-week educational module has daily, one-hour lesson plans introducing students to engineering, bridge engineering, and ABC.
WD-10	Summer Teacher Program- Each consortium member will develop a two-day-long summer camp for elementary, middle and high school teachers to familiarize them with basics of transportation engineering in general and principles of bridge engineering and ABC in particular.	FIU, ISU, UNR	No additional work to report for the 2013 grant during this reporting period. Future Summer teacher programming is being planned under the 2016 grant.
WD-11	Online e-Zine Go- ISU will publish quarterly articles in the online “e-zine Go!” related to the ABC-UTC’s mission.	ISU	No additional articles were published in the previous reporting period. All previously posted articles are archived on the e-Zine Go! website.
WD-12	Offer travel scholarship with emphasis on traditionally underrepresented students	All (FIU, ISU, UNR)	Travel scholarships were offered for students to attend and present at the annual TRB conference.
WD-13	Make presentations on transportation careers at major minority institutions and conferences.	All (FIU, ISU, UNR)	Previously prepared video presentations are housed on the ABC-UTC website.

Technology Transfer

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

Task #	Brief Description of Task	Lead Institution	Progress (October 1, 2018 – May 31, 2019)
T2-1	<p>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.</p>	All (FIU, ISU, UNR)	<p>The ABC-UTC hosted the AASHTO Technical Committee for Construction (T-4) 2018 mid-year meeting on November 28-29 in Miami prior to the ABC-UTC Advisory Committee Annual Meeting, and the Director gave an update on ABC-UTC activities.</p> <p>Key researchers attended the AASHTO T-10 meeting at the PCI Convention held in Louisville, KY on February 26- March 2, 2019.</p>
T2-2	<p>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.</p>	All	<p>The UTC meeting during the January 2019 TRB Annual Meeting in Washington, DC was attended by the Director, Coordinator, and Co-Director of Research.</p> <p>Key researchers from the consortium attended the 01/14/19 ABC Joint Subcommittee (AFF00(2)) meeting during the TRB Annual Meeting; the Director gave an update on ABC-UTC activities, the Director of Workforce Development gave an update on the ABC Research Database, and the Director of Technology Transfer serves as the Subcommittee Vice-Chair. The Director also gave a presentation during a 01/13/19 ABC Workshop at the TRB Annual Meeting.</p> <p>Key researchers attended the TRB NDE of Bridges in Washington, DC in January 2019.</p>

Task #	Brief Description of Task	Lead Institution	Progress (October 1, 2018 – May 31, 2019)
			<p>A consortium member attended committee meeting for SEI-ASCE Technical Council on Life-Cycle Performance, Safety, Reliability and Risk of Structural Systems, Task Group 1 - Life-Cycle Performance of Structural Systems under Uncertainty 2019 Structures Congress, Orlando, Florida, USA</p> <p>The Director will be attending the CUTC 2019 Summer meeting to be held June 2019 in Norman, OK.</p>
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>For list of publications, presentation and conferences, please see section below.</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>Key researchers gave presentations at the October 11, 2018 ABC workshop in Oklahoma City, OK hosted by FHWA and facilitated by the Oklahoma DOT and the Southern Plains Transportation Center (SPTC).</p> <p>The ABC-UTC held its Advisory Committee Annual Meeting in Miami on November 29-30, 2018.</p> <p>All universities have been active in outreach and assisting local and national agencies to learn about ABC.</p> <p>Key researchers at all three institutions routinely give presentations at national conferences.</p>

Task #	Brief Description of Task	Lead Institution	Progress (October 1, 2018 – May 31, 2019)
			Dr. Azizinamini has given several presentations on ABC at national gatherings and more are planned.
T2-5	ABC strategic plan: In collaboration with AASHTO T-4 Technical Committee on Construction, a strategic implementation plan will be developed to promote and support the use of ABC across the U.S.	All	The ABC-UTC continues to collaborate with the AASHTO SCOBS Technical Committee for Construction (T-4) in support of the T-4 strategic plan.
T2-6	Collaboration with bridge groups: The research team will work with other bridge groups such as the FHWA Long-Term Bridge Performance Program.	All	The ABC-UTC continues to coordinate with bridge owners on project submissions to the ABC Project Database, with six projects in MN, NY, and PA approved and opened during this reporting period.
T2-7	Provide bridge owners with tools to implement ABC as a standard practice: Research team will convene meetings of select practicing engineers and bridge owners to assist them in the implementation of ABC as a standard practice.	FIU	The Implemented Advanced Technologies initiative continues to be populated on the website.
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	The ABC-UTC continues its development of a process to provide an independent perspective on the recently renamed Implemented Advanced Technologies.
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.	All	Nothing new to report.

