Steel Erection

- §1926 Subpart R
Objectives

In this course, we will discuss the following:

- Conception of the Steel Erection Rule
- Scope of the standard
- The key provisions of 1926 Subpart R
- A review of each of the key provisions
- Safe working practices
Subpart R - Final Rule

- Steel Erection Rule was published on January 18, 2001
- OPN 121
Sets forth requirements to protect employees from the hazards associated with steel erection activities involved in:

- Construction, alteration, and/or repair of:
  - Single and multi-story buildings
  - Bridges
  - Other structures where steel erection occurs
Scope

- Does **not** include:
  - Electrical transmission towers
  - Communication and broadcast towers
  - Tanks
Scope

- Covers all employers engaged in steel erection activities

- Contains two lists of activities:
  - **Primary list**
    » All are covered (connecting, bracing, guying…)
  - **Ancillary list**
    » Covered only “when they occur during and are a part of steel erection activities” (sealing, caulking, etc…)
Steel erection activities include:

- Hoisting, laying out, placing, connecting, welding, burning, guying, bracing, bolting, plumbing and rigging structural steel, steel joists, bridge steel girders and metal buildings; installing metal decking and moving point-to-point while performing these activities.
Scope

Employer has the burden of establishing and determining when to implement employee fall protection measures.
Steel Erection Decision Tree

Is the activity at the jobsite listed in 1926.750(b)(1)?

Yes

Then this activity IS covered by Subpart R

No

IS the activity listed in .750(b)(2)?

Yes

Then you must determine if this is going on in conjunction with (during and a part of) steel erection activities in (b)(1). A question to ask: Does this (b)(2) activity have to be done for steel erection to continue: If yes, and if done during (b)(1) activities, then it is covered by the standard.

No

Because it is listed in neither (b)(1) nor (b)(2), it is not covered by the standard.
Key Provisions of 1926 Subpart R

- Site layout, site-specific erection plan and construction sequence
- Hoisting and rigging
- Structural steel stability requirements
  - Structural steel assembly
  - Column anchorage
  - Beams and columns
  - Open web steel joists
Key Provisions of 1926 Subpart R

- Systems-engineered metal buildings
- Falling object protection
- Fall protection
- Worker training
Controlling contractor ensures the steel erector is provided with written notification.

- Concrete being used has reached sufficient strength to support the intended load
- Repair, replacements and modification of steel bolts were conducted in accordance with §1926.755(b)

Steel erection contractor shall not proceed without ensuring that concrete has reached sufficient strength to support intended load.
Site Layout, Site-Specific Erection Plan and Construction Sequence

- Site layout
  - Adequate access roads
    » Safe delivery of supplies
    » Movement of equipment
  - Firm, properly graded, and drained area
    » Allows for work with adequate space
    » Allows for safe operation of equipment

1926.752(c)
Site Layout, Site-Specific Erection Plan and Construction Sequence

- Site-specific erection plan
  - See 1926 Subpart R, Appendix A
    » Provides guidelines for a non-mandatory site specific erection plan
Hoisting and Rigging

- Provides additional crane safety for steel erection by requiring a pre-shift crane inspection

- Minimizes employee exposure to overhead loads through pre-planning and work practice requirements
Hoisting and Rigging

- Provides multiple lift rigging procedures (Christmas-treeing)
Structural Steel Assembly

- Structural stability
- Walking/working surface
- Plumbing up
- Metal decking
Structural Stability

- Shall be maintained at all times during construction
Structural Stability

1926.754(b)

- Multi-story structures
  - Permanent floors installed as erection progresses
    - Eight stories maximum between erection floor and upper-most permanent floor
  - Four floors maximum (or 48 feet) of unfinished bolting or welding above foundation or uppermost permanently secured floor
  - Fully planked floor or nets maintained within two stories (or 30 feet) directly under erection work
Shear connectors and other similar devices

- Field-installed rather than shop installed
- Installed after the metal decking
- Not attached until after walking/working surface has been installed
Walking/Working Surfaces 13 NCAC 07F .0205(c)(1)

