SECTION 39
ACCELERATED BRIDGE CONSTRUCTION

39.1 GENERAL INFORMATION

This section provides general guidance for the use of accelerated bridge construction (ABC) techniques.

A standard practice for project delivery, ABC evaluates innovative materials, construction techniques, project planning, and design methods to safely and efficiently reduce construction time and traffic impacts for new and rehabilitated structures. CDOT is committed to using ABC as a tool to achieve the following goals:

- Embrace FHWA's Every Day Counts (EDC) initiatives
- Decrease and minimize maintenance of traffic (MOT) operations to reduce user costs associated with delays
- Encourage innovation
- Improve motorist and worker safety

To further strengthen CDOT's role as stewards of the taxpayers' dollars and to achieve the above goals, CDOT has developed tools and resource materials for evaluating ABC techniques to determine their applicability toward a given project. For Analytic Hierarchy Process (AHP) software downloads and specific resource materials mentioned in this section, refer to Accelerated Bridge Construction documents on CDOT's website at https://www.codot.gov/business/designsupport/abc-documents.

39.2 ABC EVALUATION OVERVIEW

39.2.1 Background

CDOT uses an ABC decision chart during project scoping to determine if ABC is appropriate for the project and site constraints. This chart was based on the FHWA manual entitled *Decision-Making Framework for Prefabricated Bridge Elements and Systems (PBES)*, May 2006. This process is based on a set of questions about specific constraints of each project. If certain thresholds are met, ABC was recommended.

Subsection 39.2.2 outlines the approach for the ABC decision-making process and how it is used during project development. The ABC Evaluation and Decision Matrix Workflow, shown in Figure 39-1, has been developed to graphically assist project engineers and planners in implementing the ABC process.

39.2.2 ABC Evaluation Process

The intent of the evaluation process is to apply some form of ABC on most projects. To encourage the use of ABC, a two-step process is presented as follows:

1. Complete the CDOT Prescoping ABC Rating spreadsheet (refer to Subsection 39.3.2 for additional information). The Design Team completes this spreadsheet at the pre-scoping level based on a general understanding of the project and its site constraints. If, according to the supplemental flowchart, the resulting ABC rating indicates little to no benefit in implementing ABC, the evaluation process is complete and is documented as part of this first step. This spreadsheet should be included in both simple and complex structure pre-scoping reports.

2. If the ABC rating indicates a benefit to implementing ABC, the Design Team shall execute the FHWA AHP software. This process uses a structured technique to organize and analyze only complex bridge construction decisions. It also provides a more in-depth evaluation to select the most appropriate ABC methods to meet the project goals and constraints. The ABC Construction Matrix (Figure 39-2) provides examples of construction methods with respect to project complexity. The second step will take place after pre-scoping but before completion of FIR level design efforts. This interactive process is completed with the CDOT specialty groups and led by the Project Engineer and a CDOT subject matter expert (SME). The Design Team shall capture and document for the project files summaries of each step of the decision process.

This ABC methodology shall be evaluated for all projects that include bridges. The final project submittal will include a justification letter written to the project file explaining why an ABC technique is or is not used. The Design Team shall also document the ABC decision process, including any supporting materials, in the Structure Selection Report (refer to Section 2.10 of this BDM for additional information) as part of FIR level design tasks.

Approval of ABC is at the discretion of each Resident Engineer/Region in coordination with the Unit Leader and should be communicated and approved at a level commensurate with the complexity of the ABC method and project cost. For example, a self-propelled modular transporter (SPMT) bridge move should receive the Regional Transportation Director's , Chief Engineer's concurrence for a bridge over light rail tracks, whereas use of prefabricated bridge elements may require approval from only the Unit Leader and Resident Engineer.

The ABC Workshop PowerPoint presentation (dated March 6, 2013) offers project-specific examples illustrating the use of the pre-scoping ABC rating and AHP software, as well as ABC project case histories. It is also recommended that the Design Team work with the designated SME for guidance and information about the use of the ABC materials. Subsection 39.3 discusses these resources in further detail.

39.3 ABC MATERIALS AND RESOURCE GUIDANCE

39.3.1 ABC Evaluation and Decision Matrix Workflow

Figure 39-1 graphically illustrates the two-phase approach for the ABC decision-making process from project inception to FIR level design efforts.

