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CHAPTER 6
SHOP DRAWINGS, CONSTRUCTION PROCEDURES, AND OTHER SUBMISSIONS

6.1 OVERVIEW OF THE SUBMISSION AND REVIEW PROCESS

6.1.1 Contractor's Requirements and Responsibilities in the Submission Process

6.1.1.1 General. The requirements for Contractors for submitting shop drawings and construction procedures as well as their responsibilities in the review and approval process is described in Subsection 5.02 of Division I of the MassDOT *Standard Specifications for Highways and Bridges*. The requirements and responsibilities of Designers in reviewing and approving shop drawings and construction procedures are outlined in this Chapter of this Bridge Manual.

6.1.1.2 Shop Drawings. Bridge element shop drawings and other detail drawings that are prepared in compliance with the design detailed on the Construction Drawings for the purpose of fabricating those elements, and which do not include original design by the Contractor, are not required to be stamped by a Professional Engineer registered in Massachusetts.

6.1.1.3 Construction Procedures. Drawings or plans whose original design is the responsibility of the Contractor, such as for, but not limited to: support of excavation; cofferdams; sign, signal and lighting supports; temporary structures; erection drawings; demolition drawings; assembly plans, and computations supporting those designs and procedures that are submitted by the Contractor for approval shall bear the seal of a Professional Engineer of the appropriate discipline registered in Massachusetts.

6.1.2 Communication between Contractors, Fabricators, and Suppliers

6.1.2.1 The Contractor, Fabricator and the Designer are responsible for approaching the Shop Drawing submittal, review, approval, and distribution process as a team effort in order to ensure accurate and timely construction of the structure. This effort should include the following:

- All parties must cooperate and maintain open lines of communication, so problems can be quickly addressed and resolved.
- Verbal discussions and agreements are encouraged and should be quickly documented with written confirmation.
- Efforts should be made to expedite information and drawing transmission, including use of e-mail and electronic file transfer, when applicable.
- Requests for Information (RFI's) should indicate the urgency of a reply. The Designer should provide a timely response or acknowledgement (explanation, decision, request for additional information, or estimate of time needed for evaluation), usually within two business days.

6.1.2.2 Contractors, Fabricators, and Suppliers often contact the Designer directly with inquiries. In order to avoid confusion and potential claims, all answers to the Contractor shall be made through the appropriate MassDOT District Construction personnel, except in cases where the inquiry is related to resolving review comments on shop drawings. Direct communication between the Contractor, Fabricator, or Supplier and the Designer is encouraged for the timely and effective resolution of review comments on shop drawings.

6.1.3 Definition of Shop Drawing Categories

The following are the Categories of Shop Drawings whose review and approval is outlined in this Chapter of this Bridge Manual and whose distribution is specified in Table 6.4.2-1. All shop drawings shall be submitted, reviewed, returned for corrections, and approved and distributed as electronic PDF files.

- **Special Metal Pipe** - Corrugated metal pipe culverts and three-sided frames and arches with spans greater than 10 feet.
- **Steel and Aluminum Highway Structures** - Structures and their anchorages including signal poles, strain poles, highway and high-mast lighting poles, toll gantry structures, and cantilever, bridge mounted and overhead sign structures.
- **Precast Concrete Bridge Elements** - Mild-steel-reinforced precast concrete bridge elements, including: pile caps, precast substructure elements (abutments, piers, footings, wingwalls, & approach slabs), box culverts with spans greater than 10 feet, and three-sided frames and arches with spans greater than 10 feet.
- **Prestressed Concrete Beams** - All precast, prestressed concrete bridge beams using straight or draped pretensioning or post-tensioning strands, such as NEXT F beams, NEXT-D beams, NEBT beams, NEDBT beams, adjacent or spread deck or box beams.
- **Prefabricated Bridge Units (PBUs)** - Prefabricated bridge units (consisting of mild-steel-reinforced precast concrete bridge deck supported by steel girders and diaphragms).
- **Highway and Traffic Precast Products** - All contract specific products not listed under "Construction Standard Details" and/or "Standard Drawings for Traffic Signals and Highway Lighting". Both construction details are located on MassDOT's website.
- **Standard Precast Concrete Highway Products (Traffic and Non-Traffic)** - Mild-steel-reinforced precast concrete highway elements, including: all precast concrete elements listed in the MassDOT Construction Standard Details, including temporary and permanent barriers, box culverts with spans less than or equal to 10 feet, catch basins, drainage pipes, manholes, handholes, proprietary retaining wall systems, traffic light pole bases and luminaire bases.

