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Steel Construction | From the Mill to Topping Out



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Session Description

18.6 Erection Engineering – Stability During Construction November 26, 2018

This session provides an overview of the steps taken by the Erector's Engineer to ensure stability of each stage of construction during structural steel erection. Topics include:

- Code of Standard Practice requirements for the EOR and Erector
- Design standards / Design Guides
- The importance of load path
- Global stability
- Element stability, i.e. stability of long span trusses
- Temporary bracing/shoring design
- Staged Construction considerations



Learning Objectives

- List why erection engineering is needed on a steel project.
- Identify where in the AISC Code of Standard Practice addresses support of a structure during construction.
- List factors that must be considered and known in order to perform an accurate erection stability analysis.
- Describe how a connection design can affect steel framing stability during erection.

Night School 18: Steel Construction

From the Mill to Topping Out

Session 6: Erection Engineering – Stability During Construction

November 26, 2018



Benjamin Miller, PE, SE
Project Engineer
Ruby+Associates, Inc. Structural Engineers
Bingham Farms, MI



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Night School 18

- 18.1 Introduction to the Steel Construction Process Oct. 15
- 18.2 The Manufacturing of Structural Steel Shapes Oct. 22
- 18.3 A Virtual, Detailed Tour of the Steel Fabrication Process Oct. 29
- 18.4 Connection Design as the Fabricator's Representative Nov. 5
- 18.5 It Doesn't Get Built Without the Erector Nov. 19
- **18.6 Erection Engineering – Stability During Construction** **Nov. 26**
- 18.7 Field Fixes and Solutions Dec. 3
- 18.8 Quality Control and Quality Assurance Dec. 10



Presentation Outline

1. Introduction
2. Industry Codes and Standards
3. Stability Analysis
4. Effects of Staged Construction
5. Connection Design's affect on stability
6. Miscellaneous EP Topics
7. Questions?



What is Erection Engineering and Who Needs It?

Design of a system which maintains stability during each stage of construction of the *structural steel* frame.

Most directly, the Erector needs the services of an Engineer.

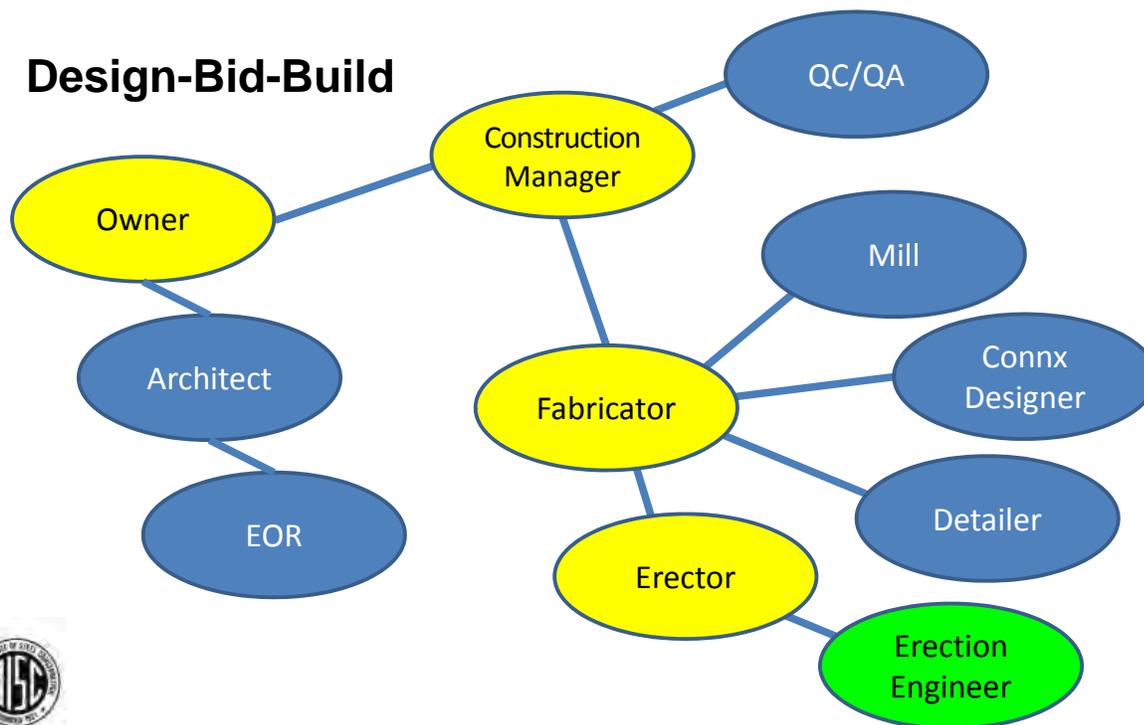
Sometimes, GC procures the Erection Engineer services – for consistency of bids.



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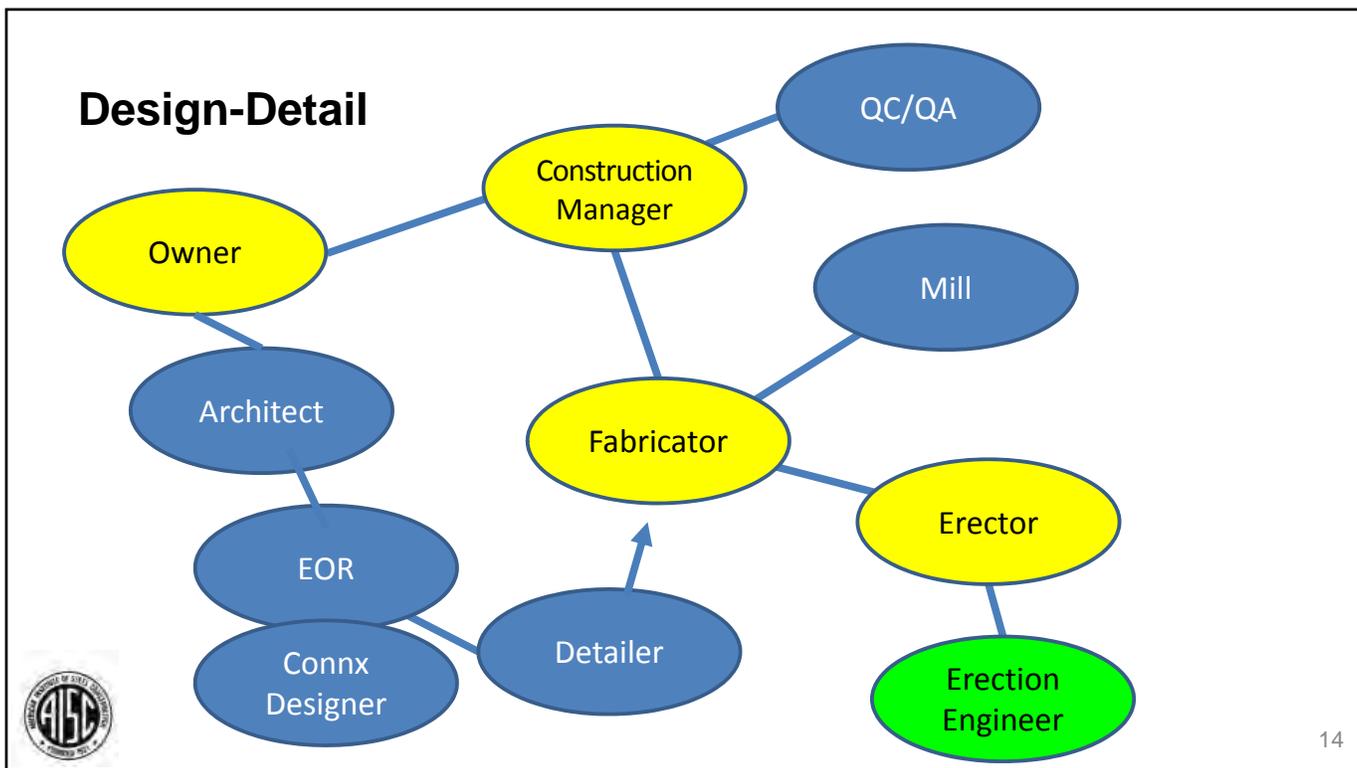
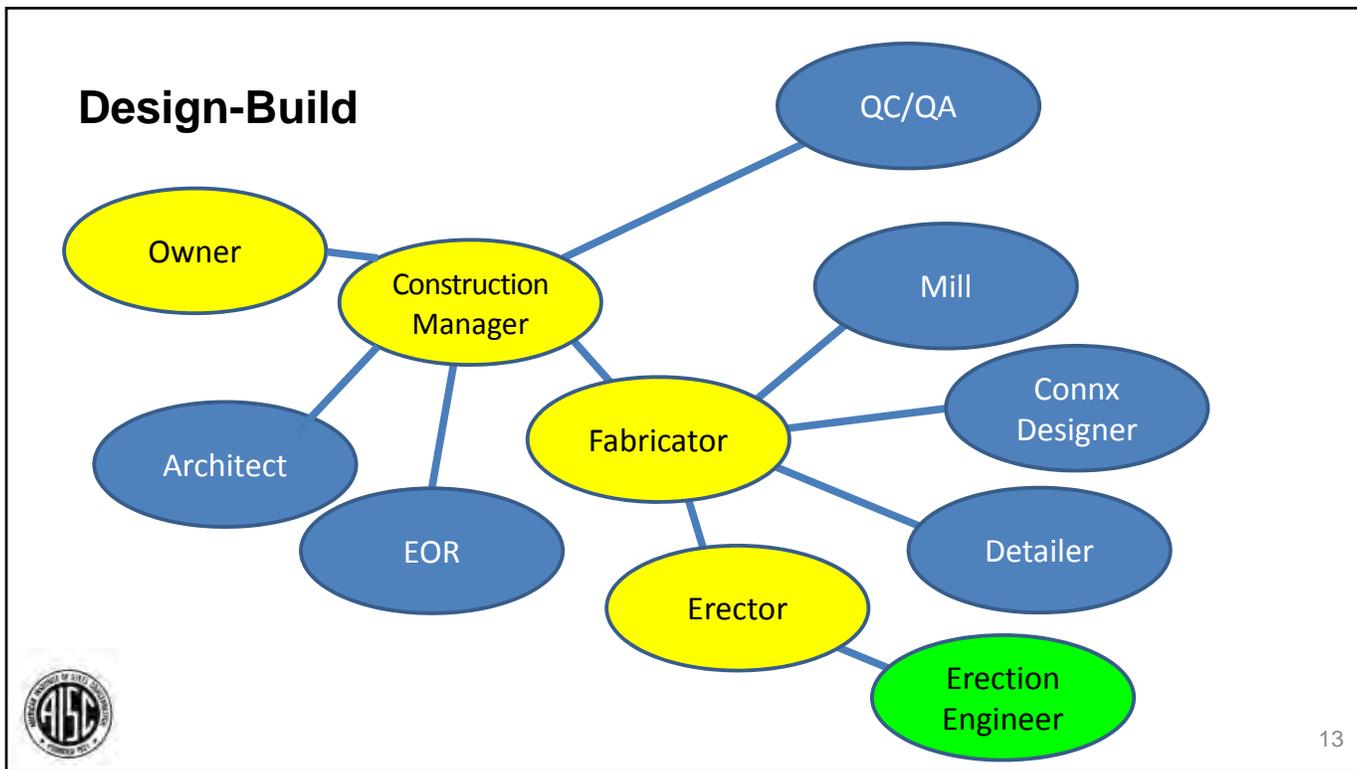


Design-Bid-Build



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Why is Erection Engineering needed?

ODRD designs for stability and structural adequacy in the final, completed condition.

Erector is responsible for stability during each phase/sequence of construction.

