Section 5 Structures

June, 2024

COLORADO
Department of Transportation
Office of the Chief Engineer

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5.01 Introduction

This section provides guidance for preliminary engineering plan submittal and approval for buildings, major and minor bridges, snow sheds, tunnels, geotechnical structures featuring wall systems or ground improvement systems, and hydraulic structures.

5.02 Major Structure (Bridge)

Major structures are bridges and culverts with a total length of greater than 20 feet, inclusive of all spans, barrels, and cell separations. Retaining walls with both a total length greater than 100 feet and a maximum exposed height at any section of over 5 feet are assets that will be inspected but walls do not have a major or minor category. The length is measured along the centerline of roadway for bridges and culverts, and along the top of the wall for retaining walls. Overhead sign structures (sign bridges, cantilevers and butterflies extending over traffic), tunnels and high mast light standards also are structures which are tracked assets and inspected but don't have major/minor categories.

Refer to the Colorado Department of Transportation (CDOT) "CDOT Bridge Design Manual", Section 3, for minimum design loading. All structures should be analyzed individually for the optimal design. Any substantial costs for deviation from the most economical design need to be considered in the structure selection process and must be agreed to by the Resident Engineer. The selection of a bridge rather than a large culvert is determined from estimated construction and maintenance costs, structural aesthetics, hydraulic needs, and environmental considerations.

For bridges over waterways and culverts carrying waterways, please refer to the "CDOT Drainage Design Manual". Hydraulic design of the bridge or culvert opening shall be completed by a licensed Hydraulic Engineer, or under the direct supervision of a Hydraulic Engineer licensed in the state of Colorado.

The Resident Engineer is responsible for submitting to the Project Structural Engineer the preliminary information including the following:

1. Current and proposed roadway and waterway plans, profiles, and cross-sections for both upper and lower features, with alignment data.
2. Bridge situation sheet with all topography including contours, utilities, and railroads (bridge site data).
3. Any hydraulics report, right of way restrictions, and selected guardrail types.
4. Any region design recommendations, including deviations from M Standards.
5. Requirements for electrical conduit, lighting, and utility locations.
6. Corridor aesthetics, environmental consideration, and architectural concepts, if applicable.
7. Request a foundation report from the Geotechnical group and arrange for access, traffic control, and the locations for drilling to be surveyed.

This information should be delivered to the Project Structural Engineer as early in the project after scoping as possible. Typically this information should be delivered prior to the Field Inspection Review (FIR) so all structural decisions can be made prior to commencing final design.

Any subsequent revisions to the roadway alignments or profiles shall be transmitted to the Project Structural Engineer without delay.

The Project Structural Engineer's responsibilities include:

1. Review preliminary alignments and bridge site data.
2. Prepare structure selection reports or a wall selection report, or both, including appropriate engineering and economic studies.
3. Prepare structure layouts and specific details that reflect a recommended structure type, size, and location.
4. Request foundation report from the Resident Engineer. See Section 5.08.

For a complete description of responsibilities, see the Programs – "Policies & Procedures" section of the Colorado Department of Transportation (CDOT) "CDOT Bridge Design Manual".

The following is a brief overview of the bridge design process outlining the responsibilities of the Project Structural Engineer:

1. Preliminary Bridge Design
    a. Attend Design Scoping Review meeting.
    b. Obtain and review bridge site data.
    c. Review preliminary alignment to determine structure location
    d. Determine conceptual structure layout and alternative structure types.
    e. Prepare engineering and economic recommendations.
    f. Prepare general layouts and special details.
    g. Prepare selection report outlining all design criteria and restrictions and recommended structure.
    h. Prepare drawings for foundation investigations.
    i. Attend the FIR and make required revisions to layout.
    j. Obtain structure numbers

2. Final Bridge Design
    a. Design all structural elements.
    b. Prepare all structural plans and specifications.
    c. Provide independent design, detail, and quantity check.
    d. Attend Final Office Review and make required revisions to Plans and Specification. At the discretion of the Resident Engineer, a separate structure Final Office Review or a

structure advance plan review meeting may be held prior to the overall project Final Office Review.

e. Provide final structural submittal (i.e., the final detail letter, final design notes, independent design check notes, field package and rating package), see “Policies & Procedures, Section E.4” of the Colorado Department of Transportation “(CDOT) Bridge Design Manual”.
f. Provide revised plans and specifications as per the Final Office Review (FOR) comments for construction.

