AISC Live Webinars

Thank you for joining our live webinar today.
We will begin shortly. Please standby.

Steel Erection: Engineering and Execution
Session 1: The Erector's Perspective
August 27, 2020

Smarter. Stronger. Steel.

AISC Live Webinars

Today's live webinar will begin shortly. Please stand by.

Today's audio will be broadcast through the internet. Please be sure to turn up the volume on your speakers.

Please type any questions or comments through the chat feature in the left portion of your screen.

Smarter. Stronger. Steel.

AISC Live Webinars

AIA Credit

AISC is a Registered Provider with The American Institute of Architects Continuing Education Systems (AIA/CES). Credit(s) earned on completion of this program will be reported to AIA/CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

This program has been submitted to AIA/CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Smarter. Stronger. Steel.

AISC Live Webinars

Copyright Materials

The information presented herein is based on recognized engineering principles and is for general information only. While it is believed to be accurate, this information should not be applied to any specific application without competent professional examination and verification by a licensed professional engineer. Anyone making use of this information assumes all liability arising from such use.

Smarter. Stronger. Steel.

AISC Live Webinars

Course Description Submitted for AIA CE Credit

The Erector's Perspective
August 27, 2020

Structural steel erection consists of assembling the building's frame on site safely and economically. This session will address how steel erection gets done, from securing the work to executing it. Topics include:

- Erectors' contractual relationships
- Estimating
- AISC Code of Standard Practice
- Erection schematic
- Selling an erection project
- Contracts
- Prefabrication coordination
- Erection pre-mobilization planning
- Prosecuting the work

Smarter. Stronger. Steel.

AISC Live Webinars

Learning Objectives Submitted for AIA CE Credit

- List items that a steel erector must extract from a project's construction documents for supporting an accurate estimate.
- Identify good and bad steel details that affect a steel erector's ability to safely and efficiently perform work.
- List items addressed in a site safety plan.
- List steel erection challenges and solutions highlighted through real project examples.

Smarter. Stronger. Steel.

Steel Erection: Engineering and Execution

Session 1: The Erector's Perspective

August 27, 2020

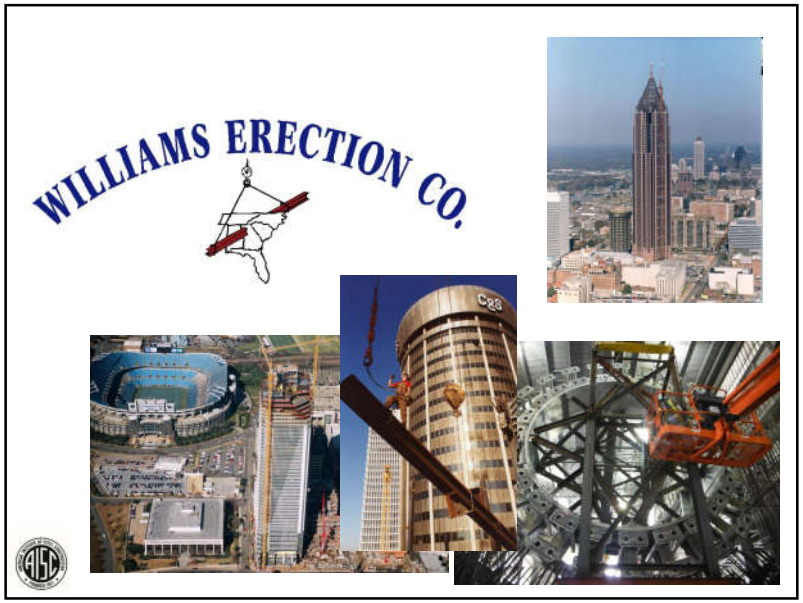
Tim Duke
Corporate Quality Control and Risk Management Director
Williams Erection Company
Atlanta Steel Erectors
Smyrna, GA

Smarter. Stronger. Steel.

Three-Part Webinar Series

- Session 1: The Erector's Perspective — Aug. 27
- Session 2: Erection Engineering of Low-Rise Buildings — Sept. 3
- Session 3: Erection Engineering of High-Rise Buildings — Sept. 10

8



The Plan for Today:

Part One:
- **Who we are and how we get work to perform**
- **Estimating the job**
- **AISC Code of Standard Practice**
- **Construction Contracts for Erectors**
- **Erection scheme committed to paper or model**
- **Selling an Erection Project**

Part Two:
- **We have a contract, now what?**
- **Erector Pre mobilization planning**
- **Site specific Erection plan**
- **Engineered Stability Plan**
- **Doing the Work**

Part Three:
- **Questions**

10

Our Community

- The internet says there are 1,197 Structural Fabricators in the USA, AISC says 1,700.
- The internet also claims there are around 11,500 Steel Erectors.
- Changes per the day you search the internet. But there is an order of magnitude more erectors than fabricators by somewhere around 10:1 to 7:1.

11

Part One
Where do the jobs come from?

- 95% of requests for quotation come from Fabricators that we have performed work for in the past
- Pre Qualification requirements of General Contractor / Construction Manager (Owner's Designated Representative for Construction)
  - AISC Erector Certification
  - Bonding Capacity
  - Safety Record
- Drawings, Models and Specifications Furnished by Fabricator
  - In the olden days hard copies, now mostly electronic.
- Sample Contract Documents
- Site Visit

12

Estimate - Drawing Review

- Architectural and Civil Drawings
- Structural Drawings S001 General Structural Notes
- S100 – S500 Structural Drawings
- Specifications 5000 series:

Job Specifications contain important information, but may not always reference the most current document.

2.4 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."

ERECTION

B. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."

13

Estimate information

From the drawings:

- Column counts (may vary if too heavy for crane(s))
- Beam/Girder count
- Truss and or joist count (Truss weights for crane)
- Stud count
- Bracing count, Vertical X or K
- Bracing horizontal
- Decking square footage
- Deck edge angle, bent plate, closure and support angle (attention to attachment)
- Bracing for edge bent plate etc.
- Roof frames - penetrations
- Moment connections and Welded column splices (Calculate weld weight)
- Detail cost drivers special connections or conditions.

14

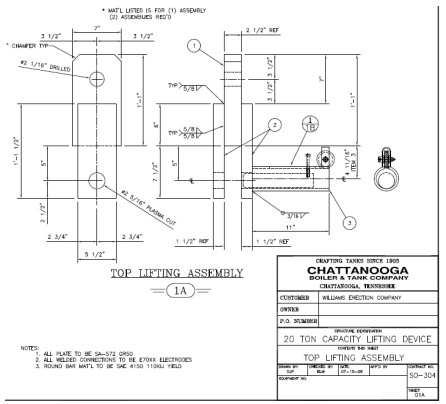
Estimate information

From the Fabricators:

- Bolt count
- Tonnage
- Stairs part of the package?
- Fabricator or Erector to furnish the Studs?
- Fabricator to drill holes for safety cable?
- Fabricator furnish safety cable posts?
- Column lifting holes?
- Special field weld preparations
- Shop assembly of components (please)
- Shoring
- Bond

15

Column Hitch



16

Estimate information

From the GC - ODRC:

- Job access
- Traffic control for material delivery
- Lay down area
- Gravel and dewatering
- Furnish cranes? What limitations for Erector
- Power 440 three phase?
- Special Safety requirements (crane limitations)
- Site personnel requirements
- GC's on site management team
- CCIP OCIP Insurance (deductibles)

17

AISC Code of Standard Practice

2016 Code of Standard Practice
Preface:

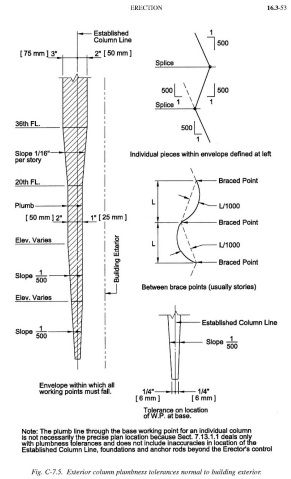
As in any industry, trade practices have developed among those that are involved in the design, purchase, fabrication and erection of structural steel. **This Code provides a useful framework for a common understanding of the acceptable standards when contracting for structural steel**. As such, it is useful for owners, architects, engineers, general contractors, construction managers, fabricators, steel detailers, erectors and others associated with construction in structural steel. **Unless specific provisions to the contrary** are contained in the contract documents, the existing trade practices contained herein are considered to be **the standard custom and usage of the industry** and are thereby incorporated into the relationships between the parties to a contract.

18

AISC Code of Standard Practice

Erector
Owner's Designated Representative for Design
General Contractor
Fabricator

19



Note: The plumb line through the base working point for an individual column is not necessarily the precise plan location because Sect. 7.13.1.1 deals only with plumbness tolerances and does not include inaccuracies in location of the Established Column Line, foundations and anchor rods beyond the Erector's control

Fig. C-7.5. Exterior column plumbness tolerances normal to building exterior.

Code of Standard Practice for Steel Buildings and Bridges, June 15, 2016
AMERICAN INSTITUTE OF STEEL CONSTRUCTION

20

College
Football Hall
of Fame
Atlanta, GA

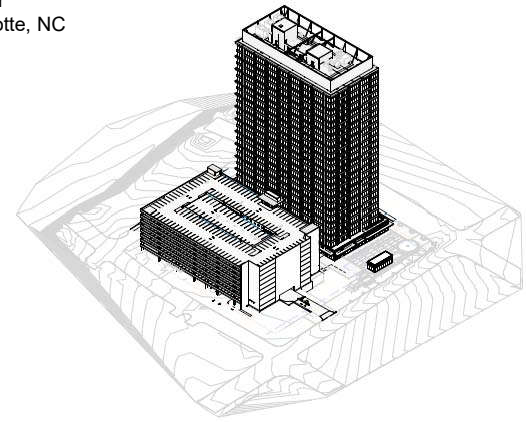
21

TABLE 10.1
AESS Category Matrix

	Category	AESS C	AESS 4	AESS 3	AESS 2	AESS 1	SSS
Id	Characteristics	Custom Elements	Showcase Elements	Feature Elements in close view	Feature Elements not in close view	Basic Elements	Standard Structural Steel
1.1	Surface preparation to SSPC-SP 6		*	*	*	*	
1.2	Sharp edges ground smooth		*	*	*	*	
1.3	Continuous weld appearance		*	*	*	*	
1.4	Standard structural bolts		*	*	*	*	
1.5	Weld spatters removed		*	*	*	*	
2.1	Visual samples	Required	*	*	optional		
2.2	One-half standard fabrication tolerances		*	*	*		
2.3	Fabrication marks not apparent		*	*	*		
2.4	Welds uniform and smooth		*	*	*		
3.1	Mill marks removed		*	*			
3.2	Butt and plug welds ground smooth and filled		*	*			
3.3	HSS weld seam oriented for reduced visibility		*	*			
3.4	Cross sectional abutting surface aligned		*	*			
3.5	Joint gap tolerances minimized		*	*			
3.6	All welded connections		optional	optional			
4.1	HSS seam not apparent		*				
4.2	Welds contoured and blended		*				
4.3	Surfaces filed and sanded		*				
4.4	Weld show-through minimized		*				
C.1							
C.2							
C.3							
C.4							

AESS 1: Basic elements.
AESS 2: Feature elements viewed at a distance greater than 20 ft (6 m).
AESS 3: Feature elements viewed at a distance less than 20 ft (6 m).
AESS 4: Showcase elements with special surface and edge treatment beyond fabrication.
AESS C: Custom elements with characteristics described in the *contract documents*.

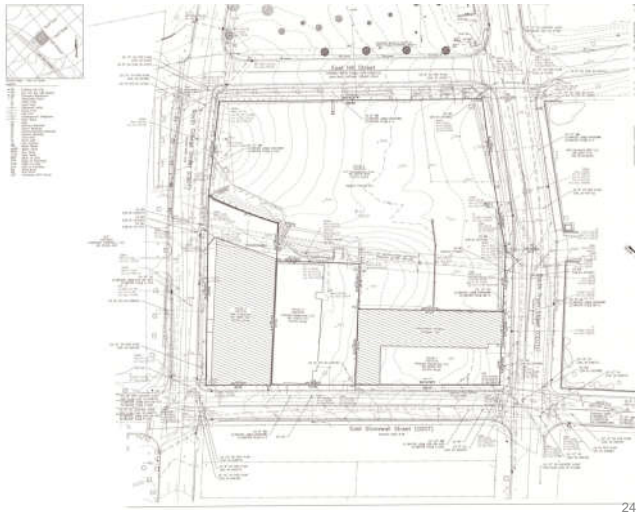
Ally Charlotte
Center
Charlotte, NC



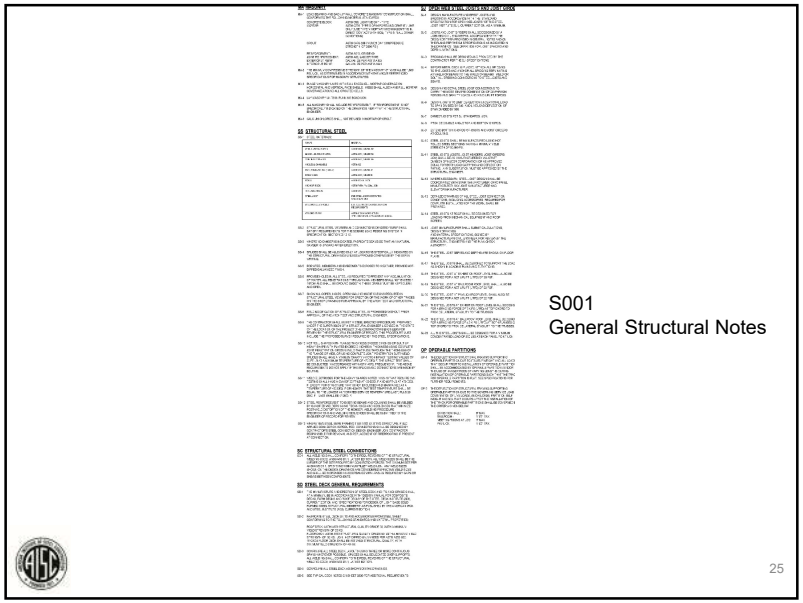
EXTERIOR AXON - EAST

23

Survey
Site layout



24



S001
General Structural Notes

25

S001 General Structural Notes

SHAPE	MATERIAL
WIDE FLANGES & WT'S	ASTM A992, GRADE 50
MISCELLANEOUS PLATES	ASTM A572, GRADE 50
CONTINUITY PLATES	ASTM A572, GRADE 50
ANGLES & CHANNELS	ASTM A36
RECTANGULAR HSS (TUBES)	ASTM A500, GRADE B
ROUND HSS	ASTM A500, GRADE B
BOLTS	ASTM A325 N, UON
ANCHOR RODS	ASTM F1554, Fy=36ksi, UON
THREADED RODS	ASTM A36
STEEL JOIST	PER STEEL JOIST INSTITUTE'S SPECIFICATIONS
WELDING ELECTRODES	E70, SEE SPECIFICATIONS FOR CVN REQUIREMENTS
WELDED STUDS	ASTM A108 HEADED STUDS: TYPE H4L OR S3L BY NELSON OR EQUAL.

