

CHAPTER 5A

STRUCTURAL STEEL

5A-01. GENERAL

a. This chapter covers structural steel including steel for buildings, hangars, bridges, etc. Welding is covered only generally, since it is more thoroughly covered in the chapter entitled Welding. Structural steel lock and dam gate erection is not included in this chapter, but is covered in Chapters 22K & 22L. Make sure that you have in hand the following:

(1) American Institute of Steel Construction (AISC) Publications: Specification for the Design, Fabrication and Erection of Structural Steel for Buildings (Nov 1, 1978) with Commentary. Specification for Structural Joints Using ASTM A325 or A490 Bolts (Feb 4, 1976; Errata Jul 1, 1976)

5A-02. PREPARATORY INSPECTION

- a. Receive and review shop drawings
- b. Coordinate with other trades
- c. Check mill test reports
- d. Check welder certificates for appropriateness and expiration
- e. Check to see if weld procedure is qualified or if using AWS pre-qualified welds
- f. Check for high strength bolting requirements
 - (1) Type
 - (2) Size
 - (3) Bolt tightening methods.
- g. Check painting requirements
- h. Check for erection procedure and handling requirements.

5A-03. SHOP DRAWINGS

- a. All critical connections are to be shown on the contract drawings and must be fabricated in accordance with the contract drawings. Connections not shown on contract drawings are to be detailed in accordance with AISC.
- b. Approved shop drawings must be on hand prior to the start of steel erection.
- c. particular attention should be given to requirements and arrangement of temporary bolting and bracing, guy lines and fastenings.

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5A-04. STEEL ON THE JOB SITE

Upon arrival of the structural steel and prior to erection, the steel should be checked for the following items:

a. Sizes and Shapes

(1) Check every member against the shop drawings for correct size, shape, and weight.

(2) Check sizes and type of bolts, rivets, washers and welds as well as hole diameters.

(3) Watch for beams made up of welded plates being substituted for a rolled beam.

b. Alignment and Damage

(1) Members must be free of kinks, bends or other damage.

(2) Check the specifications for allowable tolerances.

(3) No straightening of bent or misaligned members should be allowed in the field except as approved by the Contracting Officer.

c. New Steel

(1) Check that the steel furnished is new.

(2) Look for such tell-tale evidence as old rivet and bolt holes which may have been filled with weld material, ground smooth, and painted over.

(3) Check that furnished steel is domestic and not of foreign manufacture.

d. Shop Fabrication

(1) Has the steel been inspected in the shop by a Government inspector or other authorized inspectors acting for the Government?

(a) If no shop inspection, then all shop connections must be inspected in the field with the same care required for field connections.

(b) Steel inspected in the shop should be examined upon arrival at the job site to determine if damage has been incurred during transportation or if errors and faulty workmanship may have gone undetected during shop inspection.

(2) Check if column ends, scheduled to be milled, have been milled. Check to determine whether cap and base plates on columns have been welded as required.

(3) Shop connections, are discussed in the Field Connection paragraph.

e. Shop Painting

(1) Inspect shop painting for holidays, abraded areas and loose mill scale or rust, making sure that all defects are satisfactorily corrected immediately.

(2) Check the specifications to determine if contact surfaces for joints to be connected with high tensile bolts are not to be painted. Contact surfaces for friction type connections must be free of paint. Check the AISC for treatment permitted.

(3) Normally paint will not be permitted on steel embedded in concrete and steel surfaces to be field welded or on which fire proofing is spray applied.

f. Storage and Handling

(1) Steel should be stored neatly off the traveled ways and not scattered all over the site.

(2) Require steel members to be blocked off the ground to avoid corrosion and to aid inspection. For prolonged storage, the steel should be properly protected against the elements.

(3) When unloading or during erection of long flexible steel members or trusses, require the contractor to use a double choker or double sling so as not to overstress the member by picking it up at only one point.

(4) Handling of steel should be such as to prevent distortion or damage during unloading and storage.

(5) Check for adequate connections in partly fabricated units. When not completely welded in the shop, the units should be bolted to prevent damage in shipment and handling.

5A-05. CONTRACTOR*S EQUIPMENT

a. Check cranes to insure that they have been inspected, tested and are of adequate capacity for the intended loads at the most critical position and boom radius required by the operation to be performed.

b. Check to insure that the cables are new or are in good condition, not frayed or worn, and that necessary safety stops are installed. The provisions for steel handling and erection as well as equipment inspection in the Safety and Health Requirements Manual should be carefully reviewed.

