



Steel Structures – General – Construction

Revision and Approval

Revision	Date	Nature of Changes	Approved By
0	04-25-2023	Original Issue	Richard Foley

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Background

This process establishes Structure Construction (SC) responsibilities and procedures for constructing steel structures, including field welding, materials fabrication, installation and removal of falsework, erecting steel members, fastener assembly acceptance, and installation of components.

Prior to reviewing this Bridge Construction Memo (BCM), it is essential to review the [Contract Specifications](#), Section 55-1.03, *Steel Structures – General – Construction*, that this BCM is based on as identified in the title block above. The information in the *Contract Specifications* typically will not be repeated in the text of this BCM.

Process Inputs

1. Contract documents
2. Authorized shop drawings
3. Structural steel components inspected and released to the job site
4. Test reports
5. Authorized submittals

Procedure

1. All work associated with this process is charged as [Project Direct – Construction](#).
2. Inspection of field work for this process is:
 - a. [Intermittent](#) for general activities of constructing steel structures, unless noted otherwise.
 - b. [Continuous](#) for fasteners assembly testing.
3. Before construction begins:
 - a. Review:
 - i. The [contract documents](#)
 - ii. *Contract Specifications*:
 1. Section 55-1.01D, *Steel Structures – General – Quality Assurance*
 2. Section 55-1.02A-D, *Steel Structures – General – Materials*
 3. Section 55-1.02E, *Steel Structures – General – Materials – Fabrication*
 - iii. *Construction Manual*, Chapter 4, [Section 4-55](#), *Construction Details – Steel Structures*
 - iv. Attachments as follows:
 1. [Attachment 1](#), *Discussion of Basic Construction Terms and Topics for High- Strength Bolted Connections*
 2. [Attachment 2](#), *Inspection Procedure for Checking Tension in High-Strength Bolts*
 3. [Attachment 3](#), *Approved Methods of Tensioning High-Strength Bolted Connections*.
 - b. Coordinate any working space or lane closures required during steel erection with the Resident Engineer (RE).
 - c. Discuss with the Contractor to verify that working areas have adequate space for the essential equipment to complete the planned work; this would likely entail a site visit.
 - d. Review Division of Construction [Code of Safe Practices](#) (COSP) in addition to any project specific guidance, if available.
 - e. Coordinate materials release and applicable field inspections with the Materials Engineering and Testing Services Representative ([METS Rep](#)).

- f. Discuss field erection requirements with the Bridge Design Structure Project Engineer, on structures with short radii, long spans, skewed curved spans, or other unusual conditions.
 - g. Work with the Bridge Construction Engineer (BCE) to obtain new safety harnesses as needed from SC headquarters, and training in its use.
 - h. Verify that torque wrenches being utilized by the Contractor for verification testing:
 - i. Display a torque value that can be clearly read.
 - ii. Are calibrated to 2 percent of the actual torque.
 - iii. Have up to date calibrations.
 - i. Verify that bolt tension measuring devices:
 - i. Are certified and calibrated.
 - ii. Include the necessary attachment plates for the fastener assemblies and bolt types being utilized on the project.
 - j. Review authorized shop drawings for details including:
 - i. Erection plans.
 - ii. Locations and details of temporary supports.
 - iii. Sequencing of installation.
 - iv. Camber values to include into the final deck grades.
 - k. Review authorized falsework shop drawings required for structural steel erection.
 - l. Reconcile any difference between the quantities in the plans with those in the RE Pending File (see [BCM C-2](#), *Using the Resident Engineer's Pending File for Structure Work*).
4. During construction:
- a. Verify materials delivered to the job site:
 - i. Are listed on [Form CEM-3101](#), *Notice of Materials to be Used*.
 - ii. Are properly tagged with Form TL-0624, *Inspection Release Tag* (commonly referred to as "Orange Tags") and can be matched up with [Form TL-0029](#), *Report of Inspection of Material*, for material tracking, and materials on hand payment.
 - iii. Are undamaged and properly stored above ground on supports.
 - iv. Are sloped or protected to prevent ponding of water on the surface.

