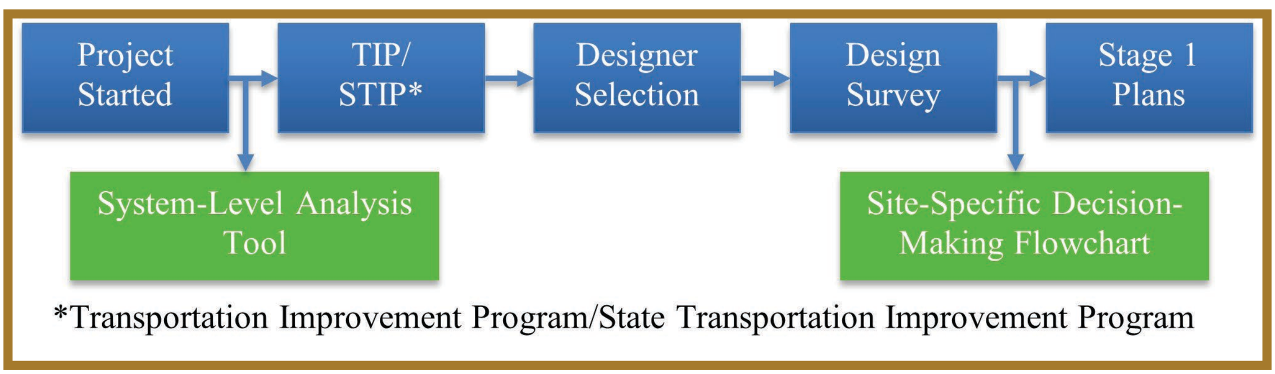
JOINT TRANSPORTATION
RESEARCH PROGRAM
INDIANA DEPARTMENT OF TRANSPORTATION
AND PURDUE UNIVERSITY

Advancing Accelerated Bridge Construction and Fabrication in Indiana



Camila N. Duarte and Ashley P. Thrall

SPR-4843 • Report Number: FHWA/IN/JTRP-2025/12 • DOI: 10.5703/1288284317858

RECOMMENDED CITATION

Duarte, C. N., & Thrall, A. P. (2025). *Advancing accelerated bridge construction and fabrication in Indiana* (Joint Transportation Research Program Publication No. FHWA/IN/JTRP-2025/12). West Lafayette, IN: Purdue University. https://doi.org/10.5703/1288284317858

AUTHORS

Camila N. Duarte
Graduate Student
Department of Civil & Environmental Engineering & Earth Sciences
University of Notre Dame

Ashley P. Thrall
Myron and Rosemary Noble Associate Professor of Structural Engineering
Department of Civil & Environmental Engineering & Earth Sciences
University of Notre Dame
(574) 631-2533
athrall@nd.edu
Corresponding Author

ACKNOWLEDGMENTS

This work was supported by the Joint Transportation Research Program administered by the Indiana Department of Transportation (INDOT) and Purdue University. The support of Business Owner Stephanie Wagner; Project Advisor Prince Baah; and Study Advisory Committee Members Joshua Heigert, Jim Lesh, Patrick Patterson, Adam Post, Donald Shaw, Seth Schickel, and Tyler Wolf is appreciated. The authors are grateful to all individuals who participated in the interview process. The authors also appreciate the contributions of graduate student James (Luke) Linder.

JOINT TRANSPORTATION RESEARCH PROGRAM

The Joint Transportation Research Program serves as a vehicle for INDOT collaboration with higher education institutions and industry in Indiana to facilitate innovation that results in continuous improvement in the planning, design, construction, operation, management and economic efficiency of the Indiana transportation infrastructure. https://engineering.purdue.edu/JTRP.

Published reports of the Joint Transportation Research Program are available at https://docs.lib.purdue.edu/jtrp/.

NOTICE

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA/IN/JTRP-2025/12		

4. Title and Subtitle Advancing accelerated bridge construction and fabrication in Indiana	**5. Report Date** May 8, 2025 **6. Performing Organization Code**
7. Author(s) Camila N. Duarte Ashley P. Thrall https://orcid.org/0000-0002-4026-3847	**8. Performing Organization Report No.** FHWA/IN/JTRP-2025/12
9. Performing Organization Name and Address Joint Transportation Research Program Hall for Discovery and Learning Research (DLR), Suite 204 207 S. Martin Jischke Drive West Lafayette, IN 47907	**10. Work Unit No.** **11. Contract or Grant No.** SPR-4843
12. Sponsoring Agency Name and Address Indiana Department of Transportation (SPR) State Office Building 100 North Senate Avenue Indianapolis, IN 46204	**13. Type of Report and Period Covered** Final Report **14. Sponsoring Agency Code**

15. Supplementary Notes

Conducted in cooperation with the U.S. Department of Transportation, Federal Highway Administration.

16. Abstract

The aim of this research was to increase the use of the accelerated bridge construction (ABC) and accelerated bridge fabrication (ABF) in Indiana. Specific research objectives included: (1) understand barriers to implementing ABC and evaluate ABF capabilities in Indiana, (2) investigate the benefits and limits of various ABC/ABF strategies specific to Indiana, and (3) develop guidelines and recommendations for implementing ABC/ABF in Indiana. The focus was on the scoping stage, with the goal of triggering which projects are candidates for ABC or ABF early in the process. Research culminated in (1) a system-level analysis tool that scores all bridges in the Indiana bridge inventory according to their potential for ABC and (2) a site-specific decision-making flowchart to be used at an early stage of design for a specific bridge.

17. Key Words	18. Distribution Statement
accelerated bridge construction, rapid fabrication	No restrictions. This document is available through the National Technical Information Service, Springfield, VA 22161.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	54, including appendices	

From DOT F 1700.7 (8-72) Reproduction of completed page authorized

EXECUTIVE SUMMARY

Introduction

The aim of this research was to increase the use of accelerated bridge construction (ABC) and accelerated bridge fabrication (ABF) in Indiana. Specific research objectives included: (1) understand barriers to implementing ABC and evaluate ABF capabilities in Indiana, (2) investigate the benefits and limits of various ABC/ABF strategies specific to Indiana, and (3) develop guidelines and recommendations for implementing ABC/ABF in Indiana.

The focus was on the scoping stage with the goal of triggering which projects are potential candidates for ABC or ABF early in the process. Early triggering of projects is particularly important for a traditional design-bid-build (DBB) contract where the development of an ABC design would likely require extra time. The intent was not to create a tool with a binary answer for whether a project should use ABC or not. Rather, the intent was to identify potential ABC projects earlier and provide tools to those involved throughout the process to make site-specific decisions. This is particularly important given that the higher initial cost of ABC is a major barrier to its broader use in Indiana. The tools developed in this research can help identify projects where the benefits of ABC can justify that added cost.

Research tasks included: (1) reviewing and synthesizing existing guidelines and recommendations for the use of ABC from the Federal Highway Administration (FHWA) and other departments of transportation (DOT), (2) interviewing key stakeholders in Indiana to understand existing challenges to using ABC/ABF and potential opportunities, and (3) investigating and developing methods for evaluating bridges at a system level and a site-specific level for the potential use of ABC.

Findings

Findings from synthesizing existing guidelines and recommendations:

- Existing documents on ABC from the FHWA and DOTs across the country were reviewed and categorized as (1) manuals, (2) decision-making tools, or (3) other resources.
- Utah and Connecticut DOTs' decision-making tools, while state specific, offered starting points for the system-level analysis developed in this research.
- For prestressed concrete girder bridges, ABF documentation included design manuals from the Precast/Prestressed Concrete Institute (PCI) and standardized girder sections. For steel girder bridges, ABF practices focused on press-brake formed tub girders and precast decks on steel beams.

Findings from interviewing key stakeholders in Indiana:

- A total of 24 stakeholders were interviewed, including designers, fabricators, contractors, asset managers, district directors, construction inspectors, load raters, and others.
- Major recommendations from the interviews included:
  – Clarify Indiana DOT (INDOT) expectations and goals for ABC/ABF;
  – Focus on prefabricated bridge elements and systems as method for ABC;
  – Improve communication between designers, fabricators, and contractors at the scoping stage;
  – Enhance early engagement with the fabricators and contractors during Stage 2 of design by providing detailed designs and information;
  – Standardize components to improve efficiency and reduce costs;
  – Provide clear project definitions and decision-making processes;
  – Incentivize stakeholders to be trained/educated and to participate in ABC/ABF projects.
- Additionally, contractors and fabricators cited communication gaps during traditional design-bid-build (DBB) contracts. INDOT may benefit from enhancing the Stage 2 review process to specifically flag ABC-identified projects, improving early contractor awareness and collaboration.
- As prestressed concrete girders dominate the bridge market in Indiana and there are existing PCI design manuals for their use, the remainder of the project focused only on ABC as opposed to ABF.

Findings from investigating and developing methods for evaluating bridges for ABC:

- Based on discussions with the Study Advisory Committee (SAC), a two-stage approach for evaluating which bridges should be prioritized for ABC was developed, including (1) a system-level analysis tool that scores all bridges in the INDOT inventory and (2) a site-specific decision-making flowchart to be used at an early stage of design for a specific bridge (see further discussion in Implementation).

Implementation

This research has led to two products for INDOT to use to determine if a project should be considered for ABC:

- *System-Level Analysis Tool*: A Python-based computer code has been developed that uses existing data and automatically scores all bridges in the Indiana bridge inventory according to their potential for ABC. The scores are calculated based on available data in the INDOT Total Assets Management Systems (iTAMS) for the following criteria: (1) average daily traffic (ADT), (2) facility carried, (3) geometry, (4) clear roadway, and (5) detour length. The computer code is included in Appendix B. A user manual, included in Appendix C, has been written to facilitate use by INDOT. The computer code will be stored and used internally by INDOT.
- *Site-Specific Decision-Making Flowchart for ABC:* Based on the findings of this research, a set of guidelines and recommendations for using ABC have been developed to further evaluate if ABC should be used for a specific bridge. This flowchart is intended to be used at an early stage in the design process. The flowchart will be made available on the INDOT Bridge Design website.

The intention is that the system-analysis tool could be used periodically (e.g., once per year) to score all bridges in the inventory. Then, during the scoping stage of a bridge project, an INDOT asset manager could consult the scores to determine if a bridge is a strong candidate for ABC early in the process. The site-specific decision-making flowchart for ABC would be used later in the project by the designer (e.g., during early design development).

This research was disseminated through a poster presentation at the Joint Transportation Research Program Poster Session and a master's thesis.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

Bridges are critical components of transportation infrastructure, yet many existing structures are aging and require rehabilitation or replacement. Traditional bridge construction methods often face extended road closures, leading to significant traffic impact and safety risks. Accelerated Bridge Construction (ABC) and Accelerated Bridge Fabrication (ABF) have emerged as promising alternatives to these challenges by reducing onsite construction time through prefabrication, efficient and innovative construction techniques, and optimized project delivery methods (Culmo, 2011).

More specifically, ABC offers major benefits including improved construction time (both onsite construction time and total project delivery time), work zone safety (for the traveling public and construction workers), constructability, and quality, among others (Culmo, 2011). As work zones have been shown to increase the likelihood of accidents and fatalities to the traveling public—with recent research in Indiana indicating a 27.5% increase of accidents when construction is present (Huebschman et al., 2003)—and to construction workers—according to the Federal Highway Administration (FHWA, 2022) traveling vehicles cause 44% of all injuries to bridge construction workers, with two-thirds of these resulting in a fatality—there are major safety benefits in reducing the time of onsite construction.

ABC has various technologies, including foundation/wall elements, rapid embankment construction, prefabricated bridge elements and systems (PBES) and structural placement methods, and fast track contracting (Culmo, 2011). PBES allows structure elements to be fabricated in a controlled environment before being transported and assembled at the bridge site, ensuring greater precision and efficiency. Alternatively, structural placement methods include self-propelled modular transporters (SPMTs) and bridge slide-in. SPMTs use motorized vehicles to transport large structures from offsite locations and place the structures into position, allowing rapid removal and placement of structures with minimal disruption (FHWA, 2018). For slide-in bridge construction, a new superstructure is built adjacent to the existing bridge and then slid into place after the demolition of the existing structure (FHWA, 2013b). This project specifically focuses on PBES and structural placement methods.

In comparison, ABF focuses on the accelerated fabrication of bridge components (e.g., girders) to be used in either conventional construction or ABC approaches, with the overall aim of reducing overall project construction times. For prestressed concrete girder bridges, ABF practices include the use of standardized girder sections, documented through design manuals from the Precast/Prestressed Concrete Institute (PCI), which facilitates rapid production and installation (PCI, 2023). For steel girder bridges, ABF efforts have focused on innovations such as press-brake formed tub girders (Tumbeva et al, 2023, Thrall et al, 2024, Figure 1.1) and rolled steel beams where standardized sections are readily available offering advantages in terms of accelerated project timelines and improved precision. Having access to these components readily available optimizes the fabrication process while enhancing quality control.

Figure 1.1 Built-Up Press Brake-Formed Tub Girders.

While ABC has been successfully implemented in states like Utah and Oregon, where departments of transportation (DOTs) have actively promoted its use and have incorporated detailed recommendations and guidelines in their design manuals through policy incentives and dedicated funding programs (FHWA, 2022), Indiana has yet to establish a structured approach to encourage widespread adoption. Key barriers are higher initial costs, lack of familiarity among contractors with ABC technologies, and lack of standardized guidelines tailored to the state's specific needs (Schickel, 2020).

Despite these challenges, Indiana has recently implemented ABC technologies in projects, such as I-70 over SR 121 and US 52 over Mud Creek bridge replacements. The I-70 project used the slide-in method, where the new bridge was constructed adjacent to the existing structure (in the median). After demolishing the original bridge, the new superstructure was slid into place, significantly reducing traffic disruption (Volk et al., 2019). The second project, US 52 over Mud Creek, used PBES, with precast bridge slabs and precast substructure elements that were connected by ultra-high-performance concrete (UHPC). Both projects showed the feasibility of these ABC methods in Indiana and triggered Indiana Department of Transportation's (INDOT) interest in expanding their use to future projects (Summers, 2022).

Current ABF practices are in the prestressed concrete girder and rolled steel beam spaces where standard sections are readily available. ABF has also been explored through the design and construction of two built-up, press-brake formed tub girder bridges (Tumbeva et al., 2023). However, further advances in quality control and inspection methods, and the exploration of additional fabrication opportunities are needed to maximize the benefits of ABF.

1.1 Problem Statement

Overall, there are existing barriers to implementing ABC and ABF in Indiana, and there is urgent research need to understand and overcome these challenges to harness the benefits of these technologies. Research needs include:

1. While ABC has advanced significantly over the last decade and is widely used in other states, Indiana has only used ABC technologies for a few projects;

2. Capabilities for ABF in Indiana need to be assessed for the bridge industry;
3. Potential benefits of adopting ABC and/or ABF in Indiana include reduced overall project time and cost, as well as improved work zone safety, among others;
4. Currently, ABC projects have high initial cost compared to conventional methods, which indicates a major barrier to widespread adoption in Indiana; and
5. There is no existing research aimed toward understanding the current barriers to using ABC and ABF technologies in Indiana or the opportunities that these technologies can provide.

In accordance with these research needs, this research aimed to increase the use of ABC and ABF in Indiana.

1.2 Objectives

To address these needs, research objectives included:

1. Understand barriers to implementing ABC and evaluate ABF capabilities in Indiana;
2. Investigate the benefits and limits of various ABC/ABF strategies specific to Indiana; and
3. Develop guidelines and recommendations for implementing ABC/ABF in Indiana.

The focus was on the scoping stage with the goal of triggering which projects are candidates for ABC or ABF early in the process. Early triggering of projects is particularly important for a traditional design-bid-build (DBB) contract where the development of an ABC design would likely require extra time.

2. SYNTHESIS OF EXISTING GUIDELINES AND RECOMMENDATIONS

A comprehensive literature review was conducted to identify existing guidelines, case studies, and evaluation criteria related to ABC and ABF. Key resources included publications from the FHWA, the American Association of State Highway and Transportation Officials (AASHTO), and various state DOTs. These resources provide a foundation for understanding the technical, economic, and practical aspects of ABC and ABF.

Figure 2.1 shows the United States map with the states that have developed their own ABC Manual highlighted in red, the states that have a chapter related to ABC in their Bridge Design Manual identified in blue, and the states that have the developed their own decision-making tool or guidelines as hashed. Note that even though some states do not have their own documents on ABC, they may still follow other guidelines developed by FHWA, AASHTO, or another state DOT.

By reviewing these existing resources, this section provides clarification and insights for engineers interested in the technical aspects of ABC and ABF. Figure 2.2 illustrates a timeline of published manuals categorized by ABC guidelines, ABF guidelines, as well as specific content on SPMT and PBES. Notably, there has been a marked increase in publications in 2024, with five new ABC manuals contributing to the growing body of knowledge in this field. Figure 2.3 shows the timeline for decision-making tools developed by the FHWA and different DOTs. In 2024, there were five decision-making tools developed by state DOTs, highlighting the growing need for personalized decision-making processes aligned with each state's current practices.

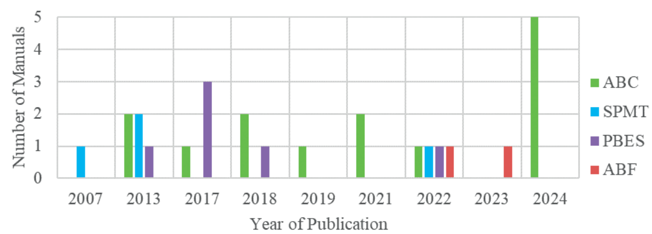


Figure 2.2 Timeline for ABC/ABF Manuals.

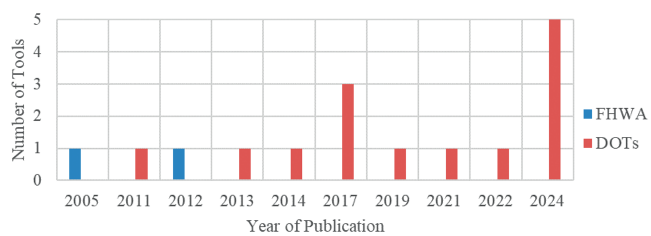


Figure 2.3 Timeline for Decision-Making Tools.

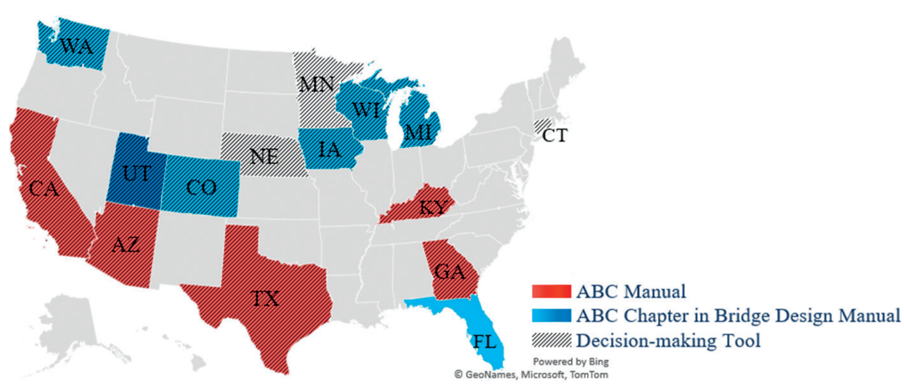


Figure 2.1 Existing ABC Resources Across the U.S.

Based on this literature review, all the content was classified into the following categories: (1) ABC manuals, (2) ABF manuals, (3) decision-making guidelines and tools, and (4) other resources.