Notes trigger closer examination and cost drivers

Seismic Job

SS-2 STRUCTURAL STEEL MEMBERS AND CONNECTIONS DENOTED "SLRS" SHALL SATISFY REQUIREMENTS FOR THE SEISMIC LOAD RESISTING SYSTEM IN SPECIFICATION SECTION 05 12 10.

SS-3 WHERE NO CAMBER IS INDICATED, FABRICATE BEAMS SO THAT ANY NATURAL CAMBER IS UPWARD AFTER ERECTION

SS-4 SPLICES SHALL BE ALLOWED ONLY AT LOCATIONS SPECIFICALLY INDICATED ON THE STRUCTURAL DRAWINGS UNLESS APPROVED OTHERWISE BY THE SER IN WRITING.

SS-5 FOR STEEL MEMBERS AND EMBEDMENTS EXPOSED TO WEATHER, PROVIDE HOTDIPPED GALVANIZED FINISH.

SS-6 PROVIDE HOLES IN ALL STEEL AS REQUIRED TO PREVENT ANY ACCUMULATION OF WATER. ALL PENETRATIONS THROUGH MAIN MEMBERS SHALL NOT EXCEED 1 1/8"DIA AND SHALL BE GROUND SMOOTH. THESE DRAINS MUST BE KEPT CLEAN

26

Engineered Erection Stability Plan

SS-8 FIELD MODIFICATION OF STRUCTURAL STEEL IS PROHIBITED WITHOUT PRIOR APPROVAL OF THE ARCHITECT AND STRUCTURAL ENGINEER.

SS-9 THE CONTRACTOR SHALL SUBMIT A STEEL ERECTION PROCEDURE, PREPARED UNDER THE SUPERVISION OF A STRUCTURAL ENGINEER LICENSED IN THE STATE OF THE LOCATION OF THE PROJECT (THE CONTRACTOR'S ENGINEER) FOR REVIEW BY THE STRUCTURAL ENGINEER OF RECORD. THIS PROCEDURE MUST SINCLUDE THE PROPOSED SURVEY REQUIRED BY THE STEEL SPECIFICATIONS.

SS-10 HOT ROLL SHAPES WITH FLANGE THICKNESS EXCEED 2 INCHES OR BUILT UP HEAVY SHAPE WITH PLATES EXCEED 2 INCHES IN THICKNESS USING COMPLETE JOINT PENETRATION GROOVE WELD THAT FUSE THROUGH THE THICKNESS OF THE FLANGE OR WEB, OR USING COMPLETE JOINT PENETRATION BUTT WELD SPLICES SHALL HAVE A MINIMUM CHARPY V-NOTCH IMPACT TESTING VALUES OF O 20 FT-LB AT A MAXIMUM TEMPERATURE OF +70 DEG F. THE IMPACT TEST SHALL BE CONDUCTED IN ACCORDANCE WITH ASTM A673 FREQUENCY P. THE ABOVE REQUIREMENTS DO NOT APPLY IF THE SPLICES AND CONNECTIONS ARE MADE BY BOLTING.

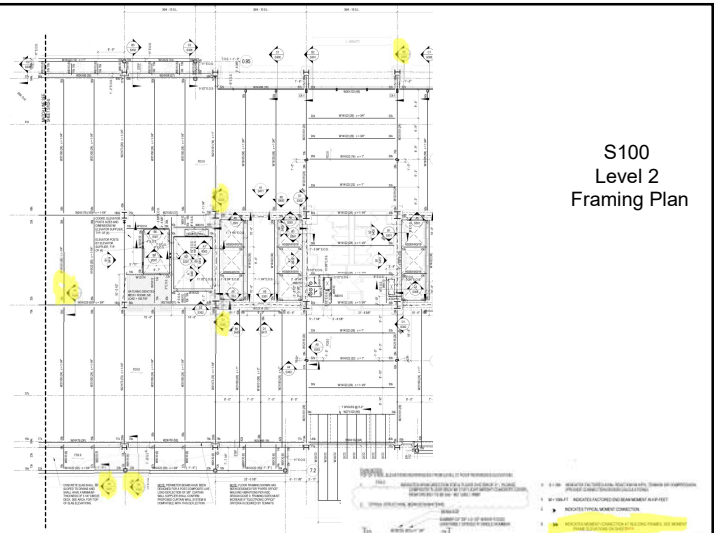
Impact Requirements WPS and Welder

SS-11 WELD ELECTRODES FOR THE HEAVY SHAPES NOTED IN SS-10 THAT REQUIRE CVN TESTING SHALL HAVE A CVN OF 20 FT-LB AT -20 DEG. F AND 40 FT-LB AT +70 DEG. F, EXCEPT FOR STRUCTURE THAT IS NOT ENCLOSED AND MAINTAINED AT A TEMPERATURE OF +50 DEG. F OR HIGHER, THE TEST TEMPERATURE SHALL BE O EQUAL TO THE LOWEST ANTICIPATED SERVICE TEMPERATURE (LAST) PLUS 20 DEG. F. LAST SHALL BE -7 DEG. F.

SS-12 STEEL REINFORCEMENT TO EXISTING BEAMS AND COLUMNS SHALL BE WELDED BY QUALIFIED WELDERS USING TECHNIQUES AND SEQUENCES THAT MINIMIZE POST-WELD DISTORTION OF THE MEMBER. WELDING PROCEDURE SPECIFICATIONS AND WELDING SEQUENCES SHALL BE SUBMITTED TO THE ENGINEER OF RECORD FOR REVIEW.

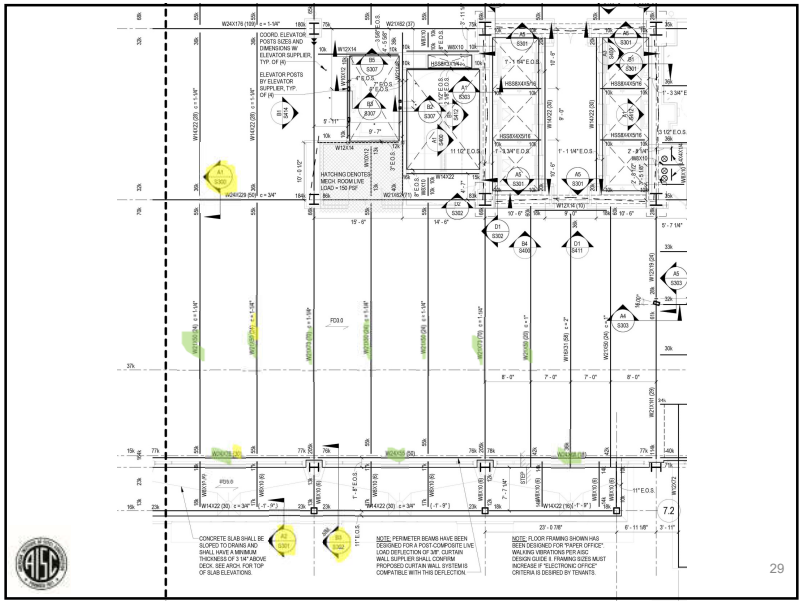
SS-13 WHERE NEW STEEL BEAM FRAMING TIES INTO EXISTING STRUCTURE, FIELD APPLIED CONNECTION IS REQUIRED. CONNECTIONS SHALL BE DESIGNED BY CONTRACTOR'S STEEL CONNECTION DESIGN ENGINEER UON. CONTRACTOR RESPONSIBLE FOR REMOVAL AND REPLACEMENT OF FIREPROOFING IF PRESENT AT CONNECTION.

