Shop Drawing Review Process

Description

This document summarizes the Michigan Department of Transportation's (MDOT) shop drawing review process for permanent structural elements, temporary bridges, and temporary works that are required to have shop drawings submitted for approval. It is important for MDOT to respond quickly to shop drawing submittals in order to keep the project moving forward. The document discusses the purpose of shop drawings, MDOT's process for reviewing and stamping drawings, and differences in the review process based on different contracting methods. A high-level workflow of the shop drawing submittal process from Contractor submittal through MDOT approval is also included to provide users with a quick visual aid to better understand the process. ProjectWise workflow steps are included to ensure consistency in folder structure, naming convention, work states, and document storage. A listing of common shop drawings required to be submitted for review and approval by MDOT and a list of the associated MDOT technical review areas is also included to assist the shop drawing coordinator. Information for developing this document has been obtained from the 2012 MDOT Standard Specifications for Construction (MDOT SSC) and the current MDOT Bridge Design Manual (MDOT BDM). This document is broken down into the following sections:

1. Shop Detail Drawings
2. Submittal Requirements
3. Coordinator Responsibilities
4. Innovative Contracting
5. High-Level Workflow
6. ProjectWise Workflow
7. Common Shop Drawing List
8. MDOT Technical Review Areas

1. Shop Detail Drawings

Shop detail drawings, commonly called shop drawings, are a type of working drawing that the Contractor develops prior to fabrication. The Contractor is responsible for providing drawings that accurately show the appropriate details, dimensions, material requirements, fabrication procedures, and other requirements necessary to fabricate and erect elements of the structure in conformance with the contract documents. The owner's general responsibility is to review the drawings to ensure that the Contractor has correctly interpreted the intent of the contract documents and verify the details properly reflect material and fabrication requirements. When reviewing shop drawings, it is not necessary to check the exact dimensions. It is the responsibility of MDOT to ascertain that the Contractor is supplying the items specified, while it is the Contractor's responsibility that all items are fabricated to the correct dimensions. Shop drawing review is the first level of a quality assurance program, is vital for the successful delivery of fabricated materials to the field, and is also important for fabricated materials that are not accepted based on "Fabrication Inspection" per MDOT's Materials Quality Assurance Procedures manual.

Subsection 104.02 of the MDOT SSC discusses general requirements of contract plans and working drawings for MDOT projects. The Department's review and approval of shop drawings does not relieve the Contractor of full responsibility for all negligence in the construction of the project resulting from the shop drawings and it is not a warranty of the adequacy and correctness of the drawings. However, the Contractor and Department should approach the submittal, review, approval, and distribution process as a team effort to ensure accurate and timely construction of the structure. Subsection 104.02 of the MDOT SSC states, "The Department will require a reasonable amount of time for review and approval", but some non-standard pay items have language in the special provision that requires each shop drawing review cycle (from receiving the submittal to providing a response) to be completed within a specified number of days.

2. Submittal Requirements

The Contractor must submit for review all shop drawings and calculations (design and load rating, when applicable) not furnished by MDOT for all parts of the work as required by the contract in Adobe Portable Document Format (PDF) into ProjectWise as discussed in Sections 5 and 6 of this document. The Contractor is responsible for the correctness of the shop drawings and calculations (when applicable), and ensuring their design (when applicable) complies with any permit requirements. It is the Contractor's responsibility that all items are fabricated to the correct dimensions. MDOT's approval of the shop drawings is a verification that the drawings appear to be consistent with the contract documents. Approval does not relieve the Contractor of the responsibility for the accuracy of dimensions on shop drawings or for complete submittals satisfying applicable contract requirements, nor does it permit deviations from the contract without MDOT's documented consent. Subsection 104.03 of the MDOT SSC discusses deviations from the plans. The Contractor is required to submit a Request for Information (RFI) seeking approval from the MDOT Construction Engineer (Engineer) to deviate from the contract plans. The Engineer must provide the RFI to the MDOT Design Project Manager (Design PM) for their disposition on the proposal. For more information on RFI's see MDOT's Structural Fabrication Request for Information Process

