Course Overview

• Steel Erection

• Course Description
  • Key Terms, fall protection, controlled decking zones, starting steel erection, hoisting and rigging, crane safety, structural steel assembly, training and other considerations.
  • Estimated Length: 60 minutes.
  • Audience: Workers, Foremen, Supervisors, Managers, Safety Personnel
Course Overview

• Course Objective
  – Upon completion, the student will be able to recognize Steel Erection hazards in construction.
  – Specifically, the student will be able to:
    – 1: Identify major hazards associated with steel erection hazards
    – 2: Describe types of steel erection hazards
    – 3: Protect themselves from steel erection hazards
    – 4: Recognize employer requirements to protect workers from exposure to steel erection hazards
Course Overview

• References

• Fed-OSHA Standard
  – 29 CFR 1926 Subpart “R”
  – Revised standard developed by the Steel Erection Negotiated Rulemaking Advisory Committee, or SENRAC.

Safety Tip: The Steel Erection Negotiated Rulemaking Advisory Committee (SENRAC) was established by OSHA in 1994 in accordance with the Federal Advisory Committee Act (FACA) to make a recommendation to OSHA on the contents of a Notice of Proposed Rulemaking.
Course Overview

• Get Site-Specific Training
  – This training course:
    • Provides basic occupational safety and health information.
    • Is not a substitute for specific, hands-on training and information.
Introduction

- Hazards
  - Hazards identified by SENRAC: [sub]
    - Working under loads
    - Hoisting
    - Landing/placing decking
    - Column stability
    - Double connections
    - Landing/Placing steel joints
    - Falls to lower levels

Safety Tip: Appointees to the SENRAC Committee included representatives from labor, industry, public interests and government agencies. OSHA was a member of the committee, representing the Agency's interests.
Introduction

• Statistics

• Falls are leading cause of death in the construction industry:
  – 442 construction worker fatalities in one year.
  – Many of these fatalities occur during steel erection activities and many more suffer lost workday injuries.

Safety Tip: Despite being covered since 1971 under the original steel erection standard, America's 56,000 steel erectors continue to suffer 35 fatal accidents per year, a rate of one death per 1,600 workers.
Introduction

• OSHA Citations: Fall Related

• In one year OSHA issued:
  – 4,164 citations for fall protection during 3,197 inspections.
  – Proposed construction fines total = $11,662,000.
Definitions

Definition of terms used in steel erection

- **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.

- **Connector**
  - A connector is an employee who, working with hoisting equipment, is placing and connecting structural members and/or components.

- **Competent Person**
  - OSHA defines a Competent Person as one who is capable of identifying existing and predictable hazards in the work area, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

- **Qualified Person**
  - A Qualified Person by OSHA’s definition is a person who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter, the work, or the project.

- **Controlling Contractor**
  - The Controlling contractor is the prime contractor, general contractor, construction manager, or any other legal entity having the overall responsibility for the construction of the project: its planning, quality, and completion.
Definitions

• Definitions

• Controlled Decking Zone (CDZ)
  – Means an area in which certain work may take place without the use of guardrail systems, personal fall arrest systems, fall restraint systems, or safety net systems, but where access to the zone is controlled.

• Leading edge
  – A floor, roof, or form-work which changes location as additional floor, roof, decking, or form-work sections are constructed.

• Unprotected side or edge
  – A walking/working surface where there is no wall or guardrail system at least 39 inches high. An exception: entrances to points of access.

• Personal Fall Arrest System
  – consists of Anchorage point rated at 5000 lbs., or designed with a safety factor of at least 2.
  – A harness
  – A lanyard

• Fall Arrest Components
  – D-rings and snaphooks: 5000# tensile strength, proof tested to 3600#
  – Locking-type latches or Double action snaphooks required.
  – Body belts NOT permitted for fall arrest.
  – No free fall of more than 6 feet. [4 feet in California]
Definitions

• Definitions
• Fall Restraint System
  – A fall protection system that prevents the user from falling. Comprised of either a body belt or body harness, along with anchorage point, connector.
  – Other components: lanyard, lifeline, other devices.
• Positioning Device
  – A body belt or harness system rigged to allow a worker to be supported on an elevated vertical surface (wall or column) with both hands free. Positioning device system must limit the fall distance to no more than 2 feet.
• Guardrail Systems
  – Top rail height 42 in. (+/- 3 in.) and withstand 200 lbs. force in any direction. Midrails installed at 21 inches, must withstand 150 lbs. force and not deflect more than 3 inches. Guardrail systems also consist of vertical stanchions or posts. There are non-mandatory guidelines in the fall protection standard (Appendix B) to assist in meeting the requirements.
  – Wooden post are to be 2 by 4 in. Wire rope must be 1/4 inches in diameter and the top rope flagged every 6 feet.