6.1.4 Contract Required Information on Shop Drawings

6.1.4.1 Required Project Information. Designers are reminded that Subsection 5.02 of Division I of the MassDOT *Standard Specifications for Highways and Bridges* requires that the title block of shop drawings include, at a minimum, the following information: fabricator's name and address; city(ies) or town(s) where the project is located; location(s) where the material is to be used; MassDOT contract number; Federal aid project number, when applicable; MassDOT Project Info Number; name of the general contractor; date of drawing and date of all revisions. The title block for shop drawings of bridge projects shall also include: the bridge number and BIN; facility on the bridge; the feature under the bridge. All of this project information is summarized in a title block facsimile presented in Figure 6.1.4-1. If this information is not provided, the Designer is obligated to reject the shop drawings due to their nonconformance with the Contract Documents.

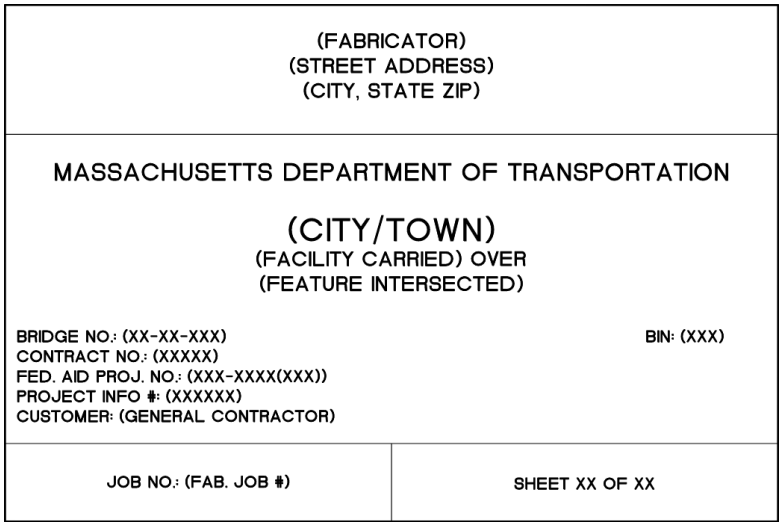

Figure 6.1.4-1: Project Information Required on Shop Drawing Title Blocks

6.1.4.2 On shop drawings for structural steel, precast and/or prestressed concrete structural members, steel or iron castings, bronze or wrought iron plates, metals railing and machinery, and structural timber the Designer shall make sure that the following notation is on the shop drawings before approval is given:

INSPECTION TO BE PERFORMED BY THE MASSACHUSETTS DEPARTMENT OF TRANSPORTATION OR DESIGNATED REPRESENTATIVE

6.1.5 Contract Requirements for Structural Steel Shop Drawings

In accordance with Subsection 5.02 of Division I of the MassDOT *Standard Specifications for Highways and Bridges*, structural steel shop drawings shall be prepared and presented in accordance with the *AASHTO/NSBA Steel Bridge Collaboration G1.3 Shop Detail Drawings Presentation Guidelines*. Structural steel shop drawings shall be reviewed and approved in accordance with the *AASHTO/NSBA Steel Bridge Collaboration G1.1 Shop Detail Drawing Review/Approval Guidelines for Fabricated Structural Steel.* If there are any conflicts between these guides, this Bridge Manual, and the Standard Specifications, the Standard Specifications shall govern.

6.2 SHOP DRAWING REVIEW PROCESS

6.2.1 Getting Started

6.2.1.1 General. The Designer shall review the submitted shop drawings for general conformance with the design concept of the project as detailed on the Construction Drawings. Shop drawings are not to be used as a vehicle for Contractors or Fabricators/Precasters to submit alternate designs from the ones shown on the Construction Drawings. Proposed revisions shall be submitted as a request by the Contractor for a change to the Contract Documents. If an alternate design is encountered on the shop drawings, the Designer is obligated to reject the shop drawings (stamped Revise and Resubmit) due to their nonconformance with the Construction Drawings.

6.2.1.2 For all projects designed by private consultant firms, the Designer shall be the consultant firm as indicated on the Construction Drawings. For projects designed by MassDOT, the Designer may be

the District, the Bridge Section, Highway, or Traffic Engineer depending on the origin of the design. For Design Build projects, the Designer referred to in this Bridge Manual is the Engineer of Record for the Design-Build team.