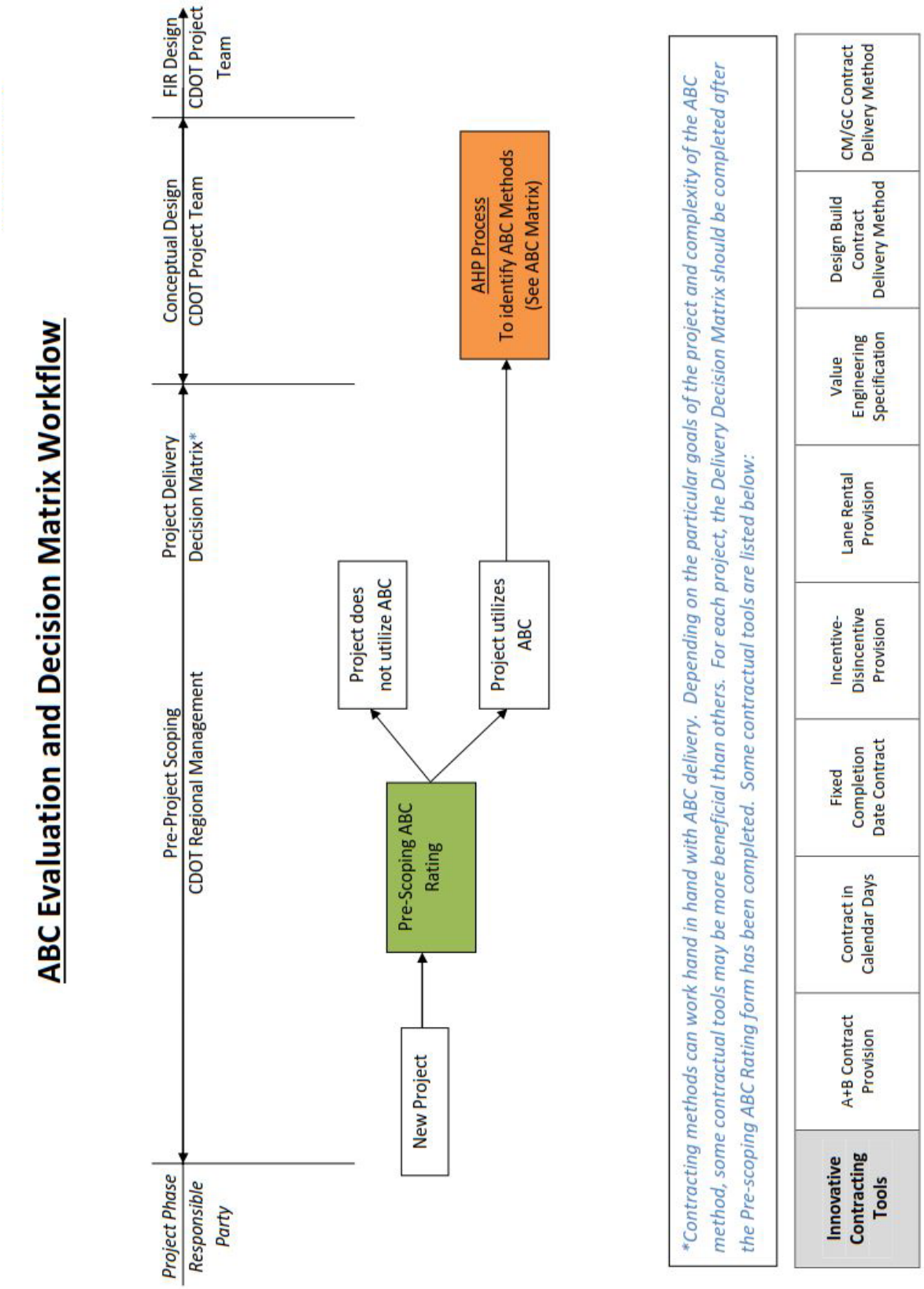

Figure 39-1: ABC Decision Matrix Workflow

39.3.2 Pre-scoping ABC Rating

39.3.2.1 ABC Rating Procedure

The pre-scoping ABC rating spreadsheet is required during the bridge pre-scoping level and calculates an ABC rating score that accounts for all the project measures defined in Subsection 39.3.2.3, except environmental issues. This spreadsheet is located under ABC Documents on CDOT's website. Weighting factors have been assigned to each measure to coincide with FHWA's EDC initiatives and CDOT's goals. The Designer shall not modify the weighting factors for individual projects.

