6000. STEEL

- 6100 & 6200
  - 6130 - Design Data, Principles and Tools
  - 6140 - Codes and Standards
  - 6200 - Material
- 6300
  - 6310 - Members and Components
  - 6320 - Connections, Joints and Details
  - 6330 - Frames and Assembles
- 6400
  - 6410 - AISC Specifications for Structural Joints
  - 6420 - AISC 303 Code of Standard Practice
  - 6430 - AWS D1.1 Structural Welding Code
- 6500
  - 6510 - Nondestructive Testing Methods
  - 6520 - AWS D1.1 Structural Welding Code Tests
- 6600
  - 6610 - Steel Construction
  - 6620/6630 - NUREG-0800 / RG 1.94

6600. Other Key Regulations and Reports -

6610. Steel Construction

- Preparation of steel construction
- Arrangement at the job site
- Erection and installation

6620. NUREG-0800 Standard Review Plan (SRP)

- NUREG-0800 Section 3.8.2 Steel Containment
- NUREG-0800 Section 3.8.3 Concrete and Steel Internal Structures of Steel or Concrete Containments

6630. RG 1.94: Quality Assurance Requirements

- QA

6600. Other Key Regulations and Reports -

6610. Steel Construction

Structural Steel Erection Video (by AISC)

- StructuralSteelErection.mpg

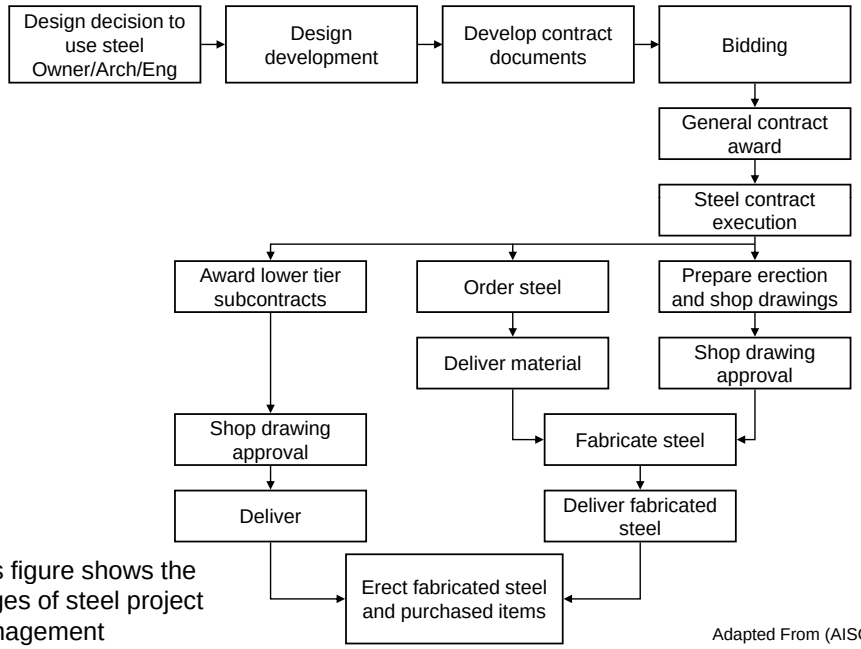
Jobsite Layout Considerations

The controlling contractor must consider many factors when laying out a site to support construction operations

- Site and building size and configuration
- Location of adjacent roads, buildings, and utilities
- Soil conditions and excavation requirements
- Construction sequence and schedule
- Location of underground utilities
- Equipment requirements
- Material quantity, storage, and delivery
- Worker parking
- Tool and equipment storage
- Construction operations facilities and trailers
- Sanitary facilities

(AISC 1999)

Stages of Steel Management



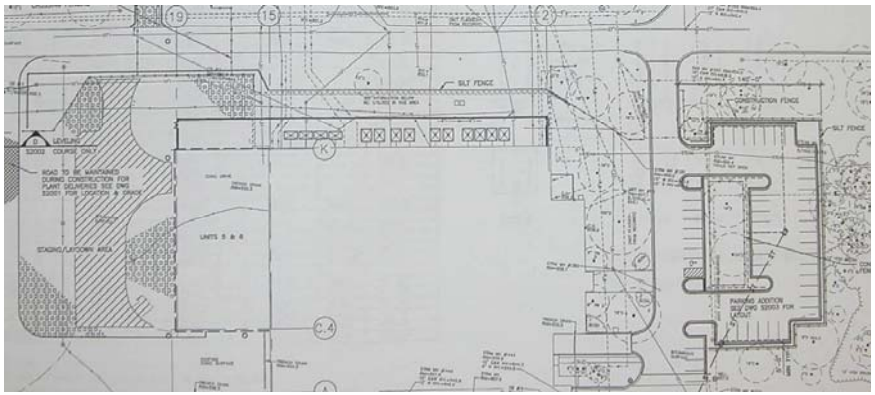
This figure shows the stages of steel project management

Adapted From (AISC 1999)

