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Steel Erection: Engineering and Execution

Session 2: Erection Engineering of Low-Rise Buildings

September 3, 2020

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Course Description

Erection Engineering of Low-Rise Buildings
September 3, 2020

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 of low-rise buildings. Topics include:

- AISC 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
- Design examples

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Learning Objectives

- Explain how the effect of shielding is addressed when calculating wind loads acting on unenclosed buildings during construction.
- Identify a design choice that may ensure truss chord stability during erection without temporary supports.
- Describe why the Occupational Safety and Health Administration (OSHA) requires four anchor bolts for a column, and how the demand on those anchor bolt during erection can greatly exceed OSHA requirements.
- Identify how the choice of moment connection detail can impact the erection of a steel frame.

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Steel Erection: Engineering and Execution

Erection Engineering of Low-Rise Buildings

September 3, 2020

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Project Engineer
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Three-Part Webinar Series

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

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Presentation Outline

1. Introduction
2. Industry Codes, Standards, and Guides
3. Stability Analysis – Global and Local
4. Effects of Staged Construction
5. Connection Design's Affect on Stability
6. Summary

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What is a Low-Rise Building?

ASCE 7-10:

Enclosed or partially enclosed buildings that comply with the following conditions:

1. Mean roof height h less than or equal to 60ft.
2. Mean roof height h does not exceed least horizontal dimension

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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 Structural Steel Erector needs the services of an Erection Engineer.

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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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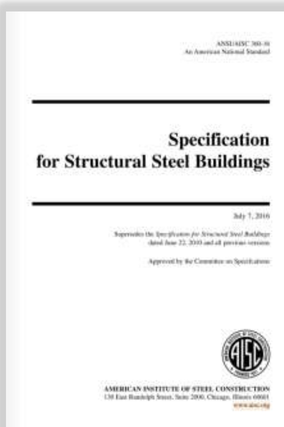
Industry Codes, Standards, and Guides



Section M4.2.
The frame of structural steel buildings shall be carried up true and plumb within the limits defined in Code of Standard Practice Chapter 7. As erection progresses, the structure shall be secured to support dead, erection and other loads anticipated to occur during the period of erection. Temporary bracing shall be provided, in accordance with the requirements of the Code of Standard Practice, wherever necessary to support the loads to which the structure may be subjected, including equipment and the operation of same. Such bracing shall be left in place as long as required for safety.

2205.1 General. The design, fabrication and erection of structural steel elements in buildings, structures and portions thereof shall be in accordance with AISC 360.

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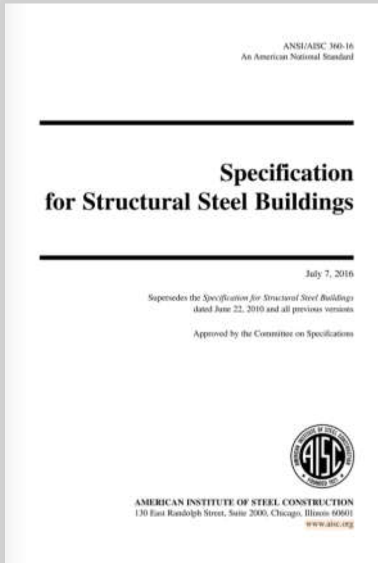
Industry Codes, Standards, and Guides



Section 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 load that are likely to be encountered during erection, including those due to wind and those that result from erection operations…

Section 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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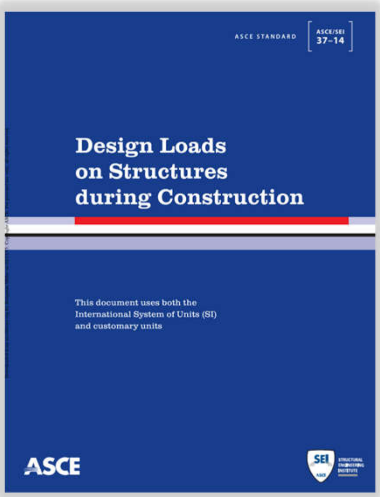
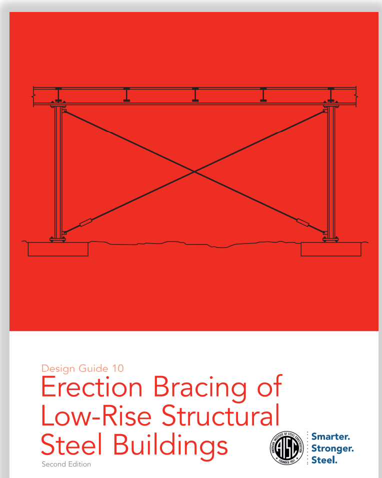
Industry ~~Codes,~~ Standards, and Guides





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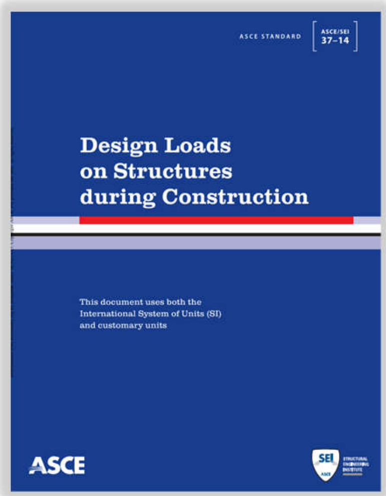
ASCE 37 – Chapter 6



6.2 WIND

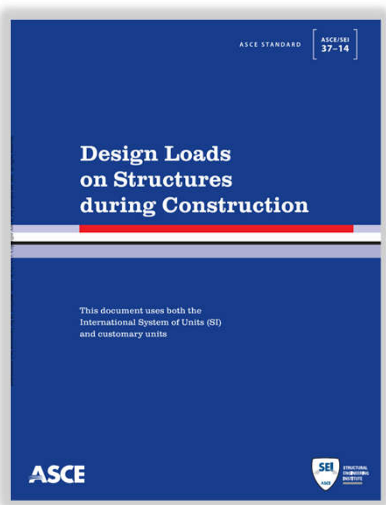
Except as modified herein, wind loads shall be calculated in accordance with procedures in ASCE/SEI 7-10.

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/m^2) 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.

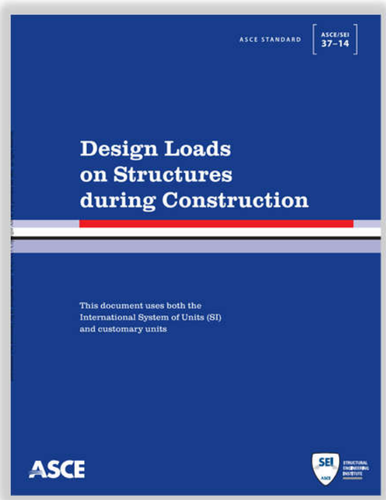
Construction Period	Factor
Less than six weeks	0.75
From six weeks to one year	0.8
From one to two years	0.85
From two to five years	0.9

ASCE 37 – Chapter 6 Example



- Risk Category II structure in Detroit, MI
- ASCE 7-10 wind map → 115mph design wind speed
- Structure erected in 6weeks to 1 year time period → 0.8 factor
- Erection Period Design Wind = 0.8*115mph = 92mph
- 92mph is input in the velocity pressure equation given in ASCE 7.
- $q_z = 0.00256(K_z)(K_{zt})(K_d)(V^2)$
- If K_{zt}=1.0, K_d=0.85, Exposure B with K_z = 0.85
- q_z = 15.7 PSF
- How is this pressure applied to the structure?

ASCE 37 – Chapter 6



6.2.2 Frameworks without Cladding Structures shall resist the effect of wind acting upon successive unenclosed components.

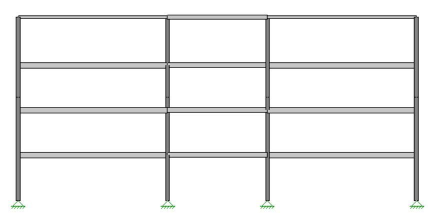
Treatment of staging, shoring, and falsework with a regular rectangular plan as trussed towers in accordance with ASCE/SEI 7-10 shall be permissible. Unless detailed analyses are performed to show that lower loads may be used, no allowance shall be given for shielding of successive rows or towers.

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:

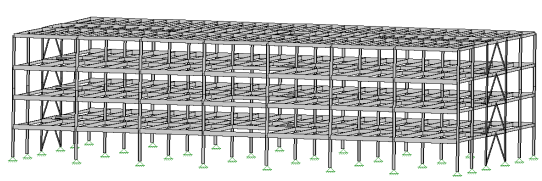
1. The loads on the first three rows of elements along the direction parallel to the wind shall not be reduced for shielding.
2. The loads on the fourth and subsequent rows shall be permitted to be reduced by 15%.
3. Wind load allowances shall be calculated for all exposed interior partitions, walls, temporary enclosures, signs, construction materials, and equipment on or supported by the structure. These loads shall be added to the loads on structural elements.

ASCE 7 – Wind Loads on Other Structures

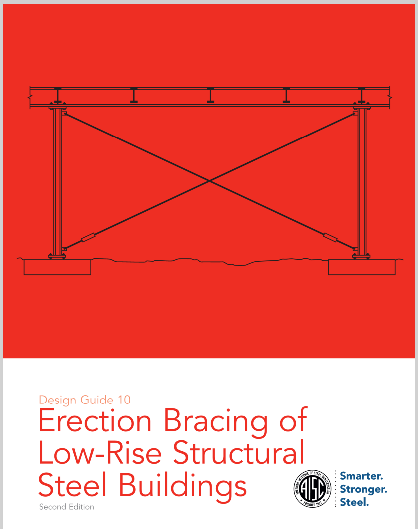
- 29.4: Design Wind Loads - …Solid Signs?



- 29.5: Design Wind Loads - …Lattice Framework?