Task #	Brief Description of Task	Lead Institution	Progress (October 1, 2018 – May 31, 2019)
	Network for Earthquake Engineering Simulation (NEES).		
T2-10	Offices of technology transfer: As appropriate, cooperative agreements will be developed with industries for eventual marketing of products developed through research studies conducted by the ABC-UTC. At the request from an individual researcher, industry partner or the ABC-UTC Director, it will be determined if there is a merit to develop a patent based on research outcomes.	All	Several patents have been developed based on research outcomes.
T2-11	Three forms of publication: ABC-UTC publications will be of three forms, each serving a different purpose: (1) journal articles, (2) conference papers; and (3) research reports.	All	See list of publications, conference papers below. Also all research reports can be viewed on our website at https://abc-utc.fiu.edu/research-projects/
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 updated with the latest research, workforce development, and technology transfer activity.
T2-14	Periodic e-newsletter (ABC Talk): An online newsletter (ABC Talk) will be published to present the highlights of ABC-UTC	All	Nothing new to report.

Task #	Brief Description of Task	Lead Institution	Progress (October 1, 2018 – May 31, 2019)
	activities. The availability of the newsletter will be communicated through resources available to AASHTO, FHWA, and TRB.		
T2-15	Printed newsletter: Annually, a hard copy version of the select articles from e-newsletter (ABC Talk), summarizing the highlights of ABC-UTC activities, will be published	All	The ABC-UTC has decided to change the Annual Highlights report to a biennial (once every two years) Highlights report. Our next report will cover 2017 and 2018 and will be published in 2019.
T2-15a	Webcasting and video Clips: Selected tests will be webcast, and video clips of critical parts of selected tests will be developed.	All	Nothing to report.
T2-16	Social media: Researchers will actively participate in professional social media such as Facebook, Twitter, and LinkedIn.	All	ABC-UTC have continued using Hootsuite to coordinate and market all webinars, seminars, events, and any other large events hosted by ABC-UTC via Facebook, Instagram, Twitter, and LinkedIn.
T2-17	Statewide or region-wide continuing education courses: Three short courses, each four hours long, will be developed: a short course on basic principles of ABC and overview (FIU), a short course on issues related to seismic (UNR), and a short course on use of principles 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	Efforts are underway to systematically educate state DOT's on the implementation of ABC.

Task #	Brief Description of Task	Lead Institution	Progress (October 1, 2018 – May 31, 2019)
T2-18	In-depth web conference training: Specific featured presentation topics from the planned monthly webinars will be expanded to 3- to 4-hour in-depth web conference training to assist practitioners in developing a better understanding of the specific topics.	FIU	The archive for the 2018 In-Depth Web Training was completed (https://abc-utc.fiu.edu/webinars/in-depth-web-training-archive/). Plans are underway for the 2019 In-Depth Web Training, currently scheduled for fall 2019.
T2-19	Monthly ABC webinars: The current FIU ABC center monthly webinars, attracting 3000 to 5000 participants, will be continued. Webinars will be archived for subsequent viewing.	FIU	The ABC-UTC conducted a monthly webinar with featured presentation in each of the eight months of this reporting period, with registered sites ranging from 700 to 1150. Details are available on the Monthly Webinar Archives at https://abc-utc.fiu.edu/webinars/webinar-archives/ .
T2-20	ABC Conferences: In coordination with FHWA, state DOTs, and industry, a national ABC conference will be organized each year.	FIU	The ABC-UTC is sponsoring the 2019 International ABC Conference: Including Automation, Service Life and UHPC to be held December 11-13 in Miami. Ongoing advertising continues for the conference. As of date we have over 30 Sate DOT's FHWA and TRB that have Cosponsored the conference. More information on the upcoming conference can be found at https://abc-utc.fiu.edu/conference/
T2-21	Annual workshop: An annual 1.5-day technical workshop on ABC topics of current concern will be held at FIU. FIU held its first 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	The ABC-UTC plans to sponsor 7 half-day and one full-day pre-conference workshops on December 11, 2019 in Miami, prior to the start of the 2019 Conference.

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

- Educational modules

- Monthly webinars
- In-depth webinars
- Research Day
- 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.

How have the results been disseminated?

The results have been disseminated as follows:

- Monthly webinars
- In-depth webinars
- Research Day
- 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.

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

The 2013 Grant is completed as of 5/31/2019. All projects have been completed and final reports submitted.

Publications, conference papers, and Presentations

Publications/Conference Papers

Su, Y.-F., Bhattacharya, S., Lee, C., Shin, M. & Lee, S. J. "Allometric Description of Granular Materials", *IS-Atlanta 2018: Geomechanics from Micro to Macro in Research and Practice*, Georgia Tech, Atlanta, GA on Sep. 9–12

Shoushtari, E., M. Saiidi, A. Itani, and M. Moustafa, "Design, Construction, and Shake Table Testing of a Steel Girder Bridge System with ABC Connections," *Journal of Bridge Engineering*, ASCE, Special Issue: Accelerated Bridge Construction, Submitted

Shoushtari, E., M. Saiidi, A. Itani, and M. Moustafa, "Pretest Analysis of Shake Table Response of a Two-Span Steel Girder Bridge Incorporating ABC Connections," *Chinese Academy of Engineering, Journal of Frontiers of Structural and Civil Engineering*, Special Issue: High Performance Structures–Building Structures and Materials, Accepted.