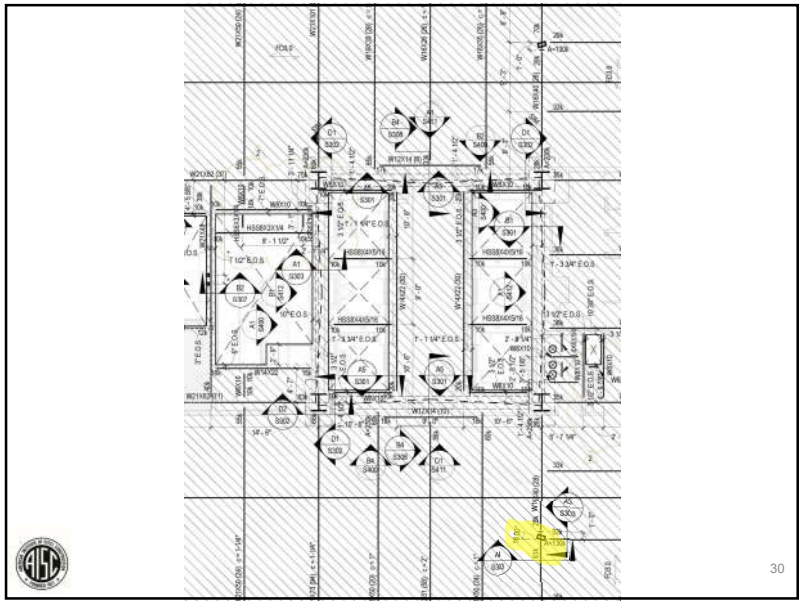
27

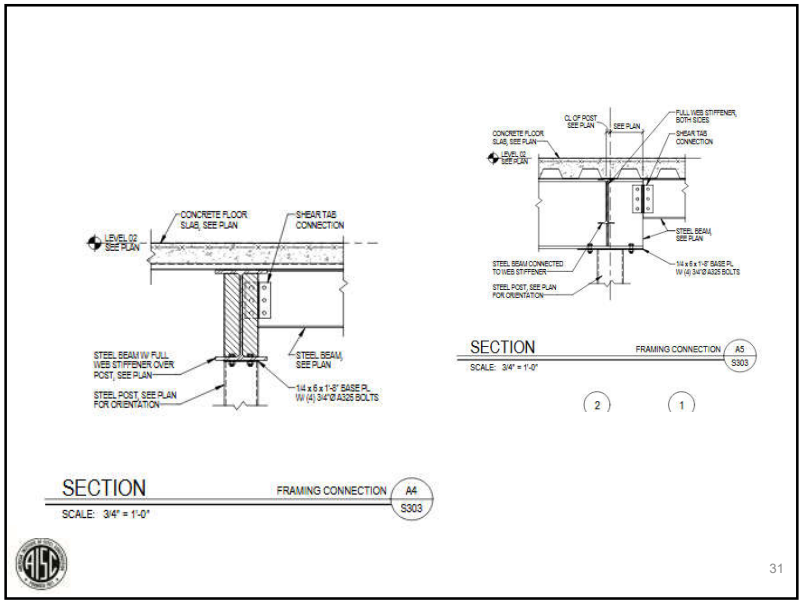


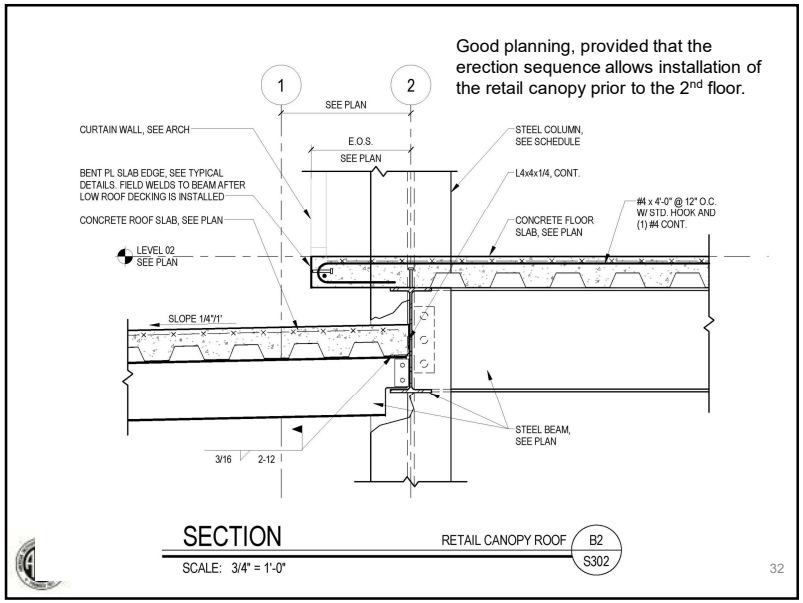
S100
Level 2
Framing Plan

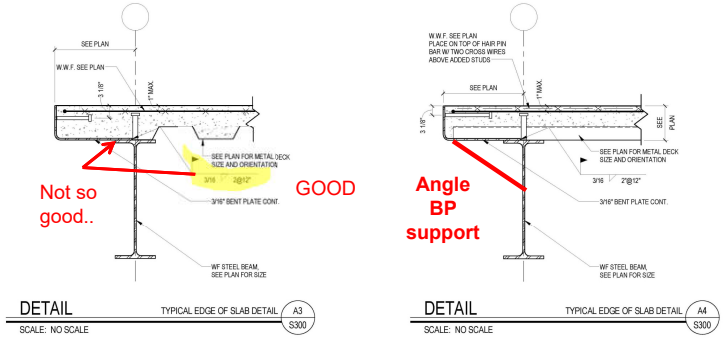
28





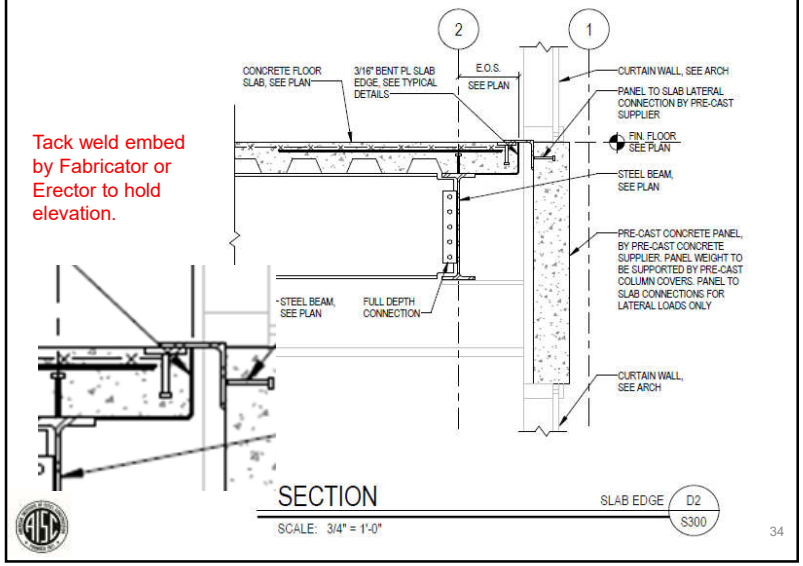




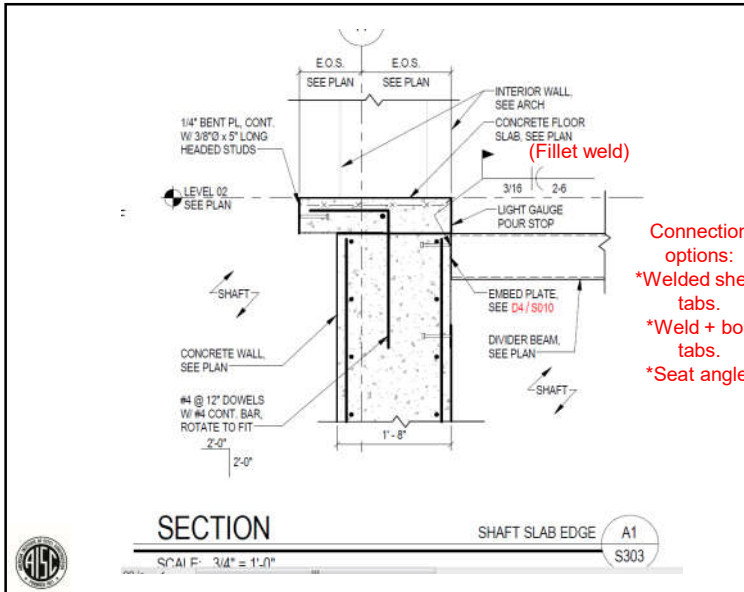


Detail Review

33

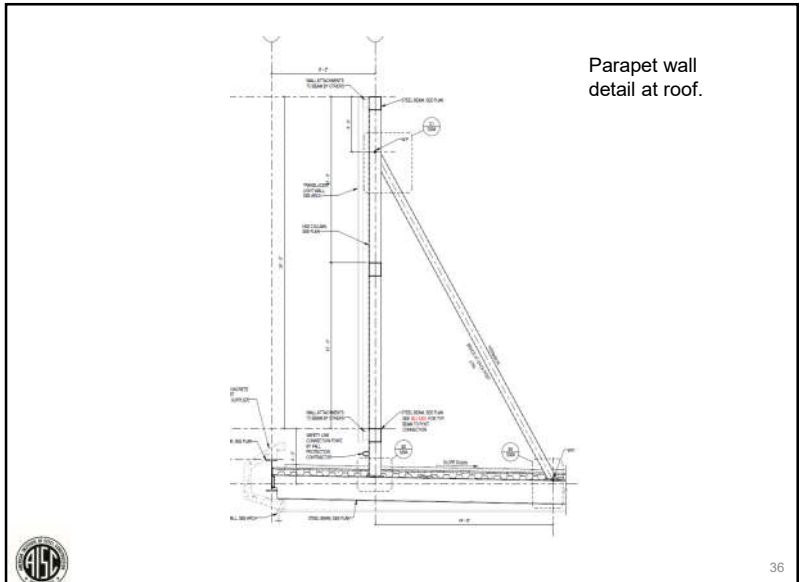


34



Connection options:
*Welded shear tabs.
*Weld + bolt tabs.
*Seat angle.

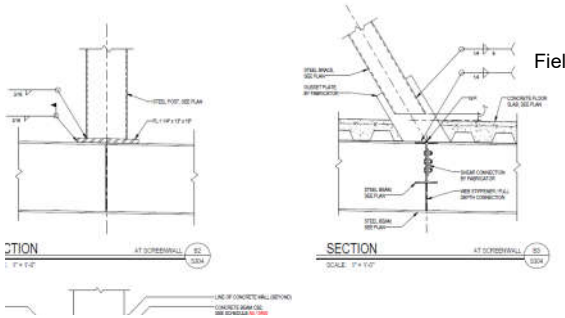
35



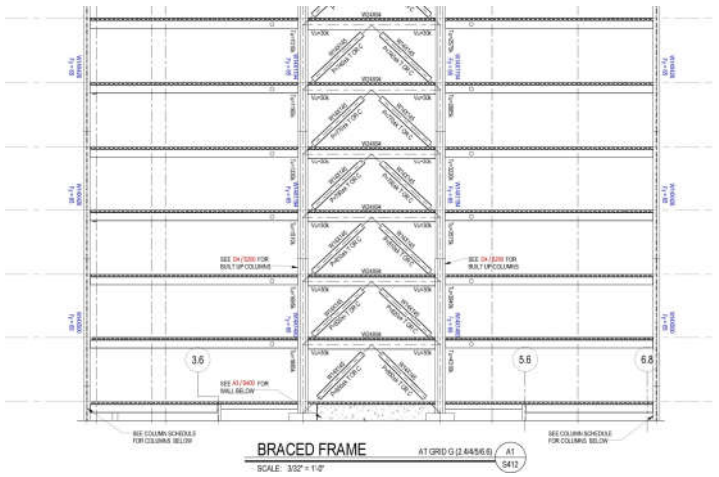
Parapet wall detail at roof.

36

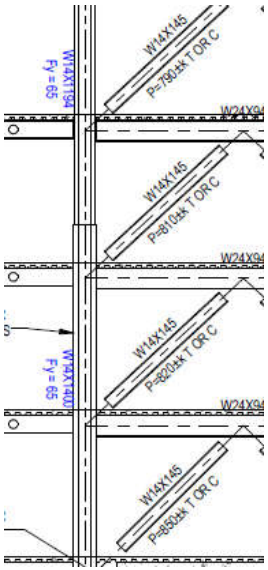
Provide bolted field connections to assist location and plumbing
Then field weld to structure.



37

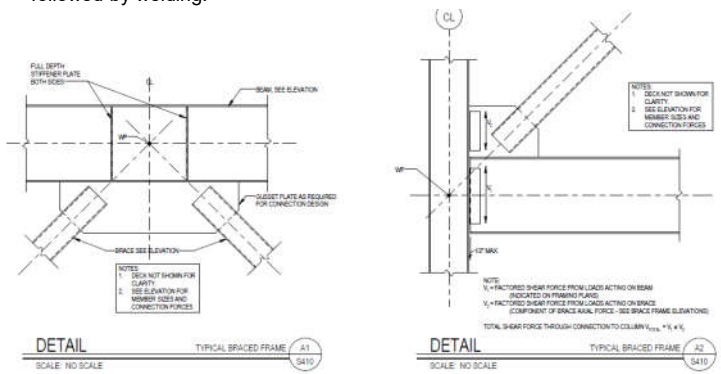


38



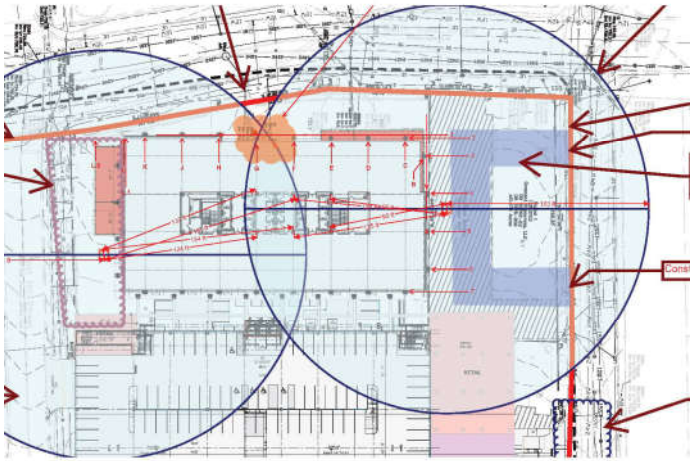
39

Typically one or two
erection bolts
followed by welding.

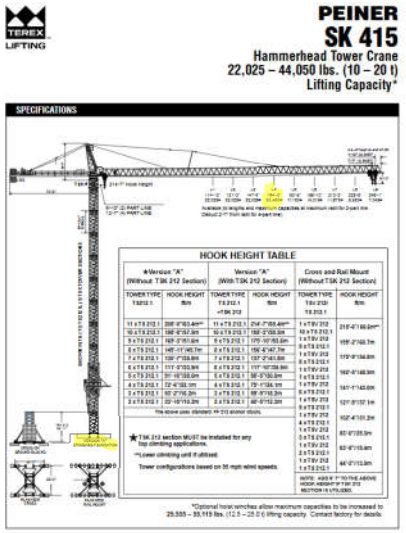


40

Lay down area



41



42

LOAD CHARTS FOR 2-PART LINE (US / METRIC)

2-PART LINE WB 76-100/4F ~108 HP (7

(pounds / feet)

AVAILABLE JIB LENGTHS IN FEET

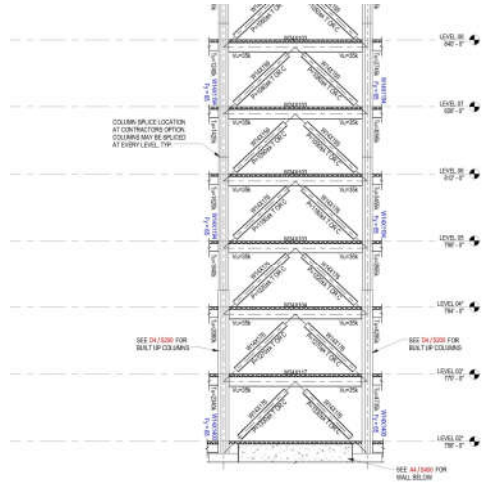
Hook Radius (ft) ▼	L9 246	L8 229.6	L7 213.2	L6 196.8	L5 180.4	L4 164	L3 147.5	L2 131.2	L1 114.8
9.8	22025	22025	22025	22025	22025	22025	22025	22025	22025
101.7	22025	22025	22025	22025	22025	22025	22025	22025	22025
105.0	21880	22025	22025	22025	22025	22025	22025	22025	22025
108.2	21085	22025	22025	22025	22025	22025	22025	22025	22025
111.5	20340	22025	22025	22025	22025	22025	22025	22025	22025
114.8	19635	22025	22025	22025	22025	22025	22025	22025	22025
118.1	18975	21770	22025	22025	22025	22025	22025	22025	22025
121.4	18350	21065	22025	22025	22025	22025	22025	22025	22025
124.7	17755	20395	22025	22025	22025	22025	22025	22025	22025
128.0	17195	19770	22025	22025	22025	22025	22025	22025	22025
131.2	16660	19170	21480	22025	22025	22025	22025	22025	22025
134.5	16155	18605	20855	22025	22025	22025	22025	22025	
137.8	15670	18060	20260	22025	22025	22025	22025	22025	
141.0	15215	17545	19695	21575	22025	22025	22025	22025	
144.3	14775	17055	19150	20990	22025	22025	22025	22025	
147.6	14355	16585	18635	20430	21905	22025	22025	22025	
150.9	13955	16135	18140	19900	21335	22025	22025	22025	
154.2	13575	15705	17665	19385	20795	22025	22025	22025	
157.4	13210	15295	17215	18900	20275	21505	22025	22025	
160.7	12855	14900	16780	18430	19780	20985	22025	22025	
164.0	12520	14520	16365	17960	19300	20480	22025	22025	
167.3	12195	14160	15965	17545	18840	19980	21440	22025	
170.6	11885	13810	15580	17130	18400	19430	20855	22025	
173.9	11585	13475	15210	16735	17980	19075	20470	21625	
177.1	11300	13150	14855	16350	17570	18640	20010	21135	
180.4	11020	12840	14510	15960	17160	18205	19545	20645	
183.7	10755	12540	14180	15625	16780	17800	19110	20175	
187.0	10495	12250	13865	15275	16410	17405	18685	19730	
190.2	10250	11970	13555	14945	16055	17025	18275	19300	
193.5	10010	11700	13260	14625	15710	16660	17885	18885	
196.8	9775	11440	12970	14315	15380	16310	17505	18485	
200.1	9550	11190	12695		15060	15970	17140	18100	
203.4	9335	10945	12425		14745	15640	16785	17725	
206.6	9125	10710	12165		14440	15315	16440	17360	
209.9	8920	10480	11915		14145	15000	16105	17005	
213.2	8725	10260	11670		13860	14695	15780	16660	

Tower Crane Load Chart

127.9	17195	19770	22025	22025	22025	22025	22025	22025
131.2	16660	19170	21480	22025	22025	22025	22025	22025
134.5	16155	18605	20855	22025	22025	22025	22025	
137.8	15670	18060	20260	22025	22025	22025	22025	
141.0	15215	17545	19695	21575	22025	22025	22025	
144.3	14775	17055	19150	20990	22025	22025	22025	

Load capacity at 133' = 22,250 lbs.

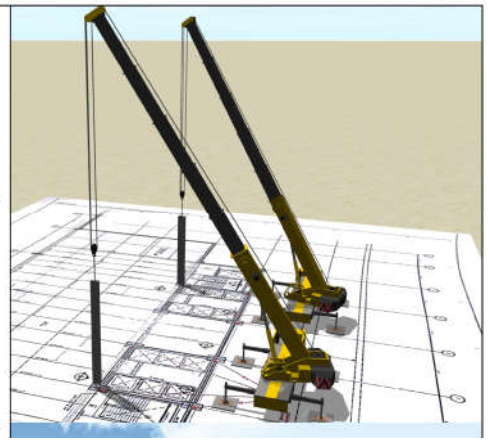
43



Lift Radius 133'
Crane capacity 22,025 lbs.
Safety factor 85%
Allowable load 18,720
Max length of W14 x 1400
Column 13' long #18,200

44

Crane	
Grove GMK5275	
119.1' Main Boom at 58.5°	
Base: 100% Outriggers	
Counterweight: 169,700 lbs	
57' Lift Radius (360°)	
Crane Capacity at 57' = 79,000 lbs	
Load	
Block	1,320 lbs
Rigging	150 lbs
Total Rigging Weight	**1,470 lbs**
Load	60,494 lbs
Total Load	**61,964 lbs**
78% of capacity	
Crane	
Grove GMK5275	
119.1' Main Boom at 58.5°	
Base: 100% Outriggers	
Counterweight: 169,700 lbs	
57' Lift Radius (360°)	
Crane Capacity at 57' = 79,000 lbs	
Load	
Block	1,320 lbs
Rigging	150 lbs
Total Rigging Weight	**1,470 lbs**
Load	60,494 lbs
Total Load	**61,964 lbs**



45

Estimate Erection Plan

We know:

- Material Quantities for Erection
- Site conditions for access, shake out, potential use of mobile crane
- Furnished Tower Crane capacity at each pick point
- Piece weight of each crane pick of concern
- Know (or suspect) the need for engineered stability plan
- Desired schedule from GC/Owner
- Contract issues that might drive cost
- Column lengths for Tower crane picks
- Use of large mobile crane at the lower level to avoid cuts
  - Cost of Field welded splice CJP
  - Time required for splice and impact to schedule
  - Do splices need to be complete prior to setting the next tier?
- Shoring and stability requirements
  - Preliminary contact with erection engineer for cost and ideas
- Fabricator's shipping schedule
- Sequences for the job

46

Estimate Erection Plan cont.

We commit to the plan:

- Critical path Critical activity (often field welding or bolting)
- Staffing for this critical activity
- Equipment for this activity
- Second shift considerations or Overtime
- GC pour schedule drives clean up crew sizes
- Preliminary site specific safety plan
- Office management and field Project Engineer and Ironworker supervision

47

Williams Erection Company

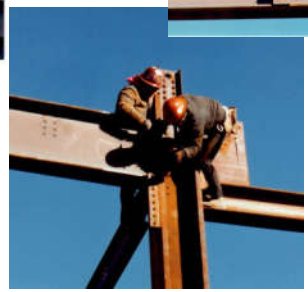
Risk & Safety Program

Site Specific Safety & Erection Plan
Ally Charlotte Center
601 South Tryon Street
Charlotte, North Carolina

48

Table of Contents - I

49



The Not So Good Old Days

50

WEC/ASE
Job Safety Analysis & Training

Fall Protection Anchorage

Tasks Performed

We perform many tasks in steel erection that involve fall protection and the requirement to tie off to a proper anchorage. These include
- Steel Erection
- Welding
- Use of Scaffolds
- Climbing Vertical Ladders
- Aerial Lift Operation

Hazards / Fall Injury Potential

Erection Activities Exposure You to Hazards & injuries such as:
- Fall from Elevation
- Fall from Scaffold
- Fall from Ladders

Resulting in:
- Broken Bones
- Severe Injury
- Death

Connect the retractable hook directly to the "D" ring as shown, or "D" Ring Extension.