3. Construction Support
   a. Review shop drawings.
   b. Provide information and support for any Requests for Information (RFI’s) or other construction issues.

The Resident Engineer should compare the roadway and bridge plans to verify grade, alignment and clearances.

Additional Resources:

“CDOT Bridge Design Manual”

“CDOT Bridge Detailing Manual”

American Association of State Highway and Transportation Officials “(AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications”

“AASHTO Manual for Bridge Evaluation”

“CDOT Bridge Rating Manual”

“CDOT Drainage Design Manual”

5.03 Minor Structure (Culvert)

A culvert is used in lieu of a bridge based on estimated construction and maintenance costs, when either alternative is viable hydraulically. There will be instances where a culvert structure will provide superior hydraulic performance to a bridge structure, or where particular permit requirements are more easily fulfilled using a culvert structure. For culvert sizing and other design requirements, refer to the “CDOT Drainage Design Manual”.

A culvert is considered a major structure if it has an opening measured along the center of the roadway greater than 20 feet between the inside faces of the outside walls or spring lines of arches. It may also include multiple pipes, where the clear distance between the centerlines of the exterior pipes plus the radius of each of the exterior pipes is greater than 20 feet.

For all non-standard structures the Resident Engineer should expect a structure selection report from the Project Structural Engineer.

All culverts not included in the Colorado Department of Transportation (CDOT) Miscellaneous & Safety (M&S) Standard Plans shall be designed by the Project Structural Engineer. The Project Structural Engineer will request a foundation exploration and foundation report as required.

Hydraulic design of a drainage structures shall be completed by a qualified Engineer with knowledge of hydrology and hydraulics. Larger or more complex drainage structures, or both; for example, complex concrete box culverts, storm sewers and channel improvements may require additional specialization and support.

The following procedures and documentation are required when designing a culvert or concrete box culvert on the project:

1. When selecting pipe material, designers shall use the recommendations of the “CDOT Pipe Material Selection Policy”.
2. For major structures, the hydraulic designer will provide adequate designs for both a culvert or bridge alternatives. The roadway, structural designers, and environmental permitting specialists will determine the most economical alternative.
3. A cost comparison should be made to determine what structure alternative is the best choice to be constructed. Project grade adjustments should be included in the cost comparison alternatives.
4. Obtain structure numbers.

Additional Resources:

“CDOT Roadway Design Guide”

“CDOT Drainage Design Manual”

“CDOT Bridge Design Manual”

“CDOT Bridge Detailing Manual”

“American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications”

“CDOT Pipe Material Selection Policy”

5.04 Major Structure – Unusual

An unusual bridge is one involving: (1) difficult or unique foundation characteristics, (2) new or complex designs with unique operational or design features, (3) exceptionally long bridge spans, (4) unique or unusual construction requirements, or (5) designs with procedures that depart from currently recognized acceptable practices.

Examples of unusual bridges include cable-stayed, suspension, arch, segmental concrete, movable, or truss bridges. Other examples are bridge types that deviate from American Association of State Highway and Transportation Officials (AASHTO) bridge design standards or AASHTO guide specifications for highway bridges such as: bridges requiring abnormal dynamic analysis for seismic design; bridges using three-dimensional computer analysis; bridges with spans exceeding 500 feet; and bridges with major supporting elements of "ultra" high strength concrete or steel.

Unusual structures are:

1. Buildings;
2. Snow sheds;
3. Tunnels;
4. Geotechnical structures featuring new or complex wall systems or ground improvement systems;
5. Hydraulic structures that involve complex stream stability countermeasures, designs, or design techniques that are atypical or unique; or
6. Unusual hydraulic structures, such as those serving large storm drainage systems, stormwater pumping facilities, dams or levees.

