



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



Scope

1926.750(a)

- 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

1926.750(a)

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



Scope

1926.750(b)

- 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...)





Scope

13 NCAC 07F .0205(b)(1)

- 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.





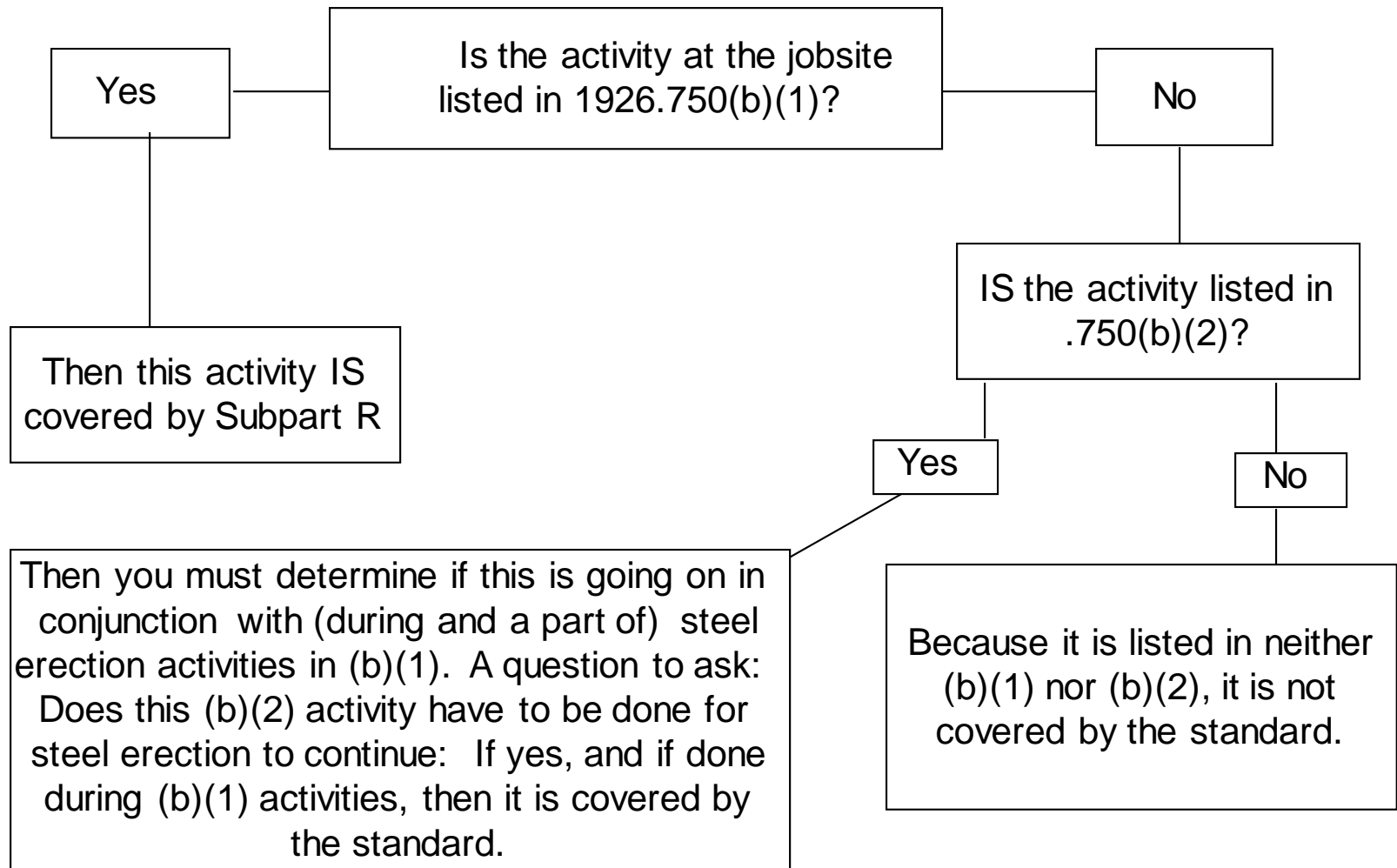
Scope

13 NCAC 07F .0205(b)(2)

- Employer has the burden of establishing and determining when to implement employee fall protection measures.



