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CHAPTER 4
CONSTRUCTION DRAWINGS AND DESIGN DELIVERABLES

4.1 GRAPHICAL STANDARDS

All Construction Drawings shall be created as per procedures specified in the current version of the MassDOT Highway Division CAD Standards Manual.

4.2 PREPARATION OF CONSTRUCTION DRAWINGS

4.2.1 General

4.2.1.1 Construction Drawings shall clearly and accurately depict all pertinent aspects and details necessary to construct the proposed structure. They shall be organized in a logical sequence, as outlined below, which follows the flow of the construction work. Ideally, related details should be grouped on the same sheet. If this is not possible, related details should then be located on adjacent sheets so that flipping between sheets is minimized. In no way should related details be scattered throughout the construction drawings. Appropriate scales shall be used to show a clear presentation of the details of the structure.

Sections shall be numbered in consecutive order from the start to the end of the bridge construction drawings. The first section that appears on the bridge construction drawings shall be Section 1 and there shall be no repetition of any section number. Details shall be identified by a title or by a letter consistent with the Bridge Manual drawings. The first detail identified by a letter that appears on the bridge construction drawings shall be Detail A and subsequently lettered details shall be organized in an alphabetical sequence without repetition.

4.2.1.2 The baseline of survey shall be the basic reference line for the layout of the bridge. The centerlines of bearings on the abutments and piers shall be the basic lines to be tied to the baseline of survey. Thus, the beam layout, footing layout, Construction Drawings of piers and abutments should be referenced by the station of the intersection of the baseline and the centerline of bearings and by the angle between them. In some cases, the baseline of survey may be away from the structure, in which case the baseline or centerline of construction shall be used. Where the bridge is on a curve, the skew angles of the centerlines of bearings of the beams should be computed to a tangent to the horizontal curve at the centerline of bearings, and all offsets for the layout should be at right angles to that tangent. Radial offsets to the curve are not acceptable.

4.2.1.3 Construction Drawings shall be prepared to fit a standard sheet size as shown on Dwg. No. 1.1.1 of Part II of this Bridge Manual.

4.2.2 Organization

4.2.2.1 The following is an accepted sequence for organizing Construction Drawings:

1. First Sheet
2. Second Sheet
3. Boring Sheets
4. Plan and Elevation Sheet
5. Stage Construction Traffic Management Sheets

6. Construction Sequence Sheets (i.e. Water Control, etc.)
7. Substructure Sheets
8. Superstructure Sheets
9. Deck Detail Sheets
10. Miscellaneous Detail Sheets

The first sheet including borders and title blocks shall be laid out as shown on Dwg. No. 1.1.1 of Part II of this Bridge Manual. All subsequent sheets including borders and title blocks shall be laid out as shown on Dwg. No. 1.1.2 of Part II of this Bridge Manual.

4.2.2.2 First Sheet. (See Dwg. No. 1.1.1 of Part II of this Bridge Manual for the organization of the first sheet). The first sheet shall contain the following information:

Standard Title Block: (See Dwg. No. 1.1.3 or Dwg. 1.1.4 of Part II of this Bridge Manual). During the preparation of Construction Drawings, maintain a 3" high "Reserved Zone" above the Standard Title Block for potential future revisions. The project description shall be specified as follows:

PROPOSED BRIDGE - New substructure and superstructure. Any existing bridge structure may be retained, in whole or in part, or may be removed in its entirety; however, no portion of the existing bridge structure will be incorporated into the proposed bridge structure.

PROPOSED SUPERSTRUCTURE REPLACEMENT - All elements of the superstructure are replaced. Substructure elements are retrofitted to meet current code requirements and/or some, but not all, substructure elements are replaced.

PROPOSED BRIDGE REHABILITATION - Some superstructure and substructure elements are replaced and/or existing elements that are to remain are retrofitted to meet current code requirements.