6.2.1.3 As noted in Subsection 6.1.5, the *AASHTO/NSBA Steel Bridge Collaboration G1.1 – Shop Detail Drawing Review/ Approval Guidelines for Fabricated Structural Steel* should be followed, where practical. This publication gives general review instructions and an approval checklist that.

6.2.1.4 Verifying the Fabricator, Precaster, or other Material Manufacturers/Suppliers. Before starting the review of shop drawings for the production of major bridge components, the Designer must first verify that MassDOT has approved the Fabricator, Precaster, or other Material Manufacturers/Suppliers for the category of work to be performed. If the Fabricator, Precaster, or other Material Manufacturers/Suppliers listed on the shop drawings is not approved by MassDOT, the Designer is obligated to reject the shop drawings and inform both the Contractor and MassDOT of this fact. An up to date list of approved Fabricators, Precasters, or other Material Manufacturers/Suppliers may be obtained from the MassDOT website as follows:

- For fabricators of bridge metals, such as structural steel, railings, aluminum protective screen, strip seals, sign structures, signals and other metal products, the Approved Metal Fabricators List can be obtained from the following link:

  https://www.mass.gov/massdot-approved-fabricators

- For producers of prestressed concrete and precast products, such as prestressed concrete beams, precast concrete bridge elements, other bridge related precast concrete components, and or other Material Manufacturers/Suppliers an up to date list can be obtained from the following link:

  https://www.mass.gov/service-details/qualified-construction-materials-list

6.2.1.5 Verifying Material Specifications. As part of the shop drawings review process, the Designer shall verify that all AASHTO or ASTM specifications for the materials to be supplied as part of the work detailed on the shop drawings comply with the required material specifications as stipulated in the MassDOT Standard Specifications, Supplemental Specifications, or Special Provisions.

6.2.1.6 Approvals the Designer is Not Authorized to Make. Sometimes shop drawings include, materials that are found on the MassDOT Qualified Construction Materials List whose use requires pre-approval, and contain or include submittals for fabrication methodology such as welding procedures. These must be approved by other disciplines within MassDOT and not by the Designer. In the event that the Designer receives shop drawings with material or metals related procedure submittals that they are not authorized to approve, the Designer is obligated to cross them out and return the shop drawing stamped "Revise and Resubmit" with a note that the deleted material shall be forwarded to:

MassDOT Research and Materials email: RMSShopDrawings@dot.state.ma.us,

or,

MassDOT Metals Control email: MassDOTMetalsControlReview@dot.state.ma.us,

as appropriate, for review and approval.

Examples of products and materials to be approved by MassDOT Research and Materials include, but are not limited to: concrete mix designs for both ready-mix concrete and precast concrete products;

concrete patch materials; grouts; epoxies; concrete sealers; membranes; joint sealers and fillers; geotextiles; mechanical reinforcing bar splicers; and coatings.

Examples of metals related procedures and certifications to be approved by the MassDOT Metals Control Engineer include, but are not limited to: all welding procedures, cambering procedures, coating procedures, and any metal repair procedures for any fabrication related errors.

6.2.1.7 For Design/Build projects, the Design/Build team's QC manager shall approve those procedures listed in Paragraph 6.2.1.6 and shall forward to the appropriate MassDOT Unit for acceptance.

6.3 SHOP DRAWING APPROVAL/ACCEPTANCE AND DISTRIBUTION PROCESS

6.3.1 Designer's Responsibility in Reviewing and Approving Shop Drawings

6.3.1.1 General. Shop drawings shall be reviewed as expeditiously as possible and returned to the Fabricator. A shop drawing submittal shall be reviewed and approved as a complete set. So that there is no question as to what was reviewed and accepted by the Designer, as defined in Paragraph 6.2.1.2, the Designer will affix their electronic stamp to each PDF sheet in the entire set to indicate that the sheet has been reviewed and the Designer's disposition before the set is returned to allow fabrication to begin. This stamp shall include the Designer firm's name, the reviewer's signature or initials, the date of the stamping, and the disposition stating "Approved", "Approved as Noted", or "Revise and Resubmit".

6.3.1.2 In case a Railroad is involved, the following procedures shall be followed:

Highway Over Railroad: Railroad will not approve shop drawings.

Railroad Over Highway: Railroad will approve all drawings of the structure.

6.3.2 Definition of Stamps Indicating Shop Drawing Disposition

6.3.2.1 **Approved.** Drawings shall be stamped "Approved" if the Reviewer is satisfied that the drawings fundamentally meet the contract requirements and do not require any corrections.

