27-10. Checklists and Forms.
Not Applicable.

Chapter 28
Steel Erection

28-1. References.
29 CFR 1926 Subpart R, Steel Erection (https://www.govinfo.gov/content/pkg/CFR-2020-title29-vol8/pdf/CFR-2020-title29-vol8-part1926-subpartR.pdf)

28-2. Definitions.

a. Anchored Bridging. Steel joist bridging that is connected to a bridging terminus point. (28-2.a)

b. Bolted Diagonal Bridging. Diagonal bridging that is bolted to a steel joist or joists. (28-2.b)

c. Bridging Clip. A device that is attached to the steel joist to allow the bolting of the bridging to the steel joist. (28-2.c)

d. Bridging Terminus Point. A structural element (for example, wall, beam, tandem joists with all bridging installed and a horizontal truss in the plane of the top chord) at an end or intermediate point of a line of bridging that provides an anchor point for the steel joist bridging. (28-2.d)

e. Controlled Decking Zone (CDZ). An area in which certain work (for example, initial installation and placement of metal decking) may take place without the use of guardrail systems, PFAS, fall restraint systems, or safety net systems and where access to the zone is controlled. (28-2.e)

f. Decking Hole. A gap or void more than 2 inches (5.1 cm) in its least dimension and less than 12 inches (30.5 cm) in its greatest dimension in a floor, roof or other walking or working surface. Pre-engineered holes in cellular decking (for example, for wires, cables) are not included in this definition. (28-2.f)

g. Derrick Floor. An elevated floor of a building or structure that has been designated to receive hoisted pieces of steel prior to final placement. (28-2.g)

h. Erection Bridging. The bolted diagonal bridging that is required to be installed prior to releasing the hoisting cables from the steel joists. (28-2.h)

i. Girt (in systems-engineered metal buildings). A "Z" or "C" shaped member formed from sheet steel spanning between primary framing and supporting wall material. (28-2.i)

j. Metal Decking. A commercially manufactured, structural grade, cold-rolled metal panel formed into a series of parallel ribs; this includes metal floor and roof decks, standing seam metal roofs, other metal roof systems, bar gratings, checker plate, expanded metal panels, and similar products. (28-2.j)

k. Multiple Lift Rigging (MLR). A rigging assembly manufactured by wire rope rigging suppliers that facilitates the attachment of up to five independent members of similar structural types spaced at a minimum of 7 feet (2.1 m) apart to the hoist rigging of a crane. (28-2.k)

l. Permanent Floor. A structurally completed floor at any level or elevation, to include slab on grade. (28-2.l)

m. Project Structural Engineer of Record. The RPE responsible for the design of structural steel framing and whose seal appears on the structural design drawings. (28-2.m)

n. Purlin (in systems-engineered metal buildings). A "Z" or "C" shaped member formed from sheet steel spanning between primary framing and supporting roof material. (28-2.n)

o. Snug Tight. A condition that exists when all plies in a connection have been pulled into firm contact by the bolts in the joint and all of the bolts in the joint have been tightened sufficiently to prevent removal of the nuts without the use of a wrench. (28-2.o)

p. Steel Erection. The construction, alteration, or repair of steel buildings, bridges, and other structures, including the installation of metal decking and all planking used during the process of erection. (28-2.p)

q. Steel Joist. An open web, secondary load-carrying member of 144 feet (43.9 m) or less, designed by the manufacturer, that is used for the support of floors and roofs. This does not include structural steel trusses or cold-formed joists. (28-2.q)

r. Steel Joist Girder. An open web, primary load-carrying member, designed by the manufacturer, used for the support of floors and roofs. This does not include structural steel trusses. (28-2.r)

s. Steel Truss. An open web member designed of structural steel components by the project structural engineer of record. A steel truss is considered equivalent to a solid web structural member. (28-2.s)

t. Structural Steel. A steel member, or a member made of a substitute material (for example, fiberglass, aluminum, composite members). These members include, but are not limited to, steel joists, joist girders, purlins, columns, beams, trusses, splices,

seats, metal decking, girts, and all bridging cold-formed metal framing that is integrated with the structural steel framing of a building. (28-2.t)

u. Systems-Engineered Metal Building. A metal, field-assembled building system consisting of framing, roof, and exterior wall coverings. Typically, many of these components are cold-formed shapes. These individual parts are fabricated in one or more manufacturing facilities and shipped to the jobsite for assembly into the final structure. The engineering design of the system is normally the responsibility of the systems-engineered metal building manufacturer. (28-2.u)

28-3. Personnel Required Qualification/Training.

a. A QP must provide the training required by this chapter. (28-3.a)

b. The employer must ensure special training is provided for employees engaged in the following areas: (28-3.b)

(1) Multiple Lift Rigging (MLR). Train each employee who performs MLR on the nature and hazards associated with multiple lifts, and the proper procedures and equipment to perform multiple lifts (see chapter 15).