AISC Design Guide 10 – Section 2.2.1



ASCE/SEI 7-10 does not specifically address main wind force-resisting system (MWFRS) wind loading on bare frame open structures. It does however address certain other structures in Chapter 29, such as solid freestanding walls and solid signs, other structures, rooftop structures and equipment, parapets, and roof overhangs. It is the judgment of the authors that the provisions for signs are the best analogous geometries to the surfaces of bare frame open structures. Thus, the appropriate equation for design wind force, F, on bare frame structures is ASCE/SEI 7-10, Equation 29.4-1:

$$F = q_h G C_f A_s$$

(ASCE/SEI 7-10 Eq. 29.4-1)

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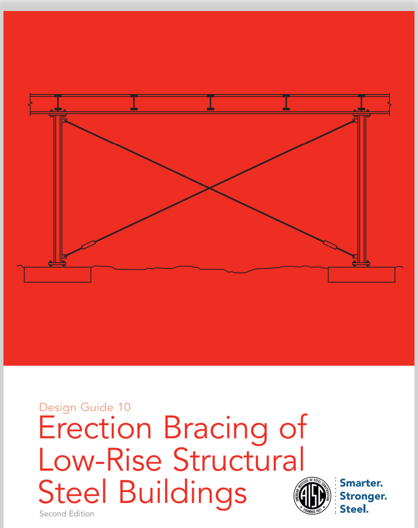
AISC Design Guide 10 – Element Shielding



Shielding of multiple parallel elements can also be evaluated using the following equation taken from DIN 1055 *Actions on Structures—Part 4: Wind Loads* (DIN, 2005). See Figures 2-1 and 2-2. Note that the variables a, d, and l used in these figures are in consistent units. The total factored area, A, is determined using Equation 2-1:

$$A = \left[1 + \eta + (n-2)\eta^2\right] A_1 \qquad (2\text{-}1)$$

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AISC Design Guide 10 – Element Shielding

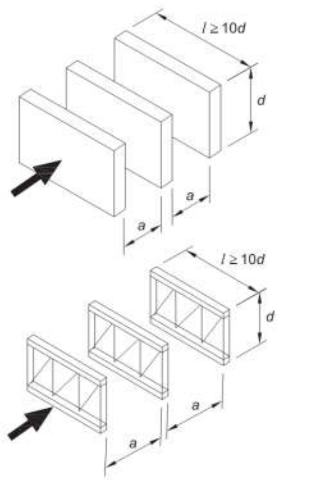

Fig. 2-1. Parameters for use with Fig. 2-2 (DIN, 2005).

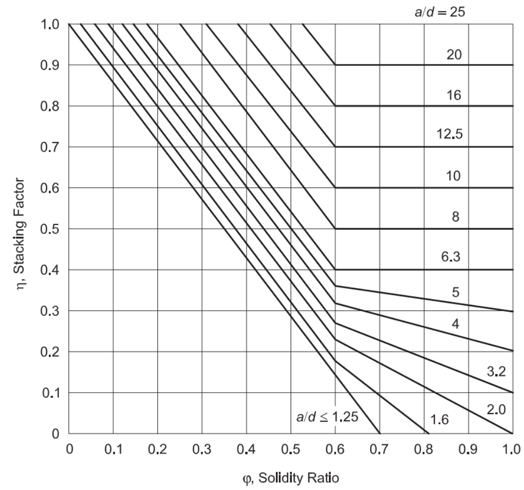

Fig. 2-2. Stacking factor versus solidity ratio (DIN, 2005).

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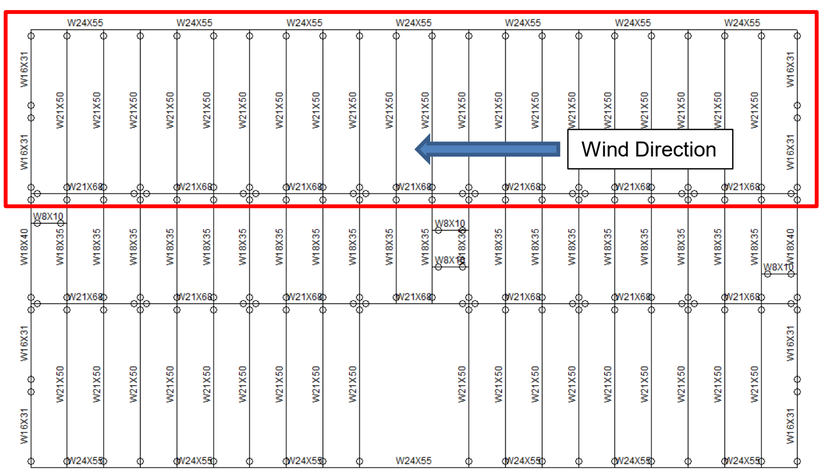
AISC Design Guide 10 – Element Shielding



ROOF - PLAN VIEW

- Apply DIN 1055 to infill members within the red box.
- Beam – W21x50
- Span – 45ft
- Spacing – 10ft
- Solidity Ratio, φ – 1.0
- a/d ratio – 120"/20.8" = 5.77
- Number of elements, n = 20
- A_1 = 45'(20.8")(1'/12") = 78ft^2

- η = 0.36 → 0.4 to be conservative

- A = [1+0.4+(20-2)(0.4)^2](78ft^2)
  = 333.8
  = 334ft^2

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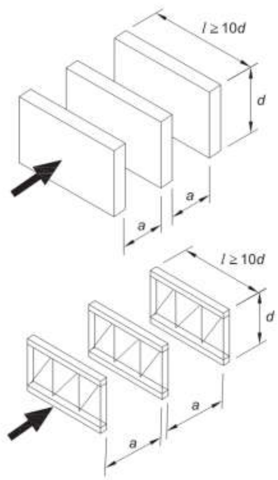
AISC Design Guide 10 – Element Shielding



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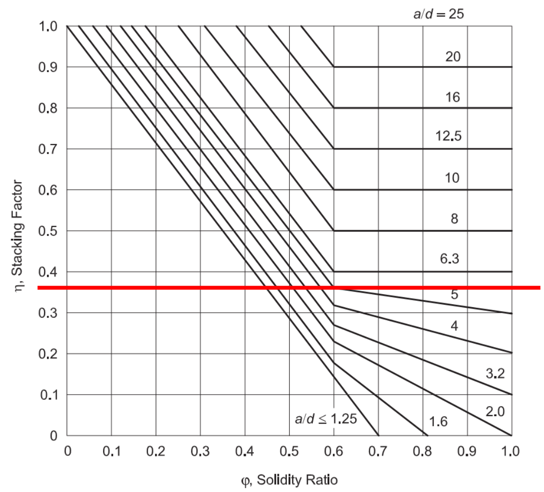

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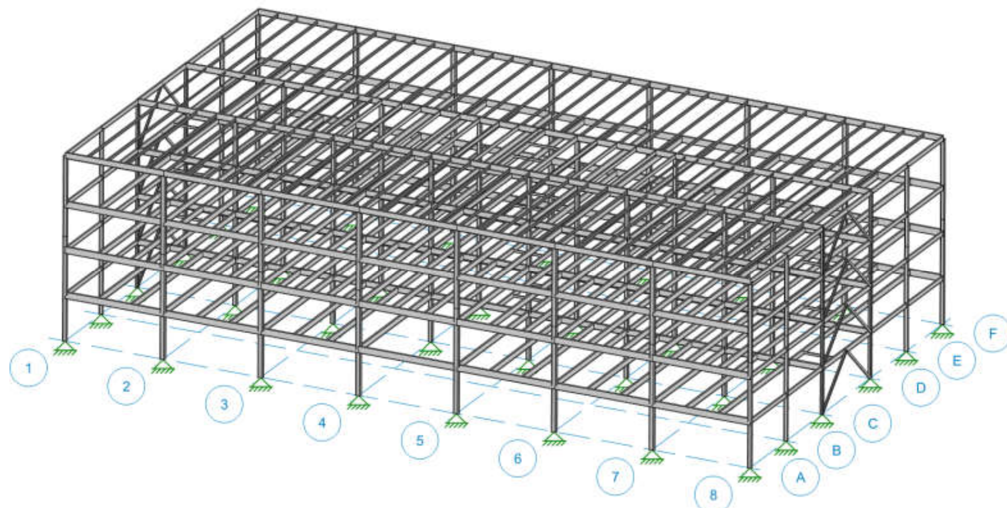
Stability Analysis – Global and Local



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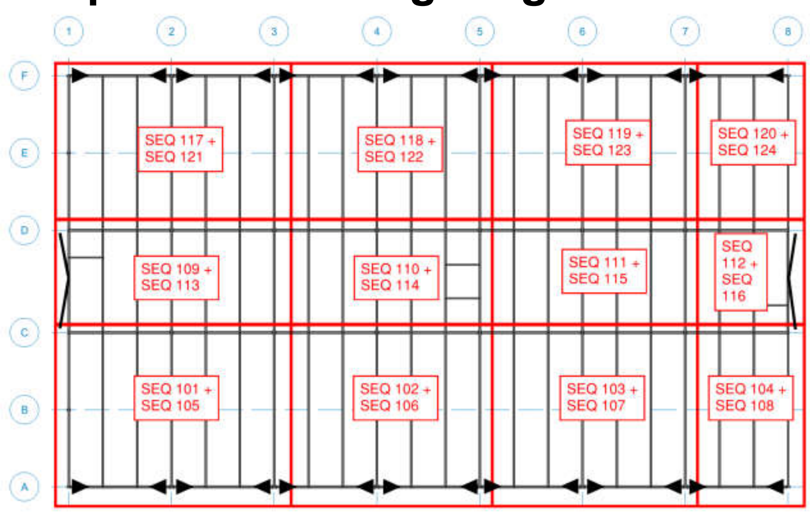
Sequence Blocking Diagram



- Lateral Load Resisting System consists of concrete slab on metal deck diaphragms at floor levels spanning horizontally to vertical bracing at Grid 1 and Grid 8 and moment frames at Grid A and Grid F.
- At the roof level, the diaphragm consists of metal roof deck only spanning to the vertical bracing and moment frames.