If revisions are necessary after the shop drawing set is approved, the Contractor is required to submit a complete shop drawing set (proposed new sheets, revised sheets, and remaining sheets that are already stamped approved) for review to ensure each submittal is a standalone set. Previously approved shop drawing sets can be moved to the "Rejected" folder located in ProjectWise so they are kept for historical purposes. Incomplete shop drawing submittals must be rejected back to the Contractor; however, large projects may consist of several smaller shop drawing sets, known as a series (100, 200, 300, etc.), to facilitate production provided each series is complete and contains all general notes required for that series to standalone and be individually approved. Subsequent series submitted for review and approval must either reference the general notes located on an earlier approved series or the series must contain all relevant general notes to standalone and be individually approved.

3. Coordinator Responsibilities

The MDOT Bridge Design PM (or their delegate) is responsible for coordinating the shop drawing review process for all shop drawings required for pay items on bridge plan sheets, whereas the Engineer (or their delegate) is responsible for coordinating the shop drawing review process for all shop drawings required

for pay items on road plan sheets. The Coordinator (Bridge Design PM or Engineer) must distribute the shop drawings to the MDOT technical review areas shown in this document. MDOT shop drawing review checklists can be found in Chapter 10 of the MDOT BDM for common structural elements. These checklists are used by the MDOT technical review areas to ensure consistent, accurate, and efficient shop drawing reviews.

In general, shop drawings do not require a Contractor's Professional Engineer's (PE) seal; however, there are some circumstances where a PE seal is warranted. Below are a few instances where the Contractor may be required to provide shop drawings with a PE seal:

- Contract specifications, although extremely rare, may mandate a PE seal as evidence of a PE's review.
- Shop detail drawings may be required to have a PE's seal if the Contractor has proposed significant changes to the design of the structure. For example, if the Contractor submits a Structural Fabrication Request for Information (RFI) proposing to fabricate something different (e.g. smaller weld size) than specified in the contract documents then they may be required by MDOT to have a PE seal the shop drawings to show compliance with their new design.
- Value-engineering change proposals (VECP) require a PE's seal and a formal submittal from the Contractor to MDOT with all calculations and justifications for the change. Requiring the PE to seal the shop drawings may be required to ensure the drawings comply with the VECP.

Shop drawing review comments (both external comments for the Contractor's action and internal comments for the Coordinator's information) must be placed in the Adobe PDF file located in ProjectWise (see Section 6 of this document for more information) using Adobe commenting tools. The Coordinator is responsible for ensuring that all comments have been addressed by either reviewing the revised shop drawings or sending the revised submittal back to the applicable MDOT technical review area for them to confirm. After the Coordinator is satisfied with the shop drawings, they electronically stamp them approved. Contact MDOT's Structural Fabrication Unit at MDOT-StructuralFabrication@michigan.gov to obtain MDOT's shop drawing stamps and instructions for installing them.

MDOT does not have specific qualification requirements for the Coordinator; however, shop drawing reviewers typically hold the same certification as the work they are reviewing (e.g. the reviewer should have a PE license if they are reviewing structural calculations performed by a PE) and are qualified to perform the review.

The following three stamp designations (see Figures 1 and 2) will be used by the Coordinator (or their delegate) when stamping shop drawings:

- **Approved** – this stamp is used when the shop drawings appear to be in general conformance with the contract plans. All sheets are required to be stamped "Approved".
- **Approved Subject to Correction** – this stamp is used when the shop drawings appear to be in general conformance with the contract plans, but there are very minor corrections needed for historical records that will not affect fabrication of the elements. Only the first sheet is stamped "Approved Subject to Correction" and the drawings must be resubmitted for review and approval.
- **Revise and Resubmit** – this stamp is used when the shop drawings are not in general conformance with the contract plans and approval could result in elements being incorrectly fabricated. Only

the first sheet is stamped "Revise and Resubmit". The Contractor would be working at their own risk if they began fabricating and the Structural Fabrication Unit would notify the Engineer immediately and recommend fabrication wait until after drawings are stamped approved.