Steel Erection Decision Tree



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



Site Layout, Site-Specific Erection Plan and Construction Sequence

1926.752(a)-(b)

- 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

1926.752(c)

- 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



Site Layout, Site-Specific Erection Plan and Construction Sequence

1926.752(e)

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



Hoisting and Rigging

1926.753(c)-(d)

- 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

1926.753(e)

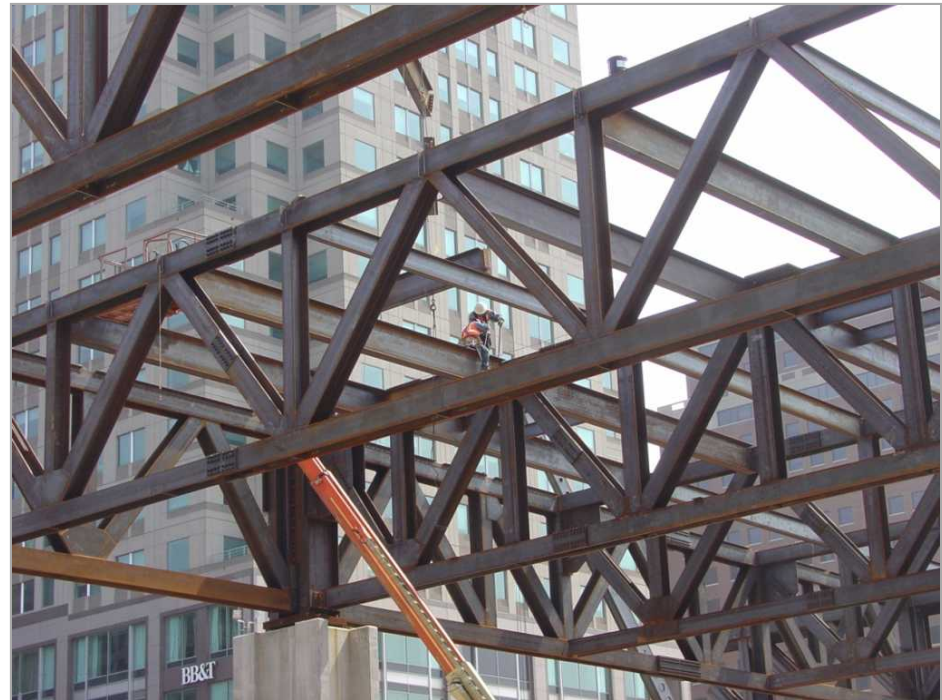
- Provides multiple lift rigging procedures (Christmas-treeing)



Structural Steel Assembly

1926.754

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



Structural Stability

1926.754(a)

- 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



Walking/Working Surfaces

1926.754(c)

- 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



Shear Connectors



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

1926.754(d)

- 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

1926.754(e)(1)

- 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

1926.754(e)(2)

- 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

1926.754(e)(3)

- 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**”



Metal Decking

1926.754(e)(5)

- 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

1926.755(a)

- 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

1926.752(b) and 1926.755(b)

- 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



Beams and Columns

1926.756

- Placing and bolting solid web structural members
- Diagonal bracing
- Double connections and seats
- Column splices
- Perimeter columns



Beams and Columns

1926.756(a)

- 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

1926.756(b)

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



Double Connections

1926.756(c)(1)