Shoushtari, E., M. Saiidi, A. Itani, and M. Moustafa, "Seismic Performance of A Two-Span Steel Girder Bridge with ABC Connections," *Earthquake Spectra, Journal of the Earthquake Engineering Research Institute*, Submitted, Feb. 2019

Benjumea, J., M. Saiidi, and A. Itani, "Assessment of a Pretest Analytical Model of a Two-Span ABC Bridge System Tested under Biaxial Ground Motions," *Proceedings, the 5th International Symposium on Bridge Design and Construction, Bucaramanga, Columbia, November 2018.*

Rezaei N and Garber D, "Study of Bridge Demolition DOT Survey and Available Standard Specifications," accepted by *Advances in Civil Engineering*, 2019.

Farhangdoust, S. & Mehrabi, A. B. (2019). Health Monitoring of Accelerated Bridge Construction Closure Joints – Review of Non-destructive Testing Methods. *Journal of Advanced Concrete Technology*.

Farhangdoust, S. & Mehrabi, A. B. (2019). A New Approach to Structural Health Monitoring of Closure Joints in Accelerated Bridge Construction. *Journal of Performance of Constructed Facilities*.

Lee, S. J., Lee, C.–H., Shin, M., Bhattacharya, S. & Su, Y. F. (2019) "Influence of Coarse Aggregate Angularity on the Mechanical Performance of Cement–based Materials", *Construction and Building Materials*, 204, 184–192

Su, Y.–F., Bhattacharya, S., Lee, C., Shin, M. & Lee, S. J. "Allometric Description of Granular Materials", *IS–Atlanta 2018: Geomechanics from Micro to Macro in Research and Practice*, Georgia Tech, Atlanta, GA on Sep. 9–12

Zhang, N., Alipour, A., and Coronel, L. "Application of novel recovery techniques to enhance the resilience of transportation networks", *Transportation Research Record*

Benjumea, J., M. Saiidi, and A. Itani, "Assessment of a Pretest Analytical Model of a Two-Span ABC Bridge System Tested under Biaxial Ground Motions," *Proceedings, the 5th International Symposium on Bridge Design and Construction, Bucaramanga, Columbia, November 2018.*

Azizinamini, Atorod, Sheharyar Rehmat, and Amir Sadeghnejad. "Enhancing Resiliency and Delivery of Bridge Elements using Ultra-High-Performance Concrete as Formwork." *Transportation Research Record* (2019): 0361198119834907.

Farzad, Mahsa, Mohamadreza Shafieifar, and Atorod Azizinamini. "Experimental and numerical study on an innovative sandwich system utilizing UPFRC in bridge applications." *Engineering Structures* 180 (2019): 349-356.

Farzad, Mahsa, Mohamadreza Shafieifar, and Atorod Azizinamini. "Experimental and numerical study on bond strength between conventional concrete and Ultra High-Performance Concrete (UHPC)." *Engineering Structures* 186 (2019): 297-305.

Mohamadreza Shafieifar, Mahsa Farzad, Atorod Azizinamini “An Investigation on a Detail for Connecting Precast Columns to Precast Cap Beams Using Ultra High Performance Concrete (UHPC)”, ASCE's Journal of Bridge Engineering 2019 (under review)

Nerma Caluk, Islam Mantawy, Atorod Azizinamini “Durable Bridge Columns using Stay-In-Place UHPC Shells for Accelerated Bridge Construction”, Infrastructures (under review).

Alireza Valikhani, Azadeh Jaber Jahromi, and Atorod Azizinamini “Robust Upgrading Technique Using Ultra High-Performance Concrete for Resilient Bridge Superstructure” Infrastructures (under review).

Farzad, M.; Fancy, S.F.; Lau, K.; Azizinamini, A. Chloride Penetration at Cold Joints of Structural Members with Dissimilar Concrete Incorporating UHPC. *Infrastructures* 2019, 4, 18.

Farzad, M.; Shafieifar, M.; Azizinamini, A. Experimental and numerical study on bond strength between conventional concrete and Ultra High-Performance Concrete (UHPC). *Eng. Struct.* 2019, 186, 297–305.

Sheharyar Rehmat, Amir Sadeghnejad, Islam Mantawy and Atorod Azizinamini “New Connection Details for Concrete Filled Tubes using UHPC for Resilient Bridge Substructure” *Infrastructures* (published).