Early Coordination

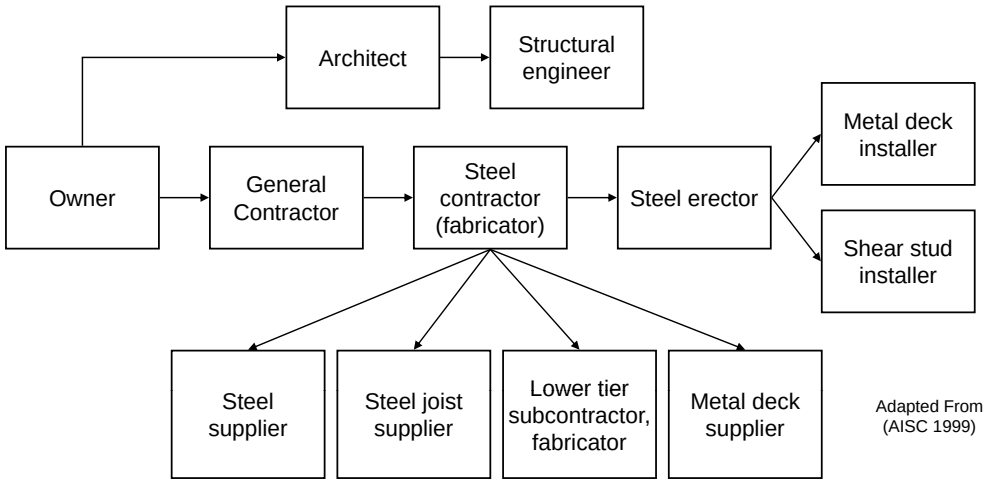
- While preparing bids, a controlling contractor will define subcontract workscopes and seek prices from subcontractors
- Early interaction between a controlling contractor and subcontractors is important
- The steel contractor should always be provided with complete contract documents as described in the AISC Code of Standard Practice (2000) (AISC 1999)

Early Coordination



- The steel contractor, typically the fabricator, (who is not also an erector) will seek lower tier subcontracts for:
  - Steel erection
  - Shear studs
  - Metal deck supply and installation
  - Special fabrications
- The controlling contractor will often require that the steel contractor provide input for the preliminary project schedule and jobsite layout
- The jobsite layout (above) is key in allowing the steel erector to operate efficiently (AISC 1999)

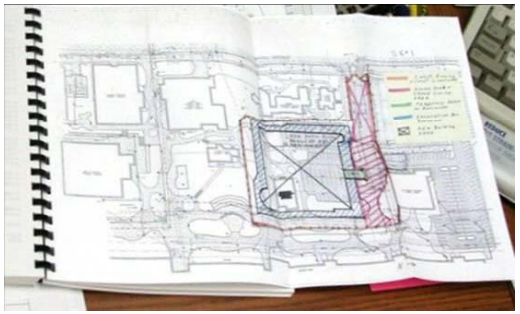
Lines of Responsibility

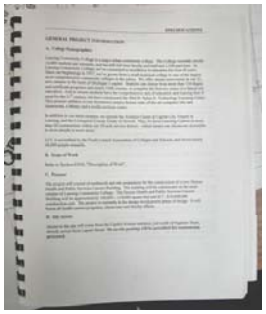


Adapted From (AISC 1999)

- This figure shows the contractual lines of responsibility for a typical structural steel project
- It should be noted that in some cases the steel contractor will have both fabrication and erection responsibilities (AISC 1999)

Bid Package





- The bid package given to each contractor will usually include information related to:
  - Work scope
  - Jobsite conditions and site layout
  - Space limitations
  - Allowable temporary facilities
- A pre-bid meeting may be held to address questions related to the bid package
- During this pre-bid stage the steel contractor will make a preliminary determination of the crane requirements for the project

Pre-Bid Essentials

1.2 VEHICLE ACCESS AND PARKING

A. Access Roads

1. Owner's existing roads may be used for access to and egress from the Project site, provided such use does not interfere with Owner's operations. The Owner will determine the type and maximum weight of the equipment which the Contractor may operate on these roads.
2. Keep Owner's roads free of construction spillages and debris at all times. Repair damage caused to these roads by Contract-related construction vehicles by replacing damaged pavement and curbing to match existing construction. Refer to 01560.10 in Section 01000.

B. Construction Parking

1. Refer to Section 01500.

1.3 FIELD OFFICES, BUILDINGS AND SHEDS

A. General

1. Provide temporary field office and other temporary buildings for storage and maintenance as needed.

The steel contractor will need information from the controlling contractor including:

- Soil conditions
- Schedule
- Sequencing of other trades
- Crane size and provider
- Placement of crane, job trailer, storage and laydown area
- Site access points
- Deliveries
- Parking
- Beginning and ending points for erection of steel
- Workscope