Incomplete structures may not be stable without temporary measures during construction.



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Presentation Outline

1. Introduction
2. Industry Codes and Standards
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7. Questions?



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Industry Codes and Standards



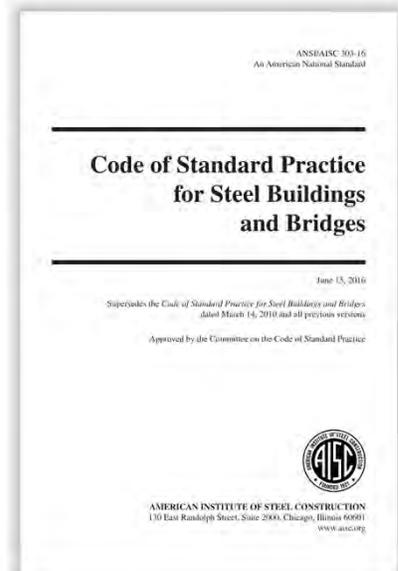
17

Code of Standard Practice

7.10 Temporary Support of Structural Steel Frames

7.10.1. The *owner's designated representative for design* shall identify the following in the *contract documents*:

- a) The lateral force-resisting system and connecting diaphragm elements that provide for the lateral strength and stability in the completed structure.
- b) Any special erection conditions or other considerations that are required by the design concept, such as the use of shores, jacks or loads that must be adjusted as erection progresses to set or maintain camber, position within specified tolerances or prestress.

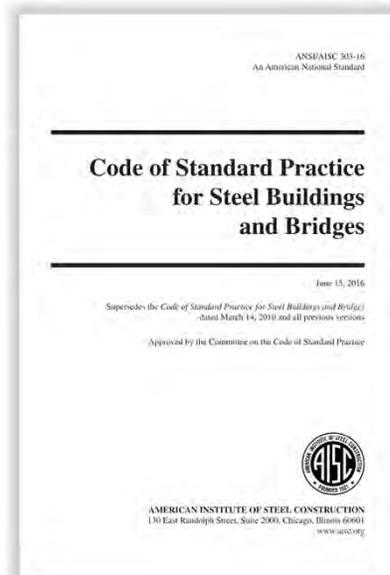


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Code of Standard Practice

AISC-303: 7.10.1(a) - Example

All lateral load resistance and stability of the building in the completed structure is provided by moment frames with welded beam to column connections framed in each orthogonal direction (see plan sheets for locations). The composite metal deck and concrete floors serve as horizontal diaphragms that distribute the lateral wind and seismic forces horizontally to the vertical moment frames; *the girders in line with the moment frames act as drag struts and deliver the diaphragm shear to the moment frames.* The vertical moment frames carry the applied lateral loads to the building foundation; *column anchorages have been designed as pinned/fixed.*



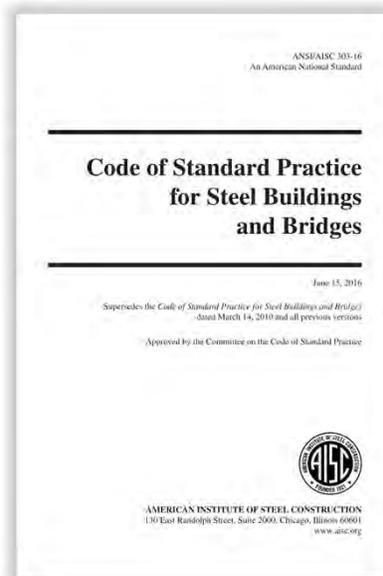
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Code of Standard Practice

AISC-303: 3.1.2

When option (2) or (3) above is specified, the ODRD shall provide the following information in the structural design drawings and specifications:

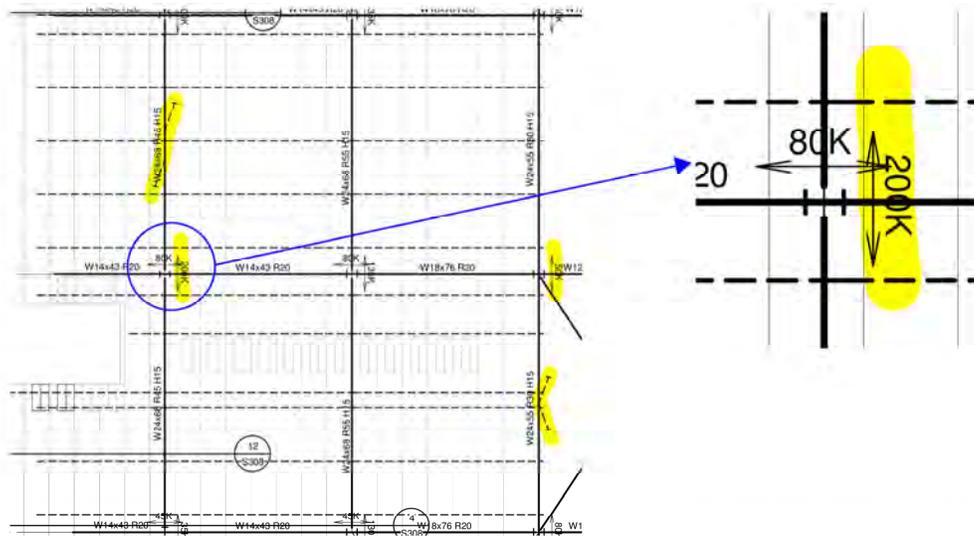
(b) Data concerning loads, including shears, moments, axial forces and transfer forces, that are to be resisted by the individual members and their *connections*...



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AISC-303: 3.1.2 - Example

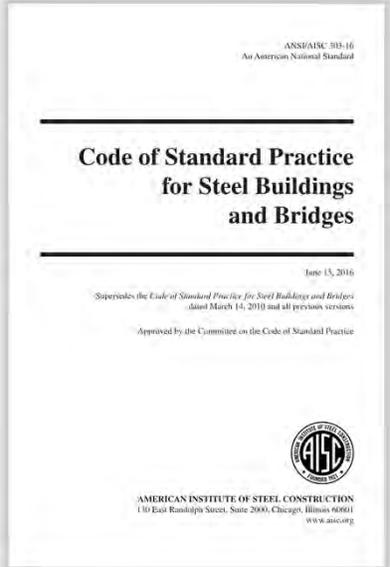


Code of Standard Practice

AISC-303: 7.10.1(a) – Example 2

All lateral load resistance and stability of the building in the completed structure is provided exclusively by precast concrete shear walls at the building perimeter (see plan sheets for locations).

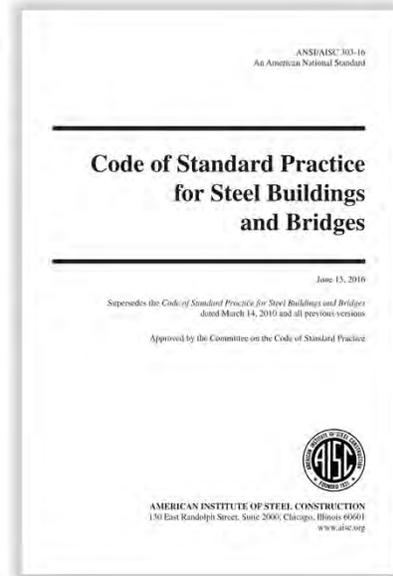
Stability of structural steel is provided by non-structural steel.



Code of Standard Practice

AISC-303: 7.10.2

The *owner's designated representative for construction* shall indicate to the *erector* prior to bidding, the installation schedule for non-*structural steel* elements of the lateral-load-resisting system and connecting diaphragm elements identified by the *owner's designated representative for design* in the *contract documents*.

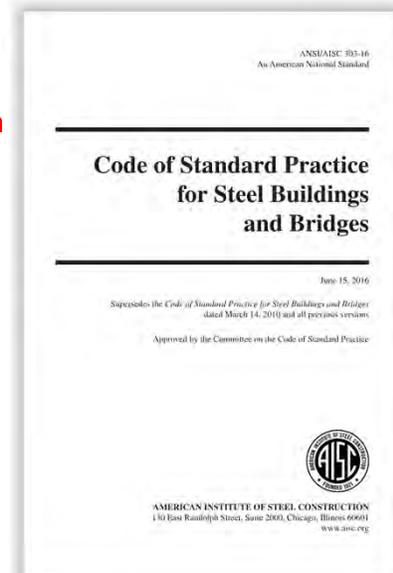


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Code of Standard Practice

AISC-303: 7.10.4

...**Temporary supports** provided by the *erector* shall remain in place until the portion of the *structural steel* frame that they brace is complete and **the lateral force-resisting system and connecting diaphragm elements** identified by the *owner's designated representative for design* in accordance with Section 7.10.1 **are installed**....



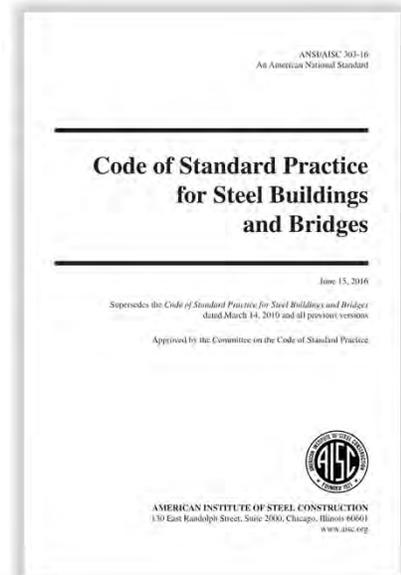
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AISC 303: 2.2

Non-Structural Steel Elements

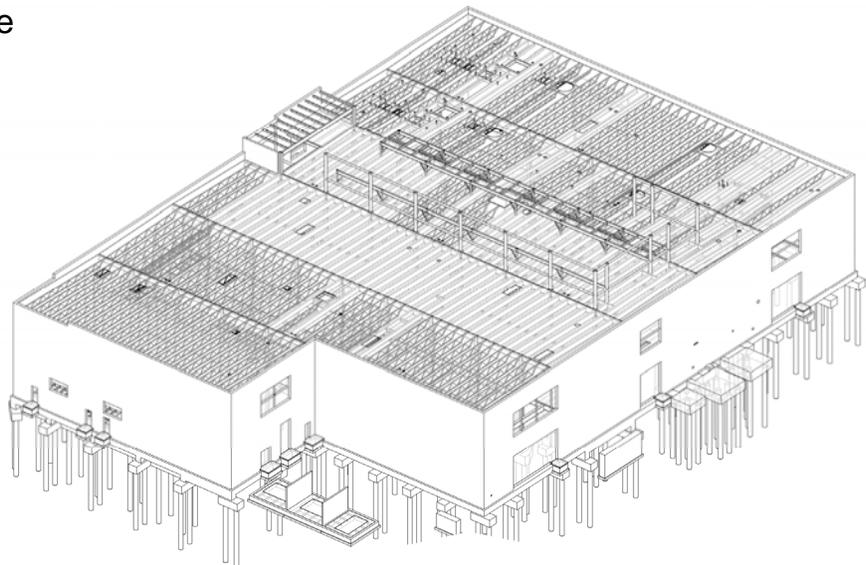
- Masonry Shear Walls
- Concrete Shear Walls
 - Standard Reinforced Construction
 - Precast Construction
- Steel Open-Web Joists
- Steel Joist Girders
- Steel Deck
- Concrete Floor Diaphragms
- Cold-formed steel



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AISC-303: 7.10.1 - Example

- 2-Story Industrial
- SOMD at Level 2
- Metal Roof Deck
- Main LLRS
 - Perimeter Precast Shear Wall



