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UTC Semi Annual Progress Report University Transportation Centers

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1. ACCOMPLISHMENTS: What was done? What was learned?

The information provided in this section allows the grants official to assess whether satisfactory progress has been made during the reporting period. The ABC-UTC 2016 grant was awarded in December 2016.

1.1 What are the major objectives of the program?

The major goals of the ABC-UTC program fall into six different categories:

1.1.1 Research

The objectives of the Accelerated Bridge Construction University Transportation Center (ABC-UTC) are to advance the frontier of Accelerated Bridge Construction (ABC); develop new ABC knowledge; effectively transfer the state-of-the-art ABC knowledge to the profession; develop a next-generation ABC workforce; provide leadership in making contributions to solve national transportation issues; and collaborate with the Federal Highway Administration (FHWA), the American Association of State Highway and Transportation Officials (AASHTO), Departments of Transportation (DOTs), other UTCs, and the transportation profession to make ABC the best solution for the nation's aging bridge infrastructure, in line with ***Fixing America's Surface Transportation (FAST) Act research priority area: "Improving the Durability and Extending the Life of Transportation Infrastructure" and non-exclusive topic areas: "Construction Methodologies" and "Application of New Materials and Technologies."***

The ABC-UTC will also contribute to FAST Act's priority areas of "Reducing Congestion (Improve Operations)", "Promoting Safety (Transportation Worker Safety/ Construction Zones)," "Preserving the Environment (Environmentally Responsible Planning and Construction)," and "Preserving the Existing Transportation Systems (Retrofits and Multiple Uses of Infrastructure)".

1.1.2 Leadership

The proposed ABC-UTC consortium members have well-established, working relationships with one another that span decades. Collectively, the five institutions have the expertise and synergy to accomplish the Center's objectives. The ABC-UTC's research team, many of whom are recognized experts in the field and are in leadership positions, is particularly well suited to solving the remaining barriers to widespread implementation of ABC practices and the construction of longer service-life bridges. The research team members will continue their leadership through professional publications, articles, media outputs, and conferences to extend their leadership beyond the academic arena. The program will also invest in young faculty to become future leaders in the area. We demonstrate our leadership in innovations in education, workforce development, deployment of research results and conducting research.

1.1.3 Education and Workforce Development

All ABC-UTC partners have well-established education and workforce development programs that will be further strengthened through the ABC-UTC. FIU, ISU, UNR, UW, and OU, each offer graduate degrees, leading to M.S. and Ph.D. degrees in all traditional fields of civil engineering, including transportation engineering, structural engineering, and construction engineering. The quality of these programs is best evidenced by the many awards and recognition their students have received in recent years.

The objectives of the Accelerated Bridge Construction University Transportation Center (ABC-UTC) are to develop successful programs in the areas of seminars, workshops, and training courses for graduate and undergraduate students.

1.1.4 Technology Transfer

One of the strongest aspects of the current ABC-UTC is the knowledge and leadership role that it has and will play in bridge engineering in terms of Technology Transfer. The keys to the FIU's ABC-UTC success in Technology Transfer are: a) a solid, extensive knowledge of ABC; b) a strong focus (ABC); c) coordination of its activities with AASHTO, FHWA, DOTs, and consultants; d) identification of the knowledge gaps, e) identification of the bridge community needs; f) teamwork; g) identification of the best means, methods, and format of transferring the knowledge, and most importantly; h) involvement of stakeholders and adopters early in the process, and continuously seeking and receiving feedback from the community and making necessary improvements and adjustments.

Some of the highlights of technology transfer will include:

- Partnerships across Sectors to Move Research into Practice
- Peer-reviewed Journals and Other Publications to Showcase Research Results
- Information Exchanges
- Academic and Continuing Education Programs
- Distance Learning
- Conferences, Webinars, and Workshops
- Assessment of Outreach and Progress Implementing Research Results

1.1.5 Collaboration

The ABC-UTC is a consortium of FIU (as lead university) located in Miami, Florida (Region 4); ISU located in Ames, Iowa (Region 7); UNR located in Reno, Nevada, (Region 9); OU located in Norman, Oklahoma (Region 6); and UW located in Seattle, Washington (Region 10). This structure will foster collaboration among experts in various areas of ABC and will result in the wider dissemination of results. In addition to the partnerships that occur through individual projects and the pooled-fund program, ABC UTC will facilitate external collaboration through the

Advisory Board and Advisory Panels consisting of external industry and US and State Transportation members.

Partnership with Government Agencies:

The existing ABC-UTC already has a strong working relationship with AASHTO SCOBs T-4, T-3 and T-11, FHWA, TRB ABC Subcommittee, and NCHRP, and these relationships will expand and continue.

Communication capabilities already in place will allow for remote control and operation of experimental work conducted at any or all partner university facilities. Such real-time viewing, control, and data manipulation is just one example of how the partner universities will work collaboratively.

The requirements for all partner universities for effective collaboration include:

- Linkage among Research, Education, Workforce Development and Technology Transfer Activities
- Working with Minority-Serving Institutions
- Advisory Boards and Committees
- Metrics for Measuring Collaboration Success

1.1.6 Diversity

- The lead university is a Minority Serving Institution and Hispanic Serving Institution. With a current enrollment of approximately 55,000, FIU is among the top 10 largest public universities in the U.S. and **annually grants more than 11,000 BS, MS, and PhDs to Hispanic students. FIU also has an R1 Carnegie Classification**, which is the highest research activity rating universities can achieve. FIU has an established national reputation for excellence in Accelerated Bridge Construction and has an excellent Transportation Engineering program. Additionally, the consortium of universities is diverse. Specifically, 1) the consortium is made up universities in large (Miami, Seattle), medium (Reno), and small (Ames and Norman) population areas; 2) the consortium encompasses the Eastern (FIU), Midwest (ISU and OU), and Western (UNR and UW) regions of the United States; 3). The consortium covers both seismic (UNR, UW) and non-seismic regions (FIU, ISU, and OU) and 4). The consortium is multi-disciplinary, including both engineering (construction, structural, geotechnical, transportation and safety) and non-engineering (policy and management) disciplines. Further, FIU contributes to ABC, ITS, and construction engineering expertise.
- ABC-UTC activities, FIU will provide one of the best platforms for consortium member universities and **other anticipated UTCs** to attract qualified minority students to their graduate programs. OU has a large Native American student enrollment and provides opportunities for consortium members to attract Native American students also houses the Center for Diversity in Engineering and

Computing (CDEC). The goals of the CDEC are to increase the overall number of students pursuing engineering careers and to increase the proportion of students from traditionally underrepresented populations in the overall number of students who pursue an engineering degree.

