

**AISC Night School**

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

**Modern Methods for Learning the Basics of Structural Stability: From Behavior to Practice**  
Session 6: Behavior of Beam-Columns – Practical Considerations  
November 17, 2020

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**AISC Live Webinars**

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## AISC Live Webinars

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## AISC Live Webinars

### Course Description

Behavior of Beam-Columns – Practical Considerations  
November 17, 2020

In this session, the speakers will discuss the results of the learning module on beam-columns and provide some advice for further exploration. They will then present a case study from practice involving beam-columns. They will close out the topic of beam-columns with some final lessons.



## AISC Live Webinars

### Learning Objectives

- Describe how the five effects that must be considered for stability design (per the AISC *Specification*) are accounted for in design.
- Explain how to construct a beam-column interaction curve using finite element analysis.
- Compare the beam-column interaction curve from analysis with the interaction curve used in the AISC *Specification*.
- List several modeling decisions that need to be made when analyzing a beam-column in a case study from practice.



## Modern Methods for Learning The Basics of Structural Stability: From Behavior to Practice

Session 6: Behavior of Beam-Columns – Practical Considerations  
November 17, 2020



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## Modern Methods for Learning The Basics of Structural Stability: From Behavior to Practice

Course Introduction

Compression Members

Flexural Members

Beam-Columns

Systems



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## Course Overview (2)

Strength/Weight + Stiffness/Weight + Competitive \$

Slender Systems, Members, and Cross-sections

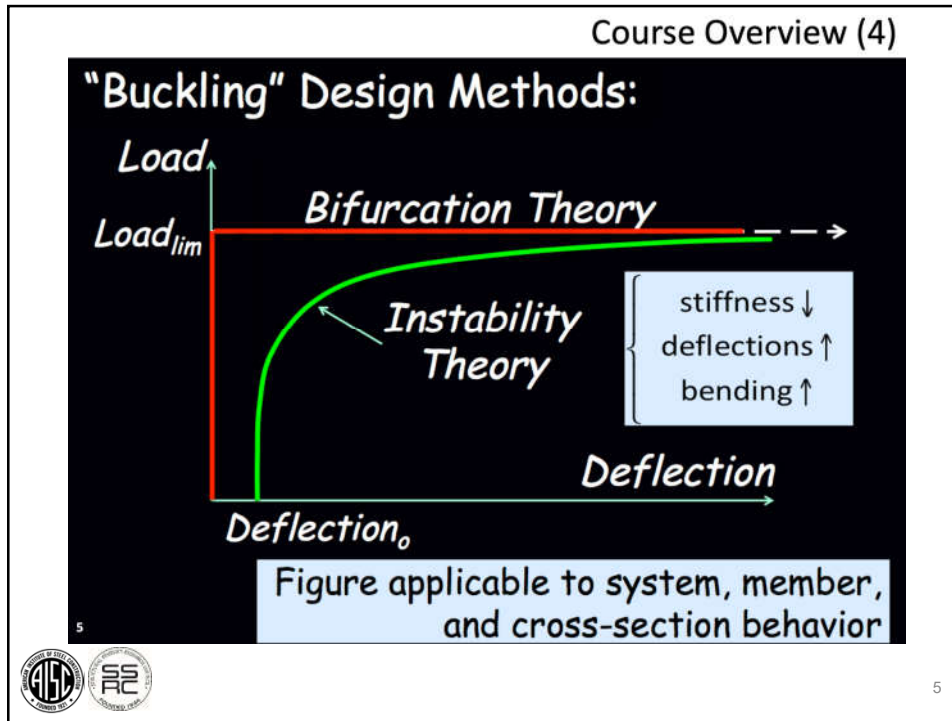
Design for Stability!