(2) Connecting. Train each employee who performs connections on the nature and hazards associated with connecting, and the establishment, access, proper connecting techniques, and work practices required by this chapter and 29 CFR 1926 Subpart R.

(3) Falls. Train each employee exposed to fall hazards training according to chapter 21.

(4) Controlled Decking Zone (CDZ). Train each employee working in CDZs on the nature and hazards associated with CDZs, and the establishment, access, proper installation and work practices required by this chapter and 29 CFR 1926 Subpart R.

28-4. Roles and Responsibilities.

a. The Controlling Contractor must. (28-4.a)

(1) Develop sequence of erection activities according to paragraph 28-7.a.

(2) Provide written notifications according to paragraphs 28-8.b and 28-8.m.

(3) Ensure adequate site layout according to paragraph 28-8.g.

(4) Coordinate other construction processes according to paragraph 28-8.x.

b. Competent Persons (CP) must: (28-4.b)

(1) Evaluate bracing equipment according to paragraph 28-8.j.

(2) Evaluate the need for guying or bracing on columns according to paragraph 28-8.m.

(3) Determine bolting requirements according to paragraph 28-8.n.

c. Qualified Persons (QP) must: (28-4.c)

(1) Provide all training required by this chapter and according to paragraph 28-3.

(2) Prepare steel erection plans according to paragraph 28-7.

(3) Direct the use of shim packs according to paragraph 28-8.m.

(4) Design alternate means of stabilizing joists according to paragraph 28-8.s.

(5) Approve the use of joists, girders, purlins, or girts for fall arrest anchorage according to paragraphs 28-8.s and 28-8.x.

d. Structural Engineer of record must: (28-4.d)

(1) Approve all repairs, replacements, or modifications to anchor rods or bolts according to paragraph 28-8.m.

(2) Specify bolt tightness according to paragraphs 28-8.n and 28-8.o.

(3) Approve all modifications to joists and girders according to paragraph 28-8.s.

28-5. Inspection Requirements.
Not Applicable.

28-6. Activity Hazard Analysis (AHA) Requirements.
Develop AHAs according to paragraphs 1-6 or 2-6, as applicable.

28-7. Minimum Plan Requirements.
Prior to beginning the erection of any structural steel, submit a Steel Erection Plan to the USACE supervisor for approval or to the KO or COR for acceptance. The plan must be signed and dated by the QP responsible for its preparation and modification. This plan must include the following:

a. Detailed description of the activity being performed to include: (28-7.a)

(1) Steel erection activities and procedures such as column, beam, joist, and purlin erection, erection of bridging terminus points, connections, decking, ornamental and miscellaneous iron.

(2) The sequence of erection activates developed in coordination with the controlling contractor.

(3) Stability considerations requiring temporary bracing and guying.

(4) Procedures for providing written notifications for anchor points according to paragraph 28-8.b.

(5) Procedures for coordination with other trades and construction activities.

(6) Material delivers procedures.

(7) Identification of staging, and storage areas.

(8) Procedures for developing a SLP according to chapter 16.

(9) Identification of any lifts classified as critical lifts, requiring separate plans (see chapter 16).

b. Description of the anticipated hazards or concerns and the control measures that will be implemented to control to an acceptable level to include: (28-7.b)

(1) An AHA (see paras 1-6 or 2-6, as applicable).

(2) A fall protection plan (see chapter 21).

c. Assignment of personnel and their roles and responsibilities. Include necessary information/documentation to support qualification/training of the following as required. (28-7.c)

(1) CP and QP.

(2) Documentation for each employee who has received training for performing steel erection operations, according to this chapter and 29 CFR 1926.761 (29 CFR 1926 Subpart R).

d. Inspection and oversight methods to ensure adherence to the plan. (28-7.d)

e. A description of the procedures that will be utilized in the event of rescue or emergency response. (28-7.e)

28-8. General Requirements.

a. Steel erection activities include but are not limited to, hoisting, laying out, placing, connecting, welding, burning, guying, bracing, bolting, plumbing, and rigging structural steel, steel joists and metal buildings; installing metal decking, miscellaneous metals, ornamental iron, and similar materials; and moving point-to-point while performing these activities (see 29 CFR 1926.750 (29 CFR 1926 Subpart R)). (28-8.a)

b. Written Notifications. Before authorizing the commencement of steel erection, the controlling contractor must ensure that the steel erector is provided with the following written notifications: (28-8.b)

(1) The concrete in the footings, piers, and walls has attained, on the basis of an appropriate ASTM standard test method of field-cured samples, either 75% of the intended minimum compressive design strength or sufficient strength to support the loads imposed during steel erection.

(2) Any repairs, replacements, and modifications to the anchor bolts were conducted according to with contract specifications or project structural engineer of record.