- ABC-UTC works closely with the CDEC and takes full advantage of the CDEC's expertise and the various outreach programs it has developed. Currently, the CDEC has several ongoing programs targeting elementary, middle, and high school level students.

Over the last twelve years, the CDEC has been focused on increasing the flow of traditionally underrepresented ethnic/gender groups and students with disabilities into the engineering and computing pipeline. At the K-12 level, the Center implements programs such as summer and academic enrichment programs, tutoring services, teacher training, mentorships, career/college/financial awareness seminars, dual enrollment, counseling services, parental workshops, and physical fitness. Other programs such as the Florida-Georgia Louis Stokes' Alliance for Minority Participation (FGLSAMP) provide many FIU STEM students with the need/merit-based scholarships and opportunities to conduct research and receive faculty mentoring. These and other activities are supported by various grants from the U.S. Department of Education, NSF, Motorola Foundation, Miami-Dade County Public Schools, Miami Children's Trust, the Caterpillar Foundation, Office of Naval Research, and others.

The Center's Summer Transportation Program recruits 40 middle school students and engages them in a five-week summer program consisting of a host of activities designed to prepare and inspire them to pursue careers in the design, operation, safety, and optimization of modern land, sea, space, and air transportation systems.

Specific activities proposed for the proposed ABC-UTC will include: 1) adapting and modifying the outreach materials from CDEC for transportation careers and targeting the materials to K-12 and undergraduate student groups via websites and social media such as Facebook and Twitter; 2) offering fellowships that specifically target traditionally underrepresented students; 3) providing funding to support campus visits of prospective minority students; and 4) making presentations on transportation careers at major minority institutions and conferences.

OU highly values diversity and inclusion, and the university's Gallogly College of Engineering has full-time staff to organize and engage in activities targeted toward attracting and retaining minority students. Located in the heart of the Native American Country, Native American outreach is one of OU's strengths. The outreach activities include summer camps and summer bridge and site visits.

- One of the measures of success in ABC-UTC diversity activities will be the number of minority students admitted from FIU into the undergraduate and graduate programs of ABC-UTC consortium member universities.

1.2 What was accomplished under these goals?

1.2.1 Research

- Ongoing updates to the Operation Manual. We continue to update the Operation manual as needed to best fit our goals and objectives.
- In this period we have entered into discussion with lightweight industry to try to develop a more comprehensive joint research activities.
- In this period all active research projects in Cycles 1, 2, and 3 are ongoing. In addition, the research ideas for Cycle 4 were requested. In the next period, we are planning to finalize the research project selection for Cycle 4. Cycle 4 projects will start as early as January 2021.
- 2020 Research Day 1 was held on April, 27th 2020 and PI's made a total of 19 online presentations on Cycle-3 projects to the public. The next Research Day will be held on November 6th, 2020.
- The following Research Seminars were presented during the reporting period with the number of independent sites attending also highlighted. Many sites have multiple attendees, so the actual number of attendees is higher. Research Seminars continue to give exposure to our students to the industry.

	Date	Research Seminar Title	Student(s) Presenter	# sites attending
1	4/30/2020	Rapid Retrofitting Techniques for Induced Earthquakes – Phase I	Sumangali Sivakumaran, (M.S., OU)	443
2	7/31/2020	Synthesis of Available Methods for Repair of Reinforced Concrete and Prestressed Concrete Girders	Azin Ghaffary, (Ph.D., UNR)	576

The following table provides a list of the research projects, with PI and the status of the project.

Project #	Project Title	Principal Investigator	Status
FIU-2016-1-1	Development Of Guide For Selection Of Substructure For ABC Projects (Joint project with OU)	Armin Mehrabi & Hesham Ali	98% Complete Final deliverable to be posted soon
FIU-2016-1-2	Field Demonstration- Instrumentation and monitoring of Accelerated Repair Using UHPC Shell	Kingsley Lau	80% Complete (Experimental)
FIU-2016-1-3	Envisioning Connection Detail for Connecting Concrete Filled Tube	Atorod Azizinamini	95% Complete

Project #	Project Title	Principal Investigator	Status
	(CFT) Columns to Cap Beam for High-Speed Rail Application (Joint project with UW)		
FIU-2016-1-4	Innovative Foundation Alternative for High-Speed Rail Application (Joint project with UNR)	Seung Jae Lee	75% Complete
FIU-2016-1-5	Eliminating Column Formwork Using Prefabricated UHPC Shells: (Originally a subproject of "Envisioning Connection Detail for Connecting Concrete Filled Tube (CFT) Columns to Cap Beam for High-Speed Rail Application")	Atorod Azizinamini	99% Complete
FIU-2016-2-1	Development of Non-Proprietary UHPC Mix (Joint project with all partner universities)	David Garber	80% Complete
FIU-2016-2-2	Performance of Existing ABC Projects - Inspection Case Studies (Joint project with all partner universities)	Armin Mehrabi	100% Complete Final deliverable received
FIU-2016-2-3	Development of ABC Course Module- Available ABC Bridge Systems for Short Span Bridges	Armin Mehrabi	95% Complete Final deliverable to be posted soon.
FIU-2016-2-4	Optimization of Advanced Cementitious Material for Bridge Deck Overlays and Upgrade, Including Shotcrete	Islam Mantawy	50% Complete
FIU-2016-2-5	Robotics and Automation in ABC Projects	Islam Mantawy	90% Complete
FIU-2016-2-6	Laminated Wood Deck System for Folded Plate Girder	Atorod Azizinamini	25% Complete
FIU-2016-2-7	Understanding Critical Impacting Factors and	Lu Zhang	55% Complete

Project #	Project Title	Principal Investigator	Status
	Trends on Bridge Design, Construction, and Maintenance for Future Planning		
FIU-2016-2-8	Complex Networks Perspectives Towards Accelerated Bridge Construction (ABC)	Arif Mohaimin Sadri	60% Complete
FIU-2016-3-1	Alternative Materials and Configurations for Prestressed-precast Concrete Pile Splice Connection	Armin Mehrabi	25% Complete
FIU-2016-3-2	Alternative Technical Concepts for Contract Delivery Methods in Accelerated Bridge Construction	Mohamed ElZomor	15% Complete
FIU-2016-3-3	Work Zone Safety Analysis, Investigating Benefits from Accelerated Bridge Construction (ABC) on Roadway Safety	Islam Mantawy	75% Complete
FIU-2016-3-4	Use of UHPC in Conjunction with Pneumatic Spray Application and Robotic for Repair and Strengthening of Culverts- Phase I	Atorod Azizinamini	20% Complete
FIU-2016-3-5	Prefabricated Barrier System Utilizing UHPC Connections	Islam Mantawy	45% Complete
FIU-2016-3-6	Robotic Bridge Construction: Experimental Phase I	Atorod Azizinamini	35% Complete
FIU-2016-3-7	Rapid Repair and Retrofit of Timber Piles Using UHPC	Islam Mantawy	40% Complete
FIU-2016-3-8	Automated MFL System for Corrosion Detection	Atorod Azizinamini	40% Complete
FIU-2016-3-9	UHPC connection for SDCL steel bridge system	Atorod Azizinamini	50% Complete