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## Course Overview (3)

- Focus of the course is on fundamentals!
- Better understanding of behavior will result in improved design
- Key Definitions
  - **Stability:** Under load, component returns to current state after applying a small disturbance such as a deflection
  - **Bifurcation (critical load):** Theoretical point at which loading a component results in an instantaneous change from current state to significant deflection – two options: not buckled or buckled
  - **Instability:** Loading a component results in a realistic transition from small deflection to significant deflection – buckling preceded by deflection

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Course Overview (5)

Analysis acronyms:

**LBA:** linear buckling analysis; **elastic critical load analysis**; elastic eigenvalue analysis; assumes bifurcation theory

**GNA:** geometric nonlinear analysis; **2<sup>nd</sup>-order elastic analysis**; assumes equilibrium on the deformed shape and linear elastic material, with no initial imperfections

**GNIA:** same as GNA, but **includes initial imperfections**

**MNA:** material nonlinear analysis; **1<sup>st</sup>-order inelastic analysis**; assumes equilibrium on the undeformed shape and accounts for yielding, with no initial imperfections

**GMNIA:** geometric and material nonlinear analysis; **2<sup>nd</sup>-order inelastic analysis**; assumes equilibrium on the deformed shape, accounts for yielding, and includes initial imperfections

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## Modern Methods for Learning The Basics of Structural Stability: From Behavior to Practice

Course Introduction

Compression Members – Sessions 1 & 2

Flexural Members – Session 3 & 4

Beam-Columns – Sessions 5 & 6

Systems – Session 7 & 8



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## Course Learning Module (LM) Schedule

Course Introduction

Compression Members – Sessions 1 (LM1) & 2 (LM2)

Flexural Members – Session 3 (LM5) & 4 (LM4)

Beam-Columns – Sessions 5 (LM7) & 6 (LM8)

Systems – Session 7 (LM9) & 8 (LM9)



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## Limit States of Flexural Members

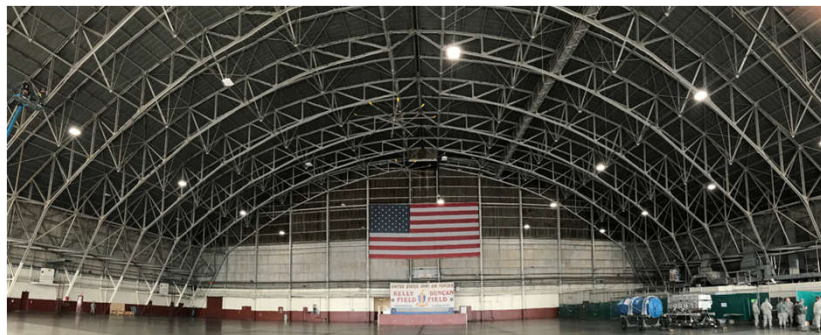
- Full yielding (**today!**)
- Instability
  - Along the member length
    - Lateral torsional buckling (Sessions 3 and 4)
    - Flexural buckling (Sessions 1 and 2)
    - Torsional-flexural buckling (**today!**)
  - At the cross section
    - Local buckling



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## Session 6

### Beam-Column Member Lab and Case Study



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## Session Overview

- Review Session 5
- Perform LM8
- Apply case study from practice



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## Session 5 Review

Session 5 Slides 12 - 14

Initial Yield

$$\left| \sigma_{res} + \frac{P}{A} + \frac{M}{S} \right| \leq \sigma_y \Rightarrow \left| \frac{\sigma_{res}}{\sigma_y} + \frac{P}{A\sigma_y} + \frac{M}{S\sigma_y} \right| \leq 1.0$$

Member strength:

$$\frac{P}{P_n} + \frac{8M}{9M_n} \leq 1.0$$

$$\frac{1P}{2P_n} + \frac{M}{M_n} \leq 1.0$$

Cross section strength  
(full yield):

$$\frac{P}{P_y} \geq 0.2 \quad \frac{P}{P_y} + \frac{8M}{9M_p} \leq 1.0$$

$$\frac{P}{P_y} < 0.2 \quad \frac{1P}{2P_y} + \frac{M}{M_p} \leq 1.0$$



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## Session 5 in AISC 360-16

- Interaction Equation (Chapter H)

- Cross section strength
- Member strength
  - Elastic
  - Inelastic

**H1. DOUBLY AND SINGLY SYMMETRIC MEMBERS SUBJECT TO FLEXURE AND AXIAL FORCE**

**1. Doubly and Singly Symmetric Members Subject to Flexure and Compression**

The interaction of flexure and compression in doubly symmetric members and singly symmetric members constrained to bend about a geometric axis (x and/or y) shall be limited by Equations H1-1a and H1-1b.