Federal Highway Administration (FHWA) Washington Headquarters shall approve all movable bridges and unusual bridges, tunnels, hydraulic structures, and geotechnical structures. A Structure Selection Report should be submitted to the FHWA for review and approval. On federal aid projects, the FHWA Division Office shall approve all other bridges (not included in the previous sentence) that have an estimated total deck area greater than 125,000 square feet and all bridges on the National Highway System, major hydraulic structures, and major geotechnical features.

The Resident Engineer shall submit a "Structure Selection Report" as well as the "Field Inspection Review" and "Final Office Review" plans to the FHWA. The Project Structural Engineer will provide the Resident Engineer with plans for bridges, earth retaining structures, and tunnels. The local FHWA Division will review those submittals and may forward them to the Washington Headquarters for approval as appropriate.

The Resident Engineer must coordinate the required submittals with the Project Structural Engineer. The Structure Selection Report submitted with the initial request for review and approval shall include environmental concerns and suggested mitigation measures, and studies of alternate spans and bridge types.

Additional Resources:

Colorado Department of Transportation "(CDOT) Bridge Design Manual"

"American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications"

5.05 Minor Structures

Minor structures are structures that are 20 feet or less along the centerline of roadway. Culverts must be 4 feet in diameter or greater to be considered a minor structure. Culverts that are less than 4 feet in diameter are included in the maintenance group's responsibilities. Design requirements and deliverables are similar to Major Structures.

5.06 Pedestrian Overpasses & Underpasses

Pedestrian facilities should be provided where pedestrian volume, traffic volume, or other conditions merit their use. These facilities are usually located in central business districts centers, factory areas, school zones, athletic fields, parks, and other major activity centers.

Pedestrian separation, either over or under the roadway, is usually desirable at freeways or expressways where cross streets are terminated or where conditions impose an extreme inconvenience or safety hazard to pedestrians due to heavy vehicle traffic. They are also desirable at locations where the need for a pedestrian crossing is otherwise warranted and the separation is economically and environmentally feasible.

When designing pedestrian overpasses and underpasses, the requirements should be the same as for any other highway structure where the same geometric and architectural considerations should be considered (see Section 5.02 of this manual). The Resident Engineer is responsible for providing the Project Structural Engineer with the preliminary geometric layout, vertical profiles, and cross-sections for the location of the structure. Additionally, topography of the surrounding area should be provided in electronic format.

The Project Structural Engineer is responsible for reviewing and commenting on the proposed alignments submitted and preparing a structure selection report including a general layout for the selected structure with appropriate widths, clearances, and accommodations for the physically handicapped. The Project Structural Engineer shall request that the appropriate foundation investigations be completed.

The design of pedestrian overpasses and underpasses should accommodate accessibility for the physically handicapped, and bicycle traffic, where warranted.

Public safety features such as vertical clearance, fencing and lighting should be included in the design of the structures. Design criteria for overpasses and underpasses are in the Colorado Department of Transportation "(CDOT) Roadway Design Guide". Pedestrian underpasses could be categorized as a "Major" or "Minor" structure. Pedestrian overpasses are considered a "Miscellaneous" structure for asset management purposes.

Additional Resources:

American Association of State Highway and Transportation Officials "(AASHTO) Policy on Geometric Design of Highways and Streets"

"CDOT Bridge Design Manual"

"CDOT Bridge Detailing Manual"

"CDOT Bridge Rating Manual"

"Design of Pedestrian Overpass and Underpass to Accommodate the Handicapped, Publication N5040.38, Federal Highway Administration (FHWA)"

"Pedestrian and Bicycle Accommodations and Projects, Code of Federal Regulations, Title 23 Highways, Part 652"

"AASHTO LRFD Bridge Design Specifications"

"AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities"

"AASHTO Guide Specifications for Design of Fiber Reinforced Polymer (FRP) Pedestrian Bridges"

"AASHTO Load and Resistance Factor Design (LRFD) Guide Specifications for the Design of Pedestrian Bridges"

"CDOT Roadway Design Guide"

5.07 Architectural & Aesthetic Treatments

Aesthetically pleasing structures should be compatible with their surroundings and include features and treatment that prove to be enduring. Care must be exercised when incorporating architectural features and aesthetic treatment in a structure because most structures will be in service 75 to 100 years.