• Multiple Lift Rigging or “Christmas Treeing”
  – A rigging assembly manufactured by wire rope rigging suppliers. Facilitates attachment of up to five independent loads to crane hoist rigging.
Definitions

• Decking Hole/Derrick Floor
  – A gap or void more than 2 inches in least dimension and less than 12 inches in greatest dimension in a floor, roof, or other walking/working surface.
  – Derrick floor: Elevated floor designated to receive hoisted pieces of steel prior to final placement.

• Metal Decking
  – Metal decking is a commercially manufactured, structural grade, cold rolled metal panel formed into a series of parallel ribs, to include:
    – Metal floor, roof decks.
    – After installation/fastening these materials:
      – Help the structure resist, distribute, transfer loads.
      – Stiffen structure and provide diaphragm action.
      – Provide walking/working surface and a form for concrete slabs.
      – Support roofing systems & finish floor/roof.
      – Standing seam metal roofs, gratings, checker plate, expanded metal panel.

• Safety Deck Attachment & Permanent Floor
  – The initial attachment to secure an initially placed sheet of decking to keep proper alignment and bearing with structural support members.
  – Permanent floors are a structurally completed floor at any level or elevation.

• Systems-engineered Metal Building
  – A metal, field-assembled building system:
    – Consists of framing, roof, and wall coverings.
    – Individual parts fabricated and shipped to the job site for assembly. Engineering design responsibility of the metal building manufacturer.
Starting Steel Erection

• Starting Steel Erection
  – Before authorizing steel erection to begin:
    • Controlling contractor must provide steel erector with written notification, which must identify:
      – repairs, replacements, modifications which may have occurred to anchor bolts

Safety Tip: The steel erection standard in Subpart R does not apply to:
Electrical transmission towers
Communication and broadcast towers
Tanks
Starting Steel Erection

• Notification
  – The written notification must document that:
    • Concrete in footing, piers, walls, and mortar in masonry piers has:
      – Either 75% of intended minimum compressive design strength, or
      – Sufficient strength to support loads

Safety Tip: Concrete certification is to be based on appropriate ASTM standard test method of field-cured samples.
Starting Steel Erection

• Site Layout
• Controlling contractor must provide safe site layout:
  – Routes for hoisting loads
  – Means of pedestrian/vehicular control
  – Exception: does not apply to roads outside site

Safety Tip: Exception: this requirement does not apply to roads outside of the construction site.
Starting Steel Erection

• Site Layout
• Controlling contractor must ensure:
  – firm, 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.
  – all hoisting operations to be pre-planned to ensure loads not hoisted over workers
Site-Specific Erection Plan

- Site-Specific Erection Plan
- Controlling contractor to pre-plan steel erection process.
  - A site-specific plan may develop alternate means for employee protection.
  - Plan to be developed by a qualified person and be available at the work site.
  - Affected personnel must be trained on this plan.
Site-Specific Erection Plan

• Developing a Site-Specific Plan
• Contractors to hold:
  – Pre-construction meeting and site inspection(s).
  – Purpose of such meetings is to develop and review the site-specific erection plan.
Site-Specific Erection Plan

• Components of Site Specific Plan
• Key components include:
  – Sequence of erection activity.
  – Description of steel erection activities and procedures.
Site-Specific Erection Plan

- Components of Site-Specific Plan
- Description of activities/procedures includes:
  - Material deliveries
  - Staging and storage
  - Coordination with other trades
  - Stability considerations requiring temporary bracing and guyng
  - Erection bridging terminus point
  - Anchor bolt notifications regarding repair, replacement and modifications
Site-Specific Erection Plan

- Components of a Site-Specific Plan
- The plan must also include:
  - Inventory and layout of columns, beams, joists, purlins, connections, decking and any ornamental and miscellaneous iron should be included in the site-specific erection plan.
- Description of the fall protection procedures.
- Name(s) of the competent and qualified persons.
- Certification of the required of training.