● Tripping hazards
  – Employees protected from falls due to tripping hazards
    » Employees protected from falling hazards greater than 6 feet by suitable fall protection systems
    » Shear connectors not welded or applied until working/walking surface is installed
    » Shear connectors covered by temporary decking, metal, or wood box until walking/working surface is installed
Plumbing-Up Equipment

- Installed in conjunction with steel erection process to ensure stability of structure
- In place and properly installed before structure is loaded with construction material
- Be removed only with approval of competent person
Metal Decking

- Bundle packaging and strapping cannot be used for hoisting
- Any loose items placed on top of metal decking bundles must be secured
- Support provided so bundles will not be dislodged when bands are removed
- Metal decking secured at end of shift
Metal Decking

- Structural member turned down to allow continuous deck installation
- Roof and floor holes and openings shall be decked over
- Holes and openings shall not be cut prior to its intended use
Metal Decking

- Covers for roof and floor openings should support twice the weight of their intended load.

- Covers shall be marked with the word “HOLE” or “COVER”.

1926.754(e)(3)
Metal Decking

- Installation of metal decking
  - Laid tightly and immediately secured to prevent accidental movement or displacement
  - Metal decking panels placed to ensure full support by structural members
Column Anchorage

- Minimum 4 anchor bolts per column

- Set on level finished floor, pre-grouted leveling plates, leveling nuts, or **shim packs**

- Competent person determines whether guying or bracing is needed
Column Anchorage

- Written notification of proper curing of concrete in footings, piers, walls for steel columns

- Written notification of adequacy of anchor bolts modified, replaced or repaired in the field

1926.752(b) and 1926.755(b)
Beams and Columns

- Placing and bolting solid web structural members
- Diagonal bracing
- Double connections and seats
- Column splices
- Perimeter columns
Two bolts per connection installed before releasing the hoisting line

- Competent person shall determine if more are needed to ensure the stability of cantilevered members
Diagonal Bracing

- Solid web structural members used as diagonal bracing secured by at least one bolt drawn up wrench tight

1926.756(b)
Double Connections

When connecting two structural members, at least one bolt shall remain connected to the first member.

- Unless a seat is supplied to prevent the column from being displaced
Seat Design

- Seats designed to support the load during the double connection process

[Image of seats and connections]
Perimeter columns must extend a minimum of 48 inches (1.2 m) above the finished floor to permit installation of perimeter safety cables prior to erection of next tier.
Perimeter Columns

- Perimeter columns must have holes in/attached to perimeter columns at 42-45 inches above finished floor and midpoint between finished floor and top cable

1926.756(e)(2)
Open Web Steel Joists

- Attachment of steel joists and joist girders
- Erection of steel joists
- Erection bridging
- Landing and placing loads
Open Web Steel Joists

- Steel joist shall be field-bolted at column to provide lateral stability during erection

- Where constructability does not allow it, an alternate means shall be installed
  - Designed by qualified person
  - Shop installed
  - Included in erection drawings
Field-Bolted Joists

- Connections of individual steel joists to steel structures in bays of 40 feet or more shall be fabricated to allow field bolting during erection.

- Steel joists and girders shall not be used as anchorage points for fall arrest systems.
Attachment of Steel Joists and Girders

- Attachment of “K”, “LH”, and “DLH” series steel joists and girders

- Each steel joist must be attached to support structure
  - Immediately upon placement in the final erection position, and
  - Before additional joists are placed

- Pre-assembled panels attached with bridging to structure at each corner before hoisting cables are released
Erection of Steel Joists

1926.757(c)(1)-(3)

- Attach both sides of the seat of one end of each steel joist to the support structure before hoisting cables are released.

- For joists over 60 feet:
  - Both ends of the joist must be attached, and
  - Meet provisions of paragraph (d) before releasing hoisting cables.