Corridors typically have an existing architectural-aesthetic theme developed during the National Environmental Policy Act (NEPA) process or from a local entity preference. The Project Structural Engineer and Resident Engineer will determine the structure specific architectural treatment guidelines. An architect may be consulted for ideas on features and treatments.

Preliminary design and architectural details must be documented in the “Structure Selection Report” (see Section 5.09 of this manual).

Visually appealing structures should be adopted and developed early before final design commences because inclusion of these details is not easily accomplished after the structure design has begun. Some aesthetically pleasing features can be incorporated in a structure at low cost while others increase cost significantly. New or untried features and treatments must be thoroughly investigated before they are incorporated into a structure. Aesthetics are important in high-profile, frequently viewed structures.

Additional Resources:

Colorado Department of Transportation “(CDOT) Bridge Design Manual”

“Bridge Aesthetics Around the World, Transportation Research Board (TRB) National Research Council, 1991”

“Bridgescape: The Art of Designing Bridges”, Frederick Gottemoeller, 1998

5.08 Foundation Investigation & Recommendation

The foundation investigation gathers data and provides foundation design criteria and support recommendations based on existing subsurface conditions. Typical requests include foundation studies for bridges, major concrete box culverts, high-mast lighting, sign structures, sound walls, and retaining walls. Investigation requests should be made at the conceptual stage of structure design so that preliminary foundation recommendations are available for inclusion in the Structure Selection Report prepared by the Project Structural Engineer.

When a boring or a geotechnical study is required, the Project Structural Engineer will send a foundation investigation request, including the proposed general layout, to the Resident Engineer. A copy of the request and the general layout will be sent to the Geotechnical Program manager. Locations of the structure borings may be included in the request but the locations will follow the “Geotechnical Design Manual “and American Association of State Highway and Transportation Officials (AASHTO) requirements.

The Resident Engineer will be responsible for obtaining access. The Resident Engineer or survey crew will arrange for traffic control. When the Resident Engineer has completed the access and traffic control has been arranged, they shall notify the Geotechnical Engineer and the Project Structural Engineer in writing. The Resident Engineer will have the final boring locations surveyed for inclusion in the report.

Any questions the Geotechnical Engineer may have related to the boring locations shall be addressed to the Project Structural Engineer. The Geotechnical Engineer is responsible for examining the site and scheduling utility locates, as required.

The Geotechnical Engineer will analyze subsurface data and provide an engineering geology plan sheet and geotechnical report.

The Geotechnical Engineer should be included in the Design Scoping Review and should participate in the follow-up and resolution of any structural problems identified.

Additional Resources:

Colorado Department of Transportation "(CDOT) Bridge Design Manual"

"CDOT Bridge Detailing Manual"

"American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications"

5.09 Structure Selection Report

A structure selection report documents the important factors that lead to the recommended selection and establishes the basis upon which the final structure design will proceed. The selection report is needed to document the good stewardship of funds as well.

During the conceptual and preliminary design stages of a project, the Project Structural Engineer shall develop a structure selection report for all structures in accordance with "Policies & Procedures" section of the "CDOT Bridge Design Manual".

Selection of the best structure type alternative may be based in part on the lowest cost, but other requirements to be considered include:

1. Site requirements (topography, alignment)
2. Safety (during construction, traffic, detours)
3. Structural (future widening, foundation conditions)
4. Environmental (appearance, wetlands, public exposure)
5. Construction (ease of construction, false work, season)
6. Hydraulics (stream flow, bank and pier protection, culvert alternates, scour)
7. Life cycle costs (maintenance, durability)

8. Accelerated Bridge Construction requirements
9. Other (commitments to officials and community, team studies)

The Resident Engineer will provide the Project Structural Engineer the information required to prepare a structure layout, structure selection report, and final design. See Section 5.02 of this manual.