ROOF - PLAN VIEW

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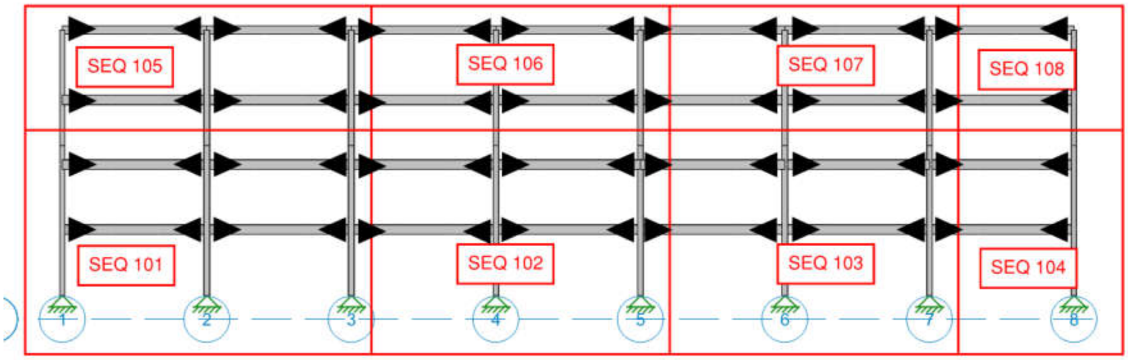
Sequence Blocking Diagram



Elevation Along Grid A – Looking North

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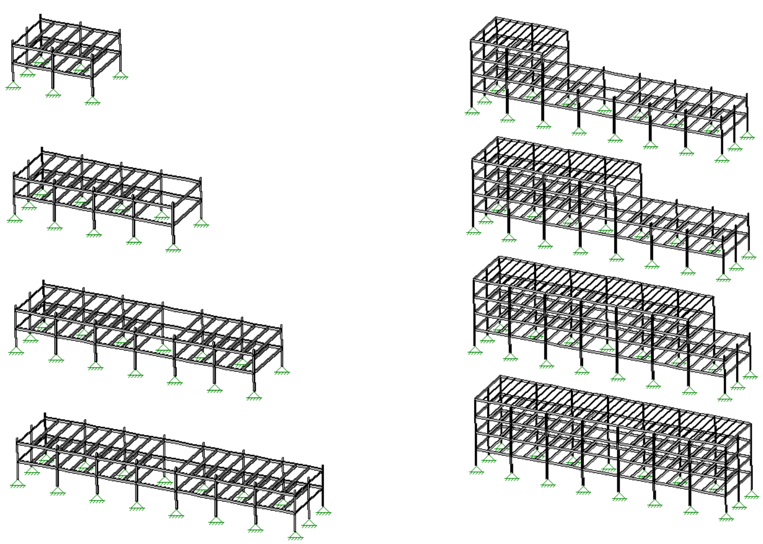
Sequenced Analysis – Seq 101 thru 108



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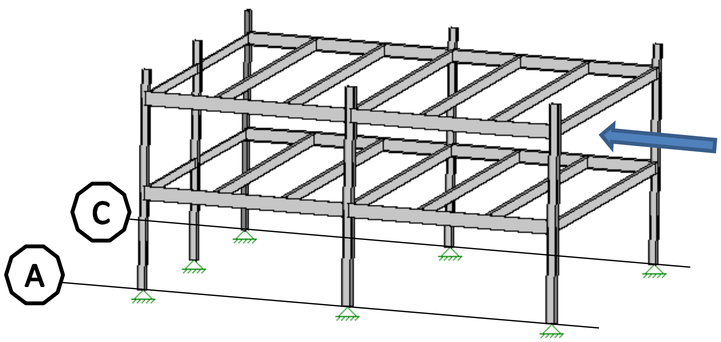
Sequenced Analysis – Seq 101 Erected



- Is this structure stable without temporary measures?
- What possible elements of the permanent structure can provide stability during steel erection?
  - Does the moment frame along Grid A maintain stability along Grid A?
    - Depends on the connection type.
  - Does column anchorage to foundation have sufficient strength to act as a fixed base?
    - Depends on the AR layout, size, embed, etc…
  - For this example, lets assume moment connections are field welded CJP and anchorage does not provide base fixity.

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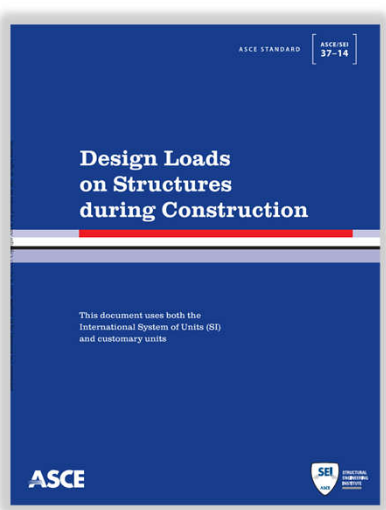
ASCE 37 – Chapter 6 Example



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- ASCE 7-10 wind map → 115mph design wind speed
- Structure erected in 6weeks to 1 year time period → 0.8 factor
- Erection Period Design Wind = 0.8*115mph = 92mph
- 92mph is input in the velocity pressure equation given in ASCE 7.
- $q_z = 0.00256(K_z)(K_{zt})(K_d)(V^2)$
- If K_{zt}=1.0, K_d=0.85, Exposure B with K_z = 0.85 (Height = 60ft)
- q_z = 15.7 PSF

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ASCE 7-10: 29.4 – Solid Signs

- Design Force is given by equation 29.4-1

$$F = q_h(G)(C_f)(A_s)$$

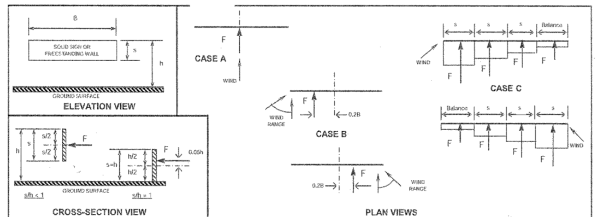
- q_h = 15.7psf
- G = 0.85
- C_f = 1.9
- A_s = 172 ft^2 (accounting for shielding per DG 10 methodology)

- F = 4361 lbs @ each floor level due to easterly wind

The total design force on the columns (A_s = 109 ft^2) at each Grid line is F = 2621 lbs, due to easterly wind.

Base Shear on Grid A = 6982 → 7000 lbs

Design Wind Loads		All Heights
Figure 29.4-1	Force Coefficients, C_f	Solid Freestanding Walls & Solid Freestanding Signs
Other Structures		



C_f, CASE A & CASE B

Clearance Ratio, s/h	Aspect Ratio, B/s ≤ 0.05	0.1	0.2	0.5	1	2	4	5	10	20	30	≥ 45
1	1.80	1.70	1.65	1.55	1.45	1.40	1.35	1.35	1.30	1.30	1.30	1.30
0.9	1.85	1.75	1.70	1.60	1.55	1.50	1.45	1.45	1.40	1.40	1.40	1.40
0.7	1.90	1.85	1.75	1.70	1.65	1.60	1.60	1.55	1.55	1.55	1.55	1.55
0.5	1.95	1.85	1.80	1.75	1.75	1.70	1.70	1.70	1.70	1.70	1.70	1.75
0.3	1.95	1.90	1.85	1.80	1.80	1.80	1.80	1.80	1.80	1.85	1.85	1.85
0.2	1.95	1.90	1.85	1.80	1.80	1.80	1.80	1.80	1.85	1.90	1.90	1.95
≤ 0.16	1.95	1.90	1.85	1.85	1.80	1.80	1.85	1.85	1.85	1.90	1.90	1.95

ASCE 7-10 Figure 29.4-1

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ASCE 7-10: 29.5 – Lattice Frameworks

- Design Force is given by equation 29.4-1

$$F = q_z(G)(C_f)(A_f)$$

- q_z = 15.7psf
- G = 0.85
- C_f = 1.8
- A_f = 562 ft^2

F = 13,500lbs total base shear

F_{grid} = 6750lbs

Comparable design wind load between the two sections of ASCE 7.

∈	Flat-Sided Members	Rounded Members $D\sqrt{q_z} \le 2.5$ ($D\sqrt{q_z} \le 5.3$)	Rounded Members $D\sqrt{q_z} > 2.5$ ($D\sqrt{q_z} > 5.3$)
< 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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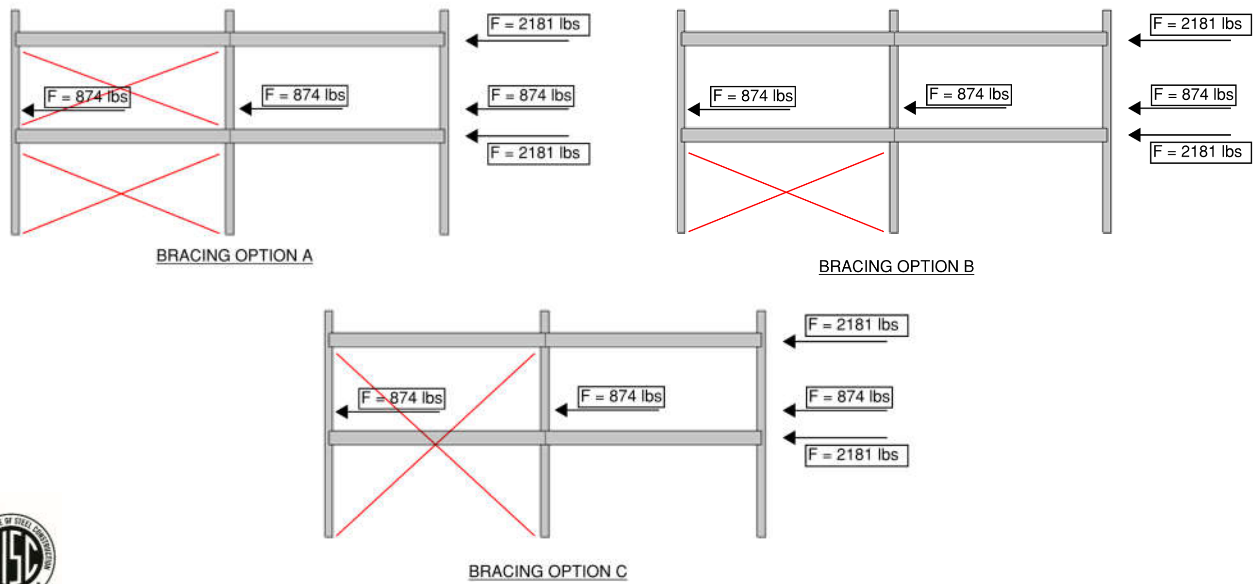
Sequenced Analysis – Seq 101; Grid A Temp. Bracing