- Only one employee is allowed on steel joists that do not require erection bridging under Tables A and B until all bridging is installed and anchored.
Erection of Steel Joists

- Employees not allowed on steel joists where span of joist is equal to or greater than span shown in Tables A and B

- When permanent bridging terminus points cannot be used during erection, temporary bridging required

1926.757(c)(4)-(5)
Erection Bridging

Specific procedures related to span of steel joists
- Bolted diagonal bridging and installation
- Releasing of hoisting cables
- Number of employees allowed on these spans during bridging
Landing and Placing Loads

- Loads not to exceed carrying capacity of steel joists
- Attention paid to weight and placement of load within the structure
- No bundle of decking placed on joists until bridging is installed
Systems-Engineered Buildings
Systems-Engineered Metal Buildings

- Structural columns anchored by a minimum of four anchor bolts
- Rigid frames
  - Shall have 50% of their bolts or number specified by manufacturer installed before releasing hoisting equipment

1926.758(a)-(c)
Systems-Engineered Metal Buildings 1926.758(d)-(e)

- Construction loads not placed on structural steel framework unless secured

- When girts or eave struts share common connection holes:
  - At least one bolt must remain connected to the first member
  - Field-attached seat supplied by the manufacturer may be used in lieu of the bolt
Systems-Engineered Metal Buildings 1926.758(f)-(g)

- Both ends of steel or cold-formed joists fully bolted or welded before:
  - Releasing cables
  - Allowing employees on the joists
  - Allowing construction loads on the joists

- Purlins and girts not used as anchorage points for a fall arrest system
Systems-Engineered Metal Buildings

- Purlins may be used as a walking/working surface when installing safety systems
  - After installation of permanent bridging, and
  - Fall protection provided

- Construction loads placed within a zone that is within 8 feet of the center-line of the primary support member

1926.758(h)-(i)
Falling Object Protection

- Secure loose items aloft
- Protection from falling objects other than materials being hoisted
Fall Protection

- Fall protection requirements
- Connectors
- Controlled decking zone (CDZ)
- Criteria for fall protection equipment
- Custody of fall protection
Fall Protection

- Employees must be protected by conventional fall protection
  - When on walking/working surface with unprotected edge more than 15 feet above lower level

- Perimeter cables required
  - Must be installed “as soon as the metal decking has been installed”

- Connectors and employees working in CDZ shall be protected from fall hazards
Connectors

- Connectors between 15 and 30 feet/2 stories
  - Provided all equipment necessary to be tied off or provided other fall protection
  - Completed connector training
  - Not required to tie off
Controlled Decking Zone

- Deckers between 15 and 30 feet/2 stories can use a CDZ instead of fall protection

- Be no more than 90 feet wide and 90 feet deep from leading edge

- Limited access to CDZ

- Boundaries designated and clearly marked

- Employees must complete CDZ training
Fall Protection Equipment

- Fall protection equipment must conform to 1926.502
- Fall arrest system components shall be used in fall restraint systems
- Body belts or body harnesses shall be used in fall restraint systems
- Perimeter safety cables shall meet criteria for guardrail systems
Custody of Fall Protection

Steel erector may leave fall protection in place so it may be used by other trades if the controlling contractor:

- Has directed the steel erector to leave the fall protection in place, **and**
- Has inspected and accepted control and responsibility of the fall protection before authorizing other trades to work in the area
Training

- Training provided by a qualified person

1926.761(a)
Fall Hazard Training

Training shall include the following:

- Recognition and identification of fall hazards
- Use and operation of guardrail systems
- Correct procedures for erecting, maintaining, disassembling, and inspecting fall protection systems
- Procedures to prevent falls
- Fall protection requirements

1926.761(b)
Special Training

- Multiple lift rigging
  - Hazards associated with multiple lifts
  - Procedures and equipment to perform multiple lifts
Special Training

- Connector procedures
  - Hazards associated with connecting
  - Establishment, access, proper connecting techniques and work practices
Special Training

- Controlled decking zone procedures
  - Hazards associated with work within a controlled decking zone
  - Establishment, access, proper connecting techniques and work practices
Summary

In this course, we discussed the following:

- Conception of the Steel Erection Rule
- Scope of the standard
- The key provisions of 1926 Subpart R
- A review of each of the key provisions
- Safe working practices
Thank You For Attending!

Final Questions?
Handouts

Place all handouts at the end of this presentation.