<table>
<tr><td colspan="5">Technical Report Documentation Page</td></tr>
<tr><td colspan="2">1. Report No.</td><td colspan="2">2. Government Accession No.</td><td>3. Recipient’s Catalog No.</td></tr>
<tr><td colspan="2">ABC-UTC-FIU-2016-C5-FIU03</td><td colspan="2"></td><td></td></tr>
<tr><td colspan="3">4. Title and Subtitle</td><td colspan="2">5. Report Date</td></tr>
<tr><td colspan="3" rowspan="3">Development of Accelerated Bridge Construction Handbook (ABC Handbook)</td><td colspan="2">February, 2025</td></tr>
<tr><td colspan="2">6. Performing Organization Code</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="3">7. Author(s)</td><td colspan="2">8. Performing Organization Report No.</td></tr>
<tr><td colspan="3">Atorod Azizinamini, Bijan Khaleghi, Mary Lou Ralls Newman, Kingsley Lau, Ali Ebrahimian, Aaron Yakel, Anil Misra, Ankitha Arvan, Mark Finlayson</td><td colspan="2"></td></tr>
<tr><td colspan="3">9. Performing Organization Name and Address</td><td colspan="2">10. Work Unit No. (TRAIS)</td></tr>
<tr><td colspan="3" rowspan="3">(Example:)
Department of Civil and Environmental Engineering
Florida International University
10555 West Flagler Street, EC 3680
Miami, FL 33174</td><td colspan="2"></td></tr>
<tr><td colspan="2">11. Contract or Grant No.</td></tr>
<tr><td colspan="2">Enter the correct number:
69A3551747121</td></tr>
<tr><td colspan="3">12. Sponsoring Organization Name and Address</td><td colspan="2">13. Type of Report and Period Covered</td></tr>
<tr><td rowspan="3">Accelerated Bridge Construction University Transportation Center
Florida International University
10555 W. Flagler Street, EC 3680
Miami, FL 33174</td><td colspan="2" rowspan="3">US Department of Transportation
Office of the Assistant Secretary for Research and Technology
And Federal Highway Administration
1200 New Jersey Avenue, SE
Washington, DC 201590</td><td colspan="2">Final Report (June 2022 – February 2025)</td></tr>
<tr><td colspan="2">14. Sponsoring Agency Code</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="5">15. Supplementary Notes</td></tr>
<tr><td colspan="5">Visit www.abc-utc.fiu.edu for other ABC reports.</td></tr>
<tr><td colspan="5">16. Abstract
The proposed study takes advantage of a tremendous number of activities that Accelerated Bridge Construction-University Transportation Center (ABC-UTC) have had over years in ABC area and provides the professionals with a handbook that is perhaps the most comprehensive document for ABC. This report results in the most comprehensive document in the U.S. and devoted to ABC, developing, collecting and referencing current and existing ABC knowledge and providing bridge professionals with one document that they can start with to get an answer to their questions. Besides the PI and Co-PIs, several practicing bridge engineers are also involved in development of chapters. There are several state-of-the-art publications in the area of Accelerated Bridge Construction for different topics and ABC area in addition to the LRFD Guide Specification for Accelerated Bridge Construction. The proposed Handbook refers to other documents and pays great attention to the existing resources developed by different AASHTO committee to use the same terms and terminologies.</td></tr>
<tr><td colspan="3">17. Key Words</td><td colspan="2">18. Distribution Statement</td></tr>
<tr><td colspan="3"></td><td colspan="2">No restrictions.</td></tr>
<tr><td>19. Security Classification (of this report)</td><td>20. Security Classification (of this page)</td><td>21. No. of Pages</td><td colspan="2">22. Price</td></tr>
<tr><td>Unclassified.</td><td>Unclassified.</td><td></td><td colspan="2"></td></tr>
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Development of Accelerated Bridge Construction Handbook (ABC Handbook)

Final Report

February, 2025

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Co-Principal Investigators: Dr. Bijan Khaleghi, Mary Lou Ralls Newman, Dr. Kingsley Lau, Dr. Ali Ebrahimian, Dr. Aaron Yakel, Dr. Anil Misra, Dr. Ankitha Arvan, Dr. Mark Finlayson

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Sponsored by
Accelerated Bridge Construction University Transportation Center

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The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the information presented herein. This document is disseminated in the interest of information exchange. The report is funded, partially or entirely, by a grant from the U.S. Department of Transportation's University Transportation Program. However, the U.S. Government assumes no liability for the contents or use thereof.