6.3.2.2 **Approved as Noted.** Drawings shall be stamped "Approved as Noted" if the Reviewer is satisfied that the drawings fundamentally meet the contract requirements and only require limited corrections. Examples of limited corrections include sporadic, minor dimensional errors and shop notes not fully consistent with the Standard Specifications or Special Provisions. Prior to stamping the drawings, the Designer shall contact the shop drawing detailer via e-mail or telephone to discuss the notes. Drawings stamped "Approved as Noted" shall be considered approved and final.

6.3.2.3 **Revise and Resubmit.** Drawings shall be stamped "Revise and Resubmit" if the Reviewer finds a nonconformance with the contract requirements, poor quality (legibility, lack of details, lack of notes, contradictory information) or other problems that may lead to shop errors. Only individual sheets with such errors or required modifications shall be stamped "Revise and Resubmit". If any of the sheets are stamped "Revise and Resubmit", then the entire set must be returned for corrections and resubmitted. Only those sheets that need revisions shall be stamped "Revise and Resubmit". All other sheets shall be unstamped. The Designer needs to clearly identify the sheets that require a revision in the transmittal letter.

6.3.3 Shop Drawing Approval Procedure

Approval Procedure. The actual procedure to be used for a specific project, including the handling of the shop drawings, lines of communication, review times, and persons to be kept informed of the submission status by copies of transmittal emails, shall be agreed to at the Pre-Construction Meeting. However, the general acceptance procedure shall be as follows for all projects regardless of Designer:

- The Fabricator/Supplier shall submit the PDF set of the shop drawings through the Contractor to the Designer for review with a copy of the transmittal email to the District Construction Engineer.
- Within two (2) weeks, the Designer, after reviewing the initial shop drawing submittal and making any necessary comments, shall return the PDF set of shop drawings through the Contractor to the Fabricator/Supplier, with a copy of the transmittal email to the District Construction Engineer. In the event that a design issue is discovered during the shop drawing review process, the Designer shall confer with the Bridge Section.
- If any sheets of the shop drawings need to be stamped "Revise and Resubmit", that set of shop drawings shall be returned through the Contractor to the Fabricator/Supplier, with a copy of the transmittal email to the District Construction Engineer in accordance with Paragraph 6.3.2.3.
- Subsequent reviews, if needed, shall take no longer than one (1) week.
- After the Fabricator/Supplier has reconciled all of the comments on the shop drawings, the Fabricator/Supplier shall submit a revised PDF set of the shop drawings through the Contractor to the Designer for review and approval with a copy of the transmittal email to the District Construction Engineer.
- Once the shop drawings are accepted, the Designer shall affix their electronic stamp noting their acceptance of the shop drawings, in accordance with Subsection 6.3.1 above, to each PDF sheet in the set so that there is no question as to what was reviewed and what was accepted by the Designer. Shop drawings stamped "Approved" or "Approved as Noted" shall be distributed as promptly as possible in accordance with Subsection 6.3.4. The entire set shall be approved or approved as noted before any sheets are returned to allow fabrication to begin. Any exception to the above would require the approval of the Engineer. As part of this review and approval process, the Fabricator shall be responsible for providing and updating a table listing each shop drawing; the revision status of each sheet; and the approval status of each sheet. This table shall be included in all shop drawing submittals and returns and shall be checked by the Designer to assure its accuracy.

6.3.4 Distribution

Once the shop drawings have been accepted and stamped as specified in Subsection 6.3.3, they shall be sent by the Designer to the appropriate email address as shown in Table 6.3.4-1 according to the distribution shown in Table 6.3.4-2. Letters of Transmittal PDFs shall not be attached to the PDF set of shop drawings, but shall be attached separately, in order to facilitate archiving of the shop drawings without having to delete the transmittal letter first.

Table 6.3.4-1: Shop Drawing Distribution Emails

Research & Materials:	rmsshopdrawings@dot.state.ma.us
Metals Control:	MassdotMetalsControlShopDrawings@dot.state.ma.us
Bridge Section:	MassDOTbridgeshopdrawings@dot.state.ma.us
Traffic:	StateTrafficEngineer@dot.state.ma.us
District:	The District email contact for distributing shop drawings varies by District. Check with each District for the appropriate email address to use.
Contractor:	As provided by the Contractor.