**User Note:** Section H2 is permitted to be used in lieu of the provisions of this section.

(a) When  $\frac{P_c}{P_c} \geq 0.2$

$$\frac{P_c}{P_c} + \frac{8}{9} \left( \frac{M_{rx}}{M_{rx}} + \frac{M_{ry}}{M_{ry}} \right) \leq 1.0 \quad (H1-1a)$$

(b) When  $\frac{P_c}{P_c} < 0.2$

$$\frac{P_c}{2P_c} + \left( \frac{M_{rx}}{M_{rx}} + \frac{M_{ry}}{M_{ry}} \right) \leq 1.0 \quad (H1-1b)$$

Where does stability fit in all this?



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## Session 5 in AISC 360-16

**C1. GENERAL STABILITY REQUIREMENTS**

Stability shall be provided for the **structure as a whole** and for **each of its elements.**

Sessions 7 & 8

Sessions 1- 6

- Member stability must account for:
  - Axial, flexural, shear, torsional, connection deformations
  - Second order effects (P-Δ and P-δ)
  - Geometric imperfection
  - Stiffness reductions due to inelasticity
  - Uncertainty in system, member, and connection strength and stiffness

Session 5  
Slide 82  
&  
Chapter C



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## Session 5 in AISC 360-16

- Stability design methods
  - Any rational method of design
  - Direct analysis method (C2)
  - Alternative methods (App. 7)
    - Effective length method
    - First order analysis method

Basic Requirement in Section C1	Provision in Direct Analysis Method (DM)	Provision in Effective Length Method (ELM)
(1) Consider all deformations	C2.1(a). Consider all deformations	Same as DM (by reference to C2.1)
(2) Consider second-order effects (both $P-\Delta$ and $P-\delta$ )	C2.1(b). Consider second-order effects ( $P-\Delta$ and $P-\delta$ ) <sup>H</sup>	Same as DM (by reference to C2.1)
(3) Consider geometric imperfections. This includes joint-position imperfections <sup>I</sup> (which affect structure response) and member imperfections (which affect structure response and member strength)	Effect of system imperfections on structure response	C2.2a. Direct modeling or C2.2b. Notional loads
	Effect of member imperfections on structure response	Included in the stiffness reduction specified in C2.3
(4) Consider stiffness reduction due to inelasticity. This affects structure response and member strength	Effect of member imperfections on member strength	All these effects are considered by using $L_e = KL$ from a sidesway buckling analysis in the member strength check. Note that the differences between DM and ELM are: • DM uses reduced stiffness in the analysis and $L_e = L$ in the member strength check. • ELM uses full stiffness in the analysis and $L_e = KL$ from sidesway buckling analysis in the member strength check
	Effect of stiffness reduction on structure response	Included in the stiffness reduction specified in C2.3
(5) Consider uncertainty in strength and stiffness. This affects structure response and member strength	Effect of stiffness reduction on member strength	Included in member strength formulas, with $L_e = L$
	Effect of stiffness/strength uncertainty on structure response	Included in the stiffness reduction specified in C2.3
	Effect of stiffness/strength uncertainty on member strength	Included in member strength formulas, with $L_e = L$

<sup>H</sup> In typical building structures, the "joint-position imperfections" refers to column out-of-plumbness.  
<sup>I</sup> Second-order effects may be considered either by a computational  $P-\Delta$  and  $P-\delta$  analysis or by the approximate method (using  $B_1$  and  $B_2$  multipliers) specified in Appendix 8.