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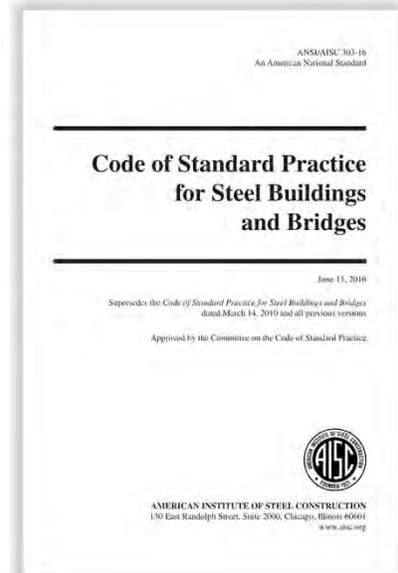


Code of Standard Practice

AISC-303: 7.10.1

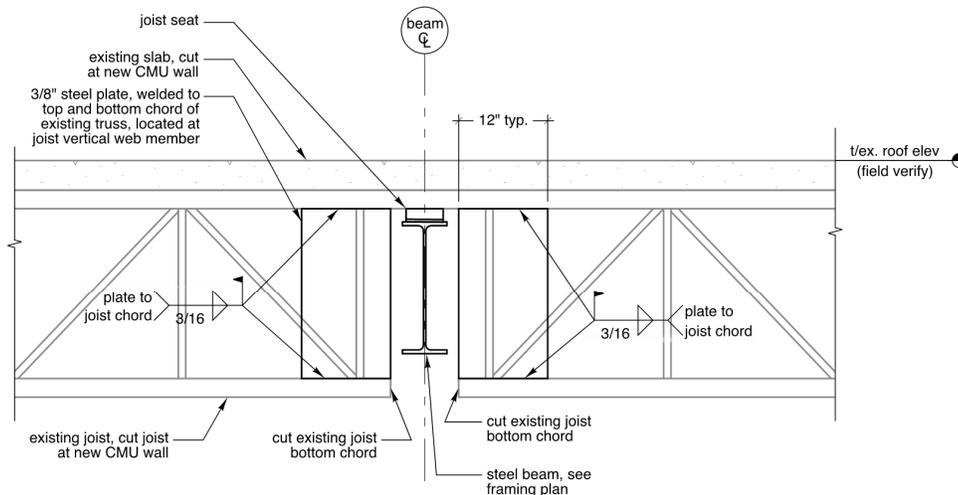
The owner's designated representative for design shall identify the following in the contract documents:

- a) The lateral force-resisting system and connecting diaphragm elements that provide for the lateral strength and stability in the completed structure.
- b) Any special erection conditions or other considerations that are required by the design concept, such as the use of shores, jacks or loads that must be adjusted as erection progresses to set or maintain camber, position within specified tolerances or prestress.



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AISC-303: 7.10.1(b) - Example



shore existing roof and joists before cutting existing joists. shoring to be designed for unfactored load of 10 kips per joist.



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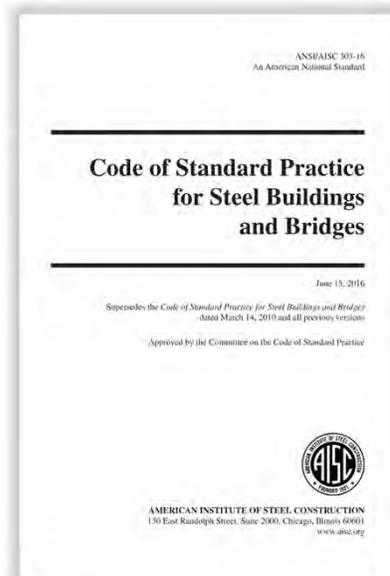
Code of Standard Practice

AISC-303: 7.10.3

Based upon the information provided in accordance with Sections 7.10.1 and 7.10.2, the erector shall determine, furnish and install all temporary supports, such as temporary guys, beams, falsework, cribbing or other elements required for the erection operation. These temporary supports shall be sufficient to secure the bare structural steel framing or any portion thereof against loads that are likely to be encountered during erection, including those due to **wind** and those that result from erection operations.

The erector need not consider loads during erection that result from the performance of work by, or the acts of, others, except as specifically identified by the owner's designated representatives for design and construction, **nor those that are unpredictable, such as loads due to hurricane, tornado**, earthquake, explosion or collision.

...



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Project Specification

3.02 PREPARATION

A. Temporary Shoring and Bracing:

1. The lateral-load resisting or stability-providing system and connecting diaphragms are identified on the drawings. Comply with the provisions of the Code of Standard Practice regarding stability of the structure during the erection process, except where stricter requirements are noted herein.
2. The Erector shall design and provide all required temporary shoring and bracing to hold structural framing securely in position and **to safely withstand all loads as specified in the Code of Standard Practice and ASCE 37**.



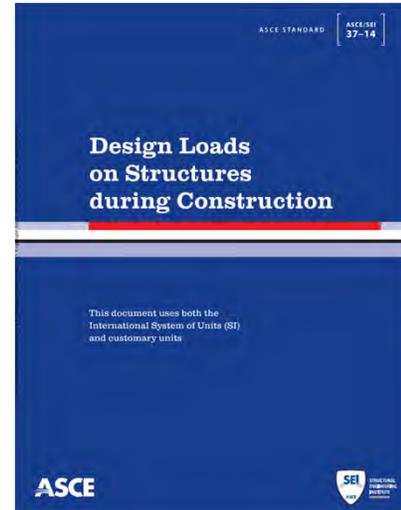
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ASCE 37-14

6.2.1.1.1 Construction Period in Hurricane-Prone Areas

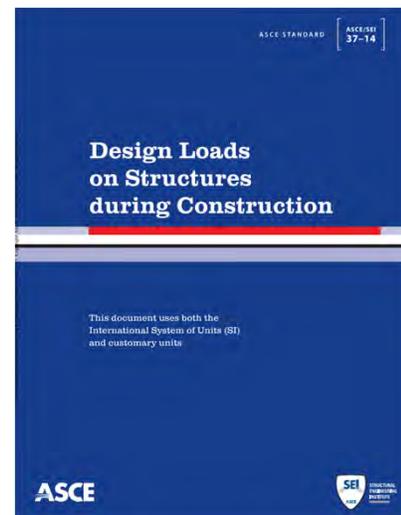
For construction between November 1 and June 30 (outside of the hurricane season), the basic wind speed of 115 mph (51 m/s) shall be permitted for structures sited near the Gulf Coast and Eastern Seaboard, where the ASCE/SEI 7-10 specified basic wind speed exceeds 115 mph (51 m/s) (3 second gust) (hurricane-prone areas). The 115 mph (51 m/s) wind speed is permitted to be reduced by the factors in Section 6.2.1 only for a construction period between November 1 and June 30.



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ASCE 37-14

Between July 1 and October 31, basic wind speed of 115 mph (51 m/s) shall be permitted for structures sited near the Gulf Coast and Eastern Seaboard, where the ASCE/SEI 7-10 specified basic wind speed exceeds 115 mph (51 m/s) (3 second gust) provided additional bracing is prepared in advance and applied in time before the onset of an announced hurricane. The 115 mph (51 m/s) wind speed shall not be reduced by the factors in Section 6.2.1 for the construction period. The bracing shall be designed for the full, unmodified wind load determined using the mapped wind speed and procedures found in ASCE/SEI 7-10.



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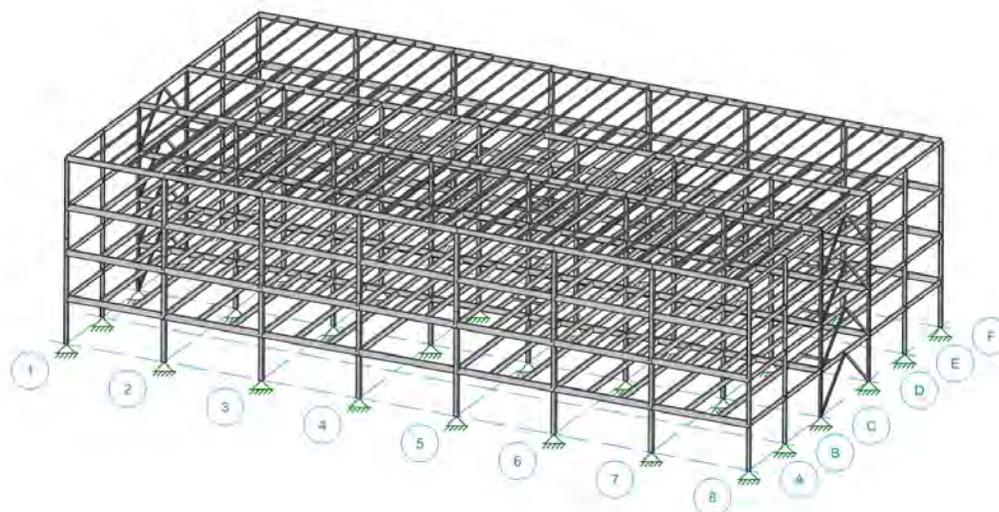
Presentation Outline

1. Introduction
2. Industry Codes and Standards
3. **Stability Analysis**
4. Effects of Staged Construction
5. Connection Design's affect on stability
6. Miscellaneous EP Topics
7. Questions?



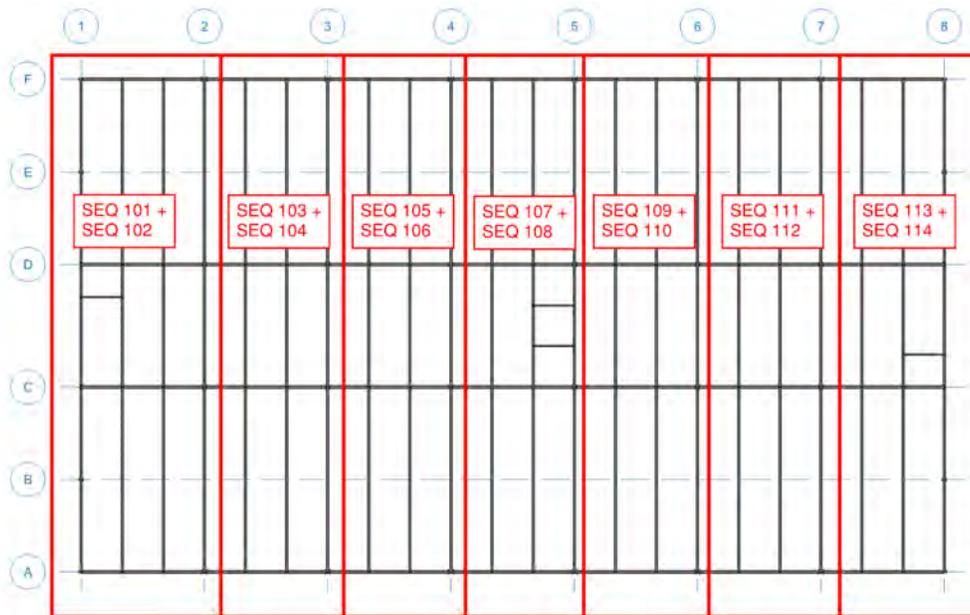
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Stability Analysis