Definition of Workscopes

SECTION 01100
SUMMARY

1 PART 1 - GENERAL

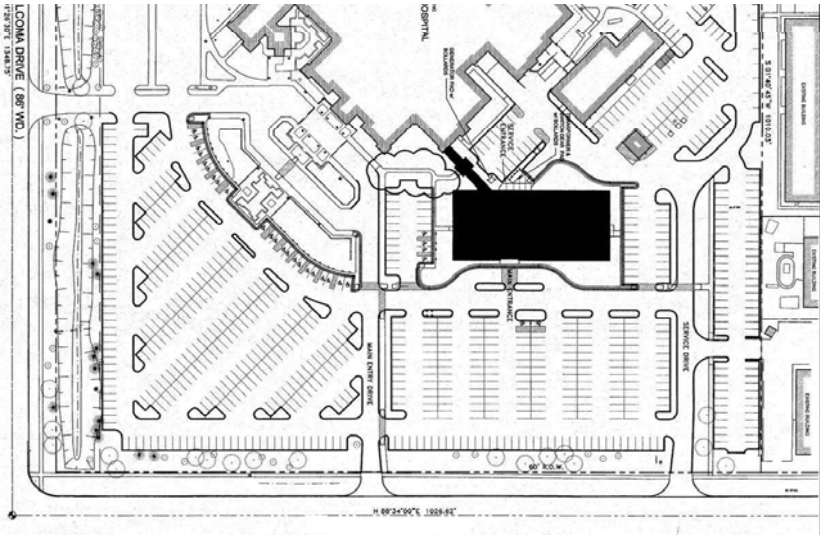
1.1 SUMMARY OF WORK

A. Work Under This Contract

1. This Contract encompasses the furnishing of all labor, materials, services, equipment, and insurance to complete the following as shown on the Drawings and specified herein:
2. Any premium time necessary to complete the Project as scheduled, shall be included in the Base Bid.
3. Pertinent requirements of the Invitation to Bidders, Instructions to Bidders, and Conditions of the Contract shall form a part of the Specifications and the Contractor shall consult them for instructions pertaining to the Work in the Divisions of the Specifications

- The controlling contractor defines the subcontract workscopes and solicits subcontract prices during the bidding process
- A workscope definition should include the general conditions or services which the subcontractor must provide and those which the controlling contractor will provide for the subcontractor
- The controlling contractor may wish to subcontract the complete structural steel package to a single steel subcontractor or may choose to divide the steel portion of the project into multiple subcontracts (AISC 1999)

Site Plan



- Site plans usually include existing site conditions, adjacent roads, and topographical information
- Above is an example of a site plan that is included in the project drawings
- The black area shows the location of the building to be constructed

Site Size and Configuration

- The jobsite layout and equipment used will be controlled by the site constraints
- High on the list of considerations a steel erector will have are:
  - Crane size and location(s)
  - Laydown area size
  - Laydown area location (Mincks and Johnston 2004)

Layout for Optimization

- The goal of site layout is to optimize erection processes
  - The number of crane locations is kept to a minimum
  - Laydown areas should be as close as possible to the structure
- This is all dependent on site size and crane specifications
- The entire structure shown above was able to be erected with the crawler crane located in one position on the left side of the building

Building Footprint On Site

The relationship between a new building's footprint and the size of the site has a significant impact on the erector's planning and sequencing
Space is required for:

- Deliveries
- Construction Materials
- Equipment
- Temporary Facilities

Laydown Area Location

- Laydown areas may move as erection progresses to keep the steel as close as possible to the point of installation (Mincks and Johnston 2004)
- At the site shown above the laydown area started within the building footprint and moved to a smaller area outside the building footprint as erection progressed

Crane Inside Building Footprint

- Additional communication may be required if the steel contractor determines that it is necessary to operate the crane within the footprint of the building to be erected
- Installation of some utilities and systems may need to be delayed to avoid damage from the crane

Planning the Schedule

The overall project schedule and erection sequencing are somewhat dependent on:

- Crane locations
- Size of the building being constructed

Per the Occupational Safety & Health Administration Standard 1926.753(d) people, other than the employees engaged in the initial connection of the steel or employees necessary for the hooking or unhooking of the load, are not to be under a hoisted load.

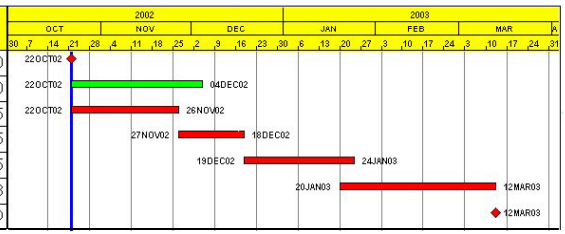
- This will limit work of other trades during erection of steel

Planning the Schedule

- If the size of the building and/or jobsite allows the erection of steel to progress efficiently without hoisting over other trade workers it may be possible for other contractors to work during the erection of steel
- At the site shown above a new sewer line, foundation waterproofing, and floor slab reinforcing are being installed as structural steel is being erected

Planning the Schedule

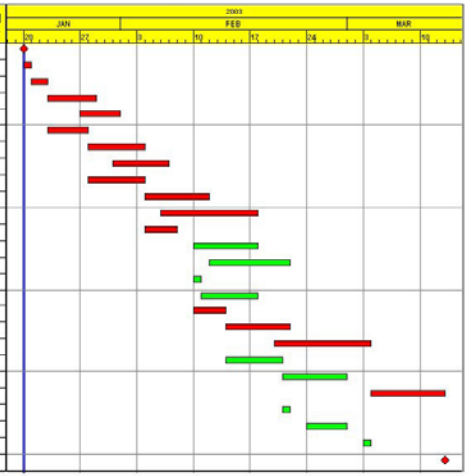
Activity ID	Activity Description	Orig Dur
200	Project Start	0
400	Material Procurement	30
600	Shop Drawing Generation	25
800	Shop Drawing Approval	15
1000	Fabrication	25
1200	Erection	38
1400	Project Finish	0