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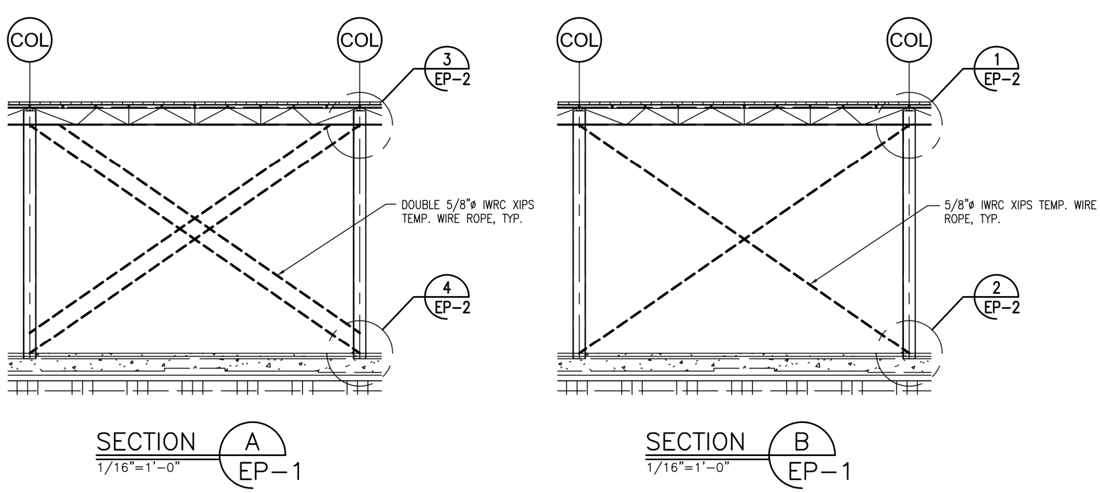
Cable Bracing Design



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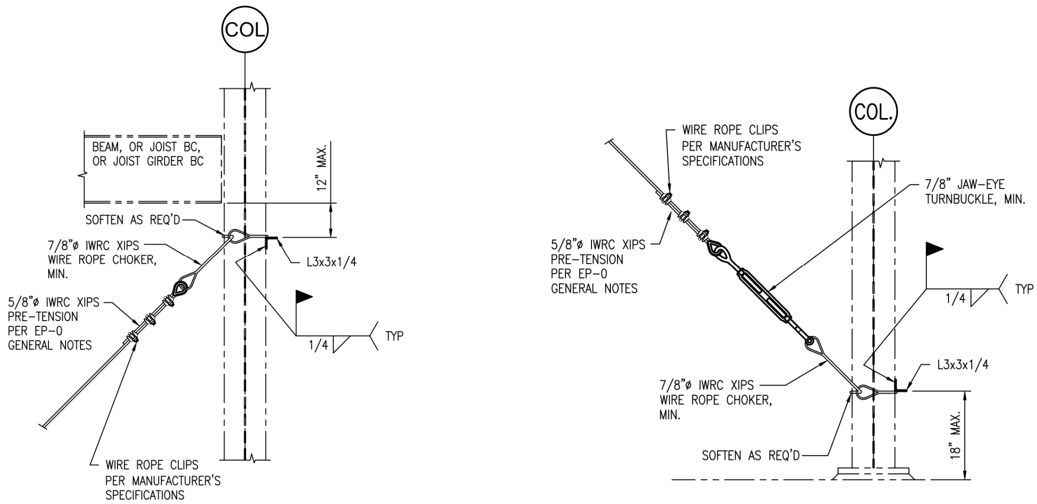
Cable Bracing Design



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Cable Bracing

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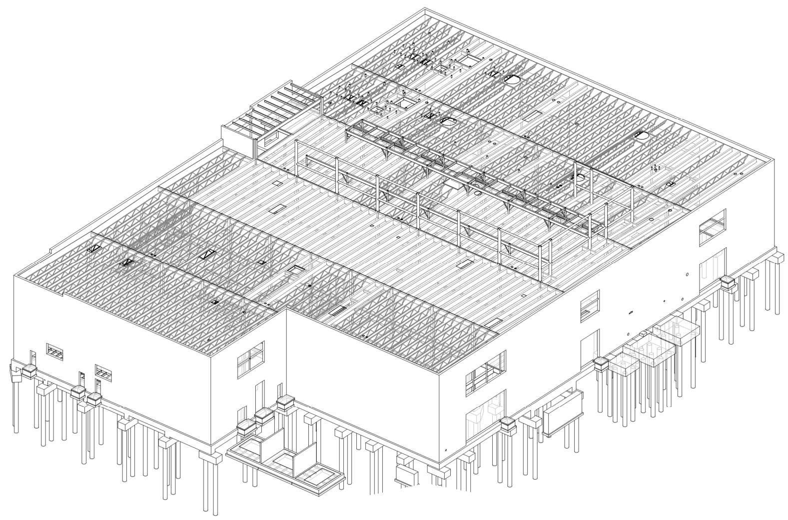
Example Project 2:

- 2-Story Industrial
- SOMD at Level 2
- Metal Roof Deck
- LLRS - 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.



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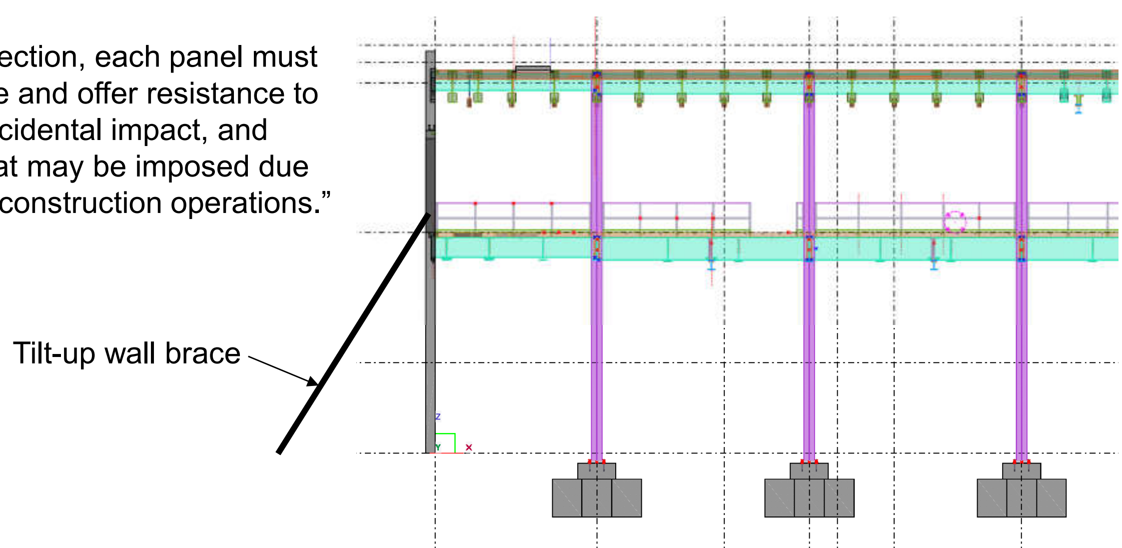
PCI: Architectural Precast Concrete Third Ed.

"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."



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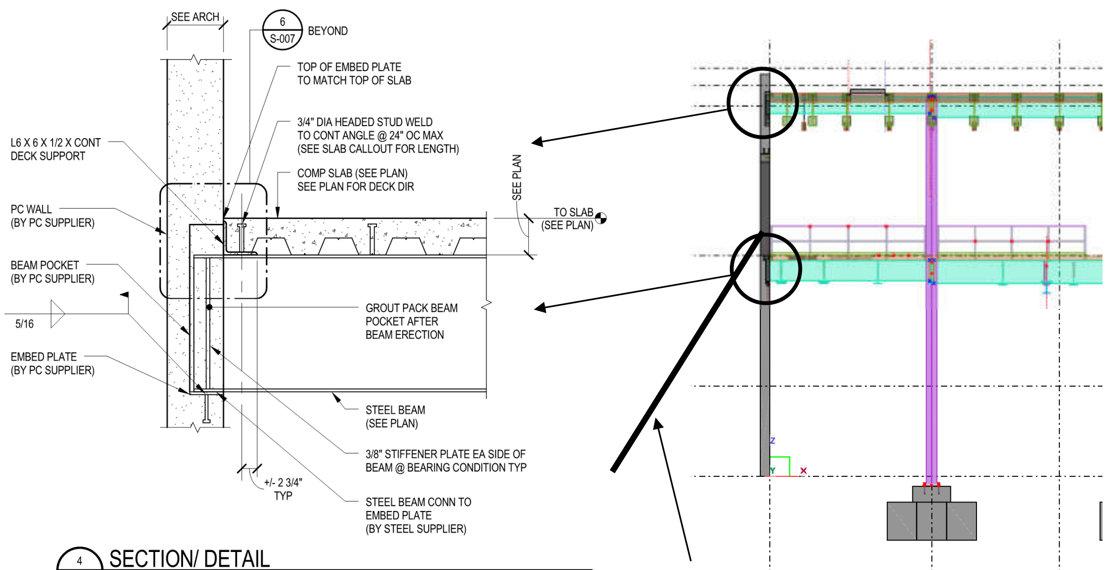
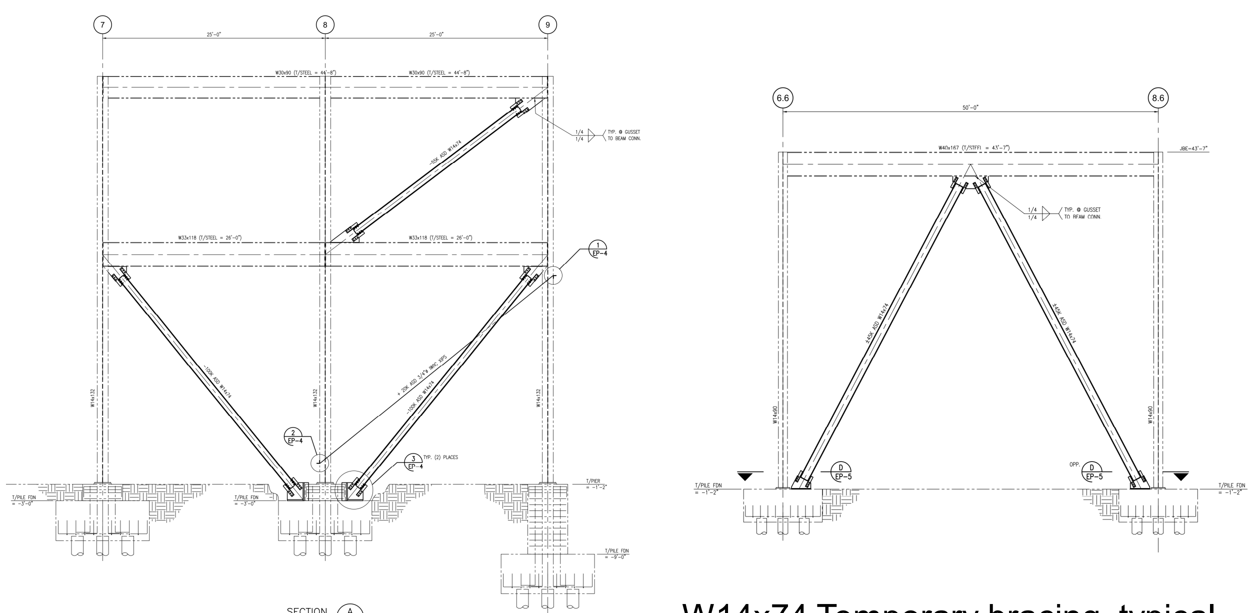