2.1 ABC Manuals

The following ABC manuals provide comprehensive guidance across different stages of a project. These resources include design specifications and construction methodologies with detailed information for prefabrication techniques and slide-in construction. The following documents are ordered by specificity, including first the broadest manuals that cover all ABC aspects followed by manuals about specific ABC technologies:

- *Load and Resistance Factor Design (LRFD) Guide Specifications for Accelerated Bridge Construction (AASHTO, 2018)*: These specifications provide comprehensive guidelines on the design, construction, and maintenance of ABC projects. The specifications address key aspects in bridge design, such as ABC definitions, design responsibilities, and design procedures, as well as construction methods, inspection, and maintenance. They also provide detailed procedures for the design of different elements in ABC bridges and cover a wide range of ABC construction methods. In addition, they give valuable guidance on the inspection and maintenance of ABC bridges to ensure long-term serviceability.
- *Structures Design and Detailing Manual (Utah DOT, 2022)*: Chapter 20 of this manual provides comprehensive guidelines for designing and detailing ABC projects. It covers various aspects of ABC construction, including SPMT operations, bridge slide-in, and PBES. The chapter offers design guidance, recommendations, and requirements for ensuring structural integrity, safety, and efficiency in ABC projects. It also discusses planning items, decision making processes, and construction method selection.
- *Structures and Geotechnical Guidance and Manuals (Utah DOT, 2023b)*: This website contains documents that focus on broader structural and geotechnical guidelines. It also presents relevant information on ABC-specific considerations, such as foundation design, material selection, and construction techniques. Besides that, it has an inventory of lessons learned reports for ABC projects and project highlights identified by year.
- *Accelerated Bridge Construction: Experience in Design, Fabrication and Erection of Prefabricated Bridge Elements and Systems* (Culmo, 2011): This FHWA manual provides comprehensive guidance on planning, designing, and implementing ABC projects. It covers a wide range of topics, including project feasibility, design considerations, construction techniques, and maintenance. The manual offers practical advice and tools for owners, engineers, and contractors to effectively utilize ABC methods. It also includes case studies and examples for successful applications of ABC.
- *Contracting and Construction of Accelerated Bridge Construction Projects with Prefabricated Bridge Elements and Systems* (FHWA, 2013a): This manual provides detailed guidance on planning, contracting, and constructing ABC projects using PBES. It considers several stages of the project lifecycle, including pre-bid considerations, contract management, construction scheduling, and quality control. The manual offers practical advice and tools for the project execution.
- *Recommended Guidelines for Prefabricated Bridge Elements and Systems Tolerances and Recommended Guidelines for Dynamic Effects for Bridge Systems* (National Cooperative Highway Research Program Project 12-98) (Culmo, 2017): The document presents the results of two primary studies. The first developed tolerance guidelines for PBES by synthesizing industry practices and analyzing fabrication data. The second study investigated dynamic effects of lateral bridge slides and SPMT bridge moves, conducting full-scale testing to develop design specifications and a dynamic response spectrum. The studies were compiled into two guideline documents presented in the standard AASHTO format—Appendix C: Proposed Guidelines for Prefabricated Bridge Elements and Systems Tolerances and Appendix D: Proposed Guidelines for Dynamic Effects for Bridge Systems.
- *Slide-in Bridge Construction Implementation Guide (FHWA, 2013b)*: This guide addresses information on planning, design, construction, and maintenance of slide-in construction projects. It considers factors that influence its feasibility, outlines design requirements, describes construction techniques, and provides maintenance and inspection recommendations.
- *Manual on Use of Self-Propelled Modular Transporters to Remove and Replace Bridges (FHWA, 2007)*: This manual outlines the process of using SPMTs to remove or install bridges, covering planning, design, transportation, and safety considerations. It includes example calculations, diagrams, and specifications to support project planning and execution. The manual is a valuable resource for understanding SPMT technology and assessing its applicability to specific projects.

2.2 ABF Manuals

The following ABF manuals focus on improving the efficiency of manufacturing and assembling steel and precast bridge components. These guidelines cover advanced fabrication techniques, material selection, and quality requirements to ensure precision and structural integrity. They also address project planning, logistics, and collaboration between stakeholders to minimize construction timelines. Documents focusing on steel are presented first followed by documentation on concrete:

- *Accelerated Steel: Achieving Speed in Steel Bridge Fabrication (American Institute of Steel Construction [AISC], 2022a)*: This document provides comprehensive guidance on accelerating the fabrication process for steel bridges. It emphasizes the importance of collaboration between owners, engineers, and fabricators to streamline the design, fabrication, and construction phases. The guide offers practical tips and strategies for optimizing fabrication activities, such as improving shop layout, utilizing advanced technology, and implementing lean manufacturing principles. It also addresses challenges and potential solutions to ensure efficient and timely delivery of steel bridge components.
- *Steel Bridge Design Handbook, Chapter 17: Bridge Deck Design (AISC, 2022b)*: This handbook includes design and detailing considerations for steel bridges with various deck systems, including concrete deck slabs and metal decks. It presents general recommendations for selecting appropriate deck types, along with construction considerations such as load transfer mechanisms, composite action, and integration with steel girders.
- *Bridge Design Manual (PCI, 2023)*: This manual from PCI provides detailed guidance on the application of AASHTO LRFD Bridge Design Specifications (AASHTO, 2020), as well as best practices for designing precast bridge components such as girders, deck panels, and substructures. The manual also covers

fabrication techniques, quality control measures, and case studies demonstrating the successful implementation of precast bridge systems in ABC projects. This manual serves as a critical reference for optimizing bridge design and construction efficiency while ensuring structural integrity and durability.

- *Guidelines for Precast Substructures used in ABC (PCI, 2022)*: These guidelines from PCI provide standardized recommendations for the use of precast substructures in ABC projects, promoting efficiency, uniformity, and streamlined project execution. It includes schematic reinforcement details for key substructure elements such as abutments, pier caps, pier columns, and footings. It aligns with the AASHTO LRFD Guide Specifications for ABC (AASHTO, 2018) and emphasizes detailing precision and accuracy to prevent conflicts during construction. These guidelines help optimize fabrication, reduce construction timelines, and improve long-term structural performance.
- *Northeast Extreme Tee (NEXT) Beam Guide Details (PCI, 2021)*: This document is a guide for the industry in the design, fabrication, and construction of NEXT beams for ABC. It covers three different beam types: NEXT "F," "D," and "E," along with their structural purposes, design details, and typical reinforcement. It includes frequently asked questions on design considerations, bridge geometry, railing, deck surfaces, and wearing surfaces.

2.3 ABC Decision-Making Guidelines and Tools

This section focuses on frameworks and tools that help engineers and asset managers determine the suitability of ABC methods for specific bridge projects. Each document provides an approach to assess project feasibility that could focus on construction site limitation, traffic maintenance and costs evaluation. The following documents are presented starting with ABC decision-making guidelines and then moves to specific tools designed to evaluate individual projects for ABC implementation.

- *Innovative Bridge Designs for Rapid Renewal ABC Toolkit (Strategic Highway Research Program 2, 2013)*: This toolkit includes standardized design plans, sample design calculations, and recommended construction specifications for ABC projects. It can be used to identify potential ABC applications and to understand the challenges and opportunities associated with implementing ABC projects.
- *Framework for Prefabricated Bridge Elements and Systems Decision-Making (FHWA, 2005)*: This document provides a foundational framework for evaluating the feasibility of using PBES in bridge construction. Key considerations include project complexity, site constraints, available resources, and cost-benefit analysis. This framework includes a flowchart, matrix, and considerations section to guide users in evaluating the suitability of prefabricated bridges for specific projects. The framework is intended for use by representatives of owner agencies, contractors, designers, and project managers. Overall, the framework is a valuable tool for decision-makers to assess the feasibility and effectiveness of using prefabricated bridges for specific projects.
- *Slide-in Bridge Construction Cost Estimation Tool Guidelines (FHWA, 2015)*: Through the EveryDay Counts initiative, a spreadsheet tool was developed to assist transportation agencies in estimating the costs associated with slide-in bridge construction (SIBC) cost for typical bridge replacements. This document offers general guidelines to utilize this tool, where state DOTs can better evaluate the potential benefits of SIBC.
- *ABC Decision Making and Economic Modeling Tool (Doolen et al., 2011)*: This study created a decision-making tool that is based on the Analytical Hierarchy Process (AHP), which is a more detailed decision-making tool that can be used by agencies that need more substantial justification for the use of ABC. The process compares one option to another, typically conventional construction versus ABC. It could also be used to compare two ABC options.
- *ABC Rating Procedure Spreadsheet and Decision Flow Chart (Utah DOT, 2014)*: This spreadsheet evaluates the feasibility of ABC projects based on specific criteria with determined weight factors to calculate an ABC score. In the decision step, it uses the following factors: (Average Daily Traffic) ADT to measure highway volume and traveler impact, delay/detour time to assess disruption significance, bridge classification to determine structural importance, user costs to quantify financial impact on travelers, economy of scale to identify cost reductions through repetition, use of typical details to measure design complexity, safety considerations for work zone setup, and railroad impacts (applicable only if the bridge crosses a railroad). The spreadsheet also takes into consideration the total project cost for different alternatives. Once the final score is calculated, the final decision could be made based on a decision flow-chart available.
- *ABC Matrix Decision-Making Tool (Connecticut DOT, 2017)*: This tool provides a structured approach to evaluating the feasibility of ABC compared to conventional construction. It emphasizes roadway user impacts, calculating delays based on the number of vehicles per day rather than direct monetary values. A key component of the tool is its consideration of ways to offset the higher costs of ABC by identifying savings in construction management and traffic control. These savings include reductions in field inspection hours, back-office staff time, and rental costs for field offices. Traffic management savings are also assessed, including the elimination of temporary signals, phased construction, and overbuilt bridges required for staged work zones. The spreadsheet-based tool features multiple calculation tabs to quantify delay times for detours, lane reductions, and alternating traffic, while the main input page collects data on site conditions, ADT, delay times, and project duration. The tool compares total project cost estimations to determine whether ABC is more cost effective compared to conventional construction. The final ABC rating process generates a score from 0 to 100, where projects scoring 60 or higher are strong candidates for ABC, while those below 50 are generally not recommended. This is a powerful framework that allows engineers to ensure that ABC is considered where it offers the most benefit.

2.4 Other Resources

This section covers other resources such as training materials and case studies focusing on disseminating knowledge and sharing successful ABC implementation. Resources with general information are provided first, followed by selected case studies of ABC projects from across the country.

- *National Cooperative Highway Research Program (NCHRP) 12-102A: AASHTO guide specification for ABC design and construction—Implementation workshops* (NCHRP, 2019): This is a complete training that covers the implementation of the *AASHTO LRFD Guide Specifications for ABC* (AASHTO, 2018). The document contains ten modules that are intended to be used by designers for the preparation of plans and specifications for ABC projects. Besides that, it also presents three modules focused on program managers and project delivery managers for ABC bridge programs, representing the primary decision-makers in most agencies.

- *Accelerated Bridge Construction (FHWA, 2021)*: This website contain key information related to ABC with construction method definitions and publications for structural solutions such as PBES, Structural Placement Methods, and UHPC.
- *Performance of Accelerated Bridge Construction Projects in Utah as of May 2023 (Utah DOT, 2023a)*: This document is a lessons-learned report that inspected 49 bridge sites. It focused on critical findings and overall performance of ABC details, including precast concrete deck panels, SPMTs, lateral and longitudinal slide-ins, and UHPC. It also points out issues and probable causes, as well as recommendations to improve future projects.
- Prefabricated Bridge Elements and Systems Cost Study: Accelerated Bridge Construction Success Stories (FHWA, 2017): This website presents a report on nine projects across the country that used PBES including cost studies.
- *US 33 Over Blue River: ABC With Steel (Arnold et al., 2024)*: This document presents the case study of the INDOT ABC project, which used prefabricated steel beam modular superstructure units and UHPC for 8-inch closure pours. It contains information on how the project became an ABC project, costs as compared to conventional methods, and design resources. Additionally, it provides an overview of the project's construction and fabrication stages, highlighting challenges faced and lessons learned.
- *Slide-in Bridge Construction: Case Study (FHWA, 2014)*: This is a technical brief that reports bridge slide-in projects in Nevada and Missouri, highlighting key findings from each project.
- *Indiana Accelerated Bridge Construction Case Study (Volk, 2019)*: This document reports the construction of a slide-in project on SR 121 over I-70 in Indiana. It discusses the decision-making process of going from conventional construction to choosing an ABC method appropriate for the construction site. It also provides information on the ABC procurement and discusses the A+B bidding procedure.

2.5 Summary of Information Available on DOT Websites

Table 2.1 provides links to the available documentation from select state DOTs. The links were functional as of the time of the writing of the report but may not be functional in perpetuity.

TABLE 2.1
Documentation from Select State DOT.

Arizona	*ABC Decision-Making Matrix and Decision-Flowchart* (Arizona DOT, n.d.)
	ABC Guidelines (AZDOT, 2018)
California	*Accelerated Bridge Construction Manual* (California DOT, 2021)
Colorado	*Bridge Design Manual, Section 39: Accelerated Bridge Construction* (Colorado DOT, 2024)
Connecticut	*ABC Decision Matrix Tool and Guide* (Connecticut DOT, 2017)
Delaware	*ABC Workshop Presentations* (Delaware DOT, 2015)
Florida	Monthly webinars on Innovative Bridge Technologies offered by the ABC-University Transportation Center (Florida DOT, 2025a)
	Structures Detailing Manual, Chapter 25: Prefabricated Bridge Elements and Structures (PBES) (Florida DOT, 2025b)
Georgia	*ABC Guidance* (Georgia DOT, 2024)
Iowa	*LRFD Bridge Design Manual, Chapter 8: Accelerated Bridge Construction* (Iowa DOT, 2025)
	ABC Workshop Presentations (Iowa DOT, 2014)
Indiana	*Accelerated Bridge Construction Case Study* (INDOT, 2022)
Kentucky	*ABC guidelines* (Kentucky Transportation Cabinet, 2013)
	Decision-Making Tool Between Prefabricated Bridge Elements and Structures (PBES) and Conventional Methods (Kentucky Transportation Cabinet, 2013)
Massachusetts	*Bridge Manual, Part III - Prefabricated Bridge Elements* (Massachusetts DOT, 2024)
Michigan	*Bridge Design Manual, Section 7.01.19: Accelerated Bridge Construction (ABC)* (Michigan DOT, 2013)
	Workshop presentations on ABC (Michigan DOT, 2014a)
	Project Scoping Manual, Chapter 6, Items to Consider When Scoping a Project (Michigan DOT, 2014b)
Minnesota	Example Accelerated Bridge Construction options (Minnesota DOT, 2025a)
	National ABC resources (Minnesota DOT, 2025b)
Nebraska	ABC Decision Tool (Barutha et al., 2024)
New Jersey	*Bridge Design Manual, Section 37: Prefabricated Bridge Elements and Systems* (PBES) (New Jersey DOT, 2016)
Oregon	*Bridge Design Manual, Section 1.16.2: Accelerated Bridge Construction (ABC) Guidelines* (Oregon DOT, 2024)
	ABC Decision Making and Economic Modeling Tool Research Final Report (Doolen et al., 2011)
	ABC AHP Tool Manual (Oregon DOT 2012)
	ABC AHP Tool (Oregon DOT, 2017)
Texas	Accelerated Construction Guidelines (Texas DOT, 2018)
	Accelerated Construction Economic Screening Tool (Texas DOT, 2017)
Utah	ABC Rating Procedure Spreadsheet and Decision Flow Chart (Utah DOT, 2014)
	Accelerated Bridge Construction (ABC) Information: ABC Lessons Learned Reports (UDOT, 2023b)
	Geotechnical Manual of Instruction, Section 15.10: Geotechnical Considerations for Accelerated Bridge Construction (UDOT, 2022)
	Structures Design and Detailing Manual, Chapter 20: Accelerated Bridge Construction (UDOT, 2023b)
Washington	*Bridge Design Manual, Chapter 14: Accelerated and Innovative Bridge Construction* (Washington DOT, 2024)
Wisconsin	*Bridge Manual, Chapter 7: Accelerated Bridge Construction* (Wisconsin DOT, 2019)

3. INTERVIEWS OF KEY STAKEHOLDERS IN INDIANA

A total of 24 interviews were conducted with key stakeholders across Indiana, including designers, contractors, asset managers, fabricators, inspectors, load raters, district director, and others (Figure 3.1). Appendix A includes the interview questions asked for each stakeholder's group. The goal of these interviews was to gain a comprehensive understanding of the barriers, opportunities, and potential strategies for adopting ABC methodologies within the state. Among all interviews conducted, it was concluded that the stakeholders with the most impact on ABC/ABF implementation are designers, contractors, and designers. This section presents key challenges and opportunities that were identified through interviews with these three stakeholders.

3.1 Designers

Designers play a critical role in the early stages of bridge projects where decisions regarding construction methodologies such as ABC can significantly impact project timelines and costs. Key insights from designers included:

- Challenges:
  - Contractors' lack of experience: Designers noted that fear of the unknown, particularly regarding costs and construction complexities, prevents broader adoption of ABC methods. There is a general lack of confidence among contractors in these methods due to limited exposure and understanding.
  - Decision-making process: Designers emphasized that the decision to pursue ABC should occur at the scoping stage. However, without early interest from clients and district-level decision-makers, ABC opportunities are often overlooked. Designers may recommend ABC methods, but these recommendations may not be considered later in the process due to late-stage funding challenges.
  - High initial cost: The higher initial cost of ABC compared to conventional methods is seen as a major limitation on its implementation, making it difficult to justify without early planning and commitment.
  - Substructure complexity: A lot of time can be saved with ABC methods for the superstructure, but constructing substructures is a significant challenge.

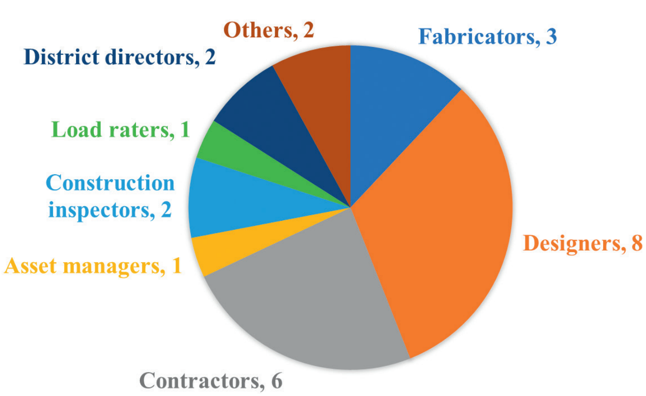


Figure 3.1 Interviews Conducted.

- Opportunities:
  - High-traffic projects: ABC methods would be particularly beneficial in urban areas and on high-traffic interstates where minimizing road closures and improving safety are critical.
  - Prefabricated components: Prefabricated elements like decks, slabs, and piers offer a faster and potentially more cost-effective construction method. They are also an accessible starting point for expanding ABC use in Indiana.
  - Knowledge sharing: Designers mentioned the importance of documenting and sharing lessons learned from previous projects statewide, including case studies from other states with successful ABC implementations.
  - Contractor involvement: Having the contractor involved from the beginning is very beneficial for ABC, so they can share their knowledge with techniques to achieve ABC. Using delivery methods, such as Design-Build (DB) could make this possible.

3.2 Contractors

Contractors provided insights into the practical challenges of implementing ABC/ABF methods, focusing on workforce issues, project scheduling, and cost management.

- Challenges:
  - Labor shortages: Contractors face difficulties in finding qualified labor to meet the accelerated timelines associated with ABC projects. Labor unions are trained based on conventional construction techniques, and it is outside their normal expectations to work on ABC.
  - Risk aversion: Contractors expressed concerns about the risks associated with ABC, especially when they have little prior experience. The potential benefits of adopting ABC are not evident for them, since it is often perceived as more expensive.
  - Project coordination: Coordinating multiple projects, managing lead times for materials, and maintaining traffic flow are significant challenges.
  - Owner priorities: Aligning project goals with owner priorities (budget, quality, time) can be challenging.
- Opportunities:
  - Temporary bridges and slide-in techniques: These methods were seen as particularly effective in minimizing traffic disruptions.
  - Early contractor involvement: Encouraging alternative delivery methods such as DB would allow contractors to contribute their expertise early in the project.
  - Incentive programs: Contractors suggested implementing bonus/penalty systems based on completion times to motivate faster adoption of ABC methods.
  - Standardized guidelines: Clear and detailed specifications, as well as statewide ABC decision-making frameworks, would reduce uncertainty and encourage more contractors to engage with these methodologies.
  - Market opportunity: Successful implementation of ABC projects can open new market opportunities for contractors

3.3 Fabricators

Fabricators are critical to the success of ABF methods, providing the prefabricated components essential to accelerated construction timelines. Their feedback focused on logistical and design-related challenges.

- Challenges:
  - Communication gaps: Fabricators often face delays due to poor communication with designers and contractors, leading to multiple revision cycles for shop drawings.
  - Logistical constraints: Transportation costs for heavy prefabricated components can be significant, especially for rural projects. Fabricators emphasized the need for strategic planning to locate fabrication sites closer to construction areas.
  - Seasonal demand peaks: Fabricators reported peak demand during February-March and summer, affecting lead times and scheduling flexibility.
  - Design details: Once a project is bid, fabricators have limited opportunities to propose design optimizations.
- Opportunities:
  - Standardization components: Developing a catalog of standard bridge designs and span lengths could streamline fabrication processes and reduce project timelines.
  - Fabricator involvement: Involving fabricators during the design phase would help address potential fabrication challenges early, reducing delays.
  - Steel constant demand: With 93% of steel content being recycled, fabricators highlighted steel's sustainability advantages for ABC projects, and the constant demand for steel would be a good benefit.
  - Proximity considerations: Locating fabrication facilities closer to construction sites could reduce logistical costs and transportation times.
  - NEXT beams: NEXT beams have a lot of potential for ABC, with reduced fabrication and installation costs.