Keys to Controlling the Hazards

- Only tie off to a proper anchorage capable of withstanding 5000 lbs of force/worker
- Tie off high – above your head if possible to limit fall distance.
- If using a choker, Use only a 8/16" choker for tie off. Use the shortest choker possible to wrap the structural member. Use the choker in basket.
- If using a retractable, affix the retractable to a proper anchorage with the manufacturer supplied carabineer.
- If tying off to a retractable, tie off the retractable hook directly to the harness "D" ring or to a proper "D" ring extension. Never connect a retractable to a shock absorbing lanyard
- WEC/ASE engineered fall protection systems such as skinner lines, rat lines, horizontal life lines must be installed properly under the direction of a competent person and inspected on a daily basis. 3 clamps on each cable. Never saddle a dead horse.
- If using a rope grab, use rope in good condition and keep the rope grab above your head.
- If using a beamer, connect and adjust the beamer correctly.
- In an aerial lift – tie off only to the marked anchorage

Protect Yourself & Save Your Life!

51

Fall Protection Cable Systems for Stadium Raker Erection

52

Estimate Erection Plan cont.

We price the plan:

Labor:

- Raising gang(s)
- Plumbing and perimeter safety gang
- Bolt up
- Welding
- Decking
- Stud crew
- Stair crew
- Miscellaneous crew
- Site support
- Travel and per diem
- Weather delay estimate

Equipment:

- Cranes
- Man lifts
- Welding equipment
- Generator (if no power)
- Air compressor
- Hoisting

54

Pricing continued:

Tools and supplies:

- Welding electrode
- Preheating supplies
- Rigging
- Safety cable
- Posts
- Personal protection equipment
- Fuel
- Small tools
- Delivery

55

Formalize the:

Erection Scope, Assumptions and Exclusions

A. Engineered lift plan and logistics plan is not required or included.
B. Price Based on all wide flange bracing with bolted splices.
C. Welded Column Splices to be converted to PJP to resist indicated loads and an erection load of 200 Kip Feet of Moment.

PROVISIONS:

- Access inside and around structure, including all roads, ramps, etc. to be provided and maintained by the general contractor.
- All steel and deck shall be sequenced by Williams Erection Company, delivered to the hook by the fabricator.
- No Marshaling of steel is included in this proposal. Controlling contractor (GC) to provide adequate area for unloading and shakeout of material within reach of the erecting cranes.
- Fabricator to provide a 13/16" diameter hole approximately 1' from each end of the top flange of each beam or girder framing column to column only for safety tie off system. Sketch available upon request.

56

- Horizontal and vertical control lines to be by the general contractor.
- We include two strands of 3/8" galvanized aircraft cable to be installed at the perimeter and all major interior openings (including roof). Maintenance and removal will be by the general contractor including all handrail posts and becomes the property of the general contractor.
- This proposal is based on the current edition of **AISC "Code of Standard Practice".**
- Power will be provided by the general contractor. 480 Volts, 3-Phase, 600 Amps. Including cost of power, hook up and material.
- All bent plate or continuous angles shall be shipped loose. If plate is loose then shop attach studs or deform anchors to vertical leg. Fabricator to provide outriggers for all bent plate 1'-0" or greater.

57

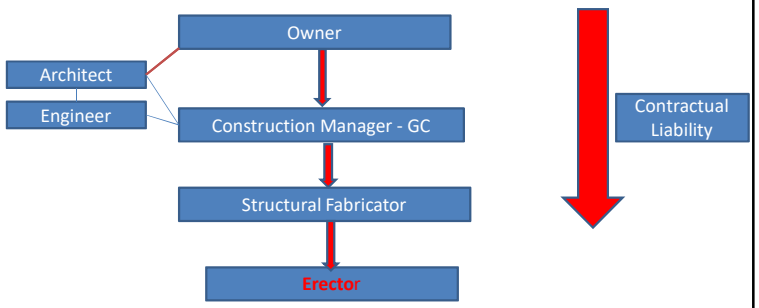
- Fabricator to shop assemble all support frames to maximum extent possible.
- Sidelaps of all floor deck shall be "Button Punched".

Exclusions:
- Cost of bond
- Waiver of subrogation
- Builders Risk Deductible
- Liquidated Damages in excess of 1% of contract price

58

Steel Erection Contractual Relationships

- **Subcontracted to the Structural Fabricator**



59

Scary Contractual Requirements…

- Contract flow down - Incorporation of all the contracts above
- **Schedule changes**
- Subcontractor agrees to comply with any schedule for the Project set forth in the Contract Documents, and with any subsequent updates or modifications to the Project schedule issued by the Owner, the Prime Contractor, or Fabricator.
- **Pay if Paid**

  Progress Payments, less applicable retainage, shall be paid to Subcontractor within 7 days after Fabricator receives payment from the Prime Contractor. To the extent enforceable under applicable law, Fabricator's receipt of payment from the Prime Contractor is specifically made a condition precedent to Fabricator's obligation to make payment to the Subcontractor. In the event of such nonpayment by the Owner or Prime Contractor, Subcontractor's rights and remedies shall be the same as those available to Fabricator under the Trade Contract.

60

- Requirement to proceed without change orders

Time of the Essence - The Subcontractor agrees and recognizes that time is of the essence in its performance of this Subcontract Agreement. Subcontractor further recognizes that the Owner, the Prime Contractor, and Fabricator may sustain financial loss if the Project or any part of it is delayed because the Subcontractor fails to perform any or all of its Work in accordance with the Contract Subcontract Agreement. Subcontractor agrees to begin performance when directed by Fabricator and to perform in such a manner, at such times, and in such order as Fabricator may direct, so as not to delay the Project. **Subcontractor agrees that in the event of any claim, dispute or other matter in question arising out of or relating to this Subcontract Agreement (hereinafter "dispute"), the Subcontractor shall continue to diligently perform all obligations as required under this Agreement and will not directly or indirectly stop or delay the Work in any way, notwithstanding the existence of such dispute(s).**

61

With the signing of the contract the marriage is official.
Torchio's two laws of construction contracts:

1. **A bad contract with a good customer is much to be preferred to a good contract with a bad customer**
2. **Perfect performance of the parties obviates the contract.**

The way to assure the contract stays in the drawer is to perform as expected and communicate with your customer.

The Golden Rule
Bonding
Legal Process
Mediation
Arbitration
Court

62

PART TWO
We have a job!

- Pre detailing meeting to request changes for ease of erection or economic betterment
- Erector Pre mobilization planning
- Site specific Erection plan
- Engineered Stability Plan (if required)
- Doing the Work

63

Pre Mobilization Planning

Fabricator's pre detailing meeting

- **Finalize sequencing**
  - **Driven by lay down area, shake out area, delivery restriction for traffic control**
- **Finalize connection design for erection ease**
- **Welded splice joint design**
- **Erection connections for hoisting**
- **Stability provisions**

64

Erection Sequence Plan from Site Erection Plan

Note that multipe sequences may arrive on site and be unloaded, cribbed and spread in laydown area or erected directly off of truck. For clarify, we are listing the receiving of each sequence in order. Basic Erection Sequence is to erect columns, erect beams so as to box in floor by floor for column stability in addition to connecting frame to core concrete embeds. This erection plan may be adjusted at the discretion of the WEC project manager and foreman.

The Basic Sequence Summary Tables Are As Follows:

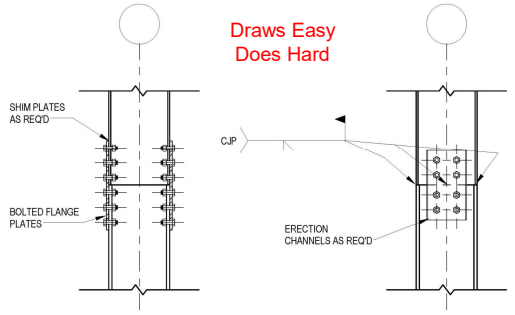
Steel Erection Project Set Up

Sequence #	Description – 300 Tryon Tower Erection Set Up
Set Up	Verify Field Survey Anchor Bolts and Shear Wall Embeds – All Sequences as Tower Proceeds
Set Up	Locate and Set up WEC office and con ex
Set Up	Locate and Arrange Electrical for Welding Equipment
Set Up	Inspect Rigging and Check Rigging Certification for All Riggers
Set Up	Perform WEC safety orientation for initial crew

Embed and Connection Material Steel Erection

Sequence #	Embed Sequences
1	Verify & Install Embeds Below Ground - Follow Embed Drawings
2	Verify & Install Embeds Ground Floor to Level 5 - Follow Embed Drawings
3	Verify & Install Embeds Level 6 to Level 5 - Follow Embed Drawings
4	Verify & Install Embeds Level 16 & Above - Follow Embed Drawings
Sequence #	**Clips / Connection Material to Concrete**
5	Verify & Install Clips & Connection Steel Below Ground Floor – Follow Connection Drawings
6	Verify & Install Clips & Connection Steel Ground Floor to Level 5
7	Verify & Install Clips & Connection Steel Level 6 to Level 16
8	Verify & Install Clips & Connection Steel Level 16 & Above
Sequence #	**Canopy @ Level 2 and 3**
9	Erect Canopy Steel Level 2 Erection on Hold
10	Erect Canopy Steel Level 3 Erection on Hold

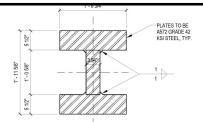
Draws Easy
Does Hard

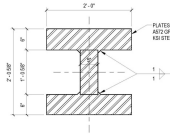


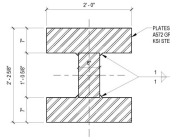
DETAIL — TYPICAL COLUMN SPLICE — B2 / S300
SCALE: 3/4" = 1'-0"

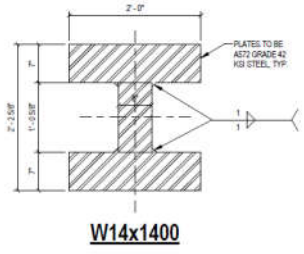
LOAD

66









PLAN DETAIL — W14 BUILT-UP COLUMNS — D4 / S200
SCALE: 1" = 1'-0"

PLAN DETAIL — W14 BUILT-UP COLUMNS — D4 / S200
SCALE: 1" = 1'-0"

67

Complete Joint Penetration (CJP) for W14 x 1194

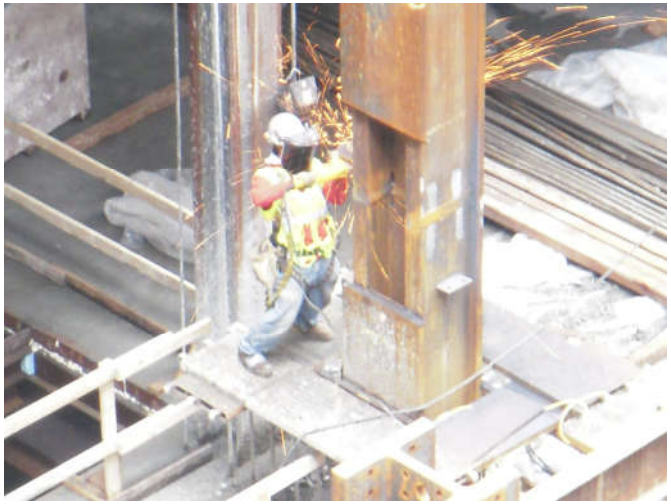
Assume 30 degree bevel, 3/8 root - AWS D1.1
Prequalified B U 4a (leaving out the web)

Flange weld area 6" X 3.46" X 24" = 498 in^3
Root opening 2 @ 6" X .375 X 24" = 108in^3
Run off tabs 4@ (6"X 3.46 X 2")/2 = 83in^3

Total Volume 690 in^3 Steel weight 193 lbs.
FCAW weight 230 lbs.

Assuming a welder deposits 35 lbs. of FCAW an 8 hour shift this is a **6.5 Man day column splice**

68



69

70

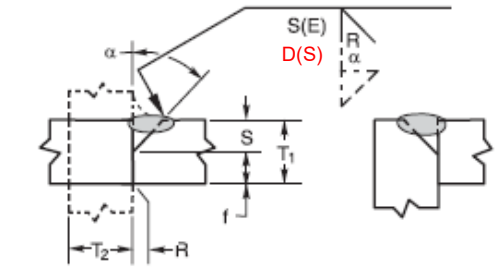
71

AWS D1.1 Currently **S** **E**
AWS D1.1 D 2020 **D** **S**

CL	Level	upper col	lower col	Tension		
F5	4	W14x1194	W14x1400	4295	3.25	3.125
F5	6	W14x1194	W14x1194	3570	2.75	2.625
F5	8	W14x1194	W14x1194	2885	2.375	2.25
F5	10	W14x873	W14x1194	2235	2.375	2.25
F5	12	W14x808	W14x873	1645	1.875	1.75
F5	15	W14x605	W14x808	1110	1.625	1.5
F5	17	W14x257	W14x605	675	1.25	1.125
F5	19	W14x257	W14x257	285	0.875	0.75
F5	21	W14x257	W14x257	105	0.75	0.625
F5	23	W14x257	W14x257	165	0.875	0.75
F5	25	W14x257	W14x257	220	0.875	0.75
F5	27	W14x90	W14x257	55	NA	CJP
G4	4	W14x1194	W14x1400	1510	1.5	1.375
G4	6	W14x1194	W14x1194	1165	1.25	1.125
G4	8	W14x1194	W14x1194	860	1.125	1
G4	10	W14x873	W14x1194	580	1.125	1
G4	12	W14x808	W14x873	355	0.875	0.75
G4	15	W14x605	W14x808	170	0.75	0.625
G4	17	W14x257	W14x605	21	0.625	0.5
G4	19	W14x257	W14x257	0	0.625	0.5
G4	21	W14x257	W14x257	155	0.75	0.625
G4	23	W14x257	W14x257	355	1	0.875
G4	25	W14x257	W14x257	530	1.125	1
G4	27	W14x90	W14x257	85	NA	CJP
G5	4	W14x1194	W14x1400	3575	2.75	2.625
G5	6	W14x1194	W14x1194	2885	2.375	2.25
G5	8	W14x1194	W14x1194	2285	2	1.875

PJP Welds sized per tension and moment loads
and use of 70 KSI Filler Metal

72



73

PJP for W14 x 1194

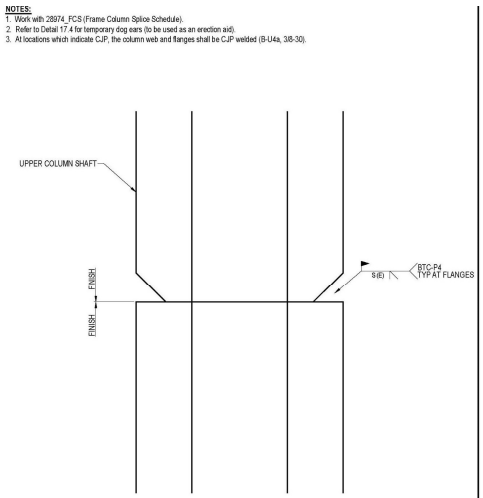
Assume 45 degree bevel, AWS D1.1 Prequalified BTC P4 GF
Weld Groove from Table 3.25"
Flange weld area 3.25" X 3.25" X 24" = 254 in^3
Root opening 0
Run off tabs 4@ (3.25"X 3.25 X 1.5")/2 = 32in^3

Total Volume 286 in^3 Steel weight 80 lbs. FCAW weight 95 lbs.

