



STEEL SHOP DRAWING REVIEW CHECKLIST

SE University has compiled a Steel Shop Drawing Review Checklist to assist structural engineers in reviewing shop drawings during the construction phase.

The Checklist is divided into 3 Sections:

- A. Steel Erection Shop Drawing Review
- B. Steel Detail Shop Drawing Review
 - 1. General
 - 2. Steel Beam Shop Drawings
 - 3. Steel Column Shop Drawings
 - 4. Steel Bracing Shop Drawings
- C. Coordination with Other Submittals
 - 1. General
 - 2. Steel Supporting Elevators
 - 3. Steel Supporting Stairs
 - 4. Steel Supporting Exterior Walls

Please refer to the **SEU Construction Submittals – Initial Review Checklist** (also available through SEU Resource Center) for a concise checklist of items for structural engineers to initially look for when first receiving any construction submittal.

This checklist is intended to serve as an overall starting point for your shop drawing review efforts as the SER. Please customize as required to meet the needs of your specific project. Do you have additional items to include as part of this checklist? We welcome your feedback! Please email Cathleen Jacinto at Cathleen.Jacinto@LearnWithSEU.com.

II. Steel Shop Drawing Review

A. Erection Shop Drawing Review

1. Confirm drawings and/or transmittal are stamped by the General Contractor as required by project Specifications.
2. Check gridline or column-to-column dimensions.
3. Check north arrow orientation on plan drawings.
4. Confirm correct framing layout shown.
5. Check member sizes, locations, and orientation.
6. Check column orientation.
7. Check lateral frame sizes, locations, and geometry.
 - a. For braced frames, check widths, heights, and bracing angles are consistent with design drawings.
 - b. Check orientation of bracing members.
 - c. If bracing centerlines do not align with the centerlines of supporting elements (i.e. to avoid cladding), confirm the details on the erection drawings show the appropriate offset dimensions.
8. Check steel elevations.
9. If you receive partial steel submittals for specific areas of your project, check that connections for steel submitted separately from another area is included. Consider any connecting plates needed, bolt hole coordination, and expansion joint steel. Verify no conflicts occur.
10. Coordinate steel shown in erection shop drawings with elements provided by a different subcontractor such as the support for architectural elements, MEP equipment, concrete foundation, etc.
11. Sweep typical details to confirm secondary steel is provided including but not limited to:
 - a. Framing around floor openings
 - b. Slab support around wet columns (columns with adjacent pipe penetrations through the slab)
 - c. Slab edge support steel
 - d. Cladding support steel, if required
12. Check anchor bolt layout and configuration.
13. Check moment connection locations are correct if indicated on plan.

A. Erection Shop Drawing Review (cont'd)

14. Check field connection details are in accordance with design drawing details and/or delegated connection design submitted by the Contractor's connection engineer.
 - a. Check field bolt sizes, quantity, spacing, locations, and type (i.e. slip-critical).
 - b. Check field weld sizes and number of lines of weld.
 - c. Check connecting element sizes (i.e. angle size, plate size, etc).
 - d. Check copes are within maximum copes allowed per connection design calculations.
 - e. Check connection eccentricities are consistent with connection design calculations.
15. Check that the locations for any steel connections along the member span (i.e. beam splices, column splices, intermediate stiffeners, cover plates) do not conflict with connections for secondary elements (i.e. vertical exterior wall girt connections).
16. For any asymmetric members such as channels or angles, confirm the orientation of the flanges or outstanding angles is correct and does not conflict with miscellaneous steel.
17. Coordinate any areas that interface with existing structures (i.e. match holes). Add notes as necessary to field verify existing conditions prior to fabrication.
18. It is good practice to add a note indicating that after removal of any temporary erection aids, grind welds smooth and touch up areas with paint in accordance with the Specifications.
19. Confirm submittals incorporate any revisions due to RFI's, construction sketches issued, or any drawing issuances that occurred after bid documents were released.
20. Confirm all questions asked by the detailer or General Contractor are addressed.