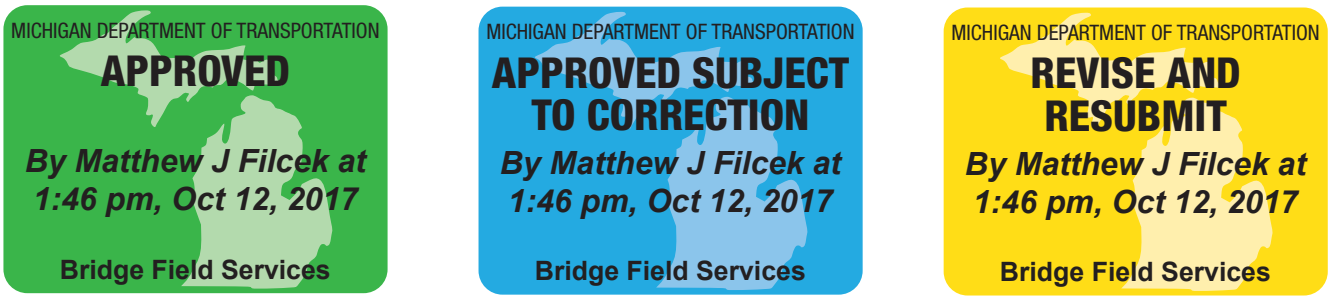

Figure 1. Depiction of MDOT's shop drawing stamps. The Coordinator's work area (e.g. Bridge Design, Xxxx Region, or Xxxxx TSG) is shown on the bottom of the stamp.

Figure 2. Depiction of MDOT's consultant shop drawing stamps when shop drawing coordination is delegated to them by MDOT's Bridge Design PM. The consultant's company name is shown on the bottom of the stamp.

Changes to the approved shop drawings during the fabrication process by the Contractor and omissions or errors discovered during fabrication require resubmittal of the shop drawings for MDOT's review and approval immediately if the changes will affect how the element is fabricated, whereas minor changes must be reviewed and approved prior to shipping. Shop drawings must be revised and submitted for MDOT's review and approval if an approved RFI is incorporated into the project. Approved

nonconformance reports (NCR) are used by MDOT's quality assurance inspector (QAI) in conjunction with the approved shop drawings for inspection and acceptance. Approved NCRs are not required to be incorporated into the shop drawings since they will become part of the fabrication inspection records along with the approved shop drawings. For more information on NCRs see *MDOT's Structural Fabrication Nonconformance Process.*

4. Innovative Contracting

The shop drawing review process in this document applies to Design-Bid-Build projects, but this section will discuss subtle changes required to successfully review shop drawings for innovative contracting such as Design-Build projects. Design-Build is an innovative construction method that pairs the EOR with the Contractor. The Design-Build contract documents contain the shop drawing requirements, but the main difference between a Design-Build and a Design-Bid-Build project is that the EOR on the Design-Build team is required to completely review and approve the shop drawing submittal prior to MDOT's review. Once the Design-Build team is satisfied with the submittal and has stamped each sheet "Approved", the MDOT Design-Build Project Manager (Design Build PM) acts as the shop drawing coordinator and distributes the submittal to all applicable MDOT technical review areas. The Design Build PM collects comments from all MDOT technical review areas and returns them to the Contractor for their response. Once satisfied, the Design Build PM places a "**Released for Construction**" stamp on each shop drawing sheet. It is important to note that the EORs (contractor's design firm) shop drawing stamp **does not** state "*For MDOT*" since they are working for the Contractor; however, the stamp must contain the following information:

- Consultant's company name
- Engineer of Record's name
- Date of approval
- Stamp designation (Approved, Approved Subject to Correction, or Revise and Resubmit)