Project #	Project Title	Principal Investigator	Status
ISU-2016-1-1	Delivery Methods for Accelerated Bridge Construction Projects: Case Studies and Consensus Building	Katelyn Freeseaman	100% Complete Final deliverable received
ISU-2016-1-2	Bedding of Accelerated Bridge Construction Projects: Case Studies and Consensus Building	Katelyn Freeseaman	100% Complete Final deliverable received
ISU-2016-1-3	Accelerated Repair and Replacement of Expansion Joints	Brent Phares	100% Complete Final deliverable received
ISU-2016-2-1	Development of Non-Proprietary UHPC Mix (Joint project with all partner universities)	Behrouz Shafei	90% Complete
ISU-2016-2-2	Performance of Existing ABC Projects- Inspection Case Studies (Joint project with all partner universities)	Katelyn Freeseaman	50% Complete
ISU-2016-2-3	Synthesis of available contracting methods	Jennifer S. Shane,	95% Complete Final deliverable to be posted soon
ISU-2016-2-4	Development of ABC Course Module- Design of Link Slabs	Behrouz Shafei	80% Complete
ISU-2016-3-1	Investigation of The Efficacy Of Helical Pile Foundation Implementation In Accelerated Bridge Construction Projects – Phase I	Justin Dahlberg	25% Complete
ISU-2016-3-1	Multi-Span Lateral Slide Laboratory Investigation: Phase 1	Katelyn Freeseaman	20% Complete
UNR-2016-1-1	Innovative Foundation Alternative for High-Speed Rail Application (Joint project with FIU)	Mohamed Moustafa	100% Completed Final deliverable received
UNR-2016-1-2	Identify the Risk Factors That Contribute to	Mohamed Moustafa	60% Complete

Project #	Project Title	Principal Investigator	Status
	Fatalities and Serious Injuries and Implement Evidence-Based Risk Elimination and Mitigation Strategies		
UNR-2016-1-3	More Choices for Connecting Prefabricated Bridge Elements and Systems (PBES)	Mohamed Moustafa	99% complete Final deliverable to be posted soon
UNR-2016-2-1	Development of Non-Proprietary UHPC Mix - Application to Deck Panel Joints (Joint project with all partner universities)	Mohamed Moustafa	80% complete
UNR-2016-2-2	Synthesis of available methods for repair of prestress girder ends	Mohamed Moustafa	95% complete Final deliverable to be posted soon
UNR-2016-2-3	Performance of Existing ABC Projects - Inspection Case Studies	Mohamed Moustafa	30% Complete
UNR-2016-3-1	Quantitative assessment of soil-structure interaction effects on seismic performance of bridges with ABC connections	Elnaz Seylabi	20% Complete
UNR-2016-3-2	Investigating the Potential Applications of Elastomeric Polymers (Such As Polyuria And Polyurethane) For Accelerated Bridge Construction And Retrofit	Hamed Ebrahimian	5% Complete
UNR-2016-3-3	Application of Methacrylate Polymers for Seismic ABC Connections	Mohamed Moustafa	45% Complete
OU-2016-1-1	Development of Guide For Selection Of Substructure For ABC Projects (Joint project with all partner universities)	Musharraf Zaman (Joint project with FIU)	95% Complete Final deliverable to be posted soon
OU-2016-1-2	Rapid Retrofitting Techniques for Induced Earthquakes	Philip Scott Harvey Jr.	100 % Completed

Project #	Project Title	Principal Investigator	Status
OU-2016-2-1	Development of Non-Proprietary UHPC Mix (Joint project with all partner universities)	Royce W. Floyd	95% Completed
OU-2016-2-2	Development of ABC Course Module - The risk due to Induced Earthquakes and Accelerated Solution (under technology transfer activity)	Philip Scott Harvey Jr	100% Complete Final deliverable received
OU-2016-2-3	Performance of Existing ABC Projects - Inspection Case Studies (Joint project with all partner universities)	Musharraf Zaman	70% Complete
OU-2016-3-1	Service Life Design Guidance for UHPC Link Slabs	Royce Floyd	20% Complete
OU-2016-3-2	Development of User-friendly Tools and Decision-making Algorithms for Service Life Design of ABC Bridges	Shima Mohebbi	40% Complete
UW-2017-1-1	Performance Evaluation of Structural Systems for High-Speed Rail In Seismic Regions	John Stanton	85% Complete
UW-2017-1-2	New Seismic-Resisting Connections or Concrete-Filled Tube Components In High-Speed Rail Systems (Joint Project with FIU)	Dawn Lehman	98% Complete
UW-2016-2-1	Development of Non-Proprietary UHPC Mix - Evaluation of the Shear Strength of UHPC (Joint project with all partner universities)	Paolo Calvi	90% Complete
UW-2016-2-2	Development of ABC Course Module- Seismic Connections	John Stanton	35% Complete

Project #	Project Title	Principal Investigator	Status
UW-2016-2-3	Development of ABC Course Module - Design of CFST Components and Connections for Transportation Structures	Dawn Lehman	95% Complete
UW-2016-2-4	Performance of Existing ABC Projects - Inspection Case Studies (Joint project with all partner universities)	John Stanton	20% Complete
UW-2016-2-5	Tsunami Design Forces for ABC Retrofit	Marc Eberhard	20% Complete
UW-2016-3-1	Design Guidelines for ABC Column-to-Drilled-Shaft Foundation Connections in High Seismic Zones	Marc Eberhard	15% Complete
UW-2016-3-2	Economic Pier-to-Pile Connections for Permanently Cased Shaft (CFST) Piles	Dawn Lehman	30% Complete

1.2.2 Leadership

Several of the partner universities faculty members and students serve on national committees, panels, and other volunteer positions.

1.2.3 Education and Workforce Development

The core Education and Workforce Development tasks continued during the past reporting period. These are summarized in the below table.

