SECTION 2
DESIGN SUBMISSIONS & CONTRACT DOCUMENTS

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2.1 DESIGN REVIEW SUBMISSIONS

2.1.1 General

The following list outlines the design process and describes the submissions required for the design of bridges, box culverts and retaining walls. It should not be regarded as fully complete. The following items, where applicable, should be submitted in the order listed to the **CTDOT** for review and approval:

1. Environmental Review of the site,
2. Hydrologic Study,*
3. Preliminary Hydraulic Study (including any temporary facility as required),*
4. Scour Analysis (draft / final),*
5. Structure Type Studies or Rehabilitation Study Report,
6. Railroad Clearance Diagram,
7. Structure Layout for Design (SL/D) plans and Soils & Foundation Report,
8. Final Hydraulic Study,*
9. Final Plans for Review,
10. Incorporation of Review Comments, and
11. Final Submission.

* for structures crossing a waterway

2.1.2 Hydrologic Study

Prior to the start of the structure design and prior to the start of a Hydraulic Study to determine the waterway opening, the design discharge shall be calculated and submitted for approval. All pertinent "backup" data shall be submitted to facilitate the review process. This work shall conform to the latest edition of the **Drainage Manual**.

2.1.3 Preliminary Hydraulic Study

A Hydraulic Study is required if the structure requires work within the floodplain of a watercourse or stream with a watershed area exceeding one square mile. All work within the floodplain must meet the requirements of Sections 13a-94, 22a-344 and 25-68b through 25-68h of the *Connecticut General Statutes* along with the **Drainage Manual**. If a floodway is established, every effort should be made to avoid encroachment into it. Note, certain activities, such as the construction of bridge piers within the floodway may be acceptable provided there is no increase in the "with floodway" water surface profile for the base flood or the ten year flood. Prior to the preparation of a Structure Type Study, a preliminary Hydraulic Study must be prepared and submitted for review and approval. If Stream Channel Encroachment Lines are established, they should be shown on the plans.

2.1.4 Scour Analysis

The potential for scour at bridges over waterways must be evaluated and submitted to the **CTDOT** for review and approval. For this purpose, the FHWA document entitled "Evaluating Scour at Bridges" (**HEC-18**) or successor documents shall be used. Substructures for bridges over waterways shall be designed to safely support the structure subjected to the design scour. Substructures, subjected to scour shall be designed with pile foundations, foundations on rock, foundations located below the maximum estimated scour depth, or any other means approved by the **CTDOT**, provided adequate scour protection is maintained. The preferred foundation types are pile foundations and foundations on rock.

2.1.5 Structure Type Studies

Structure Type Studies shall be prepared for each new highway, pedestrian and railway crossing. The studies should consider the safety, serviceability, maintainability, constructability, permit requirements, economics and aesthetics of the proposed structures. The studies shall be developed after careful appraisal of the site conditions, foundation conditions, hydraulic and drainage conditions, design discharge and scour potential, coordination with DEEP fisheries, rights of way, utilities, and highway limitations (including maintenance and protection of traffic and environmental impacts) both present and future. Additional studies may be requested if the **CTDOT** finds the original proposals unsuitable or inadequate.

Multiple studies done just for quantity are not desired but only those studies that show promise or feasibility within the parameters herein should be pursued. For a group of bridges in a contract, structure type should be similar so that similarity of construction details may result in economy of costs. Repetition of a structure type merely for ease of design is to be avoided. Attention to detail in the appearance of the structure is to be kept foremost in mind. New materials and developments may be incorporated into the design of the proposed structure with the prior approval of the **CTDOT**.

Where the structure is required to have more than one span, the resulting multi-span structure shall be designed as continuous to eliminate the need for deck joints.

The structure type studies shall incorporate or otherwise resolve all requirements and constraints from applicable studies, reports and analysis developed by groups both within and outside the **CTDOT** for the crossing location.