Tilt-up wall brace



W14x74 Temporary bracing, typical

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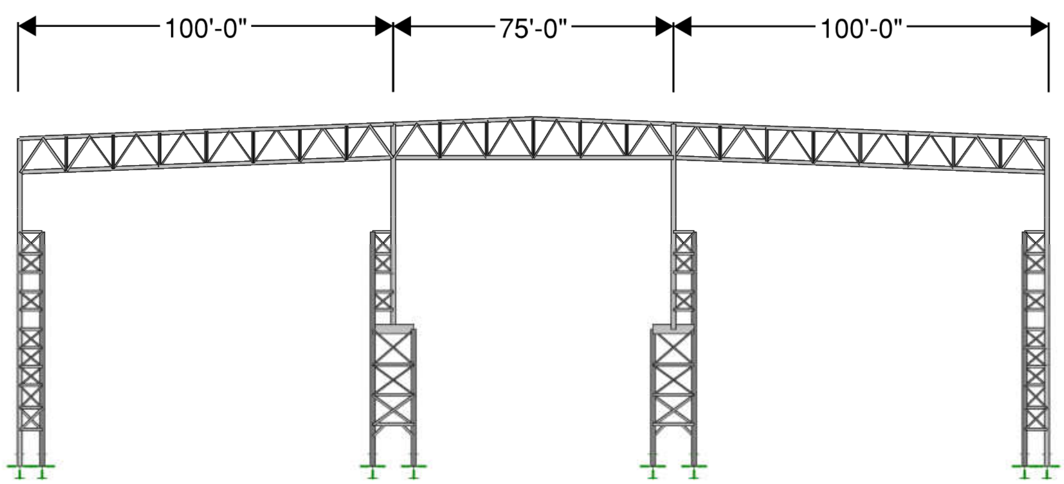
Stability Analysis – Global and Local



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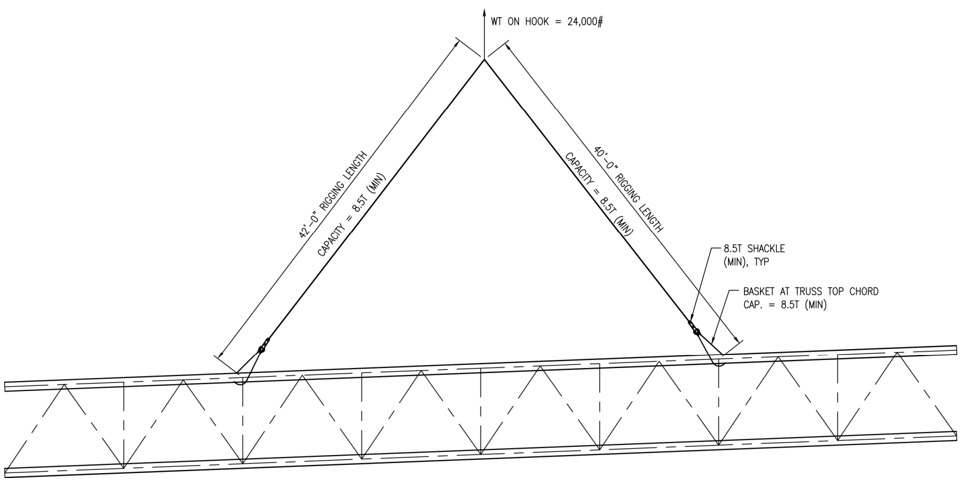
Truss Stability – Under Hook



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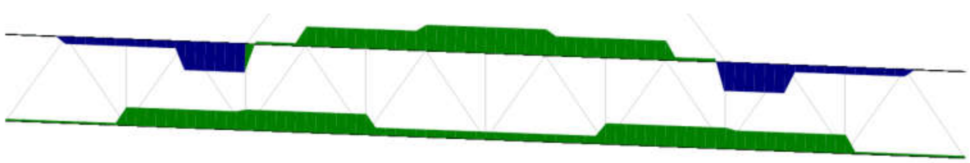
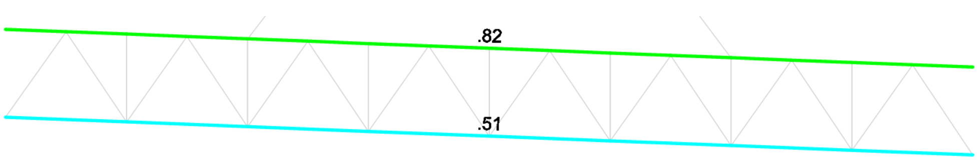
Truss Stability – Under Hook



Chord Axial Load



Chord Axial Unity

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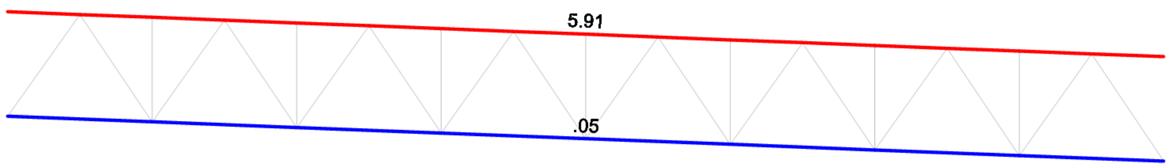
Truss Stability – At Set



Chord Axial Load

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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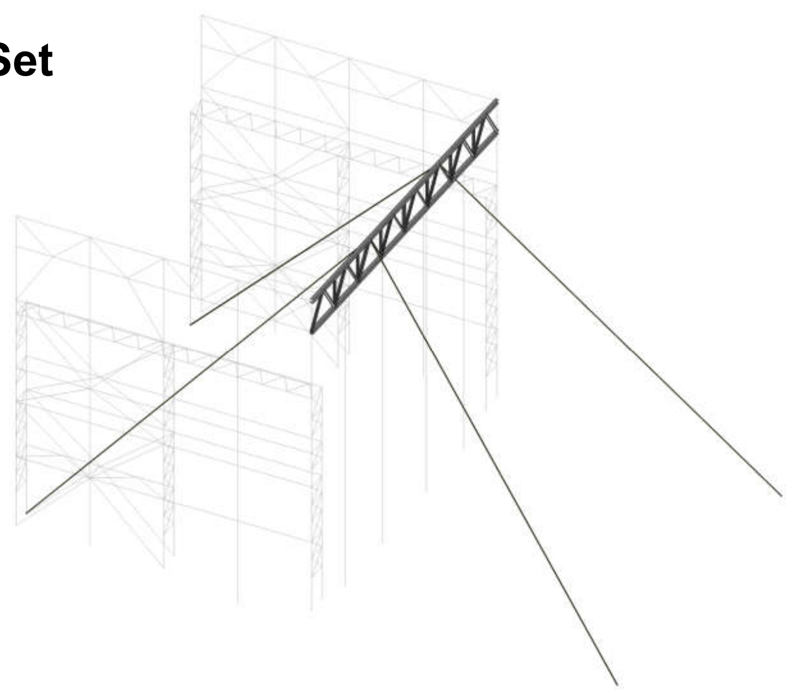
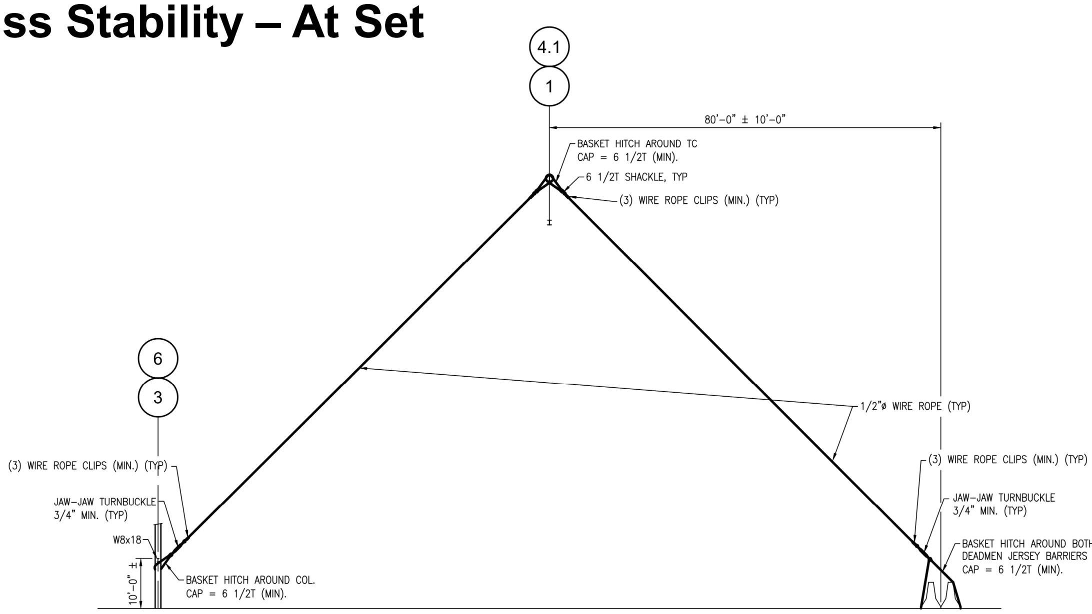
Truss Stability – At Set