6.3.5 Highway and Traffic Metal Structures and Precast Products

6.3.5.1 Sign Supports. Unless the structures have been pre-approved by MassDOT, overhead, cantilever, and ground mounted signs, light standards, and traffic signal assemblies shall be designed by the Contractor. Complete design calculations must be prepared for all these structures and must accompany the shop drawing submittals. The design calculations must include analysis of the sign structure, foundations, and all connections. The design calculations and shop drawings shall be reviewed by the Designer.

6.3.5.2 Sign supports installed on bridges or walls, whether they are installed as part of those original construction projects or installed subsequently on existing structures, shall be designed by the Designer of the original bridge and wall project or by the Designer of the subsequent sign installation project, and all structural details shall be provided on the Construction Drawings. The same procedure as outlined in Section 6.3 shall be followed for reviewing and approving those shop drawings.

6.3.5.3 Light Standards, Traffic Signal Assemblies, and High Mast Lighting Assemblies. The requirements and procedures of Section 6.3 shall apply, except that for High Mast Lighting Assemblies the following criteria shall also be met:

- The lowering device motor must have a sufficient rating to withstand the torque imposed on it by the ring assembly as it is lowered or raised.
- The lowering device housing must be made of a material able to withstand the shear and tensile stresses imposed on it by the lowering and raising of the ring assembly.
- PDF copies of the Manufacturer's test results must be submitted with the shop drawings as documentary proof that the aforementioned requirements have been met.

Table 6.3.4-2: Shop Drawing Distribution

(Recipients by Type of Shop Drawing Distributed by the Designer)

SHOP DRAWING CATEGORY	CONTRACTOR	RESEARCH & MATERIALS	METALS CONTROL	BRIDGE SECTION	DESIGNER	TRAFFIC	DISTRICT
REINFORCING STEEL AND S.I.P. FORMS	X			X	X		X
STRUCTURAL STEEL (INCLUDING STEEL FRAMING FOR PBU'S), METAL BRIDGE AND HAND RAILINGS, PROTECTIVE SCREENS, METAL CASTING AND MACHINERY	X		X	X	X		X
STRUCTURAL TIMBER BRIDGE COMPONENTS	X		X	X	X		X
STRIP SEAL BRIDGE JOINT SYSTEMS, MODULAR JOINTS, AND FINGER JOINT SYSTEMS	X		X	X	X		X
STEEL AND ALUMINUM HIGHWAY STRUCTURES	X		X		X	X	X
SPECIAL METAL PIPES, PIPE ARCHES, PLATE PIPES AND PLATE ARCHES	X			X	X		X
BEARINGS (DISC AND SLIDING)	X	X	X	X	X		X
ELASTOMERIC BEARINGS	X	X		X	X		X
PRECAST CONCRETE BRIDGE ELEMENTS (INCLUDING PRECAST CONCRETE PBU DECKS), PRECAST CONCRETE DECK PANELS	X	X		X	X		X
PRESTRESSED CONCRETE BEAMS	X	X		X	X		X
HIGHWAY AND TRAFFIC PRECAST PRODUCTS	X	X			X	X	X
STANDARD PRECAST CONCRETE HIGHWAY PRODUCTS – TRAFFIC	X				X	X	X
STANDARD PRECAST CONCRETE HIGHWAY PRODUCTS - NON-TRAFFIC	X				X		X

6.4 EFFECT OF CONTRACT DRAWING REVISIONS ON SHOP DRAWINGS

6.4.1.1 When Contract Drawings are revised after the contract has been awarded for construction and the revision affects the work of a supplier or fabricator, the following procedures shall apply:

1. Where shop drawings have not been prepared, the drawings shall be processed in accordance with the standard procedure of this Chapter of this Bridge Manual incorporating the revisions.
2. Where part of a series of related shop drawings is in the process of review and a revision relative to this series is made to the Construction Drawings, those shop drawings of this series not yet submitted for review shall include and make note of such Construction Drawing revisions. Those drawings, already approved shall be revised as outlined in the following.
3. Where the shop drawings have been approved prior to a revision to the Construction Drawings, revised shop drawings shall be made and processed in accordance with the standard procedure of this Chapter of this Bridge Manual. A note shall be shown on the shop drawings to include the date and nature of revision.

6.4.1.2 When it becomes necessary to issue revised shop drawings after the accepted, stamped PDF set of shop drawings has been distributed, the Designer shall notify the Construction Engineer as to the extent of the revisions and the probable time of issuance of the revised Construction Drawings. The Designer shall also notify the Construction Engineer and the Contractor which previously approved shop drawings will be affected, and approval rescinded.