3.4 Conclusions and Recommendations

The interviews revealed significant challenges and opportunities for the broader adoption of ABC methods in Indiana. The most significant barriers include labor shortages, communication gaps, and risk aversion. The stakeholders highlighted the potential of high-traffic projects, urban locations, and emergency repairs as primary candidates for ABC methods. Technologies such as PBES, SIBC, and temporary bridges offer the greatest potential for Indiana. Figure 3.2 summarizes the most frequently mentioned challenges by stakeholders, while Figure 3.3 presents the identified opportunities.

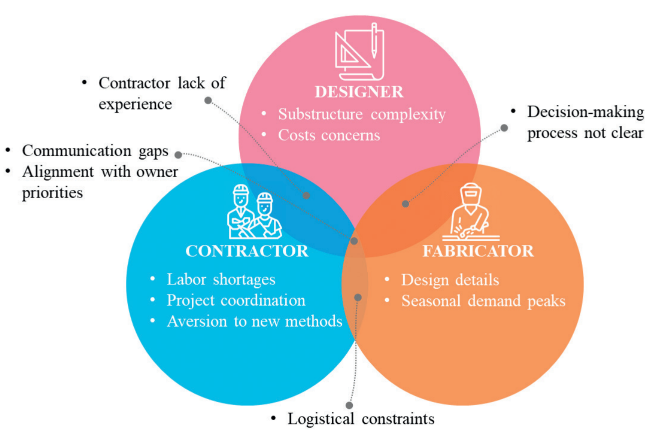


Figure 3.2 Challenges Identified by Stakeholders for ABC Implementation.

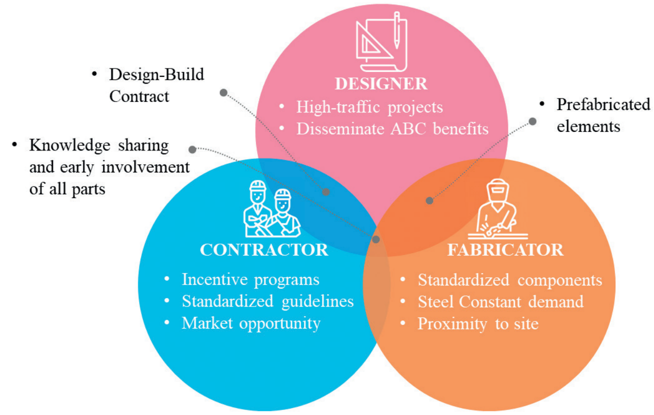


Figure 3.3 Opportunities Identified by Stakeholders for ABC Implementation.

Workforce development, standardized guidelines, early contractor and fabricator involvement, and strategic use of incentives were identified as key areas of opportunity. Improvements in these areas would lead to the broader adoption of ABC methodologies, ultimately enhancing the efficiency, safety, and sustainability of bridge construction projects across Indiana.

The lack of early communication between contractors and fabricators is recurrent in traditional DBB delivery. Under current practices, contractors are not engaged until later in the process, which limits feedback on constructability and cost-effective solutions specific to ABC. INDOT could enhance the existing Stage 2 plan-sharing process by clearly highlighting ABC projects to the contractors. This would help draw early attention, encourage engagement, and allow contractors to anticipate and prepare for the specific requirements of ABC delivery.

The following recommendations were captured from the interviews:

- Standardized components: Utilize standardized components to improve efficiency and reduce costs, especially prefabricated elements.
- Early decision making: ABC should be considered at the earliest stages of project planning to minimize rework and maximize efficiency with clear project definitions and decision-making processes.
- Collaboration and communication: Enhanced communication among designers, contractors, asset managers, and fabricators is critical for successful ABC project execution.
- Workforce development: Address labor shortages and improve workforce skills through training programs focused on ABC techniques. Existing training resources, such as those developed under NCHRP Project 12-102A (NCHRP, 2019), are valuable tools for workforce development.
- Incentives: Implement financial incentives, such as bonus/penalty clauses based on project completion times, to encourage the adoption of ABC methods and make the risk profile more attractive.
- Spread information: Utilize existing resources and share knowledge, using email updates and periodicals to disseminate the information available on INDOT websites.

- Owner expectations: Clarify INDOT expectation and goals for ABC to ensure alignment with industry stakeholders.
- Minimal impact on load raters and inspectors: ABC does not have a substantial impact/interference on load raters' and inspectors' work.

These findings show the importance of aligning project goals with owner priorities, such as budget, quality, and time. Clearly defining project objectives and involving stakeholders in the decision-making process are critical to ensuring successful ABC implementation.

As prestressed concrete girders dominate the bridge market in Indiana and there are existing PCI design manuals for their use, the remainder of the project focused only on ABC as opposed to ABF.

4. INVESTIGATING AND DEVELOPING METHODS FOR EVALUATING BRIDGES FOR ABC

This task focused on investigating and developing methods for evaluating candidate bridges where ABC would be the most beneficial. Note that the original proposal included Task 3: Identifying bridge types/spans/locations for ABC/ABF and Task 4: Performing a benefit-limit analysis on using ABC/ABF for these candidate bridge types/spans/locations. However, based on research findings, this task was appropriately shifted to focus on methods for evaluating candidate bridges where ABC would be the most beneficial.

Based on the literature review and recommendations from the Study Advisory Committee (SAC), a two-stage approach for evaluating which bridges should be prioritized for ABC was developed. This approach is intended to help INDOT identify projects where the benefits of ABC can justify the higher initial costs, which is currently a barrier to broader ABC adoption in Indiana. The two components of this approach are: (1) a System-Level Analysis Tool that scores all bridges in the Indiana DOT inventory and (2) a Site-Specific Decision-Making Flowchart to be used when evaluating an ABC method for a specific bridge at an early stage of design.

Currently at scoping stages, INDOT asset managers utilize the "Determination of Significant Work Zone Impacts" worksheet (Figure 4.1 [INDOT, 2021a]). This checklist includes a set of questions to help identify when the project may be significant based on factors such as Annual Average Daily Traffic (AADT), project location, maintenance of traffic, and seasonal impact.

Additionally, INDOT follows the *Project Development Process (PDP) Manual* (INDOT, 2021b), which outlines all steps for the development of a typical project. It guides the project manager and development team from initial concept to construction and completion, including milestones for preservation and reconstruction projects.

DETERMINATION OF SIGNIFICANT WORK ZONE IMPACTS

Route: ________ Des: _________ Project Development Stage: ___________ Date: _________

Note: this worksheet should be completed during scoping and the results placed in the SPMS project schedule.

1. Determination by Federal Rule (Interstate corridors only)	YES	NO
a. Is the project in a Traffic Management Area (see list below)?	☐	☐
b. Will travel lane(s) be affected, continuously or intermittently, for more than three days?	☐	☐
If answers to both 1a and 1b are yes, then the project is significant If no proceed to item 2, If yes, item 2 may be skipped	Significant ☐	
2. Determination by INDOT Policy (All INDOT corridors)		
a. Is project scope major reconstruction or new construction?	☐	☐
b. Is AADT > 12,000 for 2 lane roads or 30,000 for multilane?	☐	☐
c. Is the project in an urban or suburban area?	☐	☐
d. Will mobility along corridor be significantly impacted?	☐	☐
e. Will capacity of the highway be significantly reduced?	☐	☐
f. Will alternative routing be needed?	☐	☐
g. Will communities, local businesses, schools, hospitals be significantly impacted?	☐	☐
h. Are seasonal impacts significant?	☐	☐
i. Are grade changes significant?	☐	☐
If the answers to one or more of 2a thru 2i are yes, then the project may be significant – engineering judgment should be applied. If answers to all questions are no, then project is non-significant.	Significant ☐ Non-Significant ☐	

3. Comments:

Figure 4.1 Determination of Significant Work Zone Impacts (INDOT, 2021a).

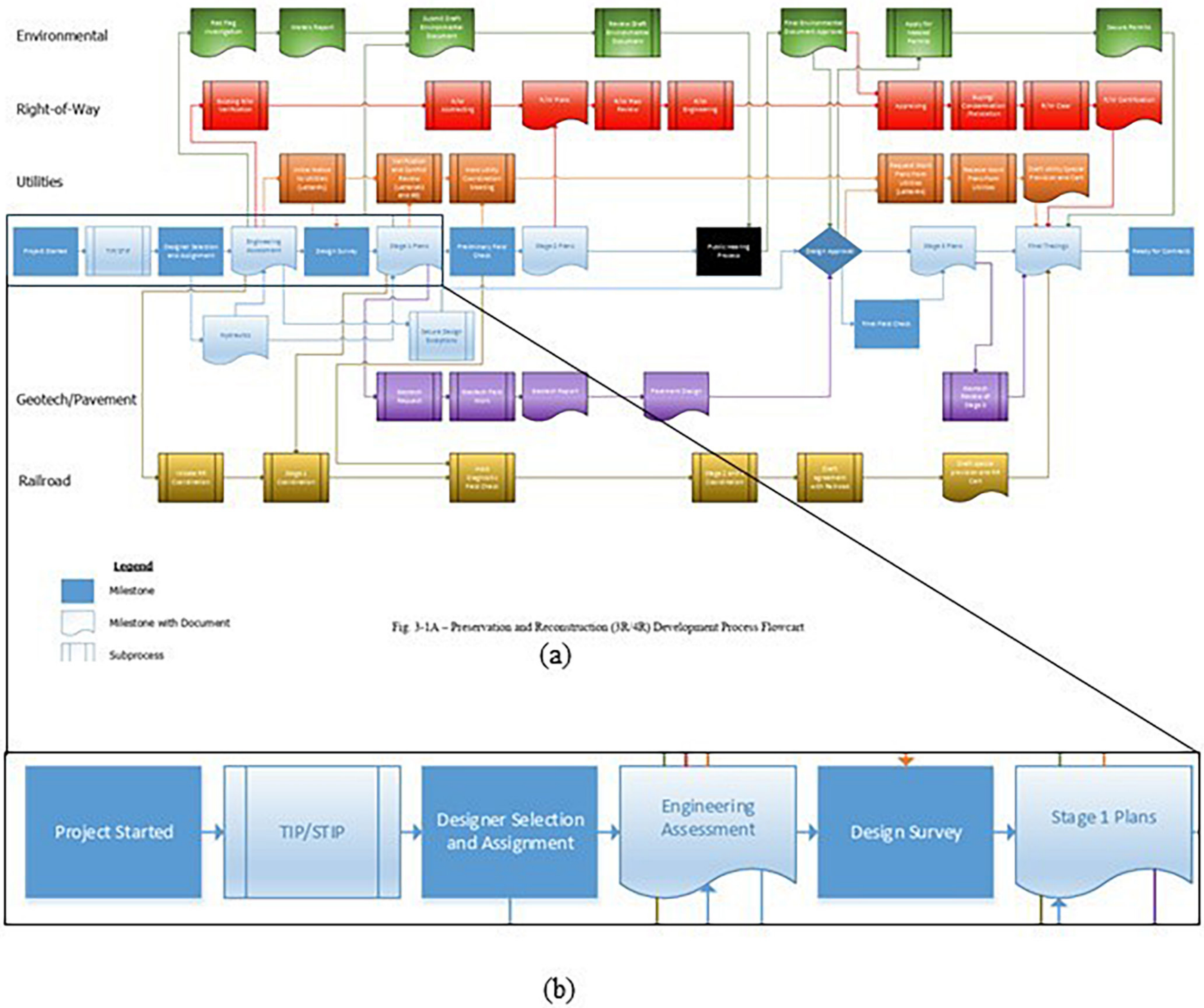


Figure 4.2 (a) Preservation and Reconstruction (3R/4R) Development Process Flowchart, and (b) Zoomed-In View of Steps Included in the Initial Phase on the Project (INDOT, 2021b).

This research was built upon the Preservation and Reconstruction Development Process Flowchart (Figure 4.2a) from the *PDP Manual* by introducing two additional steps at the initial phase of the project, highlighted in Figure 4.2b, to assist the identification of candidates bridges for ABC. These steps include: (1) a system-level analysis that provides a score to each bridge in the Indiana inventory based on defined criteria and weighted factors, helping to identify bridge locations where ABC would provide the most benefit and (2) a decision-making flowchart with key considerations to further evaluate ABC, including the use of different methods (Figure 4.3).

4.1 System-Level Analysis Tool

The system-level analysis scores Indiana's state-owned bridge inventory using data from the Indiana Total Asset Management System (iTAMS [INDOT, 2025]). This platform is currently used by INDOT to track, maintain, and manage transportation assets across the state. It provides key asset data, including traffic volume data, bridge geometry, structure and material type, location information, and maintenance history.

The scoring methodology was developed based on decision-making tools from Utah DOT (2014) and Connecticut DOT (2017). Note that both existing tools are applied to a singular project, while the system-level analysis developed in this research provides comprehensive scoring of the entire bridge inventory. For this research, specific considerations for a singular project will be covered by the site-specific decision-making flowchart introduced in Section 4.3.

Based on the criteria used by the existing decision-making tools, Table 4.1 shows the criteria considered for defining the score in this system-level analysis, with the justification for the condition more suitable for ABC and the respective weight

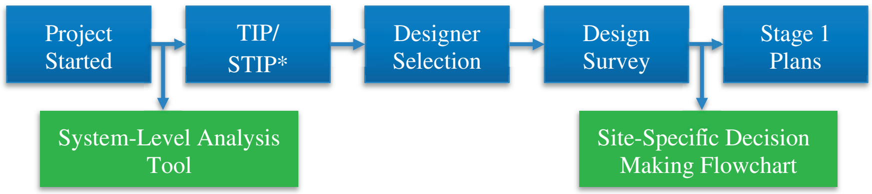


Figure 4.3 Steps of the Existing PDP With Developed Methods Shown in Green.
*Transportation Improvement Program/State Transportation Improvement Program

TABLE 4.1
Criteria and Indicator for ABC.

Criteria	Justification for Most Suitable Condition for ABC	Weight Factor
ADT	High ADT is given higher priority for quick replacement because of closure impact	7
Facility Carried	Interstates have a higher impact on INDOT mobility	7
Geometry	No skew, straight bridges can lead to quicker on-site assembly	3
Clear Roadway	Wider bridges can enable maintenance of traffic during phased construction	2
Detour Length	Longer detours lead to more user impact	1

factors assigned based on their importance. Each criterion is assigned with a rating scale from 0 to 5, with weight factors ensuring that the most significant criteria (ADT and Facility Carried) contribute more heavily to the final score.

The scoring system utilizes iTAMS attributes, including ADT, facility carried by the structure, skew angle, bridge roadway width, direction of traffic, and bypass detour length. These attributes are exported in Excel format from iTAMS for all Indiana state-owned bridges, filtering out county bridges and nonvehicular bridges. A Python script (Appendix B) processes this data by assigning ratings to each criterion, applying weight factors, and computing a final score for every bridge. The generated output is an Excel spreadsheet listing all bridges with their respective score, with the maximum possible score of 100, with higher scores indicating stronger candidates for ABC implementation. The user manual is provided in Appendix C, with detailed instructions for exporting data from iTAMS and using the Python script.

The following sub-subsections cover each criterion in detail and the respective rating.

4.1.1 Average Daily Traffic (ADT)

Bridges with higher traffic have a greater impact on road users if closed for long durations. ABC methods are particularly beneficial for these high-traffic structures, minimizing disruptions.

Traffic volume is measured by AADT or ADT, where ADT is measured over a short period of time (often one week), while AADT is normalized over the entire year. Even though the AADT value is more representative, the ADT value is used in this research since iTAMS only provides this data currently. Bridges carrying more than 100,000 vehicles per day, which is currently equivalent to 0.97% of the bridges, receive the highest priority for ABC (Table 4.2).

TABLE 4.2
ADT Rating.

Rating	ADT	Bridges in Indiana Inventory (%)
0	< 5,000	42.1
1	5,001–10,000	20.2
2	10,001–20,000	20.4
3	20,001–50,000	12.7
4	50,001–100,000	3.61
5	> 100,000	0.97

4.1.2 Facility Carried

Facility Carried identifies the type of roadway carried by the bridge. Interstates are the highest priority for ABC because they handle high traffic volumes where prolonged closures can cause significant disruptions.

If a bridge is located along an Interstate, the "Facility Carried" field begins with "I-" or "Ramp I", and the code assigns it the maximum rating of 5. Bridges located along Highways, where the "Facility Carried" field begins with "US" or "SR", receive a rating of 3. All other roadways fall into the lowest rating category (0), as shown in Table 4.3. Table 4.3 also shows the percentage of bridges that fall into each category.

4.1.3 Geometry

Bridge geometry influences the complexity of construction. Simple geometries allow for straightforward prefabrication and faster installation, making them ideal candidates for ABC. This classification was based on the provided skew angle for each bridge. Bridges without skew are the most suitable for ABC, as they simplify foundation work and enable efficient prefabrication, receiving the highest rating. Curved bridges (identified in iTAMS with a skew of 99), on the other hand, have more

TABLE 4.3
Facility Carried Rating.

Rating	Facility Carried	Bridges in Indiana Inventory (%)
0	Others (Street., Road)	12.6
3	Highway (US, SR)	60.7
5	Interstate	26.7

TABLE 4.4
Geometry Rating.

Rating	Geometry	Bridges in Indiana Inventory (%)
0	Curved	2.53
1	Skew > 60	0.29
2	30 < Skew < 60	16.0
3	15 < Skew < 30	26.7
4	Skew < 15	25.7
5	No Skew	28.7

complex geometry that may require more customized design details, leading to the lowest rating of 0 (Table 4.4).

Table 4.4 also shows the percentage of bridges that fall into each category.

4.1.4 Clear Roadway

The clear roadway criterion evaluates whether traffic can be maintained through staged construction, where part of the bridge remains open to traffic while the other part is reconstructed. Wider bridges can accommodate staged construction, reducing the need for full closures, while narrower bridges may require full detours, increasing disruption. Note that bridge widening could be a possibility for phased construction, but it was not included in the system-level analysis as it would need to be evaluated for each specific site.

The minimum width required to maintain traffic varies based on whether the bridge is located on an Interstate or a non-Interstate route. This criterion is categorized into three different rating sets: (1) Interstate bridges with two bounds, where cross-over traffic could be explored, (2) Interstate bridges without two bounds, and (3) non-Interstate bridges. This criterion also considers the direction of traffic to determine the necessary clear roadway width.

For Interstate bridges, maintenance of traffic requirements follows the "INDOT Interstate Highway Congestion Policy" (INDOT, 2017), where two lanes of traffic are required in each direction and lane splitting is not permitted (Figure 4.4 and Figure 4.5).

Based on these requirements, different construction stages were analyzed to determine the minimum roadway width needed to maintain traffic in each scenario. Table 4.5 to Table 4.9 shows these construction stages in the third column, including the work zone (WZ) indicated by a traffic cone and the section highlighted in blue indicating the new construction. The required zone width was determined as follows:

- To maintain two lanes of traffic, the work zone critical width needs to be at least 28 feet, to accommodate: 3-foot concrete barrier, 1-foot shoulder, two 11-foot lanes of traffic in one direction, 1-foot shoulder, and an additional 1-foot gap between the existing structure and the new one.
- To maintain one lane of traffic, the work zone critical width needs to be at least 17 feet, to accommodate: 3-foot concrete barrier, 1-foot shoulder, one 11-foot lane of traffic in one direction, 1-foot shoulder, and an additional 1-foot gap between the existing structure and the new one.

It is important to note that the work zone cannot be placed between two lanes of traffic moving in the same direction (i.e., lane splitting), which influences the required width. Additionally, a 3-foot width is required for barriers placed on the edge of a section (2-foot barrier + 1-foot anchor zone [INDOT, 2003]), while if they are not on an edge (i.e., temporary barrier separating traffic), they only need to be 2 feet wide (INDOT, 2019). The 1-foot gap is necessary for construction continuity between phases.