Task #	Brief Description of Task	4/1/20 to 9/30/20
WD-1	Student Education and Research Assistantships: Each ABC-UTC consortium member will be expected to mentor a minimum of one graduate student for approximately each \$75,000 in project work and provide research assistantship opportunities for graduate students.	41 (FIU, UNR, ISU, OU, UW) MS/Ph.D. students have been supported
WD-2	Undergraduate Internships: Each ABC-UTC consortium member will be expected to support undergraduate students on research projects.	11 (FIU, UNR, ISU, OU) Undergraduate students have been supported

Task #	Brief Description of Task	4/1/20 to 9/30/20
WD-3	Student Publications: Each ABC-UTC consortium member will be expected to support students to publish and present their work.	27 publications (submitted, accepted, or published) Due to Covid-19, there were no conference presentations (presented)
WD-4	Travel Scholarships: Each ABC-UTC consortium member will be expected to support students who travel to conferences to present their work.	Due to Covid-19, there were no travel scholarships provided
WD-5	Research Seminars: Each graduate student will be required to give a technical presentation at the conclusion of their research study. These presentations will be delivered electronically as part of the ABC-UTC technology transfer activities.	Total of 2 students presented in 2 research seminars 1019 sites attended the seminars

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

- K-7 Learning Module - an introduction video titled, *Intro to Structural Engineering and Paper Bridge (K-7)*, was created for teachers of K-7 students to show in their classroom. This video gives a brief introduction to structural engineering, load path, and types of forces. The activity that is introduced shows students how a piece of paper can be modified to hold a significant amount of weight. The video is featured in the following url link: <https://abc-utc.fiu.edu/education/k-12-resources/k-12-videos/>; video and activity were used by 5-6 grade teacher.
- Due to COVID-19, implementation of the following WD activities below, for the previous reporting period were temporarily postponed:
 - Parent-Child Camp (K-8) – multi-day camp designed for parents and their children (K-8) to learn about bridge engineering
 - Public Library Outreach – partner with libraries to develop and run extracurricular activities related to bridge engineering
 - Edutainment Learning – partnering with Digital Innovations and Pinecrest Academy of Nevada (Edutainment); K-12 teachers request interview with expert in specific field and expert uses video communications to interact with class
 - 3D Printing Workshops and Model Development – partnering with Miami Beach Urban Studios on 3d printing and model development
 - Teacher Workshops – two-day teacher workshops hosted by different partner universities to introduce teachers to bridge engineering curriculum developed by ABC-UTC researchers

Future 2020 WD are being reevaluated based on the current situation with COVID-19. The ABC-UTC continues to host all their digital K-12 resources at <https://abc-utc.fiu.edu/education/k-12-resources/>.

1.2.4 Technology Transfer

During this reporting period, planning began for the 2021 International Accelerated Bridge Construction Conference. A web meeting was held with state Department of Transportation non-financial co-sponsors of past ABC-UTC Accelerated Bridge Construction Conferences to receive stakeholder input.

Two new events were planned and developed during this reporting period. The half-day regional Contractor/Owner Collaboration on ABC Programs Workshop will be held in Nebraska in 2021 when state DOTs are again able to travel following the pandemic. The one-day virtual Symposium on ABCs of ABC will be held in December 2020.

ABC-UTC representatives attended the virtual 2020 American Association of State Highway and Transportation Officials (AASHTO) Committee on Bridges and Structures Annual Meeting in June 2020. During this meeting, the ABC-UTC Director presented an update on ABC-UTC activities to the AASHTO Technical Committee for Construction (T-4) per their request.

Six Monthly Webinars were conducted during the reporting period. For these free webinars, the number of registered sites ranged from 1,020 to 1,810 although the web room software limit is 1,000 participants. Five presentations were given by bridge owners (Pennsylvania DOT, Vermont Agency of Transportation, Greater New Orleans Expressway Commission, Iowa DOT and Iowa counties) and their industry partners, featuring design and construction details and lessons learned on state-of-the-art ABC technologies incorporated in recently completed bridge projects in their states. One presentation was given by industry representatives on micropiles, an innovative ABC foundation type.

This year's In-Depth Web Training, held in September 2020, featured use of the AASHTO LRFD Guide Specifications for Accelerated Bridge Construction, 1st Edition, 2018. A total of 1,078 sites registered for this free training although attendance in the web room was limited to 1,000 sites. The 4-hour training consisted of six 40-minute modules, each with a 30-minute presentation and 10-minute Q&A session.

The ABC-UTC website (<https://abc-utc.fiu.edu/>) was updated with the latest ABC-UTC research and workforce development activities. Also posted were the Monthly Webinar, Research Seminar, Research Day, and In-Depth Web Training recordings and other documents. Also, work continued on data entry of completed ABC construction projects in the ABC Project Database, working with bridge owners to complete these submissions for posting on the open web. In addition, various other ABC events, news items, and details were posted.

PERFORMANCE METRICS FOR CURRENT REPORTING PERIOD:

Research	Goals	Research Performance Measures	04/1/20-9/30/20
Outputs	ABC-UTC Guides documents – Short documents that provide essential information needed to put results of research into practice; note that projects with similar topics may have a combined document	Number of documents submitted	4
	Research Seminar – Principal Investigator(s) and graduate student(s) will co-present project findings in quarterly Research Seminar series; products of the research project, at completion, will be presented	Number of seminars	2
	Publications – Peer-reviewed publications on research products	Number of peer-reviewed publications on research products	4
	Presentations – Research projects presented at conferences and other events	Number and quality of conferences and events during which results of the research are presented	4
	Development of Educational Materials – Continuing education courses, web-based training, part of conference workshops, or modules for college courses	Number of developed educational materials We are currently working on developing 4 short courses, work currently in progress. (See Research Section, project #'s FIU-2016-2-3; ISU-2016-2-4; UW-2016-2-2; UW-2016-2-3)	1
Outcomes	Activities Requested by Stakeholders – Presentations, workshops, etc. Number of activities conducted	Number of activities conducted	2
	Separate Financial Contributions for Research Projects or Follow-on Research Projects – The impact of the research projects will be assessed by the level of interest expressed by state DOTs and/or industry	Number of separate financial contributions for research projects or follow-on research projects	6
	Use in ABC Projects – Product(s) used in an ABC construction project	Number of times research products are incorporated in bridge construction projects, as identified by the PIs in collaboration with the bridge owners	0

Research	Goals	Research Performance Measures	04/1/20-9/30/20
Impacts	<i>Governing State, Local, and National Specifications</i>	Number of changes, to incorporate products, that are made to the state, local, or national (e.g., AASHTO) bridge design and/or construction specifications or guidelines.	0
	<i>Standard Use of Products in ABC Projects</i>	Number of states using the products in their bridge construction as a standard practice, as identified by the PIs in collaboration with the bridge owners	0

Outcomes reported in this period, per the above table, are described below. No impacts were reported in this period. It should be noted that we are re-visiting the definition of “impact”. We believe that “impact”, is closely related to “influence”, in practice that could be measured. What is reported in this period with respect to “impact”, does not consider the “influence” of our work in practice. During next reporting cycle, this will be corrected, and “impact” will be reported accordingly.