5. High-Level Flowchart

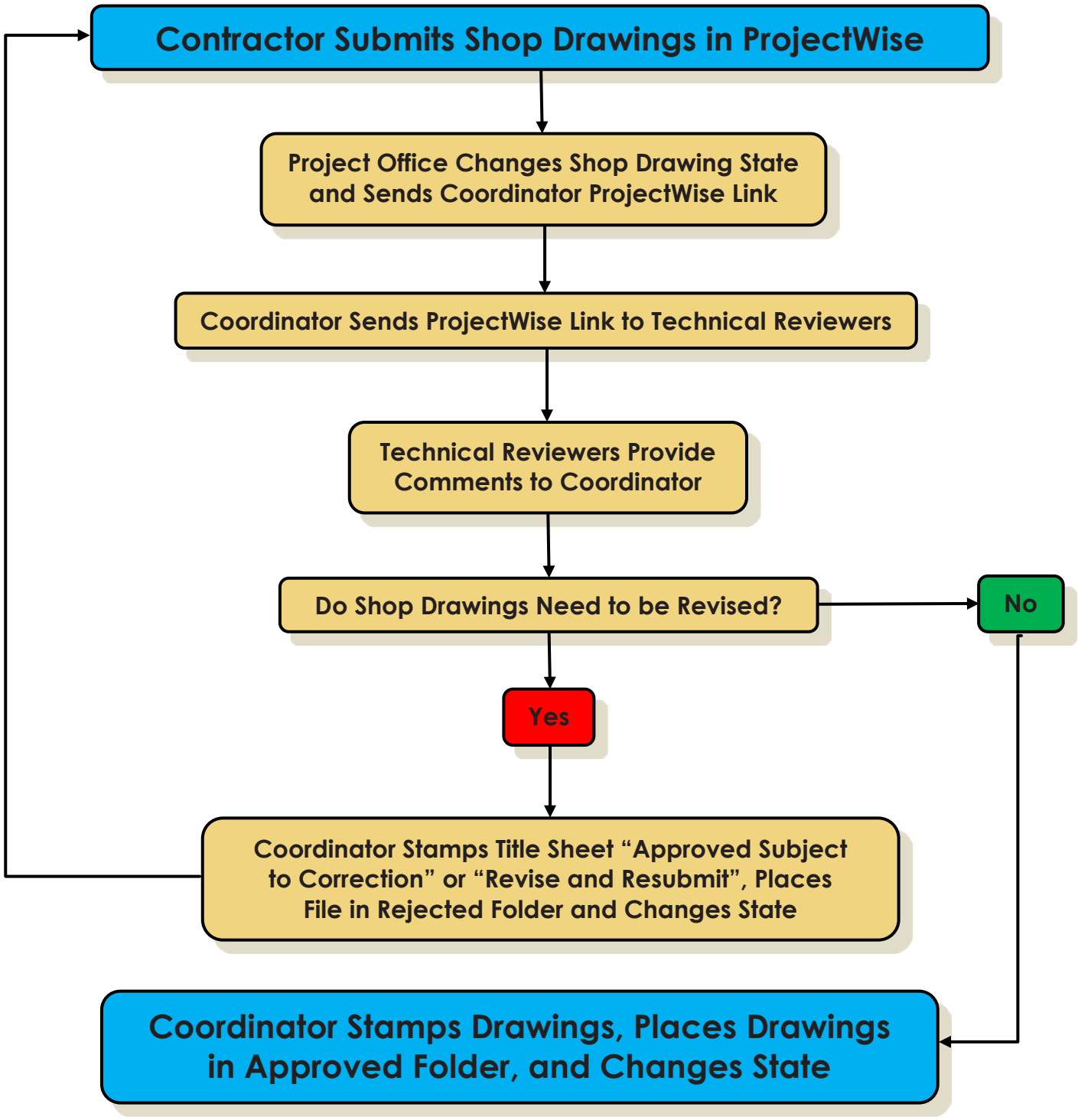

Figure 3. MDOT shop drawing review process showing high-level functions.