If the Peak Hour Volume % is... [1]	and Daily Vehicular Volume (total) is at least...	...Or Daily Truck Volume (total) is at least...	Then...
Any	30,000	10,000	Two lanes are required in each direction. [2]
7%	26,000	8,000	
8%	23,000	7,000	
9%	20,500	6,500	
≥ 10%	18,500	6,000	

[1] Design Hourly Volume (DHV) percentage from the Traffic Forecast Report can be used.
[2] A determination for the minimum number of lanes is required when the peak hour volume exceeds 1,800 vph for a short duration, e.g., 1 or 2 hours.

Figure 4.4 Minimum Thresholds Requiring Two Lanes (INDOT, 2017).

Option[3]	Cross Section Configuration[4][5]	Shoulder Width	Comments
1	2 lanes @ 12 ft	2 ft	Preferred option. May require temporary widening.
2	1 lane @ 12 ft[1], and 1 lane @ 11 ft	2 ft	Analysis must show physical constraints result in additional construction that is prohibitive due to cost or time. Review of crash history[2].
3	2 lanes @ 11 ft	2 ft	Savings in time and cost over option 2 must be demonstrated.

Notes

[1] The 12 ft lane may be located right or left considering barrier placement, edge of pavement, and zone of intrusion.

[2] Include the crash history of prior construction projects on the corridor in the same area, reviewing the work zone queuing and crashes.

[3] Options 2 and 3 require supporting justification.

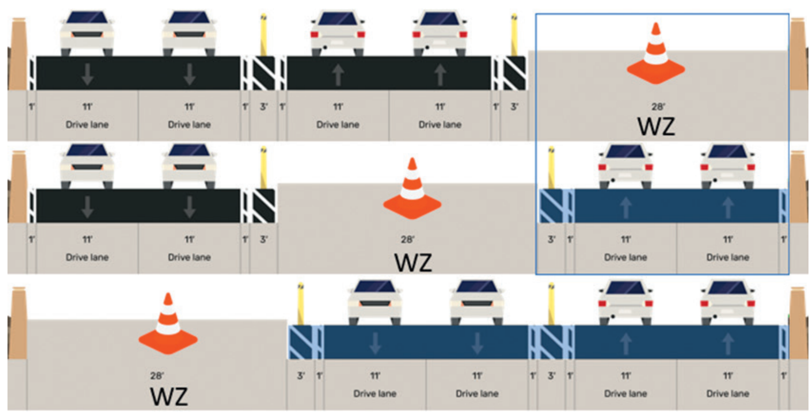
[4] At an isolated physical constraint such as a bridge pier, concrete barrier or sign foundation, an 11 ft lane with a 1 ft shoulder may be provided. This reduction is only applicable at the physical restriction. Advanced "ROAD NARROWS" warning signs should be considered.

[5] Providing 2 lanes @ 11 ft with 1 ft shoulder for long segment lengths or long duration requires an exception.

Table 3 – Cross Section Elements for Two Lane MOT Schemes.

Figure 4.5 Cross Section Elements for Two Lane MOT Schemes (INDOT, 2017).

TABLE 4.5
Interstate Bridges with Traffic in Two Directions Clear Roadway Rating.

	width < 55'		Construction Stages
0	If can maintain 2 lanes of traffic in 2 directions	width > 82'	
5	Cannot maintain traffic in 2 directions	width < 82'	

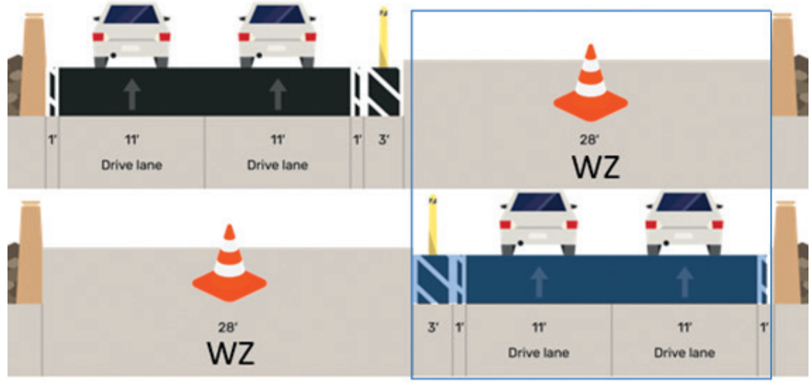
For bridges along Interstates with traffic in both directions, the following ratings are used (Table 4.5):

- Rating 0: If the bridge under replacement is sufficiently wide that two lanes of traffic can be maintained in each direction as well as a work zone (at least 82-foot clear roadway width), then staged construction can be used and there is less need for ABC.
- Rating 5: If the bridge is not sufficiently wide to maintain two lanes of traffic in each direction with a work zone, staged construction is not possible, requiring a full bridge closure for replacement.

For bridges along Interstates with traffic in one direction, the following ratings are used (Table 4.6):

- Rating 0: If the bridge under replacement is sufficiently wide that two lanes of traffic can be maintained as well as a work zone (at least 55-foot clear roadway width), then staged construction can be used and there is less need for ABC.
- Rating 5: If the bridge is not sufficiently wide to maintain two lanes of traffic with a work zone, staged construction is not possible, requiring a full bridge closure for replacement.

TABLE 4.6
Interstate Bridges with Traffic in One Direction Clear Roadway Rating.

Clear Roadway Rating			Construction Stages
0	If can maintain 2 lanes of traffic in 1 direction	width > 55’	
5	Cannot maintain traffic in 1 direction	width < 55’	

For Interstate bridges with two bounds (opposing traffic directions) on separate structures, the following ratings are used (Table 4.7):

- Rating 0: If the bridge under replacement can maintain two lanes of traffic (55 feet wide), phased construction can be used.
- Rating 2: If the contra-flow bridge can accommodate an additional lane, then one lane of traffic can be moved to the contra-flow bridge and one lane of traffic can be maintained on the bridge under replacement for phased construction. Based on that, the contra-flow bridge needs a minimum width of 39 feet, to accommodate: two 11-foot lanes of traffic in the opposite direction, two 1-foot shoulders in both directions, a 2-foot temporary concrete barrier, and one 11-foot extra lane in the direction of the bridge to be replaced.
- Rating of 5: If the bridge under replacement cannot maintain two lanes of traffic and the contraflow bridge cannot accommodate an additional lane of traffic, staged construction is not possible, and a full bridge closure would be required.

TABLE 4.7
Interstate Bridges with Two Bounds Clear Roadway Rating.

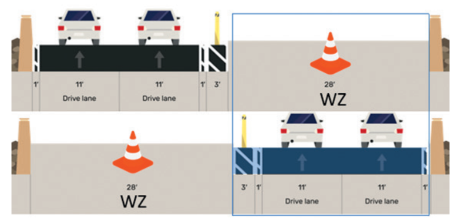
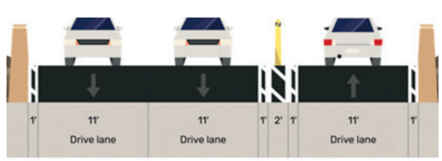
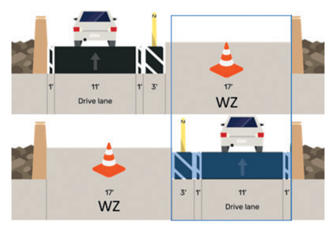
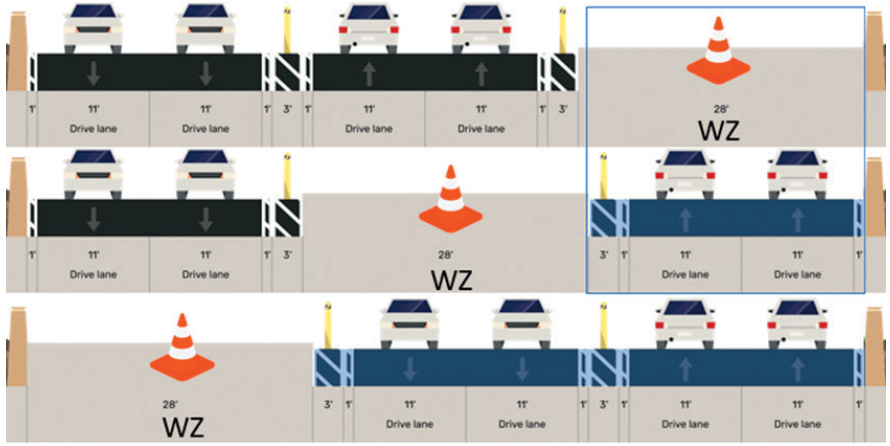
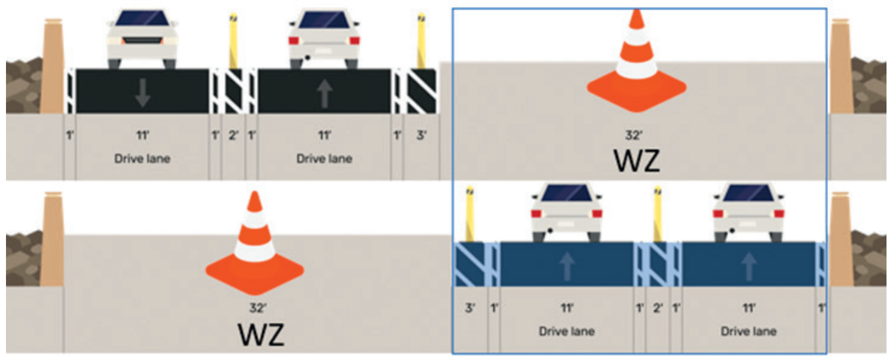
Clear Roadway Rating		Contra-Flow Bridge		Bridge to be Replaced, Construction Stages
0	If Interstate can maintain 2 lanes width > 55’	No cross-over necessary		
2	If contra-flow bridge can accommodate an extra lane	Opposite bridge w >39’		
5	Cannot maintain traffic on contra-flow bridge	Opposite bridge w < 39’		

TABLE 4.8
Non-Interstate Bridges with Traffic in Two Directions Clear Roadway Rating.

Clear Roadway Rating			Construction Stages
0	If can maintain 2 lanes of traffic in 2 directions	width > 82’	
3	If can maintain 1 lane of traffic in 2 directions	width > 63’	
5	Cannot maintain traffic in 2 directions	width < 63’	

For non-Interstate bridges with traffic in two directions, the following ratings are used (Table 4.8):

- Rating of 0: Two lanes of traffic can be maintained in both directions (clear roadway width > 82 feet), allowing phased construction.
- Rating of 3: One lane of traffic in each direction can be maintained (clear roadway width > 63 feet), allowing phased construction with some traffic disruption.
- Rating of 5: Traffic cannot be maintained, requiring full closure and detour if the width is less than 63 feet.

Lastly, for non-Interstate bridge with traffic in one direction (Table 4.9):

- Rating of 0: Two lanes of traffic can be maintained (clear roadway width > 55 feet), allowing phased construction.
- Rating of 3: One lane of traffic can be maintained (clear roadway width > 33 feet), allowing phased construction with some traffic disruption.
- Rating of 5: Traffic cannot be maintained, requiring full closure and detour if the width is below 33 feet.

4.1.5 Detour Length

Longer detours increase travel time and user costs, making ABC more attractive as a solution for reducing closure durations and economic impact. For bridges with detours exceeding 8 mi, a rating of 5 will be assigned, having the greatest need for ABC, while smaller detours, less than 3 mi, a rating of 0 will be assigned (Table 4.10). The percentage of bridges that fall into each rating is shown in Table 4.10.

4.2 System-Level Analysis Tool Results

The system-level analysis generates a spreadsheet with all state-owned bridges with its respective information, criteria rating, and final score. It also provides hyperlink access to the bridge profile on iTAMS, where complementary information could be accessed. Figure 4.6 shows a sample output from the script. Asset managers can conduct this analysis on a periodic basis (e.g., annually) to reassess ABC prioritization.

TABLE 4.9
Non-Interstate Bridges with Traffic in One Direction Clear Roadway Rating.

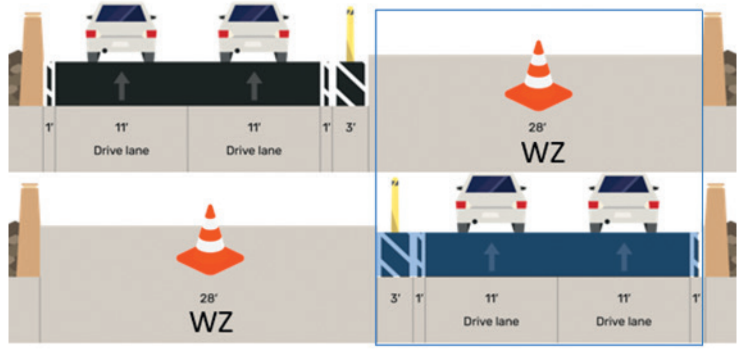
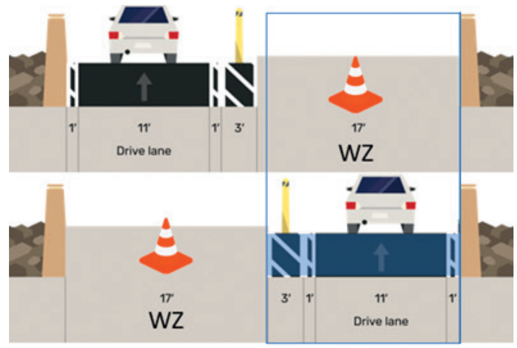
Clear Roadway Rating			Construction Stages
0	If can maintain 2 lanes of traffic in 1 direction	width > 55’	
3	If can maintain 1 lane of traffic in 1 direction	width > 33’	
5	Cannot maintain traffic in 1 direction	width < 33’	

TABLE 4.10
Detour Length Rating.

Rating	Detour Length	Bridges in Indiana Inventory (%)
0	Detour length < 3 mi	47.7
2	3 < length < 6 mi	39.4
3	6 mi < length < 8 mi	5.33
5	Detour length > 8 mi	7.57

By incorporating this system-level approach, INDOT can systematically identify and prioritize high-impact bridges for ABC.

Figure 4.7 shows the highest scoring bridge, Asset I80-05-07833 A, with a score equal to 92. This bridge scores the highest value for ADT (185,778), and the highest score for Facility Carried since it is located on an Interstate (I-80 WB). It presents a small skew angle of 8°, rating 4 for the geometry. In addition, the bridge width would not be sufficient to maintain two lanes of traffic in the West direction, meaning the bridge would need to be entirely closed during the reconstruction, so the clear roadway rating scores a maximum of 5.

Figure 4.8 shows Asset I80-02-08472 AEBL, with a final score of 85. This bridge carries I-80 with an ADT of 172,512, which scores 5 for traffic volume. It also scores the highest value for Facility Carried, as it is located on an Interstate. With no skew (0°), the bridge geometry receives a rating of 5. The deck width of 85.8 feet would allow staged construction, resulting in a clear roadway rating of 0. The detour length is 1 mile, scoring the lowest rating of 0.

Figure 4.9 shows another high-score bridge, Asset I465-124-05268 CNBL, with a score of 85. This bridge carries I-465 NB and has a high ADT of 101,476, which results in a maximum ADT score of 5. It is located on an Interstate, scoring 5 for Facility Carried. The bridge has no skew, leading to a geometry rating of 5. However, the clear roadway score is 0, as the clear roadway width of 76.3 feet is wide enough to accommodate staged construction, not requiring a full closure. The short detour of 2 mi also results in a low detour rating of 0.

Figure 4.10 shows Asset 050-15-02169 C with a mid-range score of 57. This bridge carries US 50 with an ADT of 21,622, earning a moderate ADT rating of 3. It is located on a US highway, also scoring 3 for Facility Carried. The skew angle listed as 99, indicated that the bridge is curved, so the

Contact(s)	Asset Name	Asset Number	Skew:	ADT	Facility Carried:	Detour Length:	Traffic Lanes:	Rdwy Width	Parallel Structur	Hyperlink	ADT Rating	Geometry Rating	Facility Rating	Clear Rdwy Rating	Detour Rating	Structure Type	Final Score
Seymour | '	I64-123-04691 D	34520	0	80030	I-64	18	2	42	N	https://itams	4	5	5	5	5	Arch - Thru	93
Border Brid	I64-124-00KYTC	34523	0	94180	I-64 EB/WB	18	1	42	N	https://itams	4	5	5	5	5	Stringer/Mult	93
La Porte	I80-05-07833 A	45599	8	185778	I-80 WB RAMP	1	1	35.7	N	https://itams	5	4	5	5	0	Stringer/Mult	92
Border Brid	I275-0-05639	49660	0	40222	I-275	22	2	62.3	N	https://itams	3	5	5	5	5	Truss - Thru	86
Greenfield	I65-110-05713 ANBL	36320	2	61726	I-65 NB	1	1	46.2	R	https://itams	4	4	5	5	0	Stringer/Mult	85
Greenfield	I465-124-05268 CNBL	50210	0	101476	I-465 NB	2	1	76.3	R	https://itams	5	5	5	0	0	Stringer/Mult	85
Greenfield	I465-124-05268 CSBL	50220	0	101476	I-465 SB	2	1	76.3	L	https://itams	5	5	5	0	0	Stringer/Mult	85
La Porte	I80-02-08472 AEBL	76846	0	172512	I-80/I-94 EB	1	1	85.8	R	https://itams	5	5	5	0	0	Box Beam	85
Greenfield	I65-112-10626 SBL	80844	2	53313	I-65 SB, SBL RA	1	2	78.8	R	https://itams	4	4	5	5	0	Tee Beam	85
Greenfield	I65-111-10602 SBL	80880	3	58288	I-65 SB	1	1	54.4	L	https://itams	4	4	5	5	0	Tee Beam	85
Greenfield	I65-112-10619 NBL	80912	2	51774	I-65 NB	1	1	42.2	N	https://itams	4	4	5	5	0	Tee Beam	85
Greenfield	I65-112-10621 SBL	80914	3	53313	I-65 SB	1	1	49	N	https://itams	4	4	5	5	0	Tee Beam	85
Seymour	I64-123-04687	34460	0	65848	I-64	18	2	135.5	N	https://itams	4	5	5	0	5	Culvert	83
Greenfield	I65-113-05673 D	36700	3	118986	I-65	4	2	118.8	N	https://itams	5	4	5	0	0	Stringer/Mult	82
Greenfield	I65-114-05367 C	36720	9	124369	I-65	4	2	127.3	N	https://itams	5	4	5	0	0	Stringer/Mult	82
Greenfield	I65-114-05369 C	36760	2	167273	I-65	4	2	148.6	N	https://itams	5	4	5	0	0	Stringer/Mult	82
Greenfield	I65-115-05370 C	36770	6	167273	I-65	4	2	124	N	https://itams	5	4	5	0	0	Stringer/Mult	82
Crawfordsv	I70-059-05180 CEBL	41780	0	51175	I-70 EB	1	1	48.7	R	https://itams	4	5	5	2	0	Slab	82
Crawfordsv	I70-059-05180 JCWB	41790	0	51175	I-70 WB	1	1	52.4	L	https://itams	4	5	5	2	0	Slab	82
Crawfordsv	I70-063-05182 CEBL	41830	0	65674	I-70 EB	1	1	39.7	R	https://itams	4	5	5	2	0	Stringer/Mult	82
Crawfordsv	I70-063-05182 CWBL	41840	0	65674	I-70 WB	1	1	39.7	L	https://itams	4	5	5	2	0	Stringer/Mult	82
Greenfield	I70-077-05391 C	42120	11	102132	I-70	2	2	105.5	N	https://itams	5	4	5	0	0	Stringer/Mult	82
Greenfield	I70-078-05394 B	42160	2	163150	I-70	2	2	107.1	N	https://itams	5	4	5	0	0	Stringer/Mult	82
Greenfield	I70-078-05395 A	42180	15	143345	I-70	2	2	105.8	N	https://itams	5	4	5	0	0	Stringer/Mult	82
Greenfield	I70-080-05646 E	42260	2	109416	I-70	1	2	116.7	N	https://itams	5	4	5	0	0	Stringer/Mult	82
Greenfield	I70-080-05648 B	42280	2	137908	I-70	1	2	116.4	N	https://itams	5	4	5	0	0	Stringer/Mult	82

Figure 4.6 System-Level Analysis Spreadsheet (Showing Only a Limited Number of Bridges).

Contact(s)	Asset Name	Skew	ADT	Facility Carried	Detour Length	Rdwy Width	ADT Rating	Geometry Rating	Facility Rating	Clear Rdwy Rating	Detour Rating	Final Score
La Porte	I80-05-07833 A	8	185778	I-80 WB RAMP	1	35.7	5	4	5	5	0	92

Figure 4.7 Top-Rated Bridge: Asset I80-05-07833 A (iTAMS, 2025; Maps Data: Google ©2025).