- 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

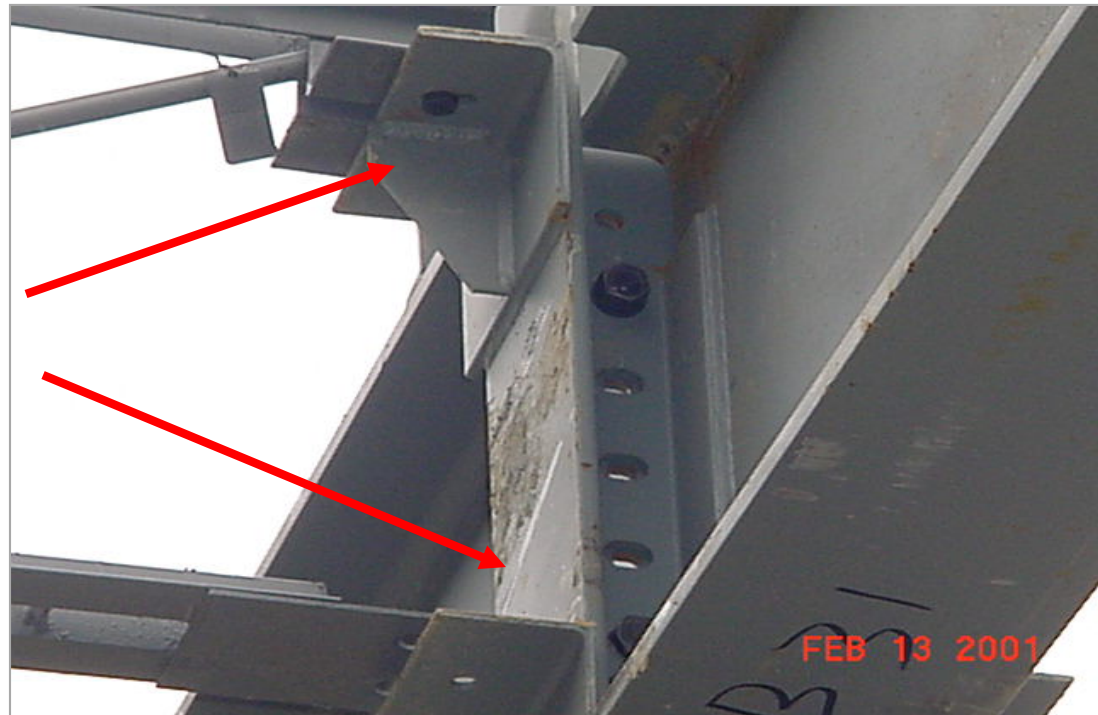


Seat Design

1926.756(c)(2)

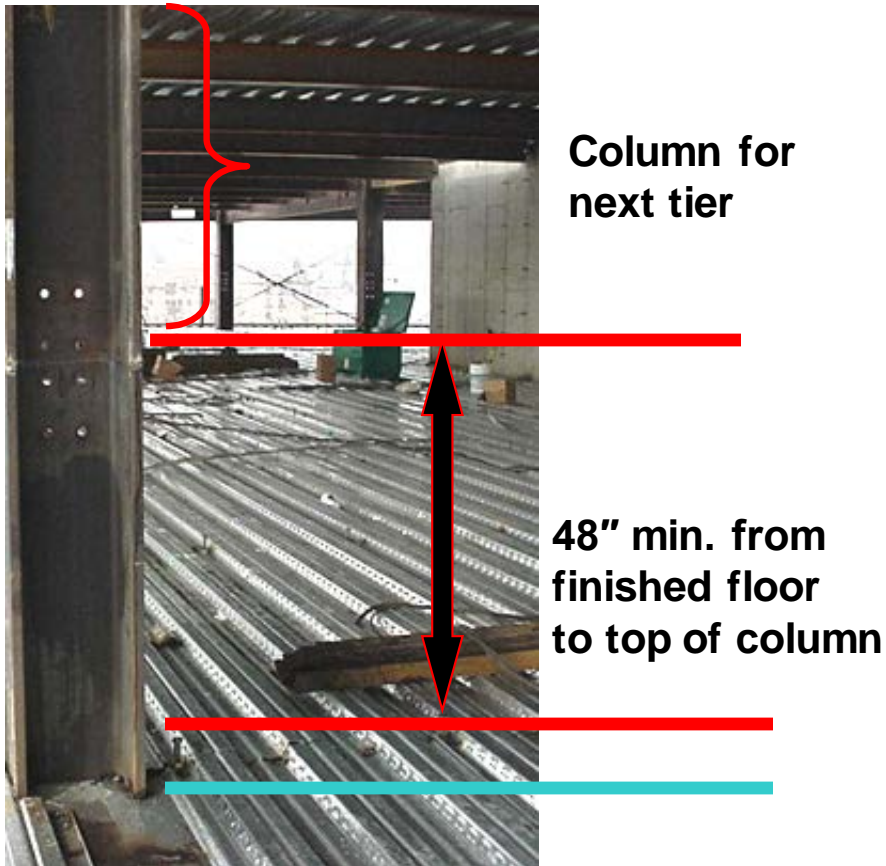
- Seats designed to support the load during the double connection process

Seats



Perimeter Columns

1926.756(e)(1)



- 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

1926.756(e)(2)

- 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





Open Web Steel Joists

1926.757

- Attachment of steel joists and joist girders
- Erection of steel joists
- Erection bridging
- Landing and placing loads



Open Web Steel Joists

1926.757(a)

- 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

1926.757(a)

- 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 1926.757(b)

- 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

1926.757(c)(4)-(5)

- 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



Erection Bridging

1926.757(d)

- 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

1926.757(e)

- 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

1926.758(a)-(c)