Prior to commencing the final structure design, the Project Structural Engineer will prepare and distribute a structure selection report, including an economic analysis, to the Resident Engineer. The Resident Engineer shall make distribution within the region and to the Federal Highway Administration (FHWA). The structure selection report should be reviewed and approved prior to the Field Inspection Review meeting or as soon as possible thereafter prior to commencing final design.

5.010 Retaining Walls

Retaining walls are used primarily for retaining soils or roadway cuts and fills to create a grade change. They are also used when it is necessary to contain the roadway fill within the available Right of Way (ROW), as well as other applications.

Retaining walls are classified into three categories according to basic mechanisms of retention and source of support:

1. An externally stabilized system uses a physical structure to hold the retained soil, e.g., Cast-in-Place concrete wall.
2. An internally stabilized system uses soil reinforcement to make the retained soil self-supporting, e.g., Mechanical Stabilized Earth Walls or Soil Nail Walls.
3. A hybrid or mixed system combines elements of both externally and internally stabilized systems.

Factors affecting the selection of a retaining wall are:

1. Spatial constraints—functions of a wall, space limitations, proposed profile.
2. Behavior constraints—earth pressure, water table, foundation pressure.
3. Economic considerations—environmental, aesthetic.

Retaining walls should be designed to resist corrosion, deterioration, and other environmental factors compromising the durability of the wall. Permanent retaining walls should be designed for a minimum service life of 75 to 100 years.

The Project Structural Engineer in cooperation with the Resident Engineer will be responsible for the selection and design of the best-suited wall type. Where appropriate, alternative wall designs may be developed. The Project Structural Engineer will request a foundation investigation and foundation report.

The required documentation for the wall selection report is outlined in the Colorado Department of Transportation "(CDOT) Bridge Design Manual", "Policies & Procedures" section.

The default wall design and design alternative documentation provided by the Project Structural Engineer will include:

1. Default design—defined to mean the best wall obtained from the selection process (see the "CDOT Bridge Design Manual", Programs – "Policies & Procedures" section).
2. Design alternatives—the products of the design selection process (see the "CDOT Bridge Design Manual", Appendix 11A). For a proprietary wall, refer to Section 2.022 "Proprietary Items" in this manual.

Additional Resources:

"CDOT Bridge Design Manual"

"CDOT Bridge Detailing Manual"

"American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications"

5.011 Noise Walls

The Resident Engineer, in cooperation with the Project Structural Engineer, will be responsible for the selection of the best-suited wall type. Based on the noise analysis, the Resident Engineer will provide the Project Structural Engineer with the alignment, height, and configuration. The Project Structural Engineer will be responsible for the structural design and requesting the foundation investigation. The Resident Engineer will need to review the structural plans for any potential conflicts with buried utilities.

Additional Resources:

"CDOT Bridge Design Manual"

"CDOT Bridge Detailing Manual"

"AASHTO LRFD Bridge Design Specifications"

"AASHTO Guide Specifications for Structural Design of Sound Barriers"

5.012 Analysis of Structures to be Resurfaced

A structural analysis/review is performed before a structure is resurfaced because resurfacing may affect the load carrying capacity of the structure, vertical clearance, effective bridge rail height, bridge expansion devices, or a combination thereof. Additional pavement can be placed on a structure if there is adequate load carrying capacity. The total thickness of asphalt after resurfacing shall be typically limited to 3 inches on the structure. Thicknesses greater than 3 inches will generally require a re-rating of the structure.

The Resident Engineer will request recommendations from the Project Structural Engineer for resurfacing of structures.

The Project Structural Engineer will send a surfacing recommendation memo to the Resident Engineer. The memo will include conditions related to the structure resurfacing (milling restrictions/overlay limits), Bridge Preventative Maintenance (BPM)-funded repairs to maintain the integrity of the riding surface or other structural integrity requirements, existing waterproofing membrane conditions, and existing bridge rail safety levels as well as recommended safety levels to maintain roadway safety. Bridge rail replacements are not eligible items for BPM funding.