6.5 CONSTRUCTION PROCEDURES

6.5.1 General Requirements for Construction Procedures

Construction Procedures are designs including calculations, drawings, and procedures prepared by the Contractor and/or the Contractor's Engineer as required by the Contract Documents. These procedures typically include, but are not limited to, the detailing of the equipment and methods that the Contractor intends to employ to complete the construction. A PDF set of these procedures shall be signed and sealed by a licensed Professional Engineer of the appropriate discipline registered in the Commonwealth of Massachusetts, working for the Contractor, and submitted to MassDOT. The Designer shall review the procedures for structural adequacy and conformance with the Contract Documents and shall affix a stamp to the PDF of the procedures stating "No Exceptions Taken", "Reviewed with Comments", or "Revise and Resubmit".

6.5.2 Reviewing Construction Procedures

6.5.2.1 Review where a Railroad is Not Involved. See Table 6.5.3-1 for a description of each construction procedure category and the required distribution. All construction procedure submittals shall be made as PDFs and shall be initially forwarded by the Contractor through the District.

- For Category 1 procedures, the Designer shall review these submittals for structural adequacy and conformance with the Contract Documents and shall inform the District accordingly. When all comments have been resolved, the Designer shall notify the District that the submission is acceptable.
- For Category 2 and 3 procedures, the Designer shall review these submittals and return them to the Contractor for resolution of comments. When all comments have been resolved and

the submittal is found acceptable, the Designer shall affix their acceptance stamp to the submittal PDFs and distribute them.

- For Category 4 procedures, the District shall perform all reviews and distributions.

6.5.2.2 Review where a Railroad is Involved. See Table 6.5.3-1 below for a description of each construction procedure category and required distribution. All submittals shall be initially forwarded by the Contractor through the District.

- The railroad will review demolition procedures, erection procedures, sheeting procedures, and anything concerning the safety of railroad traffic and personnel. The District shall forward the Contractor's submittals under Categories 1 and 2 to the railroad for their review. The District shall also coordinate the railroad comments with those made by the Designer in order to ensure that all comments are resolved.

6.5.2.3 Revise and Resubmit. Submittals shall be stamped "Revise and Resubmit" if the Designer finds a nonconformance with the contract requirements, poor quality (legibility, lack of supporting calculations, lack of details, lack of notes, contradictory information) or other problems.

6.5.2.4 Distribution. The accepted PDF of the construction procedure submittal shall be distributed by either the District or the Designer as outlined in Subsection 6.5.3.

6.5.2.5 Design/Build projects. The Design/Build team's Designer shall review the Construction Procedures, however MassDOT reserves the right to perform an independent review of them as well. In either case, the submittal shall be distributed according to the project's policy and procedures for final disposition.

6.5.3 Distribution

Distribution Procedure. The reviewed and accepted construction procedures shall be distributed by either the District or the Designer in accordance with Table 6.5.3-1 below.

Table 6.5.3-1: Construction Procedure Distribution (By Type and By Whom)

CATEGORY	DESCRIPTION	DISTRICT	DESIGNER
1	STEEL BEAM ERECTION PRESTRESSED CONCRETE BEAM ERECTION BRIDGE DEMOLITION DECK REMOVAL & SHIELDING DESIGN	X[1]	
2	ALL QUALITY CONTROL PLANS FOR ASSEMBLY SHEETING / COFFERDAM DESIGNS TEMPORARY BRIDGES BEAM OR PIPE JACKING PROCEDURE		X[2]
3	PILE DRIVING (WAVE EQUATION METHOD) PILE LOAD TESTS DRILLED SHAFT CONSTRUCTION PROCEDURES DRILLED SHAFT LOAD TESTS DRILLED SHAFT CROSS-HOLE SONIC LOGGING (CSL) RECORDS EMBANKMENT SETTLEMENT SIGN SUPPORTS / STRAIN POLES		X[2,4]
4	PILE CAPACITY (UNDER 100 KIPS) SCHEDULES & CONSTRUCTION EQUIPMENT	X[5]	
5	DUNNAGE PLAN		X[3]
6	ERRORS AND CHANGES	See Section 4.4 of Part I of this Bridge Manual	

1 – District shall make the following distribution: Designer, Resident Engineer, District Construction Office, Contractor, Railroad (if involved).

2 – Designer shall distribute. Distribution shall be the same as for 1.

3 – Designer shall distribute to R&M. Calculations shall not to be included in this distribution to R&M.

4 – PDF copies of Category 3 items, except non-ground mounted sign supports/strain poles

5 – Category 4 items shall also be distributed to the Geotechnical Engineer