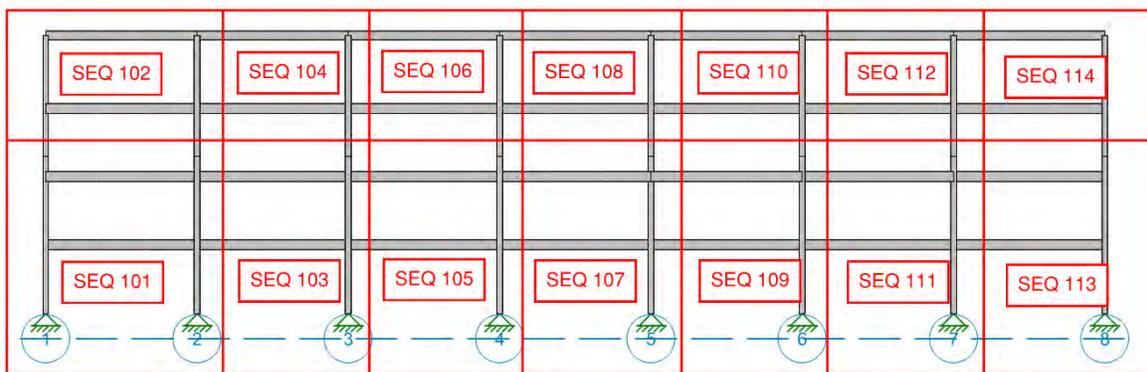
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Sequence Blocking Diagram



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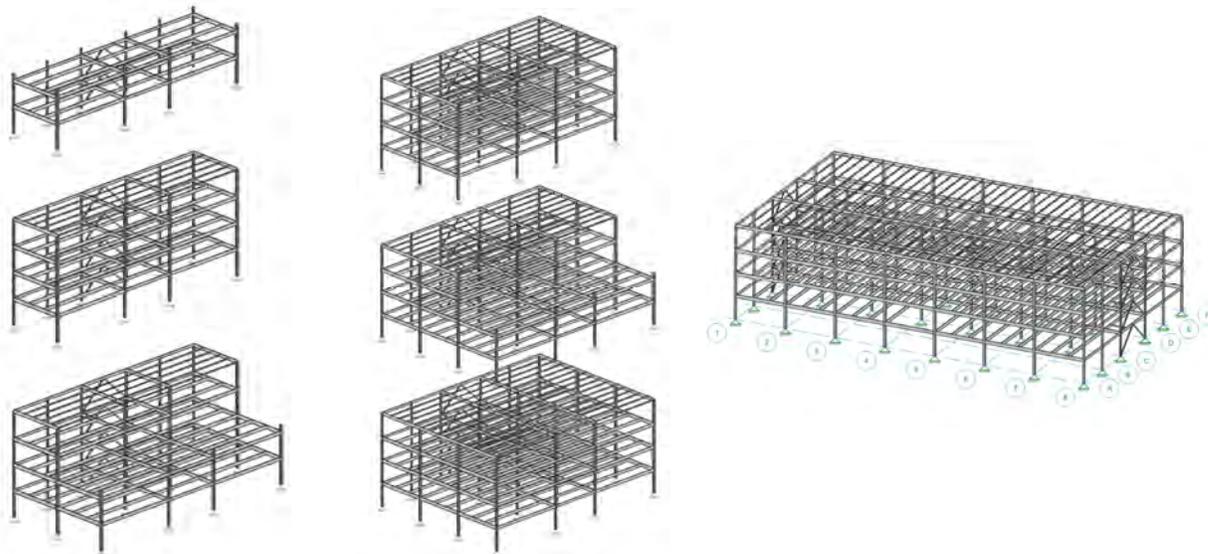
Sequence Blocking Diagram



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Sequenced Analysis



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ASCE 37-14: Wind Loading

6.1 RISK CATEGORY

Unless otherwise required by the authority having jurisdiction, the risk category, as defined in ASCE/SEI 7-10, shall be taken as Risk Category II for all environmental loads during construction, regardless of the risk category assigned for the design of the completed structure.

6.2 WIND

Except as modified herein, wind loads shall be calculated in accordance with procedures in ASCE/SEI 7-10.

Design wind pressures shall be based on design wind speeds calculated in accordance with Section 6.2.1. The minimum wind pressure of 16 psf (0.77 kN/m²) specified by ASCE/SEI 7-10 need not be applied.

6.2.1 Design Wind Speed The design wind speed shall be taken as the following factor times the basic wind speed in ASCE/SEI 7-10, except as required in Section 6.2.1.1.1.

Construction Period	Factor
Less than six weeks	0.75
From six weeks to one year	0.8
From one to two years	0.85
From two to five years	0.9



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ASCE 37-14

ASCE 7-10: 27.3.2

$$q_z = (0.00256)(K_z)(K_{zt})(K_d)(V)^2$$

$$V = 115\text{mph (LRFD)} / 90\text{mph (ASD)}$$

$$V_{\text{const}} = 0.75 * 115\text{mph} = 86\text{mph} / 0.75 * 90\text{mph} = 68\text{mph}$$

Base Wind Pressure during Construction:

$$(0.75)^2 = 0.5625 \rightarrow 56.25\% \text{ of design pressure}$$

6.2.2 Frameworks without Cladding

For unenclosed frames and structural elements, wind loads shall be calculated for each element. Unless detailed analyses are performed, load reductions due to shielding of elements in such structures with repetitive patterns of elements shall be as follows:

1. The loads on the first three rows of elements along the direction parallel to the wind shall not be reduced for shielding.
2. The loads on the fourth and subsequent rows shall be permitted to be reduced by 15%.



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ASCE 7-10

ε	Flat-Sided Members	Rounded Members	
		$D\sqrt{q_z} \leq 2.5$ ($D\sqrt{q_z} \leq 5.3$)	$D\sqrt{q_z} > 2.5$ ($D\sqrt{q_z} > 5.3$)
< 0.1	2.0	1.2	0.8
0.1 to 0.29	1.8	1.3	0.9
0.3 to 0.7	1.6	1.5	1.1

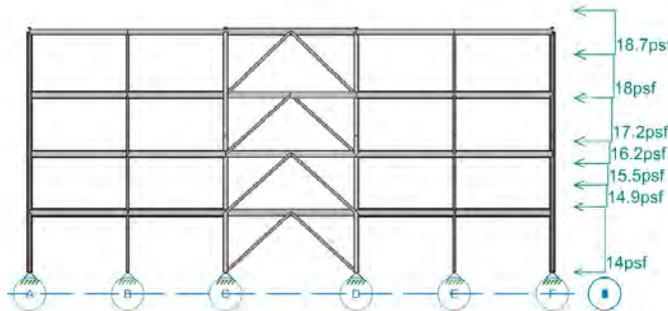
ASCE 7-10 Figure 29.5-2



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Construction Period Wind



Construction Wind Calculations

Chapter 20: Wind Loads on Other Structures (MAYERS)

Basic Wind Speed (Strength), $V =$	115 mph	Risk Category II during construction	7-10 (Figure 26.5-1a) p.249 37-34 (Sec. C5.3) p.28
Construction Period Factor	0.75	Less than six weeks	37-34 (Sec. C5.3) p.28
Exposure Category =	C		7-10 (Sec. 26.7.3) p.250
Topographic Factor, $K_{zt} =$	1.0		7-10 (Sec. 26.8) p.251
Directionality Factor, $K_d =$	0.85	Open Structure	7-10 (Table 26.6-1) p.250
Gust Factor, $G =$	0.85	Other Structure	7-10 (Sec. 26.9.3) p.254
Force Coefficient, $C_f =$	2	$As/A < 0.1$	7-10 (Figure 26.5-1) p.249
Velocity Pressure	$q_s = 0.00256 K_z K_{zt} K_d V^2$ (psf)		7-10 (Eq. 27.5-1) p.260
Velocity Pressure, $q_s =$	16.19 K_z (psf)		
Design Pressure	$P = q_s C_{GC}$ (psf)		7-10 (Eq. 29.5-1) p.268
Design Pressure, $P =$	27.52 K_z (psf)		

Height	Exposure Category	
	B	D
0-15	0.57	0.85
20	0.62	0.9
25	0.66	0.94
30	0.7	0.98
40	0.76	1.04
50	0.81	1.09
60	0.85	1.13
70	0.89	1.17
80	0.93	1.21
90	0.96	1.24
100	0.99	1.26
120	1.04	1.31
140	1.09	1.36
160	1.13	1.39
180	1.17	1.43
200	1.2	1.46
250	1.28	1.53
300	1.35	1.59
350	1.41	1.64
400	1.47	1.69
450	1.52	1.73
500	1.56	1.77

Height	Design Pressure	
	Windward	Leeward
0-15	23.4	14.0
20	24.8	14.9
25	25.9	15.5
30	27.0	16.2
40	28.6	17.2
50	30.0	18.0
60	31.1	18.7
70	32.2	19.3
80	33.3	20.0
90	34.3	20.5
100	34.7	20.8
120	36.0	21.8
140	37.4	22.5
160	38.3	23.0
180	39.4	23.6
200	40.2	24.1
250	42.1	25.3
300	43.6	26.1
350	45.1	27.1
400	46.5	27.9
450	47.6	28.6
500	48.7	29.2

Design Base Shear – Wind:

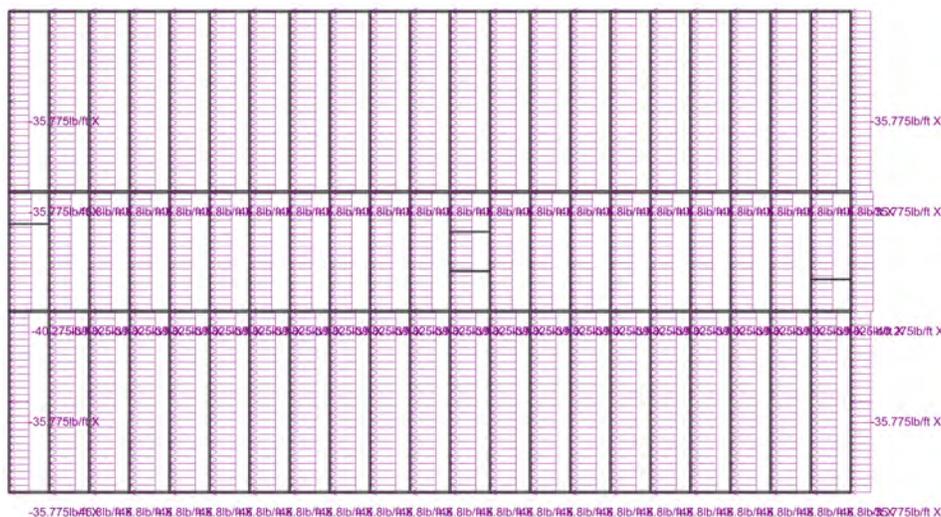
$N/S = 270k$; $E/W = 170k$

Const. Period Base Shear – Wind:

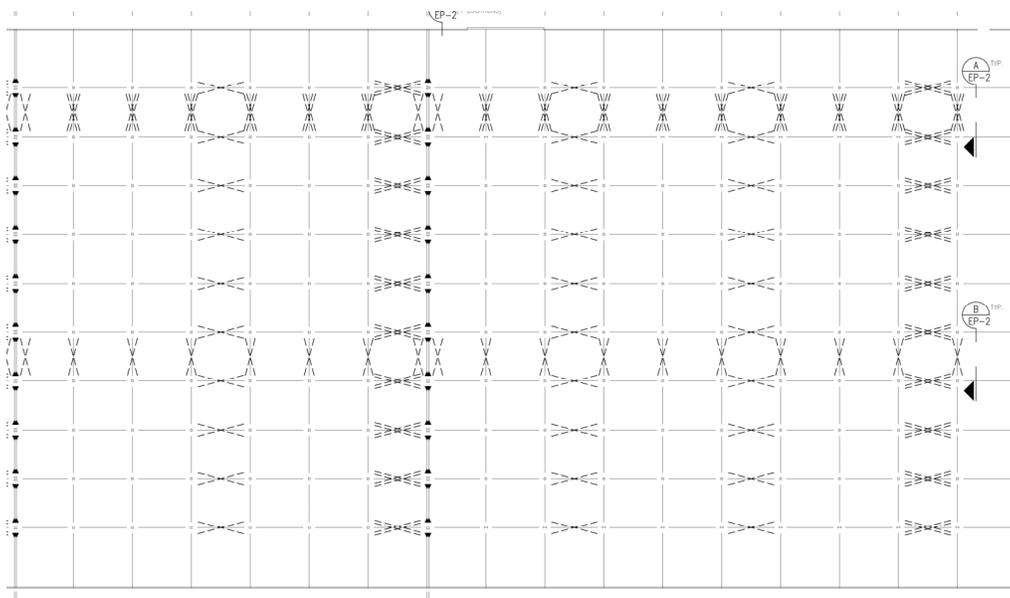
$N/S = 231k$; $E/W = 429k$



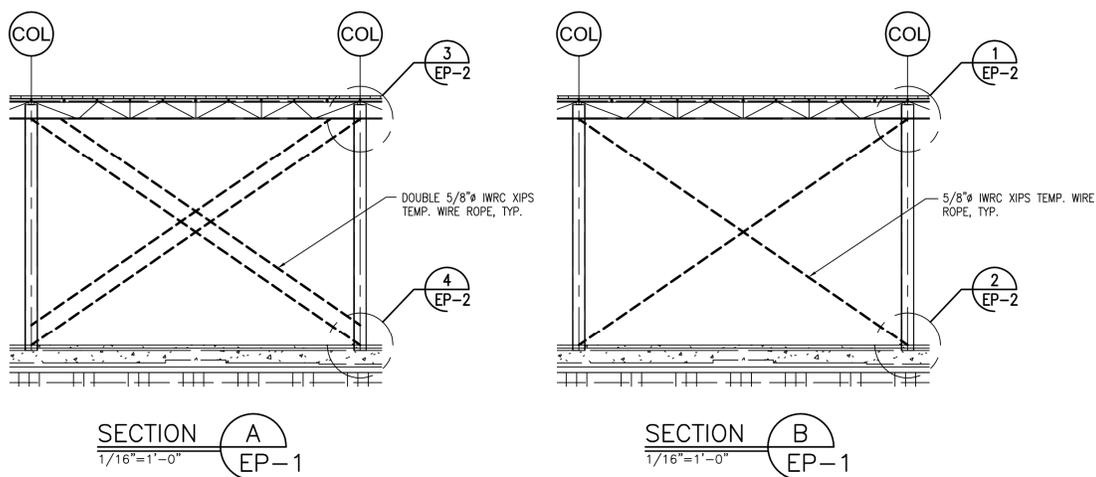
Construction Period Wind



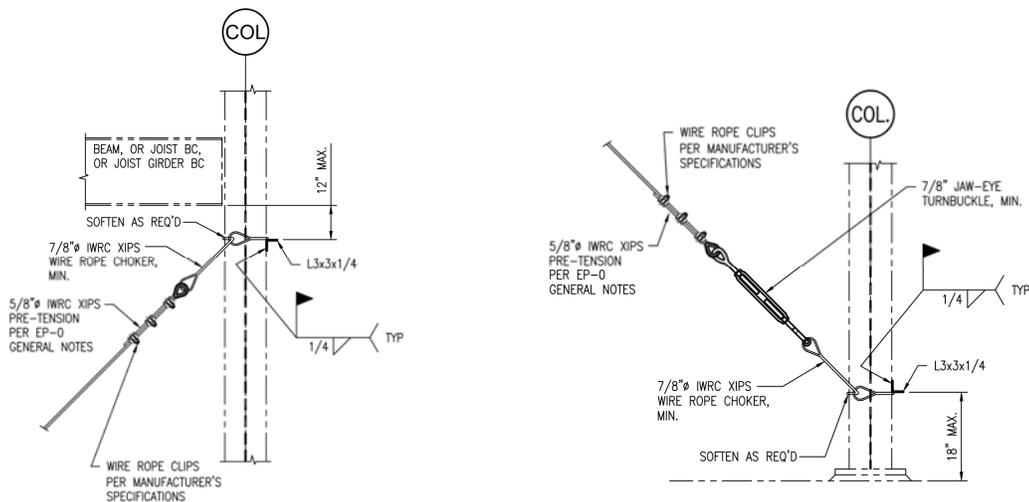
Cable Bracing Design



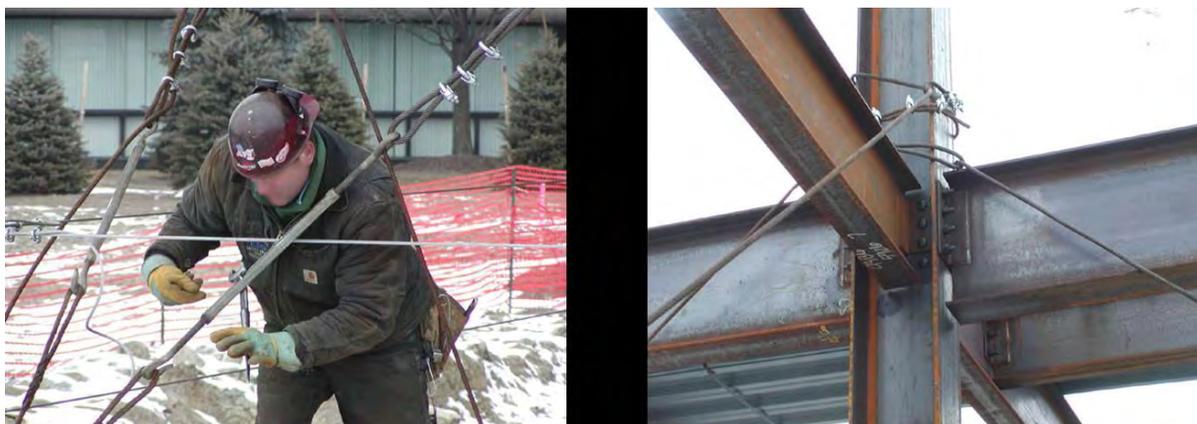
Cable Bracing Design



Cable Bracing Design



ASCE 37-14

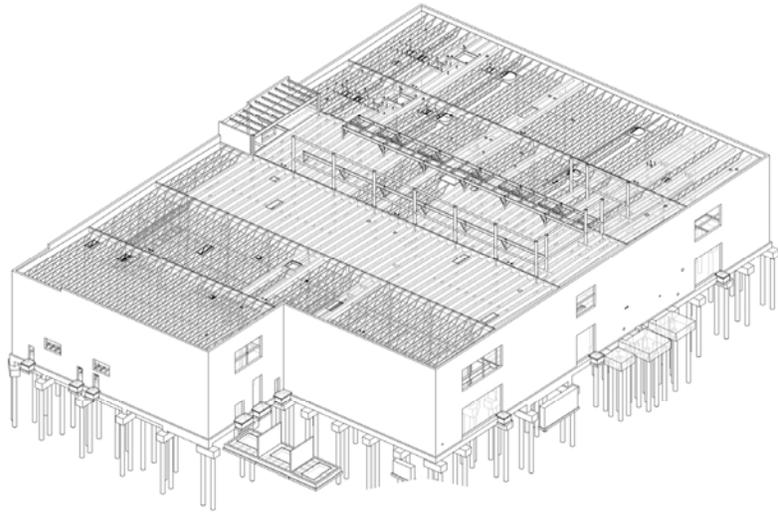


Example Project 2:

- 2-Story Industrial
- SOMD at Level 2
- Metal Roof Deck
- BF at Grid G
 - Only below Level 2
- Precast Shear Wall

Two Erection Options:

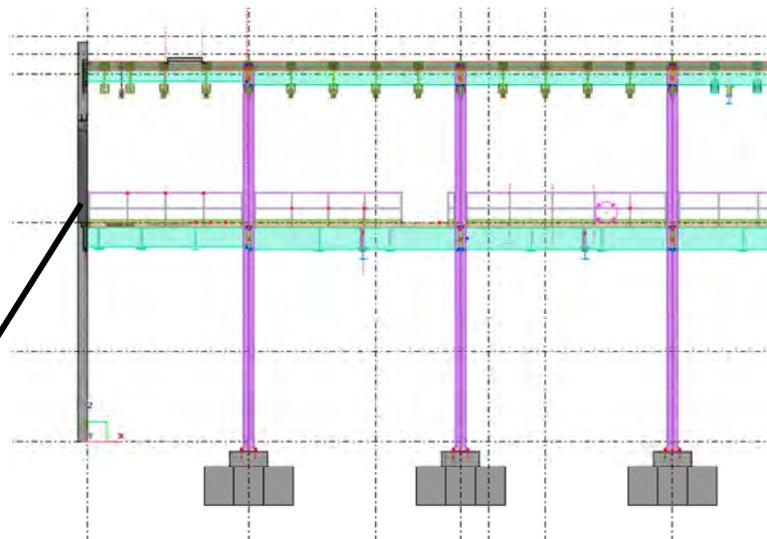
1. Start erection of steel frame first then install precast panels.
2. Start erection of precast panels first then install steel frame.