Assuming a welder deposits 50 lbs. of FCAW an 8 hour shift
this is a 1.9 Man day column splice

Labor saving by using PJP = 4.6 man days
Direct labor cost at $50 per hour = $1,840
Indirect savings ??

74



75

Some Interesting Jobs and Special Erection Considerations

76

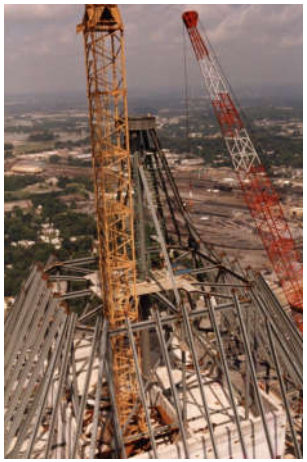
77

78

79

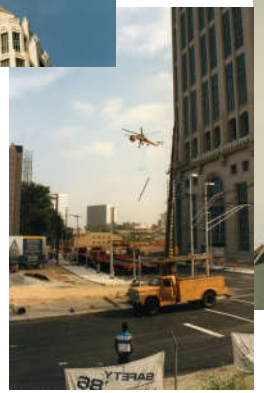
80

Multi Crane Combinations



Concrete cored building with exterior cranes tied off to the core prevented cranes going higher.
Third crane installed to complete skin and steel erection

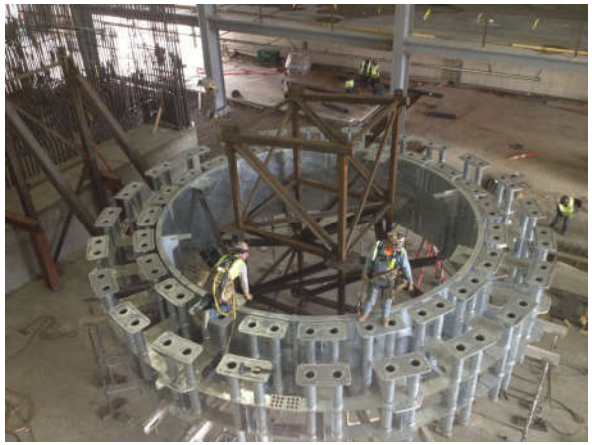
81



Alternative Hoisting
20,000 Lb. Capacity

82

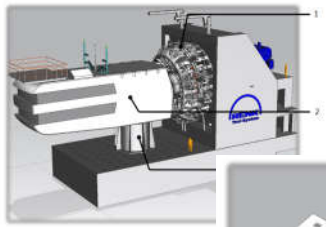
Precision Placement of Concrete Embed

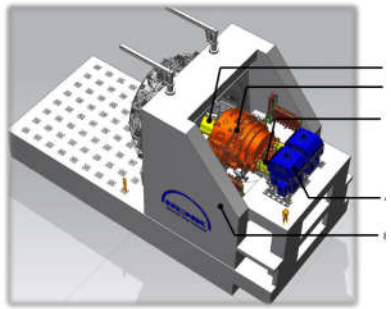


Small (relatively) but precise

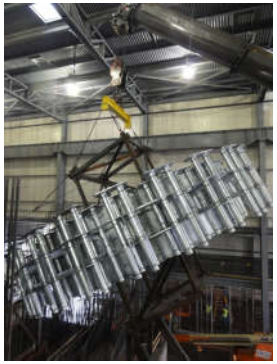
83

15 Mega Watt Test Stand

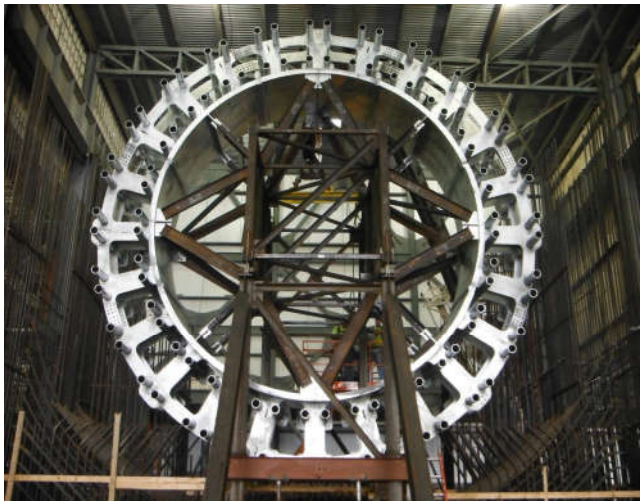




84

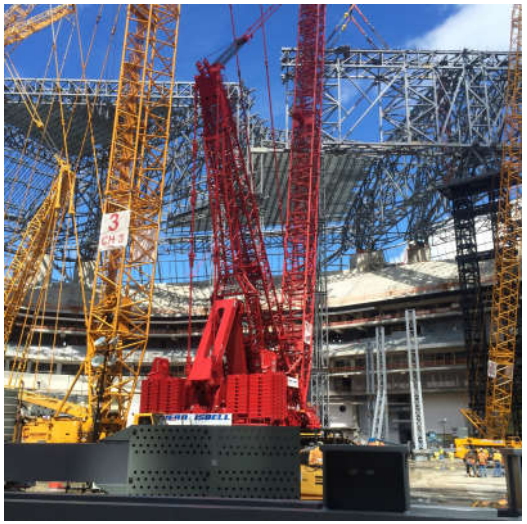


85



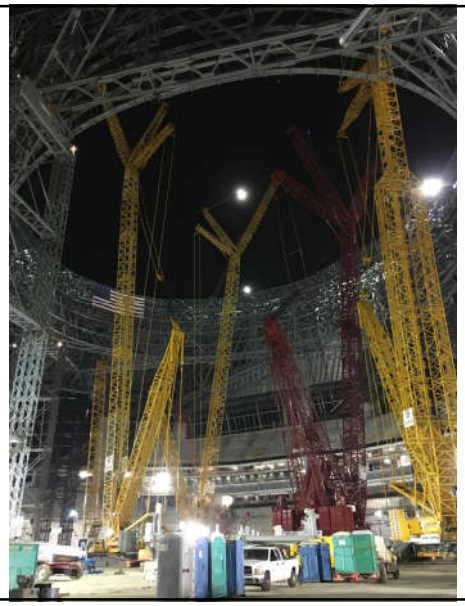
86

Large Cranes
600 Ton Lifts

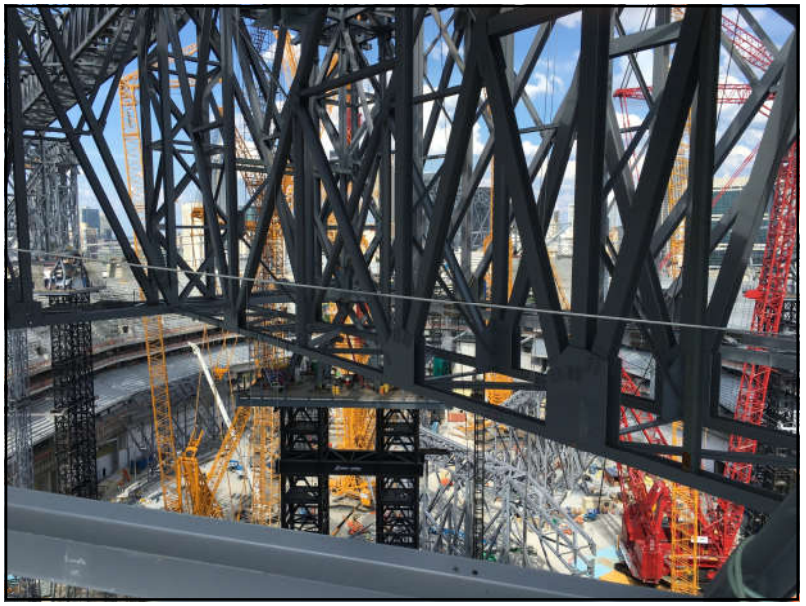


87

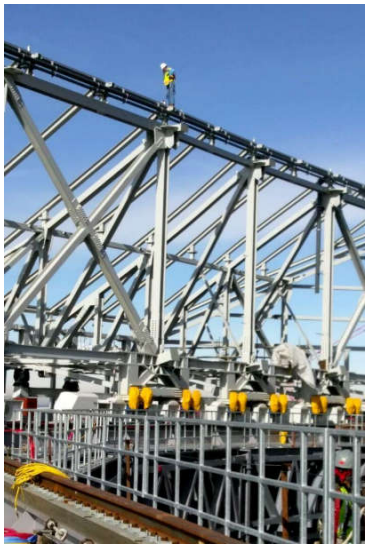
88



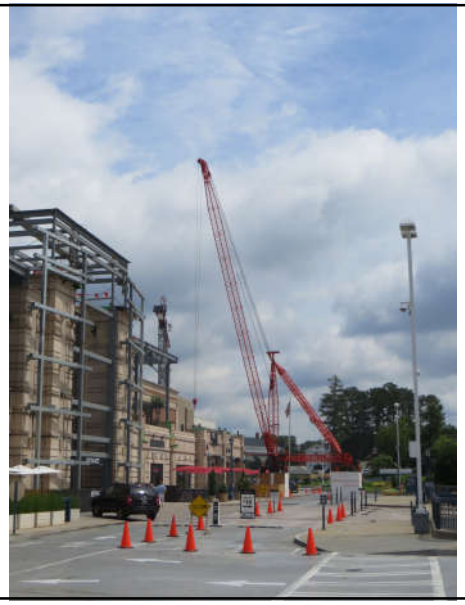
89



91



92



Alternative to use of large cranes:

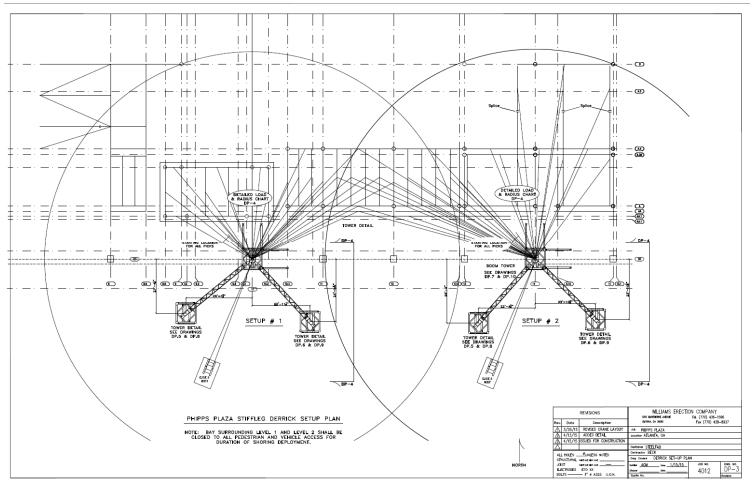
Derrick VS 500 ton Truck Crane

$3,500/ Month

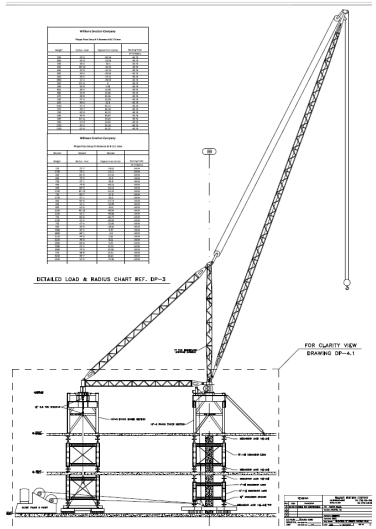
VS

$4,000/ day

93



94



95

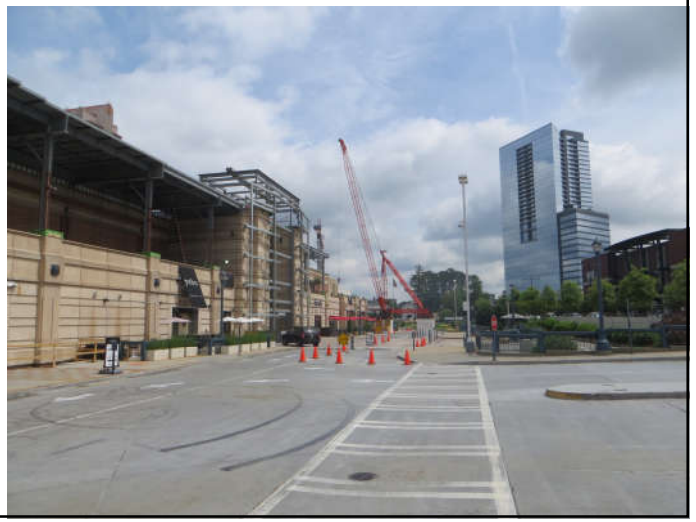
Williams Erection Company

Phipps Plaza Setup # 1 Between 8 & 12 Lines

Weight	Radius - Feet	Degree From Center	Starting Point
			14'-0 Radius
390	34'-9	-60.24	-43.76
820	43'-9	-52.04	-43.76
300	48'-0	-40.5	-43.76
650	38'-10	-46.13	-43.76
650	32'-9	-34.74	-43.76
800	39'-2	-20.94	-43.76
650	28'-5	-19.12	-43.76
1850	22'-2	-39.06	-43.76
650	26'-11	0	-43.76
300	36'-8	5.08	-43.76
855	28'-0	13.39	-43.76
680	33'-8	24.56	-43.76
370	48'-8	25.56	-43.76
500	37'-5	29.59	-43.76
920	40'-2	35.8	-43.76
1150	41'-9	42.11	-43.76
370	29'-7	44.18	-43.76
730	60'-9	43.72	-43.76
500	46'-9	45.87	-43.76
500	50'-11	50.24	-43.76
500	55'-4	53.94	-43.76
1750	47'-0	63.16	-43.76
1150	63'-9	61.32	-43.76