- v. Are marked by piece number.
- vi. Contain faying and bearing surfaces which meet flatness requirements.
- b. Discuss acceptance criteria with Assistant Structure Representatives and Contractor as materials arrive.
- c. Notify the Contractor of any non-compliance issues with materials using both verbal and written communications requesting a plan for remediation.
- d. During erection of components in the field:
 - i. Verify working areas have adequate space to accommodate the crane locations.
 - ii. Verify that temporary supports and falsework are constructed per the authorized plans.
 - iii. Provide adjustments to the horizontal position of bearings assemblies due to temperature, as outlined in CS, 55-1.03C(3), *Steel Structures – General – Construction – Erection – Bearings and Anchorages*.
 - iv. Verify that temporary lifting ears:
 - 1. Are fully removed unless otherwise authorized.
 - 2. Are fully removed using an authorized plan on fracture critical or tension members.
 - v. Coordinate field welding with the METS Rep.
- e. For high strength (HS) fastener assemblies, ensure the Contractor performs all pre-installation tension tests, and rotational capacity tests on all lots, as follows:
 - i. Witness preinstallation testing for:
 - 1. Rotational capacity testing of two fastener assemblies per lot received on site.
 - 2. Installation tension testing as fastener lots are received on site as follows:
 - a. Test three representative fastener assemblies per lot in accordance with:
 - i. *The Specifications for Structural Joints Using High-Strength Bolts* of the [Research Council on Structural Connections](#) (RCSC).
 - 1. Note that this can be accessed on the SC Intranet Site under the “Field Resources” tab, and selecting [Resources for Structural Steel & Welding](#).

- ii. The *Structural Bolting Handbook* of the Steel Structures Technology Center (SSTC) for short bolts; consult with BCE to obtain a copy.
 - b. Coordinate with the Contractor to store the fastener assemblies in their original containers, protected from adverse weather conditions.
- ii. Verify that field drilled holes:
 - 1. Are not more than 1/16 inch larger than the nominal bolt diameter for fasteners less than 1 inch in diameter and not more than 1/8 inch larger for fasteners 1 inch and greater in diameter in conformance with Table 3-1, *Nominal Bolt Hole Dimensions*, of the 2020 RCSC Specifications.
 - 2. Locations are established using a template or steel connection piece.
 - 3. Are only reamed to their planned dimension.
 - 4. With any non-compliant holes are corrected using an authorized remediation plan.
- iii. Verify installation of HS fastener assemblies are made with:
 - 1. HS steel bolt, nut, and hardened washer, or
 - 2. Similar assembly with a direct tension indicator under the bolt head, or
 - 3. Tension control bolt, nut, and hardened washer.
 - 4. No more than one additional hardened washer under the non-turning element.
 - 5. Beveled washers if the slope of the joint is greater than 1:20.
 - 6. The same bolt head orientation in a connection.
 - 7. The nut side located away from traffic.
- iv. Ensure minimum tension of installed fastener assemblies by:
 - 1. Verifying no later than 48 hours after connection is fully tensioned.
 - 2. Witnessing the determination of inspection torque for each rotational capacity lot of fasteners.
 - 3. Selecting the fasteners to be tested with:
 - a. 10 percent of each type of fastener assembly per connection.
 - b. Minimum of two assemblies per connection.

4. Utilizing the procedure in Section 10, *Arbitration*, in the *Specification for Structural Joints Using High-Strength Bolts* of the RCSC (see procedure step 4.e.i.2.a.i. for reference location).
 5. Utilizing the *Arbitration of Disputes, Torque Method – Short Bolts*, from the *Structural Bolting Handbook* (SSTC) (obtain a copy from the BCE).
 6. Verifying direct tension indicators do not have all protrusions completely crushed.
- v. Verify bolt stickout:
1. Is at least flush with the nut face and not more than 1/4 inch beyond the outer face of the nut.
 2. Is the first full thread from the face of the nut to the sheared end of the bolt.
 3. On tension control bolts, is sealed with at least 50 mils (0.05 inch) of an authorized gray caulking.
- f. Coordinate inspection of field welded joints with the METS Rep.
- g. Document all inspection, construction, and quality assurance activities, pertinent to this BCM, in the daily reports per [BCM C-7](#), *Daily and Weekly Reports*.
5. After construction:
- a. Review as-built shop drawings for accuracy.
 - b. Verify the Contractor submits final shop drawings to SC Office Associates in a timely manner.
6. File all project documentation (correspondence, materials acceptance documentation, daily reports, etc.) in the appropriate category in the project records as specified in the *Construction Manual*, Chapter 5, [Section 5-102](#), *Contract Administration – Organization of Project Documents*.

Process Outputs

1. Daily reports
2. Completed steel structures installed per contract documents
3. Material certifications and test reports
4. Final shop drawings submitted by the Contractor

Attachments

1. [Attachment 1](#), *Discussion of Basic Construction Terms and Topics for High-Strength Bolted Connections*
2. [Attachment 2](#), *Inspection Procedure for Checking Tension in High-Strength Bolts*
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