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



48

Truss Stability – At Set



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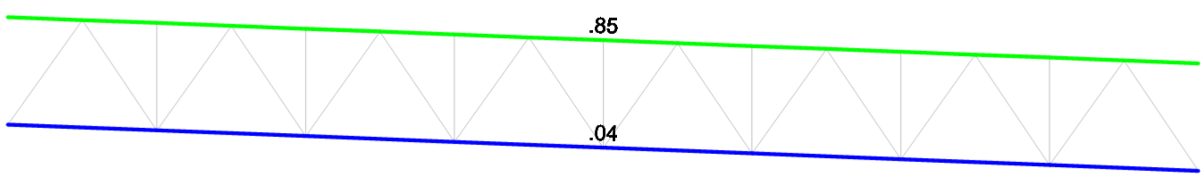
Truss Stability – At Set



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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Truss Stability – Comp. Chord Aspect Ratio

Rule of Thumb:

- L/b < 80: Stability of chord likely ok
- 80 ≤ L/b < 100: Design check of chord is necessary
- 100 ≤ L/b: Secondary bracing likely required

L = maximum dimension (inches) of:

- Distance between lifting points
- Length of cantilever portion of lift
- Distance between braced points
- Distance between points of support

b = width of compression flange (inches)

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Presentation Outline

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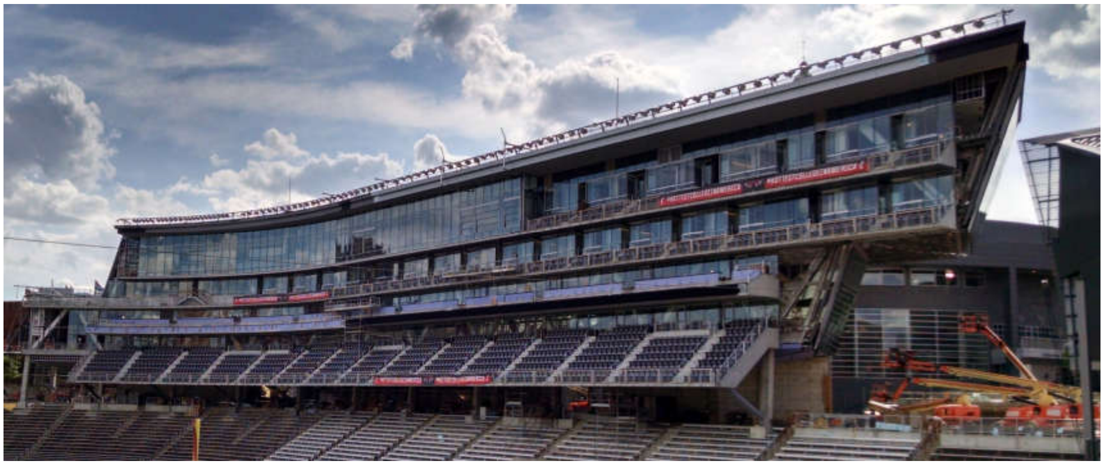
Nippert Stadium



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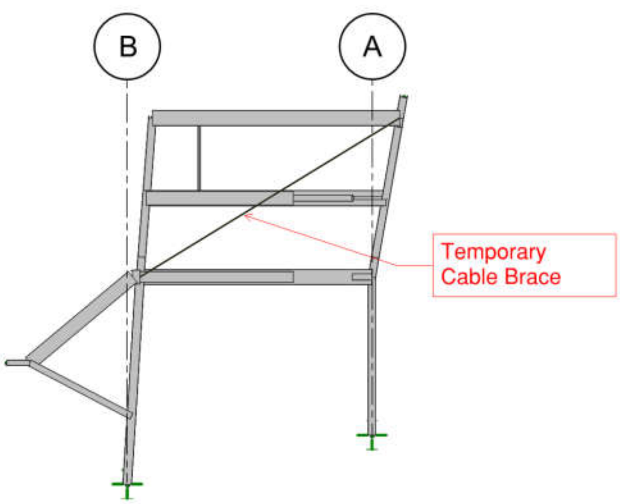
Nippert Stadium



	1.4*DL		1.0*DL	
Location	M_{strong} (k-ft)	M_{weak} (k-ft)	M_{strong} (k-ft)	M_{weak} (k-ft)
A/21.5	-1	-0.5	-0.7	-0.4
A/21N	28	2	20.0	1.4
A/21S	4	-4	2.9	-2.9
A/19N	-15	-4	-10.7	-2.9
A/19S	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	-35.0	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	9	6	6.4	4.3

	1.4*DL		1.0*DL	
Location	M_{strong} (k-ft)	M_{weak} (k-ft)	M_{strong} (k-ft)	M_{weak} (k-ft)
B/22.5	-1	-1	-0.7	-0.7
B/22N	-27	-4	-19.3	-2.9
B/22S	-4	4	-2.9	2.9
B/20N	-15	-4	-10.7	-2.9
B/20S	-32	3	-22.9	2.1
B/18N	-48	-3	-34.3	-2.1
B/18S	-16	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	-55	-3	-39.3	-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

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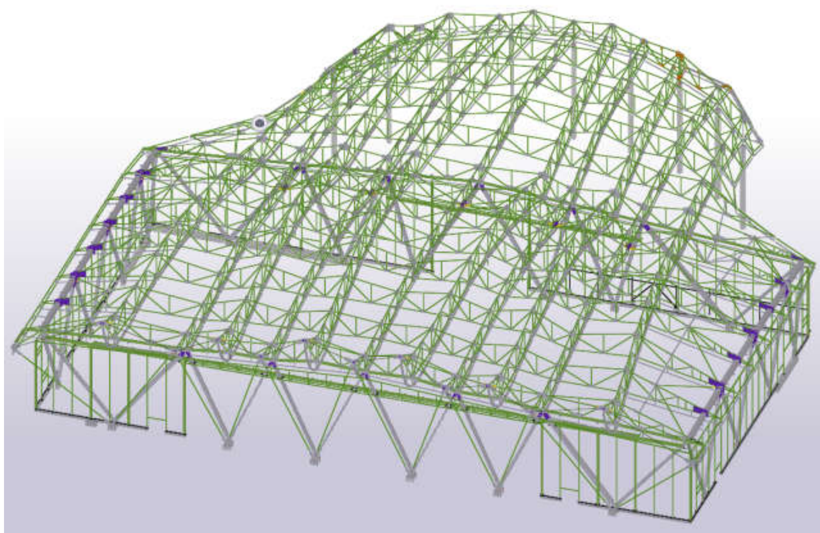
Flex Field Truss Shoring



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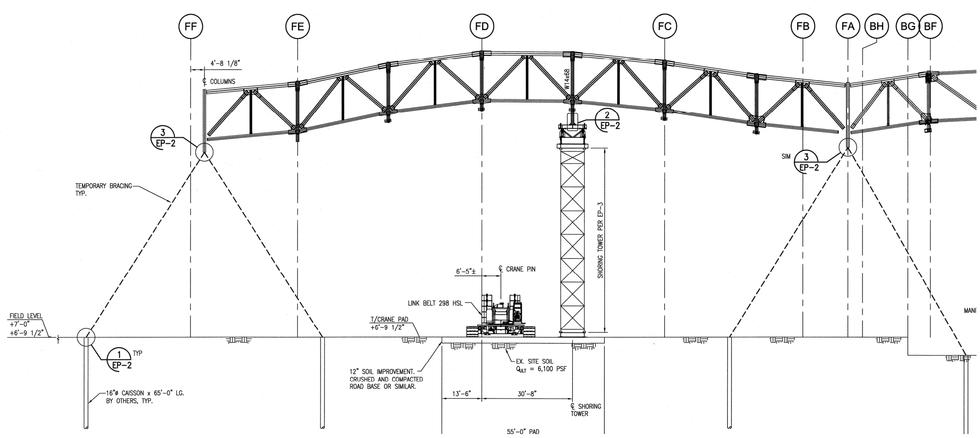
Flex Field Truss Shoring



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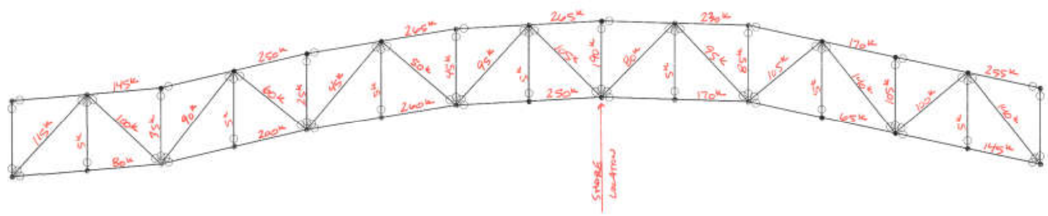
Flex Field Truss Shoring



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.

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Presentation Outline

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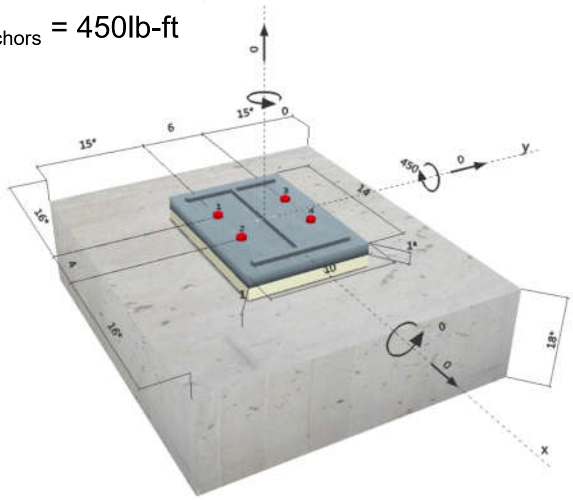
Column Anchorage

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

$M_{anchors}$ = 450lb-ft



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OSHA

2 Load case/Resulting anchor forces

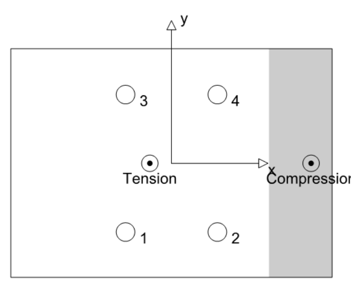
Load case: Design loads

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 ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	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