ACKNOWLEDGMENTS

This project was supported by the Accelerated Bridge Construction University Transportation Center (ABC-UTC at www.abc-utc.fiu.edu) at Florida International University (FIU), as lead institution, Iowa State University (ISU), Oklahoma University (OU), University of Washington (UW) and the University of Nevada-Reno (UNR) as partner institutions. The authors would like to acknowledge the ABC-UTC support.

The author would like to extend special appreciation to the ABC-UTC and the U.S. Department of Transportation Office of the Assistant Secretary for Research and Technology for funding this project.

The author would like to thank all the State DOTs that participated in the survey; this work would not have been possible without their participation.

The author would like to thank the Research Advisory Panel members: Bijan Khaleghi (Washington State DOT), Bruce Johnson (Former State Bridge Engineer, Oregon). Elmer Marx (Alaska DOT&PF), Tom Ostrom (California DOT), and William Oliva (Wisconsin DOT).

Disclaimer: Due to the availability of vast information on the topics of accelerated bridge construction and a need for proper synthesis, the drafting of the handbook is underway and will be published for readers very soon, mostly within the next six months. The present report includes an executive summary in form of a final report providing an overview of the chapters and the topics that are being developed. Please contact Dr. Atorod Azizinamini at aazizina@fiu.edu for further information regarding the availability of the handbook.

Executive Summary

The proposed research study takes advantage of a tremendous number of activities that Accelerated Bridge Construction-University Transportation Center (ABC-UTC) have had over years in ABC area and provides the professionals with a handbook that is perhaps the most comprehensive document for ABC. This report results in the most comprehensive document in the U.S. and devoted to ABC, developing, collecting and referencing current and existing ABC knowledge and providing bridge professionals with one document that they can start with to get an answer to their questions. Besides the PI and Co-PIs, several practicing bridge engineers are also involved in development of chapters. There are several state-of-the-art publications in the area of Accelerated Bridge Construction for different topics and ABC area in addition to the LRFD Guide Specification for Accelerated Bridge Construction. The proposed Handbook refers to other documents and pays great attention to the existing resources developed by different AASHTO committee to use the same terms and terminologies.

A brief overview of the chapters and corresponding authors is presented below:

Chapter 1 - Introduction to ABC

a. What is ABC

b. Past, present and future of ABC

Author: Mary Lou Ralls Newman

In this chapter, introduction of ABC will be presented including prefabricated bridge elements and systems (PBES), lateral slide, and self-propelled modular transport (SPMTs). In addition, the past, current, and future directions of ABC will be provided. The chapter will provide information to engineers with no ABC experience to help them navigate the handbook.

Chapter 2- Definitions

Author: Mary Lou Ralls Newman

In this chapter, all definitions, abbreviations and acronyms related to ABC will be listed. The chapter will use the same language used by FHWA and bridge community related to ABC. The authors will pay great attention to the existing resources developed by different AASHTO committees, FHWA, and other DOTs advancing ABC and will use the same terms and terminologies.

Chapter 3– Decision Tools

Authors: Dr. Ali Ebrahimian and Dr. Islam Mantawy

In this chapter, different decision-making tools will be reviewed and collected. Decision-making tools developed by FHWA, Utah DOT, Wisconsin DOT, and Connecticut DOT, among others, will be explained in detail.

Chapter 4– ABC Construction Techniques and Equipment

Author: Dr. Islam Mantawy

In this chapter, different equipment and machinery used in ABC for heavy lift and transportation of bridge elements or systems including slide-in bridge construction (SIBC) lateral slide and SPMTs will be presented. Design examples will be included in Chapter 15 for case studies of the use of SPMT and SIBC to move a bridge and details of the method used and challenges in execution.

Chapter 5- Overview of AASHTO ABC Guide Specification

Author: Dr. Atorod Azizinamini

In this chapter, an overview of the recently published AASHTO- LRFD Guide Specifications for ABC will be presented. This chapter will refer to the guide and will help the readers navigate through the guide.