Contact(s)	Asset Name	Skew	ADT	Facility Carried	Detour Length	Rdwy Width	ADT Rating	Geometry Rating	Facility Rating	Clear Rdwy Rating	Detour Rating	Final Score
La Porte	I80-02-08472 AEBL	0	172512	I-80/I-94 EB	1	85.8	5	5	5	0	0	85

Figure 4.8 Top-Rated Bridge: Asset I80-02-08472 AEBL (iTAMS, 2025; Maps Data: Google ©2025).

Contact(s)	Asset Name	Skew	ADT	Facility Carried	Detour Length	Rdwy Width	ADT Rating	Geometry Rating	Facility Rating	Clear Rdwy Rating	Detour Rating	Final Score
Seymour	050-15-02169 C	99	21622	US 50	10	57.3	3	0	3	5	5	57

Figure 4.9 Top-Rated Bridge: Asset I465-124-05268 CNBL (iTAMS, 2025; Maps Data: Google ©2025).

Contact(s)	Asset Name	Skew	ADT	Facility Carried	Detour Length	Rdwy Width	ADT Rating	Geometry Rating	Facility Rating	Clear Rdwy Rating	Detour Rating	Final Score
Greenfield	I465-124-05268 CNBL	0	101476	I-465 NB	2	76.3	5	5	5	0	0	85

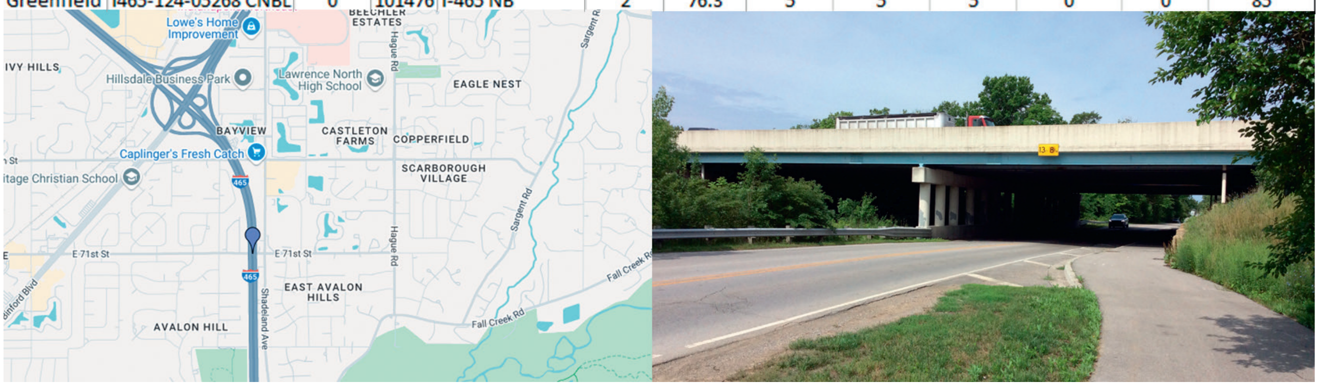


Figure 4.10 Mid-Score Bridge: Asset 050-15-02169 C (iTAMS, 2025; Maps Data: Google ©2025).

geometry rating is 0. The deck width of 57.3 feet is not sufficient to maintain traffic during staged construction, resulting in a clear roadway score of 5. The detour length of 10 mi leads to a detour rating of 5.

Figure 4.11 shows a second mid-score bridge, Asset 066-82-08006 AEBL, with a final score of 53. This bridge carries SR 66 EB with an ADT of 46,155, earning a moderate traffic rating of 3. Its geometry score is 0 due to its curved geometry. Facility Carried scores 3, as it is a state route. The clear roadway width of 53.7 feet does not allow for staged construction, rating 3 for clear roadway. The 10-mile detour earns a detour score of 5.

Figure 4.12 shows another mid-score bridge with a score of 52, Asset 006-17-03843 C. This bridge has an ADT of 6,458, leading to a low rating of 1, and it is located on the highway US 6, equivalent to a score of 3. With a skew of 15°, it is rated 4 for geometry. The clear roadway width would not allow staged construction, to keep traffic in both directions of the bridge, resulting in a clear roadway score of 5.

Figure 4.13 shows a low-score bridge, Asset P000-75-07444, with a score of 12. This bridge carries Thayer Road and has an ADT of 1,807, resulting in an ADT score of 0. It has a curved geometry, rating 0 in geometry. As a local road, it receives 0 for Facility Carried. The deck width of 31.5 feet would not allow staged construction, leading to a clear roadway rating of 5.

Figure 4.14 shows Asset (37)I69-55-10531, also with a low score of 12. The bridge carries Perry Road and has an ADT of only 1,200, scoring 0 for ADT. It is a curved bridge leading to a geometry score of 0, and the Facility Carried score is 0 since it is a local road. It has a narrow width (36.1 feet), resulting in a clear roadway rating of 5 due to the need for full closure. The detour length is 3 mi, giving a detour rating of 2.

Figure 4.15 shows Asset P000-31-07079 A, which has the lowest score of 6. The ADT is extremely low (143), and the bridge carries Cold Friday Road, which both result in 0 scores for ADT and Facility Carried. It has a skew angle of 40°, resulting in a geometry rating of 2.

Contact(s)	Asset Name	Skew	ADT	Facility Carried	Detour Length	Rdwy Width	ADT Rating	Geometry Rating	Facility Rating	Clear Rdwy Rating	Detour Rating	Final Score
Vincennes	066-82-08006 AEBL	99	46155	SR 66 EB	10	53.7	3	0	3	3	5	53

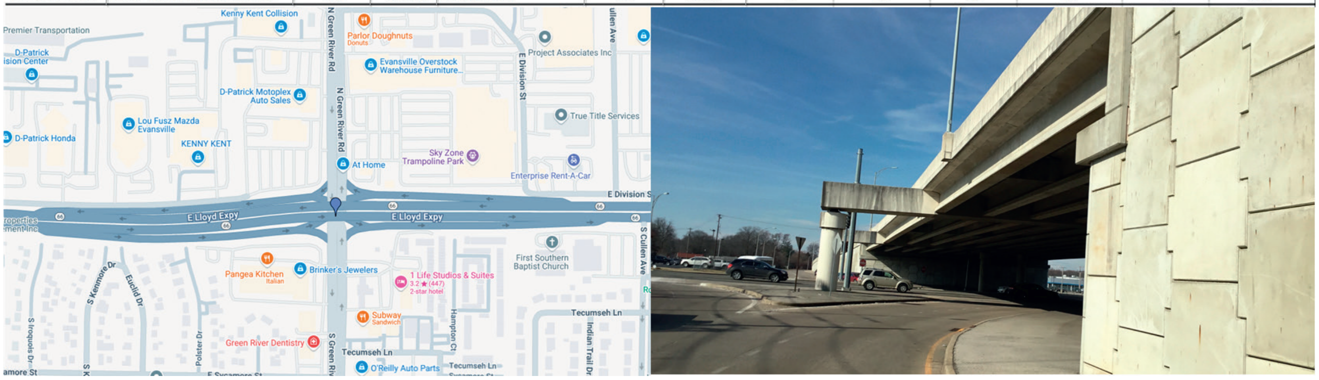


Figure 4.11 Mid-Score Bridge: Asset 066-82-08006 AEBL (iTAMS, 2025; Maps Data: Google ©2025).

Contact(s)	Asset Name	Skew	ADT	Facility Carried	Detour Length	Rdwy Width	ADT Rating	Geometry Rating	Facility Rating	Clear Rdwy Rating	Detour Rating	Final Score
Fort Wayne	006-17-03843 C	15	6458	US 6	3	43.3	1	4	3	5	2	52

Figure 4.12 Mid-Score Bridge: Asset (46)7-03-01811 C (iTAMS, 2025; Maps Data: Google ©2025).

Contact(s)	Asset Name	Skew	ADT	Facility Carried	Detour Length	Rdwy Width	ADT Rating	Geometry Rating	Facility Rating	Clear Rdwy Rating	Detour Rating	Final Score
La Porte	I65-231-04889B	99	1807	THAYER RD	4	31.5	0	0	0	5	2	12

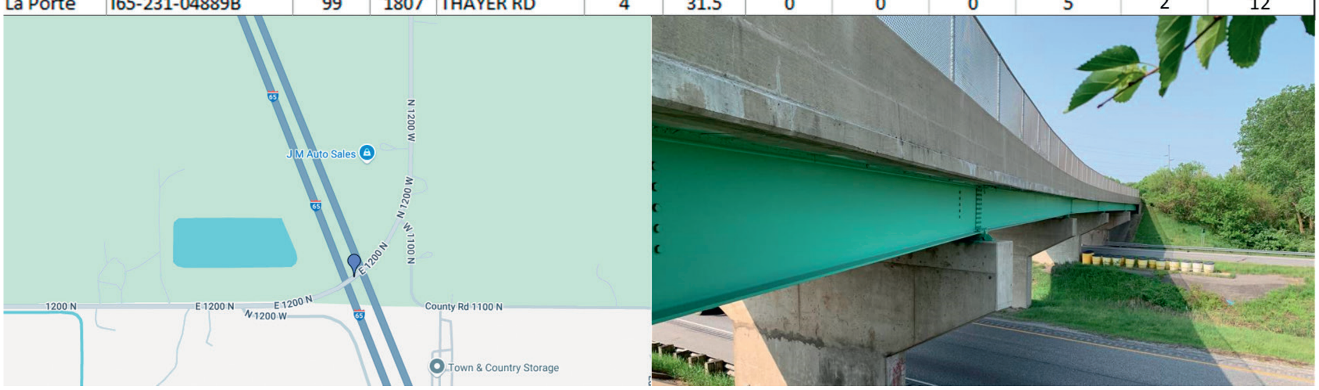


Figure 4.13 Low-Score Bridge: Asset I65-231-04889B (iTAMS, 2025; Maps Data: Google ©2025).

Contact(s)	Asset Name	Skew	ADT	Facility Carried	Detour Length	Rdwy Width	ADT Rating	Geometry Rating	Facility Rating	Clear Rdwy Rating	Detour Rating	Final Score
Seymour	(37)I69-55-10531	99	1200	PERRY RD	3	36.1	0	0	0	5	2	12

Figure 4.14 Low-Score Bridge: Asset (37)I69-55-10531 (iTAMS, 2025; Maps Data: Google ©2025).

Contact(s)	Asset Name	Skew	ADT	Facility Carried	Detour Length	Rdwy Width	ADT Rating	Geometry Rating	Facility Rating	Clear Rdwy Rating	Detour Rating	Final Score
Seymour	P000-31-07079 A	40	143	COLD FRIDAY RD	0	12.5	0	2	0	0	0	6

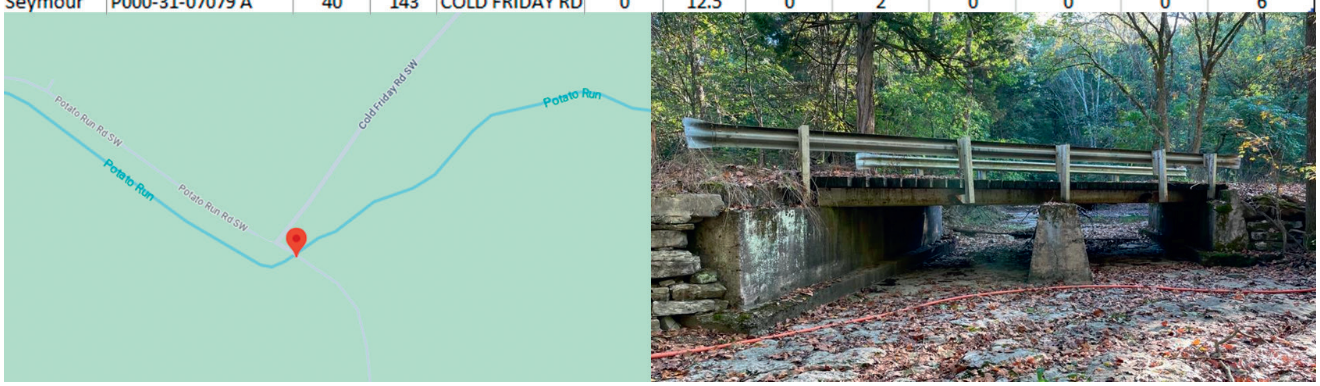


Figure 4.15 Low-Score Bridge: Asset P000-31-07079 A (iTAMS, 2025; Maps Data: Google ©2025).

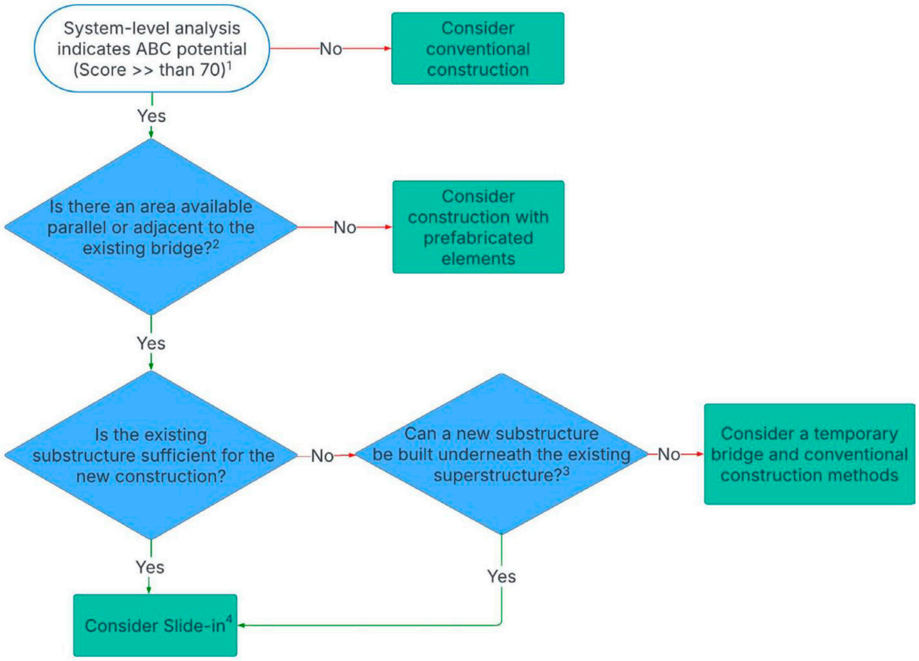
4.3 Site-Specific Decision-Making Flowchart for ABC

The site-specific decision-making flowchart for ABC (Figure 4.16) was developed to assist asset managers and decision-makers in considering ABC and defining which ABC methodology would be the most appropriate considering construction site limitations and project conditions. It would be used at an early design stage, according to Figure 4.3, where enough information can be gathered for the project and considerations about the construction site can be made. It also focuses on bridges which scored highly (i.e., greater than 70) on the system-level analysis.

The "Decision-making Flowchart for Superstructure Construction over Roadway or Land" from the FHWA ABC manual (Culmo, 2011) was used as reference and properly adapted for Indiana's needs based on findings from interviews with stakeholders and SAC feedback. At the time this flow-chart was developed, SPMTs were not readily available in Indiana and were considered cost prohibitive. As a result, the SPMT option available in existing FHWA flowchart was not considered.

In the developed site-specific decision-making flowchart for ABC (Figure 4.16), three ABC technologies considered the most suitable for Indiana were included: (1) PBES, which was highly recommended by stakeholders due to its potential to reduce on-site construction time; (2) bridge slide-in, that provides rapid bridge replacement, minimizing traffic disruption; and (3) temporary bridges, which is an effective solution for maintaining traffic while the primary bridge is under construction.

By utilizing this flowchart, INDOT can standardize ABC decision-making, ensuring that the most efficient and effective construction methodology is selected for each project.



[1] At the time this flow-chart was developed a score above 70 represented 9% of the Indiana Department of Transportation vehicular bridge inventory (i.e., 587 bridges) and was deemed an appropriate cut-off. If the cost of ABC is reduced in the future, the cut-off score may be reduced.

[2] At the time this flow-chart was developed, self-propelled modular transporters (SPMTs) were not readily available in Indiana and were considered cost prohibitive. As a result, this flow-chart focuses on prefabricated bridge elements, slide-ins, and temporary bridges. SPMTs may be considered in the future.

[3] Consider permanently widening the existing structure to serve as a temporary traffic lane for the project and a future additional travel lane.

[4] See SHRP2 ABC Toolkit and Projects using the Toolkit, including the I-70 over SR121 case study (INDOT, 2016).

Figure 4.16 Site-Specific Decision-Making Flowchart for ABC.

5. CONCLUSIONS, RECOMMENDATIONS, BENEFITS, AND IMPLEMENTATION

5.1 Summary of Research Findings

This research has demonstrated that Indiana has significant potential to benefit from increased adoption of ABC technologies. The synthesis of existing guidelines and recommendations from FHWA and various states DOTs served as a foundation to identify what resources would be the most valuable and the best practices applicable to Indiana. Additionally, interviewing key stakeholders in Indiana, including designers, fabricators and contractors, provided the perspective of the industry on ABC and revealed areas for improvement such as enhancing workforce skills, improving communication among project participants, and establishing clear decision-making frameworks.

Despite the challenges identified, this research also gathered important recommendations to enhance ABC implementation in Indiana. Key recommendations included the prioritization of ABC methods such as PBES, slide-in construction, and temporary bridges, given that they align well with the state's existing capabilities and can be efficiently applied. Furthermore, stakeholders emphasized the need for clear project definitions and incentives for training programs to increase industry confidence and participation in ABC projects.

A major outcome of this research was the development of a two-stage approach for evaluating which bridges should be prioritized for ABC, including: (1) a system-level analysis tool that scores all bridges in the Indiana DOT inventory and (2) a site-specific decision-making flowchart to be used at an early stage of design for a specific bridge. These contributions aim to facilitate the decision-making process, providing early identification of ABC candidates.

5.2 Expected Benefits, Deliverables, and Implementation

This research has contributed to the current INDOT strategic priorities as described in Table 5.1.

This research has led to two products for Indiana DOT to use to determine if a project should be considered for ABC:

- *System-Level Analysis Tool*: A Python-based computer code that uses existing data and automatically scores all bridges in the Indiana bridge inventory according to their potential

TABLE 5.1
Research Contributions to INDOT Strategic Priorities.

INDOT Strategic Priority	Research Contributions
Time Savings	ABC can significantly reduce on site construction time by using technologies such as PBES and slide-in construction. The system-level analysis tool developed in this research automatically scores all bridges in the Indiana inventory to identify strong ABC candidates early in the project scoping stage, streamlining the decision-making process. Additionally, the site-specific decision-making flowchart guides ABC feasibility evaluation, reducing the time required for a specific project assessment.
Cost Savings	PBES and slide-in technologies are well aligned with Indiana's current fabrication and construction capabilities. Focusing on these ABC methods helps avoid excessive costs due to unfamiliar or complex systems. The research emphasized standardization and prefabrication, which help reduce onsite labor, avoid schedule delays, and enhance cost predictability throughout project delivery.
Safety	ABC techniques significantly reduce work zone duration, minimizing the exposure of both construction workers and the traveling public to active construction hazards.
Mobility/Reduced Congestion	Promoted ABC strategies reduce road closure durations, leading to less disruption to traffic flow during bridge replacement or rehabilitation. In addition, the system-analysis tool prioritizes bridges located on high-traffic corridors (i.e., Interstates), where minimizing traffic disruptions is critical.
Quality	The use of PBES improves construction quality by allowing elements to be fabricated in controlled environments, enhancing precision. The system-level analysis tool also provides consistent evaluation criteria for ABC project suitability.

for ABC. The scores are calculated based on available data in iTAMS for the following criteria: (1) ADT, (2) facility carried, (3) geometry, (4) clear roadway, and (5) detour length. The computer code is included in Appendix B. A user manual, included in Appendix C, has been written to facilitate use by INDOT. The computer code will be stored and used internally by INDOT

- *Site-Specific Decision-Making Flowchart for ABC:* Based on the findings of this research, a set of guidelines and recommendations for using ABC have been developed to further evaluate if ABC should be used for a specific bridge. This flowchart is intended to be used at an early stage in the design process and is shown in Appendix D. The flowchart will be made available on the INDOT Bridge Design website.

The intention is that the system-analysis tool could be used periodically (e.g., once per year) to score all bridges in the inventory. Then, during the scoping stage of a bridge project, an INDOT asset manager could consult the scores to determine if a bridge is a strong candidate for ABC early in the process. The site-specific decision-making flowchart for ABC would be used later in the project by the designer (e.g., during early design development). Both tools are intended to help INDOT prioritize projects where the benefits of ABC are most likely to justify the high initial costs compared to conventional construction.