The structure studies are to be prepared in a pamphlet form on letter size sheets. US Customary units of measurement shall be used in all studies. The sheets are to be numbered and each structure study is to be indexed. Construction costs shall be prepared for each structure type. One complete quantity and cost estimate sheet per study or structure shall be prepared. Additional costs for contingencies, such as minor items not normally computed, shall not exceed five percent of the total cost.

The structure studies shall be submitted for review. A meeting will be held to review the structure studies and select the type of structure to be designed. Upon approval of the structure type, the designer shall be authorized to proceed with the preparation of the Structure Layout for Design (SL/D) Plans.

2.1.6 Rehabilitation Study Reports

A condition survey and rehabilitation study shall be prepared for each existing highway, pedestrian and railway crossing. The report should consider the safety, historical significance, serviceability, constructability, economics and aesthetics of the proposed structure repairs or improvements. For structures over waterways, the report should include the necessary requirements listed in **BDM** [2.1.2 through 2.1.5]. The report shall be developed after careful appraisal of the existing condition of the structure, the intent of the project such as roadway widening or structure repairs, and highway limitations (including maintenance and protection of traffic and environmental impacts) both present and future. Additional studies may be requested if the original proposals are found to be unsuitable or inadequate.

The structure studies are to be prepared in a pamphlet form on letter size sheets. US Customary units of measurement shall be used in all studies. The sheets are to be numbered and each structure study is to be indexed. Construction costs shall be prepared for each alternate studied. One complete quantity and cost estimate sheet per study or structure shall be prepared. Additional costs for contingencies, such as minor items not normally computed, shall not exceed five percent of the total cost.

The structure studies shall be submitted for review. A meeting will be held to review the reports and select the desired rehabilitation plan for the structure to be designed. Upon approval of the rehabilitation plan, the designer may be authorized to proceed with the preparation of the Structure Layout for Design (SL/D) Plans.

2.1.7 Railroad Clearance Diagram

The Designer shall develop a “Railroad Clearance Diagram” and an “Approval of Railroad Clearance” form for approval by the railroad and the **CTDOT**. See **BDM** [Division 2] for examples of the clearance diagram and approval form.

2.1.8 Structure Layout for Design Plans

Upon approval of the structure type studies or the Rehabilitation Study Report, and following notification authorizing the start of the final design phase, the designer shall prepare Structure Layout for Design (SL/D) Plans for all bridges, box culverts and retaining walls.

The SL/D plans should be prepared on full size sheets. US Customary units of measurement shall be used in all plans. All details shall be drawn to scale. Extraneous information not relevant to the construction of the structure should not be shown on the plans. This includes miscellaneous topographic information such as trees, shrubs, signs, utility poles and other items that are detailed on the highway plans.

The SL/D plans shall contain the following:

a. Site Plan - A plan showing the location of the structure and approaches, topographical data including original and final contours, adjacent ramp and intersecting roadways and channels, if any, etc.

b. General Plan - A "Structure Plan" showing baseline stationing, controlling horizontal dimensions, span lengths, skew angle and clearances for the structure and approaches.

Projected below the "Structure Plan" should be an "Elevation" view showing the proposed structure with controlling dimensions and clearances, footing elevations, foundations, pertinent water and rock elevations, etc.

A typical cross section of the structure showing lane and shoulder arrangements, sidewalks if required, bridge railings, member spacing, slab thickness, and other pertinent details. For box culverts, this cross section shall show the number and size of the cells and type of construction, precast or cast-in-place.

The "General Plan" should also include a table of "Transportation Dimension and Weight" in accordance with **BDM** [1.3] and the "Notice to Bridge Inspectors" block.

c. Boring Plan(s) - Borings shall be plotted in accordance with **BDM** [2.2.2.2].

d. Stage Construction Plans, if applicable.

e. Pier Plan(s) - A pier "Plan" and "Elevation," if applicable, showing the proposed pier with controlling dimensions, footing elevations, foundation, etc.

f. Additionally, architectural aspects of the structure shall be noted, on the SL/D plans, such as bridge railing, pier and abutment configuration, surface treatment, etc.