Note. Both steel and concrete contractors must keep a copy of this written notification onsite.

c. The fall protection threshold height requirement is 6 feet (1.8 m) for all work covered by this manual, whether performed by Government or contractor work forces, unless specified differently below. This includes steel erection activities and systems-engineered activities (that is, prefabricated metal buildings). (See chapter 21) (28-8.c)

d. Do not place construction loads on a structure or portion of a structure unless the employer determines, based on information from a person who is qualified in structural design, that the structure or portion of the structure can support the loads. (28-8.d)

e. Do not permit employees to work above or in positions exposed to protruding reinforcing steel, fasteners, or other impalement hazards unless provisions have been made to control the hazard. (28-8.e)

f. Do not permit employees to work under bundled material loads or other suspended loads. Riggers securing lower loads to multi-lift rigging assemblies and workers setting suspended structural components such as beams, trusses, and precast members are excluded from this requirement. In these cases, work controls must be used to minimize the time spent directly under loads. (28-8.f)

g. Site layout. The controlling contractor must ensure that the following is provided and maintained: (28-8.g)

(1) Adequate access roads into and through the site for the safe delivery and movement of derricks, cranes, trucks, other necessary equipment, and the material to be erected; and means and methods for pedestrian and vehicular control.

Note. This requirement does not apply to roads outside of the construction site.

(2) An adequately compacted, properly graded, drained area readily accessible to the work with adequate space for the safe storage of materials and the safe operation of the erector's equipment.

(3) Pre-planning of overhead hoisting operations. Pre-plan all steel erection hoisting operations.

h. Walking-working surfaces, shear connectors, and other similar devices. (28-8.h)

(1) Tripping hazards. Do not attach shear connectors (for example, headed steel studs, steel bars, steel lugs), reinforcing bars, deformed anchors, or threaded studs to the top flanges of beams, joists, or beam attachments so that they project vertically from or horizontally across the top flange of the member until after the metal decking, or other walking-working surface has been installed.

(2) When shear connectors are used in construction of composite floors, roofs, and bridge decks, lay out and install the shear connectors after the metal decking has been installed, using the metal decking as a working platform.

i. Structural steel assembly. (28-8.i)

(1) Maintain structural stability always during the erection process.

(2) The following additional requirements apply to multi-story structures:

(a) Install the permanent floors as the erection of structural members progresses. There must not be more than eight stories between the erection floor and the upper-most permanent floor, except where the structural integrity is maintained as a result of the design.

(b) At no time will there be more than four floors or 48 feet (14.6 m), whichever is less, of unfinished bolting or welding above the foundation or uppermost permanently secured floor, except where the structural integrity is maintained because of the design.

j. Install bracing equipment, as required, before the structure is loaded with construction material (for example, loads of joists, bundles of decking, or bundles of bridging). (28-8.j)

(1) When deemed necessary by a CP, install temporary erection bracing equipment in conjunction with the steel erection process to ensure the stability of the structure.

(2) Do not remove bracing equipment until approved by a CP.

k. Metal Decking. Hoist, land, and place metal decking bundles. (28-8.k)

(1) Lay tightly and secure metal decking upon placement to prevent accidental movement or displacement. Do not lay more than 3,000 ft^2 (278.7 m^2) before securing.

(2) During initial installation, place metal-decking panels so that they are fully supported by structural members.

(3) Do not use bundle packaging and strapping for hoisting unless specifically designed for that purpose.

(4) If loose items such as dunnage, flashing, or other materials are placed on the top of metal decking bundles to be hoisted, secure such items to the bundles.

(5) Land the bundles of metal decking on joists according to paragraph 28-8.w.

(6) Land metal decking bundles on framing members so that enough support is provided to allow the bundles to be un-banded without dislodging the bundles from the supports.

(7) At the end of the shift or when environmental or jobsite conditions require, secure metal decking against displacement.

(8) Roof and floor holes and openings. Install metal decking at roof and floor holes and openings as follows:

(a) Framed metal deck openings must have structural members turned down to allow continuous deck installation except where not allowed by structural design constraints or constructability.

(b) Deck over or protect roof and floor holes and openings according to chapter 24.

(c) Do not cut metal decking holes or openings until immediately prior to being permanently filled with the equipment or structure needed or intended to fulfill its specific use and that meets the design drawings and/or manufacturers requirements or immediately cover or guard the hole or opening according to chapter 24.

l. Derrick Floors. (28-8.l)

(1) Fully deck and/or plank all derrick floors and complete the steel member connections to support the intended floor loading.

(2) Distribute temporary loads placed on derrick floors over the underlying support members to prevent local overloading of the deck material.

m. Column Anchorage. (28-8.m)

(1) General requirements for erection stability.

(a) Anchor all columns using a minimum of four anchor rods or anchor bolts.

(b) Design each column anchor rod or anchor bolt assembly, including the column-to-base plate weld and the column foundation, to resist a minimum eccentric gravity load of 300 lbs. (136.2 kg) located 18 inches (45.7 cm) from the extreme outer face of the column in each direction at the top of the column shaft.

(c) Set columns on level finished floors, pre-grouted leveling plates, leveling nuts, or shim packs. If shim packs are used, a QP must direct their use.

(d) A CP must evaluate all columns to determine whether guying or bracing is needed. Install all required guying or bracing.