Amir Sadeghnejad, Sheharyar Rehmat, and Atorod Azizinamini “Feasibility Study of Using Stay-in-Place UHPFRC Formworks for Short-Span Bridge Superstructures” *Infrastructures* (under review).

Presentations:

Azizinamini, Atorod , ABC-UTC Developing Economical, Innovative and Implementable, Transportation Infrastructure Solutions “UTC Spotlight Meeting Congress”, Washington, DC,

Azizinamini, Atorod, Sheharyar Rehmat, and Amir Sadeghnejad. "Enhancing Resiliency and Delivery of Bridge Elements using Ultra-High Performance Concrete as Formwork." *Transportation Research Record* (2019): 0361198119834907.

Seung Jae Lee and Ali Bakhtiari. “A Predictive Computer Program for Proactive Demolition Planning” ABC–UTC Research Day, Miami, FL, 11/18 (Webinar)

Seung Jae Lee, Atorod Azizinamini, Roberto Rodriguez, Mohamed Moustafa and Mohammad Abbasi. “Innovative Foundation Alternative for High Speed Rail Application” ABC–UTC Research Day, Miami, FL, 11/18 (Webinar)

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

Saiidi, M., “ABC Column Connections,” Alaska Department of Transportation Workshop, Juneau, Alaska, April 2018.

Saiidi, M., "Innovative Superelastic Materials for Seismic Resiliency and Accelerated Bridge Construction (ABC)," Proceedings, the 31st US-Japan Bridge Engineering Workshop, Los Angeles, California, Topic 4- Innovative Materials, July 2018.

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

Shoushtari, E., M. Saiidi, A. Itani, and M. Moustafa, "Biaxial Shake Table Response of a Two-Span Steel Girder ABC Bridge," American Iron and Steel Institute Task Force Meeting, Atlanta, Georgia, August 2018.

Moustafa, MA, N. Naeimi, and M. Aboukifa, 2018. "Finite Element Modeling and Analysis of UHPC Seismic Bridge Columns with High Strength Steel", Structures Congress, Fort Worth, TX, April 19-21, 2018.

Saiidi, M., "Futuristic Resilient Bridge Design - from Research to Implementation," Keynote Speech, the 5th International Symposium on Bridge Design and Construction, Bucaramanga, Columbia, November 2018.

Benjumea, J., M. Saiidi, and A. Itani, "Assessment of a Pretest Analytical Model of a Two-Span ABC Bridge System Tested under Biaxial Ground Motions," Presented by J. Benjumea, the 5th International Symposium on Bridge Design and Construction, Bucaramanga, Columbia, November 2018.

Saiidi, M., "Innovation in Seismic Evaluation and Design of Bridge Columns w/ Advanced Materials," Keynote Speech, the XXI Mexican National Congress of Structural Engineering, Campeche, Mexico, November 2018.

Saiidi, M., "Proposed AASHTO Seismic Specifications for ABC Column Connections- An Update," Transportation Research Board 98th Annual Meeting, Washington, DC, January 2019.

Alireza Valikhnai (corresponding author), Azadeh Jaber Jahromi, Atorod Azizinamini (2019), "Development of Rapid Retrofit UHPC Based Solution to Repair Damaged Flexural Members", 2nd International Interactive Symposium on UHPC, Albany, NY June 2-5, 2019 (Accepted for presentation)

Zhang, N. and Alipour, A. (2017) Application of novel recovery techniques to enhance the resilience of transportation networks, *CCEE Graduate Research Poster Showcase*. (Poster Presentation)

Zhang, N. and Alipour, A. (2017) Total cost and duration optimization of Accelerated Bridge Construction under a limited time period, Graduate and Professional Research Conference. (Oral Presentation)

Barutha, P., Zhang+, N., Alipour, A., Miller, C., and Gransberg, D. (2017) “Social return on investment as a metric to prioritize use of Accelerated Bridge Construction in rural regions,” Transportation Research Board 96th Annual Meeting. (Oral Presentation)

Zhang, N. and Alipour, A. (2018) “Improved resilience of the transportation network with innovative recovery strategies”, ASCE SEI Structures Congress, Fort Worth, TX, April 19-21.

Zhang+, N. and Alipour, A. (2017) “An Integrated Project to Enterprise-Level Decision Making Framework for Prioritization of ABC”, ABC-UTC conference, Miami-FL

Coronel, L. and Alipour, A., Shane, J. (2017) Development of Guidelines to Establish Effective and Efficient Timelines and Incentives for ABC”, ABC-UTC conference, Miami-FL

Barutha, P., Zhang+, N., Alipour, A., Miller, C., and Gransberg, D. (2017) “Social return on investment as a metric to prioritize use of Accelerated Bridge Construction in rural regions,” Transportation Research Board 96th Annual Meeting. (Oral Presentation)

Zhang+, N. and Alipour, A. (2018) “Improved resilience of the transportation network with innovative recovery strategies”, ASCE SEI Structures Congress, Fort Worth, TX, April 19-21.