- Structural steel is a long lead time item that is typically ordered immediately after contract execution
- It is important to make thorough plans and scheduling decisions early in the project and stick to them
- Once the schedule has been determined it is important that it not be changed
- It may not be possible to make late material and/or equipment changes without delays due to limited availability

Planning the Schedule

Activity ID	Activity Description	Orig Dur
1200	Structural Steel Erection Start	0
1205	Crane Set Up	1
1210	Hoisting Sequence 1	2
1215	Bolt up and Detail Work Sequence 1	4
1220	Deck and Studs Sequence 1	5
1225	Hoisting Sequence 2	3
1230	Bolt up and Detail Work Sequence 2	5
1235	Deck and Studs Sequence 2	5
1240	Hoisting Sequence 3	5
1245	Bolt up and Detail Work Sequence 3	6
1250	Deck and Studs Sequence 3	8
1255	Hoisting Sequence 4	4
1260	Bolt up and Detail Work Sequence 4	6
1265	Deck and Studs Sequence 4	8
1270	Plumbing Up Sequences 1-4	1
1275	Final Bolt Up Sequences 1-4	5
1280	Hoisting Sequence 5	4
1285	Bolt up and Detail Work Sequence 5	6
1290	Decking and Studs Sequence 5	8
1295	Hoisting Sequence 6	5
1300	Bolt up and Detail Work Sequence 6	6
1305	Decking and Studs Sequence 6	7
1310	Plumbing Up Sequences 5-6	1
1315	Final Bolt Up Sequences 5-6	5
1320	Crane Demobilization	1
1325	Structural Steel Erection Finish	0



- The steel erector and fabricator break down large steel projects into sequences
- A given sequence defines a section of the project and the pieces of steel included in that section
- The project shown above is divided into six sequences (AISC 1999)

Adjacent Roads

- Pedestrian traffic must be kept at a safe distance from the construction site
- Fencing and barricades may be necessary to block off all or part of a road during construction operations

Site Access Points

- The controlling contractor, as stated in the Occupational Safety & Health Administration Standard 1926.752, is responsible for providing access points into the construction site
- The steel contractor is responsible to communicate any necessary special access requirements to the controlling contractor

Worker Parking

- Parking for workers is another important consideration in the jobsite layout
- Parking availability on and around a jobsite will typically be addressed in the bid package for a project
- If parking is available on the jobsite it should be located as close to the work operations as possible without causing interference with work operations (Mincks and Johnston 2004)
- Space is available for only a couple of vehicles at the jobsite shown above

Worker Parking

In some cases parking will not be available on the jobsite

- Parking on a street or in an adjacent parking area may need to be arranged
  - For the job pictured above, parking spaces along adjacent streets were leased from the city for the duration of the project
- Some situations may require that a remote parking area be secured and transportation be provided for workers from the parking area to the jobsite

Entrance Points for Workers

- The controlling contractor usually provides access for workers into the structure of the building (above left)
- Access for the erector's employees from floor to floor is provided by the erector (above right)

Entrance Points for Workers

The controlling contractor may provide a footbridge over the excavation around a foundation wall (above left) or temporary stairs to upper levels (above right)

Soil Conditions and Excavation

- Proper jobsite conditions are the responsibility of the controlling contractor (AISC 2000, OSHA 2001)
- It is important to consider how soil conditions and excavation of a site will change over the duration of a project

Soil Conditions and Excavation

- Bearing capacity of soil in areas where a crane will operate should be verified
- Consideration must be given to the proximity of the crane to the edge of an excavation or foundation wall
- A geotechnical engineering report furnished by the controlling contractor may be necessary
- In the pictures above the crane is positioned very close to an excavation retaining wall

Soil Conditions and Excavation

- The type of soil on a jobsite and the excavation requirements for a project will dictate if the outside edge of an excavation is to be shored, sloped, or benched
- Care should be taken not to remove more soil than necessary if the excavation is sloped or benched
- An excavation that is sloped more shallowly than originally specified may:
  - Create problems with the erector's predetermined crane locations
  - Require extra effort for the erection crew to safely access the top of the foundation to erect steel

Use of a Man-Lift

If a man-lift is to be used on a project, the controlling contractor should take care to ensure that the site and the excavated area around the building footprint are suitable for its operation

Overhead Utilities

A jobsite should be free from overhead obstructions such as power lines or telephone lines
(AISC 2000)

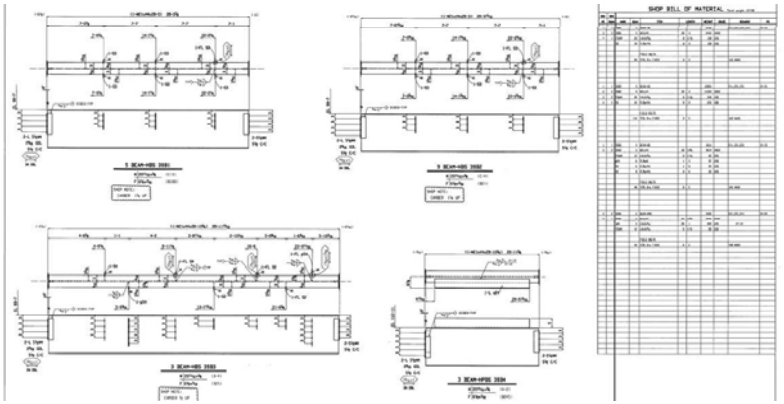
Underground Utilities

- Precautions may need to be taken if a crane will be operated over certain underground utilities
- The controlling contractor should inform the erector of underground utilities located within or near the construction site