5A-06. FOUNDATIONS ALIGNMENT

a. Physical dimensions of foundations should be checked against the contract drawings.

b. Check footings for spacing, elevations and size.

5A- 07. ANCHOR BOLTS

a. Prior to the erection of structural steel, the anchor bolt settings should be checked for accuracy of layout.

b. Check to insure that sufficient length of bolt is protruding above the concrete to allow full engagement by the nut.

c. Chipping of concrete and bending of anchor bolts to fit bearing plates is not permitted.

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5A-08. STEEL ERECTION

a. Base-plates

(1) See that temporary connections necessary to hold all steel in proper position are provided before permanent welds are accurately fitted, aligned, plumbed, and leveled.

(2) Check that top of concrete is clear of dirt or foreign material and laitance.

(3) Check that base plate is set at proper line and level or slope, as required for alignment of frame, and firmly anchored down over metal wedges, shims and/or setting nuts. The space between top of concrete and bottom of base plate should be a minimum of 1/24 base plate width.

(4) Shims should be steel plates of varying thicknesses and not nuts or odd pieces of metal.

(5) The frame must be plumbed and properly guyed before making final adjustments to setting. Setting shims and wedges should be snugly fitted so they cannot be easily dislodged.

(6) Check that the dry-pack bedding mortar between top of concrete and bottom of bearing-plate is properly rammed and completely placed.

(7) Check that provision is made for proper curing of exposed edge of mortar bedding.

(8) Shims and wedges should remain in place. Parts projecting beyond edge of bearing-plates should be cut off.

(9) Separate setting plates are not permitted.

b. Alignment

(1) Check that all steel members are accurately fitted, leveled, plumbed, and guyed and adequate temporary connections made before permanent riveted, welded, or bolted connections are completed.

(2) Do not permit rough handling of material, such as heavy pounding with sledges.

(3) Driftpins may be used only to bring together the several parts; they should not be used in such a manner as to distort or damage the metal.

(4) Do not permit the use of a gas-cutting torch for correcting fabrication errors on any major member in the structural framing. Its use will be permitted on minor members when the member is not under stress and then only with the approval of the Resident Engineer.

c. Guys and Supports

(1) Check guys and supports for size and condition, adequacy of anchorage and suitability of anchorage points.

(2) Guy-lines must be taut.

(3) Check that contact between guy-lines or braces and erection equipment is avoided.

(4) Procedures which might cause back-guys to break during plumbing-up or erection operations should not be permitted.

d. Field Connections

(1) Bolting, General

(a) Check type, length and size of bolt, size and type of washers, and size of hole.

(b) Check to assure all bolt heads and nuts are resting squarely against the metal, and that bolts have been drawn adequately tight.

(c) Check for the requirements for upset threads or lockwashers and for compliance with these requirements.

(d) Check for alignment of holes. Poor matching of holes should be cause for rejection of the members. Burning to correct misalignment should not be permitted.

(2) High-strength Bolted Connection

(a) The A325 high-strength bolt may be identified by three radial marks on the head and three long indented marks on the nut. The A490 bolt head is marked "A490" and the nut is marked either "2H" or "DH". The bolt is used with a washer on the side of the element that is turned, except for A325 bolts when turn-of-nut tightening method is used. The inspector should make sure that ordinary washers and nuts are not being used and he should have available AISC Pamphlet "Specification For Structural Joints Using ASTM A325 or A490 Bolts". Recommendations on inspection in the pamphlet should be followed.

(b) Some of the items to check in a high-tensile, bolted connection are as follows:

1. Unless noted otherwise in the specifications, contact surfaces of a high-tension - bolted connection should show only the normal tight mill scale and should be free of dirt, oil, loose scale, burrs, pits, and other defects that would prevent the solid seating of the parts.

2. Paint is permitted in bearing-type connections. Check the AISC. specification for surface treatments permitted in friction type connections. The drawings will usually define these connections.

3. The contractor should provide the means and should calibrate twice a day all wrenches to be used for calibrated wrench tightening method.

4. Check required bolt tension by use of a torque wrench furnished by the contractor. All high-strength bolts need not be checked. Normally 5 to 10 percent of the bolts should be checked. Since AISC specifies bolt tightening in terms of bolt tension, it is necessary that the torque wrench be calibrated using a device which will indicate actual bolt tension.