Conference Sessions:

ASCE-SEI 2019 Conference, April 24-25, 2019 in Orlando, FL.

Session: Life-Cycle Performance of ABC Bridges

- A Project- to Network-Level Mixed-integer Programming Model for Prioritization of Accelerated Bridge Constructions- Ning Zhang; ningzh@iastate.edu , Alice Alipour ; alipour@iastate.edu ; ISU
- Performance Comparison of In-Service, Full-Depth Precast Concrete Deck Panels to Cast-in-Place Decks – David Garber – FIU; dgarber@fiu.edu
- Corrosion Durability of Reinforced Concrete repaired using accelerated methods and UHPC; Potential Chloride Penetration at Cold Joints- Mahsa Farzad (mfarz003@fiu.edu), Ahsan Sabbir, Atorod Azizinamini, Kingsley Lau (kilau@fiu.edu) - FIU
- NDT Inspection of critical ABC details to assure life cycle performance and avoid future unforeseen excessive repairs – Saman Farhangdoust, sfarh006@fiu.edu, Armin Mehrabi, amehrabi@fiu.edu ; FIU
- UHPC shell technologies to reduce life cycle cost of ABC projects- Dr. Atorod Azizinamini – FIU; aazizina@fiu.edu

Session: Accelerated Bridge Construction in High Seismic Areas

- New ABC connection detail for connecting precast cap beam to precast columns with well-defined plastic hinges – Dr. Atorod Azizinamini- FIU- aazizina@fiu.edu
- Extending simple for dead and continuous for live load steel bridge system for ABC application in high seismic areas – Dr. Atorod Azizinamini – FIU- aazizina@fiu.edu
- First shake table test using ABC steel bridge system suitable for high seismic areas – Dr. Saiid Saiidi- UNR- saiidi@unr.edu
- Design concepts for ABC systems in high seismic areas – Dr. John Stanton – UW- stanton@uw.edu

Website(s) or other Internet site(s)

- **ABC-UTC Website (<https://abc-utc.fiu.edu/>)**: The ABC-UTC website continues to be updated as needed. 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.

Technologies or techniques

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

Inventions, patent applications, licenses

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

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

Other products

UNR prepared promotional video clips for engineering recruitment events.

PARTICIPANTS & COLLABORATING ORGANIZATIONS

What organizations have been involved as partners?

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

Industry Partners and Collaborators

ABC-UTC Advisory Committee Members

The ABC-UTC has an Advisory Committee that provides recommendations on ABC-UTC operations. The ABC-UTC also has advisory boards that provide recommendations under each of its focus areas of Research, Workforce Development, and Technology Transfer. Additionally, advisory panels and committees make recommendations on specific projects or activities. The members of the Advisory board can be found by visiting <https://abc-utc.fiu.edu/about-us/advisory-members/>

IMPACT

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

The ABC-UTC has now become the focal point for ABC at national level. Many designers are contacting ABC-UTC for help and getting started in use of ABC. ABC-UTC is continuing providing an excellent service to bridge profession and assisting U.S. DOT through its research, education and workforce development and technology transfer activities. ABC-UTC is taking a national lead in ABC area and has established a very good working relation with FHWA and AASHTO T-4 that is responsible for developing the national roadmap for State DOTs for implementing ABC. The Director of ABC-UTC was also elected to be liaison between the TRB ABC committee and ABC-UTC. These connections and activities are allowing ABC-UTC to better fill the knowledge gap, especially in the research, technology transfer and workforce development areas. ABC-UTC has also made major accomplishments in developing a close working relationship with State DOTs. Twenty-six state DOTs Co-sponsored the 2014 National ABC Conference, thirty State DOTs co-sponsored the 2015 National ABC Conference, 32 state DOTs co-sponsored the 2017 National ABC Conference and to date 31 state DOTs have co-sponsored the 2019 International ABC Conference Including Automation, Service Life and UHPC to be held in December of 2019 at Hyatt Regency Hotel in Miami, FL. The State DOT engineers of sponsoring State DOTs work very closely with ABC-UTC director to develop the conference program. The connection created with State DOT bridge engineers will greatly facilitate the implementation of ABC-UTC work.

About 25% of the 607,000 bridges in our inventory are substandard and need repair or replacement.

In mid-2000's the use of ABC was rare, and many bridge professionals would travel long distances to witness construction of ABC projects. ABC-UTC has played a major role in advancing the forefront of ABC and has helped State DOTs to be educated about various ABC technologies as well as assist them in its implementation. The trust, credibility and network that ABC has built within the bridge community is unheard of. This in turn allows, for ABC-UTC to transfer results of research into practice in a very short time period. About 75% of the research topics undertaken by ABC-UTC is driven by immediate needs of State DOT engineers, while 25% are driven by faculties and out of the box thinkers to push the envelope. ABC-UTC is continuously in communication with stakeholders in a number of different ways and has the industry's pulse. ABC-

UTC is fully aware of what it takes to address the immediate needs while continuously developing advanced and innovative technologies. ABC-UTC's strategy is to keep the US bridge engineering industry at the forefront internationally.