NOTE: The project descriptions above are intended for those projects types whose designs are governed by this Bridge Manual. Other project descriptions may be used for bridge projects that are not fully governed or not governed at all by this Bridge Manual, but which more accurately describe the type of work detailed on those Construction Drawings, such as:

PROPOSED DECK REPLACEMENT, PROPOSED BRIDGE REPAIRS, PROPOSED BRIDGE PRESERVATION, PROPOSED BRIDGE WIDENING, PROPOSED SCOUR REPAIRS

The names of Facility Carried / Feature Intersected must be exactly the same as those given on the SI&A. The generic Feature and/or Facility Codes (i.e. WATER, HWY, RR, etc.) should be omitted, but the Interstate (I-), US Route (US) and State Route (ST) code along with the route number, followed by the local street names (if any) in parentheses, shall be provided. The local street names shall be fully spelled out (e.g., N WSHNGTN ST on the SI&A shall be spelled out as North Washington Street). If the same stretch of road has several numbered routes associated with it, then all of the routes shall be provided separated by a slash (/) starting with the Interstate then the US Route then the State Route and followed by the local street name (if any) in parenthesis. The following are examples of the proper identification of the bridge with some common Facility Carried/Feature Intersected:

- *ST 19 (WALES ROAD) OVER MILL BROOK*
- *ST 20A (PLAINFIELD STREET) OVER I-91*
- *US 202 (GRANBY ROAD) OVER ST 116 (NEWTON STREET)*
- *I-95/US 1/ST 3 OVER WEST STREET*
- *ST 31 (RESERVOIR STREET) OVER PROVIDENCE & WORCESTER RR*
- *WOLOMOLOPOAG STREET OVER AMTRAK/MBTA*

Federal Aid Block: (See Dwg. No. 1.1.5 of Part II of this Bridge Manual)

Locus: Same as for Sketch Plans, A small-scale plan, whose dimensions are no greater than 4½" by 4½", which serves as a map to locate the structure that is being presented on these Construction Drawings. The scale should not be larger than 1" = 2000' and the Locus should not include any extraneous information, such as the start and end stations of the project, locations of other bridges that may be part of a larger project, or any other information that is not absolutely critical to establishing the location of the structure that is being presented on these Construction Drawings.

Key Plan and Profile: Same as for Sketch Plans, the Key Plan and the Profile of the road segment the bridge is on shall be drafted with the Key Plan over the Profile and with the baseline stations on the two drawings lining up as much as practical.

The Key Plan of the proposed structure is typically drawn to a scale of 1" = 40', showing baseline of survey, baseline or centerline of construction, curve data, roadway widths, angles of intersection to establish geometry of the structure, equation of stations of intersecting baselines, existing and relocated utilities, configuration of proposed and existing structures and their footings, topographical features, and layout lines if available. Where a waterway is involved, show the old location and the proposed location of the stream. Show riprap treatment and any channel paving. The locations of all borings, test pits and/or other subsurface investigations shall be shown on the key plan.

The Profile of the road shall be shown with proposed and existing ground grades, outline of proposed and existing structures and limits of any pre-loaded earth embankments. Observed, design and base (100-year) water surface elevations shall be shown on the profile where applicable. For most structures, the vertical scale is ⅛" = 1'- 0" and the horizontal scale shall match the horizontal scale of the Key Plan.

Additional Profiles: Same as for Sketch Plans, a profile of each road, railroad or stream bed that runs under the bridge shall be shown with proposed and existing ground grades, outline of proposed and existing structures and limits of any pre-loaded earth embankments. Observed, design and base (100-year) water surface elevations shall be shown on the profile where applicable. For most profiles, the vertical scale is ⅛" = 1'- 0" and the horizontal scale is 1" = 40'.

Estimated Quantities: The estimated quantities of the bridge related items only shall typically be located along the right margin directly under the Federal Aid Block (if the Index of Sheets is long, the Estimated Quantities can be moved to the Second Sheet).

Index of Sheets: Index to the set of Construction Drawings describing the details on a given sheet and its sheet number, located along the right margin under the Estimated Quantities.

4.2.2.3 Second Sheet. *(See Dwg. No. 1.1.2 of Part II of this Bridge Manual for the organization of the second sheet)*. In addition to the Federal Aid Block and the Subsequent Sheets Title Block, the second sheet shall contain the following information:

General Notes: The standard general construction notes are outlined below and are intended to be located on the second sheet on the left hand side. The wording and content may vary or additional general construction notes may need to be added to suit the particular needs of the project:

GENERAL NOTES

DESIGN:

IN ACCORDANCE WITH THE AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS LRFD BRIDGE DESIGN SPECIFICATIONS, XTH EDITION, 20XX, FOR HL-93 LOADING. (*If the design loading is different from HL-93, specify the actual design loading*.)