Safety Tip: The plan must also include a description of the procedures that will be utilized in the event of rescue or emergency response, as well as identifying the site and project. The plan should be signed and dated by the qualified person(s) responsible for its preparation and modification.
Site-specific Erection Plan

- Crane and derrick selection/placement
- Consider:
  - size
  - capacity
  - boom length
  - site conditions
  - and set up area

Safety Tip: All hoisting operations in steel erection shall be pre-planned to minimize employee exposure to overhead loads.
Site-specific Erection Plan

- Crane and derrick selection/placement
  - Also consider:
  - Overhead and underground utilities?
  - Excavations?
  - Rigging requirements?
  - Weather conditions?
  - Qualifications and experience of operator and erection crew?
  - Path for overhead loads/critical lifts?

Safety Tip: A pre-shift visual inspection of cranes by a competent person is required.
Hoisting and Rigging / Crane Safety

• Hoisting and Rigging Safety

• What safety related issues must be considered prior to mobilizing a crane or derrick?
  – Size
  – Capacity
  – Boom length
  – Site conditions
  – Set-up area
Hoisting and Rigging / Crane Safety

• Crane Inspection

• Inspections must include:
  – All control mechanisms for maladjustments
  – Control and drive mechanism
  – Safety devices
    • boom angle indicators
    • boom stops
    • boom kick out devices
    • anti-two block devices and load moment indicators
Hoisting and Rigging / Crane Safety

• Crane Inspection

• Inspection must also include:
  – Air, hydraulic, and other pressurized line
  – Hooks and latches.
  – Wire rope properly reeved
Hoisting and Rigging / Crane Safety

• Inspection

• Other inspection requirements:
  – Electrical apparatus.
  – Hydraulic system for proper fluid level
  – Tires for proper inflation and condition
  – Ground conditions and stability
  – The hoisting equipment for level position, initial set up and after each move
Hoisting and Rigging / Crane Safety

- Identified Deficiency
- Identified Deficiency requires:
  - Immediate determination by the competent person.
- Damaged equipment will be removed from service
- If there is any doubt as to safety, the operator shall have the authority to stop and refuse to handle load
Hoisting and Rigging / Crane Safety

• Rigging
  – Rigging must be: Inspected by a qualified rigger prior to each shift
    • Headache ball, hook, or load shall not be used to transport personnel except on an approved personnel platform
Hoisting and Rigging / Crane Safety

• Rigging

• Safety latches on hooks:
  – must be in good working condition
  – should not be deactivated or made inoperable
    • unless otherwise determined by a qualified rigger or addressed in the site-specific erection plan
• Rigging

• Routes for suspended loads:
  – Will be pre-planned to ensure that no employee is required to work directly below a suspended load.
  – Exceptions: initial connection of steel and hooking or unhooking of the load
• Working Under Suspended Load
  – For Work under suspended loads:
    • Materials rigged to prevent unintentional displacement
    • Hooks with self-closing safety latches
    • All loads shall be rigged by a qualified rigger
Multiple Lift Rigging

- Guidelines:
  - A lift must never exceed a maximum of five members per lift
  - Only beams and similar structural members to be lifted
  - Only trained personnel
  - No crane permitted for multiple lift contrary to the manufacturer's specifications

Christmas Treeing: A multiple lift [christmas treeing] must follow certain criteria to ensure the safety of the lift and personnel receiving the load. Only a manufactured multiple lift rigging assembly is approved for use with a multi lift.
Hoisting and Rigging / Crane Safety

– Multiple Lift Rigging

– Rigging Components:
  • Be specifically designed and assembled with a maximum capacity certified by the manufacturer or a qualified rigger
  • Have a 5 to 1 safety factor for all components
  • Total load shall not exceed the rated capacity of the hoisting equipment or rigging
Hoisting and Rigging / Crane Safety

• Multiple Lift Rigging
  – Rigging assembly must be rigged with members attached at their center of gravity and maintained reasonably level.
  – Rigged from top down and at least 7 feet apart.
  – Members on multiple lift rigging assembly set from bottom up.
  – Controlled load lowering whenever load is over connectors.
• Steel Assembly
  – Structural Stability:
    • Must be maintained at all times.
    • Permanent floors shall be installed as the erection of structural members progresses.
Structural Steel Assembly

- Steel Assembly
  - Restrictions:
    - Not more than eight stories between the erection floor and the upper-most permanent floor
    - No more than four floors or 48 feet, whichever is less, of unfinished bolting or welding above the foundation or uppermost permanently secured floor
Structural Steel Assembly