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5. An acceptable and preferred method of torquing high strength bolt is the "turn of nut" method described in the AISC. pamphlet "Structural Joints using ASTM A325 or A490 Bolts". Be familiar with this method.

6. The AISC specification permits the use of direct tension indicators (indicator washers) providing the correct indication of tension has been achieved. In other words, the tension required must be determined by testing with a torque wrench.

7. High strength bolts cannot be reused.

(3) Unfinished Bolted Connections

(a) Check to see if specifications require that bolts be dipped in red lead paint before installation.

(b) Check that the same number of threads are exposed in any one connection and that the correct length of bolt is used.

(c) Check for the contractors use of an approved welding procedure prior to the commencement of welding.

(4) Turned Bolts

Turned or rivet bolts in reamed holes have the same value as rivets. The same checks should be made for turned bolts as for other bolts.

(5) Ribbed Bolts

The ribbed bolt is the equivalent of a rivet and is used without a washer. The same checks should be made for ribbed bolts as for other bolts.

(6) Welded Connections

Some of the items to check in a welded connection areas follows:

(a) Check on the qualifications of the welders and for qualified procedures in accordance with Section 5 of the Structural Welding Code, AWS D1.1.

(b) Check to see that all of the welds called for on the approved shop drawings have actually been made, and that they are accurately located and of the specified sizes. Check to see that shop non-destructive tests (Radiographing, Magnifluxing) required by the specifications have been performed and location for the tests are known.

(c) Check finished welds for size, length and standards of workmanship with respect to contour and appearance of the weld surface, surface defects, craters, undercutting, overlapping edges of welds, cracks, etc. Unacceptable welds should be removed, rewelded, and re-examined promptly.

(d) Weld location is important; placing weld in the wrong location may be just as serious as omitting the welds altogether.

(a) Over-welding either in size or length of welds is to be discouraged since such practices may introduce distortions.

(f) Surfaces to be welded should be free from loose scale, slag, rust, grease, paint, and any other foreign material, except that mill scale which withstands rigorous wire brushing may remain.

(g) Joint surfaces to be welded should be free from fins and tears.

(h) Field welding requires similar checks to shop welding and in addition, the inspector must be aware of minimum ambient temperature in weld vicinity of zero degrees F. (-18°C) and of the preheat requirements.

e. Inserts and Attachments

(1) Structural steel should not be cut for passage of conduits, pipes, etc. unless shown on the approved shop drawings.

(2) The burning of holes for attachment of supports should not be permitted.

f. Final Painting

(1) prior to final painting, the steel should be cleaned of all foreign matter and the prime coat touched up, including rivets, bolts, areas welded, etc.

(2) Final coats of paint should be applied prior to surfaces being made inaccessible by masonry, roofing, etc.

(3) Remember that steel to be encased in concrete or on which fireproofing is spray applied is not to be painted unless otherwise specifically required.

g. Open Web Steel Joists

(1) Check to see if holes in bearing plate at one end have been slotted, where specified.

(2) As soon as joists are in place, all bridging should be completely installed and the joists permanently fastened into place before the application of any loads.

(3) Question conditions which provide excessive concentrated loads not so indicated on structural drawings, including loads not located at panel points. Your supervisor should investigate.

(4) The ends of all bridging lines terminating at walls or beams should be anchored thereto at plane of top and bottom chords as noted on the drawings or as specified.

(5) See that the principal tension members are the full length of joist without splicing or jointing.

(6) Check the anchorage of the joist to its supports.

(7) Do not allow the burning or enlargement of holes in the joist.

(8) Check to see that all rust, scale, weld flux, slag and spatter has been removed and joist is clean before it is painted. Check specifications to determine if steel joists over crawl spaces are to have asphalt paint.

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5A-09. STEEL TANKS

a. Field inspection of steel tank materials will be made upon delivery, as for structural steel.

b. Foundation pads, anchor bolts, or other supports should be checked before erection of tank starts.

c. Surfaces to be welded should be free from loose scale,slag, heavy rust, grease, paint and any other foreign material excepting tightly adherent mill scale. Surfaces shall also be smooth, uniform and free from fins, tears, and other defects which adversely affect proper welding.

d. Damage to shop coat of paint both inside and outside of assembled tank should be touched up with specified paint prior to final painting.

e. Ladders and safety cages should be checked for rough or sharp edges, loose rungs, clearances, etc.

f. Field painting should not be permitted until all water,dirt, grease, etc., are removed and the tank surfaces are dry.