If the bridge carries a railroad, substitute the following note:

IN ACCORDANCE WITH THE 20XX SPECIFICATIONS OF AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION, INCLUDING INTERIM SPECIFICATIONS THROUGH 20XX. *(Use this note for bridges carrying railroads)*

MASSDOT BENCH MARK:

Provide location and elevation of the control benchmark set by MassDOT. It is to be noted that if a structure is in a pre-loaded area and the nearest benchmark becomes covered, another benchmark outside the area should be selected. Following the elevation of the benchmark, the following note should be added:

ELEVATIONS ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988.

DATE:

TO BE PLACED ON THE INSIDE FACE OF THE -- AND -- HIGHWAY GUARDRAIL TRANSITIONS. A SHEET SHOWING SIZE AND CHARACTER OF NUMERALS WILL BE FURNISHED. THE DATE USED SHALL BE THE LATEST YEAR OF CONTRACT COMPLETION AS OF THE DATE THE FIRST HIGHWAY GUARDRAIL TRANSITION IS CONSTRUCTED. BOTH HIGHWAY GUARDRAIL TRANSITIONS SHALL FEATURE THE SAME DATE.

MASSDOT SURVEY NOTEBOOKS:

Specify the MassDOT survey notebooks used in the preparation of construction drawings:

Baseline _____, Details _____, Cross-sections _____, or, if electronic survey was used, state that copies of files may be obtained from MassDOT. This information MUST be provided. It is not acceptable to omit this information.

SCALES:

SCALES NOTED ON THE PLANS ARE NOT APPLICABLE TO REDUCED SIZE PRINTS. DIVIDE SCALES BY 2 FOR HALF-SIZE PRINTS (A3).

FOUNDATIONS:

FOUNDATIONS MAY BE ALTERED, IF NECESSARY, TO SUIT CONDITIONS ENCOUNTERED DURING CONSTRUCTION, WITH THE APPROVAL OF THE ENGINEER.

UNSUITABLE MATERIAL:

ALL UNSUITABLE MATERIAL SHALL BE REMOVED WITHIN THE LIMITS OF THE FOUNDATIONS OF THE STRUCTURE, AS DIRECTED BY THE ENGINEER.

ANCHOR BOLTS:

ALL ANCHOR BOLTS SHALL BE SET BY TEMPLATE BEFORE THE CONCRETE IS PLACED.

CONCRETE:

UNLESS OTHERWISE SPECIFIED, ALL CONCRETE SHALL BE 5000 HP CONCRETE, EXCEPT THAT THE CT-MTL2 BARRIER SHALL BE 5000 3/8 IN. HP CONCRETE.

ALL CIP AND PRECAST CONCRETE POURS SHOWN ON THESE CONSTRUCTION DRAWINGS WHERE ALL VOLUMETRIC DIMENSIONS ARE 4 FEET OR GREATER SHALL BE CONSIDERED TO BE MASS CONCRETE PLACEMENTS AND SHALL REQUIRE A HEAT OF HYDRATION ANALYSIS AND THERMAL CONTROL PLAN, AS SPECIFIED IN THE MASSDOT STANDARD SPECIFICATIONS.

REINFORCEMENT:

REINFORCING STEEL SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M 31 GRADE 60. UNLESS OTHERWISE NOTED ON THE CONSTRUCTION DRAWINGS, ALL BARS SHALL BE LAPPED AS FOLLOWS:

MODIFICATION CONDITION	#4 BARS	#5 BARS	#6 BARS
1. NONE	16”	17”	21”
2. 12” OF CONCRETE BELOW BAR	18”	22”	27”
3. EPOXY COATED BARS, COVER < $3d_b$, OR CLEAR SPACING < $6d_b$	21”	26”	31”
4. COATED BARS, ALL OTHER CASES	17”	21”	25”
5. CONDITION 2. AND 3.	23”	29”	35”
6. CONDITION 2. AND 4.	21”	27”	32”

ALL OTHER BARS SHALL BE LAPPED AS SHOWN ON THE CONSTRUCTION DRAWINGS.