The inspection access features, if required, should be shown on the Structure Layout for Design (SL/D) Plans. The SL/D plans will be submitted to the Bridge Safety and Evaluation Unit for review. The Bridge Safety and Evaluation Unit review should indicate one or more of the following:

- No special inspection access features required.
- The inspection access features shown are adequate.
- Certain inspection access features shown are not required.
- The following additional inspection access features are required.

The designer shall submit the SL/D plans, along with a copy of the Soils and Foundations Report for review and approval. Upon approval of the SL/D plans, the designer will be authorized to proceed with the development of the final contract documents.

2.1.9 Soil and Foundation Investigation

2.1.9.1 General

Subsurface exploration and testing programs shall be performed to provide pertinent and sufficient information for the design of substructures and retaining walls. The subsurface exploration and testing programs shall also provide pertinent and sufficient information for the design and construction of temporary support elements (sheet piling, cofferdams, soldier pile and lagging, etc.). The investigations shall conform to the **CTDOT**'s *Geotechnical Engineering Manual.*

2.1.9.2 Soil and Foundation Reports

A Soils and Foundation Report shall be prepared for each structure in accordance with the **CTDOT**'s *Geotechnical Engineering Manual*. The Report shall include any information necessary for the proper design of all structural elements and components that may be influenced by subsurface conditions. The Report should include, but not be limited to, boring logs, excavation requirements, foundation recommendations, soil and rock properties and capacities, axial and lateral pile capacities, design criteria, backfill and drainage requirements, and related special provisions.

The Report shall be made entirely with US Customary units of measurement. The Report shall be submitted for review and approval. A copy of the Report shall be submitted with the Structure Layout for Design (SL/D) Plans.

2.1.10 Final Hydraulic Study and Scour Reports

Final Hydraulic Study and Scour Reports based on the selected structural type must be prepared and submitted. The Final Hydraulic Study should address any concerns presented during the Preliminary Hydraulic Study and should contain a Hydrology Section as approved by the **CTDOT** in addition to the detailed hydraulic analysis. The hydraulic and scour data should be tabulated on the plans

2.1.11 Final Plans for Review *(Rev. 12/19)*

As part of the "Final Plans for Review Submission," the designer shall submit the following structure related items. The actual number of copies required varies and must be coordinated with the individual Project Engineer for the particular job:

- Final Plans for Review,
- Specifications,
- proposal estimates,
- Soils Report – Structure,
- Final Hydraulic Report,
- design computations,

- load rating package,
- quantity computations,
- structure costs with estimated steel weights (if applicable), and
- Final Scour Report.

The "Final Plans for Review" shall be complete. All bridge plans not prepared by the **CTDOT** shall be signed by the responsible party from the Consultant Engineer or the Municipality.

Incomplete submissions of plans, specifications or other data required for the Final Plans for Review Submission will not be accepted. The structural material submitted and the design of the same should be well coordinated with the roadway and utility plans and shall satisfy the needs of maintenance and protection of traffic.

The "Final Plans for Review" for structures incorporating special features to facilitate inspection and items requiring special attention will be submitted to the Bridge Safety & Evaluation Unit for review. They will indicate whether these features are adequate for future inspection and return the plans with comments or signify that the plans are satisfactory.

2.1.12 Incorporation of Review Comments

The various submissions will be reviewed and the review comments will be forwarded to the designer. All comments received shall be incorporated into the design prior to the next submission or mutually resolved. Written responses to all comments are desired.

2.1.13 Final Submission *(Rev 04/19)*

Upon completion of the review of the "Final Plans for Review," all plans, specifications and cost estimates that require modifications will be returned to the designer for incorporation of the review comments.