96

99



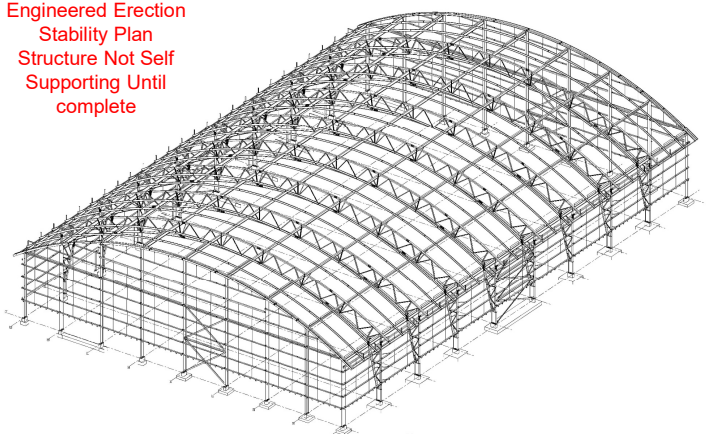
Engineered Erection Plans

Big and Light

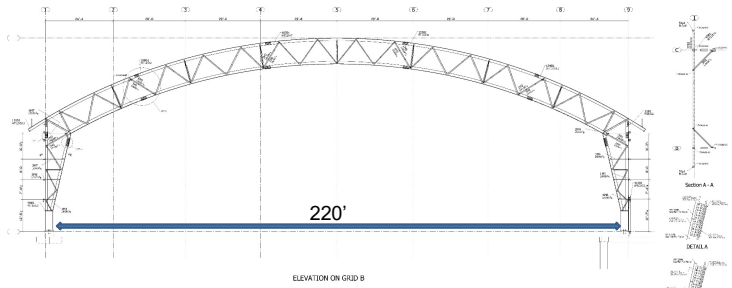
Big and Heavy

101

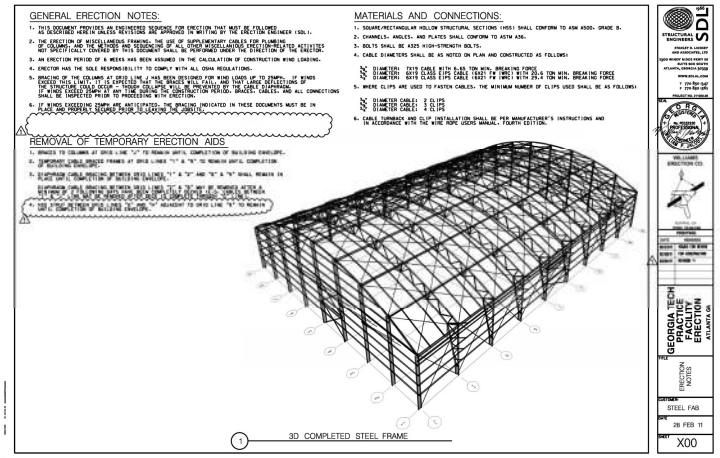
Georgia Tech Football Practice Facility
Engineered Erection Stability Plan
Structure Not Self Supporting Until complete



102



103



104

GENERAL ERECTION NOTES:

1. THIS DOCUMENT PROVIDES AN ENGINEERED SEQUENCE FOR ERECTION THAT MUST BE FOLLOWED AS DESCRIBED HEREIN UNLESS REVISIONS ARE APPROVED IN WRITING BY THE ERECTION ENGINEER (SDL).
2. THE ERECTION OF MISCELLANEOUS FRAMING, THE USE OF SUPPLEMENTARY CABLES FOR PLUMBING OF COLUMNS, AND THE METHODS AND SEQUENCING OF ALL OTHER MISCELLANIOUS ERECTION-RELATED ACTIVITES NOT SPECIFICALLY COVERED BY THIS DOCUMENT SHALL BE PERFORMED UNDER THE DIRECTION OF THE ERECTOR.
3. AN ERECTION PERIOD OF 6 WEEKS HAS BEEN ASSUMED IN THE CALCULATION OF CONSTRUCTION WIND LOADING.
4. ERECTOR HAS THE SOLE RESPONSIBILITY TO COMPLY WITH ALL OSHA REGULATIONS.
5. BRACING OF THE COLUMNS AT GRID LINE J HAS BEEN DESIGNED FOR WIND LOADS UP TO 25MPH. IF WINDS EXCEED THIS LIMIT, IT IS EXPECTED THAT THE BRACES WILL FAIL, AND THAT LARGE DEFLECTIONS OF THE STRUCTURE COULD OCCUR - THOUGH COLLAPSE WILL BE PREVENTED BY THE CABLE DIAPHRAGM. IF WINDS EXCEED 25MPH AT ANY TIME DURING THE CONSTRUCTION PERIOD, BRACES, CABLES, AND ALL CONNECTIONS SHALL BE INSPECTED PRIOR TO PROCEEDING WITH ERECTION.
6. IF WINDS EXCEEDING 25MPH ARE ANTICIPATED, THE BRACING INDICATED IN THESE DOCUMENTS MUST BE IN PLACE AND PROPERLY SECURED PRIOR TO LEAVING THE JOBSITE.

REMOVAL OF TEMPORARY ERECTION AIDS

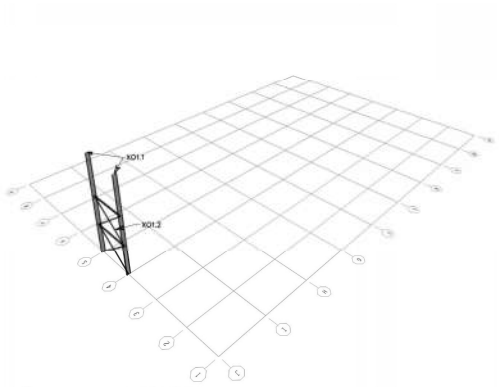
1. BRACES TO COLUMNS AT GRID LINE "J" TO REMAIN UNTIL COMPLETION OF BUILDING ENVELOPE.
2. TEMPORARY CABLE BRACED FRAMES AT GRID LINES "1" & "9" TO REMAIN UNTIL COMPLETION OF BUILDING ENVELOPE.
3. DIAPHRAGM CABLE BRACING BETWEEN GRID LINES "1" & "2" AND "8" & "9" SHALL REMAIN IN PLACE UNTIL COMPLETION OF BUILDING ENVELOPE.

   DIAPHRAGM CABLE BRACING BETWEEN GRID LINES "2" & "8" MAY BE REMOVED AFTER A MINIMUM OF 2 FOLLOWING BAYS HAVE BEEN COMPLETELY DECKED (E.G. CABLES BETWEEN "1" & "3" LINE MAY BE REMOVED AFTER DECK IS COMPLETE THROUGH "G" LINE).
4. HSS STRUT BETWEEN GRID LINES "G" AND "H" ADJACENT TO GRID LINE "9" TO REMAIN UNTIL COMPLETION OF BUILDING ENVELOPE.

105

X01.1 ERECT W30 COLUMNS AT GRID LINES J-4 AND J-5.
X01.2 ERECT PERMANENT HORIZONTAL BRACING BETWEEN COLUMNS.

NOTE: IF WIND SPEED IS ANTICIPATED TO EXCEED 25MPH, COLUMN BRACES SHALL BE IN PLACE IN ACCORDANCE WITH SHEETS X03 AND X04.



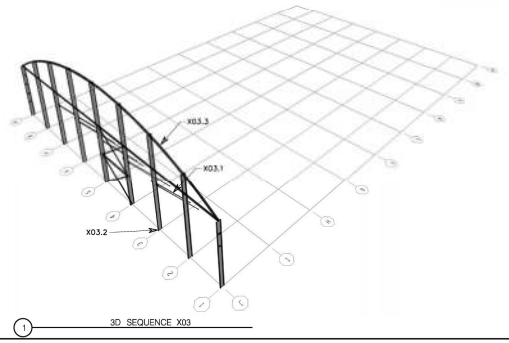
1 3D SEQUENCE X01

STRUCTURAL ENGINEERS SDL
GEORGIA TECH PRACTICE FACILITY ERECTION ATLANTA GA
ERECTION SEQUENCE X01
STEEL FAB
28 FEB 11
X01

106

X03.1 ERECT TILT-UP BRACES TO W30 COLUMNS AT GRIDS J-3, J-4, J-5, J-6, AND J-7, SEE SHEET X04 FOR DETAILS.
X03.2 WELD PLATE WASHERS TO TOP OF BASE PLATES AT COLUMNS ON GRID LINE J WITH ¼" FILLET WELDS ALL AROUND.
X03.3 ERECT W12 ARCH BEAM AT TOP OF W30 COLUMNS.

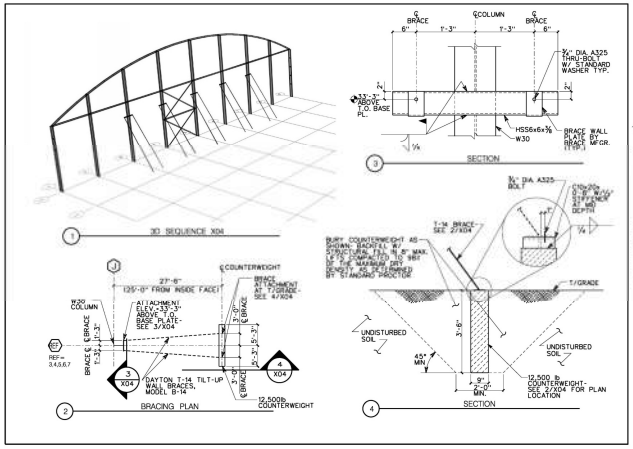
NOTE: IF WIND SPEED IS ANTICIPATED TO EXCEED 25MPH PRIOR TO SETTING OF TRUSS AT GRID LINE J, COLUMNS AT GRID LINES J-1, J-2, J-8, AND J-9 SHALL BE GUYED TO 2000LB MIN. DEADMEN IN EACH DIRECTION OR TEMPORARILY TAKEN DOWN.



1 3D SEQUENCE X03

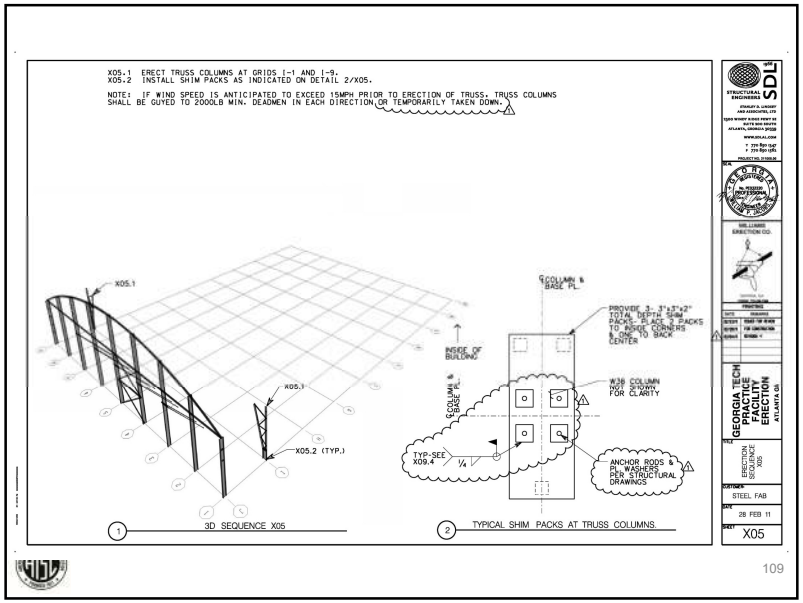
STRUCTURAL ENGINEERS SDL
GEORGIA TECH PRACTICE FACILITY ERECTION ATLANTA GA
ERECTION SEQUENCE X03
STEEL FAB
28 FEB 11
X03

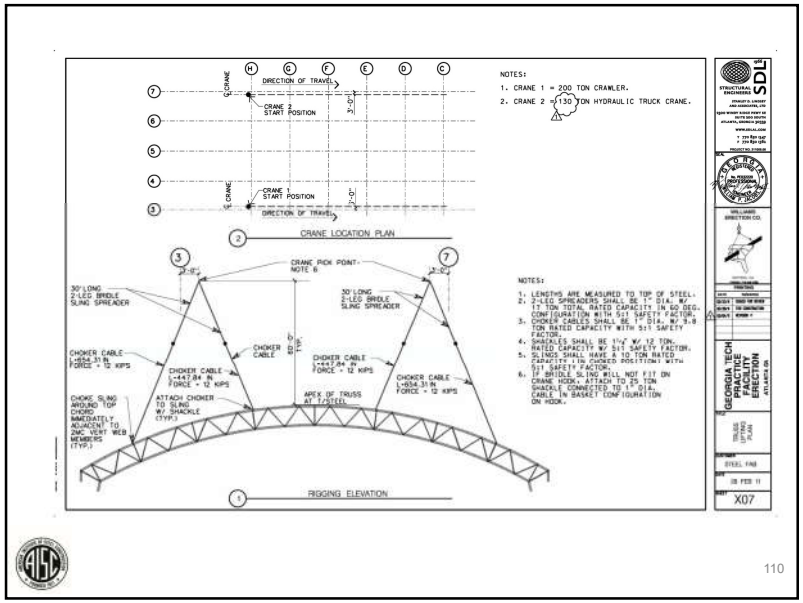
107

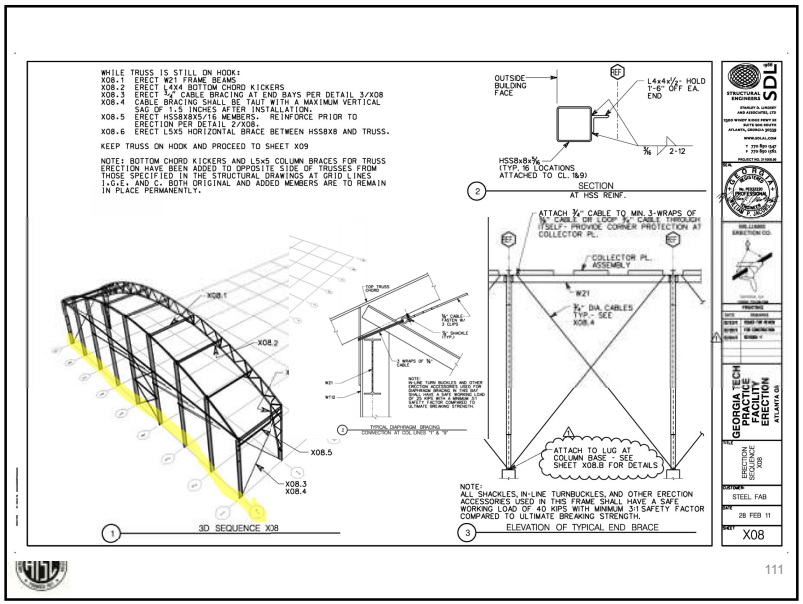


STRUCTURAL ENGINEERS SDL
GEORGIA TECH PRACTICE FACILITY ERECTION ATLANTA GA
COLUMN BRACING PLAN
STEEL FAB
28 FEB 11
X04

108







Project: RSA Judicial Office Building
Location: Montgomery, AL
GC: Bailey Harris
Fabricator: SteelFab

Project consisted of 3- 150 ft. span two story transfer trusses supporting a nine story building over a National Historic Register Building in downtown Montgomery. The trusses were assembled in place utilizing an outrigger skyhook system anchored to the adjacent concrete structure for the first truss. Truss elevation was managed by hydraulic jacking system.

Engineered erection plan and procedure was provided

Total Truss Weight for Each Truss – 300 tons fully assembled

Hoisting by 500 ton hydraulic Liebherr Luffing Crane

113

Project: RSA Judicial Office Building
Location: Montgomery, AL
GC: Bailey Harris
Fabricator: SteelFab

Erection and assembly of the final truss sections supported by the skyhook system connected to previously erected trusses. Each truss consisted of over 400 lf. of field welding and 16,000 bolts per truss.