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## Session 5 in AISC 360-16

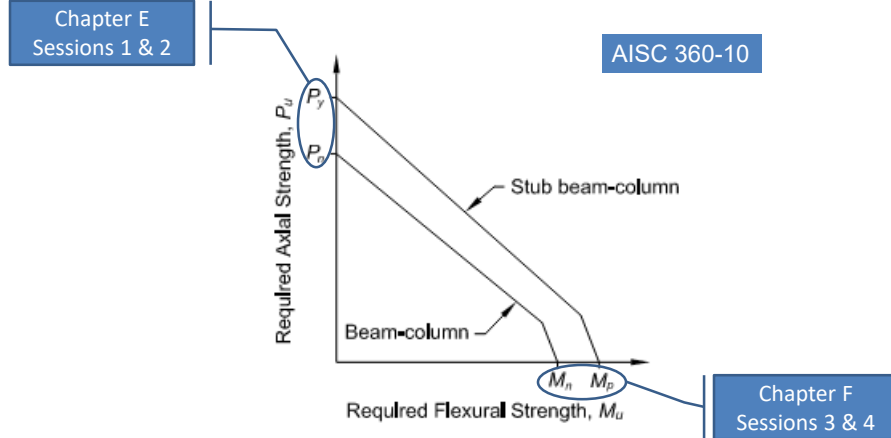


Fig. C-H1.3. Interaction curve for stub beam-column and beam-column.

Let's put the AISC curve to the test!



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## Learning Module 8 Objectives

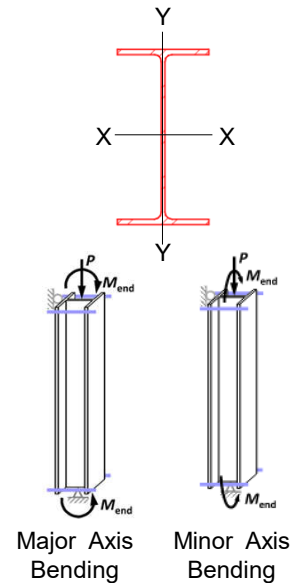
- Observe the strength limit state behavior of beam-columns, which includes the range of full yielding of the cross-section to elastic/inelastic flexural and lateral torsional buckling.
- Prepare interaction curves that plot member axial strength versus flexural strength.
- Compare results of the AISC interaction equations with results from computational analyses that account for partial yielding (accentuated by the presence of residual stresses) and initial imperfections in geometry.



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## Learning Module 8 Method

- W14x53,  $L = 15'$
- Two studies
  - AISC strength curve
  - Computational strength
- Axial and major axis (X-axis) bending
- Axial and minor axis (Y-axis) bending



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## Learning Module 8 AISC Curve

- Given P and M<sub>end</sub> combinations resulting in AISC interaction values of 1.0
- MASTAN2 GNA to find internal moment (M<sub>rx</sub> & M<sub>ry</sub>) and verify AISC interaction values of 1.0
- Plot P/P<sub>y</sub> vs M<sub>endx</sub>/M<sub>px</sub> and P/P<sub>y</sub> vs M<sub>endy</sub>/M<sub>py</sub>

(a) When  $\frac{P_r}{P_c} \geq 0.2$

Demands

$$\frac{P_r}{P_c} + \frac{8}{9} \left( \frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}} \right) \leq 1.0 \quad \text{(H1-1a)}$$

(b) When  $\frac{P_r}{P_c} < 0.2$

Capacities

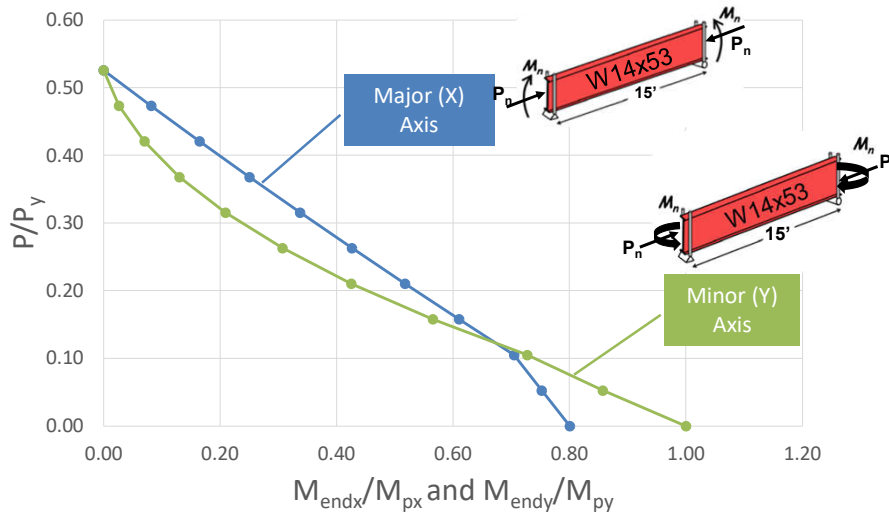
$$\frac{P_r}{2P_c} + \left( \frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}} \right) \leq 1.0 \quad \text{(H1-1b)}$$