B. Steel Detail Shop Drawing Review***1. General – Applies to all Steel Detail Shop Drawings***

- a. Are drawings stamped as required per Specifications?
- b. Check material properties including grade of steel.
- c. Check member sizes. Spot check that multiple running dimensions close consistently.
- d. Check member depth, particularly for plate girders and tapered members.
- e. Check that connections are provided for all members, and confirm location of connections.
- f. Check paint, finish, or special cleaning specified is consistent with General Notes or Specifications.
- g. If connections were designed by contractor's engineer, is the required connection easily identifiable on the shop drawings? Are connection I.D.'s shown on the shop drawings to confirm the connection engineer's designs are coordinated with the detailer's shop drawings? If not, it is helpful to write the connection I.D. on the shop drawings for internal documentation and confirmation.
- h. If connections were designed by contractor's engineer, confirm that the connections shown on the piece details and connection calculations are consistent and achieve the required connection capacity per design drawings.
- i. Check connection geometry is consistent with design drawings. If connections were delegated to a contractor's connection engineer, check the connection geometry is consistent with the connection designs submitted.
 1. Check bolt sizes, grade, quantity, spacing, locations, type (i.e. slip-critical), and edge distances.
 2. Check welding electrodes, weld types, weld sizes, and number of lines of weld.
 3. For non-fillet welds, confirm weld designations shown are acceptable pre-qualified weld notation.
 4. Check connecting element sizes (i.e. angle size, plate size, etc).
 5. Check connection eccentricities are consistent with connection design calculations.
 6. Check for overall bolt fitup between connecting elements. Do the number of bolts match between connecting elements? If one set of bolt holes are slotted, typically the connecting element does not have slotted holes.

B. Steel Detail Shop Drawing Review (cont'd)

1. General – Applies to all Steel Detail Shop Drawings (cont'd)

7. Check stiffener plates and/or doubler plates are provided where required per design drawings or connection calculation submittal. Check plate sizes, locations, and welds.
8. Where 2 plates or 2 angles are required by the connection design for double shear, confirm quantity shown is correct, particularly in bracing gusset plate connections and beam web connections.
- j. Are slotted holes provided in locations and in the proper orientation as specified in structural and architectural drawings? Consideration should include but not be limited to:
 1. Cladding support posts where slotted holes may be required to avoid transfer of floor loading onto posts.
 2. Expansion joint locations where horizontal slotted holes may be required.
- k. Where filler or shim plates are shown, check that the overall filler thickness is less than the maximum thickness allowed per calculations for bolt capacity. If they exceed, the bolt capacity will need to be confirmed for larger filler plate thicknesses shown.
- l. Check that any secondary steel elements such as column stiffeners or connection plates do not interfere with architectural elements such as cladding connections.
- m. Check that shear studs, masonry ties, or any other pieces that are required to attach to other elements are provided.
- n. Check sliding or slip connections are correctly detailed.
- o. Keep flat bed truck allowances in mind for steel piece shipping dimensions. A rule of thumb to follow are that maximum shipping lengths are approximately 42'-0" and maximum widths are approximately 8'-0". If any steel pieces border these dimensions, check with your General Contractor.
- p. If steel will be galvanized,
 1. Is the size of each shop assembled piece within the limits of galvanizing tank dimensions?
 2. Are drainage holes shown where needed?
- q. Where closed sections are used and if there is the potential for water seepage or exterior exposure, are weep holes shown on shop drawings for drainage? Weep holes are typically placed in closed sections at point of low steel elevation on the underside of beams or at the bottom of the columns.
- r. Are deck support angles shown?
- s. Are embedded plates submitted where required?

B. Steel Detail Shop Drawing Review (cont'd)

1. General – Applies to all Steel Detail Shop Drawings (cont'd)

- u. Check that steel pieces do not specify painting at locations where field welding is required, where spray-on fireproofing will be applied, or where slip-critical bolts will be used.
- v. If steel members are to be galvanized, will the field-welded elements shown in shop drawings require a good deal of repair to galvanizing after field welds are performed? If so, consider shop welds. For example, shop welds may be more appropriate for shear studs welded to the beam top flange.
- w. Review requirements per Specifications.
 - 1. Are weld procedures required?
 - 2. Is site weld testing required?
 - 3. Is special testing required for bolts?
 - 4. Is shop inspection required: NDT, Radiograph, MagParticle, etc?
- x. Is an erection procedure or sequence provided? If not, is one required per Contract Documents?
- y. Are all questions asked by detailer or GC addressed?