6. ProjectWise Workflow

It is the Design PM's responsibility to ensure the ProjectWise workflow is setup for their project before project turn in. Contact MDOT-ProjectWise@michigan.gov for assistance with the following steps:

1. Contractor receives shop drawing distribution email list for Project Office, Coordinator, and other contacts at pre-construction meeting.
2. Contractor names shop drawing file per MDOT's file naming convention document.
3. Contractor places file in "Shop Drawings" folder under Contractor Inbox.
4. Contractor changes state from "Pending" to "Submitted" generating emails to Project Office, Coordinator and other contacts defined in Step 1 with a ProjectWise path for the shop drawing.
5. Project Office moves file to "Review in Process" folder.
6. Project Office changes the state from "Pending" to "Ready for Review" generating an email that notifies the Coordinator that the file is available for review.
7. Coordinator changes the state to "Review in Process" generating an email that notifies the MDOT technical review areas that the file is available for review.
8. Technical review area add comments to the file in the "Review in Process" folder. Each area must add all of their comments, even if they duplicate comments from other areas. Technical review area then emails Coordinator notifying them that their review is complete.
9. Once all comments have been received, Coordinator **copies and pastes** file into "Original Comments" folder to be kept as project record.
10. Coordinator then consolidates comments on the file in the "Review in Process" folder for Contractor use. Coordinator stamps sheets appropriately and **cuts and pastes** file into either "Approved" or "Rejected" folder.
    - Approved shop drawings must have "Approved" stamped on every sheet and are placed in the "Approved" folder.
    - Rejected shop drawings must have "Revise and Resubmit" on the **first sheet only** and are placed in the "Rejected" folder.
    - Approved, subject to correction shop drawings must have "Approved, Subject to Correction" on the **first sheet only** and are placed in the "Rejected" folder.
11. Coordinator changes state from "Pending" to "Notified" generating an email that notifies the Project Office.
12. Project Office notifies the Contractor that file is available for them.
13. If corrections are necessary, the process repeats from Step 2 until shop drawing is approved.

7. Common Shop Drawing List

The shop drawing list shown below is applicable for most projects; however, exceptions may apply on a case by case basis based on project requirements. Design calculations may be required in accordance with the MDOT SSC or project special provision.

Table 1. Common list of shop drawings required to be reviewed and approved by MDOT. See next page for more information on superscripts next to shop drawing name.

COMMON MDOT SHOP DRAWINGS	
Bearing [1,9]	Permanent Metal Deck Form [1]
Bridge Railing [1,8, (note a)]	Permanent Sheet Piling [1,4]
Bridge Sign Connections [1,9(note a)]	Precast Bridge Element Systems (PBES) [1,8,9 (note b)]
Cantilever Sign Structure [1,9(note a)]	Prestressed Concrete Beam [1,9, (note b)]
CCTV Tower [1,4,6,9]	Rest Area Building [1,2,4,8]
Cofferdam [1,4]	Sanitary Sewer/Water Main [1,2]
Cofferdam, Left In Place [1,4]	Sound Wall [1,4,8,9]
Communication Tower [1,4,6,9]	Spun Concrete Pole [1,4,6,9]
DMS Support Structure [1,6, (note a)]	Steel Sheet Piling, Temp [1,4]
EPS Lightweight Fill [1,4]	Steel Sheet Piling, Temp, LIP [1,4]
ESS Tower [1,4,6,9]	Strain Pole [1,10]
High Mast Tower [1,2,4,9]	Structural Steel [1,9, (note b)]
High Tension Cable Barrier [3,4,9]	Temporary Bridge [1,4,5,7,9]
Light Standard [1,2,9]	Three-Sided, Arch, Box Arch, or Box Culvert (≥10 ft) [1,7,8,9,(note b),(note c)]
MSE Wall [1,4,8,9]	Traffic Signal Mast Arm and Pole [1,9,10, (note a)]
Modular Expansion Joint [1,9]	Truss Sign Structure [1,9(note a)]
Municipal Utility[1,2,8]	

(Table 1 continued)

The alphabetical superscripts next to the shop drawing name above correspond to the special notes below:

a) Bridge railing, bridge sign connections, cantilever sign structure, DMS support structure, traffic signal mast arm pole and mast arm, strain pole, and truss sign structure plan sheets are standard plans or special details that have been designed by MDOT. Since these engineering drawings are designed for repetitive use, shop drawings do not need to be reviewed and approved on a project by project basis. Each fabricator is required to submit one set of shop drawings for each standard plan (e.g. SIGN-370-A) or special detail (e.g. SIG-153-A) for MDOT review and approval. Subsequent shop drawing submittals are only required if the standard plan or special detail is revised (e.g. SIG-153-A to SIG-153-B) or if the Contractor changes the shop drawings.