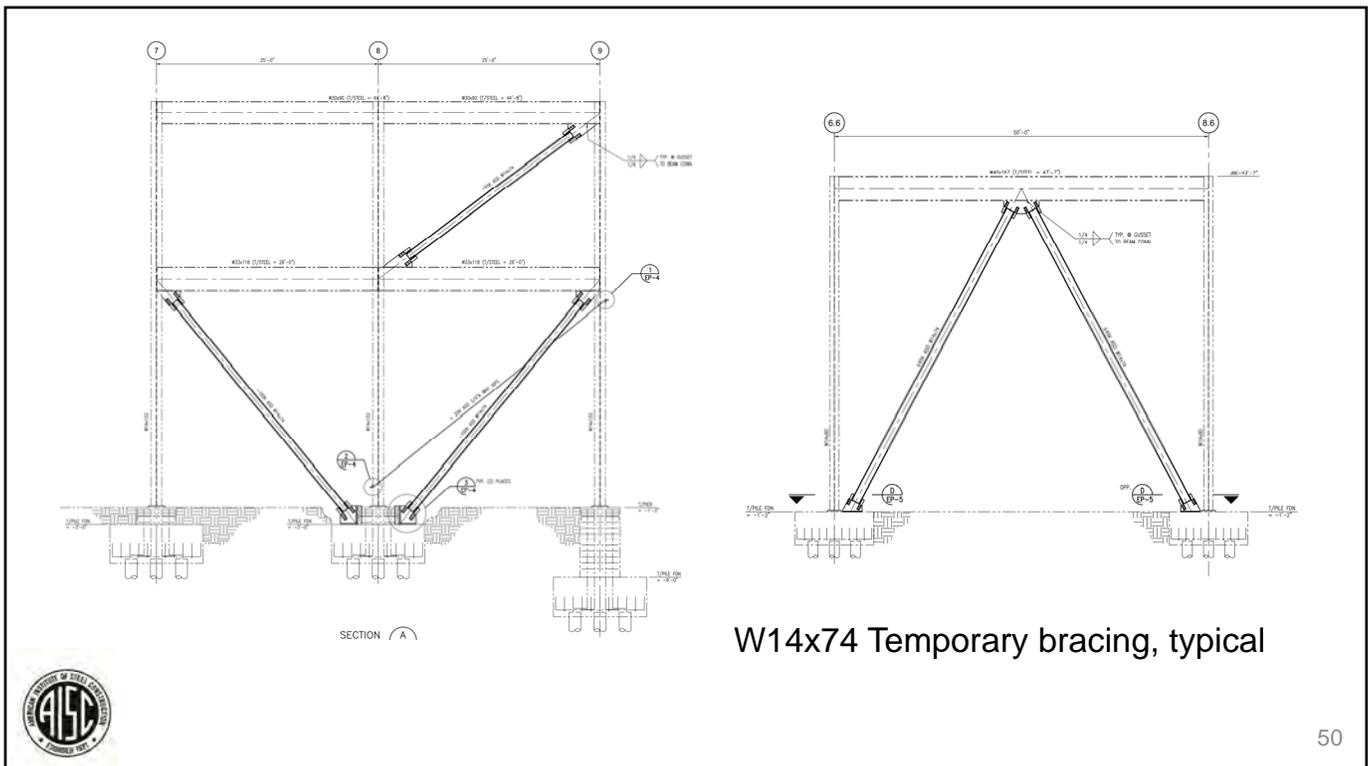
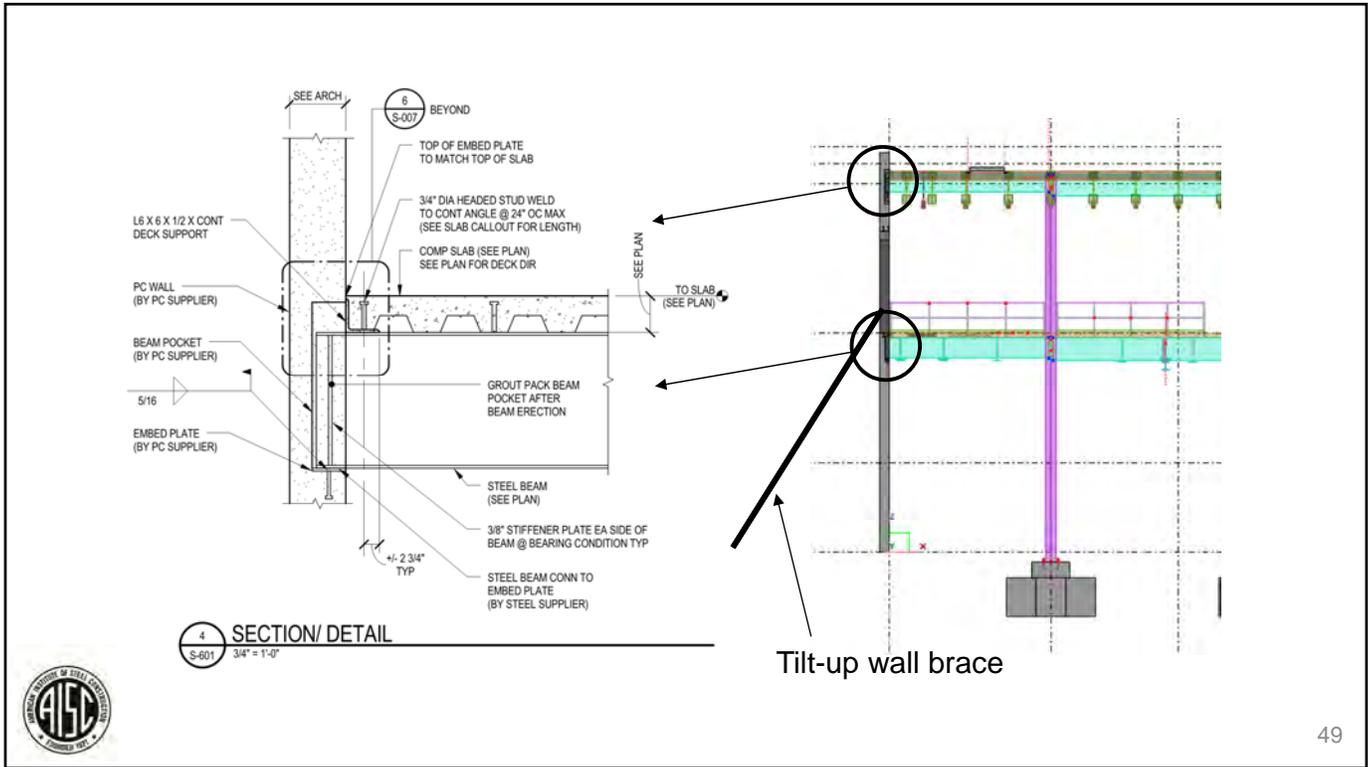


PCI: Architectural Precast Concrete Third Ed.

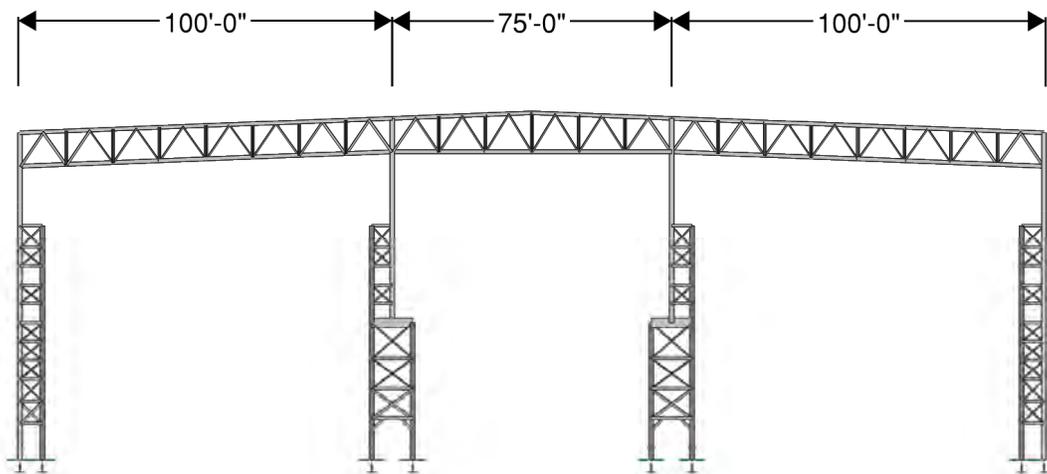
“After erection, each panel must be stable and offer resistance to wind, accidental impact, and loads that may be imposed due to other construction operations.”

Tilt-up wall brace



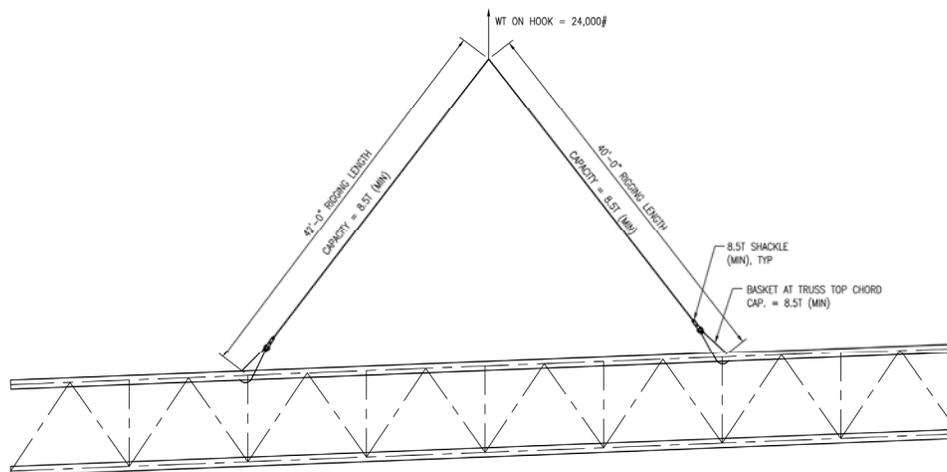


Element Stability



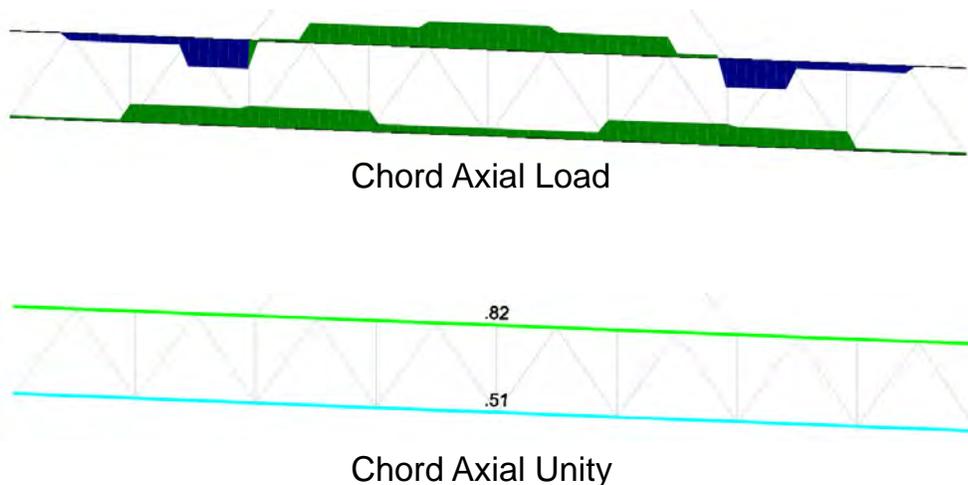
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Truss Stability – Under Hook



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Truss Stability – Under Hook



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Truss Stability – At Set



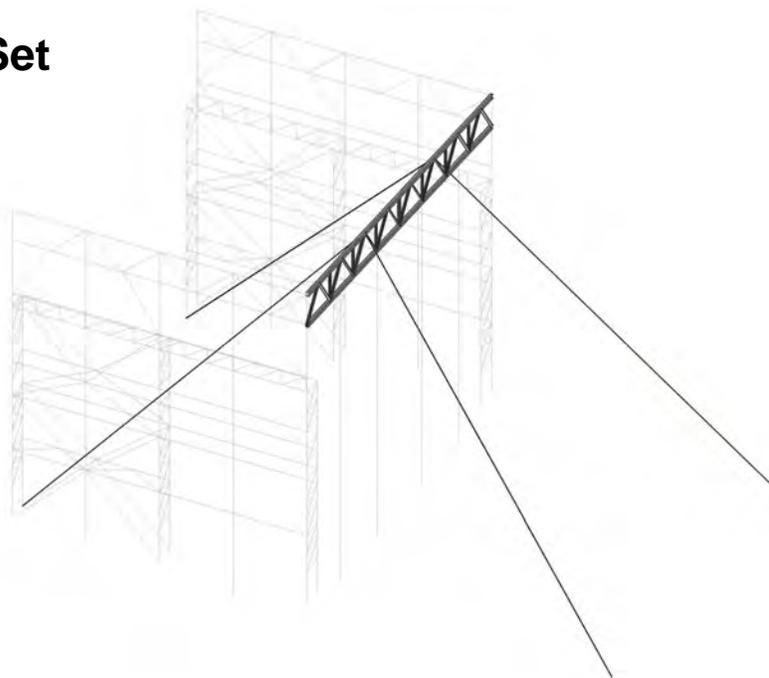
Given the truss chords are oriented with their web vertical, at truss set, the compression in the top chord results in a unity of 5.91, which means the truss cannot be released from the rigging without other supplementary stability bracing.