(2) Repair, replacement, or field modification of anchor rods or anchor bolts.

(a) Do not repair, replace or field-modify anchor rods or anchor bolts without the approval of the project structural engineer of record.

(b) Prior to the erection of a column, the controlling contractor must provide written notification to the steel erector if there has been any repair, replacement, or modification of the anchor rods or anchor bolts of that column.

n. Beams and columns. (28-8.n)

(1) Do not release the load from the hoisting line during the final placing of solid web structural members until the members are secured with at least two bolts per connection of the same size and strength as shown in the erection drawings. Tighten the bolts to snug tight and/or as specified by the project structural engineer of record.

(2) A CP must determine those pieces that require more than two bolts in each end before the piece is released from the crane. Completely bolt column erection splices prior to adding more than two floors.

o. Diagonal Bracing. Secure solid web structural members used as diagonal bracing by at least one bolt per connection drawn up snug tight and/or the equivalent as specified by the project structural engineer of record. (28-8.o)

p. Double Connections. (28-8.p)

(1) Double connections at columns or at beam webs over a column. This requirement applies when two structural members on opposite sides of a column web, or a beam web over a column, are connected sharing common connection holes. At least one bolt with its snug tight nut must remain connected to the first member unless a shop-attached or field-attached seat or equivalent connection device is supplied with the member to secure the first member and prevent the column from being displaced. (See figures 28-3 and 28-4)

(2) If a seat or equivalent device is used, design the seat or device to support the load during the double connection process. Adequately bolt or weld the seat or device to both a supporting member and the first member before the nuts on the shared bolts are removed to make the double connection.

q. Column splices. Design each column splice to resist a minimum eccentric gravity load of 300 lbs. (136.2 kg) located 18 inches (45.7 cm) from the extreme outer face of the column in each direction at the top of the column shaft. (28-8.q)

r. Perimeter columns. Do not erect perimeter columns unless: (28-8.r)

(1) The perimeter columns extend a minimum of 48 inches (121.9 cm) above the finished floor to permit installation of perimeter safety cables prior to erection of the next tier, except where constructability does not allow.

(2) The perimeter columns have holes or other devices in or attached to perimeter columns at 42-45 inches (106.7-114.3 cm) above the finished floor, and at the midpoint between the finished floor and the top cable, to permit installation of perimeter safety cables, except where constructability does not allow.

s. Open web steel joists. (28-8.s)

(1) Except as provided in paragraph 28-8.s(2) below, where steel joists are used and columns are not framed in at least two directions with solid web structural steel members, field bolt a steel joist at the column to provide lateral stability to the column during erection. For the installation of this joist:

(a) Provide a vertical stabilizer plate on each column for steel joists. The plate must be a minimum of 6 inches x 6 inches (15.2 cm x 15.2 cm), it must extend at least 3 inches (7.6 cm) below the bottom chord of the joist and have a thirteen-sixteenth (13/16) inch (2.1 cm) hole to provide an attachment point for guying or plumbing cables.

(b) Stabilize the bottom chords of steel joists at columns to prevent rotation during erection.

(c) Do not release hoisting cables until the seat at each end of the steel joist is field-bolted, and each end of the bottom chord is restrained by the column stabilizer plate.

(2) Where constructability does not allow a steel joist to be installed at the column:

(a) Install an alternate means of stabilizing joists on both sides near the column to provide stability equivalent to paragraph 28-8.s(1). The alternate means must be designed by a QP, be shop installed, and included in the erection drawings.

(b) Do not release hoisting cables until the seat at each end of the steel joist is field-bolted and the joist is stabilized.

(3) Where steel joists at or near columns that span 60 feet (18.3 m) or less, design and erect the joist by either:

(a) Installing bridging or otherwise stabilizing the joist prior to releasing the hoisting cable.

(b) Releasing the cable without having a worker on the joist.

(4) Where steel joists at or near columns span more than 60 feet (18.3 m), set the joists in tandem with all bridging installed, unless a QP designs an alternative method of erection with equivalent stability to the steel joist, and includes it in the site-specific Steel Erection Plan.

(5) Do not place a steel joist or steel joist girder on any support structure unless such structure is stabilized.

(6) When steel joist(s) are landed on a structure, secure them to prevent unintentional displacement prior to installation.

(7) Do not make any modification that affects the strength of a steel joist or steel joist girder without the approval of the project structural engineer of record.

(8) Field-Bolted Joists.

(a) Except for steel joists that have been pre-assembled into panels, fabricate connections of individual steel joists to steel structures in bays of 40 feet (12.2 m) or more to allow for field bolting during erection.

(b) Field-bolt these connections unless constructability does not allow.

(9) Do not use steel joists or steel joist girders as anchorage points for a personal fall arrest system unless a QP provides written approval.

(10) Establish a bridging terminus point before bridging is installed.

t. Attachment of steel joists and steel joist girders. (28-8.t)

(1) Attach each end of "K" series steel joists to the support structure with a minimum of two 1/8 inch (0.3 cm) fillet welds that are 2½ inches (6.35 cm) long, or with two one-half (½) inch (1.3 cm) bolts, or the equivalent.