Assumptions used in developing the above lap lengths:

- *f'_c = 5.0 ksi*
- *F_y = 60 ksi*
- *λ_{rc} = 0.4 - Reinforcement Confinement Factor, (AASHTO LRFD Bridge Design Specifications (AASHTO LRFD)) – Assumes k_{tr} = 0, therefore a minimum cover of $2d_b$ and a minimum spacing of $5d_b$ are required. This condition is typical of decks; for other applications, e.g., longitudinal steel in pier columns, the actual k_{tr} may be considered and the lap length adjusted accordingly.*
- *λ_{er} = 1.0 - Excess Reinforcement Factor, (AASHTO LRFD) – This is a conservative assumption since typical designs have A_s provided > A_s required.*
- *Class B Lap Splice 1.3 l_d (AASHTO LRFD)*
- *λ = 1.0 for normal weight concrete (AASHTO LRFD)*
- *ACI Small Bar Factor = 0.8 (refer to Subsection 3.1.9 of this Bridge Manual, ACI 318-11 and AASHTO LRFD)*

If any of these assumptions are invalid the Designer must provide the required lap splice on the drawings.

Traffic Data Block: *(Provide table as shown on Dwg. No. 1.1.6 of Part II of this Bridge Manual)*

Seismic Data Block: *(Provide table as shown on Dwg. No. 1.1.7 of Part II of this Bridge Manual)*

Hydraulic Data Block: *(Provide table as shown on Dwg. No. 1.1.8 of Part II of this Bridge Manual for any structure over a stream)*

Temporary Water Control: *(If required, provide table as shown on Dwg. No. 1.1.9 of Part II of this Bridge Manual for any structure over a stream)*

4.2.2.4 Boring Sheets. The information provided will be the same, including the same Boring Notes, as required for Sketch Plans. See Paragraph 2.8.3.3. If there is space on the second sheet, the Boring Notes can also be included on that sheet.

4.2.2.5 Plan and Elevation Sheet. A large scale plan view and one elevation view of the proposed bridge structure showing roadway and sidewalk dimensions, layout and all dimensions of the railings and paraffin joints, location of the substructure elements in square dimensions and in relation to the feature crossed, and proposed minimum clearances. The elevation view shall include design and check flood scour elevations. See Paragraph 2.8.3.4 of this Bridge Manual for guidance on how to calculate these scour elevations.

4.2.2.6 Stage Construction Detail Sheets. These sheets shall show all details and dimensions necessary to layout and construct all elements of the bridge in accordance with the approved traffic management plan. At a minimum, these details shall include:

1. Plan and cross section for each stage of construction. It is essential that all critical dimensions be included.
2. Temporary earth support details.
3. Temporary bridge barrier details.

4.2.2.7 Substructure Sheets. These sheets shall show all details and dimensions necessary to layout and construct all substructure elements for the bridge. At a minimum, these details shall include:

1. Plan and elevation view of abutments and piers showing all dimensions, bridge seat elevations, footing elevations, top of wall and other controlling elevations.
2. Foundation support details.
3. Footing layout.
4. Substructure joint details.
5. Typical sections with all reinforcement details.

4.2.2.8 Beam Detail Sheets. These sheets shall show all details and dimensions necessary for the fabrication of the bridge's load carrying members. At a minimum these details shall include:

1. Framing plan.
2. All beam details and notes necessary for correct fabrication.
3. Beam camber requirements (steel only).
4. All connection details.
5. Diaphragm details along with their connections.
6. Utility support details.
7. Shear connector details.
8. Bearing details.

4.2.2.9 Deck Detail Sheets. These sheets shall show all details and dimensions necessary for constructing the bridge deck and all related elements. At a minimum these details shall include:

1. Typical superstructure cross section.
2. Deck details including required thickness and reinforcement.
3. Haunch detail.
4. Top of Form elevations (if required).
5. Sidewalk, safety curb, barrier details including reinforcement.
6. Reinforcement details for continuous bridges including pouring sequences if required.