This research has been disseminated through a poster presentation at the Joint Transportation Research Program Poster Session:

> Duarte, C. N., Linder J. L., & Thrall A. P. (2025, February 19) *SPR-4843: Advancing accelerated bridge construction and fabrication in Indiana* [Poster presentation]. Joint Transportation Research Program Poster Session, Indianapolis, Indiana.

and a master's thesis:

> Duarte, C. N. (2025). Advancing accelerated bridge construction including a novel deployable tool for cross-frame installation [Unpublished master's thesis]. University of Notre Dame.

5.3 Future Studies

Future research on this topic to support ABC implementation could include a detailed cost-benefit analysis comparing ABC to conventional construction in Indiana, considering construction, lifecycle, and user costs. This study would provide contractors with resources to provide more accurate cost estimates and improve the accuracy of project bidding, ultimately making ABC a more viable and widely adopted approach in the state.

REFERENCES

American Association of State Highway and Transportation Officials. (2018). *LRFD guide specifications for accelerated bridge construction.* https://store.transportation.org/Item/PublicationDetail?ID=4134

American Association of State Highway and Transportation Officials (2020). *LRFD bridge design specifications* (9th ed.). https://trid.trb.org/View/1704698

American Institute of Steel Construction. (2022a). *Accelerated steel: Achieving speed in steel bridge fabrication.* https://www.aisc.org/media/ogffyb05/nsba-accelerated-steel.pdf

American Institute of Steel Construction. (2022b). Chapter 17: Bridge deck design (American Institute of Steel Construction Publication No. B917-22). In *Steel bridge design handbook*. https://www.aisc.org/media/yo1lndg0/b917_sbdh_chapter17.pdf

Arizona Department of Transportation. (2018). *Accelerated bridge construction (ABC) guidelines*. https://azdot.gov/business/engineering-and-construction/bridge/bridge-design-services/accelerated-bridge-construction

Arizona Department of Transportation. (n.d.). *ABC decision flowchart*. https://azdot.gov/sites/default/files/2019/05/bridge-abc-flowchart.pdf

Arnold, B., Heidenreich, K., & Wagner, S. (2024). *US 33 over Blue River: ABC's with steel* [Conference presentation]. Purdue Road School, West Lafayette, Indiana. https://docs.lib.purdue.edu/roadschool/2024/presentations/8

Barutha, P., Maguire, M., Saldana, E., & Pozo-Lora, F. F. (2024). *ABC decision tool final report* (Nebraska Department of Transportation Report No. SPR-FY22[009]). https://dot.nebraska.gov/media/gs1ds04h/2024-abc-decision-tool-final-report.pdf

California Department of Transportation. (2021). *Accelerated bridge construction manual*. https://dot.ca.gov/-/media/dot-media/programs/engineering/documents/abc/ctabc-2021-06-30_a11y.pdf

Colorado Department of Transportation. (2024). *Bridge design manual*. https://www.codot.gov/programs/bridge/bridge-manuals/design_manual/cdot_bridge_design_manual_2024_02.pdf

Connecticut Department of Transportation. (2017). *ABC matrix decision-making tool.* https://portal.ct.gov/dot/bureaus/engineering-and-construction/engineering/bridges/standard-practices?language=en_US

Culmo, M. P. (2011). *Accelerated bridge construction: Experience in design, fabrication, and erection of prefabricated bridge elements and systems* (Federal Highway Administration Report No. FHWA-HIF-12-013*)*. https://www.fhwa.dot.gov/bridge/abc/docs/abcmanual.pdf

Culmo, M. P. (2017). Recommended guidelines for prefabricated bridge elements and systems tolerances and recommended guidelines for dynamic effects for bridge systems (National Cooperative Highway Research Program Project 12-98). https://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w243.pdf

Delaware Department of Transportation. (2015). *Accelerated bridge construction workshop presentations*. FHWA DelDOT Workshop, Dover, Delaware. https://deldot.gov/Business/drc/index.shtml?dc=abc_workshop

Doolen, T., Saeedi, A., & Emami, S. (2011). *Accelerated bridge construction (ABC) decision making and economic modeling tool* (Oregon Department of Transportation Report No. FHWA-OR-TPF-12-06). Oregon State University. https://www.oregon.gov/odot/Programs/ResearchDocuments/ABC.pdf

Federal Highway Administration. (2005). *Framework for prefabricated bridge elements and systems decision-making.* https://www.fhwa.dot.gov/bridge/prefab/if06030.pdf

Federal Highway Administration. (2007). *Manual on use of self-propelled modular transporters to remove and replace bridges.* https://www.fhwa.dot.gov/bridge/prefab/if06030.pdf

Federal Highway Administration. (2013a). *Contracting and construction of accelerated bridge construction projects with prefabricated bridge elements and systems* (Federal Highway Administration Report No. FHWA-HIF-17-020). https://www.fhwa.dot.gov/bridge/pubs/hif17020.pdf

Federal Highway Administration. (2013b). *Slide-in bridge construction implementation guide.* https://www.fhwa.dot.gov/construction/sibc/pubs/sibc_guide.pdf

Federal Highway Administration. (2014). *Slide-in bridge construction: Case study* (Federal Highway Administration Report No. FHWA-HIF-13-057). https://www.fhwa.dot.gov/construction/sibc/pubs/hif13057.pdf

Federal Highway Administration. (2015). *Slide-in bridge construction cost estimation tool guidelines.* https://www.fhwa.dot.gov/construction/sibc/pubs/costest/sibc_costest.pdf

Federal Highway Administration. (2017). *Prefabricated bridge elements and systems cost study: Accelerated bridge construction success stories.* https://www.fhwa.dot.gov/bridge/prefab/successstories/091104/index.cfm

Federal Highway Administration. (2018). *Self-propelled modular transporters (SPMTs).* https://www.fhwa.dot.gov/bridge/abc/spmts.cfm

Federal Highway Administration. (2021). *Accelerated bridge construction.* https://www.fhwa.dot.gov/bridge/abc/

Federal Highway Administration. (2022). *Accelerated bridge construction.* https://www.fhwa.dot.gov/innovation/everydaycounts/edc-2/pdfs/edc_abc.pdf

Florida Department of Transportation. (2025a). *Monthly webinars archives*. https://abc-utc.fiu.edu/webinars/webinar-archives/

Florida Department of Transportation. (2025b). *Structures detailing manual*. Retrieved March 26, 2025 from https://www.fdot.gov/structures/structuresmanual/currentrelease/structuresmanual.shtm

Georgia Department of Transportation. (2024). *Accelerated bridge construction guidance*. https://www.dot.ga.gov/PartnerSmart/DesignManuals/BridgeandStructure/Accelerated%20Bridge%20Construction%20Guidance.pdf

Huebschman, C. R., Garcia, C., Bullock, D. M., & Abraham, D. M. (2003). *Construction work zone safety* (Joint Transportation Research Program Publication No. FHWA/IN/JTRP-2002/34*)*. Indiana Department of Transportation and Purdue University. https://doi.org/10.5703/1288284313166

Iowa Department of Transportation. (2014). *2014 accelerated bridge construction (ABC) workshop*. https://iowadot.gov/bridge/research-and-investigations/accelerated-bridge-construction

Iowa Department of Transportation. (2025). *LRFD bridge design manual*. https://iowadot.gov/bridge/policy/LRFDBridgeDesignManual.pdf

Indiana Department of Transportation. (2003). *Concrete barrier standard drawing NO. E 602-CCMB-01.* https://www.in.gov/dot/div/contracts/standards/drawings/sep24/600e/e600%20combined%20pdfs/E602-CCMB.pdf

Indiana Department of Transportation. (2016). *SHRP2 ABC toolkit and projects using the toolkit.* https://www.in.gov/dot/div/contracts/standards/bridges/2016%20Bridge%20Conference/ABC%20and%20the%20ABC%20Toolkit.pdf

Indiana Department of Transportation. (2017). *Interstate highway congestion policy.* https://www.in.gov/indot/safety/work-zone-safety/interstate-highways-congestion-policy/

Indiana Department of Transportation. (2019). *Temporary concrete barrier standard drawing NO. E 801-TCCB.* https://www.in.gov/dot/div/contracts/standards/drawings/sep24/800e/e800%20combined%20pdfs/E801-TCCB.pdf

Indiana Department of Transportation. (2021a). *Determination of significant work zone impacts worksheet.* https://www.in.gov/dot/div/contracts/design/dmforms/Significant%20Work%20Zone%20Impact%20Determination%20Worksheet.pdf

Indiana Department of Transportation. (2021b). *INDOT Project development process*. https://www.in.gov/indot/files/2021-INDOT-State-Project-Development-Process.pdf

Indiana Department of Transportation. (2022). *Accelerated bridge construction*. https://www.in.gov/dot/div/contracts/abc/accBridge.htm

Indiana Department of Transportation. (2025). *iTAMS: INDOT total asset management system* (v25.01.1-rc.1 - 2025-01-20). https://itams.sixense.co

Kentucky Transportation Cabinet. (2013). *Accelerated bridge construction (ABC)*. https://transportation.ky.gov/StructuralDesign/Pages/Accelerated-Bridge-Construction.aspx

Massachusetts Department of Transportation. (2024). Part III: Prefabricated bridge elements. In *MassDOT Bridge Manual: Hundredth Anniversary Edition*. https://www.mass.gov/info-details/part-iii-prefabricated-bridge-elements-hundredth-anniversary-edition

Michigan Department of Transportation. (2013). Chapter 7: Design criteria—New and reconstruction projects. In *Michigan design manual bridge design*. https://mdotjboss.state.mi.us/stdplan/getStandardPlanDocument.htm?docGuid=3083d916-623d-4418-bb5f-3022984b2c6b

Michigan Department of Transportation. (2014a). *Accelerated bridge construction and structural move–Workshop* (Michigan Department of Transportation Report No. RC-1610). Western Michigan University. https://mdotjboss.state.mi.us/TSSD/getTSDocument.htm?docGuid=b4047963-09af-4454-a3d6-4bc91041fe84&fileName=SPR-1610-Report.pdf

Michigan Department of Transportation. (2014b). *Project scoping manual, Chapter 6: Items to Consider When Scoping a Project*. https://mdotjboss.state.mi.us/stdplan/

Minnesota Department of Transportation. (2025a). *Example accelerated bridge construction options*. https://www.dot.state.mn.us/bridge/abc/abc-options.html

Minnesota Department of Transportation. (2025b). *National accelerated bridge construction resources*. https://www.dot.state.mn.us/bridge/abc/national-resources.html

National Cooperative Highway Research Program. (2019). *NCHRP 12-102A: AASHTO guide specification for ABC design and construction—Implementation workshops* [Workshop materials]. https://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=5433

New Jersey Department of Transportation. (2016). Section 37: Prefabricated bridge elements and systems (PBES). In *Design manual for bridges and structures* (6th ed.) (pp. 228–230). https://www.nj.gov/transportation/eng/documents/BSDM/pdf/2016DesignManualforBridgesandStructures20180604.pdf

Oregon Department of Transportation. (2012). *ABC AHP decision tool manual* (Project No. TPF-5[221]). https://www.fhwa.dot.gov/bridge/abc/dmtool/software_manual.pdf

Oregon Department of Transportation. (2017). *ABC AHP decision tool*. https://www.fhwa.dot.gov/bridge/abc/fast.cfm

Oregon Department of Transportation. (2024). Section 1.16.2: Accelerated bridge construction (ABC) guidelines. In *Bridge design manual* (pp. 1-462–1-484). https://www.oregon.gov/odot/Bridge/Guidance/BDM-2024-10.pdf

Precast/Prestressed Concrete Institute. (2021). *Northeast Extreme Tee (NEXT) beam guide details.* https://www.pci.org/PCI_Docs/PCI_Northeast/Technical_Resources/Bridge/NEXT-BEAM-GUIDE-DETAILS.pdf

Precast/Prestressed Concrete Institute. (2022). *Guidelines for precast substructures used in ABC* (Report No. PCINE-22-GPSABC). https://www.pci.org/PCI_Docs/PCI_Northeast/Technical_Resources/Bridge/2022_05_13%20PCINE-22-GPSABC.pdf

Precast/Prestressed Concrete Institute. (2023). *Bridge design manual (4th edition).* https://www.pci.org/PCI/PCI/Bookstore/Item_Detail.aspx?iProductCode=MNL-133-23&Category=FREE

Schickel, S. R. (2020). *State of ABC in state of Indiana* [Conference presentation]. Indiana Bridge Design Conference, Indianapolis, Indiana. https://www.in.gov/indot/files/08-ABC-Indiana.pdf

Strategic Highway Research Program 2. (2013). Innovative bridge designs for rapid renewal ABC Toolkit. SHRP2.

Summers, J. (2022). Indiana DOT completes first all-precast bridge replacement using carbon nanofiber UHPC. *Roads & Bridges.* https://www.roadsbridges.com/concrete/article/10654549/indiana-dot-completes-first-all-precast-bridge-replacement-using-carbon-nanofiber-uhpc.

Texas Department of Transportation. (2017). *Accelerated construction economic screening tool*. https://ftp.txdot.gov/pub/txdot/cst/regional-workshops/economic-screening-tools.xlsx

Texas Department of Transportation. (2018). *Accelerated construction guidelines*. https://ftp.txdot.gov/pub/txdot/cst/regional-workshops/accelerated-construction-guidelines.pdf

Thrall, A. P., Mutoka, S. C., & Tumbeva, M. D. (2024). *A new approach to accelerated fabrication of steel bridges: Design, optimization, and demonstration* (Joint Transportation Research Program Publication No. FHWA/IN/JTRP-2024/36). Purdue University. https://doi.org/10.5703/1288284317814

Tumbeva, M. D., Mutoka, S. C., Thrall, A. P., Zoli, T. P., Wagner, S., & Baah, P. (2023). Built-up press brake-formed tub girders. *Journal of Bridge Engineering*, *28*(12). https://doi.org/10.1061/JBENF2.BEENG-6103

Utah Department of Transportation. (2014). *ABC rating procedure spreadsheet and decision flow chart*. https://drive.google.com/uc?export=download&id=1URJLeOVqInbsLYAhYStEEpKgTGdDRYN3

Utah Department of Transportation. (2022). *Structures design and detailing manual*. https://connect.udot.utah.gov/business/structures-geotechnical-guidance-manuals/structures-design-detailing-manual/

Utah Department of Transportation. (2023a). *Performance of accelerated bridge construction projects in Utah as of May 2023*. https://drive.google.com/file/d/1DPnKaGJwQFRPfS-ykTdvaP5DaOlmPKBj/view?usp=drive_link

Utah Department of Transportation. (2023b). *Structures & geotechnical guidance and manuals*. https://www.udot.utah.gov/connect/business/structures-geotechnical-guidance-manuals/

Volk, M., Freesemen, K., & Shane, J. (2019). *Indiana accelerated bridge construction case study.* https://abc-utc.fiu.edu/wp-content/uploads/2019/07/Indiana_ABC_case_study_t2.pdf

Washington State Department of Transportation. (2024). Chapter 14: Accelerated and innovative bridge construction. In *WSDOT bridge design manual* (pp. 14-i–14-20) https://wsdot.wa.gov/publications/manuals/fulltext/M23-50/Chapter14.pdf

Wisconsin Department of Transportation. (2019). Chapter 7: Accelerated bridge construction. In *WisDOT bridge manual* (pp. 7-1–7-39). https://wisconsindot.gov/dtsdManuals/strct/manuals/bridge/ch7.pdf

APPENDICES

Appendix A. Interview Questions for Stakeholders

Appendix B. Computer Code for System-Level Analysis

Appendix C. User Manual for System-Level Analysis

Appendix D. Site-Specific Decision-Making Flowchart

Appendix A. Interviews Questions for Stakeholders

Designers & Contractors

1. In your experience, what are the biggest challenges facing bridge fabrication, construction in Indiana?
2. Have you been involved in any projects that utilized Accelerated Bridge Construction (ABC) or Accelerated Bridge Fabrication (ABF) methods?
3. If yes, can you briefly describe your role and the project?
4. What are the biggest obstacles you see to implementing ABC/ABF methods in Indiana?
5. Are there specific project types or situations where you think ABC/ABF would be most beneficial?
6. What changes to current design standards, contracting practices, or workforce skills would be necessary for wider adoption of ABC/ABF?
7. What ABC or ABF technologies would be most appropriate for Indiana?
8. How can collaboration between designers, fabricators, and contractors be improved during the ABC/ABF project planning stages?
9. What type of guidelines or resources would you find most valuable to support implementing ABC/ABF projects in Indiana?
10. Are you aware of any ABC or ABF projects completed in Indiana? If yes, can you share any insights or lessons learned from those projects? Were there any specific challenges or successes encountered during those projects?
11. Is there any additional information you would like to share regarding ABC/ABF implementation in Indiana?

Fabricators

1. In your experience, what are the biggest challenges facing bridge fabrication and construction in Indiana?
2. Have you been involved in any projects that utilized Accelerated Bridge Construction (ABC) or Accelerated Bridge Fabrication (ABF) methods?
3. If yes, can you briefly describe your role and the project?

4. What are the biggest obstacles you see to implementing ABC/ABF methods in Indiana?
5. Are there specific project types or situations where you think ABC/ABF would be most beneficial?
6. How would the lead time for fabrication differ between traditional and ABC/ABF methods for similar bridge components?
7. What factors do you consider most important when evaluating the feasibility of taking on an ABC/ABF project?
8. What type of guidelines or resources would you find most valuable to support implementing ABC/ABF projects in Indiana?
9. How can designers and contractors better collaborate with fabricators during the planning stages of ABC/ABF projects to ensure successful outcomes?
10. Are there any incentives that would encourage fabrication shops to participate more actively in ABC/ABF projects?
11. Is there any additional information you would like to share regarding ABC/ABF implementation in Indiana?

Asset Managers

1. In your experience, what are the biggest challenges facing bridge fabrication, construction in Indiana?
2. Have you been involved in any projects that utilized ABC or ABF methods?
3. If yes, can you briefly describe your role and the project?
4. What type of data do you typically use to assess the need for bridge repair or replacement?
5. What kind of information would be most helpful to you in determining if ABC or ABF is a suitable option for a particular bridge project?
6. Are there any data gaps or challenges hindering your ability to consider ABC/ABF for bridge projects?
7. What ABC or ABF technologies would be most appropriate for Indiana?
8. Are you aware of any existing guidelines or resources related to ABC/ABF that you find helpful? If so, can you elaborate on how these resources have been beneficial?

9. What type of guidelines or resources would you find most valuable to support implementing ABC/ABF projects in Indiana?
10. Are you aware of any ABC or ABF projects completed in Indiana? If yes, can you share any insights or lessons learned from those projects? Were there any specific challenges or successes encountered during those projects?
11. Is there any additional information you would like to share regarding ABC/ABF implementation in Indiana?

Load Rater & Inspectors

1. In your experience, what are the biggest challenges facing bridge fabrication, construction in Indiana?
2. Have you been involved in any projects that utilized ABC or ABF methods?
3. If yes, can you briefly describe your role and the project?
4. How comfortable are you with the level of inspection and quality control required for ABC/ABF components?
5. Are there any concerns you have regarding the long-term performance and safety of ABC/ABF bridges?
6. What ABC or ABF technologies would be most appropriate for Indiana?
7. Are you aware of any existing guidelines or resources related to ABC/ABF that you find helpful? If so, can you elaborate on how these resources have been beneficial?
8. What type of guidelines or resources would you find most valuable to support implementing ABC/ABF projects in Indiana?
9. Are you aware of any ABC or ABF projects completed in Indiana? If yes, can you share any insights or lessons learned from those projects? Were there any specific challenges or successes encountered during those projects?
10. Is there any additional information you would like to share regarding ABC/ABF implementation in Indiana?