(2) Attach each end of "LH" and "DLH" series steel joists and steel joist girders to the support structure with a minimum of two one-quarter (¼) inch (0.6 cm) fillet welds 2 inches (5.1 cm) long, or with two three-quarter (¾) inch (1.9 cm) bolts, or the equivalent.

(3) Except as provided in (4) below, attach each steel joist to the support structure immediately upon placement in the final erection position and before placing additional joists.

(4) Attach panels that have been pre-assembled from steel joists with bridging to the structure at each corner before releasing the hoisting cables.

u. Erection of steel joists. (28-8.u)

(1) Attach both sides of the seat of one end of each steel joist that requires bridging to the support structure before releasing the hoisting cables. See tables 28-1 and 28-2 for bridging requirements.

(2) For joists over 60 feet (18.3 m), attach both ends of the joist as specified in paragraph 24-8.t and incorporate the provisions of paragraph 28-8.v before releasing the hoisting cables.

(3) On steel joists that do not require erection bridging as specified in tables 28-1 and 28-2, allow only one employee on the joist until all bridging is installed and anchored.

(4) Do not allow employees on steel joists where the span of the steel joist is equal to or greater than the span shown in tables 28-1 and 28-2. Follow the requirements of paragraph 28-8 v.

(5) When permanent bridging terminus points cannot be used during erection, install additional temporary bridging terminus points to provide stability.

v. Erection bridging. (28-8.v)

(1) Where the span of the steel joist is equal to or greater than the span shown in tables 28-1 and 28-2, follow these requirements:

(a) Install a row of bolted diagonal erection bridging near the mid-span of the steel joist.

(b) Do not release hoisting cables until the required bolted diagonal erection bridging is installed and anchored, see table 28-1.

(c) Do not allow more than one employee on these spans until all other bridging is installed and anchored.

(2) Where the span of the steel joist is over 60 feet (18.3 m) and up to 100 feet (30.5 m), follow these requirements:

(a) All rows of bridging must be bolted diagonal bridging.

(b) Install two rows of bolted diagonal erection bridging near the third points of the steel joist.

(c) Do not release hoisting cables until this bolted diagonal erection bridging is installed and anchored.

(d) Do not allow more than two employees on these spans until all other bridging is installed and anchored.

(3) Where the span of the steel joist is over 100 feet (30.5 m) and up to 144 feet (43.9 m), follow these requirements:

(a) All rows of bridging must be bolted diagonal bridging.

(b) Do not release hoisting cables until all bridging is installed and anchored.

(c) Do not allow more than two employees on these spans until all bridging is installed and anchored.

(4) For steel members spanning over 144 feet (43.9 m), the erection methods used must follow paragraphs 28-8.n. through q.

(5) Where any steel joist specified in paragraph 28-8.v(2) above or paragraphs 28-8.w(1) through (3) is a bottom chord-bearing joist, provide a row of bolted diagonal bridging near the supports. Install this bridging and anchor it before releasing the hoisting cables.

(6) When bolted diagonal erection bridging is required by paragraph 28-8.v follow these requirements:

(a) Indicate the bridging on the erection drawing.

(b) Use the erection drawings as the exclusive indicator of the proper placement of this bridging.

(c) Use shop-installed bridging clips or functional equivalents where the bridging bolts to the steel joists (see figures 28-1, 28-2 and 28-5).

(d) When two pieces of bridging are attached to the steel joist by a common bolt, do not remove the nut that secures the first piece of bridging from the bolt when attaching the second piece of bridging.

(e) Do not allow bridging attachments to protrude above the top chord of the steel joist.

w. Landing and Placing Loads. (28-8.w)

(1) During the construction period, the employer must ensure that when placing a load on steel joists the load is distributed so it does not exceed the carrying capacity of any steel joist.

(2) Except as stated in paragraph 28-8.w(4) below, do not place construction loads on the steel joists until all bridging is installed and anchored and all joist-bearing ends are attached.

(3) The weight of a bundle of joist bridging may not exceed a total of 1,000 lbs. (454 kg). Place each bundle of joist bridging on a minimum of three steel joists that are secured at one end. Position the edge of the bridging bundle within 1 foot (0.3 m) of the secured end.

(4) Do not place any bundles of decking on steel joists until all bridging has been installed and anchored and all joist bearing ends attached, unless all of the following conditions are met:

(a) A QP has documented in a site-specific Steel Erection Plan that the structure or portion of the structure can support the load.

(b) The bundle of decking is placed on a minimum of three steel joists.

(c) The joists supporting the bundle of decking are attached at both ends.

(d) At least one row of bridging is installed and anchored.

(e) The total weight of the bundle of decking does not exceed 4,000 lbs. (1814.4 kg), and the edge of the construction load is placed within 1 foot (0.3 m) of the bearing surface of the joist end.

x. Systems-Engineered Metal Buildings. (28-8.x)

(1) All of the requirements of this chapter apply to the erection of systems-engineered metal buildings except paragraph 28-8.m (column anchorage) and paragraph 28-8.s (open web steel joists).