Underground Utilities

- In this case, a fire hydrant (right) which was not to be removed happened to be located in the middle of the desired crane location
- The stone base and timber mat provide just enough clearance for operation (above)

Contract Awarded



Upon contract award, the steel contractor will immediately begin a number of tasks:

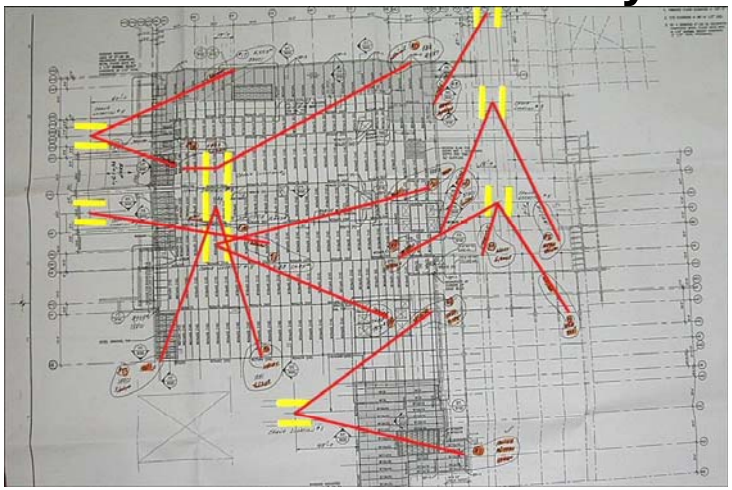
- Definition of detailed workscopes, pricing, and schedules
- Steel is ordered from the steel mill
- Anchor rod setting plans, shop drawings (example above), and erection drawings are prepared for approval
- Jobsite layout is finalized

(AISC 1999)

Fabrication

- Shop drawings may be prepared and submitted to the controlling contractor in phases to expedite the fabrication process
- Fabrication begins after the mill steel is received and the first batch of shop drawings are approved
- Steel will be fabricated in sequences as determined during scheduling
- Once fabricated, the steel is organized and awaits delivery to the jobsite (AISC 1999)

Finalization of Jobsite Layout



- The finalized jobsite layout will include laydown area details and crane locations
- On the drawing above the crane locations have been determined by the erector
- The yellow bars represent locations of the crawler crane tracks
- The red lines represent the critical lifts to be performed from each location
  - A lift is critical if it is in excess of 75% of the crane capacity

Jobsite Condition Requirements

- Per the Occupational Safety & Health Administration Standard 1926.752 and the AISC Code of Standard Practice Section 7.2, the Owner or Owner's Designated Representative for Construction shall provide and maintain certain jobsite conditions (AISC 2000, OSHA 2001)
- The following slides describe the required provisions

Adequate Access Roads

Adequate access roads into and through the site for the safe delivery and movement of:

- Derricks
- Cranes
- Trucks
- Other necessary equipment

Adequate Access Roads

- Adequate access roads must be provided into and through a site for safe delivery and movement of materials
- There must be means and methods for pedestrian and vehicular control

Space On the Jobsite

Space on the jobsite that is:
- Firm
- Properly graded
- Properly drained

Space On the Jobsite

Space on the jobsite that is:
- Readily accessible to the work
- Sufficient for safe operation of equipment

Space On the Jobsite

Space on the jobsite that is:
- Adequate for safe and secure storage of materials
- Enables the Fabricator and Erector to operate at maximum practical speed
  - ✳ Unless the structure occupies the full available jobsite

Jobsite Condition Requirements

The provisions described on the previous slides are to be met by the Owner or the Owner's Designated Representative for Construction

Operations Facilities

- A steel contractor will usually need to have a job trailer or other portable dry space on the site
- If a job trailer cannot be placed on the site due to limited space, the controlling contractor should provide a dry, secure space from which the steel contractor can operate
- Labor rules usually require the availability of a dry shack for workers to use for breaks and lunches (Mincks and Johnston, 2004)

Operations Facilities

- The steel contractor will usually have a limited number of workers on the jobsite at a time, so space requirements for a job trailer are minimal
- In the case shown above, a large transport van (center back) was used as the dry facility for the workers
- Provisions for a job trailer or dry shack, such as electricity and water, will usually be the responsibility of the steel contractor
- The controlling contractor typically provides sanitary facilities on a jobsite (Mincks and Johnston 2004)

Layout Responsibilities

- The controlling contractor is responsible for precise location of building lines and benchmarks on a jobsite and must provide the erector with a plan showing such information
- It is the responsibility of subcontractors to layout their work and inspect any construction in-place before beginning their work
- The steel fabricator supplies the controlling contractor with anchor rod setting plans for setting the structural steel anchor rods (AISC 1999, AISC 2000)