Appendix B. Computer Code for System-Level Analysis

The following script can be copied and pasted in a Python program runner. Note that lines that start with a hash symbol (#) and highlighted in gray correspond to a comment.

```
"""
Created on Thu Feb 6 14:11:08 2025

Author: Camila Duarte
Revised by: James (Luke) Linder
"""

#this command imports the functions to the library
import pandas as pd


#Creating functions for each criteria -> def function_name(parameters)
def rate_adt(adt):
    """Rate Average Daily Traffic (ADT)."""
    if adt <= 5000:
        return 0
    elif adt <= 10000:
        return 1
    elif adt <= 20000:
        return 2
    elif adt <= 50000:
        return 3
    elif adt <= 100000:
        return 4
    elif adt > 100000:
        return 5
    else:
        return 0

def rate_skew_angle(angle):
    """Rate Skew Angle (degrees)."""
    if angle == 0:
        return 5
    elif angle <= 15:
        return 4
    elif angle <= 30:
        return 3
    elif angle <= 60:
```

```
        return 2
    elif angle <= 98:
        return 1
    elif angle == 99: #correspondent to curved bridges
        return 0
    else:
        return 0


def rate_facility(facility):
    """Rate Facility Carried By Structure."""
    #checking if the information under the column is a string/text
    if not isinstance(facility, str):
        return 0

    if facility.startswith("I-") or facility.startswith("Ramp I"):
        return 5
    elif facility.startswith("US") or facility.startswith("SR"):
        return 3
    else:
        return 0

def rate_clear_rdwy(width, facility, direction, parallel_status, asset_name, data):
    """Rate Clear Rdwy based on Facility, Traffic Direction, and Parallel Structures."""

    # Check if facility, width, and direction are valid
    if not isinstance(facility, str) or pd.isna(width) or pd.isna(direction):
        return 0

    if direction == 0:
        return 0

    # Interstate w/ 2 bounds
    is_interstate = facility.startswith("I-") or facility.startswith("Ramp I")

    # Identify if the bridge has a parallel structure
    has_parallel = isinstance(parallel_status, str) and (
        "L" in parallel_status or "R" in parallel_status)

    # If this is an Interstate bridge with a parallel structure,
    #find its parallel bridge based on Asset name
    if is_interstate and has_parallel and isinstance(asset_name, str):
        # splits to a list, removes the last segment (e.g., 'JSBL')
        # ([-1]) and join is used to convert back to string
        asset_prefix = " ".join(asset_name.split(" ")[:-1])
```

```
    # Find asset name with the same prefix
    parallel_bridge = data[
        (data['Asset Name'].str.startswith(asset_prefix))
        & (data['Asset Name'] != asset_name)
    ]
    #This is going to match the parallel bridge to the current bridge
    if not parallel_bridge.empty:
        parallel_width = parallel_bridge.iloc[0][
            '(51) Brdg Rdwy Width Curb-To-Curb:']

        # Rating
        if width >= 55:
            return 0  # If bridge's own width maintain 2 lanes of traffic
        elif width == 0:
            return 0
        elif parallel_width >= 39:
            return 2  # If parallel bridge's width acommodate contraflow lane
        elif parallel_width < 39:
            return 5
        else:
            return 0

# Other Interstate
if is_interstate:
    if direction == 2 and width >= 82:
        return 0
    elif direction == 1 and width >= 55:
        return 0
    elif width == 0:
        return 0
    elif direction == 2 and width < 82:
        return 5
    elif direction == 1 and width < 55:
        return 5
    else:
        return 0

# Not Interstate
if direction == 2 and width >= 82:
    return 0
elif direction == 1 and width >= 55:
    return 0
elif width == 0:
    return 0
```

```
    elif direction == 2 and width >= 63:
        return 3
    elif direction == 1 and width >= 33:
        return 3
    elif direction == 2 and width < 63:
        return 5
    elif direction == 1 and width < 33:
        return 5
    else:
        return 0

#Each row is a column at the spreadsheet that will be used in this function
def apply_clear_rdwy_rating(row, data):
    return rate_clear_rdwy(
        row['(51) Brdg Rdwy Width Curb-To-Curb:'],
        row['(7) Facility Carried:'],
        row['(102) Direction of Traffic:'],
        row['(101) Parallel Structure:'],
        row['Asset Name'],
        data  # need to go over entire data to find parallel bridges
    )

def rate_detour_length(length):
    """Rate Detour Length."""
    #checking if the information under the column exists
    if pd.isna(length):
        return 0
    if length < 3:
        return 0
    elif length <= 6:
        return 2
    elif length <= 8:
        return 3
    elif length > 8:
        return 5
    else:
        return 0

#This function is not a Rating criterion, it provides the structure type
def get_structure_type_description(value):
    """
    Map the (43B) Structure Type, Main: Type of Design numeric code to its text.
    """
    if pd.isna(value):  # Check for missing values
        return "Unknown"
```

```
    mapping = {
        1:  "Slab",
        2:  "Stringer/Multi-beam or Girder",
        3:  "Girder and Floor beam System",
        4:  "Tee Beam",
        5:  "Box Beam or Girders - Multiple",
        6:  "Box Beam or Girders - Single or Spread",
        7:  "Frame (except frame culverts)",
        8:  "Orthotropic",
        9:  "Truss - Deck",
        10: "Truss - Thru",
        11: "Arch - Deck",
        12: "Arch - Thru",
        13: "Suspension",
        14: "Stayed Girder",
        15: "Movable - Lift",
        16: "Movable - Bascule",
        17: "Movable - Swing",
        18: "Tunnel",
        19: "Culvert (includes frame culverts)",
        20: "Mixed types",
        21: "Segmental Box Girder",
        22: "Channel Beam",
        0:  "Other"
    }
    return mapping.get(value, "Unknown")

#Creating the output file
def process_bridge_data(input_file, output_file):
    """
    Process bridge data from an Excel file and create a new Excel file with
    Rating scores, structure type description, and a final weighted score.
    """
    data = pd.read_excel(input_file)

    # Required columns to be exported from iTAMS
    required_cols = [
        '(29) Average Daily Traffic:',
        '(34) Skew:',
        '(7) Facility Carried:',
        '(51) Brdg Rdwy Width Curb-To-Curb:',
        '(102) Direction of Traffic:',
        '(19) Bypass Detour Length:',
        '(101) Parallel Structure:',
        'Asset Name'
```

```
    ]
    #if a criterion was not exported it will show this error message
    for col in required_cols:
        if col not in data.columns:
            raise ValueError(f"Column '{col}' not found in the input file.")

    # Convert to numeric where appropriate, to read the numbers for the ranting
    numeric_cols = [
        '(29) Average Daily Traffic:',
        '(34) Skew:',
         '(51) Brdg Rdwy Width Curb-To-Curb:',
        '(102) Direction of Traffic:',
        '(19) Bypass Detour Length:'
    ]
    data[numeric_cols] = data[numeric_cols].apply(
        pd.to_numeric, errors='coerce')

    # Create Rating columns example-> data['New Column'] = data['Data Column'
                                 #   ].apply(function_name)
    data['ADT Rating'] = data['(29) Average Daily Traffic:'].apply(rate_adt)
    data['Geometry Rating'] = data['(34) Skew:'].apply(rate_skew_angle)
    data['Facility Rating'] = data['(7) Facility Carried:'
                               ].apply(rate_facility)
    data['Clear Rdwy Rating'] = data.apply(apply_clear_rdwy_rating,
                                       axis=1, args=(data,))
    data['Detour Length Rating'] = data['(19) Bypass Detour Length:'
                                    ].apply(rate_detour_length)

  #  Structure Type Description
    data['Structure Type Description'] = data[
         '(43B) Structure Type, Main: Type of Design:'
         ].apply(get_structure_type_description)

#Final score

    data['Final Score'] = (
    data['ADT Rating'] * 7 +
    data['Geometry Rating'] * 3 +
    data['Facility Rating'] * 7 +
    data['Clear Rdwy Rating'] * 2 +
    data['Detour Length Rating'] * 1
)
    #Eliminate all Pedestrian bridges based on the facility carried information
    data =data[~data['(7) Facility Carried:'].str.contains("PEDESTRIAN",
                                                    case=False, na=False)]
```

```
    #Eliminate all railroad bridges based on direction of traffic equals to 0
    data =data[data['(102) Direction of Traffic:']!=0]

    #keeping hyperlink as a text, so it can be accessed in the output file
    data['Hyperlink'] = data['Hyperlink'].astype(str)

    data.to_excel(output_file, index=False)
    print(f"Processed data has been saved to {output_file}")

  # File names
input_excel_file = "Assets_export.xlsx"
output_excel_file = "bridge_data_with_ratings.xlsx"
process_bridge_data(input_excel_file, output_excel_file)
```

Appendix C. User Manual for System-Level Analysis

The system-level analysis uses Indiana's bridge inventory gathered from Indiana Total Assets Management Systems (iTAMS), applying individual scores for different criteria and calculating a weighted score for each bridge in Indiana's inventory. Note that these instructions are valid based on the iTAMS data available in 2025. This user manual or the script (see Appendix B) may need to be updated as software or data availability changes.

The following table shows the defined criteria and the respective indicators which would lead to the most beneficial scenario for the use of ABC (Table C.1).

Each criterion has a rating from 0–5 to which the weight factors are applied. The maximum score of all criteria combined is 100.

Table C.1 *Criteria*.

Criteria	Indicator for ABC	Justification	Weight factor
Average Daily Traffic (ADT)	Higher ADT	High ADT is given higher priority for quick replacement, because of closure impact	7
Facility Carried	Interstates	Interstates have a higher impact on INDOT mobility	7
Geometry	No skew	No skew, straight bridges can lead to quicker on-site assembly	3
Clear Roadway	Smaller width	Wider bridges can enable maintenance of traffic during phased construction	2
Detour Length	Longer detours	Longer detours lead to more user impact	1

Criteria Rating

Table C.2 through Table C.10 show the rating for each criterion.

Table C.2 *ADT Rating.*

Rating	ADT
0	<5,000
1	5,001-10,000
2	10,001-20,000
3	20,001-50,000
4	50,001-100,000
5	>100,000

Table C.3 *Facility Carried Rating.*

Rating	Facility Carried
0	Others (St., Road)
3	Highway (US, SR)
5	Interstate

Table C.4 *Geometry Rating.*

Rating	Geometry
0	Curved
1	Skew > 60
2	30 < Skew < 60
3	15 < Skew < 30
4	Skew <15
5	No Skew

Clear Roadway has different ratings depending on the facility carried by the bridge and the direction of traffic. The following tables apply to different scenarios: Interstate bridges without two bounds and traffic in two directions (Table C.5), Interstate bridges without two bounds and traffic in one direction (Table C.6), Interstate bridges with two bounds (Table C.7), non-Interstate bridges with traffic in two directions (Table C.8), and non-Interstate bridges with traffic in one direction (Table C.9).

Table C.5 *Interstate Bridges With Traffic in Two Directions Clear Roadway Rating.*

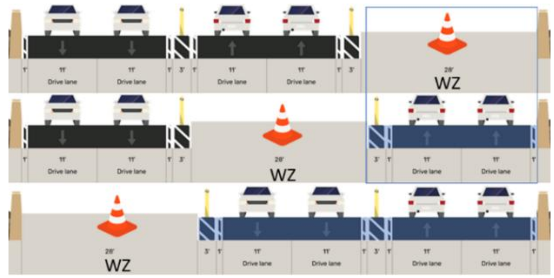
Clear Roadway Rating			Construction Stages
0	If can maintain 2 lanes of traffic in 2 directions	width > 82'	
5	Can't maintain traffic in 2 directions	width < 82'	

Table C.6 *Interstate Bridges With Traffic in One Direction Clear Roadway Rating.*

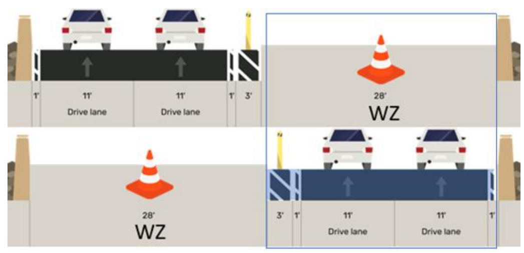
Clear Roadway Rating			Construction Stages
0	If can maintain 2 lanes of traffic in 1 direction	width > 55'	
5	Can't maintain traffic in 1 direction	width < 55'	

Table C.7 Interstate Bridges With Two Bounds Clear Roadway Rating.

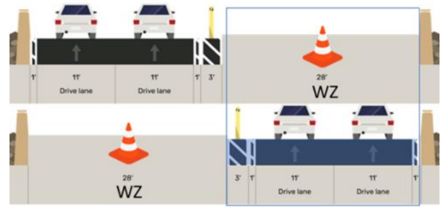
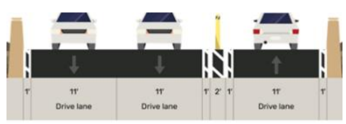
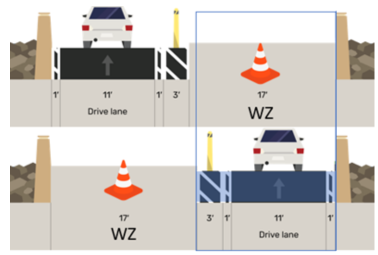
Clear Roadway Rating		Contra-Flow Bridge		Bridge to be Replaced, Construction Stages
0	If Interstate can maintain 2 lanes width > 55'	No cross-over necessary		
2	If contra-flow bridge can accommodate an extra lane	Opposite bridge w > 39'		
5	Can't maintain traffic on contra-flow bridge	Opposite bridge w < 39'		

__Table C.8__ Non-Interstate Bridges With Traffic in Two Directions Clear Roadway Rating.

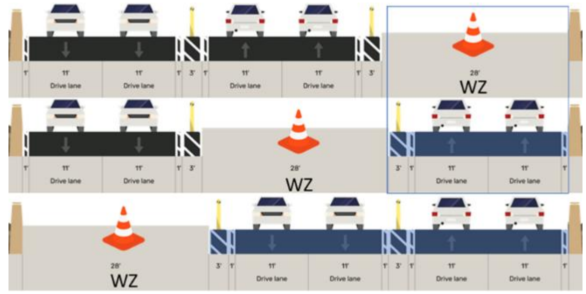
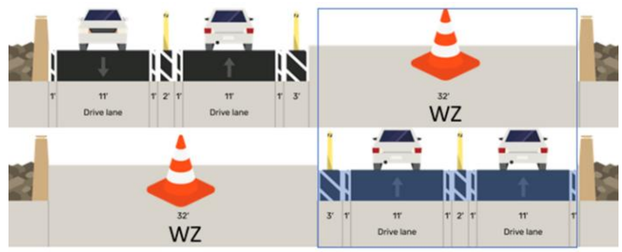
Clear Roadway Rating			Construction Stages
0	If can maintain 2 lanes of traffic in 2 directions	width > 82'	
3	If can maintain 1 lane of traffic in 2 directions	width > 63'	
5	Can’t maintain traffic in 2 directions	width < 63'	

Table C.9 Non-Interstate Bridges With Traffic in One Direction Clear Roadway Rating.

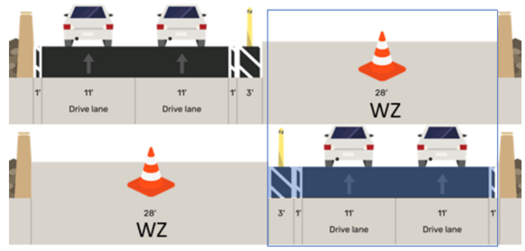
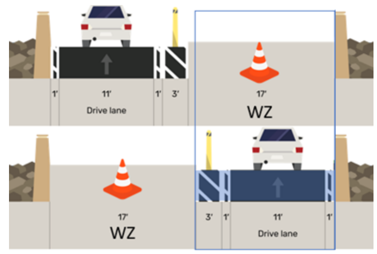
Clear Roadway Rating			Construction Stages
0	If can maintain 2 lanes of traffic in 1 direction	width > 55'	
3	If can maintain 1 lane of traffic in 1 direction	width > 33'	
5	Can't maintain traffic in 1 direction	width < 33'	

Table C.10 Detour Length Rating.

Rating	Detour Length
0	Detour length < 3 mi
2	3 < length < 6 mi
3	6 mi <length < 8 mi
5	Detour length > 8 mi

Steps for Conducting System-Level Analysis

Step 1: Exporting Data from iTAMS

i. Access [iTAMS Website](#).

ii. Under **Inventory**, click on **Assets** to display the full list of Indiana assets (Figure C.1).

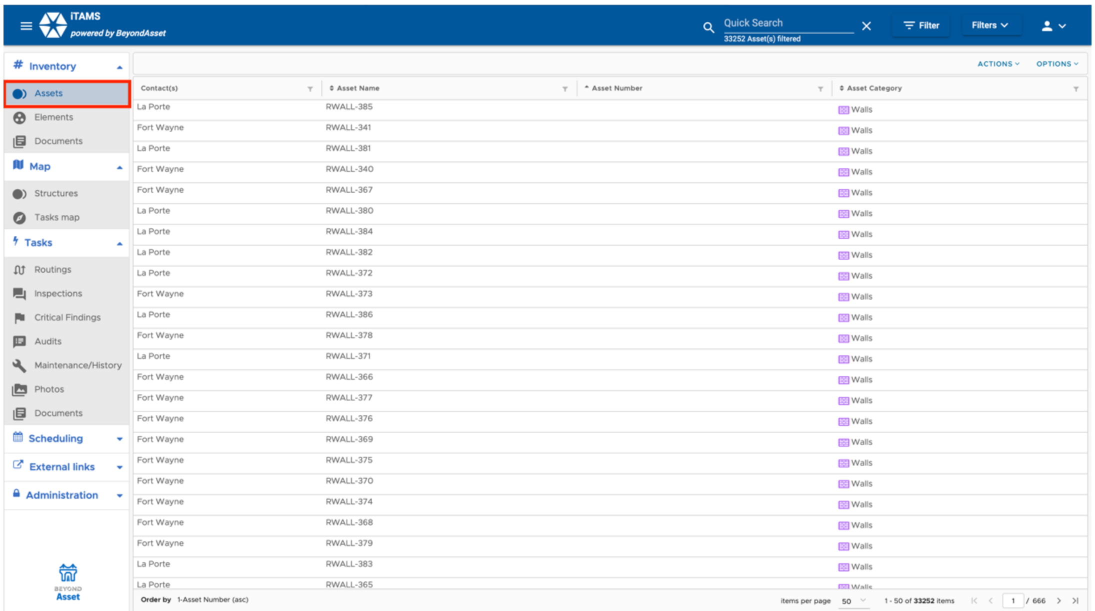


Figure C.1 *iTAMS Asset's List.*

iii. Apply a State filter:

- Go to **Filter**, select **State** → **Bridge**, then click **Apply** (Figure C.2)

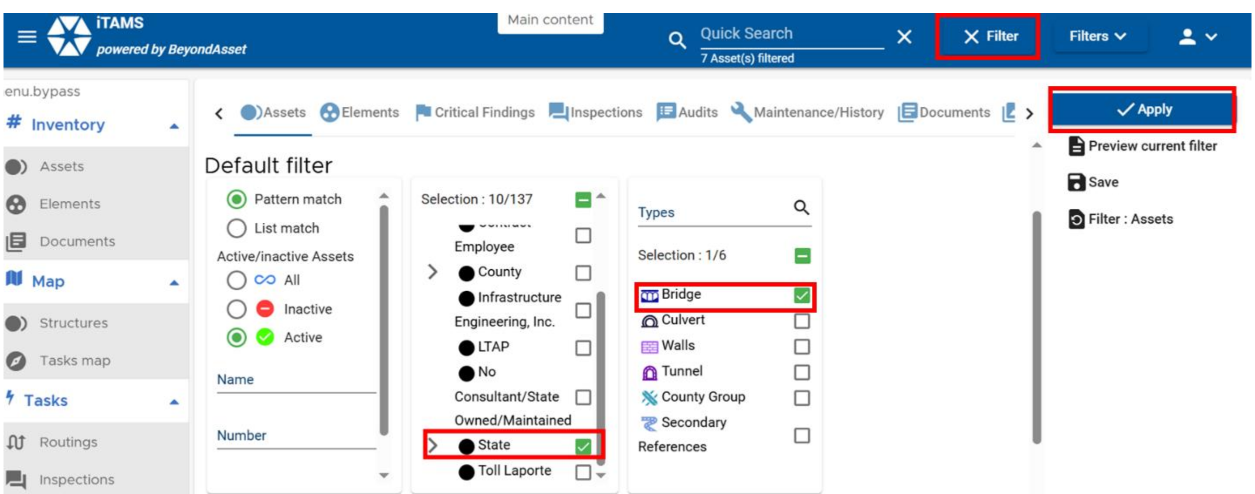


Figure C.2 *Filtering State-Owned Bridges.*

iv. Choose required **attributes** (Figure C.3):

- Go back to **Assets**
- Click on **Options** → **Choose attributes**.
- Click on **Attribute Fields**
- Type the required attribute names or numbers and select them
- Required attributes:
    - (29) Average Daily Traffic
    - (34) Skew
    - (7) Facility Carried
    - (51) Bridge Rdwy Width Curb-To-Curb
    - (102) Direction of Traffic
    - (19) Bypass Detour Length
    - (101) Structure Parallel
    - (43B) Structure Type

        *This is the mandatory data to be exported from iTAMS. More information can be added if desired (e.g., (45) Number of Spans in Main Unit).
- Click **Apply** to confirm selection.