B. Steel Detail Shop Drawing Review (cont'd)

2. Steel Beam Shop Drawings

- a. Refer to Section II.B.1 Steel Detail Shop Drawings - General of this Checklist.
- b. Check beam member lengths (Some companies prefer to only spot check lengths). Consider centerline lengths of beams, floor slopes or roof pitch, and setback dimensions to connecting element.
- c. Check beam slopes.
- d. Check camber.
- e. Check copes are within maximum copes allowed per connection design calculations.
- f. Check distance from top of beam to top web bolt are consistent between the supporting element and supported beam to avoid conflicts. Similarly, check distance to first bolt in beam flanges at flange moment connections.
- g. If beams are intended to transfer axial forces through a floor diaphragm, check if any single-sided beam web connections that may be shown are acceptable. Typically, double-sided or end-plate connections are used to transfer axial + shear loads (in the absence of moment connections).
- h. Check if skewed connections meet design intent. Is weld shown adequate for the thickness of the connected members?
- i. Check beam web penetration locations, sizes, and reinforcement.

B. Steel Detail Shop Drawing Review (cont'd)

3. Steel Column Shop Drawings

- a. Refer to Section II.B.1 Steel Detail Shop Drawings - General of this Checklist.
- b. Check all steel elevations including bottom of base plate EL, top of column EL, and top of connecting beam EL.
- c. Check column member lengths (Some companies prefer to only spot check lengths). Consider splice locations, top of steel elevations, base plate thickness, grout bed thickness, and top of supporting element (i.e. foundation) elevations.
- d. Is a column cap plate shown if required by the drawings?
- e. Check anchor bolt sizes and column-to-base plate weld sizes. Are washers shown with appropriate welds and washer hole size for anchor bolt holes oversized in the base plate?
- f. Check base plate size, thickness, hole sizes and layout, and elevations.
- g. Confirm anchor rods do not project into slab or topping slab.
- h. Confirm no discrepancies with separate anchor bolt submittal, concrete foundation rebar or formwork submittal.

4. Steel Brace Shop Drawings

- a. Refer to Section II.B.1 Steel Detail Shop Drawings - General of this Checklist.
- b. Are brace angles (θ) consistent with design drawings?
- c. Check that the geometry of bracing gusset plates meet maximum unbraced lengths assumed in connection calculations.
- d. If brace workpoints are not to align with the centerline of supporting elements (i.e. to avoid cladding conflicts), check that the gusset plates are correctly offset.

Finally, if during the course of your review, you think there is a less expensive, better way to fabricate the pieces, raise your thoughts to your project manager for discussion.

C. Coordination with other Submittals**3. General**

Part C of the Checklist includes items to review in steel required to support another element not designed by the structural engineer of record.

- a. Below are examples of non-structural, secondary elements to coordinate the steel submittal with:
 - i. Railing Posts
 - ii. Fall Protection Davit Posts/Anchors
 - iii. Canopies
 - iv. Unistrut Framing
 - v. Door Frames
 - vi. Access Hatches
 - vii. Interior Partition Walls
 - viii. Ladders
 - ix. Elevators (Refer to Section C.2 of this Checklist for add'l review items)
 - x. Stairs (Refer to Section C.3 of this Checklist for additional review items)
 - xi. Exterior Wall (Refer to Section C.4 of this Checklist for additional review items)
- b. If shop drawings have not been received for the secondary element, add a Note to the Contractor to coordinate appropriate steel connections with their subcontractor prior to fabrication of steel.
- c. Confirm the attachment details between the steel submittal and the secondary element submittal are consistent.
- d. Check that bolt holes in one submittal align with bolt holes in another submittal. i.e. Fall protection davit post base plate holes align with supporting steel flange holes. Both submittals may come from different subcontractors, but the holes should align.
- e. Check that any stiffener plates intended to support secondary elements are shown.
- f. Check eccentricity applied by connections to the supporting steel structural element is acceptable. Provide any additional stiffeners or kickers as necessary to accommodate additional force or moment.
- g. If any slotted holes were intended for secondary element connections, confirm they are provided and in the proper orientation.
- h. Provide isolation to any dissimilar metals.
 - i. Isolation can come in the form of neoprene pads, butyl tape, etc to separate steel from dissimilar metals (i.e. aluminum).