Initial out-of-straightness and partial yielding accounted for here – do not include in model



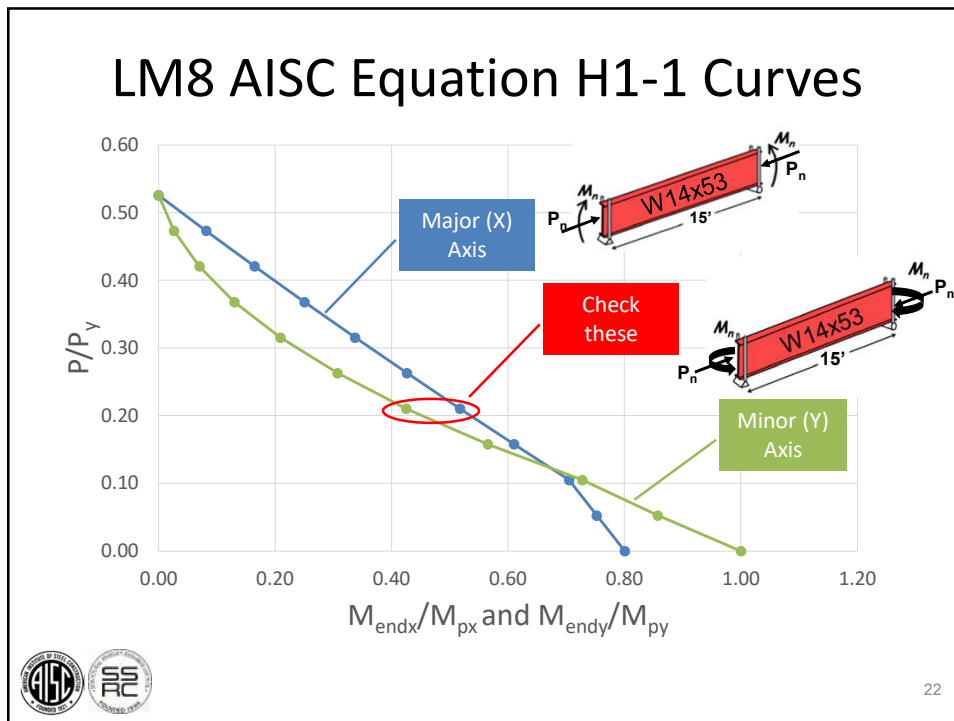
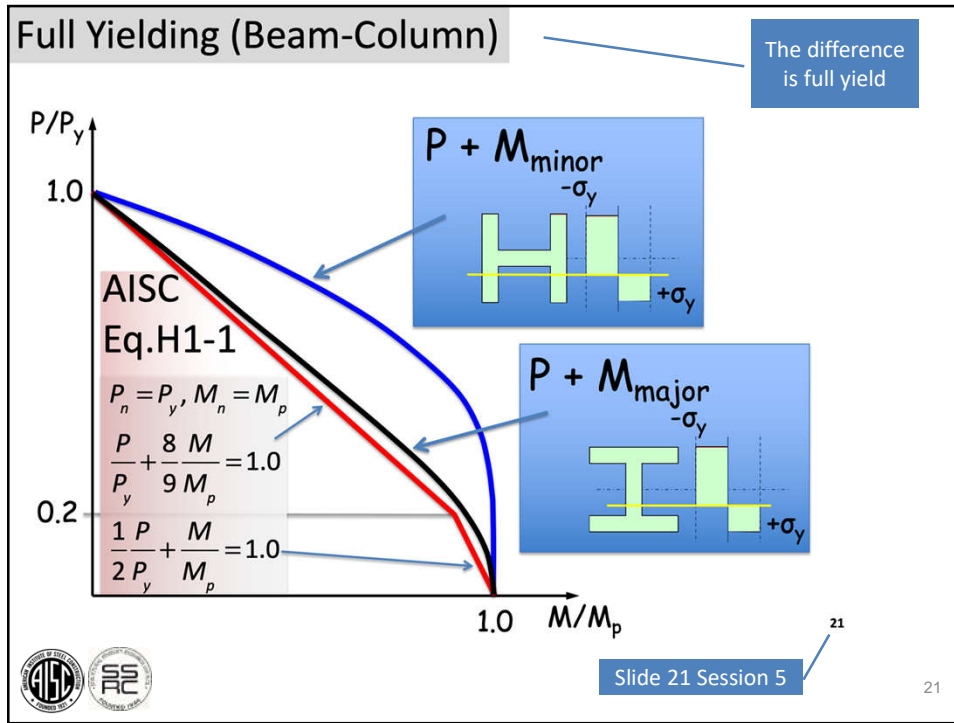
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## LM8 AISC Equation H1-1 Curves