Layout Responsibilities

- Prior to mobilization, the steel contractor should field-check the placement and elevations of the anchor rods
- Additional costs and delays may result if anchor rods are found to be improperly placed after mobilization (AISC 1999)

Modifications to Anchor Rods

- Any discrepancies from the setting plans or necessary anchor rod repairs should be brought to the attention of the controlling contractor (AISC 1999)
- Per the Occupational Safety & Health Administration Standard 1926.755(b):
  - Anchor rods shall not be repaired, replaced or field-modified without the 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 rods of that column

Erection and Installation Equipment

- The erector will typically provide most, if not all, of the erection equipment needed
- Typical equipment used for structural steel erection includes:
  - Crane(s)
  - Man-lifts
  - Generators
  - Welding Equipment
  - Air Compressors
  - Hand Tools

Crane Types

- There are several crane types used in construction
- Construction cranes are usually identified as either mobile cranes (above left), tower cranes (above right), or derricks
- Mobile cranes are traditionally preferred by contractors in North America
- Tower cranes are typically only used for high-rise construction or on jobsites where space is restricted
- A derrick is a hoisting mechanism with a hoisting engine that is not a part of the hoisting mechanism (Shapiro et al. 2000, Peurifoy and Schexnayder 2002)

Mobile Cranes

- A crane that can move around a jobsite under its own power is a mobile crane
- Common mobile crane types are:
  - Crawler
  - Rough-terrain (above left)
  - All-terrain
  - Telescoping-boom truck mounted (above right)
  - Lattice-boom truck mounted

(Shapiro et al. 2000, Peurifoy and Schexnayder 2002)

Crawler Cranes

- Crawler cranes get their name from the continuous, parallel crawler tracks that are used to move them around a construction site
  - A large ground contact area is provided by the crawler tracks
- The superstructure on a crawler crane is fully revolving (Peurifoy and Schexnayder 2002)

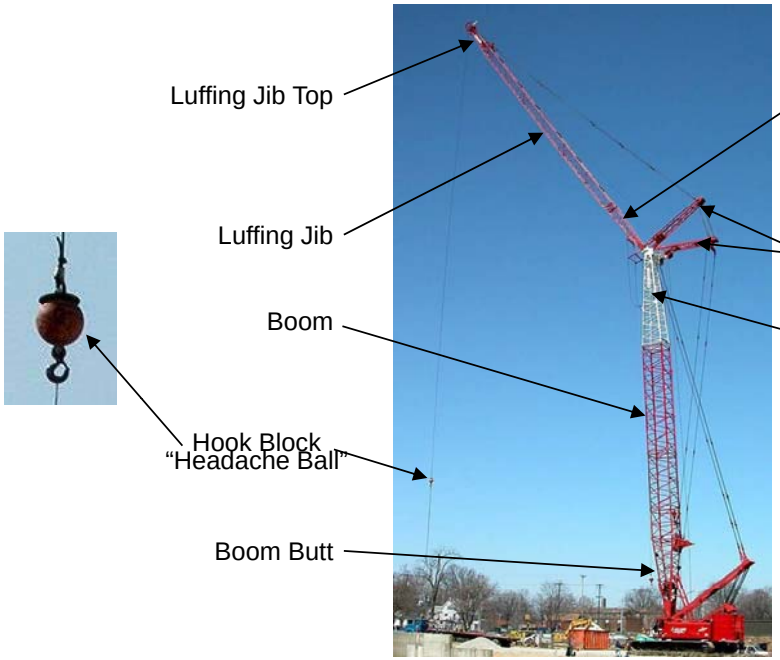
Crawler Cranes

- Prior to lifting a load, the crane must be leveled and the soil bearing capacity considered
- It is common to position the crane on timber mats to further distribute the load (Peurifoy and Schexnayder 2002)

Crawler Cranes

- Crawler cranes must be transported by truck, rail, or barge
- Time and cost to load, haul, assemble (or mobilize), operate, disassemble, reload, and haul (or demobilize) need to be considered
- Some of the largest crawler cranes need up to 15 trucks to be transported (Peurifoy and Schexnayder 2002)

Anatomy of a Crawler Crane



Anatomy of a Crawler Crane

Crawler
Operator's Cab
Car Body
Mast
Engine, Drums, and Boom Hoist (hidden)
Counterweights
Gantry

Rough-terrain Cranes

- Rough-terrain cranes are mounted on a two-axle chassis with the operator's cab located either on the upper works or the chassis
- Large wheels and a short wheel base make these cranes very maneuverable on the construction site
- Outrigger beams are used to stabilize the crane during use
- Slopes of 50 to 70% can be traversed by a rough-terrain crane (Shapiro et al. 2000, Peurifoy and Schexnayder 2002)

Anatomy of a Rough-terrain Crane

Boom Head
Telescopic Boom
Hook Block
Operator's Cab
Optional Jib
Lifting Ram
Counterweight
Outrigger
Oversized Wheels

Mobilizing the Crane

- Mobilization involves transporting the crane to the jobsite and preparing the crane for use
- Mobilizing rough-terrain, all-terrain, and telescoping-boom truck mounted cranes is a relatively fast process
- Telescoping-boom cranes can usually be positioned and ready to hoist steel in under thirty minutes