(a) Anchor each structural column using a minimum of four anchor rods or anchor bolts.

(b) Rigid frames must have 50% of their bolts or the number of bolts specified by the manufacturer, whichever is greater, installed and tightened on both sides of the web adjacent to each flange, before the hoisting equipment is released.

(c) Do not place construction loads on any structural steel framework unless such framework is safely bolted, welded, or otherwise adequately secured.

(d) In girt and eave strut-to-frame connections, where girts or eave struts share common connection holes, at least one bolt with its snug tight nut must remain connected to the first member. The exception to this is when a manufacturer-supplied, field-attached seat or similar connection device is present to secure the first member so that the girt or eave strut is always secured against displacement.

(e) Do not use purlins and girts as an anchorage point for a PFAS unless a QP for Fall Protection provides written approval to do so.

(f) Do not use purlins as a walking or working surface when installing safety systems until all permanent bridging has been installed and fall protection is provided.

(g) Only place construction loads within a zone that is within 8 feet (2.4 m) of the centerline of the primary support member.

(h) Fully bolt or weld both ends of all steel joists or cold-formed joists to the support structure before releasing the hoisting cables, allowing an employee on the joist, or allowing any construction loads on the joists.

(2) Falling object protection.

(a) Securing loose items aloft. Secure all materials, equipment, and tools that are not in use while aloft against accidental displacement.

(b) Provide protection from falling objects other than materials being hoisted. The controlling contractor must not allow other construction processes below steel erection unless overhead protection for the employees below is provided.

(3) CDZ are not permitted.

28-9. Figures and Tables.

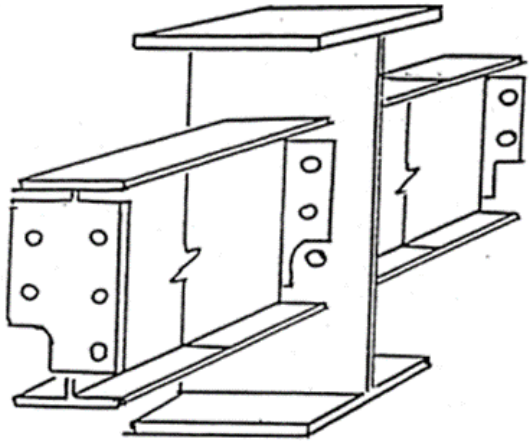


Figure 28-1. Clip End Connection

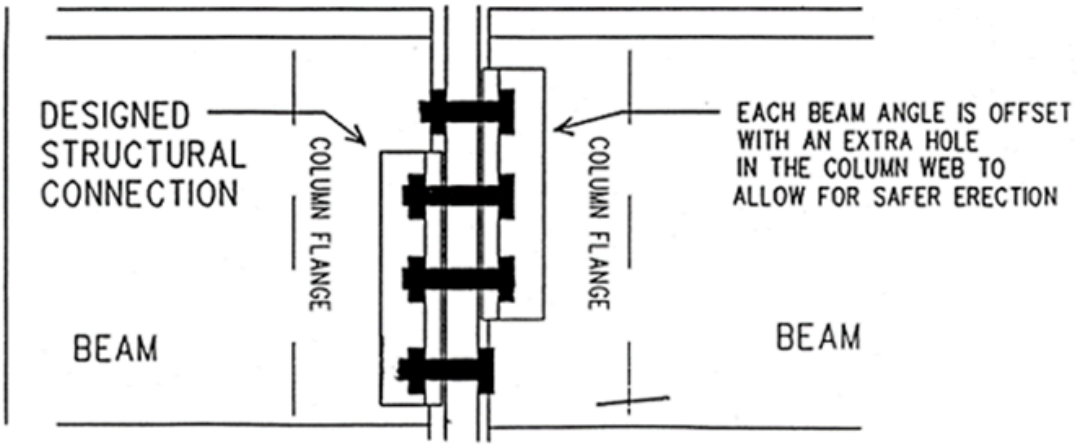


Figure 28-2. Staggered (High/Low Connection)

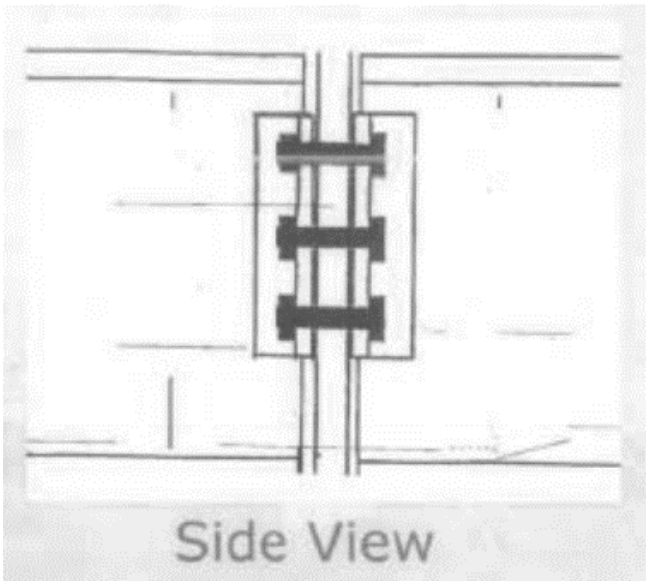


Figure 28-3. Controlling Risk for Double Connections in Steel Erection (Side View).