114

ERECTION NOTES

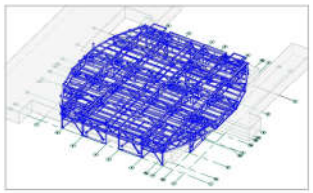
GENERAL ERECTION NOTES

1. THIS DOCUMENT PROVIDES AN ENGINEERED SEQUENCE FOR ERECTION THAT MUST BE FOLLOWED AS DESCRIBED HEREIN UNLESS REVISIONS ARE APPROVED IN WRITING BY STANLEY D. LINDSEY AND ASSOCIATES (SDL).
2. THE ERECTION OF MISCELLANEOUS FRAMING, THE USE OF SUPPLEMENTARY CABLES FOR PLUMBING OF COLUMNS, AND THE METHODS AND SEQUENCING OF ALL OTHER MISCELLANEOUS ERECTION#RELATED ACTIVITIES NOT SPECIFICALLY COVERED BY THIS DOCUMENT SHALL BE PERFORMED UNDER THE DIRECTION OF THE ERECTOR.
3. AN ERECTION PERIOD OF SIX WEEKS TO ONE YEAR HAS BEEN ASSUMED FOR THE PODIUM STEEL IN THE CALCULATION OF CONSTRUCTION WIND LOADING.
4. ERECTOR HAS THE SOLE RESPONSIBILITY TO COMPLY WITH ALL OSHA REGULATIONS.
5. CONNECTION DESIGN OF TRUSS CONNECTIONS FOR CONSTRUCTION LOADING WAS DELEGATED TO STEELFAB INC. FINAL CONSTRUCTION FORCES WERE PROVIDED TO STEELFAB BY SDL ON JUNE 20, 2011, WITH A SUPPLEMENTARY EMAIL DATED JULY 29, 2011.
6. THE ANALYSIS AND DESIGN OF TEMPORARY BRACED FRAMES AND THEIR CONNECTIONS FOR ERECTION WAS PERFORMED BY SDL AS ILLUSTRATED IN THE X4 SERIES DRAWINGS DATED JUNE 20, 2011.
7. THE GENERAL ERECTION SEQUENCING INFORMATION PROVIDED IN THIS DOCUMENT SHALL BE USED IN CONJUNCTION WITH THE DETAILED ERECTION DRAWINGS PROVIDED BY STEELFAB INC.
8. MEMBERS ILLUSTRATED WITHIN EACH SEQUENCE IN RED ARE NEW TO THAT SEQUENCE, AND MEMBERS ILLUSTRATED IN BLUE HAVE BEEN PREVIOUSLY ERECTED.
9. THE EXACT ORDER OF THE SUB#STEPS (LETTERED A, B, C, ETC) WITHIN EACH MAIN TRUSS ERECTION STEP IS NOT CRITICAL PROVIDED THAT ALL STEPS ARE COMPLETE PRIOR TO RELEASING THE TRUSS SECTION FROM THE CRANE.
10. ALL COLUMN BASEPLATES MUST BE GROUTED AND GROUT MUST ACHIEVE 75% OF ITS SPECIFIED 28#DAY COMPRESSIVE STRENGTH PRIOR TO ERECTION OF THE SUPPORTED TRUSS SECTION.
11. SEE STEELFAB SHEET E250 FOR TYPICAL TRUSS DETAILS INCLUDING ERECTION SEQUENCING INFORMATION FOR THE COMPLETION OF TRUSS CHORD SPLICES, WING PLATE CONNECTIONS, LOOSE COVER PLATES, AND TEMPORARY GUSSET ERECTION AIDS.

MATERIALS AND CONNECTIONS

1. SQUARE/RECTANGULAR HOLLOW STRUCTURAL SECTIONS (HSS) SHALL CONFORM TO ASTM A500, GRADE B.
2. CHANNELS, ANGLES, AND PLATES SHALL CONFORM TO ASTM A36.
3. BOLTS SHALL BE A325 OR A490 HIGH-STRENGTH BOLTS.
4. CABLE DIAMETERS SHALL BE AS NOTED ON PLAN AND CONSTRUCTED AS FOLLOWS:
   - 3/8" DIAMETER: 7X19 CABLE WITH 6.00 TON MIN. BREAKING FORCE
   - 5/8" DIAMETER: 6X19 CLASS EIPS CABLE (6021 PR 39PC) WITH 30.4 TON MIN. BREAKING FORCE
   - 3/4" DIAMETER: 6X19 CLASS EIPS CABLE (6021 PR 39PC) WITH 39.4 TON MIN. BREAKING FORCE
5. ANCHOR CLIPS ARE USED TO FASTEN CABLES. THE MINIMUM NUMBER OF CLIPS USED SHALL BE:
   - 3/8" DIAMETER CABLE: 2 CLIPS
   - 5/8" DIAMETER CABLE: 3 CLIPS
   - 3/4" DIAMETER CABLE: 4 CLIPS
6. CABLE TURNBACK AND CLIP INSTALLATION SHALL BE PER MANUFACTURER'S INSTRUCTIONS AND IN ACCORDANCE WITH THE WIRE ROPE USERS MANUAL, FOURTH EDITION.

Erection Stability Plan for Heavy Structure with Life Safety Issues

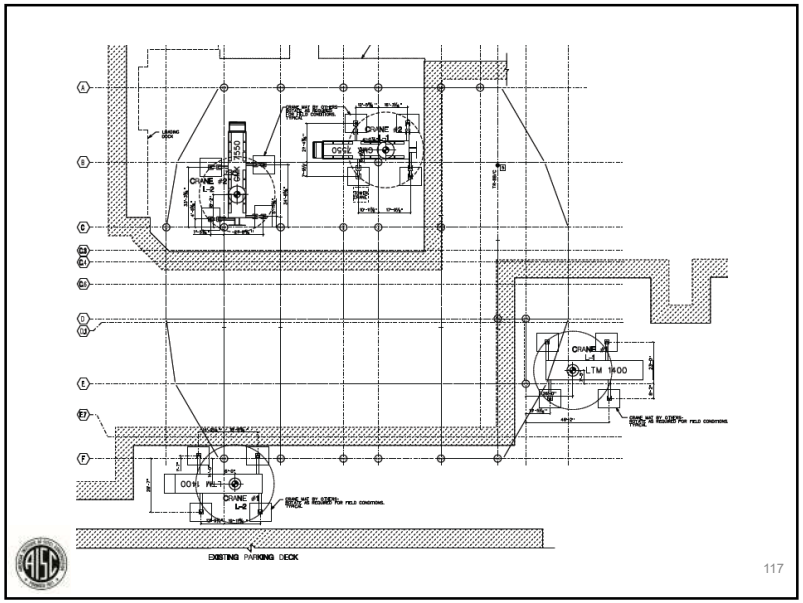


1 3D OVERALL PODIUM VIEW

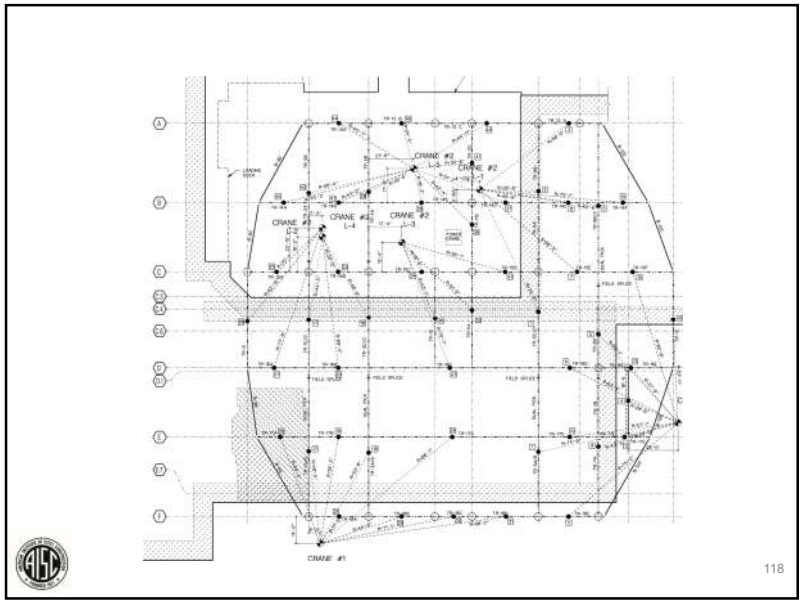
SDL
WILLIAMS ERECTION CO.
MULLOOD ICU PODIUM TRUSS ERECTION
ERECTION NOTES
STEELFAB
08/05/11
X5-1

115

116



117

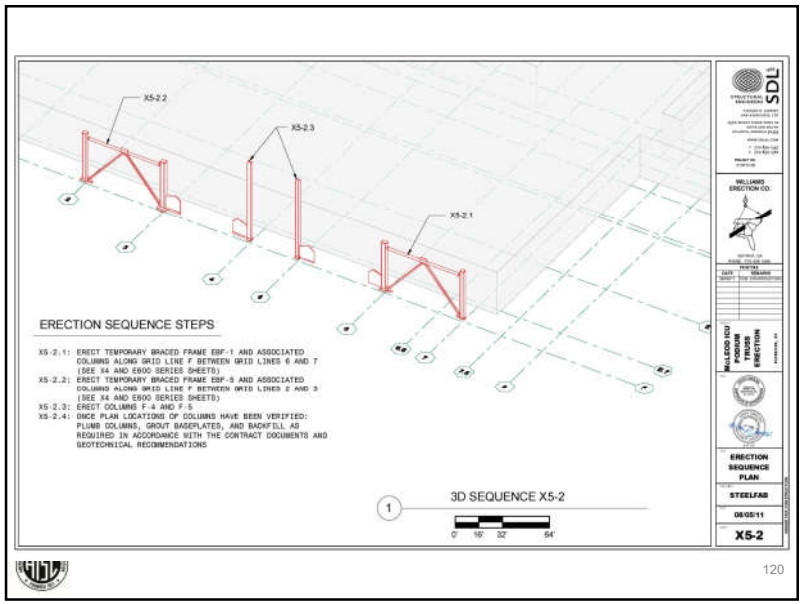


118

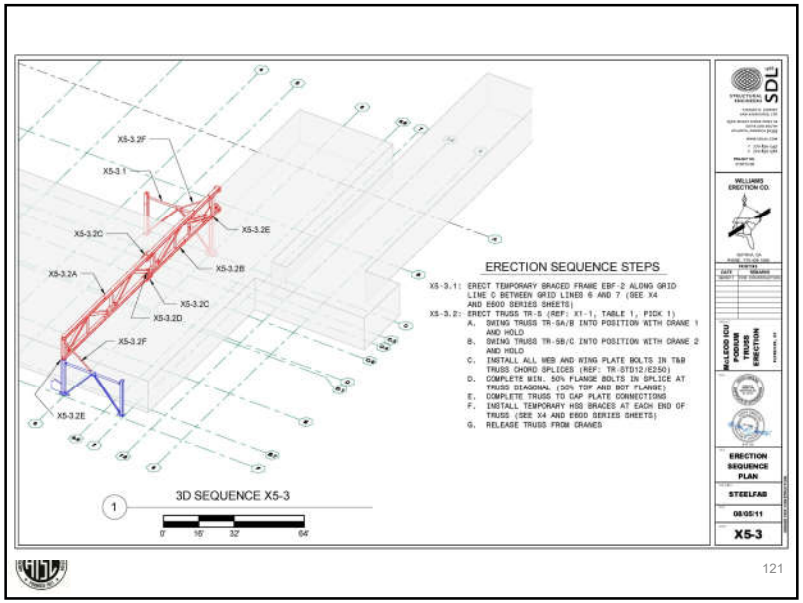
8:D-C	62,825	X	4500	67,325	67,325	53'-11"	55
2:D-F	186,976	X	6000	192,976	398,174	48'-5"	50
2:C-D	199,198	X	6000	205,198		44'-3"	45
3:D-F	160,728	X	6000	166,728	330,870	53'-8"	55
3:C-D	158,142	X	6000	164,142		48'-9"	50
E:2-3	24,515	X	4500	29,015	29,015	56'-3"	60
D:2-3	47,968	X	4500	52,468	52,468	69'-3"	70
F:2-3	56,584	X	4500	61,084	61,084	17'-2"	20
C:2-3	58,158	X	4500	62,658	62,658	20'-0"	20
D:3-5	103,930	X	4500	108,430	108,430	70'-7"	75
E:3-6	90,926	X	4500	95,426	95,426	88'-7"	90