OUTCOME/IMPACT DESCRIPTIONS FOR CURRENT PERIOD (04/01/2020 – 09/30/2020)

Research Project		Outcomes		
#	Title	Activities Requested by Stakeholders	Separate Financial Contributions for Research Projects, or Follow-on Research Projects	Use in ABC Projects
2016-C3-FIU05	Robotic Bridge Construction: Experimental Phase I		Approached by NASA to be part of research project for Artemis. ABC-UTC is now part of NASA team for sending astronauts to Moon with plan to go to Mars from Moon. Please note that this in fact is “Impact”. Until we change our definition of “Impact”, per statement above we will continue to list these items as output.	
2016-C2-FIU05	Robotics and Automation in ABC Projects: Exploratory Phase		Approached by NASA to be part of research project for Artemis	

Research Project		Outcomes		
#	Title	Activities Requested by Stakeholders	Separate Financial Contributions for Research Projects, or Follow-on Research Projects	Use in ABC Projects
2016-C3-ISU02	Multi-Span Lateral Slide Laboratory Investigation: Phase 1		Match funds from Iowa DOT	
2016-C2-ISU01	Development of Non-Proprietary UHPC Mix		Match funds from Iowa DOT	
2016-C3-UNR03	Application of Methacrylate Polymers for Seismic ABC Connections		Transpo Industries provided polymer concrete for research project	
2016-C2-UNR02	Synthesis of Available Methods for Repair of Reinforced Concrete and Prestressed Concrete Girders	In August 2020, a design firm (Quiroga Pfeiffer Engineering Corporation) requested research project outputs to assist with a bridge girder project that they were engaged in for a State DOT; relevant references were provided		
2016-C1-UNR03	More Choices for Connecting Prefabricated Bridge Elements and Systems (PBES)	Research project results on use of polymer concrete were provided per request of east coast bridge owner	Transpo Industries provided polymer concrete for research project	

An omission was noticed in the past two ABC-UTC Semi-Annual Reports, in that the numbers of outcomes and impacts were included in the table but descriptions were not included. Below are outcome/impact descriptions from those two Reports.

OUTCOME/IMPACT DESCRIPTIONS FOR PAST PERIOD (10/01/2019 – 03/31/2020)

Research Project		Outcomes		Impacts
#	Title	Activities Requested by Stakeholders	Separate Financial Contributions for Research Projects, or Follow-on Research Projects	Governing State, Local, and National Specifications
2016-C2-FIU01	Development of Non-Proprietary UHPC Mix	Collaboration between FIU, UNR, and OU invited to present a full-day non-proprietary UHPC mix workshop, held in Miami on 12-11-2019		
2016-C2-UNR01	Development of Non-Proprietary UHPC Mix – Application to Deck Panel Joints	As reported under 2016-C2-FIU01, collaboration between FIU, UNR, and OU invited to present a full-day non-proprietary UHPC mix workshop, held in Miami on 12-11-2019		
2016-C2-OU01	Development of Non-Proprietary UHPC Mix	As reported under 2016-C2-FIU01, collaboration between FIU, UNR, and OU invited to present a full-day non-proprietary UHPC mix workshop, held in Miami on 12-11-2019	Matching funds from Oklahoma DOT	Non-proprietary UHPC mix was included as an option in bid documents for traditional UHPC projects, which says they now have that option for subsequent projects
2016-C3-UW01	Design Guidelines for ABC Column-to-Drilled-Shaft Foundation Connections in High Seismic Zones	Invited presentation at 2020 Pacific Earthquake Engineering Research Center (PEER) Annual Meeting on January 17, 2020; speaker was John Stanton		
2016-C1-UW01	Performance Evaluation of Structural Systems		Match funds from Pacific Earthquake Engineering	

Research Project		Outcomes		Impacts
#	Title	Activities Requested by Stakeholders	Separate Financial Contributions for Research Projects, or Follow-on Research Projects	Governing State, Local, and National Specifications
	for High Speed Rail in Seismic Regions		Research Center (PEER)	

Note: For the 10/01/2019-03/31/2020 Report, a total of 2 outcomes and 1 impact were reported. Note that the total number reported by PIs to date for this period is 6 outcomes and 1 impact.

OUTCOME/IMPACT DESCRIPTIONS FOR PAST PERIOD (04/01/2019 – 09/30/2019)

Research Project		Outcomes		Impacts
#	Title	Activities Requested by Stakeholders	Separate Financial Contributions for Research Projects, or Follow-on Research Projects	Governing State, Local, and National Specifications
2016-C1-ISU01	Contracting Methods for ABC Projects: Case Studies and Consensus Building		Match funds from Kiewit	
2016-C1-ISU02	Bidding of ABC Projects: Case Studies and Consensus Building		Match funds from Kiewit	

Note: For the 04/01/2019-09/30/2019 Report, a total of 2 outcomes and no impacts were reported.

1.2.5 Collaboration

Collaboration among partner universities and advisory board members continues an ongoing basis for the areas of research, technology transfer and education and workforce development.

1.2.6 Diversity

Nothing to report.