Recall comparison of these curves last session

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## LM8 AISC Major Axis Model

No Twist Warping Free

W14x53, A992  
E = E

No Imperfection  
GNA

Model  
NS24\_L6\_Example\_1

P = 164 k  
M<sub>endx</sub> = 2254 k-in

Axial Load  
Uniform Moment  
Major Axis

Warping  
Continuous

L<sub>b</sub> = 15'

3D analysis

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## LM8 AISC Major Axis

P = 164 k; M<sub>endx</sub> = 2,254 k-in

**Axial Load Effect**

**Moment Load Effect**

(a) When  $\frac{P_r}{P_c} \geq 0.2$

$$\frac{P_r}{P_c} + \frac{8}{9} \left( \frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}} \right) \leq 1.0 \quad \text{(H1-1a)}$$

410 k      3485 k-in      0

(b) When  $\frac{P_r}{P_c} < 0.2$

$$\frac{P_r}{2P_c} + \left( \frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}} \right) \leq 1.0 \quad \text{(H1-1b)}$$

Note:  $\phi$  factors are not included

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### LM8 AISC Major Axis

$P = 164 \text{ k}; M_{\text{end}x} = 2,254 \text{ k-in}$

Axial Load Effect

Moment Load Effect

(a) When  $\frac{P}{P_c} \geq 0.2$

$$\frac{P}{P_c} + \frac{8}{9} \left( \frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}} \right) \leq 1.0 \quad \text{(H1-1a)}$$

(b) When  $\frac{P}{P_c} < 0.2$

0.4

0.6

0

$$\frac{P}{2P_c} + \left( \frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}} \right) \leq 1.0 \quad \text{(H1-1b)}$$

Note:  $\phi$  factors are not included

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### LM8 AISC Minor Axis Model

No Twist Warping Free

W14x53, A992  
 $E = E$

No Imperfection  
GNA

It's  
MASTAN2  
time!

Model  
NS24\_L6\_Example\_2

$P = 164 \text{ k}$   
 $M_{\text{end}y} = 468 \text{ k-in}$

Axial Load  
Uniform Moment  
Minor Axis

Warping  
Continuous

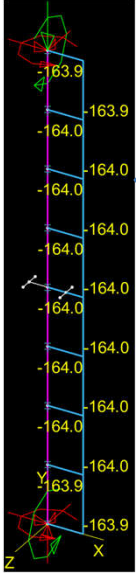
$L_b = 15'$

3D analysis


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### LM8 AISC Minor Axis

$P = 164 \text{ k}; M_{\text{endy}} = 468 \text{ k-in}$



Axial Load Effect



Moment Load Effect

(a) When  $\frac{P_r}{P_c} \geq 0.2$



$$\frac{P_r}{P_c} + \frac{8}{9} \left( \frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}} \right) \leq 1.0 \quad \text{(H1-1a)}$$

**410 k**      **0**      **1100 k-in**

(b) When  $\frac{P_r}{P_c} < 0.2$

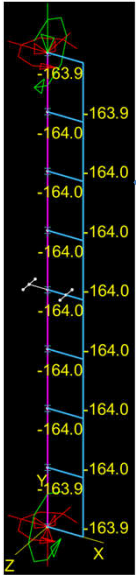
$$\frac{P_r}{2P_c} + \left( \frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}} \right) \leq 1.0 \quad \text{(H1-1b)}$$