4.2.2.10 Miscellaneous Detail Sheets. These sheets shall show all additional details necessary to construct the bridge structure. These sheets may include the following:

1. Joint details.
2. Bridge Rail to Highway Guardrail Transition Sheet (MassDOT standard sheet).
3. Railing details (MassDOT standard sheet).
4. Type II Protective Screen or Snow Fence details (MassDOT standard sheets)

4.3 STRUCTURAL SUBMITTALS AND DESIGN DELIVERABLES

4.3.1 General

All Construction Drawings shall conform to the requirements of the current MassDOT Highway Division CAD Standards Manual. All of the design deliverables that make up each Structural Submittal shall be made as electronic files in PDF format and shall consist of the materials described in the Subsections below.

4.3.2 First Structural Submittal (S1)

Fully designed and checked (QC/QA'd) Plans, Specifications and Estimate (PS&E) of the bridge project including a set of Design Calculations, a second set of Independent Check Calculations, the engineer's record of reconciliation between the two, the preliminary load rating calculations, and the completed and signed Construction Drawings Checklist shall be submitted to the Bridge Section for review. Preliminary load rating calculations shall consist of the BrR file and/or other MassDOT rating analysis software input files, spreadsheets, and other computer calculation aids that were used to develop the preliminary load rating.

The MassDOT will review the First Structural Submittal Documents and will and provide comments through Bluebeam to the Designer for their reconciliation and to provide responses.

4.3.3 Second Structural Submittal (S2)

After all of MassDOT's First Structural Submittal review comments have been addressed and reconciled, the Designer shall resubmit the updated PS&E, including an updated set of Design Calculations, a second set of Independent Check Calculations, the engineer's record of reconciliation between the two, and the preliminary load rating calculations, to the Bridge Section for a back-check review.

If an additional Structural Submittal is required it shall be given the number in sequence in relation to the previous submittal, such as S3, S4, etc. **Please note that the Designer shall keep the number of submittals to the absolute minimum, which is S1, S2, and SF. The number of submittals in the excess of the referenced above may affect the Designer's performance evaluation.**

4.3.4 FHWA Review

If the PS&E also needs to be reviewed by FHWA, MassDOT shall coordinate this review. FHWA shall give their approval prior to the Final Structural Submittal.

4.3.5 Final Structural Submittal (SF)

After MassDOT's review of the Second Structural Submittal confirms that the PS&E are acceptable and after receiving FHWA approval if needed, the Designer shall submit a final all-electronic version of the Construction Drawings, final Special Provisions, final Preliminary Estimate of Quantities, final conformed set of Design Calculations, a second set of Independent Check Calculations both of which have been stamped and digitally signed by a Professional Engineer registered in Massachusetts, the engineer's record of reconciliation between the two, and preliminary load rating calculations, to MassDOT as electronic files in PDF format. The first sheet PDF of the bridge Construction Drawings shall be submitted as a separate file from the rest of the bridge Construction Drawings to facilitate its digital signing by responsible MassDOT signatories. This first sheet submitted by an outside Design

Consultant shall have the name and address of the Designer as well as the stamp and digital (or wet) signature of a Registered Professional Engineer incorporated into the Standard Title Block, as shown on Drawing No. 1.1.4 of Part II of this Bridge Manual. The final Design Calculations and Independent Check Calculations are considered to be "Instruments of Service" as defined in 250 CMR Section 5.02 and shall be signed and sealed in accordance with 250 CMR Section 5.03 (15).

4.3.6 AASHTOWare XML or Other Rating Input Files

Along with the Final Structural Submittal, the Designer shall also submit the preliminary AASHTOWare XML or other computer rating input files that were used to generate the preliminary load rating. This submission is not in lieu of the final post-construction rating report and does not relieve the Designer of the responsibility of preparing that report and final computer rating input files based on the as-built Initial Inventory Inspection Report. This requirement is to ensure that MassDOT has the ability to perform an overload permit analysis of the completed bridge during the gap in time between the completion of construction and the preparation and submittal of the final bridge rating report for the bridge by the Design Consultant.

4.4 REVISIONS TO CONSTRUCTION DRAWINGS

4.4.1 Approval Procedure

4.4.1.1 General. It may be necessary to revise the Contract Drawings for a variety of reasons such as errors, omissions, changes in design conditions, changes requested during construction, etc. The procedure for initiating and approving these changes is outlined below and is taken from the Commonwealth of Massachusetts, Massachusetts Highway Department, Standard Operating Procedure No. CSD-24-16-1-000, *Structural Approval Procedures*.