1.2.7 How have the results been disseminated?

- Research Day was held on 04/27/2020 where the progress of each research project was presented by PI’s to a general audience (comprising of State DOTs, Industry, FHWA, and other affiliates).
- Quarterly Progress Reports posted on the website.
- Publications
- Presentations

- Conference Proceedings
- Webinars, Research Seminars, In-depth Web Training

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

Expected highlights of the next reporting period include:

- Identification of project topics and the start of the projects for Cycle 4 Research
- Implementation of Education and Workforce Development activities pending COVID-19
- Planning of the 2022 CUTC Meeting
- The planning of the next ABC-UTC Conference to be held in December 2021.
- Virtual Symposium on ABCs of ABC, will take place on December 4, 2020
- Monthly webinars and other related technology transfer activities
- The quarterly research seminar and semi-annual research day
- 2020 Research Day Two, will take place on November 6, 2020.
- Continuation of Research Projects and other activities.
- Memorandum of Understanding with Lightweight Concrete Industry
- Working with bridge owners to implement the results of research projects developed by ABC-UTC
- Commercialization of patented products developed by ABC-UTC
- Assisting State DOT engineers to identify funds available through demonstration projects for implementing ABC-UTC developed products and bridge solutions.
- Develop a cooperative working relationship with PEER (Pacific Earthquake Engineering Research Center at the University of California at Berkeley California).
- Develop a cooperative working relationship with US Forest Service
- Develop small companies for marketing products and solutions developed by ABC-UTC
- Work with State DOTs, FHWA and bridge owners to organize workshops across the U.S. for educating bridge professionals with latest in the ABC area. Specifically, we are attempting to organize a day-long ABC workshop at different locations.
- Work with State DOT engineers and other entities who have developed Non-Proprietary Ultra-High Performance Concrete (UHPC) mixes to organize a daylong workshop that will include hands-on activities to promote the use of UHPC which is an advanced cementitious material.

2. PRODUCTS

2.1 PUBLICATIONS, CONFERENCE PAPERS, AND PRESENTATION

2.1.1 Journal Articles Submitted

Citation for Article	Peer-Reviewed?
Author(s). "Article Title". <i>Journal Title</i> , Submitted <Month>, <year>.	Yes or No
Ahmed, M.A., Sadri, A.M., Mehrabi, A., Azizinamini, A. "Complex Networks Perspectives towards Accelerated Bridge Construction.", <i>Transportation Research Board Annual Meeting</i> , Submitted August, 2020	Yes
Shahrokhinasab, Esmail and Garber, David. "Long-Term Performance of Full-Depth Precast Concrete (FDPC) Deck Panels". <i>Engineering Structures</i> , Revision Submitted August, 2020.	Yes
Valikhani, Alireza, Azadeh Jaber Jahromi, Islam M. Mantawy, and Atorod Azizinamini, "Effect of Mechanical Connectors on Interface Shear Strength Between Concrete Substrates and UHPC: Experimental and Numerical Studies and Proposed Design Equation." <i>Construction and Building Materials</i> , April 2020	Yes
Dickinson, R.M.; Afzal, M.F.; Anwer, M.A.; Mantawy, I.M.; Azizinamini, A.; "Pneumatic Spray of Ultra-High-Performance Concrete for Bridge Repair Applications", <i>TRB 2021</i> , Submitted August, 2020.	Yes
Ali Javed, Islam M Mantawy and Atorod Azizinamini. "3D-Printing of Ultra-High-Performance Concrete for Robotic Bridge Construction". <i>Transportation Research Record: Journal of the Transportation Research Board</i> . August, 2020.	Yes
Sheharyar Rehmat; Amir Sadeghnejad, Atorod Azizinamini "Connection Details for Concrete Filled Tubes using UHPC for Resilient Bridge Substructure" <i>Transportation Research Board</i> . August, 2020	Yes
Abbas Khodayari, Islam M Mantawy and Atorod Azizinamini." Introducing a New Connection Detail for Connecting Prefabricated Barrier to Concrete Deck Using UHPC" <i>Transportation Research Board</i> . August 2020	Yes
Alireza Valikhani, Azadeh Jaber Jahromi; Atorod Azizinamini " An Investigation of Reinforced Concrete Beams Retrofitted with Ultra-High-Performance Concrete" <i>Transportation Research Board</i> . August 2020	Yes
Carlos Sosa Cardena, Islam M Mantawy and Atorod Azizinamini. "Repair of Timber Piles Using Ultra-High-Performance Concrete." <i>Transportation Research Record: Transportation Research Board</i> . August 2020.	Yes
Looney, T., Coleman, R., Funderburg, C., Volz, J., and Floyd, R. "Concrete Bond and Behavior of Non-Proprietary Ultra-High Performance Concrete Bridge Slab Joints," <i>ASCE Journal of Bridge Engineering</i> , Submitted October 31, 2019, 2 nd Revision Submitted July 24, 2020, Accepted September 16, 2020.	Yes
Ali, S.A., Ghabchi, R., Zaman, M., Rani, S. and Rahman, M.A. "Laboratory Characterization of Moisture-Induced Damage Potential of Asphalt Mixes Using Conventional and Unconventional Performance-Based Tests." <i>International Journal of Road Materials and Pavement Design</i> , Submitted July, 2020.	Yes

Rahman, M.A., Zaman, M., Ali, S.A., Ghabchi, R., and Ghos, S. "Mix Design Aspects and Cracking Resistance of Foamed Warm Mix Asphalt Containing RAP." <i>International Journal of Pavement Engineering</i> , Submitted June, 2020.	Yes
Ghos, S., Ali, S. A., Zaman, M., Chen, D. H., Hobson, K. R., and Behm, M. "Evaluation of Transverse Cracking in Flexible Pavements using Field Investigation and AASHTOW are Pavement ME Design". <i>International Journal of Pavement Research and Technology</i> , Submitted June, 2020.	Yes
Ghos, S., Ali, S. A., Zaman, M., Hobson, K. R., Larrain, M. M., and Behm, M. "Causes of Fatigue Cracking in Flexible Pavements in Oklahoma: A Case Study Using Laboratory and Field Investigation and AASHTOWare Simulation". <i>Journal of Transportation Engineering, Part B: Pavements</i> , Submitted September, 2020.	Yes
Abokifa, M., M.A. Moustafa, "Experimental Behavior of Poly Methyl Methacrylate Polymer Concrete for Bridge Deck Bulb Tee Girders Longitudinal Field Joints", <i>Construction and Building Materials</i> , Submitted August, 2020	Yes
Abokifa, M., M.A. Moustafa, "Full-Scale testing of Non-Proprietary Ultra-High Performance Concrete for Deck Bulb Tee Longitudinal Field Joints", <i>Engineering Structures</i> , Submitted September, 2020	Yes
Abokifa, M., M.A. Moustafa, A. Itani, "Comparative Behavior of Precast Bridge Deck Panels with UHPC and Polymer Concrete Transverse Field Joints", <i>Composites Part B: Engineering</i> , Submitted June, 2020	Yes
Aboukifa, M., M.A. Moustafa, "Experimental Seismic Behavior of Ultra-High Performance Concrete Columns with High Strength Steel Reinforcement", <i>Engineering Structures</i> , Submitted June, 2020	Yes
Zhao, M., Lehman, D., and Roeder, C. "Investigation of Force-Transfer Mechanisms in RC Column-to-Cased Concrete Pile Connections", <i>Engineering Structures</i> , Submitted August, 2020	Yes
Zhao, M., Lehman, D., and Roeder, C. "Modeling Recommendations for RC and CFST Sections in LS-Dyna including Bond Slip", <i>Engineering Structures</i> , Submitted April, 2020	Yes
Mokhtarimousavi, S., Anderson, J.C., Hadi, M., Azizinamini, A., "Hybrid Artificial Intelligence Models for Work Zone Crash Frequency Analysis at Bridge Locations," Submitted for publication in <i>Journal of Accident Analysis & Prevention</i> (under review).	Yes
Mokhtarimousavi, S., Anderson, J.C., Azizinamini, A., Hadi, M., "A Temporal Investigation of Crash Severity in Worker-Involved Work Zone Crashes: Investigating the Contributing Factors, Logistic Regression and Machine Learning Approaches," Submitted for publication in <i>Journal of Transportation Research Interdisciplinary Perspectives</i> (under review).	Yes
Mokhtarimousavi, S., Hadi, M., Sadeghvaziri E., Azizinamini, A., "Evolutionary Training Approaches for Machine Learning Models for Analyzing Classification Imbalanced Crash Datasets," Submitted to be presented at the 100th Annual Meeting of the Transportation Research Board and considered for publication at the <i>Transportation Research Record: Journal of the Transportation Research Board</i> , 2021 (under review).	Yes