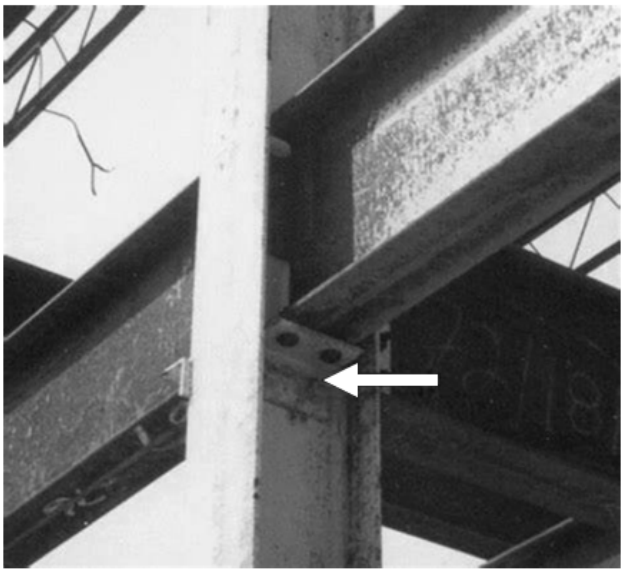


Figure 28-4. Double Connection with Seat to Support First Section While Second Section is Being Installed