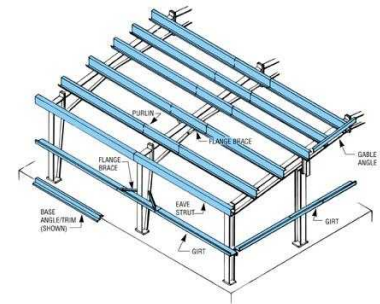
- Structural columns anchored by a minimum of four anchor bolts
- Rigid frames
 - Shall have 50% of their bolts or number specified by manufacturer installed before releasing hoisting equipment



Systems-Engineered Metal Buildings

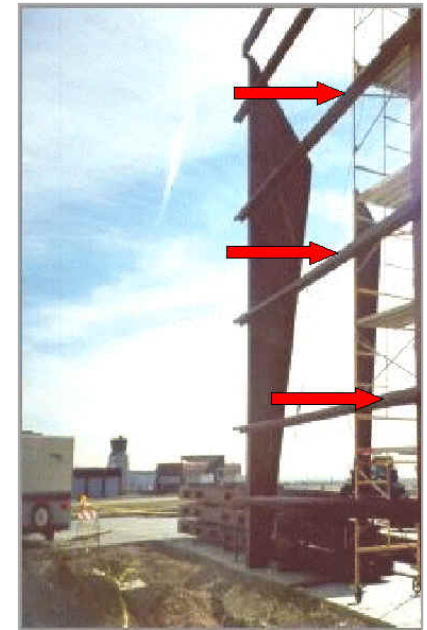
1926.758(d)-(e)

- 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



Girts

Systems-Engineered Metal Buildings 1926.758(h)-(i)

- 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



Falling Object Protection

1926.759(a)-(b)

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



Fall Protection

1926.760

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



Fall Protection

1926.760(a)

- 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

1926.760(b)

- 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

1926.760(c)

- 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

1926.760(d)

- 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

1926.760(e)

- 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

1926.761(a)

- Training provided by a qualified person



Fall Hazard Training

1926.761(b)

- 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



Special Training

1926.761(c)(1)

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



Special Training

1926.761(c)(2)

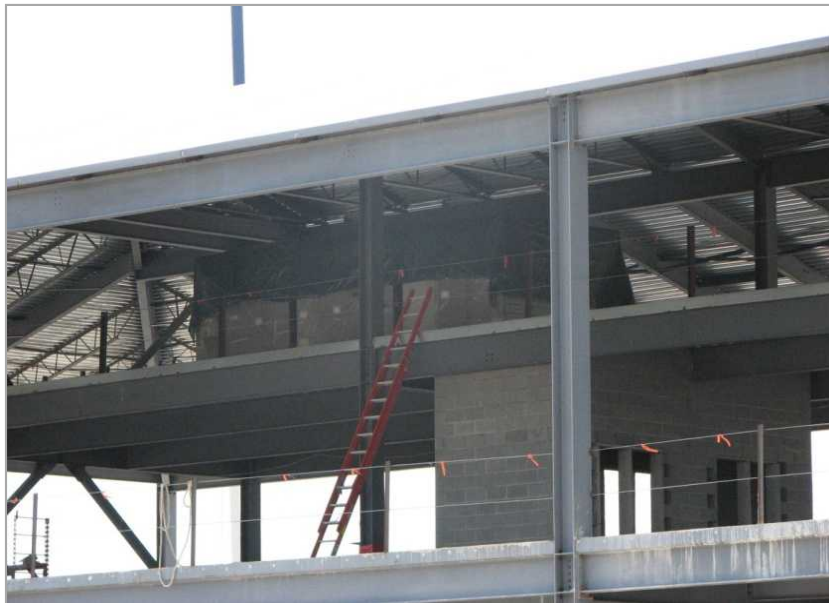
- Connector procedures
 - Hazards associated with connecting
 - Establishment, access, proper connecting techniques and work practices



Special Training

1926.761(c)(3)

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

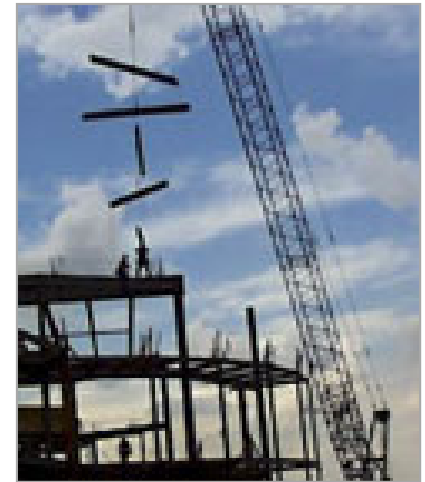




Summary

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.