- Walking/Working Surfaces
  - Shear Connectors and other similar devices:
    - Can create tripping hazards.
    - They should not be attached to the top flanges of beams, joists or beams.
Structural Steel Assembly

• Walking/Working Surfaces
  – Shear connectors:
    • On composite floors roofs, and bridge decks will be installed after metal decking is in place.
    • Installation from within a controlled decking zone (CDZ) is prohibited.
• Walking/Working Surfaces
  – Slip Resistance of Skeletal Structural Steel:
    • Must have average slip resistance of .5 measured by English XL tribometer or equivalent.
    • Certification shall be based on the appropriate ASTM standard test method conducted by a laboratory capable of performing the test.
    • Certification at jobsite and with steel erector.

Safety Tip: According to Wikipedia, a tribometer is an instrument that measures tribological quantities, such as coefficient of friction, friction force, and wear volume, between two surfaces in contact. It was invented by the 18th century Dutch scientist Musschenbroek.
Structural Steel Assembly

• Plumbing-Up
  – Plumbing-up equipment is needed to ensure the stability of the structure:
    • In place and properly installed before the structure is loaded
    • Removed only with the approval of a competent person
Structural Steel Assembly

- Metal Decking
- Bundle packaging/strapping should not be used for hoisting:
  - Unless specifically designed for that purpose.
  - Loose materials must be secured to the bundles.
• Metal Decking
  – Employer shall ensure:
    • A load on steel joists must be properly distributed.
    • Weight of a bundle of joist bridging shall not exceed a total of 1,000 pounds.
Structural Steel Assembly

- Metal Decking
- Decking Bundles:
  - Do not place on steel joists until all bridging installed, anchored and all joist bearing ends attached.
  - A qualified person must first determine and document in a site-specific erection plan that the structure or portion of the structure is capable of supporting the load.
• Metal Decking
  – Decking Bundles:
  – Placed on a minimum of three steel joists.
  – Joists supporting are attached at both ends.
  – At least one row of bridging is installed and anchored.
  – Total weight of the bundle of decking does not exceed 4,000 pounds.
  – Placement within 1 foot of the bearing surface of the joist end.
Structural Steel Assembly

- Metal Decking
- Roof and floor holes and openings:
  - Structural members turned down to allow continuous deck installation except where not allowed by structural design constraints or constructibility.
  - Roof, floor holes and openings shall be decked over. Where large size, configuration or other structural design does not allow openings to be decked over (such as elevator shafts, stair wells, etc.) employees shall be protected in accordance with fall protection provisions.
Structural Steel Assembly

• Metal Decking

• Metal decking holes and openings shall not be cut until immediately prior to being permanently filled with the equipment or structure needed or intended to fulfill its specific use.
Structural Steel Assembly

• Metal Decking

• Covers for Roof and Floor Openings:
  – Constructed to handle twice the weight of the employees, equipment and materials that may be imposed on the cover at any one time.
  – Secure to prevent accidental displacement by the wind, equipment or employees.
  – Paint with high-visibility paint or mark with the word "HOLE" or "COVER" to provide warning of the hazard.
Structural Steel Assembly

- Metal Decking
- Decking Gaps Around Columns:
  - Wire mesh, exterior plywood, or equivalent, shall be installed around columns where planks or metal decking do not fit tightly.
  - The materials used must be of sufficient strength to provide fall protection for personnel and prevent objects from falling through.
Structural Steel Assembly

- Metal Decking
- Installation of Metal Decking:
  - Except for controlled decking zones, metal decking shall be laid tightly and immediately secured upon placement to prevent accidental movement or displacement.
  - During initial placement, metal decking panels shall be placed to ensure full support by structural members.
Structural Steel Assembly

- Metal Decking
- Derrick Floors:
  - A derrick floor shall be fully decked and/or planked and the steel member connections completed to support the intended floor loading.
  - Temporary loads placed on a derrick floor shall be distributed over the underlying support members so as to prevent local overloading of the deck material.
Column Anchorage

- Column Anchorage
  - Requires:
    - 4 anchor bolts per column along with other column stability requirements.
    - Each column anchor bolt assembly, including the column-to-base plate weld and the column foundation, shall be designed to resist a minimum eccentric gravity load of 300 pounds located 18 inches from the extreme outer face of the column in each direction at the top of the column shaft.
Column Anchorage