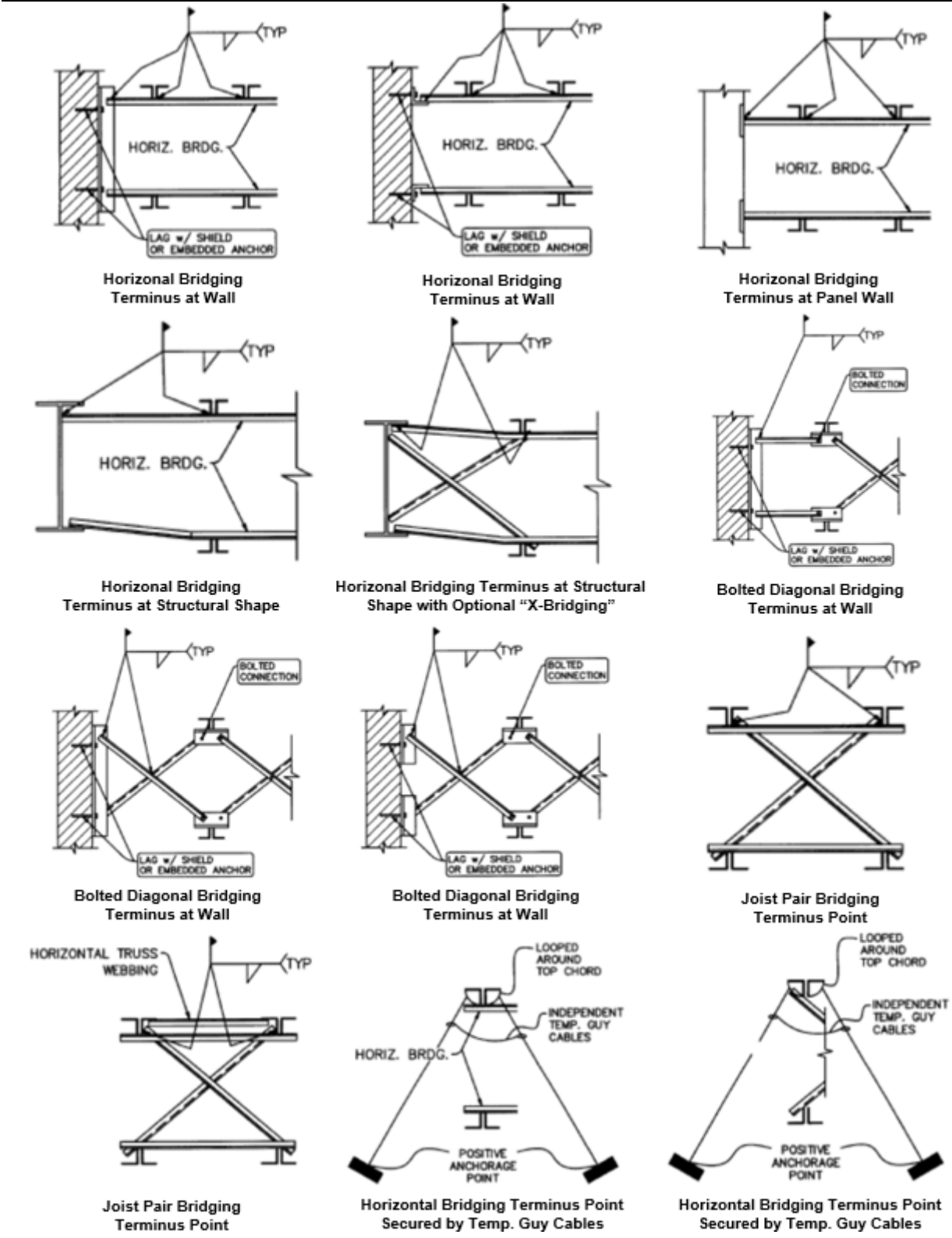


Figure 28-5. Illustrations of OSHA Bridging Terminus Points

Table 28-1
Erection Bridging for Short Span Joists

JOIST	SPAN	JOIST	SPAN	JOIST	SPAN	JOIST	SPAN
8K1	NM	16KCS3	NM	22K11	NM	26K7	43-0
10K1	NM	16KCS4	NM	22K4	34-0	26K8	44-0
10KCS1	NM	16KCS5	NM	22K5	28-0	26K9	44-0
10KCS2	NM	18K10	NM	22K6	36-0	26KCS2	39-0
10KCS3	NM	18K3	31-0	22K7	40-0	26KCS3	44-0
12K1	23-0	18K4	32-0	22K9	40-0	26KCS4	NM
12K3	NM	18K5	33-0	22KCS2	36-0	26KCS5	NM
12K5	NM	18K6	28-0	22KCS3	40-0	28K10	49-0
12KCS1	NM	18K7	NM	22KCS4	NM	28K12	53-0
12KCS2	NM	18K9	NM	22KCS5	NM	28K6	40-0
12KCS3	NM	18KCS2	28-0	24K10	NM	28K7	43-0
14K1	27-0	18KCS3	NM	24K12	NM	28K8	44-0
14K3	NM	18KCS4	NM	24K4	36-0	28K9	45-0
14K4	NM	18KCS5	NM	24K5	38-0	28KCS2	40-0
14K6	NM	20K10	NM	24K6	39-0	28KCS3	45-0
14KCS1	NM	20K3	32-0	24K7	43-0	28KCS4	53-0
14KCS2	NM	20K4	34-0	24K8	43-0	28KCS5	53-0
14KCS3	NM	20K5	34-0	24K9	44-0	30K10	50-0
16K2	29-0	20K6	36-0	24KCS2	39-0	30K11	52-0
16K3	30-0	20K7	39-0	24KCS3	44-0	30K12	54-0
16K4	32-0	20K9	39-0	24KCS4	NM	30K7	44-0
16K5	32-0	20KCS2	36-0	24KCS5	NM	30K8	45-0
16K6	NM	20KCS3	39-0	26K10	49-0	30K9	45-0
16K7	NM	20KCS4	NM	26K12	NM	30KCS3	45-0
16K9	NM	20KCS5	NM	26K5	38-0	30KCS4	54-0
16KCS2	NM	22K10	NM	26K6	39-0	30KCS5	54-0

NM = diagonal bolted bridging not mandatory.

Table 28–2
Erection Bridging for Long Span Joists

JOIST	SPAN	JOIST	SPAN
18LH02	33-0	28LH05	42-0
18LH03	NM	28LH06	46-0
18LH04	NM	28LH07	54-0
18LH05	NM	28LH08	54-0
18LH06	NM	28LH09	NM
18LH07	NM	28LH10	NM
18LH08	NM	28LH11	NM
18LH09	NM	28LH12	NM
20LH02	33-0	28LH13	NM
20LH03	38-0	32LH06	47-0 THROUGH 60-0
20LH04	NM	32LH07	47-0 THROUGH 60-0
20LH05	NM	32LH08	55-0 THROUGH 60-0
20LH06	NM	32LH09	NM THROUGH 60-0
20LH07	NM	32LH10	NM THROUGH 60-0
20LH08	NM	32LH11	NM THROUGH 60-0
20LH09	NM	32LH12	NM THROUGH 60-0
20LH10	NM	32LH13	NM THROUGH 60-0
24LH03	28-0	32LH14	NM THROUGH 60-0
24LH04	39-0	32LH15	NM THROUGH 60-0
24LH05	40-0	36LH07	47-0 THROUGH 60-0
24LH06	45-0	36LH08	47-0 THROUGH 60-0
24LH07	NM	36LH09	57-0 THROUGH 60-0
24LH08	NM	36LH10	NM THROUGH 60-0
24LH09	NM	36LH11	NM THROUGH 60-0
24LH10	NM	36LH12	NM THROUGH 60-0
24LH11	NM	36LH13	NM THROUGH 60-0
		36LH14	NM THROUGH 60-0
		36LH15	NM THROUGH 60-0

NM = Diagonal bolted bridging not mandatory for joists.