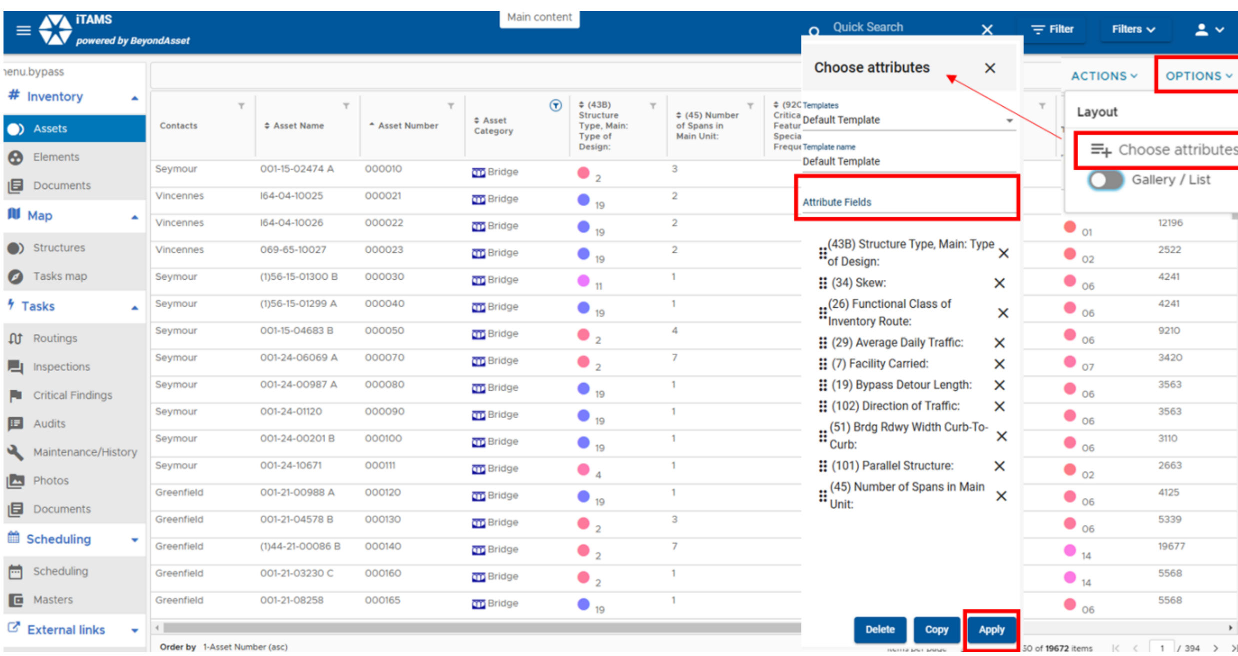


Figure C.3 Selecting Attribute Fields.

v. Export the selected data to Excel (Figure C.4):

- Under ACTIONS, select Export to Excel.
- Note: The Excel file will take several minutes to be exported.

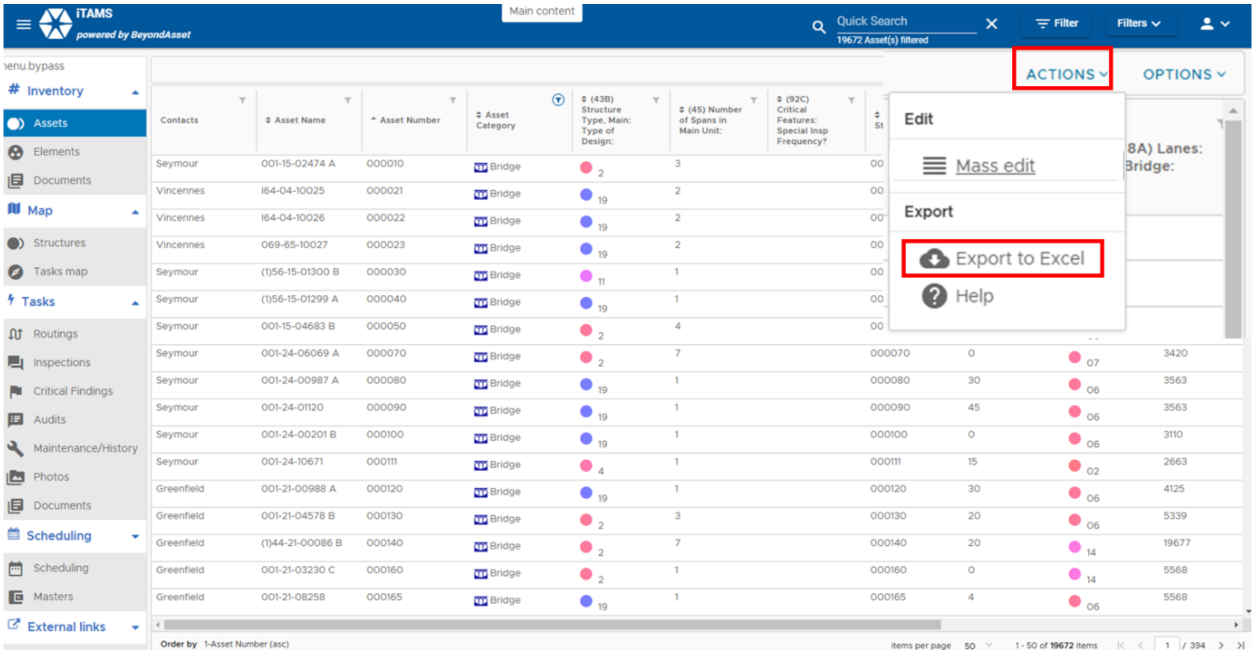


Figure C.4 *Exporting iTAMS Data to Excel.*

Step 2: Running the Python Script

i. Save the exported Excel file from iTAMS in the same folder that contains the system level analysis Python script.

ii. Rename the exported Excel file from iTAMS to “Assets_export.xlsx” so it matches the script’s required input (Figure C.5).

iii. Open the Python script and run the file [press F5 or click Run File[1]] (Figure C.6).

iv. Verify the execution status in the Console tab[2]:

   - If successful, a new Excel file (bridge_data_with_ratings.xlsx) will be generated.

v. The error “Column '{col}' not found in the input file” indicates that one of the required attributes was not exported from the iTAMS website. To solve this problem, return to iTAMS, check if the required attributes are properly selected, and repeat Step 1.

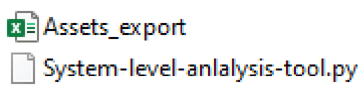


Figure C.5 *Properly Named Excel File and Python Script in the Same Folder.*

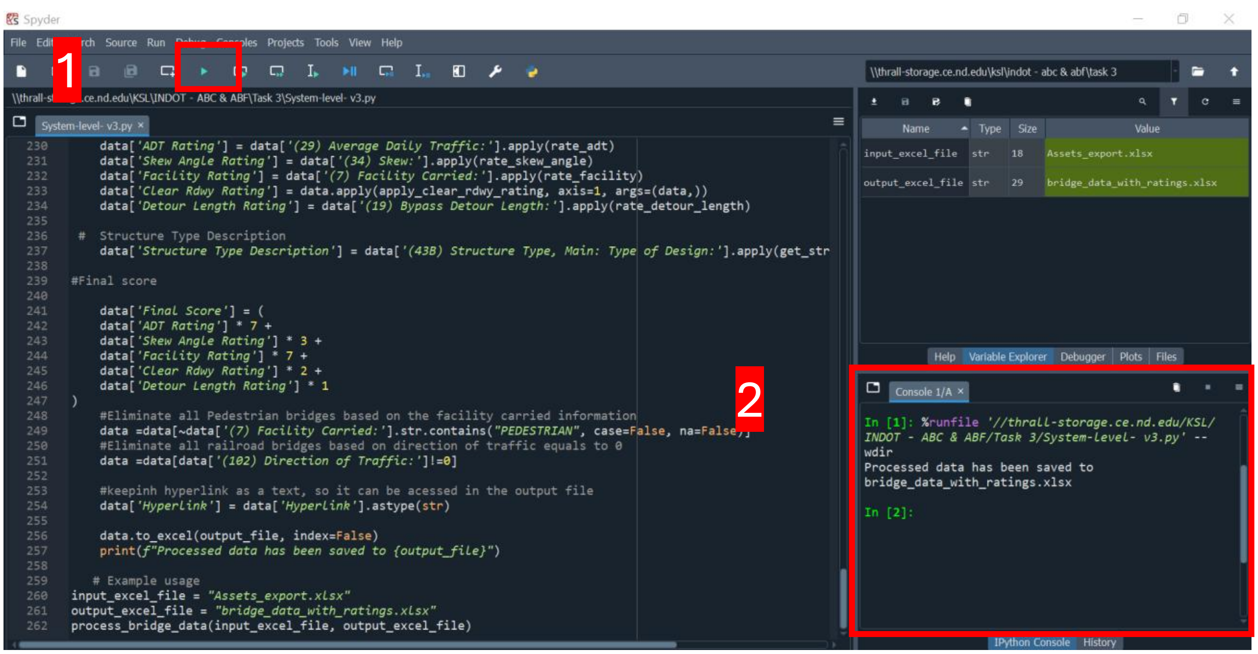


Figure C.6 *Python Script.*

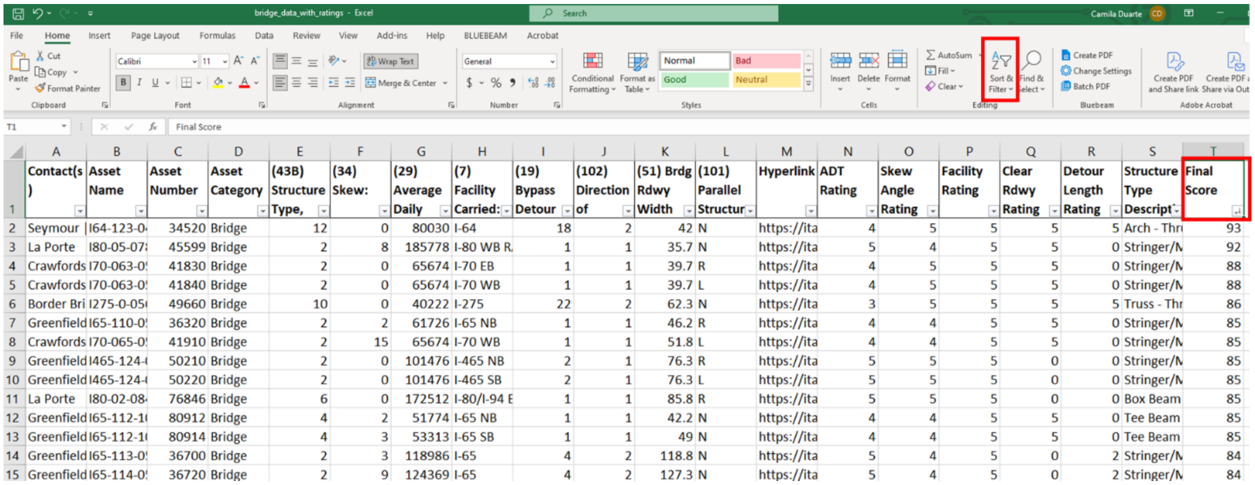
Step 3: Excel Results

i. Open the bridge_data_with_ratings.xlsx file (Figure C.7).

ii. Use the Filter function in Excel to sort bridges based on Final Score or other attributes.

iii. Use the Hyperlink column to access bridge profiles directly in iTAMS:

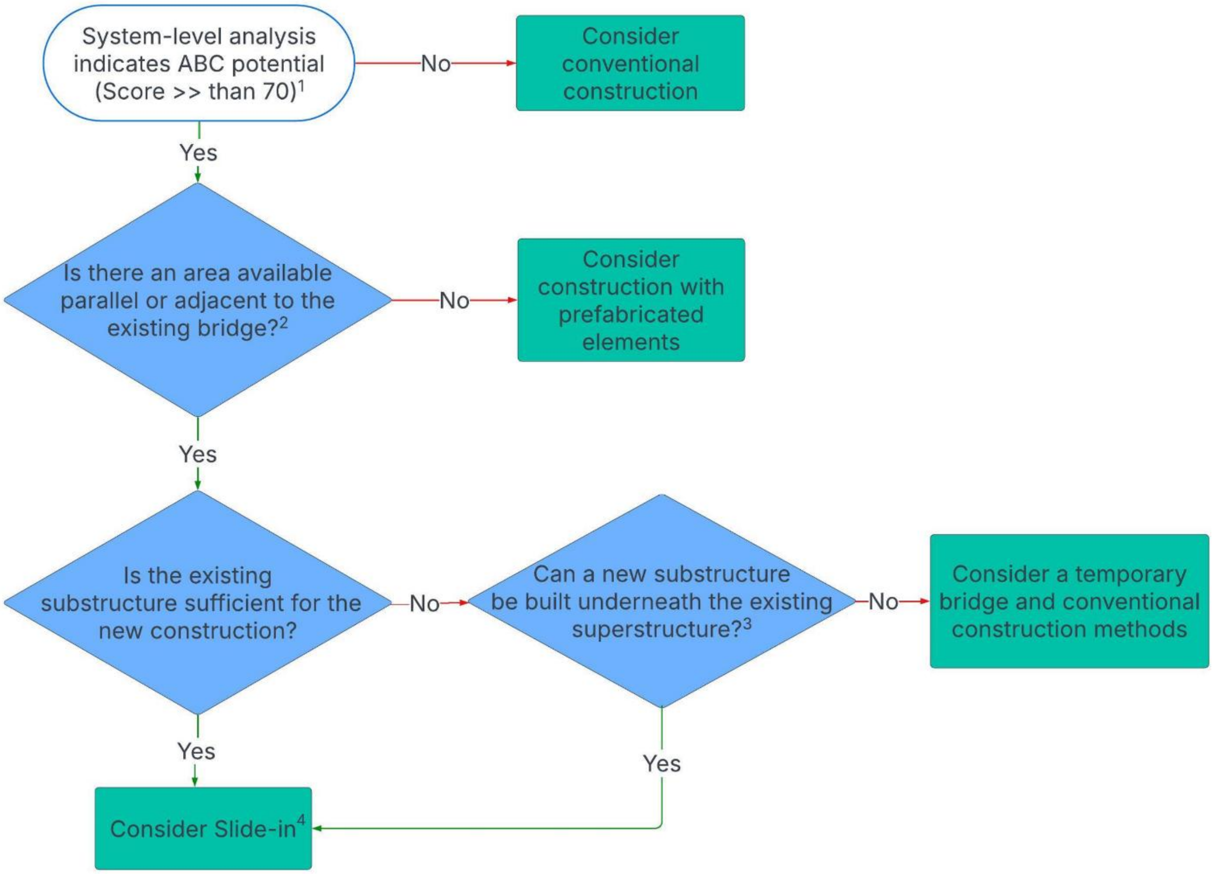
- Double-click the cell, click outside it, then click the hyperlink to open in a browser.



	Contact(s)	Asset Name	Asset Number	Asset Category	(43B) Structure Type,	(34) Skew:	(29) Average Daily	(7) Facility Carried:	(19) Bypass Detour	(102) Direction of	(51) Brdg Rdwy Width	(101) Parallel Structur	Hyperlink	ADT Rating	Skew Angle Rating	Facility Rating	Clear Rdwy Rating	Detour Length Rating	Structure Type Descript	Final Score
2	Seymour	I64-123-0	34520	Bridge	12	0	80030	I-64	18	2	42	N	https://ita	4	5	5	5	5	Arch - Thr	93
3	La Porte	I80-05-07	45599	Bridge	2	8	185778	I-80 WB R	1	1	35.7	N	https://ita	5	4	5	5	0	Stringer/M	92
4	Crawfords	I70-063-0	41830	Bridge	2	0	65674	I-70 EB	1	1	39.7	R	https://ita	4	5	5	5	0	Stringer/M	88
5	Crawfords	I70-063-0	41840	Bridge	2	0	65674	I-70 WB	1	1	39.7	L	https://ita	4	5	5	5	0	Stringer/M	88
6	Border Bri	I275-0-05	49660	Bridge	10	0	40222	I-275	22	2	62.3	N	https://ita	3	5	5	5	5	Truss - Thr	86
7	Greenfield	I65-110-0	36320	Bridge	2	2	61726	I-65 NB	1	1	46.2	R	https://ita	4	4	5	5	0	Stringer/M	85
8	Crawfords	I70-065-0	41910	Bridge	2	15	65674	I-70 WB	1	1	51.8	L	https://ita	4	4	5	5	0	Stringer/M	85
9	Greenfield	I465-124-	50210	Bridge	2	0	101476	I-465 NB	2	1	76.3	R	https://ita	5	5	5	0	0	Stringer/M	85
10	Greenfield	I465-124-	50220	Bridge	2	0	101476	I-465 SB	2	1	76.3	L	https://ita	5	5	5	0	0	Stringer/M	85
11	La Porte	I80-02-08	76846	Bridge	6	0	172512	I-80/I-94 E	1	1	85.8	R	https://ita	5	5	5	0	0	Box Beam	85
12	Greenfield	I65-112-1	80912	Bridge	4	2	51774	I-65 NB	1	1	42.2	N	https://ita	4	4	5	5	0	Tee Beam	85
13	Greenfield	I65-112-1	80914	Bridge	4	3	53313	I-65 SB	1	1	49	N	https://ita	4	4	5	5	0	Tee Beam	85
14	Greenfield	I65-113-0	36700	Bridge	2	3	118986	I-65	4	2	118.8	N	https://ita	5	4	5	0	2	Stringer/M	84
15	Greenfield	I65-114-0	36720	Bridge	2	9	124369	I-65	4	2	127.3	N	https://ita	5	4	5	0	2	Stringer/M	84

Figure C.7 *Excel File: Bridge Data With Ratings.*

Appendix D. Site-Specific Decision-Making Flowchart



[1] At the time this flow-chart was developed a score above 70 represented 9% of the Indiana Department of Transportation vehicular bridge inventory (i.e., 587 bridges) and was deemed an appropriate cut-off. If the cost of ABC is reduced in the future, the cut-off score may be reduced.

[2] At the time this flow-chart was developed, self-propelled modular transporters (SPMTs) were not readily available in Indiana and were considered cost prohibitive. As a result, this flow-chart focuses on prefabricated bridge elements, slide-ins, and temporary bridges. SPMTs may be considered in the future.

[3] Consider permanently widening the existing structure to serve as a temporary traffic lane for the project and a future additional travel lane.

[4] See SHRP2 ABC Toolkit and Projects using the Toolkit, including the I-70 over SR121 case study (INDOT, 2016).

References

Indiana Department of Transportation. (2016). *SHRP2 ABC toolkit and projects using the toolkit.* https://www.in.gov/dot/div/contracts/standards/bridges/2016%20Bridge%20Conference/ABC%20and%20the%20ABC%20Toolkit.pdf

About the Joint Transportation Research Program (JTRP)

On March 11, 1937, the Indiana Legislature passed an act which authorized the Indiana State Highway Commission to cooperate with and assist Purdue University in developing the best methods of improving and maintaining the highways of the state and the respective counties thereof. That collaborative effort was called the Joint Highway Research Project (JHRP). In 1997 the collaborative venture was renamed as the Joint Transportation Research Program (JTRP) to reflect the state and national efforts to integrate the management and operation of various transportation modes.

The first studies of JHRP were concerned with Test Road No. 1—evaluation of the weathering characteristics of stabilized materials. After World War II, the JHRP program grew substantially and was regularly producing technical reports. Over 1,600 technical reports are now available, published as part of the JHRP and subsequently JTRP collaborative venture between Purdue University and what is now the Indiana Department of Transportation.

Free online access to all reports is provided through a unique collaboration between JTRP and Purdue Libraries. These are available at docs.lib.purdue.edu/jtrp/.

Further information about JTRP and its current research program is available at engineering.purdue.edu/JTRP.

About This Report

An open access version of this publication is available online. See the URL in the citation below.

Duarte, C. N., & Thrall, A. P. (2025). *Advancing accelerated bridge construction and fabrication in Indiana* (Joint Transportation Research Program Publication No. FHWA/IN/JTRP-2025/12). West Lafayette, IN: Purdue University. https://doi.org/10.5703/1288284317858