- **Columns**
  - Requirements:
  - Columns shall be set on level finished floors, pre-grouted leveling plates, leveling nuts, or shim packs which are adequate to transfer the construction loads.
  - All columns shall be evaluated by a competent person to determine whether guying or bracing is needed; if guying or bracing is needed, it shall be installed.
Column Anchorage

• Anchor Bolts
  – Repair, Replacement or Field Modification:
  – Need approval of the project structural engineer of record.
  – Prior to the erection of a column, the controlling contractor shall provide written notification to the steel erector if there has been any repair, replacement or modification of the anchor bolts of that column.
Beams and Columns

• Solid Web Structural Members

• When Placing Solid Web Members:
  – Load shall not be released until the members are secured with at least two bolts per connection.
  – The only exception is diagonal bracing, at least one bolt per connection, wrench tight.
  – Competent person will evaluate for bolts to ensure stability
Beams and Columns

• Common Connection Holes
  – Sometimes two structural members on opposite sides of a column web, or a beam web over a column, are connected sharing common connection holes. In this case, at least one bolt with a wrench-tightened nut will remain connected to the first member. Or, a shop-attached or field-attached seat or equivalent connection device may be supplied with the member to secure the first member and prevent the column from being displaced.
Beams and Columns

• Column Splices
• Each column splice shall be designed to resist a minimum eccentric gravity load of 300 pounds located 18 inches from the extreme outer face of the column in each direction at the top of the column shaft.
Beams and Columns

• Perimeter Columns
  – Perimeter columns shall not be erected unless:
    • They extend at least 48” above finished floor to permit installation of perimeter safety cables prior to erection of next tier, except where constructibility doesn’t allow.
    • They have holes or other devices in or attached to perimeter columns at 42-45” above finished floor and midpoint between finished floor and top cable to permit installation of perimeter safety cables.
• Potential for Collapse

• To minimize potential for collapse of lightweight steel joists where steel joists are used/columns not framed in two directions a steel joist shall be field-bolted at the column to provide lateral stability.

• If constructibility doesn’t allow steel joist to be installed at column, alternate means of stabilizing joists to be installed on both sides near column.
• Vertical Stabilizer Plate

• Columns must be equipped with:
  – A vertical stabilizer plate minimum 6 inch by 6 inch extending at least 3 inches below the bottom chord of the joist with a 13/16 inch hole to provide attachment point.
  – The bottom chords of steel joists at columns shall be stabilized to prevent rotation during erection.
Alternate Means of Stabilizing Joists

Where constructibility does not allow a steel joist to be installed at the column an alternate means of stabilizing joists shall be installed on both sides near the column and shall:

- Provide stability.
- Be designed by a qualified person.
- Be shop installed.
- Be included in the erection drawings.
• Steel Joists at or Near Columns
  – Span 60 feet or less, the joist shall be designed with sufficient strength to allow one employee to release the hoisting cable without the need for erection bridging.
  – Span more than 60 feet the joists shall be set in tandem with all bridging installed unless an alternative method of erection, which provides equivalent stability to the steel joist, is designed by a qualified person and is included in the site-specific erection plan.
Open Web Steel Joists

- Support Structure
- A steel joist or steel joist girder shall not be placed on any support structure unless such structure is stabilized.
- When steel joist(s) are landed on a structure, they shall be secured to prevent unintentional displacement prior to installation.
- No modification that affects the strength of a steel joist or steel joist girder shall be made without the approval of the project structural engineer of record.
Open Web Steel Joists

• Field Bolted Joists
• Except for steel joists that have been pre-assembled into panels, connections of individual steel joists to steel structures in bays of 40 feet or more shall be fabricated to allow for field bolting during erection.
• Steel joists and steel joist girders shall not be used as anchorage points for a fall arrest system unless written approval to do so is obtained from a qualified person.
• A bridging terminus point shall be established before bridging is installed.
Open Web Steel Joists

- Attachments of Joists and Girders
- Each end of "K" series steel joists shall be attached to the support structure with a minimum of two \(1/8\)-inch fillet welds 1 inch long or with two \(1/2\)-inch bolts, or the equivalent.