Mobilizing the Crane

- Most rough-terrain cranes (above left) can travel on surface streets, but have a maximum speed of about 30 mph
- For long moves between projects, rough-terrain cranes should be transported on low-bed trailers
- All-terrain and truck mounted cranes (above right) are designed to be driven to the jobsite on surface streets (Peurifoy and Schexnayder 2002)

Mobilizing a Crawler Crane

- Assembling the many parts of a crawler crane may take several days
- Some crawler cranes can assemble themselves, while others require the use of another crane for assembly
- At this site, a rough-terrain crane was used to assemble the crawler crane

Mobilizing a Crawler Crane

- The counterweights are put into place (above left)
- The pieces of the jib wait to be assembled (above right)

Mobilizing a Crawler Crane

This photo shows line being run through the boom and jib

Delivery of Steel

- Structural steel erection requires the delivery of steel by the truckload
- It is common practice to unload steel from a truck into a laydown area
- A crew will then shakeout the steel into the order that it will be erected
- There may be several truck loads of steel in the laydown area at one time to prevent the erection process from being interrupted
- The size and location of the laydown area are important factors to be considered with structural steel erection

Delivery Access

- A flagman may be necessary to direct traffic around the construction site entrance point and unloading zone during delivery times
- Signs and gates should be used to ensure that pedestrians cannot accidentally enter the construction site

Seasonal Load Limits

Some northern parts of the country will have seasonal load limits on certain roads during late winter and early spring months

- Restrictions are implemented during the time when the ground is thawing after the cold winter months
  - This is done to reduce the wear on some roadways during the thaw cycle
- It may not be possible to deliver the required crane to a jobsite during this period
- Truck delivery capacities of structural steel may be reduced by 35 percent

Materials On Site

- Material delivery, quantity, and storage requirements will vary from project to project
- There are, however, some common requirements for structural steel construction

Laydown Area

- The laydown area needs to be flat, firm, and well drained
- Cribbing is usually placed under the structural steel members for ease of rigging and to keep the steel clean
- Steel erectors generally prefer to have a minimum of two truckloads of steel in the laydown area to ensure that erection can continue without interruption
- A typical structural steel project will require a laydown area that is between 50 feet by 50 feet and 100 feet by 100 feet
  - This area allows the steel members to be appropriately spaced and organized for efficient erection

Laydown Area

Some projects, where large, built-up trusses are used, will require a much larger laydown area for fabrication on the jobsite

Limited Space for Deliveries

- For projects where delivery space is limited, extra coordination will be required to accomplish quick unloading
- Requirements might include:
  - An off-site staging area for delivery trucks to wait until directed to proceed to the site or for trailers to be dropped until they are needed
  - Radio communication between delivery drivers and the jobsite
  - A flagman to direct traffic around the delivery point

Erecting Structural Steel

- Per the AISC Code of Standard Practice (2000), “The Erector shall be responsible for the means, methods and safety of erection of the Structural Steel frame.”
- Multiple lift rigging, as seen in the picture above, is the process where several pieces of steel are lifted simultaneously to speed erection by reducing the total number of lifts required for the frame
- Refer to the AISC Digital Library Office Building Case Study presentations and movie about Structural Steel Erection for more details related to the erection of structural steel

Adjacent Property

If the size of the site and the relationship of the building to the site and surrounding properties require that loads be lifted over adjacent property, then certain precautions may need to be taken:

- Vacancy of the affected adjacent property
- Additional barricading to ensure a safe construction zone
- Extra care to minimize the risk of damage to any adjacent property

Structural Steel Erection Complete

As stated in the Code of Standard Practice (AISC 2000):

- The controlling contractor shall accept the structural steel for plumbness, elevation, and alignment prior to the placement or installation of other materials
- "Upon the completion of erection and before final acceptance, the Erector shall remove all of the Erector's falsework, rubbish and temporary buildings."

Custody Of Fall Protection

Per the Occupational Safety & Health Administration Standard 1926.760(e):

"Fall protection provided by the steel erector shall remain in the area where steel erection activity has been completed, to 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 persons other than steel erectors to work in the area."

Demobilizing the Crane

Demobilization may take as much time as mobilization

- Cranes with telescoping booms may be demobilized in a matter of minutes
- Demobilization of a lattice boom crane may take several days

Demobilizing a Crawler Crane

This photo shows the main boom being disassembled and loaded onto a truck for transport

Demobilizing a Crawler Crane

- Crawler crane with the main boom and most of the counterweights removed (above left)
- The boom butt has been removed (above right)

Demobilizing a Crawler Crane

The base machine of this crawler crane has self-contained jacks (above left) that allow a low-bed trailer to be backed under it for transport

6000. STEEL

- 6100 & 6200
  - 6130 - Design Data, Principles and Tools
  - 6140 - Codes and Standards
  - 6200 - Material
- 6300
  - 6310 - Members and Components
  - 6320 - Connections, Joints and Details
  - 6330 - Frames and Assembles
- 6400
  - 6410 - AISC Specifications for Structural Joints
  - 6420 - AISC 303 Code of Standard Practice
  - 6430 - AWS D1.1 Structural Welding Code
- 6500
  - 6510 - Nondestructive Testing Methods
  - 6520 - AWS D1.1 Structural Welding Code Tests
- 6600
  - 6610 - Steel Construction
  - 6620/6630 - NUREG-0800 / RG 1.94