2.2 REQUIREMENTS FOR FINAL CONTRACT DOCUMENTS

2.2.1 General

The contract documents include the Final Plans and Specifications necessary to complete the contemplated construction work for a project.

US Customary units of measurement shall be used in all plans and specifications. All layout dimensions and elevations shall be given as decimal dimensions in feet. The following note shall be placed in the General Notes:

When dimensions are given to less than three decimal places, the omitted digits shall be assumed to be zeros

Detail dimensions (those not normally measured by the surveyors) should be given in feet and inches.

2.2.2 Final Plans *(Rev. 12/19)*

The final plans should be prepared on full size sheets. All details shall be drawn to scale. Plans for individual bridges shall be self-contained sets. On large projects with multiple retaining walls or resurfacing projects with numerous bridges, these structures may be combined into one set of plans for efficiency of detailing.

The designer shall prepare final contract plans for all structures. The use of a "Limited Investigation Disclaimer" should be limited only to sheets pertaining to estimated quantities, borings, and substructure components.

Existing structures (houses, garages, storage tanks, etc.), which will be demolished before the project is constructed, shall not be indicated on the structure plans. The location of the existing foundation should be noted on the contract drawings. Any existing drainage facilities that are in conflict with footings, retaining walls, etc. should be shown on the plans.

The use of the phrase "by others" on contract plans is considered acceptable as long as the reference to whom the "others" are is specified within the contract plans.

For bridges on a horizontal curve, basic layout information shall be shown as described in **BDM** [Division 3].

All final plans shall be submitted to the **CTDOT** in "MicroStation" digital CADD format. Specific requirements and materials, such as level symbology and seed files, are available from the **CTDOT**.

2.2.2.1 Presentation of Drawings

The following is the recommended order for the presentation of structure plans and generally follows the order of construction:

- General Plan (one or two sheets),
- Layout Plan (if required),
- Boring Logs,
- Stage Construction Plans,
- Foundation Plans,
- Abutment and Wingwall Plans,
- Pier Plans (if required),
- Framing Plans,
- Beam and Girder Details,
- Bearing Details,
- Slab Plans,
- Slab and Approach Slab Details,

- Joint Details,
- Metal Bridge Rail Detail Sheet (if required),
- Pedestrian Railing or Bicycle Railing Detail Sheet (if required),
- Protective Fence Detail Sheet (if required),
- Deck Drainage Details (Scuppers and Piping if required),
- Electrical Detail Sheet,
- Utility Sheets (if required), and
- Existing Structure Plans (if required).

2.2.2.2 Boring Logs

The boring logs shall be in US Customary units of measurement and shall be shown on the plans. The format of the boring logs plotted on the plans shall be identical to the format of the **CTDOT**'s standard boring log forms. A list of boring log abbreviations used for describing the soil and rock, such as colors, textures, properties, and types, shall also be shown on the plans.

2.2.2.3 Quantities *(Rev. 04/19)*

Quantities shall be tabulated and shown on the "Detailed Estimate Sheet" only.

2.2.2.4 Transportation Dimensions and Weights

The maximum transportation lengths, widths and height of bridge members along with the maximum transportation weight must be shown on the "General Plan." The following is a sample of the information required:

Member	Shipping Length	Shipping Height	Shipping Width	Shipping Weight
G-1	115 ft	9 ft	10 ft	118,000 lbs

2.2.2.5 High, Low, & Flood Water Elevations

For structures over tidal waterways, the "General Plan" shall indicate the mean high water and mean low water elevations. For structures over non-tidal waterways, the plans shall indicate the watershed area, the magnitude, frequency and the water surface elevation for the design flood, as well as the normal water surface elevation.

2.2.2.6 Quantity Disclaimer Note

The following note must be placed on those Structure Sheets that contain estimated quantities, boring and substructure components:

The information, including estimated quantities of work, shown on these sheets is based on limited investigation by the State and is in no way warranted to indicate the true conditions of actual quantities or distribution of quantities of work which will be required.