The values assigned to each project decision measure are multiplied by the corresponding weight factor. The ABC rating score is the ratio of the weighted score to the maximum score shown as a percentage and is categorized into three ranges: 0 to 20, 20 to 50, and over 50. The minimum score of 20 is intended to capture any project receiving a score of 5 in any one of the four most heavily weighted categories, while the higher threshold score of 50 is intended to capture any project receiving an average score of 3.5 in the four most heavily weighted categories. The range of scores is set to ensure that accelerated construction is commonplace when the measured benefit is more significant than the measured cost with respect to accomplishing FHWA EDC initiatives and CDOT's goals. Apply the ABC rating score to the flowchart to work toward a conclusion.

39.3.2.2 ABC Decision Flowchart

The ABC Rating Procedure described in Subsection 39.3.2.1 is the first step in determining if ABC is appropriate for a given project. The ABC Decision Flowchart applies the ABC rating score and then addresses Yes/No factors that are considered before making a final decision on the construction approach. Factors include project schedule, environmental concerns, total project cost, site conditions, and high-level indirect costs such as political capital, safety, or impacts to stakeholders.

Together, the ABC Rating Procedure and ABC Decision Flowchart are used to make a final determination of the appropriate construction methods for each project. If ABC is deemed beneficial to the project at the pre-scoping level, the Design Team should proceed to the second step in the evaluation process, applying the AHP software and discussing with CDOT specialty groups such as Staff Bridge, Utilities, Environmental, Traffic, and Hydraulics, to better identify site constraints, project goals, and preferred ABC technologies and delivery methods.

39.3.2.3 ABC Rating Procedure Measures

Using the Structure Inspection Assessment Report and Staff Bridge user costs spreadsheet in conjunction with preliminary knowledge of the project conditions, the Design Team determines the appropriate score for each ABC measure. The nine ABC measures described herein are incorporated into the Pre-Scoping ABC Rating procedure to help determine where the use of ABC is appropriate and to output the ABC rating score.

- **Average Daily Traffic (ADT)** – This is a measure of the volume of traffic traversing the bridge site. Use a value equal to the total number of vehicles on and under the bridge, where applicable. This measure accounts for the value of maintaining the interstate highway network by assigning the maximum score for this situation. This measure also addresses minimizing impacts to the traveling public during construction.
- **Delay/Detour Time** – This is a measure of the time required for vehicles to pass through or circumvent a construction site because of a project. It accounts for the time delays due to detours and construction induced congestion. If delays are anticipated for the roadways both on and under the bridge, enter the worst-case scenario. This measure addresses minimizing impacts to the traveling public during construction.
- **Bridge Importance** – This measure assigns a value for bridges on or over designated emergency evacuation routes or bridges that are economically crucial to servicing local communities and businesses. This measure addresses minimizing impacts to the traveling public by accelerating construction on these important roadways.
- **User Costs** – This is a measure of the financial impact a construction project has on the traveling public. While the contributing factors in calculating user costs are traffic delays and ADT, the duration of the impact to users is essential in measuring the burden to the traveling public. CDOT has instituted standard methods for calculating user costs using FHWA guidelines. The Design Team shall calculate user costs in coordination with the Regional Traffic Engineer to determine the total project cost for each construction option being evaluated, including, but not limited to, SPMT methods, slide-in bridge construction, prefabricated elements, or conventional construction. This measure addresses minimizing impacts to the traveling public during construction, reducing total project costs, and encouraging innovation.
- **Economy of Scale** – This measure accounts for repetition in structural elements and construction processes; how they relate to the overall project cost; and the potential savings to future projects. To account for repetition of substructure and superstructure elements, the number of spans for a proposed bridge is applied when quantifying economies of scale. This measure addresses reducing total project costs.
- **Safety** – This is a measure of the safety provided to the traveling public and contractor employees. A goal of implementing ABC methods is to reduce the amount of time motorists and workers are exposed to potentially hazardous construction environments. Project sites that require complex MOT schemes for extended periods of time are undesirable and impact the safety rating. This measure addresses improving worker and motorist safety during construction.
- **Railroad Impacts** – This is a measure of the impact to railroad operations. The quantity of railroad tracks and their importance to daily train operations are considered when determining this impact. This measure addresses total project cost, improving worker safety, and minimizing impacts to commerce.