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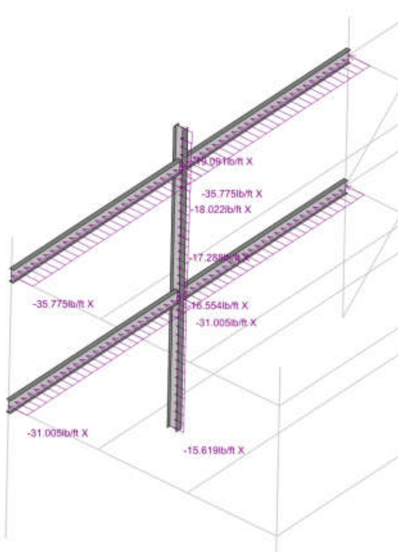
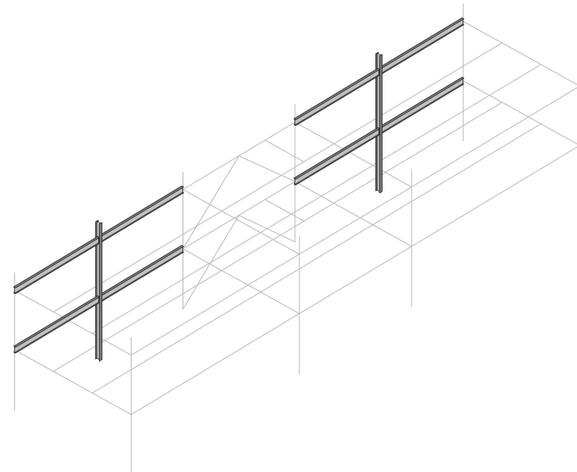
Wind Column Stability





Wind Loads:

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

Column (W12) – 15.6plf to 19.0plf

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

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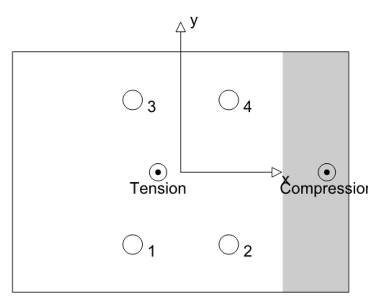
Wind Column Stability

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 ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	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

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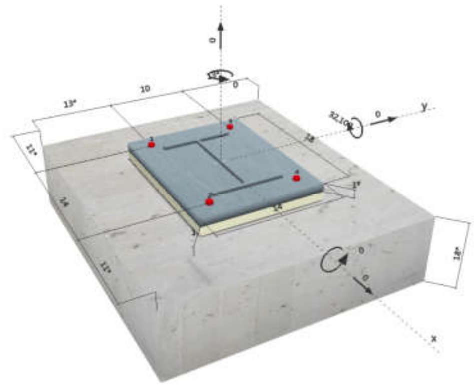
Preferred Anchorage Detail



2 Load case/Resulting anchor forces

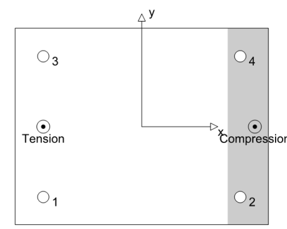
Load case: Design loads

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 ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	12,808	14,529	89	OK
Pullout Strength*	12,808	15,305	84	OK
Concrete Breakout Strength**	25,616	28,622	90	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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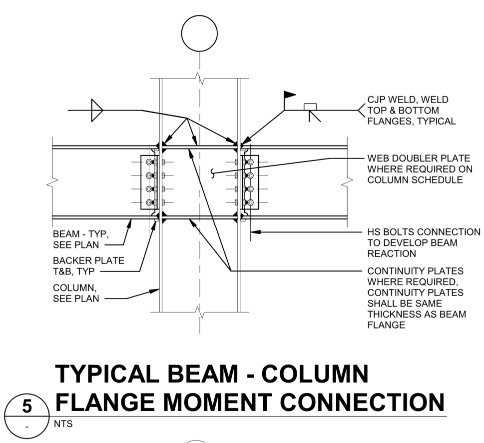
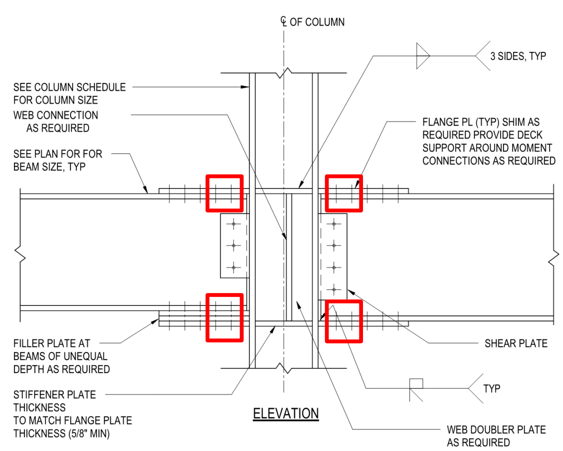
5. Connection Design's Affect on Stability





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5. Connection Design's Affect on Stability

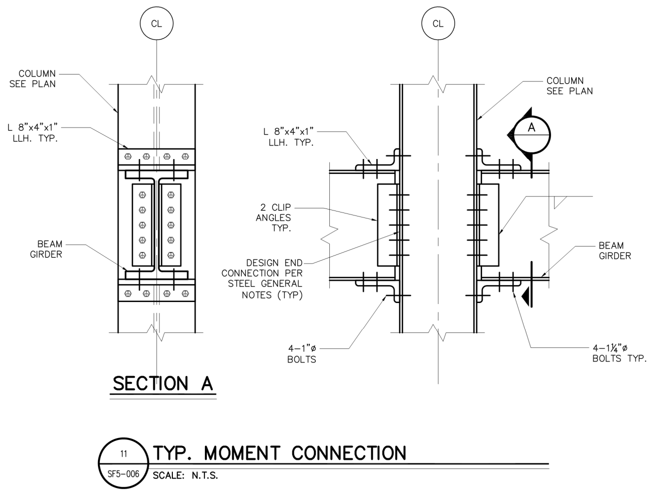

Figure 11-2 illustrates the column flange deformation and shows that only the fasteners closest to the column web are fully effective in transferring forces.

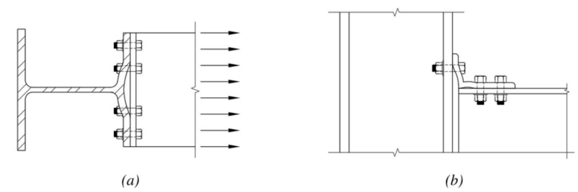

Fig. 11-2. Illustration of deformations in partially restrained moment connections.

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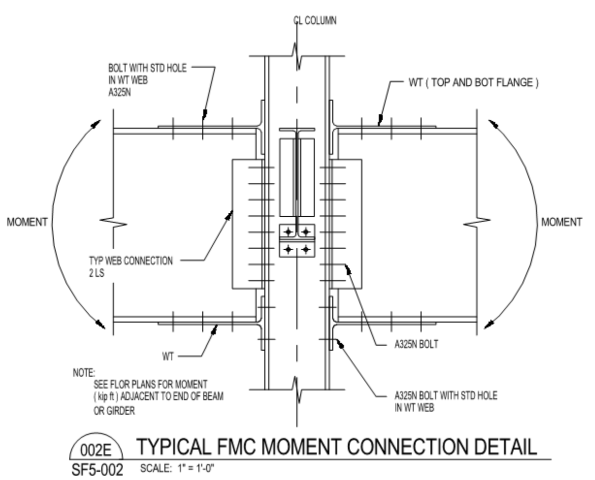
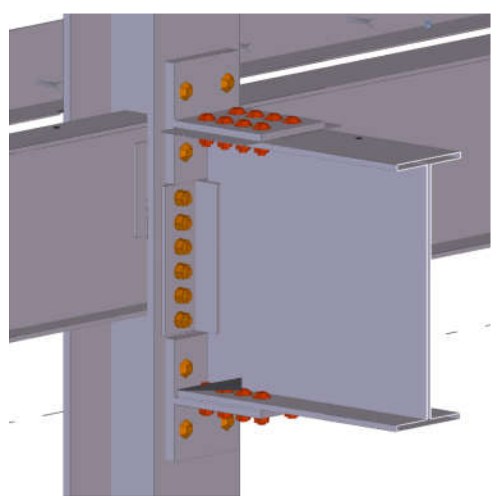
5. Connection Design's Affect on Stability





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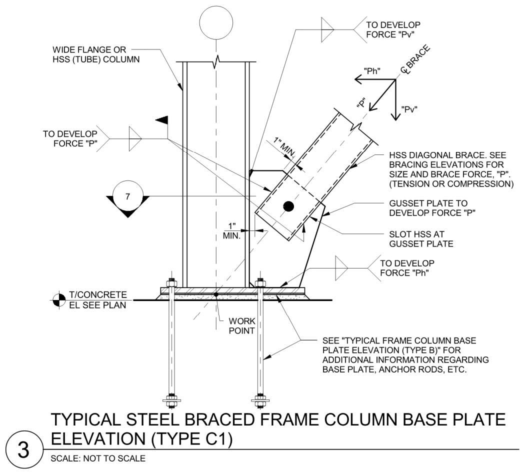
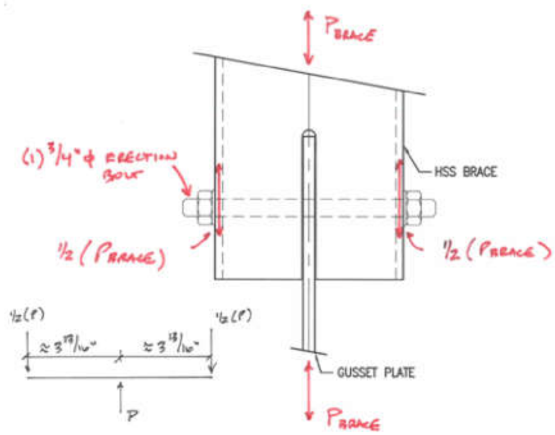
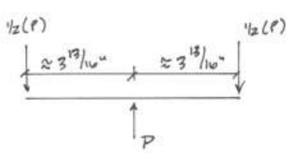
5. Connection Design's Affect on Stability





5. Connection Design's Affect on Stability



EXAMPLE:

HSS 8x8x 5/16"

ALLOWABLE $P_{BRACE} = 750^{\#}$

SHEAR CAPACITY:

$A_{BOLT} = \frac{\pi(0.75")^2}{4} = 0.442 in^2$ $\Omega = 2$

$R_n = A_b(F_n) = 0.442 in^2 (0.45)(58 ksi) = 11.5^k$ $\frac{R_n}{\Omega} = 5.75^k/WA$