2.1.2 Journal Articles Published (TT Plan Output)

Citation for Article	Peer-Reviewed?
Author(s). "Article Title". <i>Journal Title</i> , vol., pp, date.	Yes or No
Sadeghnejad, Amir, Sheharyar Rehmat, Islam M. Mantawy, and Atorod Azizinamini. "Comparative Study of Cyclic and Shake Table Tests for Simple for Dead Load and Continuous for Live Load Steel Bridge System in Seismic Area." <i>Transportation Research Record</i> (2020): 0361198120921853.	Yes
Valikhani, Alireza, Azadeh Jaber Jahromi, Samira Pouyanfar, Islam M. Mantawy, and Atorod Azizinamini. "Machine learning and image processing approaches for estimating concrete surface roughness using basic cameras." <i>Computer-Aided Civil and Infrastructure Engineering</i> (2020).	Yes
Valikhani, Alireza, Azadeh Jaber Jahromi, Islam M. Mantawy, and Atorod Azizinamini. "Numerical Modelling of Concrete-to-UHPC Bond Strength." <i>Materials</i> , 13, no. 6 (2020): 1379.	Yes
Ghaffary, A., M.A. Moustafa, (2020). "Synthesis of Repair Materials and Methods for Reinforced Concrete and Prestressed Bridge Girders", <i>Materials</i> , 13 (18), 4079	Yes

2.1.3 Meeting/Conference Presentations/Posters Made By key researchers & Students (TT Plan Output)

Meeting / Conference Name	Citation for Presentation
Meeting/Conference name, location, mo/yr	Author(s). "Presentation Title"
ABC-UTC Webinar, online, July 2020	Azizinamini, Atorod,. Brazilian Engineering Institute Webinar: "Use of UHPC in North American Bridges"
2019-Research Day 1 April 27, 2020 (Online)	19 key researchers presented. Click on link below for list and topics/projects: https://abc-utc.fiu.edu/mc-events/2020-research-day-1/?mc_id=539
ABC-UTC Research Seminar, online, April 30, 2020	Harvey, P.S., Sivakumaran, S., & Muraleetharan, K.K. "Rapid Retrofitting Techniques for Induced Earthquakes – Phase I"
AASHTO Committee on Bridges and Structures, online, June 2020	Freeseaman, Katelyn., General session and committee meeting attendee, discussion included: Missouri DOT Bridge Slide Project overview, Penn DOT SPMT Bridge Move, and an in-depth look at the AASHTO Guide Specifications for ABC and associated Training Development.
AISC TC 5, July 2020	Lehman, Dawn, Committee member: discussion of reinforcement requirements for CFST

2.1.4 Conference Proceedings (TT Plan Output)

Citation for Conference Proceedings	Peer-Reviewed?
Author(s). "Article Title". <i>Conference proceedings</i> , year, pp.	Yes or No
Rahman, M.A., Zaman, M., Gerard, B., Shawn, J., Ali, S.A., and Hobson, K.R. "Application of Intelligent Compaction (IC) as a Quality Control Tool: Oklahoma Experience." <i>Proceedings of the 16th International Conference of IACMAG</i> , Torino, Italy, will be held on May 5-8, 2021 (Accepted).	Yes
Ghos, S., Ali, S. A., Zaman, M., and Hobson, K. R. "Sensitivity of Pavement MED Input Parameters for Characterization of Cracking in Pavements in Oklahoma". <i>In Proceeding of International Conference on Transportation and Development</i> , Reston, VA: American Society of Civil Engineers, 2020, pp. 296-307.	Yes
Mokhtarimousavi, S., Atorod Azizinamini, and Mohammed Hadi. "Severity of Worker-Involved Work Zone Crashes: A Study of Contributing Factors." <i>In International Conference on Transportation and Development 2020</i> , pp. 47-59. Reston, VA: American Society of Civil Engineers, 2020.	Yes
Mokhtarimousavi, S., Azizinamini, A., Hadi, M., "Severity of Worker-Involved Work Zone Crashes: A Study of Contributing Factors," <i>In Proceeding of International Conference on Transportation & Development</i> , Seattle, Washington, May 2020, American Society of Civil Engineers, 47-59.	Yes

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

ABC-UTC Website (<https://abc-utc.fiu.edu/>): The ABC-UTC website will continue to be updated on an ongoing basis.

All social media outlets have been created and are updated on an ongoing basis, such as:

- Twitter
- Facebook:
- Instagram
- YouTube
- LinkedIn

2.3 TECHNOLOGIES OR TECHNIQUES

We have initiated joint projects with all partner universities to develop a non-proprietary UHPC mix that will be available at the end of the year, promising low cost and availability to all users.

2.4 INVENTIONS, PATENT APPLICATIONS, AND/OR LICENSES

- Azizinamini, Atorod., "Modular railing for on-site construction." U.S. Patent Application 16/263,163, filed August 22, 2019.
- We have initiated preliminary work to develop the next frontier in bridge engineering, specifically the application of automation in bridge construction inspection with an emphasis on accelerated field procedures.

2.5 OTHER PRODUCTS

Nothing to report.

3. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS: Who has been involved?

3.1 WHAT ORGANIZATIONS HAVE BEEN INVOLVED AS PARTNERS?

- Atorod Azizinamini, Florida International University
- Ahmad Itani, University of Nevada, Reno
- Mohamed A. Moustafa, University of Nevada, Reno
- Terry Wipf, Iowa State University
- Brent Pahres, Iowa State University
- John Stanton, University of Washington
- Musharraf Zaman, The University of Oklahoma University

3.2 HAVE OTHER COLLABORATORS OR CONTACTS BEEN INVOLVED?

The ABC-UTC has an Advisory Committee that provides recommendations on ABC-UTC operations. The ABC-UTC also has advisory boards that provide recommendations under each of its focus areas of Research, Workforce Development, and Technology Transfer. Additionally, advisory panels and committees make recommendations on specific projects or activities.

4. IMPACT: What is the impact of the program? How has it contributed to transportation, education, research, and technology transfer?

4.1 WHAT IS THE IMPACT ON THE DEVELOPMENT OF THE PRINCIPAL DISCIPLINE(S) OF THE PROGRAM?

The ABC-UTC is now recognized as the focal point at the national level for acquiring the entire spectrum of information in ABC area. The USDOT's support of ABC-UTC and having a Tier-1 UTC devoted to ABC has created extremely impactful activities at the national and international level and State DOTs and AASHTO look to ABC-UTC when it comes to ABC. The State DOTs, AASHTO and other bridge owners have come to

recognize the ABC-UTC as a credible source to get educated and acquire latest information about ABC. The ABC-UTC is taking a national lead in the ABC area and continues to have an excellent working relationship with FHWA and AASHTO T-4 that is responsible for developing the national roadmap for State DOTs for implementing ABC. The Director of ABC-UTC was also elected to be a liaison between the TRB ABC committee and ABC-UTC. These connections and activities are allowing ABC-UTC to better fill the knowledge gap, especially in the research and workforce development areas. ABC-UTC has also made major accomplishments in developing a close working relationship with State DOTs. Twenty-six state DOTs Co-sponsored the 2014 National ABC Conference, thirty State DOTs co-sponsored the 2015 National ABC Conference, 32 state DOTs co-sponsored the 2017 National ABC Conference and 30 state DOTs, FHWA and TRB have co-sponsored the 2019 International ABC Conference Including Automation, Service Life and UHPC which was held in December of 2019 at the Hyatt Regency Hotel in Miami, FL. The State DOT engineers of sponsoring State DOTs work very closely with the ABC-UTC director to develop the conference program. The connection created with State DOT bridge engineers will greatly facilitate the implementation of ABC-UTC work.

4.2 WHAT IS THE IMPACT ON OTHER DISCIPLINES?

ABC-UTC has identified research areas that will help the ABC cause and that falls outside the mission of ABC-UTC. Bridge engineering is a multi-disciplinary field and ABC-UTC research activities are having an influence on several other disciplines, such as robotics, automation, computer science and development of the new field in damage assessment that is related to service life design of bridges.

4.3 WHAT IS THE IMPACT ON PHYSICAL, INSTITUTIONAL, AND INFORMATION RESOURCES AT THE UNIVERSITY OR OTHER PARTNER INSTITUTIONS?

As a direct result of having USDOT's support for ABC-UTC at FIU, FIU has provided several faculty lines to the Civil and Environmental Engineering Department. These additional new faculties are allowing to diversify the scope of research mission and conduct high-quality, multi-disciplinary research. Similar to FIU, other partner universities are also receiving many new resources that otherwise would not be provided to the group. As an example, Alumni and state are helping FIU to build a state of the testing facility capable of testing a very large bridge segment.

4.4 WHAT IS THE IMPACT ON TECHNOLOGY TRANSFER?

ABC technologies are increasingly being specified on bridge replacement projects as state DOTs and other bridge owners and their partners gain understanding and expertise in ABC. The ABC knowledge is expanding in part due to the large numbers of participants in the ABC-UTC conferences and the various ABC-UTC web activities, in addition to stakeholders' use of resources on the ABC-UTC website. Also, the close involvement of state DOT, FHWA, and industry partners in the ABC-UTC's Advisory Committee, Research Advisory Board, Workforce Development Advisory Board, and Technology

Transfer Advisory Board is providing the exposure needed to understand the benefits of implementing ABC in their projects.

4.5 WHAT IS THE IMPACT ON SOCIETY BEYOND SCIENCE AND TECHNOLOGY?

Increasing safety, enhancing mobility, being environmentally responsible, building bridges that are resilient and sustainable are important consequences of using ABC. The major goal of ABC-UTC is to make ABC the method of choice for bridge replacement and retrofit and in future to call it BC. This, in turn, will improve mobility and save society in many different ways. One of the most important contributions of ABC to society is reducing the number of accidents and therefore significantly enhancing safety. A single accident could cost taxpayers millions in litigation and legal expenses. ABC is the future of bridge engineering and FHWA is very actively promoting ABC. Thanks to USDOT to dedicate a Tier-1 UTC to this very timely area. We are hearing many comments from our stakeholders, indicating that they are looking at ABC-UTC, its web site, research products, webinars, and conferences, as a single point where they can go to get an answer to their questions. We are expanding our activities on a daily basis and adjusting our activities based on feedback we are receiving from stakeholders, to better achieve our mission and goals and fulfill what we promised in our proposal.

5. CHANGES/PROBLEMS

5.1 CHANGES IN APPROACH AND REASONS FOR CHANGE

Nothing to report.

5.2 ACTUAL OR ANTICIPATED PROBLEMS OR DELAYS AND ACTIONS OR PLANS TO RESOLVE THEM.

In mid-March 2020, because of COVID-19, for about three months the experimental research activities were interrupted and was reduced in scope. From June 2020, the activities in the laboratories were slowly resumed and at the present time we are almost to full operation. During this period, all other tasks, including conducting numerical and analytical investigations, technology transfer activities and anything that could be done remotely are progressing and have increased.

5.3 CHANGES THAT HAVE A SIGNIFICANT IMPACT ON EXPENDITURES

Nothing to report.

5.4 SIGNIFICANT CHANGES IN USE OR CARE OF HUMAN SUBJECTS, VERTEBRATE ANIMALS, AND/OR BIOHAZARDS

Nothing to report.

5.5 CHANGE OF PRIMARY PERFORMANCE SITE LOCATION FROM THAT ORIGINALLY PROPOSED

Nothing to report.

6. Additional information regarding Products and Impacts

Nothing to report.