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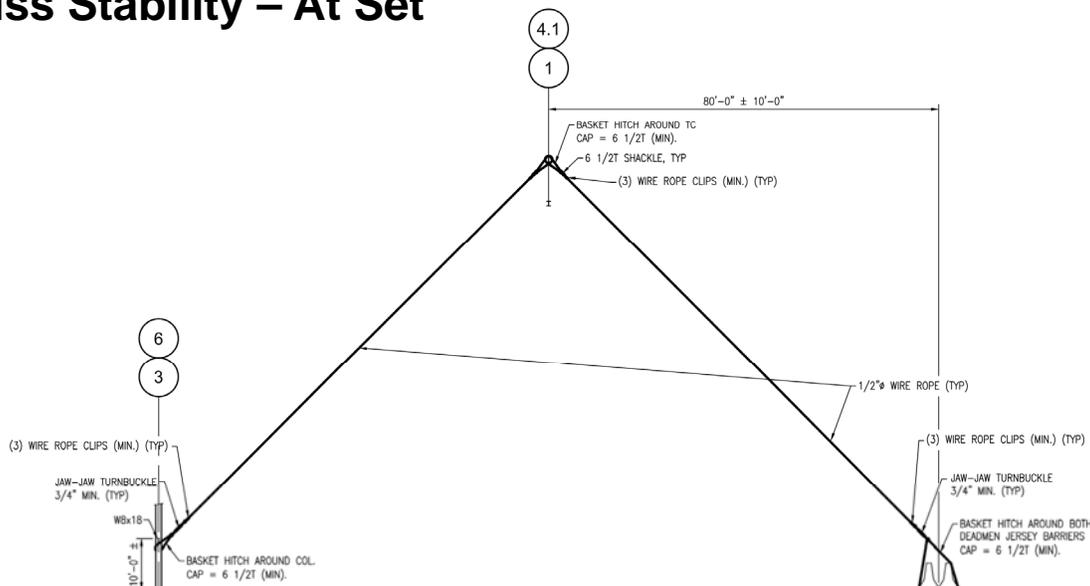
Truss Stability – At Set

Truss is guyed in each direction with cable prior to releasing the truss from the crane hook.



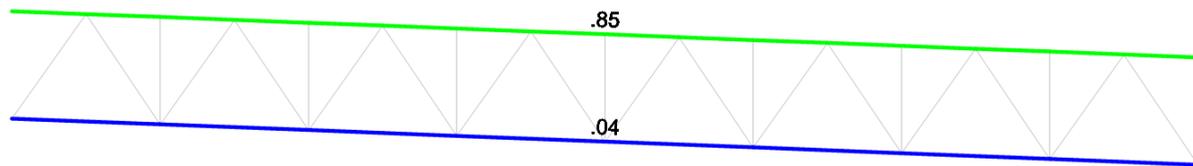
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Truss Stability – At Set



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Truss Stability – At Set



If the truss chords were oriented with their web horizontal, this truss could be released from the crane without supplemental stability bracing.



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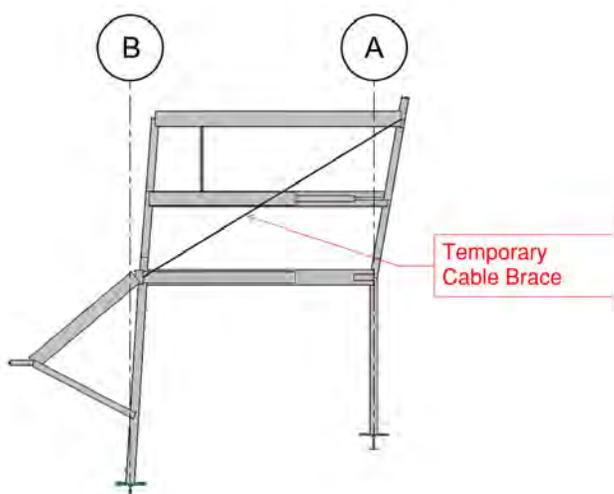


Nippert Stadium



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Nippert Stadium



Location	1.4*DL		1.0*DL	
	M _{strong} (k-ft)	M _{weak} (k-ft)	M _{strong} (k-ft)	M _{weak} (k-ft)
A/21S	-11	-0.5	-3.7	-0.4
A/21N	28	2	20.0	1.4
A/21S	4	-4	2.9	-2.9
A/18N	-15	-4	-10.7	-2.8
A/18S	32	-3	22.9	-2.1
A/17N	14	2	10.0	1.4
A/17S	-17	3	-12.1	2.1
A/15N	18	2	12.9	1.4
A/15S	-18	2	-12.9	1.4
A/13N	28	3	20.0	2.1
A/13S	-11	5	-7.9	3.6
A/11N	-6	-3	-4.3	-2.1
A/11S	6	4	4.3	2.9
A/9N	-49	7	-35.8	5.0
A/9S	44	6	31.4	4.3
A/7N	4	4	2.9	2.9
A/7S	9	5	6.4	3.6
A/5N	-15	10	-10.7	7.1
A/5S	8	6	6.4	4.3

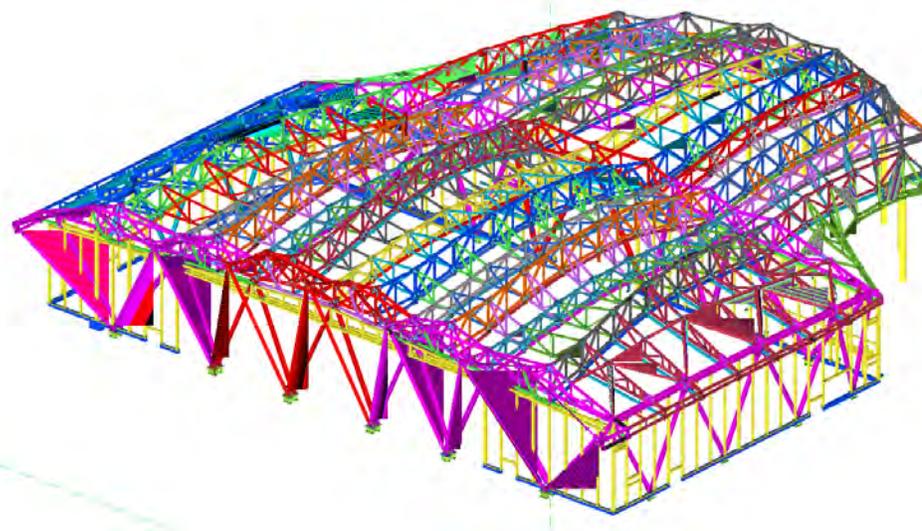
Location	1.4*DL		1.0*DL	
	M _{strong} (k-ft)	M _{weak} (k-ft)	M _{strong} (k-ft)	M _{weak} (k-ft)
B/22S	-1	-1	-0.7	-0.7
B/22N	-27	-6	-19.3	-2.9
B/22B	-4	4	-2.9	2.9
B/20N	-19	-4	-10.7	-2.9
B/20S	-32	3	-22.9	2.1
B/18N	-48	-3	-34.3	-2.1
B/18S	-18	4	-11.4	2.9
B/16N	-12	-3	-8.6	-2.1
B/16S	-3	4	-2.1	2.9
B/14N	-4	-3	-2.9	-2.1
B/14S	-6	4	-4.3	2.9
B/12N	-7	-3	-5.0	-2.1
B/12S	-6	4	-4.3	2.9
B/10N	-16	-6	-11.4	-4.3
B/10S	-56	-3	-39.8	-2.1
B/8N	-43	-3	-30.7	-2.1
B/8S	-14	5	-10.0	3.6
B/6N	-11	-5	-7.9	-3.6
B/6S	29	7	20.7	5.0
B/4N	22	-7	15.7	-5.0
B/4S	-30	1	-21.4	0.7
B/2N	-32	9	-22.9	6.4



60

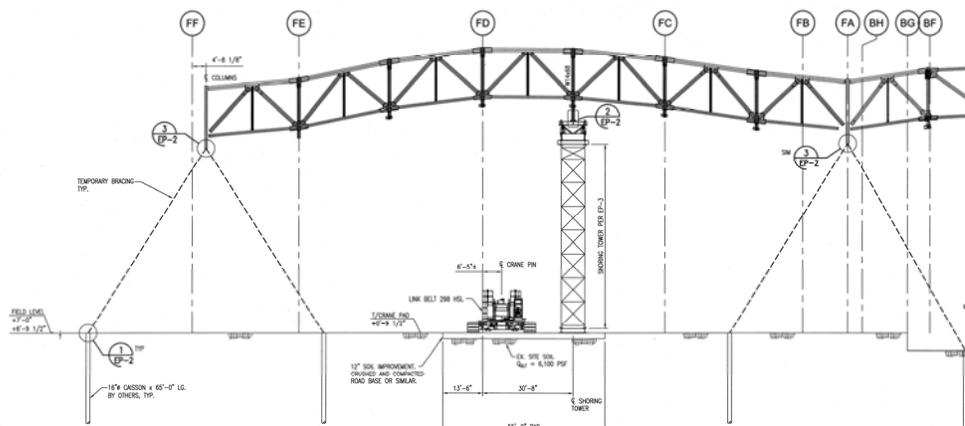


Flex Field Truss Shoring



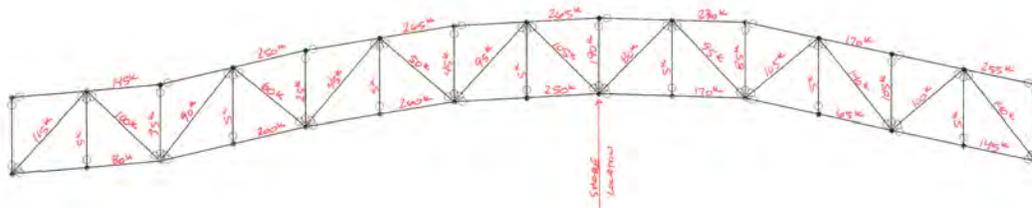
61

Flex Field Truss Shoring



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Flex Field Truss Shoring



LONGITUDINAL RIDGE TRUSS STEEL SIZES		
ELEMENT	NORTH	SOUTH
TOP CHORD	W14x68 - W14x99	W14x68 - W14x90
BOTTOM CHORD	W14x68 - W14x90	W14x90
DIAGONAL	W12x65 - W12x79	W12x65 - W12x79
VERTICAL	W12x26 - W14x68	W12x26 - W14x68

FOR AN ENVELOPE ONLY. REFER TO THE DIGITAL FABRICATION MODEL FOR EXACT SIZE AND LOCATIONS. ALL MEMBER SIZES ARE SUBJECT TO FURTHER REFINEMENT PRIOR TO ISSUANCE OF CONSTRUCTION DOCUMENTS.



Zurich - Cantilevers



Presentation Outline

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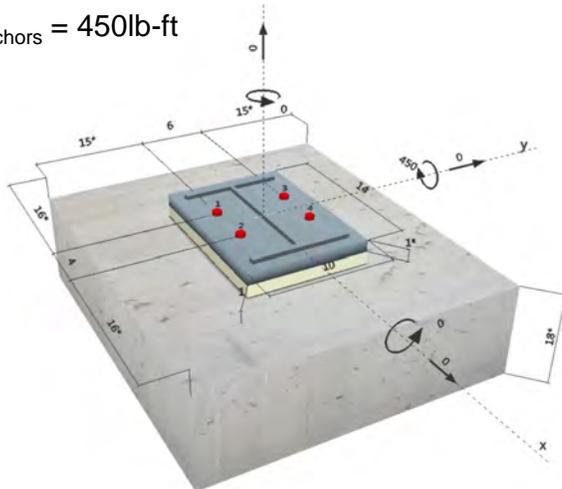


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Column Anchorage

OSHA - (4) Anchor bolts per column for
300lb load 18" away from centerline.

$$M_{\text{anchors}} = 450\text{lb-ft}$$



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OSHA

2 Load case/Resulting anchor forces

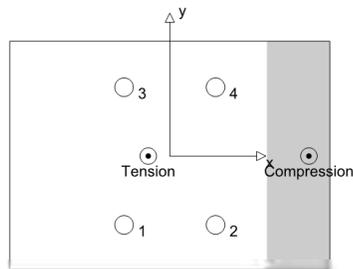
Load case: Design loads

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	283	0	0	0
2	102	0	0	0
3	283	0	0	0
4	102	0	0	0

max. concrete compressive strain: 0.01 [%]
 max. concrete compressive stress: 56 [psi]
 resulting tension force in (x/y)=(-0.941/0.000): 769 [lb]
 resulting compression force in (x/y)=(6.083/0.000): 769 [lb]