C. Coordination with other Submittals (cont'd)**3. Steel Supporting Elevators:**

Below are items to review in the steel submittal for steel supporting elevators. If you have not yet received the elevator submittal when you are reviewing the steel submittal, add a note for the GC to coordinate these items. It is also recommended to add a note to hold steel from fabrication until the Elevator Submittal can be reviewed for loads imposed onto and connection into the base structure you have designed. This is to confirm that the supporting steel will be acceptable for the final approved elevator prior to steel fabrication.

- a. Refer to Section II.C.2 Coordination with Other Submittals - General of this Checklist.
- b. Confirm that supporting steel is adequate in strength and serviceability to support elevator loads shown in the elevator submittal. Confirm elevator loads include the appropriate impact factor.
- c. Coordinate steel supporting elevator sheave beams with elevator submittal.
 - i. Check all connecting elements are provided including any stiffeners.
 - ii. Check bolt quantity and layout are consistent with sheave beam connections that may be shown in elevator submittal.
- d. Coordinate steel supporting elevator guiderails with elevator submittal.
 - i. Confirm there is a guiderail connection provided at each supporting steel location required per the elevator submittal. The guiderail is required to connect to the base structure at a maximum vertical spacing (i.e. 12'-0"). Confirm spacing with your specific elevator submittal).
 - ii. Check all connecting elements are provided including any stiffeners.
 - iii. Check bolt quantity and layout are consistent with guiderail connections that may be shown in elevator submittal.
 - iv. Check supporting steel is adequate for any connection eccentricities shown in elevator submittal.
- e. Check that equipment support beams are properly isolated from base structure.

C. Coordination with other Submittals (cont'd)**3. Steel Supporting Stairs:**

Below are items to review in the steel submittal for steel supporting stairs. If you have not yet received the stair submittal when you are reviewing the steel submittal, add a note for the GC to coordinate these items. It is also recommended to add a note to hold steel from fabrication until the Stair Submittal can be reviewed for loads imposed onto and connection into the base structure you have designed. This is to confirm that the supporting steel will be acceptable for the final approved stair prior to steel fabrication.

- a. Refer to Section II.C.2 Coordination with Other Submittals - General of this Checklist.
- b. Check eccentricity applied by any stair posts or hangers to the supporting structural element is acceptable.
- c. Check load path in the connection of the stair stringer to base steel structure framing meets the design intent.

4. Steel Supporting Exterior Walls:

- a. Refer to Section II.C.2 Coordination with Other Submittals - General of this Checklist.
- b. Check any beams that are intended to support exterior wall show required stiffeners or bolt holes to receive the exterior wall connection. If exterior wall shop drawings have not yet been received, add a Note to the Contractor to coordinate appropriate connections with the exterior wall contractor prior to fabrication of steel.
- c. Check eccentricity applied by exterior wall connections to the supporting structural element is acceptable. Provide any additional stiffeners or kickers as necessary to accommodate additional moment.
- d. If you have any beams that laterally brace spandrel beams loaded torsionally, check that the bracing beam to spandrel connections can accommodate any anticipated axial reactions or moments.
- e. If any slotted holes were intended for exterior wall connections, confirm they are provided and in the proper orientation.
- f. Provide isolation to any dissimilar metals.
 - i. Isolation can come in the form of neoprene pads, butyl tape, etc to separate steel from dissimilar metals (i.e. aluminum).