The Resident Engineer will inform the Project Structural Engineer of the final proposed resurfacing method.

Additional Resources:

Colorado Department of Transportation “(CDOT) Bridge Design Manual”

5.013 Determine Existing Structural Capacity

An existing structure must meet criteria as established by the Federal Highway Administration (FHWA) and CDOT, if it is to be left in place.

The Resident Engineer will furnish the Project Structural Engineer pertinent data involving the existing structures and proposed design.

The Resident Engineer shall request recommendations from the Project Structural Engineer regarding the adequacy of the existing structure and recommendations and documentation according to the CDOT Bridge Design Manual for repair or replacement.

The Resident Engineer shall compare the bridge width with the requirements shown on the Form 463, Design Standards, to determine adequacy of the bridge width.

The decision to leave bridges that are narrower than the proposed roadway should be documented.

Additional Resources:

For forms, see the Colorado Department of Transportation's (CDOT's) online forms library About CDOT – CDOT Forms Catalog

"CDOT Bridge Design Manual"

5.014 Crashworthy Bridge Rail

Federal Highway Administration (FHWA) approved crashworthy bridge rail must be provided on all new bridges. Rehabilitated bridges on all projects, regardless of funding, should use crashworthy bridge rail.

Crashworthy rail is defined as crash tested in accordance with the "National Cooperative Highway Research Program Report 350", American Association of State Highway and Transportation Officials "(AASHTO) Manual for Assessing Safety Hardware (MASH)", or rail which has been approved by the FHWA as being equivalent to crash-tested rail. FHWA is primarily relying on CDOT to define the crash-worthiness of their existing rail.

The Project Structural Engineer will provide a recommendation to the Resident Engineer regarding the test level of the existing bridge rail and the probable test level required. The general highway system provides a Test Level 3.l. The Resident Engineer is responsible for determining whether to install new bridge rail or to leave the existing bridge rail in place.

Approved documentation for variances and design decisions shall be in the project file.

The following bridge rails are required for new or rehabilitated bridges on the following roadway classifications:

1. Type 9 or Type 10 MASH, or other approved crash-tested bridge rail
2. Local roads under the jurisdiction of counties or cities may use approved crash tested rail per their standards or safety requirements

When a bridge also serves pedestrians or cyclists and the posted speed limit is greater than 45 Miles Per Hour (MPH), a barrier to shield them from the traveled way and a pedestrian rail at the bridge edge may be warranted as determined by the Resident Engineer.

Working drawings with currently approved bridge rail are available from the Bridge Design and Management Branch.

Detailed drawings of bridge rail with revisions or modifications are to be included in the Construction Plans as determined by the Resident Engineer.

Additional Resources:

"23 Code of Federal Regulations (CFR) Part 625, Design Standards for Highways"

"American Association of State Highway and Transportation Officials (AASHTO) Guide for Selecting, Locating, and Designing Traffic Barriers"

"AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications"

"AASHTO Roadside Design Guide"

"AASHTO Standard Specifications for Highway Bridges"

5.015 Vertical Clearance of Structure

All highway projects shall meet or exceed minimum vertical clearances according to guidelines set by the FHWA and the Colorado Department of Transportation (CDOT). These clearances shall pertain to all overpasses, underpasses, railroad and transportation facilities, bicycle and pedestrian facilities, overhead lines, sign bridges, signal mast arms, navigational streams, channels, and canals. The Resident Engineer is responsible for determining the appropriate clearances.

Vertical clearance applies to the full pavement width, including provisions for future widening and overlay. A formal variance is required if less clearance than the minimum is achieved.

Minimum vertical clearances are listed in the "CDOT Roadway Design Guide", Chapter 6.

The Resident Engineer must verify vertical clearances for all phases on detours and traffic shifts. Clearances to falsework and shoring during construction should be considered. If minimum clearances cannot be maintained during construction, appropriate signing shall be included in the plans. Vertical clearances shall be shown on the highway construction plans for all structures.