b) Load Rating Unit must be notified of any changes that affect the structural capacity of the elements shown in the contract documents.

c) Three-sided, arch, box arch, or box culvert shop drawings with 10 feet and greater span lengths (measured along roadway centerline) must include separate design and load rating calculation files with load rating specified in the name of the load rating files. Calculations are subject to approval of Coordinator and Load Rating Unit in accordance with subsection 406.03 of the MDOT SSC.

8. MDOT Technical Review Areas

The numerical superscripts next to the shop drawing name in Section 7 (Common Shop Drawing List) correspond to the MDOT technical review areas listed below. Please send shop drawing ProjectWise links to each MDOT technical review area's email resource shown below, if available. If an email resource is not shown then send the shop drawing to the MDOT technical review area's managing engineer. Below is the list of MDOT technical review areas that assist the Coordinator with shop drawing review:

1. *Design PM (Bridge or Road as applicable)
2. Design - Municipal Utilities Unit
3. Geometrics Unit
4. Geotechnical Services Section
5. Hydraulics Unit
6. Intelligent Transportation Systems
7. Load Rating Unit (MDOT-Load-Rating@michigan.gov)
8. Roadside Development Unit
9. Structural Fabrication Unit (MDOT-StructuralFabrication@michigan.gov)
10. Traffic Signals Unit

* Coordinator should provide the Engineer of Record (EOR) the opportunity to review shop drawings.

Elastomeric Bearing Shop Drawing Review List

See list below for items reviewed by MDOT. All items below are verified for conformance with the contract documents unless otherwise noted. Additional items may be reviewed at the reviewer's discretion:

1) **Design Items**
   a) Title block - Verify each sheet includes:
      i) MDOT CS and JN;
      ii) Project location;
      iii) Fabricator's name and locations of all plants working on project. Each sheet should list the plant the work detailed on that sheet will be completed at;
      iv) Contractor's name;
      v) MDOT Design PM's name;
      vi) Sheet drawn date; and
      vii) Revision box that shows date for each sheet version.
   b) Revised/re-submitted drawings - any changes made from the previous version are identified by:
      i) Encompassing the change with a revision cloud;
      ii) A revision triangle with the appropriate revision number inside; and
      iii) The revision box is filled in.
   c) General notes include:
      i) Reference to appropriate edition of MDOT Standard Specifications for Construction;
      ii) Any specification references required by project specific special provisions are included;
      iii) Tolerance table or note referencing Section 6 of AASHTO M251; and
      iv) Note stating that holes will be drilled or punched.
   d) Material specifications:
      i) 100% virgin polyisoprene (natural rubber) or polychloroprene (neoprene);
      ii) Shear modulus;
      iii) Minimum low-temperature grade of the elastomer is appropriate for the regional location of the project;
      iv) ASTM and grade of steel used to fabricate the steel shims; and
      v) ASTM and grade of steel used to fabricate the sole plates.
   e) Sole plate tilt
   f) Sole plate width is equal to the width of the form at the chamfer/radius minus a maximum of ¼". Note or detail indicating the Fabricator's intent to meet this requirement
   g) ASTM and grade of steel used for position dowels

2) **Structural Fabrication Items**
   a) Any specification references required by project specific special provisions are included
   b) Material specifications
      i) ASTM specification for hot dipped galvanizing:
         (1) Sole plates; and
         (2) Position dowels.
   c) Review any unique items related to the fabrication of the structural element

Structural Precast Concrete Shop Drawing Review List

See list below for items reviewed by MDOT. All items below are verified for conformance with the plans, proposal, and MDOT Standard Specifications for Construction unless otherwise noted. Additional items may be reviewed at the reviewer's discretion:

1) **Design Items**
   a) Title block - Verify each sheet includes:
      i) MDOT CS and JN;
      ii) Project location;
      iii) Fabricator's name and locations of all plants working on project. Each sheet should list the plant the work detailed on that sheet will be completed at;
      iv) Contractor's name;
      v) MDOT Design PM's name;
      vi) Sheet drawn date; and
      vii) Revision box that shows date for each sheet version.
   b) Revised/re-submitted drawings - any changes made from the previous version are identified by:
      i) Encompassing the change with a revision cloud;
      ii) A revision triangle with the appropriate revision number inside; and
      iii) The revision box is filled in.
   c) General notes include:
      i) Reference to appropriate edition of MDOT Standard Specifications for Construction;
      ii) Concrete fabrication (placement and curing) is in accordance with the appropriate section of the Standard Specifications or in accordance with project specific special provision;
      iii) Estimated elastic shortening is called out on shop drawings and included in bed setup length;
      iv) Any specification references required by project specific special provisions are included;
      v) Design loads are shown on drawings;
      vi) Contractor designed elements (culvert, MSE wall, etc.):
         (1) Design assumptions are appropriate;
         (2) Design loads are appropriate;
         (3) Method of manufacturer indicates wet casting is specified;
         (4) Recommended installation procedures are specified; and
         (5) The minimum depth of fill required for construction traffic to cross over the culvert is specified.
   d) Material specifications:
      i) Concrete strength at release;
      ii) Concrete strength at 28-day compressive strength;
      iii) Concrete strength for stripping forms, handling, and shipping, except prestressed beams. Calculations must be provided if specified compressive strength for stripping forms, handling, or shipping is less than 28-day compressive strength;
      iv) Prestressing strand diameter and grade (i.e. 270 ksi low relaxation); and
      v) Mild reinforcement grade.

e) An erection diagram or plan view is included that shows the general layout of the concrete elements. Details include a system for marking all elements to ensure proper orientation and location of field placement;
f) Prestressing strands:
   i) The number and location of strands for each beam;
   ii) The location and length of prestressing strand debonding and/or draping; and
   iii) The pretensioning force on the strands.
g) Size, location and type of the inserts (i.e., for end or intermediate diaphragms);
h) Proper clearances between dissimilar metals or proper insulation is provided (contact the Experimental Studies Unit in Bridge Field Services for additional information);
i) Dimension of end blocks (if used);
j) Location of hold-down devices for draped strands;
k) Lifting devices and dunnage:
   i) Location of lifting devices along the beam is acceptable based on beam stability analysis;
   ii) Size and quantity of strands used for the lifting devices; and
   iii) Location of dunnage along the beam is acceptable based on beam stability analysis.
l) The method(s) of joining adjacent elements is detailed.

2) Structural Fabrication Items

a) General notes include:
   i) How the top surface of the beam is to be finished (MDOT SSC 708.03.A.13);
   ii) Tack welding steel reinforcement is prohibited; and
   iii) All specification references required by project specific special provisions.
b) Material Specifications:
   i) ASTM specification for prestressing strands;
   ii) ASTM specification for mild reinforcement;
   iii) ASTM specification for epoxy coating;
   iv) Top flange bond breaker;
   v) Strand debonding; and
   vi) ASTM specification for any connection hardware (i.e., railing anchor bolts, etc.).
c) ASTM specification for hot dipped galvanizing of the lifting devices;
d) Verify permanent inserts required by design:
   i) ASTM specifications for coating;
   ii) Manufacturer is on MDOT Qualified Products List;
   iii) Type; and
   iv) Size.
e) ASTM specification for contractor add-ons:
   i) Hot dipped galvanized;
   ii) Epoxy coated;
   iii) Electroplate galvanizing; and
   iv) Mechanical galvanizing.
f) Review any unique items related to the fabrication of the structural element.