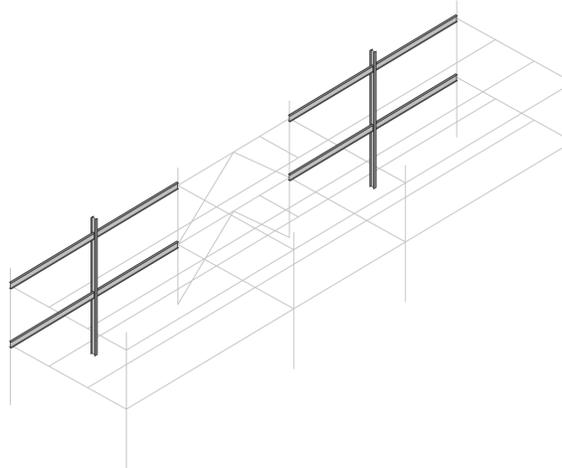
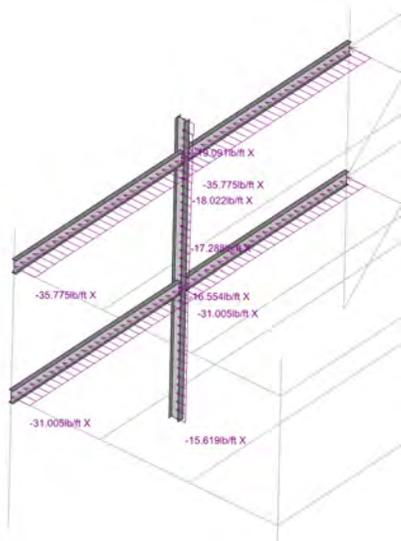
Anchor forces based on a rigid base plate assumption!

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_{Tt} = N_{ua} / \phi N_n$	Status
Steel Strength*	283	14,529	2	OK
Pullout Strength*	283	15,305	2	OK
Concrete Breakout Strength**	769	37,598	3	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A



Wind Column Stability



Wind Loads:

Beams (W16) – 31plf (2nd flr); 35.7plf (3rd flr)

Column (W12) – 15.6plf to 19.0plf

Results in $M_{base} = 32,100\text{lb-ft}$



Wind Column Stability

2 Load case/Resulting anchor forces

Load case: Design loads

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

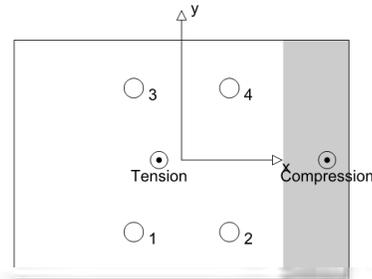
Anchor	Tension force	Shear force	Shear force x	Shear force y
1	20,163	0	0	0
2	7,256	0	0	0
3	20,163	0	0	0
4	7,256	0	0	0

max. concrete compressive strain: 0.92 [%]
 max. concrete compressive stress: 3,987 [psi]
 resulting tension force in (x/y)=(-0.941/0.000): 54,838 [lb]
 resulting compression force in (x/y)=(6.083/0.000): 54,838 [lb]

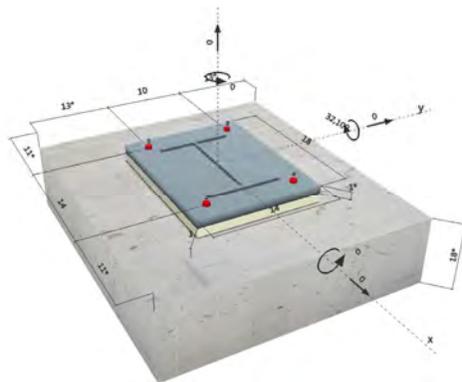
Anchor forces based on a rigid base plate assumption!

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_{Nt} = N_{ua}/\phi N_n$	Status
Steel Strength*	20,163	14,529	139	not recommended
Pullout Strength*	20,163	15,305	132	not recommended
Concrete Breakout Strength**	54,838	37,598	146	not recommended
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A



Preferred Anchorage Detail



2 Load case/Resulting anchor forces

Load case: Design loads

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

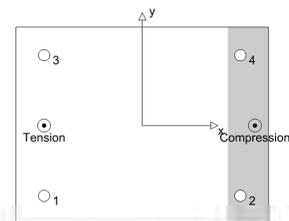
Anchor	Tension force	Shear force	Shear force x	Shear force y
1	12,808	0	0	0
2	0	0	0	0
3	12,808	0	0	0
4	0	0	0	0

max. concrete compressive strain: 0.29 [%]
 max. concrete compressive stress: 1,267 [psi]
 resulting tension force in (x/y)=(-7.000/0.000): 25,616 [lb]
 resulting compression force in (x/y)=(8.037/0.000): 25,616 [lb]

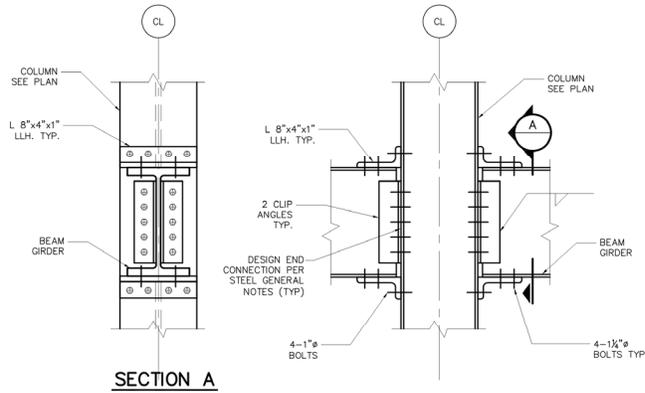
Anchor forces based on a rigid base plate assumption!

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_{Nt} = N_{ua}/\phi N_n$	Status
Steel Strength*	12,808	14,529	89	OK
Pullout Strength*	12,808	15,305	84	OK
Concrete Breakout Strength**	25,616	28,822	90	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A



5. Connection Design's Affect on Stability



SECTION A

11 TYP. MOMENT CONNECTION
SF5-006 SCALE: N.T.S.



11-4 DESIGN OF PARTIALLY RESTRAINED MOMENT CONNECTIONS

flange deformation and shows that only the fasteners closest to the column web are fully effective in transferring forces.

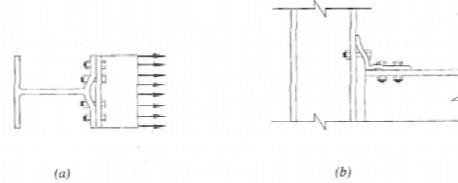
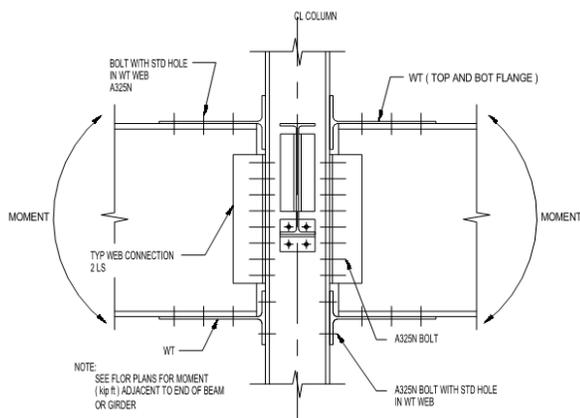
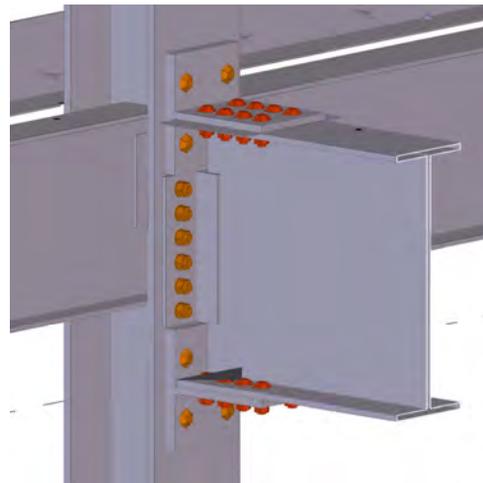


Fig. 11-2. Illustration of deformations in partially restrained moment connections.

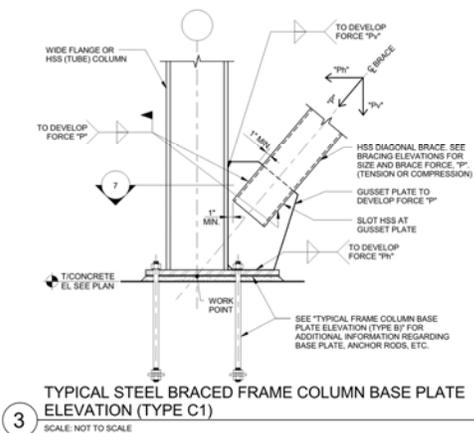
5. Connection Design's Affect on Stability



002E TYPICAL FMC MOMENT CONNECTION DETAIL
SF5-002 SCALE: 1" = 1'-0"



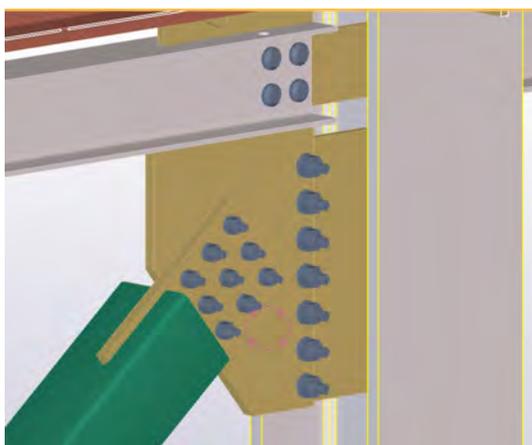
5. Connection Design's Affect on Stability



CALCULATION OF E-BOLT CAPACITY PRIOR TO WELDING



5. Connection Design's Affect on Stability



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6. Miscellaneous Erection Procedure Topics

Shoring

Crane Logistics

Heavy Lift Engineering



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West Point Science Center

Complete seismic upgrade of the facility which required removal and replacement of the existing floor diaphragms to meet current code.

Multi-span header and EFCO shoring towers were used to support existing trusses.



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6. Miscellaneous Erection Procedure Topics



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6. Miscellaneous Erection Procedure Topics



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6. Miscellaneous Erection Procedure Topics



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Summary:

- **EOR has a role in the Erection Procedure**
 - Code of Standard Practice: 7.10.1 and 7.10.2
- **There are simple design changes the EOR can implement in order to simplify steel erection.**
 - Easier steel erection results in less field time and less cost to the owner.
- **Erection Engineer is often one of the last consultants involved, earlier involvement is beneficial.**
- **Erection Engineering services go beyond just reviewing the building's sequenced construction.**

AISC | Questions?



**Smarter.
Stronger.
Steel.**

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Within 2 business days...

- 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!



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CEU/PDH Certificates

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- New reporting site (URL will be provided in the forthcoming email).
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8-Session Registrants

Access to the quiz: Information for accessing the quiz will be emailed to you by Wednesday. It will contain a link to access the quiz. EMAIL COMES FROM NIGHTSCHOOL@AISC.ORG

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Reasons for quiz:

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- CEUs/PDHS – If you watch a recorded session you must take quiz for CEUs/PDHS.
- REINFORCEMENT – Reinforce what you learned tonight. Get more out of the course.

NOTE: If you attend the live presentation, you do not have to take the quizzes to receive CEUs/PDHS.



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 - Updated on Tuesday mornings.



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Steel.**