Additional Resources:

"23 CFR Part 625, Design Standards for Highways"

"AASHTO Policy on Geometric Design of Highways and Streets"

"AASHTO Guide for the Development of Bicycle Facilities"

"AASHTO LRFD Bridge Design Specifications"

"AASHTO Standard Specifications for Highway Bridges"

Colorado Department of Transportation "(CDOT) Bridge Design Manual (Section 2)"

5.016 Accelerated Bridge Construction (ABC)

For construction projects that include one or more bridges, CDOT has developed a tool for evaluating Accelerated Bridge Construction (ABC) techniques, to determine whether or not they are appropriate for any given project.

The materials for an ABC evaluation can be downloaded at the internet link given below. The materials are compressed in a zip file. Download the materials; unzip the files; and save the files to your local computer.

Business – Accelerated Bridge Construction Documents

The accelerated bridge construction methodology is to be evaluated for all projects that will contain one or more bridges and will be included in the "Structure Selection Report". After completion of the evaluation, a justification letter must be written and added to the project file explaining why, or why not, an ABC technique will be used on the project. The justification letter should include materials completed during the ABC evaluation. The design team may choose to work with the designated Staff Bridge Engineer for guidance and information regarding the use of the ABC materials.

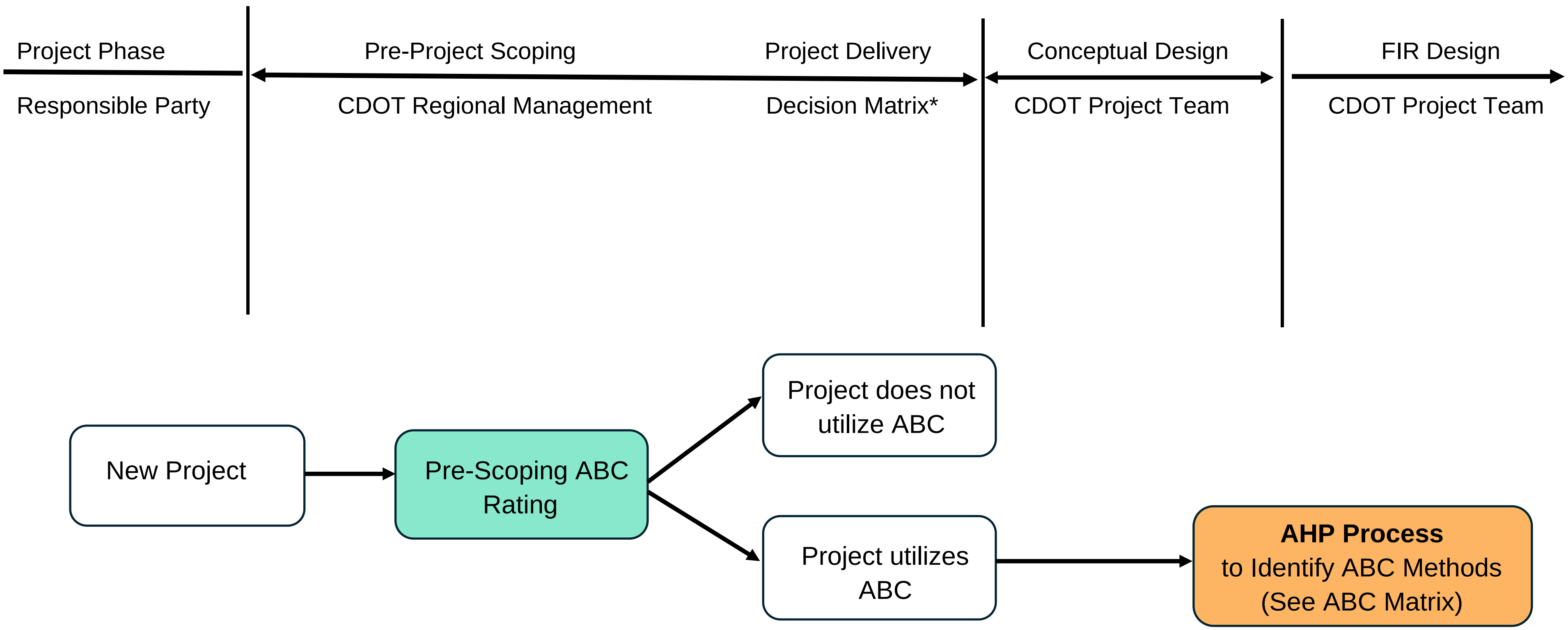
The document, "CDOT_ABC_Selection_Overview", contains an overview of the ABC process. The process is a two-phase approach. One phase is a cursory evaluation as to whether or not ABC is appropriate for a given project. The second phase is an in-depth evaluation as to what type of ABC technique will be employed.