- Each end of "LH" and "DLH" series steel joists and steel joist girders shall be attached to the support structure with a minimum of two \(1/4\)-inch fillet welds 2 inches long, or with two \(3/4\)-inch bolts, or the equivalent.
Open Web Steel Joists

- Attachments of Joists and Girders
- Each steel joist shall be attached to the support structure, at least at one end on both sides of the seat, immediately upon placement in the final erection position and before additional joists are placed.
- Panels that have been pre-assembled from steel joists with bridging shall be attached to the structure at each corner before the hoisting cables are released.
Erection of Steel Joists

Subpart R contains numerous references to Tables A and B. These tables refer to erection bridging requirements associated with short and long span joists, and can be found in 1926.757(c)(3) of subpart R.

The following web address may be helpful in locating the tables.

Open Web Steel Joists

- Erection of Steel Joists
  - Tables A and B:
  - Left column describes joist characteristics.
  - Right column describes joist span in feet.
Open Web Steel Joists

- Erection of Steel Joists
- Both sides of seat of one end of joist requiring bridging under Tables A/B attached to support structure before hoisting cables released.
- Joists over 60 feet, both ends attached with welds or bolts. In addition, before hoisting cables released, provisions for erection bridging must be met.
- Joists not requiring erection bridging, only one employee allowed on joist until bridging installed/anchored.

Safety Tip: Employees shall not be allowed on steel joists where the span of the steel joist is equal to or greater than the span shown in Tables A and B.
Open Web Steel Joists

- Erection of Steel Joists
- Using the tables
- If you have a 16K5 joist what do you know about it?
  - It is 16 inches deep
  - It is a type K series joist
  - It has a load capacity of 5
  - It has a span of 32 feet
• Erection Bridging
• If span of steel joist is equal to or greater than the span shown in Tables A and B, the following applies:
• A row of bolted diagonal erection bridging shall be installed near the mid-span of the steel joist.
• Hoisting cables shall not be released until this bolted diagonal erection bridging is installed and anchored.
• No more than one employee shall be allowed on these spans until all other bridging is installed and anchored.

Safety Tip: When permanent bridging terminus points cannot be used during erection, additional temporary bridging terminus points are required to provide stability.
Open Web Steel Joists

• Erection Bridging
• If span of steel joist is 60 – 100 feet, the following applies:
  • All rows of bridging shall be bolted diagonal bridging.
  • Two rows of bolted diagonal erection bridging shall be installed near the third points of the steel joist.
  • Hoisting cables shall not be released until this bolted diagonal erection bridging is installed and anchored.
  • No more than two employees shall be allowed on these spans until all other bridging is installed and anchored.
Open Web Steel Joists

• Erection Bridging
• If span of the steel joist is 100 – 144’ the following applies:
  • All rows of bridging to be bolted diagonal bridging.
  • Hoisting cables not to be released until all bridging is installed and anchored.
• No more than two employees to be allowed on these spans until all bridging is installed and anchored.
• For steel members spanning over 144 feet, the erection methods used to be in accordance with Sec. 1926.756.
• Erection Bridging
• If bolted diagonal erection bridging is required, the following applies:
• The bridging shall be indicated on the erection drawing.
• The erection drawing shall be the exclusive indicator of the proper placement of this bridging.
• Shop-installed bridging clips, or functional equivalents, shall be used where the bridging bolts to the steel joists.
Open Web Steel Joists

• Erection Bridging

• When two pieces of bridging are attached to the steel joist by a common bolt, the nut that secures the first piece of bridging shall not be removed from the bolt for the attachment of the second.

• Bridging attachments shall not protrude above the top chord of the steel joist.
Open Web Steel Joists

• Landing and Placing Loads
• During the construction period, the employer placing a load on steel joists shall ensure that the load is distributed so as not to exceed the carrying capacity of any steel joist.
• No construction loads are allowed on the steel joists until all bridging is installed and anchored and all joist-bearing ends are attached.
• The weight of a bundle of joist bridging shall not exceed a total of 1,000 pounds.
Open Web Steel Joists

- Landing and Placing Loads
- No decking bundle placed on joists until all bridging installed/anchored and joist bearing ends attached, unless:
  - Qualified person has determined and documented in a site-specific erection plan that structure or portion of structure can support load.
  - Decking bundle placed on a minimum of three steel joists.
  - Joists supporting the decking bundle attached at both ends.
Open Web Steel Joists

• Landing and Placing Loads
• Additional Conditions:
  – At least one row of bridging is installed and anchored.
  – The total weight of the bundle of decking does not exceed 4,000 pounds.
  – The edge of the construction load shall be placed within 1 foot of the bearing surface of the joist end.
Falling Object Protection