Whenever the Designer is contacted directly by either a Contractor, a Contractor's fabricator or by MassDOT District or Construction Division personnel with a request to make changes to an existing design that has been previously approved by the Bridge Section, the Designer must contact the Bridge Section to inform it of the request and the reason for it. Any changes to the previously approved design must be reviewed and approved by the Bridge Section prior to the Designer forwarding these changes to the party making the request. Any changes that will alter the details shown on the original Contract Drawings must be documented through a formal revision in accordance with Subsection 4.4.2 below.

4.4.1.2 Errors on the Construction Drawings. If the Designer or the Contractor's fabricator finds errors on the Construction Drawings or in the Special Provisions, the information with recommended corrective action shall be referred through the Designer directly to the State Bridge Engineer. Only a copy of the letter shall be sent to the District Highway Director and the Construction Engineer. The State Bridge Engineer will review the corrective action for approval and the Designer will distribute revised Construction Drawings and/or shop drawings. If revisions to the Construction Drawings are not necessary, the State Bridge Engineer will inform the Construction Engineer who in turn will inform the Contractor through the District Highway Director.

Errors discovered by all others will be processed through normal MassDOT channels.

4.4.1.3 Requested Changes. No request for any change shall be initiated unless all of the four following questions can be answered in the affirmative:

1. Is the change in the public interest?
2. Does it provide an equal or better material or product than originally specified?

3. Does it provide a better method of construction than originally planned?
4. If the Contractor benefits from the change, is there a corresponding benefit to MassDOT?

The Construction Engineer will determine the validity of the reasons given for any change.

I. Changes Requested by the Fabricator:

These requests shall be submitted by the Fabricator to the Designer with copies of the letter to the Prime Contractor and the District Highway Director. The Designer will review the requests and make comments and/or recommendations to the State Bridge Engineer. Approval or disapproval will be given by the State Bridge Engineer and any necessary revisions to the Construction Drawings will be made and distributed in accordance with the current revision procedure. The Designer will inform the fabricator of the approval or disapproval (copies of the letter to the prime contractor and the District Highway Director) and the shop drawings will be submitted accordingly.

II. Changes requested by the Contractor:

If the Contractor requests a change in the Construction Drawings and/or Special Provisions, he/she shall submit all the necessary information to the District Highway Director, who will forward the request to the Construction Engineer with the District's comments and/or recommendations. If the Construction Engineer determines that there is no question of structural design, he/she shall approve or disapprove the request at that level. If a design review is required it shall be processed by the State Bridge Engineer and the conclusions regarding structural integrity only will be forwarded to the Construction Engineer. The Contractor will then be informed of the approval or disapproval through the District Highway Director.

III. Changes Requested by Outside Agencies:

If requests for changes in the Construction Drawings and/or Special Provisions are made by outside agencies the same procedure as specified above for changes by the Contractor shall be followed.

4.4.1.4 Corrective Repairs. When errors are made by the Contractor during construction, and in the opinion of the District Construction Engineer corrective repairs are possible, the complete proposed method of correction including calculations, shall be submitted to the District Highway Director and forwarded to the Construction Engineer with the District's comments and/or recommendations. The Construction Engineer will review and check fully and refer to the State Bridge Engineer for structural acceptance, if deemed necessary. Approval or disapproval will be given by the Construction Engineer and the Contractor shall be so informed through the District Highway Director.

4.4.1.5 Railroad Approval. Whenever railroad approval is required for structural changes, the approval will be handled solely by the State Bridge Engineer.

4.4.1.6 FHWA Concurrence. When FHWA concurrence is required for structural matters it will be obtained by the State Bridge Engineer prior to issuance of revised Construction Drawings. The Construction Engineer will handle all other matters directly with the FHWA.

4.4.1.7 Proper Channels. District Highway Directors shall instruct all Resident Engineers and others connected with a project during construction that structural field problems shall not be referred directly to the State Bridge Engineer and/or the Designer. All information shall be reviewed and checked by the District Bridge Engineer before being referred to the State Bridge Engineer.