This cursory evaluation is to be done during the scoping phase using the spreadsheet, "CDOT_Prescoping_ABC_Rating_Attachment_B." If the results of the cursory evaluation show that an ABC technique is appropriate for the project, the design team may move on to a more in-depth evaluation using the ABC Decision Making software to determine which ABC method best meets the project's goals and constraints. If the in-depth evaluation is required, the design team shall schedule a meeting with all specialty groups including but not limited to: Staff Bridge, Utilities, Environmental, Traffic, Hydraulics, etc., to execute the ABC Decision Making software. The results of the software are to become part of the project files.

The above information is represented graphically in Figure 5-1. This is the same diagram that is included in the document titled, "ABC_Workflow_Attachment _A".

Figure 5-1 ABC Evaluation & Decision Making Matrix Workflow

Accelerated Bridge Construction (ABC) Evaluation & Decision Matrix Workflow



*Contracting methods can work hand-in-hand with ABC delivery. Depending on the particular goals of the project and complexity of the ABC method, some contractual tools may be more beneficial than others. For each project the Delivery Decision Matrix should be completed after the Pre-Scoping ABC Rating Form has been completed. Some contractual tools are listed below:

Innovative Contracting Tools	A+B Contract Provision	Contract in Calendar Day:	Fixed Completion Date Contract	Incentive-Disincentive Provision	Lane Rental Provision	Value Engineering Specification	Design Build Contract Delivery Method	CM/GC Contract Delivery Method

Note to Readers: A long description of information conveyed in Figure 5.1 follows.

Data-based information conveyed through infographic elements. All information falls under a title "Accelerated Bridge Construction (ABC) Evaluation & Decision Matrix Workflow". A process flow diagram depicts four project phases in sequence, and the responsible party associated with each phase: The first phase is pre-project scoping and the responsible party is the Colorado Department of Transportation (CDOT) regional management. The second phase is project delivery with the responsible party designated by the Decision Matrix[1]. The third phase is conceptual design and the responsible party is the CDOT project team. The fourth and final phase is Field Inspection Review (FIR) design with the CDOT project team being the responsible party.

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[1] Footnote for Decision Matrix. Contracting methods can work hand-in-hand with ABC delivery. Depending on the particular goals of the project and complexity of the ABC method, some contractual tools may be more beneficial than others. For each project the Delivery Decision Matrix should be completed after the Pre-Scoping ABC Rating Form has been completed. Some contractual tools are listed as follows: A+B Contract Provision; Contract in Calendar Day; Fixed Completion Date Contract; Incentive-Disincentive Provision; Lane Rental Provision; Value Engineering Specification; Design Build Contract Delivery Method; Construction Manager/General Contractor (CMGC) Contract Delivery Method.

A process flow matrix depicts phases of project evaluations.

The first phase is new project.

The second phase is pre-scoping ABC rating.

The third phase is comprised of two possible outcomes. One of which is the project does not utilize ABC. The other possible decision is the project utilizes ABC.

The fourth phase occurs only if the other possible decision just mentioned (project utilizes ABC) is chosen. This fourth phase being the Analytic Hierarchy Process (AHP) Process to Identify ABC Methods (See ABC Matrix).