• Hazards of Falling Objects
  – Basic Rules:
  – Secure all loose materials, equipment, and tools.
  – Controlling contractor must ensure that other construction personnel are not working below steel erection unless substantial overhead protection is provided.
  – Toeboards 3 1/2” tall, screens - install where needed.
Falling Object Protection

• Canopies
  – May be used:
    • Protect personnel on walkways, stairs or in other areas working or walking on lower levels.
    • Must be strong enough to not collapse and to prevent penetration of objects.
Falling Object Protection

• Further Guidelines
  – Only Masonry Equipment Within 4’ of Edge:
    • No material stored within 6 ft. of edge unless guardrails have been installed.
    • Barricade areas and prohibit entry by workers.
    • Signs warning personnel of “men working above” are recommended.
Fall Protection

• Unprotected Sides or Edges
  – Requirements:
    • Employees with unprotected side or edge more than 15 feet above a lower level must be protected from fall hazards by:
      • Safety net systems.
      • Guardrail systems.
      • Personal fall arrest systems.
      • Positioning device systems or fall restraint system.
• Safety Nets

• Safety nets shall be:
  – Installed as close as practical under the walking/working surface.
  – But in no case more than 30 feet below such level.
  – For nets on bridges: the potential fall area from the walking/working surface to the net will be unobstructed.
Fall Protection

• Safety Nets

• Extend Out:
  – Safety nets must extend outward from the outermost projection of the work surface.
  – A vertical distance of 5 feet requires minimum 8 feet horizontal distance from outer edge of net to edge of working surface.
Fall Protection

• Safety Nets

• Vertical distance increases:
  – More than 5 feet and up to 10, the net must extend at least 10 feet horizontally.
  – Vertical distance more than 10 feet, the net must extend at least 13 feet horizontally.
  – All distances are measured from the outer edge of the net to the edge of the working surface.
Fall Protection

• Safety Nets

• Installation:
  – Safety nets shall be installed with sufficient clearance under them to prevent contact with the surface or structures below,
  – And must be capable of absorbing an impact force equal to that produced by a drop test.
Fall Protection

• Safety Nets
  – Drop-Test
  – Safety nets and safety net installations shall be drop-tested at the jobsite after initial installation and,
  – Before being used as a fall protection system:
    • Whenever relocated.
    • After major repair.
    • Every 6-months if left in one place.
Fall Protection

• Safety Nets
• The drop test shall consist of:
• A 400 pound bag of sand 30 inches +/- 2 inches in diameter dropped into the net from the highest walking/working surface at which employees are exposed to fall hazards, but not from less than 42 inches above that level.
Fall Protection

- Safety Nets
- Exemption

- When the employer can demonstrate it is unreasonable to perform the drop-test, the employer shall certify net installation is in compliance. The certification record must identify the particular net/net installation.

Safety Tip: Certification must include the date that the identified net and net installation were in compliance and the signature of the person making the determination. The most recent certification record for each net and net installation shall be available at the jobsite for inspection.
Omit Fall Protection

- Safety Nets
- Drop Test/Exemption
  - Certification must include:
    - The date that the identified net and net installation were in compliance.
    - The signature of the person making the determination.
    - The most recent certification record for each net and net installation shall be available at the jobsite for inspection.
Fall Protection

- Safety Nets

- Defective Nets
  - Defective nets and components shall not be used.
  - Safety nets shall be inspected at least once a week or after any occurrence for wear, damage, and other deterioration.
  - Materials, scrap pieces, equipment, and tools dropped into the safety net shall be removed as soon as possible.
Fall Protection

• Perimeter Safety Cables/Rails
  – On multi-story structures:
  – Perimeter safety cables consisting of 1/2-inch wire rope, approximately 42 inches high must be installed around the periphery of the final interior/exterior perimeters of the floors as soon as the metal decking and/or temporary planked floors have been installed.
Fall Protection

• Fall Hazards

• Connectors and Workers:
  – Working in a CDZ and exposed to fall hazards of more than two stories or 30 feet whichever is less, must be protected by:
    • Guardrail systems.
    • Safety net systems.
    • Personal fall arrest systems.
    • Positioning device systems.
    • Fall restraint systems.
Fall Protection