Structural Steel Shop Drawing Review List

See list below for items reviewed by MDOT. All items below are verified for conformance with the plans, proposal, and MDOT Standard Specifications for Construction unless otherwise noted. Additional items may be reviewed at the reviewer's discretion:

1) Design Items

a) Title block - Verify each sheet includes:
   i) MDOT CS and JN;
   ii) Project location;
   iii) Contractor's name;
   iv) MDOT Design PM's name;
   v) Fabricator's name and locations of all plants working on project. Each sheet should list the plant the work detailed on that sheet will be completed at;
   vi) Sheet drawn date; and
   vii) Revision box that reflects each version.

b) Revised/re-submitted drawing sheets with changes to the details or notes:
   i) Encompassing the change with a revision cloud;
   ii) A revision triangle with the appropriate revision number inside; and
   iii) The revision box is filled in.

c) General notes:
   i) Reference to appropriate edition of MDOT Standard Specifications for Construction;
   ii) Any specific references required by project specific special provisions are included; and
   iii) All fracture critical elements are identified.

d) Material specifications:
   i) Structural steel ASTM and grade; and
   ii) Coating system top coat color.

e) An erection diagram or plan view showing general layout of the steel and marking scheme for identifying members. Details include a system for marking all elements to ensure proper orientation and location of field placement.

f) Splices:
   i) Shop splices:
      (1) All weld locations are identified; and
      (2) Verify appropriate weld information [size, length, spacing, finish, angle, weld type (complete joint penetration, partial joint penetration, or fillet)] is included if the weld was designed specifically for the project.
   ii) Field splices:
      (1) All locations are identified;
      (2) Size, spacing, and number of bolts are identified; and
      (3) Section is included showing the size of all splice materials.

g) A detail for all field connections is included:
   i) Size and number of bolts are indicated;
   ii) Faying surfaces are identified and treated appropriately; and
   iii) Number, size and spacing of shear developers.

h) Camber dimensions;
i) Blocking and lifting diagrams are included;
j) Coating system:
    i) Appropriate notes about faying surfaces are included;
    ii) Correct Federal color number is specified; and
    iii) The appropriate limits for each Federal color number are indicated.
k) Workmanship:
    i) Re-entrant corners match the design (1" minimum radius or as checked for fatigue);
    ii) Joint sealant is indicated for all un-welded joints; and
    iii) All stiffener welds stop ¼"short of inside cope clips and wrap around outside edge of stiffener.

2) Structural Fabrication Items

a) Any specific references required by project specific special provisions are included;
b) Material Specifications:
    i) ASTM specification for hardware (bolts, nuts, and washers);
    ii) ASTM specification for hot dipped galvanizing:
        (1) Connection hardware; and
        (2) Structural steel.
    iii) Charpy V-Notch impact requirements; and
    iv) Fracture critical requirements are in accordance with the Frequently Used Special Provision.
c) Coating System:
    i) Proposed system is a complete system listed on the Qualified Products List;
    ii) Appropriate surface preparation is specified;
    iii) Appropriate dry film thicknesses are specified:
        (1) Non-faying surfaces;
        (2) Faying surface; and
        (3) Top flange.
    iv) Cure times.
d) Welding:
    i) Appropriate welding process is specified for each component;
    ii) Weld callouts must include Weld Procedure Specification (WPS) # in weld tail;
    iii) WPS supported by Procedure Qualification Record (PQR) must be included with shop drawings:
        (1) Review PQR per AWS;
        (2) Review WPS per AWS; and
        (3) Approve WPS if Steps i and iii meet specifications.
    iv) Verify filler metals;
    v) NDT inspection (VT, PT, MT, UT, and RT) and the percentage of the weld requiring testing is called out in weld tail or clearly state in a general note; and
    vi) Seal welds not permitted.
e) Fabrication:
    i) Fracture critical elements defined on the contract plans and any element welded to a fracture critical element are specified;
    ii) Web and flange plate transition slope (1:2.5 or 24" radius minimum) and surface finishing (125 micro-in or less);
    iii) Web and flange splices must be offset 12 inch minimum;

iv) Primary members must have standard bolt hole sizes;
v) Long slotted holes have a plate washer covering the entire slot;
vi) A hardened washer is provided under the turned element; and
vii) A hardened washer is provided over oversized holes in bearing connections.