ABC-UTC has started to develop a series of short, concise and practical documents called "ABC-UTC Guides" on various topics. The objectives is to provide bridge owners, designers and other bridge professionals with a series of documents, filled with practical and implementable materials that they can put to use easily and immediately.

ABC-UTC, within the bridge world is now viewed as the source to go to and one-stop shop when it comes to ABC.

as the grant ends, we have seen the significant impact our efforts and research has had on the way bridge owners, bridge consultants, and other stakeholders in the industry address issues in the bridge construction and rehabilitation sector. Because of our efforts in disseminating the research results, the concept of ABC has moved to the forefront of the industry and moving more toward becoming a "norm" rather than an exception.

We are now witnessing a phenomenon that was unheard of within the bridge world. The capacity of GoToMeeting, an internet tool that we use to broadcast our webinars has a 1000 site registration limitation. Some of our monthly webinars have about 2000 sites registered, with most sites having multiple individuals listening to the webinar. Consequently, many sites have to listen to the online recording of these webinars, as the system allows the first 1000 sites, on first come first served basis. Consequently the ABC-UTC has been able to gather the largest bridge engineering professionals in one place, more than any other events worldwide. Some of our audiences, about 10%, come from overseas from more than 15 countries. This is establishing the US as the world leader in ABC.

Our research projects have produced tremendous amounts of new technologies and solutions to address substandard bridges in the US, while resulting in bridges that have longer service life, reducing significantly the interruption to traffic and more importantly enhancing the public safety. Some of the research has resulted in the development of technologies that can in an accelerated form upgrade the substandard bridges at a fraction of the cost of replacing them.

Examples of products that we have developed through our research efforts include:

- New line of technologies called, "ABC Made Conventional Through UHPC".
- Cost effective bridge systems to be used by local workforce to replace many substandard bridges, quickly and economically.
- Details that significantly reduces onsite construction activities using UHPC and other materials.
- Bridge systems best suited in moderate to high seismic areas and provide proof of concept evidences using large scale shake table tests.
- Tools allowing State DOTs to make decisions, when it comes to select ABC vs conventional methods of construction.

- Entirely new ABC connections utilizing the advantages of new and advanced materials, such as UHPC
- Guidelines on contracting methods best suited for ABC projects.

Our research efforts have also resulted in the development of patents that we are now marketing, and that will result in creating new jobs and revenue. Examples include three recently issued Patents (# 9915045, 9708821 & 10196832) which will help revolutionize the bridge industry.

ABC-UTC places an important emphasis on placing the research results in the hands of the end users. As an example, fifteen Research Seminars were presented on completed projects to national and international audiences averaging over 500 sites per seminar. Products we have developed are now being used widely in practice. In 2017 and 2018, Walsh a contractor, decided to use seven folded plate bridge system on a competitive basis while addressing replacement of substandard bridges in Pennsylvania.

One of the ABC-UTC research projects has resulted in development of the most comprehensive data base of ABC projects, providing a starting point for designers when it comes to planning and designing of an ABC project. The ABC Project Database (created through one of the ABC-UTC research projects) contains complete information on 122 completed bridge projects within the US utilizing an ABC technology or technique and is currently used by engineers as a starting point for their ABC projects.

The table below is meant to provide a snapshot of impacts and outcomes of ABC-UTC research efforts.

Outcomes & Impacts

Principal Investigator Name	ABC-UTC Research Project	Status of Outcomes	Status of Impacts
Garber, David (PI); Lee, SJ (co-PI)	Demolition Requirements for Bridge Construction Projects – Best Practices Guideline (Phase I) [ABC-UTC-2013-C2-FIU01]	Project stemming from this work: 2017 NCHRP 20-05/49-03, <i>Bridge Demolition Practices</i> ; \$45,000. Results of this project was used in development of follow up project to develop a user-friendly software for prediction of demolition scale.	This project will not directly result in changes in state, local or national specifications.
Azizinamini, Atorod (PI)	<i>Alternative ABC Connections Utilizing UHPC</i> [ABC-UTC-2013-C2-FIU03]	Lafarge contributed material as in-kind contribution.	Impact expected within the next 5-10 years. We are in discussion with FDOT to have demonstration projects
Azizinamini, Atorod (PI)	<u>Extending Application of SDCL to ABC (Phase II – Experimental)</u> [ABC-UTC-2013-C2-FIU04]	AISC and NSBA contributed \$50,000 toward fabrication of test specimens. This development is expected to reduce construction cost.	Use of this product is expected within the next 2 to 3 years.

