

INSPECTION AND QA/QC FOR ABC PROJECTS

**Quarterly Progress Report
For the period ending November 30th, 2018**

Submitted by:
PI- Katelyn Freeseaman, Brent Phares

**Affiliation: Department of Civil, Construction and Environmental Engineering, Iowa State
University**



**ACCELERATED BRIDGE CONSTRUCTION
UNIVERSITY TRANSPORTATION CENTER**

Submitted to:
ABC-UTC
Florida International University
Miami, FL

1. Background and Introduction

The application of ABC techniques has significantly increased in recent history as familiarity and confidence in the construction methods have grown. While the main benefit of ABC projects is a reduction in closure times and associated user costs, an added benefit is the increased quality of prefabricated bridge elements. However, these elements can only perform as expected if the quality and performance of the cast-in-place, field constructed joints/connections are of the same caliber. There is a general lack of existing research and knowledge regarding inspection of joint quality and performance prior to opening to traffic, despite the critical importance of these bridge elements. The proposed project will evaluate the capabilities of existing nondestructive testing technologies that could be used for inspection and QA/QC purposes. The applicability of these technologies could then be considered for ABC purposes, such as the determination of bond and joint strength between pre-formed deck panels and the cast-in-place joint strips. The applications to be explored will be based upon the literature review findings and the limitations associated with each method. Based upon the results of this review, the most promising technologies would then be proposed for utilization in a subsequent field and laboratory study and, where possible, begin the development of recommendations for inspecting ABC connections. Future research could include the testing of deck joints of existing ABC bridges in Iowa, as well as the laboratory casting of sample connection strips to allow for early-age behavior to be investigated. Depending upon the technologies used, the end result of this and subsequent studies would be recommendations for inspections and quality control standards for deck joints on ABC bridges prior to opening. These recommendations could also include required closure time after the pouring of connections based upon joint strength and bond conditions.

This research project directly contributes to the expansion of the use of ABC in practice. The creation of inspection and QA/QC guidelines for ABC projects is critical to uphold confidence in the long-term performance of completed projects. Moreover, these principals can be applied to new construction projects in order to ensure that quality infrastructural specimens are being constructed so that performance and service life expectations can be met. These steps will improve the confidence of the public and design authorities in the quality and safety of advanced construction projects.

2. Problem Statement

The effectiveness of cast-in-place joints and other connections are of critical importance for ABC projects. While high strength materials are being used for these in-field connections, there is a general lack of existing research regarding inspection of joint quality and performance prior to opening to traffic. While these joints are intended to be constructed quickly, poor quality performance/construction will be detrimental to the equally important longevity of construction. The proposed project will evaluate the capabilities of existing nondestructive testing technologies that could be used to determine bond and joint strength between pre-formed deck panels and the cast-in-place joint strips. The results of the information collection will be used to: (1) develop recommendations for inspecting ABC connections and (2) define additional research needs related to ABC inspection and will likely include laboratory studies on ABC elements and field investigation of existing ABC structures.

3. Research Approach and Methods

This research project will consist of an in-depth and exhaustive review of all technologies and methods available for the inspection of concrete structures. A better understanding of the existing technologies, and their successful applications, will allow for any future work to be defined in order to set guidelines on inspection and monitoring methods.

4. Description of Research Project Tasks

The following is a description of tasks carried out to date.

Task 1 – Literature Review

To prepare the current proposal, the research team has conducted a preliminary review of relevant studies and projects completed to date in the United States and beyond. As the main task of this project, the research team will compile all related information available in journals, conference proceedings, and technical reports in a concise and comprehensive summary. Known possible technologies to consider would include ultrasonic linear array, ground penetrating radar, x-ray, and ultrasonic pulse velocity, looking at both shear and longitudinal wave velocities. These technologies will yield varying outputs and results, including but not limited to modulus values and reconstruction images. The main objective of this task is to obtain an exhaustive understanding of the existing technologies and methods for inspection and nondestructive practices for concrete component applications.

The literature review is underway, and a field demonstration of airborne GPR technology was conducted in early November. This work was done in collaboration with Dr. Michael Scott of ADOJAM, LLC. Data was collected and the field capabilities of the device were seen. Some preliminary data processing was presented, and further refinement of the data was suggested to determine capabilities. A draft literature review is complete.

Task 2 – Applications for ABC

The findings from Task 1 will be reviewed to determine the most promising technologies and methods for the inspection and QA/QC of ABC bridges. These technologies will likely have been used for purposes other than accelerated construction practices, and thus the purpose of this task is to determine the applicability of the findings of Task 1 for ABC implementation. For instance, some methods may have access requirements and/or limitations which may make them inapplicable for bridge deck joint applications. This task will reduce the general list of inspection and nondestructive testing methods to those which are deemed valuable for future work in the ABC field.

Work is currently underway to review the literature search results and to determine viable technologies for ABC applications. This is summarized in the draft final report, which was

submitted to the TAC at the beginning of this quarter. The most promising technologies appear to be ultrasound, infrared thermography and ground penetrating radar.

Task 3- Final Report

A detailed final report will be prepared to document the project findings. In addition and where needed, experimental and laboratory tests which apply the most promising technologies will be proposed for future work.

A draft final report was submitted to the TAC this quarter. Comments were received and will be addressed next quarter, along with submission of the final report.

5. Expected Results and Specific Deliverables

The primary deliverable will be a comprehensive summary of existing technologies and methods that can be applied for QA/QC and inspection purposes on ABC projects. This work will also result in a description of additional research efforts that will be proposed for field implementation and laboratory testing.

6. Schedule

Progress of tasks in this project is shown in the table below.

Research Task	2017			2018								
	10	11	12	1	2	3	4	5	6	7	8	9
Task 1 – Literature Review	■	■	■	■	■							
Task 2 – Applications for ABC					■	■	■	■	■			
Task 3 – Final Report									■	■	■	■