4.4.1.8 Supplemental Instructions to Resident Engineers.

1. Review the Construction Drawings and Special Provisions with your assistants as soon as possible.
2. Discuss any apparent errors and/or discrepancies with the District Construction Engineer or District Bridge Engineer or their assistants who in turn will inform the Boston Construction Division.
3. Get clarification on any part of the Construction Drawings and/or Special Provisions that are not clear.
4. Avoid future claims by correcting ambiguities, discrepancies and errors before additional costs result.
5. Do not make changes or initiate changes unless they are justified and agreed to in writing by the State Bridge Engineer to be necessary.

4.4.2 Revising Construction Drawings

4.4.2.1 Legal Considerations. Designers are reminded that, under Massachusetts Regulations, Construction Drawings are defined as Instrument of Service and that their preparation and sealing is governed by 250 CMR 5.00: *Professional Practice*. Furthermore, Construction Drawings, being part of the project Contract Documents, are also legal documents in themselves that can be introduced as evidence in court proceedings, both civil and criminal. As a result, it is imperative that Construction Drawings be treated with the same due care as any other legal document.

When revising Construction Drawings, Designers must do so in a manner that preserves the traceability of any changes made so that it is eminently clear what was the original design that was sealed by the Designer of Record and what was accepted for construction by responsible MassDOT signatories, what changes were made and when. With modern electronic editing capabilities, it is very easy to modify a drawing and make it appear to be original which, when combined with the original scanned title sheet, would make it appear that, the Professional Engineer sealing that sheet and the MassDOT signatories, approved and are liable for a set of plans that, in reality, they had never seen.

4.4.2.2 It remains Bridge Section policy that NO ERASURES, DELETIONS or OTHER FORMS OF ELECTRONIC MODIFICATION of any portion of the Construction Drawings are allowed. Dwg. No.'s 1.1.10 and 1.1.11 of Part II of this Bridge Manual illustrate the proper method for making and recording revisions to contract drawings that preserve document revision traceability. These methods can still be employed for making revisions to PDF Construction Drawings as follows:

- The Designer shall receive a PDF print of the signed first sheet of the bridge Construction Drawings and shall add the revision date and description as shown in Dwg. No. 1.1.10 of Part II of this Bridge Manual.
- For the sheets to be revised, the Designer shall generate a new PDF file of the sheet with the necessary revisions. All deletions of existing drawings or dimensions on the Construction Drawings must be made by drawing a box around the part to be deleted and drawing a cross through that box as indicated on Dwg. No. 1.1.11 of Part II of this Bridge Manual.
- If extensive changes to details on a Construction Drawing sheet are required, then a PDF of the old sheet shall be generated with a large "X" drawn across the entire sheet indicating that it is being deleted in its entirety and a PDF of a new sheet shall be prepared with the revised details.

This sheet's number would be the same as the sheet it replaces with the alpha character "A" added after the sheet number and this new added sheet would be identified as a revision by the revision symbol.

Once all revisions are made, the PDF files of the revised sheets shall be submitted to the Bridge Section for review and sign off by an responsible MassDOT Signatory. The Bridge Section shall forward the revised approved PDF sheets to the Plans and Records Office to assemble into the official Construction Drawing set.

4.4.2.3 Date of Bidding Phase Revisions. Sometimes during the bidding phase, Construction Drawing revisions may be required in response to comments from bidders. During the bidding phase, these revisions are issued as Addendums to the bidding documents, however, at this time, the Construction Drawings are not revised and nor given a new revision number with each Addendum issued. Once the bids have been opened, all Addendums that require Construction Drawing revisions are then incorporated into one Construction Drawing revision following the guidelines outlined in Paragraph 4.4.2.2 above and are given a revision number of "1" and a Revision Date that is the Date of the Bid Opening. The revision description on Sheet 1 shall be "Per Bid Addendums X, X …" where X is the number(s) of each Addendum that is included in this first revision. The description on the subsequent sheets on which revisions are made will only include the Addendum number(s) that affects that sheet.

4.4.2.4 Date of Construction Phase Revisions. Revisions that are required due to situations described in Subsection 4.4.1 above shall be given a revision date that is the date when the revision was approved by the responsible MassDOT signatory. The revision number and its description shall be noted on the first sheet of the bridge Construction Drawings as well as the on the Sheets that are affected by the revision.