Principal Investigator Name	ABC-UTC Research Project	Status of Outcomes	Status of Impacts
Azizinamini, Atorod (PI)	<u>Accelerated Retrofit of Bridge Columns using UHPC Shell – Phase I: Feasibility Study (originally a sub-project of “Alternative ABC Connections Utilizing UHPC”) [ABC-UTC-2013-C2-FIU05]</u>	Lafarge contributed all the UHC material.	Impact expected within the next 2 to 3 years
Azizinamini, Atorod (PI)	<u>Experimental Investigation of High Performing Protective Shell Used for Retrofitting Bridge Elements (originally a sub-project of “Alternative ABC Connections Utilizing UHPC”) [ABC-UTC-2013-C2-FIU06]</u>	Lafarge contributed all the UHPC materials. Two patents were obtained (patent# 9708821 & 10196832) for this project.	Impact expected within the next 2 to 3 . It provides a technology that can upgrade substandard bridges at a fraction of cost of replacing them.
Garber, David (PI); Azizinamini, Atorod (PI)	<u>Compilation of ABC Solutions [ABC-UTC-2013-C1-FIU01]</u>	Used by Kimley-Horn and Associates to design PBE for Sacramento Wash Crossing at Oatman Highway Bridge on Historic Route 66 in CA	Goal would be for the project database to be the standard of practice for starting point for people new to ABC
Garber, David (PI)	<u>International Database of ABC Research [ABC-UTC-2013-C1-FIU02]</u>	The outcome of this project is available to researchers and industry for use in research and further application of ABC.	This project will indirectly impact the development of new guides and specifications.
Azizinamini, Atorod (PI)	<u>Extending Application of SDCL to ABC (Phase I & II)</u>	Received small reduction in price of fabricating test specimen by fabricator. A guideline for designing this connection has been developed.	Impact expected within the next 2 to 3 years.
Azizinamini, Atorod (PI)	Extending Maximum Length of the Folded Steel Plate Girder Bridge System (FSPGBS), exceeding 100 ft. with capability to Incorporate Camber:	A patent was obtained (Patent# 9915045) for this project.	The impact is expected to be within next 1 to 2 years.. This product is expected to significantly impact the bridge industry.
Mehrabi, Armin (PI)	NDT Methods Applicable to Health Monitoring of ABC Closure Joints	A guideline for selecting NDT methods for evaluation of closure joints was developed.	Impact expected within the next 3 to 5 years.

Principal Investigator Name	ABC-UTC Research Project	Status of Outcomes	Status of Impacts
Garber, David (PI)	Performance Comparison of In-Service, Full-Depth Precast Concrete Deck Panels to Cast-in-Place Decks	An ABC-UTC Guide for Full-Depth Precast Concrete Deck Panels was developed.	Impact expected within the next 3-5 years.
Jae Lee, Seung (PI)	A Predictive Computer Program for Proactive Demolition Planning	A procedure and software were developed along with a guideline to help contractors to proactively plan bridge demolition.	Impact expected within the next 2 to 3 years

Principal Investigator Name	ABC-UTC Research Project	Status of Outcomes	Status of Impacts
Alipour, Alice (PI); Shane, Jennifer (Co-PI)	Development of Guidelines to Establish Effective and Efficient Timelines and Incentives for ABC [ABC-UTC-2013-C3-ISU01]	AN ABC-UTC guideline was developed for this project. This guide would be a source for novice states to consider implementing ABC. Expected to be a resource for agencies making timeline and incentive decisions	Impact expected within the next 3-5 years.
Hosteng, Travis (PI); Shafei, Behrouz (Co-PI)	Integral Abutment Details for ABC Projects, Phase II [ABC-UTC-2013-C3-ISU02]	1 of 3 details tested in the project was a UHPC connection developed by Iowa DOT, which also provided match funding. Grouted rebar coupler and UHPC connections are ready for implementation; Iowa DOT plans to implement UHPC connection within the next year.	Impact expected within the next 1-2 years. Anticipated to become standard detail in Iowa.
Freeseaman, Katelyn (PI); Phares, Brent (Co-PI)	Inspection and QA/QC for ABC Projects [ABC-UTC-2013-C3-ISU03]	A guideline was developed for this project.	Impact expected within the next 5-10 years.
Shafei, Behrouz (PI); Peter Taylor (Co-PI); Phares, Brent (Co-PI)	Material Design and Structural Configuration of Link Slabs for ABC Applications [ABC-UTC-2013-C2-ISU03]	Iowa DOT provided match funding to explore the possibility of using link slabs in a case-study bridge.	Results of work to be implemented in a bridge on I35/I80 in 2020. Additionally, this project will indirectly impact the development of new guides and specifications. Anticipated to become standard mix and design approach.