2.2.2.7 Notice to Bridge Inspector

The designer shall note on the General Plan any item that would require special attention, such as fracture critical members, during inspection of the structure. This information shall be contained in the "Notice to Bridge Inspectors" block as shown in **BDM** [Division 2].

2.2.2.8 Coordinate Tabulation

The designer shall tabulate coordinates on each set of bridge plans for structures on a horizontal curve. These coordinates shall be tied into the Connecticut Coordinate Grid System. Coordinates shall be tabulated for the following:

- locations of working points,
- ends of wingwalls,
- ends of slabs,
- ends of approach slabs, and
- intersections of the centerlines of bearings at the abutments and piers with:
    - construction centerlines,
    - baselines,
    - points of application of grade,
    - gutterlines, and
    - centerlines of stringers.

2.2.2.9 Beam or Girder Lengths

The horizontal lengths of beams or girders measured center to center of bearings along the centerline of the member shall be shown on the plans.

2.2.2.10 Utility Locations *(Rev. 04/19)*

All existing underground utilities, including drainage facilities, in the vicinity of the construction must be shown on the General Plan and on all foundation drawings. It is imperative that utilities adjacent to but not actually within the excavation limits also be shown since heavy equipment, pile driving or other deep foundation work may impact them. The size, type, owner and location of the utility must be given.

2.2.3 Specifications

2.2.3.1 Standard Specifications for Roads, Bridges, Facilities and Incidental Construction

This is the category of specifications that is commonly referred to as the "Standard Specs." They are the basic construction specifications that describe and define the requirements of those items of construction most commonly used in highway construction. These specifications are in the charge of the "Standing Committee on Standard Specifications," otherwise known as the "Specifications Committee."

Amendments, additions to, or deletions from this book are accomplished through Committee action. The need for a particular action is usually brought to the attention of the Committee by those intimately concerned with the particular specification.

These specifications undergo constant change as new methods, materials and technology become available. The vehicle for accomplishing permanent change to a standard specification is the Supplemental Specification discussed in the following section.

2.2.3.2 Supplemental Specifications *(Rev. 04/19)*

As previously stated, the Supplemental Specifications permanently add to, delete, or otherwise revise the Standard Specifications. Prior to publishing and disseminating these specifications, they must have been approved by the Specifications Committee and the Federal Highway Administration.

The Supplemental Specifications are issued twice a year by the Specifications Committee, containing all the current supplements and errata that have been issued since the acceptance of the last set of *Standard Specifications*.

The Supplemental Specifications date that is to be referenced in the contract will be associated with the Final Design Plans date.

The Supplemental Specifications may be considered part of the *Standard Specifications*. When a new set of standard specifications is accepted, these are automatically incorporated. Both the Supplemental Specifications and the *Standard Specifications* set with the supplements merged into it are posted on the Department's webpage.

2.2.3.3 Special Provisions

2.2.3.3.1 General *(Rev. 04/19)*

In those cases where neither the standard specification nor subsequent supplemental specifications are found to be adequate, or where no specification exists, a special provision must be prepared.

The **CTDOT** has developed and maintains lists of standardized special provisions known as "Owned Special Provisions." The purpose of these special provisions is to establish uniformity in the specification of materials and construction methods.

These "Owned Special Provisions" shall be inserted into the contract documents unchanged. The designer is responsible for the correct application of the recurring special provisions to each project. Should a change to an "Owned Special Provision" be required, written permission from the listed owner must be obtained.

2.2.3.3.2 Contractor Designed Items

For all items requiring the Contractor to provide designs for permanent structural features, special provisions shall be included in the contract requiring the Contractor to provide PDF copies of all design plans. These PDFs shall conform to the **CTDOT**'s standard format for structural design plans and shall be signed and sealed by a Connecticut Professional Engineer.