• Fall Hazards
  – During Steel Erection:
    • Tightly planked or substantial floor shall be maintained within two stories or 30 feet, whichever is less.
    • No temporary floors or scaffolds? Use safety nets when fall distance exceeds two stories, or 30 feet.
Fall Protection

- Connectors
- Heights 15 to 30 feet must tie off with:
  - Personal fall arrest system.
  - Positioning device system.
  - Fall restraint system.
  - Connector must wear equipment necessary to tie off.
  - Must complete training prior to working as a connector.
Fall Protection

- Controlled Decking Zone
- CDZ:
  - Deckers in a CDZ and connectors must be protected at heights greater than two stories or 30 feet.
  - Connectors between 15 and 30 feet must wear fall arrest or restraint equipment.
  - Fall protection required for all others engaged in steel erection at heights greater than 15 feet.
• Controlled Decking Zone
  – A CDZ may be established:
    • In that area of the structure over 15 and up to 30 feet above a lower level where metal decking is being installed, and forms the leading edge of a work area.
Fall Protection

• Controlled Decking Zone

• The following shall apply:
  – Employees working at the leading edge in a CDZ shall be protected from fall hazards of more than two stories or 30 feet, whichever is less.
  – Access to the CDZ must be restricted to employees engaged in leading edge work.
Fall Protection

• Controlled Decking Zone
  – Boundaries of a CDZ:
    • Must be designated and marked by control lines or equivalent.
    • CDZ shall not be more than 90 feet x 90 feet from any leading edge.
    • Personnel working in the CDZ must be trained.
    • Unsecured decking in a CDZ must not exceed 3,000 square feet.
Fall Protection

• Safety Deck Attachments
• Must be performed in the CDZ from the leading edge back to the control line.
• Shall have at least two attachments for each metal decking panel.
• Final deck attachments and installation of shear connectors will not be performed in the CDZ.
Fall Protection

• Custody of Fall Protection
  – Fall protection installed by steel erector to be used by other trades, even after steel erection activity has been completed, with restrictions.
Fall Protection

• Custody of Fall Protection
  – Fall Protection may be used by other trades only if:
    • The controlling contractor or its authorized representative has directed the steel erector to leave the fall protection in place, and,
    • Has inspected and accepted control and responsibility of the fall protection prior to authorizing personnel other than steel erectors to work in the area.
Training Requirements

• Training Requirements
  – Qualified person to train exposed workers in fall protection, and exposed workers engaged in special, high risk activities.
  – Training must be documented and maintained.
  – Retraining required when changes in system or workplace occur.
  – All workers exposed to fall hazard, must be trained.
Training Requirements

• Training Requirements

• Training must include:
  – Recognition and identification of fall hazards in the work area.
  – Use and operation of guardrail systems (including perimeter safety cable systems).
  – Personal fall arrest systems, positioning device systems, fall restraint systems and safety net systems.
Training Requirements

• Training Requirements
• Training must include:
  – Procedures for erecting, maintaining, disassembling, and inspecting the fall protection systems.
  – Procedures to prevent falls to lower levels and through or into holes and openings in walking/working surfaces and walls.
  – In addition - multiple lift rigging, connector procedures and controlled decking zone (CDZ) procedures.
Exemptions to Steel Erection Standard

- Inspection, investigation, or assessment of workplace conditions prior to or after work is completed.
- Erection/dismantling or working from scaffolds.
- Work from ladders.
- Working from some tunneling equipment.
- Working from some cranes and derricks.
- Electric transmission towers.
- Communications towers, broadcast towers, water towers or tanks.
Summary

• Employers Responsibility
• Selected employer responsibilities under the Occupational Safety and Health Act of 1970.
  – Provide a workplace free from serious recognized hazards
  – Comply with standards, rules and regulations.
  – Inspect the worksite and examine workplace conditions.
  – Make sure employees have and use safe tools, equipment and maintain them.
  – Establish or update operating, safety and health procedures and communicate them.
  – Provide medical examinations and training when required.
  – Keep records of work-related injuries and illnesses.
  – Provide access to employee medical records and exposure records.

Summary

• Employer Responsibility
• Four specific controlling contractor duties.
  – Notify the steel erector in writing regarding concrete cure and anchor bolt changes.
  – Provide adequate layout areas and onsite access roads.
  – Preclude work below steel erection unless there is overhead protection.
  – Choose whether to accept responsibility for maintaining fall protection equipment left by erector (otherwise it must be removed).