Principal Investigator Name	ABC-UTC Research Project	Status of Outcomes	Status of Impacts
Wipf, Terry (PI); Sritharan, Sri (Co-PI)	<u>Development of Prefabricated Bridge Railings</u> [ABC-UTC-2013-C1-ISU03]	Pooled-fund study under development (Iowa DOT-led, 8 state DOTs) to crash test the railing details developed in this project. A patent is pending (Invention disclosure date Feb 5, 2015 Patent pending, Application number 16/263,163) for this project.	Impact expected within the next 3-5 years

Principal Investigator Name	ABC-UTC Research Project	Status of Outcomes	Status of Impacts
Saiidi, M. Saiid (PI); Itani, Ahmad (Co-PI)	<u>Evaluation of Seismic Performance of Bridge Columns with Couplers and Development of Design Guidelines</u> [ABC-UTC-2013-C1-UNR01]	This pilot study enabled the PIs to develop a successful proposal to NCHRP (Project 12-105) to develop design guidelines for ABC column connections. The ABC seismic design guidelines that are being developed though NCHRP 12-105 are expected to significantly expand the use of pocket connections in ABC columns upon completion.	Impact expected within the next 3-5 years. Acceptance criteria have been developed for seismic couplers through the NCHRP 12-105 project, which built on the findings of the ABC-UTC project. AASHTO ballot item is being prepared for the criteria. This would impact numerous projects.
Saiidi, M. Saiid (PI); Itani, Ahmad (Co-PI)	<u>Behavior and Design of Precast Bridge Cap Beams with Pocket Connections</u> [ABC-UTC-2013-C1-UNR02]		Impact expected within the next 3-5 years. Pending the completion of NCHRP 12-105 project, which utilizes the results of this ABC-UTC project.
Saiidi, M. Saiid (PI); Itani, Ahmad (Co-PI)	<u>Development and Seismic Evaluation of Pier Systems with Pocket Connections and UHPC Columns</u> [ABC-UTC-2013-C1-UNR03]	The pocket connections studied in this project provided the impetus for the PIs to develop a successful proposal to Caltrans to study bridge systems with pocket connections. The ABC seismic design guidelines that are being developed though NCHRP 12-105 are expected to significantly expand the use of pocket connections in ABC columns upon completion.	Pending the completion of NCHRP 12-105 project, which utilizes the results of this ABC-UTC project. Furthermore, Caltrans is likely to use the pocket connections in their future ABC projects.

In summary the investment that US DOT has made in establishing a UTC dedicated to ABC has paid off and continues to do so. ABC-UTC, has outperformed even our expectation. The level of trust, credibility and network that ABC-UTC has developed with bridge industry is unparalleled, never seen before in an academic setting. The key to our success has been listening to our stakeholders, understanding the needs, thinking forward and demonstrating to our clientele that ABC-UTC can deliver.

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. It is with great pleasure to state that Bridge Engineering and ABC-UTC was selected as one of the five research preeminent areas. Greater resources will be available to ABC-UTC as a result of being named preeminent program.

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

What is the impact on technology transfer?

The ABC-UTC monthly webinars are proving to be the most effective means of transferring the knowledge to the profession. Having 5000 to upward of 10000 bridge professionals participate in each monthly webinar are unparalleled. The 2014 National ABC conference was co-sponsored by 26 states who actively participated in this event. The 2015 National ABC Conference was Co-Sponsored by 30 states and 2017 Conference sponsored by 32 states. The 2019 upcoming ABC conference thus far, has been co-sponsored by 30 states, FHWA and TRB. ABC-UTC was successful in developing major travel scholarship program that allowed more than 200 state bridge engineers to attend each National ABC Conferences (2014, 2015 and 2017). These activities are providing opportunities for effective communications with State DOTs and bridge professionals, making the task of Technology transfer much easier.

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

What is the impact on society beyond science and technology?

US DOT is placing a tremendous amount of emphasis on public safety. Construction zones are a magnet for accidents. ABC reduces the onsite construction activities from months or even years to a very short time period, as little as one weekend, if needed. Increasing safety, enhancing mobility, being environmentally responsible, building bridges that are resilient and sustainable are important consequences of using ABC. The major goal of ABC-UTC is to make the ABC the method of choice for bridge replacement and retrofit and in future to call it BC. This, in turn, will improve the mobility and save the society in many different ways. One of the most important contributions of ABC to society is reducing the number of accidents and therefore significantly enhancing the safety. A single accident could cost taxpayers millions in litigation and legal expenses.

CHANGES/PROBLEMS

Changes that have a significant impact on expenditures

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

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

No changes

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

No changes

Change of primary performance site location from that originally proposed

No changes

SPECIAL REPORTING REQUIREMENTS

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

Completed by:

Florida International University: Atorod Azizinamini

Iowa State University: Brent Phares, Terry Wipf

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