$\therefore \frac{R_n}{\Omega}_{,TOT} = 11.5^k$

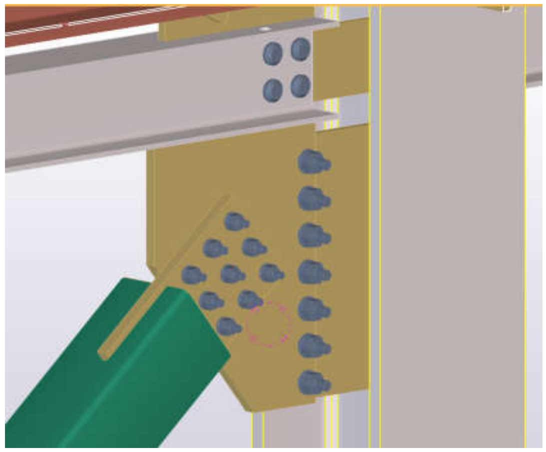
BENDING CAPACITY: $\Omega = 1.67$

$M_n = F_y(Z) \le 1.6 M_y = (36 ksi)\left(\frac{(0.75")^3}{6}\right) \le 1.6(36 ksi)\frac{(\pi)(0.75")^3}{32}$

$M_a = \frac{PL}{4}$ $2.53 k\cdot in \le \underline{2.39 k\cdot in}$

$M_a \le \frac{M_n}{\Omega}$ $\frac{P(2 \times 3.8125")}{4} = \frac{2.39 k\cdot in}{1.67}$ $P = 0.75^k = 750^{\#}$

5. Connection Design's Affect on Stability



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Summary:

- Design codes do not reference standards for stability design during erection.
  - Erection Engineering involves a significant level of judgement in design.
- ASCE 37 and AISC DG 10 provide guidance for stability design during steel erection.
- Stability is not only a global consideration; stability must be reviewed on a local basis as well.
- Connection design plays an important role in stability of partially erected structures.

AISC | Questions?

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- 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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- Reporting site (URL will be provided in the forthcoming email).
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Attendance and PDH Certificates

- You have two options to receive credit for each session.
    - Option 1: Watch the live 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.

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Course Resources

Access to video recordings and quizzes can be found on your AISC account.

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Course Resources

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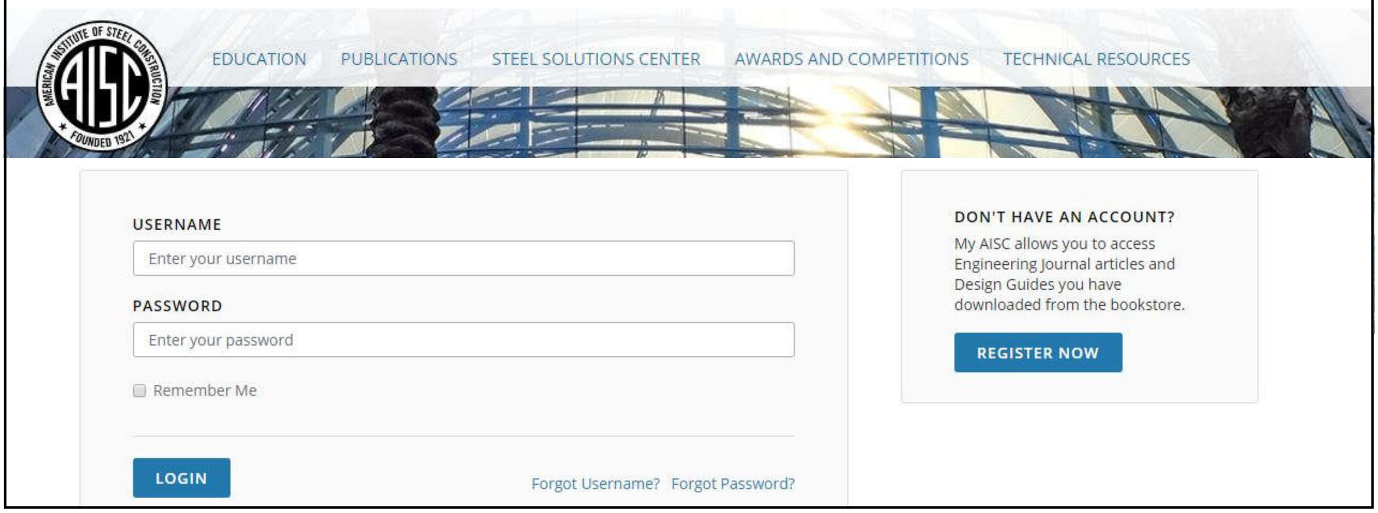

3-Session Registrants

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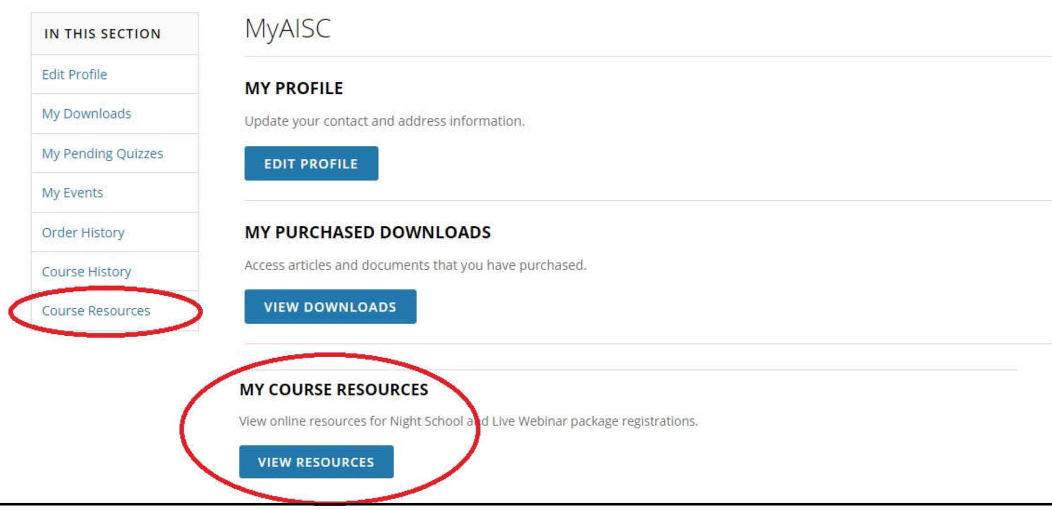

3-Session Registrants

Course Resources

EDUCATION PUBLICATIONS AWARDS AND COMPETITIONS TECHNICAL RESOURCES STEEL SOLUTIONS CENTER

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Course Resources

Event	Start Date
Seismic Design in Steel	1/1/1900 12:00:00 AM
4-Session Package-Design of Façade Attachments	5/9/2019 1:30:00 PM
NS 15 8-Session Package-Night School 15 - Fundamentals of Connection Design	10/3/2017 7:00:00 PM
NS 16 8-Session Package-Night School 16 - Seismic Design in Steel	2/5/2018 7:00:00 PM
NS 17 4-Session Package-Night School 17: Design of Façade Attachments	7/16/2018 7:00:00 PM
NS 18 8-Session Package-Night School 18: Steel Construction: Mill To Topping Out	10/15/2018 7:00:00 PM
NS 19 8-Session Package-Night School 19: Connection Design	2/4/2019 7:00:00 PM
NS 20 8-Session Package-Night School 20: Classical Methods of Structural Analysis	6/3/2019 7:00:00 PM
8-Session Package-Seismic Design in Steel - Concepts & Examples	7/16/2018 1:30:00 PM

3-Session Registrants

Course Resources

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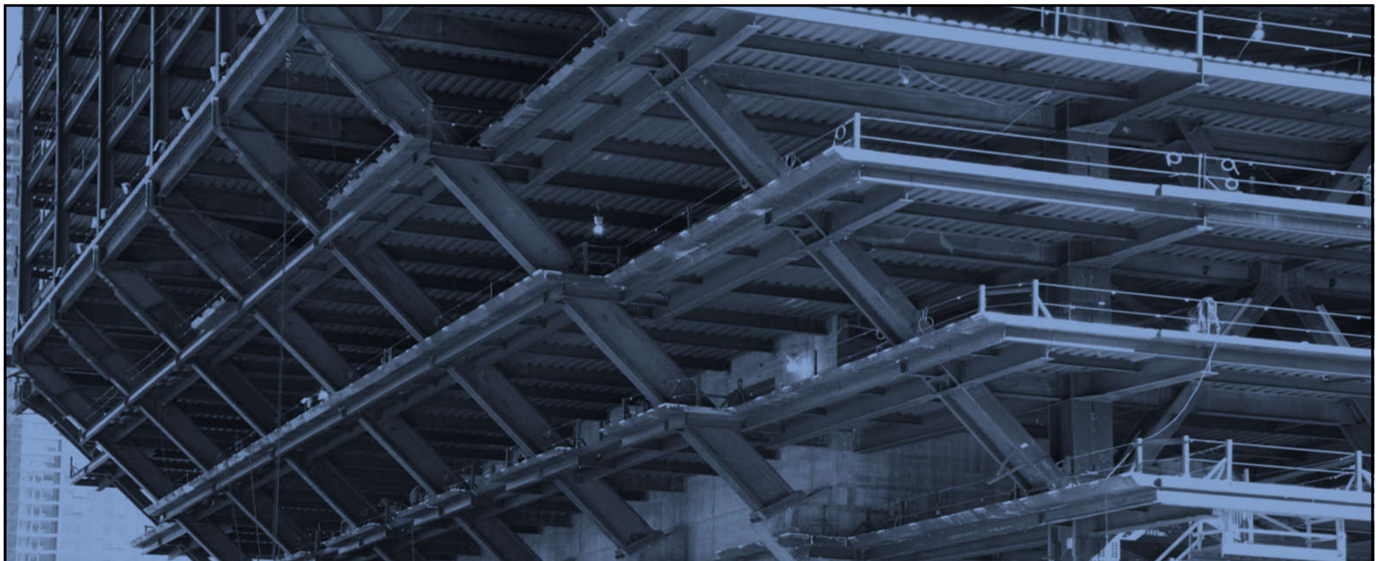
Design of Facade Attachments

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

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