Grid Piece wt. Weighed Rigging Lift Wt. Total Radius

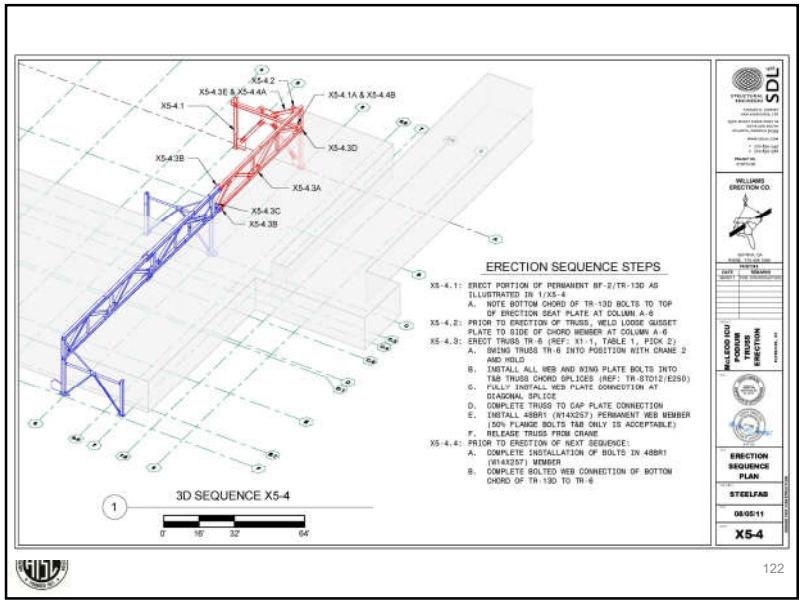
119



120



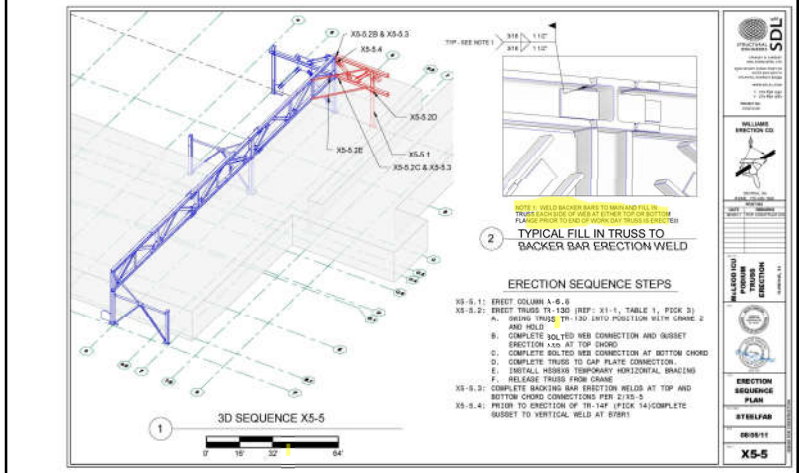
121



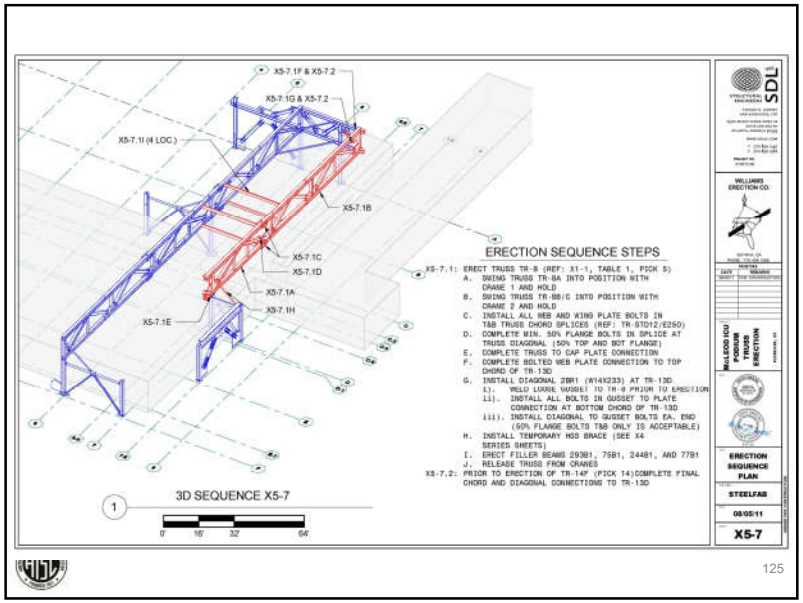
122

McLEOD REGIONAL MEDICAL CENTER ICU TOWER ERECTION, FLORENCE, SOUTH CAROLINA: McLeod Regional Medical Center proposed the construction of a new ICU tower in the location of their existing cafeteria and central utility plant; however, due to the extreme difficulty and expense associated with shutting down the utility plant for an entire hospital complex, the new building was supported by a grid of 19 transfer trusses that had to be erected over the existing and fully operational building. Each truss weighs up to 365,000lbs and several included splices to be completed over the existing hospital. Stanley D. Lindsey and Associates, Ltd (SDL) worked with Williams Erection Company to provide erection services for this operation. Stability analysis was performed at each stage of the erection for gravity loads and construction wind loading. SDL also worked closely with the fabricator and provided connection concepts and construction loads for connection design including temporary splicing connections. SDL provided crane layout and configuration plans for each crane location. In addition to the crane layout plans, a 3D Revit-based erection sequence plan was provided to illustrate each erection step. Intense coordination was required between all parties, and SDL provided several presentations including animations of crane locations and pick sequencing to clearly communicate the plan to the contractor and owner.

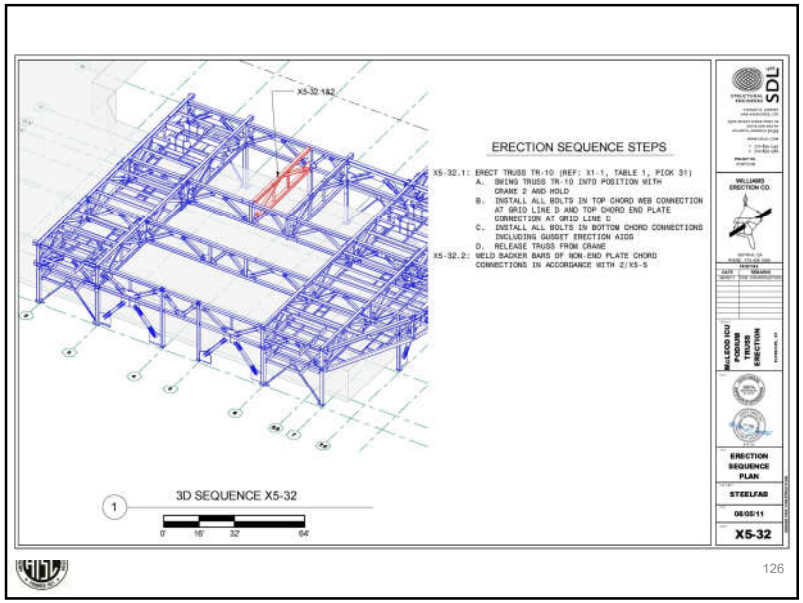
123



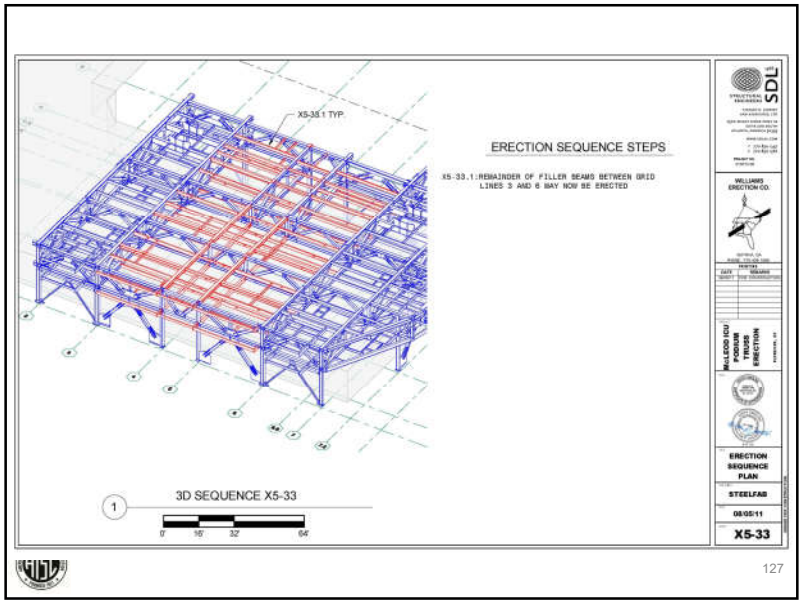
124



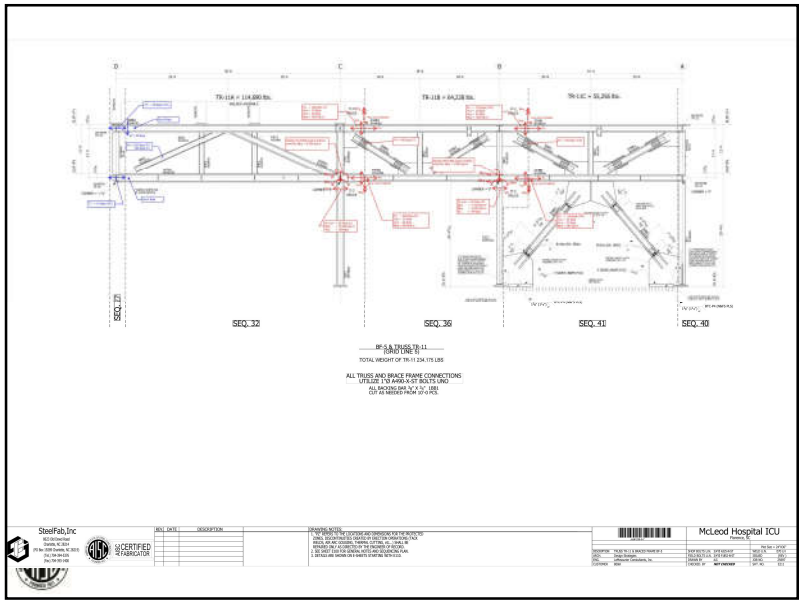
125

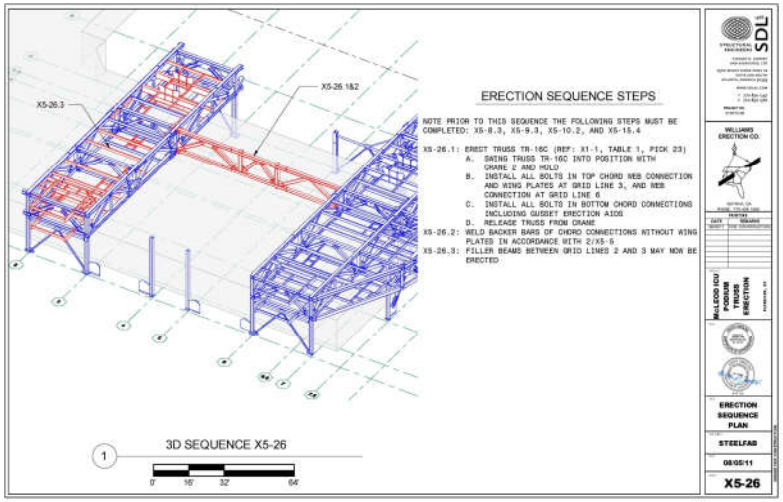


126



127





McLeod Hospital Over Build
This consists of building a truss system over the existing staff Cafeteria, laundry and power facility for the existing operating hospital

AISC | Questions?

Smarter. Stronger. Steel.

Single-Session Registrants

CEU / PDH Certificates

- You will receive an email on how to report attendance from: registration@aisc.org.
- Be on the lookout: Check your spam filter! Check your junk folder!
- Completely fill out online form. Don't forget to check the boxes next to each attendee's name!

Smarter. Stronger. Steel.

Single-Session Registrants

CEU / PDH Certificates

- Reporting site (URL will be provided in the forthcoming email).
- Username: Same as AISC website username.
- Password: Same as AISC website password.

Smarter. Stronger. Steel.

3-Session Registrants

CEU / PDH Certificates

One certificate will be issued at the conclusion of the course.

Smarter. Stronger. Steel.

3-Session Registrants

Attendance and PDH Certificates

- You have two options to receive credit for a given session.
  - Option 1: Watch the live session. Credit for live attendance will be displayed on the Course Resources table within two days of the session.
  - Option 2: Watch the recording and pass the associated quiz.

Videos and Quizzes

- For each session, find access within two business days after the live air date. (An email will be sent from webinars@aisc.org.)
- Quiz scores are displayed in the Course Resources table.

Distribution of Certificates

All certificates will be issued after the course is completed. Only the registrant will receive a certificate for the course.

Smarter. Stronger. Steel.

3-Session Registrants

Course Resources

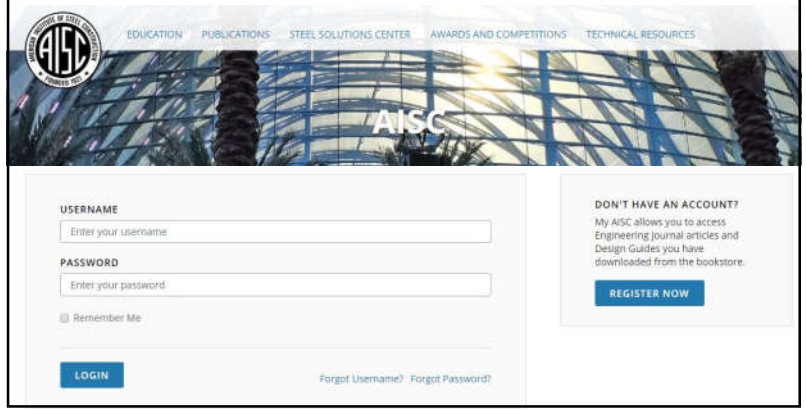
Find all your handouts, quizzes and quiz scores, recording access, and attendance information in one place!

Smarter. Stronger. Steel.

3-Session Registrants

Course Resources

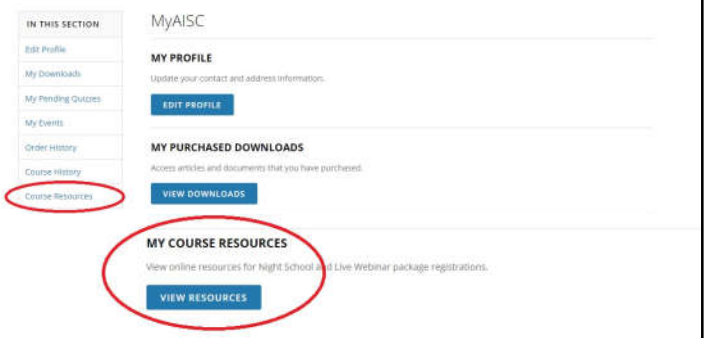
Go to www.aisc.org and sign in.



3-Session Registrants

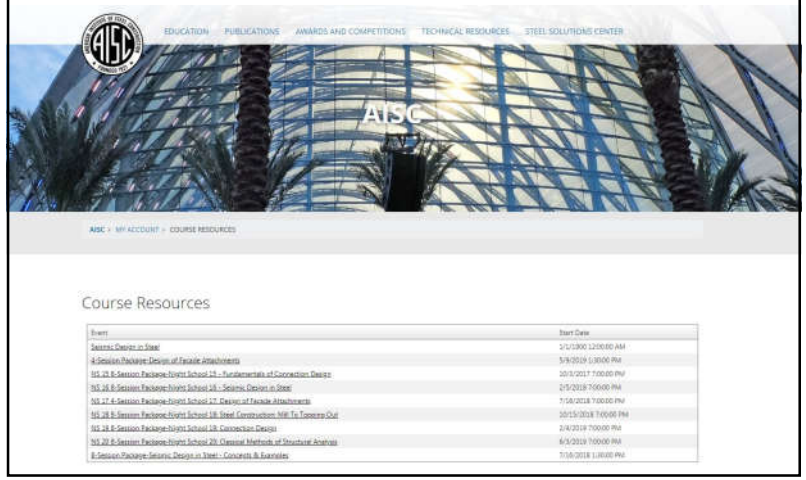
Course Resources

Go to www.aisc.org and sign in.



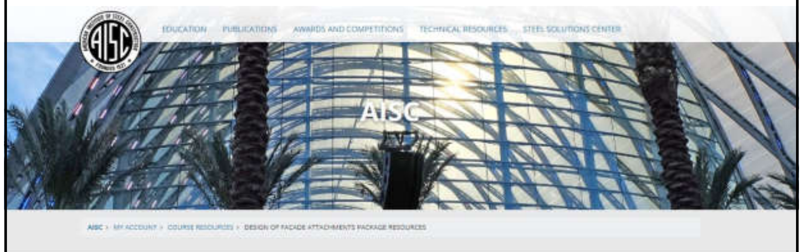
3-Session Registrants

Course Resources



3-Session Registrants

Course Resources



Design of Facade Attachments

4-SESSION PACKAGE RESOURCES

Event	Date	Handouts	Video	Quiz	Attendance
R1: Facade Fundamentals	N/A	Handouts	View Passcode: AZNS175	Pass Score: 100	N/A
L1: Façade Attachments Part 1	May 9 2019 1:30PM EDT	Handouts	Available 05/11/2019 5:00PM EDT	Available 05/11/2019 5:00 PM EDT	Pending
L2: Façade Attachments Part 2	May 16 2019 1:30PM EDT	Handouts	Available 05/18/2019 5:00PM EDT	Available 05/18/2019 5:00 PM EDT	Pending
L3: Façade Attachments - Building Lateral Drifts	May 23 2019 1:30PM EDT	Handouts	Available 05/25/2019 5:00PM EDT	Available 05/25/2019 5:00 PM EDT	Pending
Final Exam	N/A			Available 5/27/2019 5:00 PM EDT	

AISC | Thank you.

Smarter.
Stronger.
Steel.