- **Site Conditions** – This is a measure of the physical site constraints preventing the use of ABC methods. For example, vertical profile shifts over 1 ft. greatly impact, if not inhibit, the ability to accelerate construction. Additionally, time sensitive utilities may limit the time available for construction, local soil stability may preclude the use of heavy construction equipment, or adjacent ROW designations may limit staging opportunities. This measure addresses physical fatal flaws to the ABC delivery process.
- **Environmental Concerns** – The presence of endangered species or annual spawning seasons may shorten the opportunity for construction. In other cases, projects may have limitations due to wetlands, air quality, extreme weather, historical designations, or noise ordinances. ABC may be necessary to accomplish an acceptable level of impact on the surrounding environment. This measure does not specifically address a goal and is not a weighted factor in determining the ABC rating score; rather, it is included in the ABC Decision Flowchart to evaluate if ABC can provide appropriate mitigation to an environmental commitment or requirement.

39.3.3 ABC Matrix

The ABC Matrix (Figure 39-2) provides suggestions for accelerated construction techniques that may be applied depending on the complexity of the project. This matrix offers preliminary guidance only; the Design Team is encouraged to develop innovative solutions, especially if the chosen project delivery method is Construction Manager General Contractor or Design-Build. Conversely, the decision to execute ABC technologies may dictate the project delivery method because fast-track contracting methods are often tailored to Owner involvement and project goals. When using this matrix, it is important that the Design Team acknowledges total construction cost is not the primary consideration when determining suitable ABC methods where project constraints, for instance, favor public safety and/or user cost benefits.

39.3.4 ABC AHP Decision Tool Software

Refer to CDOT's website to download the AHP software and to access the complete ABC Decision Making Software materials, including definitions, user manual, and supplemental software development information.

39.4 OTHER RESOURCES

FHWA's *Accelerated Bridge Construction Manual* provides detailed guidance to educate engineers further in ABC technologies, prefabricated bridge elements, construction techniques, and project planning and decision-making tools. Refer to FHWA's Accelerated Bridge Construction website (www.fhwa.dot.gov/bridge/abc/) for the most recent manual publication, webinars, case studies, and technical contacts.

COLORADO Department of Transportation

Accelerated Bridge Construction Matrix

This matrix provides suggestions and previously utilized methods for accelerated bridge construction. It is not all inclusive nor intended to dictate any particular method.

PROJECT COMPLEXITY

Substructure	Approach, Embankment & Backfill	Superstructure	Superstructure Placement
	Pre-fabricated approach slabs	Adjacent Girders[2]	
	Flowfill	Precast Deck Panels (partial depth)[2]	
Pre-fabricated Pier Caps	Expanded Polystyrene (EPS) Geofoam	Pre-fabricated pedestrian bridge[2]	
Pre-fabricated columns		Pre-fabricated box culvert[2]	
Pre-fabricated foundations		Precast Deck Panels (full depth)[2]	
Geosynthetic Reinforced Soil (GRS) Abutment[1]		Modular Girder and Deck elements[2]	
Pre-fabricated wingwalls/backwalls[2]		Post-tensioned concrete through beams[2]	Heavy Lift Cranes
Continuous Flight Auger Piles (CFA)		Pre-fabricated truss or arch span[2]	Skid or Slide In
			Longitudinal Bridge Launch
			Self Propelled Modular Transport (SPMT)

[1] FHWA Every Day Counts Initiatives

[2] Prefabricated Bridge Elements and Systems (PBES)

ABC Costs *ABC method construction costs generally increase with project complexity. However, many methods of ABC may reduce the overall project cost, specifically where ABC methods can eliminate or reduce detours or traffic control.*

Figure 39-2: ABC Matrix