Chapter 6– Ultra-high Performance Concrete (UHPC)

Author: Dr. Atorod Azizinamini

In this chapter, comprehensive information about ultra-high performance concrete as advanced material will be reviewed and collected. Different mixes and test results especially durability testing will be reported. In addition, research results and field implementation of UHPC will be presented.

Chapter 7- Durability

Author: Dr. Kingsley Lau

In this chapter, the long-term durability characteristics of concrete materials will be presented. A comprehensive review of the corrosion of steel rebar in reinforced concrete, corrosion of prestressed concrete, corrosion durability implications of UHPC, corrosion of submerged steel piles and corrosion of atmospherically exposed steel will be presented. The chapter focuses on sustainability of the constructed environment through consciousness of materials durability to balance the need for economic development, societal demands, stewardship of our natural resources, and mitigating the impacts of the climate.

Chapter 8- ABC Steel Superstructure

Author: Dr. Aaron Yakel

In this chapter, design and construction considerations for ABC steel superstructure systems will be reviewed and collected. This chapter will include a list of the most promising ABC steel superstructure systems and methods of selection of ABC steel superstructure systems.

Chapter 9- ABC Concrete Superstructure

Authors: Dr. Bijan Khaleghi and Dr. Ankitha Arvan

In this chapter, design and construction considerations for ABC concrete superstructure systems will be reviewed and collected. This chapter will include the materials adopted for concrete superstructure systems and provides information on the precast girder bridge types, spliced-girder structural systems, precast concrete decks and deck panels and rail bridges. The chapter is also accompanied by several design examples.

Chapter 10– ABC Substructure

Authors: Dr. Anil Mirsa and Dr. Ankitha Arvan

In this chapter, design and construction considerations for ABC substructure systems will be reviewed and collected. This chapter will include a list of the most promising ABC substructure systems and methods of selection of ABC substructure systems. The chapter will focus on geotechnical considerations for ABC projects such as foundation re-use, micro piles, and other advancements in soil-structure interactions.

Chapter 11– ABC Seismic and non-seismic Systems and Connections

Authors: Dr. Bijan Khaleghi and Dr. Ankitha Arvan

In this chapter, different ABC connections for non-seismic and seismic applications will be collected and presented including bridge deck closure joints, joints for precast link slabs, superstructure diaphragm, socket connections, pocket connections, among others. Most of the recent applications of ABC in the U.S. are non-seismic applications even though significant research was/is being conducted for innovative ABC systems for seismic regions. There is also field implementation of ABC systems in New Zealand and other countries. This chapter seeks to collect the most promising ABC systems for seismic regions from research to field implementation.

Chapter 12– Additive Manufacturing (3D Printing)

Authors: Dr. Atorod Azizinamini, Dr. Faheem Afzal, Dr. Ali Javed and Dr. Ankitha Arvan

As an emerging technology, additive manufacturing (3D printing) has the potential to reshape the construction industry. Even though most of the advancements and field implementation of 3D-printing in housing and building industries, it has futuristic potential in bridge construction. This chapter will cover recent research activities in the US related to 3D-printing of structural elements in bridge construction.

Chapter 13 – Accelerated Repair and Upgrade

Authors: Dr. Islam Mantawy and Dr. Atorod Azizinamini

In this chapter, all available accelerated repair and upgrade techniques will be collected and synthetized. This chapter will include the accelerated repair and upgrade techniques for

superstructures and substructures. Examples for accelerated repair and upgrade will be part of Chapter 15.

Chapter 14 – Available Resources

Author: Dr. Islam Mantawy

In this chapter, all available resources related to ABC such as ABC-UTC website, state DOT websites, and FHWA will be collected and listed to provide the readers will additional information if needed.

Chapter 15 - Design Examples

Author: Dr. Atorod Azizinamini

In this chapter, design examples will be developed for all topics mentioned from Chapters 3 through Chapter 12. The design examples will be based on actual case studies of actual ABC projects.

Chapter 16- International Trends

Author: Dr. Atorod Azizinamini

In this chapter, most recent international advancements and trends in ABC area will be reported to guide the reader to the state of ABC outside the U.S.

Chapter 17 – Artificial Intelligence

Author: Dr. Mark Finlayson

In this chapter, the latest advancements in artificial intelligence will be collected and reviewed. The application of these methodologies to accelerated bridge construction techniques will be reviewed and comprehensive information of their use will be reported.