6620. NUREG-0800 Section 3.8.2 Steel Containment

- Loads and Loading Combinations encountered during construction, including dead loads; live loads; temperature, wind, snow, rain, and ice; and construction loads that may be applicable such as material loads, personnel and equipment loads, erection and fitting forces, and equipment reactions.
- The materials used in the construction of the steel containment, with emphasis on the extent of compliance with Article NE-2000 of ASME Code, Section III, Division 1, Subsection NE are reviewed. The major materials reviewed include the following:
  i. Steel plates used as shell components
  ii. Structural steel shapes used for stiffeners, beam seats, and crane brackets

NUREG-0800 Section 3.8.2 Steel Containment

- The quality control program proposed for the fabrication and construction of the containment with emphasis on the extent of compliance with Articles NE-2000, NE-4000, and NE-5000 of ASME Code, Section III, Division 1, Subsection NE, are reviewed including the following:
  i. Nondestructive examination of the materials, including tests to determine their physical properties
  ii. Welding procedures
  iii. Erection tolerances
- Any special construction techniques, if proposed, are reviewed on a case-by-case basis to determine their effects on the structural integrity of the completed containment.

NUREG-0800 Section 3.8.3 Concrete and Steel Internal Structures of Steel or Concrete Containments

- The review evaluates the quality control program proposed for the fabrication and construction of the containment internal structures, including nondestructive examination of the materials to determine physical properties, placement of concrete, and erection tolerances.
- Special, new, or unique construction techniques, such as the use of modular construction methods, if proposed, are reviewed on a case-by-case basis to determine their effects on the structural integrity of the completed containment internal structures.

NUREG-0800 Section 3.8.3 Concrete and Steel Internal Structures of Steel or Concrete Containments

- For containment internal structures, it is important to accommodate in-service inspection of critical areas. The review includes any special design provisions (e.g., sufficient physical access, alternative means for identification of conditions in inaccessible areas that can lead to degradation, remote visual monitoring of high radiation areas) to accommodate in-service inspection of containment internal structures.
- Postconstruction testing and in-service surveillance programs for containment internal structures, such as pressure testing of the drywell/wetwell in a BWR containment and periodic examination of inaccessible areas, are reviewed on a case-by-case basis.
- The structural integrity test for the drywell of the BWR containment is reviewed in a similar manner to that used to review the containment.

NUREG-0800 Section 3.8.3 Concrete and Steel Internal Structures of Steel or Concrete Containments

- Design of structures that use modular construction methods are reviewed on a case-by-case basis. NUREG/CR-6486 provides guidance related to the use of modular construction methods. Appendix B to NUREG/CR-6486 includes proposed modular construction review criteria.
- ANSI/AISC N690-1994 including Supplement 2 (2004) defines the structural acceptance criteria for steel structures. This specification uses the ASD method. Use of the LRFD version of the specification (N690L) is reviewed on a case-by-case basis.

6630. RG 1.94: Quality Assurance Requirements for Installation, Inspection, and Testing of Structural Concrete and Structural Steel During the Construction Phase of Nuclear Power Plants

- The requirements and guidelines are included in ANSI N45.2.5-1974 for installation, inspection, and testing of structural concrete and structural steel during the construction phase of nuclear power plants
  - Subdivision 2.1 of ANSI N45.2.5-1974 includes general provisions for planning the installation, inspection, and testing of structural concrete and structural steel.
  - Subdivision 4.10 of ANSI N45.2.5-1974 states: "Welded reinforcing bar splices shall be-subject to the requirements of Section 5.5, except that provisions of AWS D 12.1 shall apply." In addition, the provisions of Articles CC4334 and CC4330 of the "Code for Concrete Reactor Vessels and Containments" (ASME Boiler and Pressure Vessel Code, Section III, Division 2, 1975 Edition)3 for testing of welded reinforcing bar splices should be used as guidance pending endorsement of that Code by the NRC staff.

6600. Other Key Regulations and Reports -

Objective and Scope Met:

6610. Steel Construction

- Preparation of steel construction
- Arrangement at the job site
- Erection and installation

6620. NUREG-0800 Standard Review Plan (SRP)

- NUREG-0800 Section 3.8.2 Steel Containment
- NUREG-0800 Section 3.8.3 Concrete and Steel Internal Structures of Steel or Concrete Containments

6630. RG 1.94: Quality Assurance Requirements

- QA

6000. STEEL

- Objective and Scope Met
  - Provided an intermediate level review and practical application of structural analysis and design to steel buildings and nuclear power plant steel structures
  - Presented and discussed
    - Structural Steel Design Data, Principles and Tools
    - Materials

Completed Items of Overall Outline

1000. Introduction

2000. Federal Regulations, Guides, and Reports

3000. Site Investigation

4000. Loads, Load Factors, and Load Combinations

5000. Concrete Structures and Construction

6000. Steel Structures and Construction (6100 & 6200)

7000. General Construction Methods

8000. Exams and Course Evaluation

9000. References and Sources