Note:  $\phi$  factors are not included




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### LM8 AISC Minor Axis

$P = 164 \text{ k}; M_{\text{endy}} = 468 \text{ k-in}$



Axial Load Effect



Moment Load Effect

(a) When  $\frac{P_r}{P_c} \geq 0.2$



$$\frac{P_r}{P_c} + \frac{8}{9} \left( \frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}} \right) \leq 1.0 \quad \text{(H1-1a)}$$

**0.4**      **0**      **0.6**

(b) When  $\frac{P_r}{P_c} < 0.2$

$$\frac{P_r}{2P_c} + \left( \frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}} \right) \leq 1.0 \quad \text{(H1-1b)}$$

Note:  $\phi$  factors are not included



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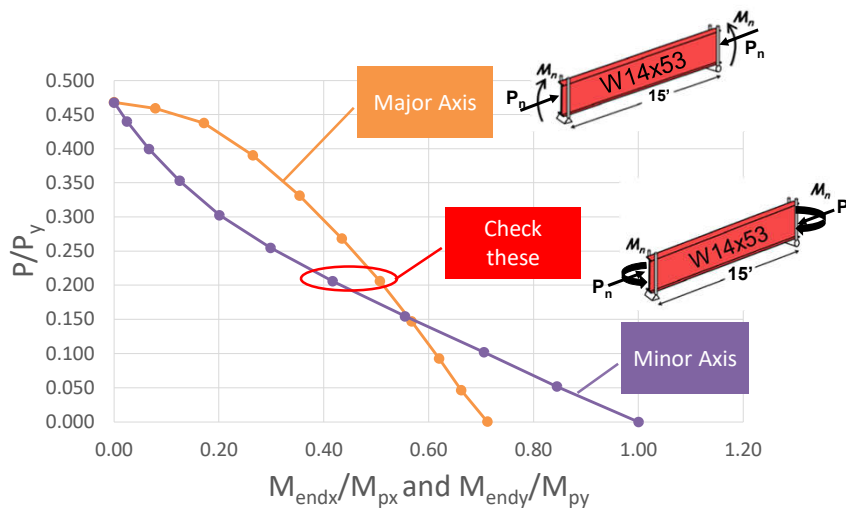
## LM8 Computational Curves

- Use same P and  $M_{end}$  combinations as AISC Curve
- MASTAN2 to run GMNIA
- Find ultimate applied load ratio ( $ALR_{ult}$ )
- Plot  $ALR_{ult} (P/P_y \text{ vs } M_{endx}/M_{px})$
- Plot  $ALR_{ult} (P/P_y \text{ vs } M_{endy}/M_{py})$



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## LM8 Computational



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## LM8 Comp. Major Axis Model

No Twist Warping Free

W14x53, A992  
 $E = E_{tm}$

Imperfection perpendicular to plane of web  
GMNIA

$P = 164 \text{ k}$   
 $M_{endx} = 2254 \text{ k-in}$

Axial Load  
Uniform Moment  
Major Axis

Warping Continuous

$L_b = 15'$

3D analysis

It's MASTAN2 time!

Model  
NS24\_L6\_Example\_3

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## Computational Major Axis

$P = 164 \text{ k}; M_{end} = 2,254 \text{ k-in}$

\*\*\* Deflected Shape: 2<sup>nd</sup>-Order Inelastic, Incr # 98, Applied Load Ratio = 0.98 \*\*\*

$P = 0.98 * 164 \text{ k} = 160.7 \text{ k}$   
 $P/P_y = 160.7 \text{ k} / 780 \text{ k} = 0.206$

$M_{endx} = 0.98 * 2,254 \text{ k-in} = 2,209 \text{ k-in}$   
 $M_{endx}/M_{px} = 2,209 \text{ k-in} / 4,355 \text{ k-in} = 0.51$

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## LM8 Comp. Minor Axis Model

No Twist  
Warping Free

W14x53, A992  
 $E = E_{tm}$

Imperfection  
perpendicular to  
plane of web  
GMNIA

$P = 164\text{ k}$   
 $M_{\text{endy}} = 468\text{ k-in}$

Axial Load  
Uniform Moment  
Minor Axis

Warping  
Continuous

$L_b = 15'$

3D analysis

It's  
MASTAN2  
time!

Model  
NS24\_L6\_Example\_4

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## LM8 Computational Minor Axis

$P = 164\text{ k}; M_{\text{endy}} = 468\text{ k-in}$

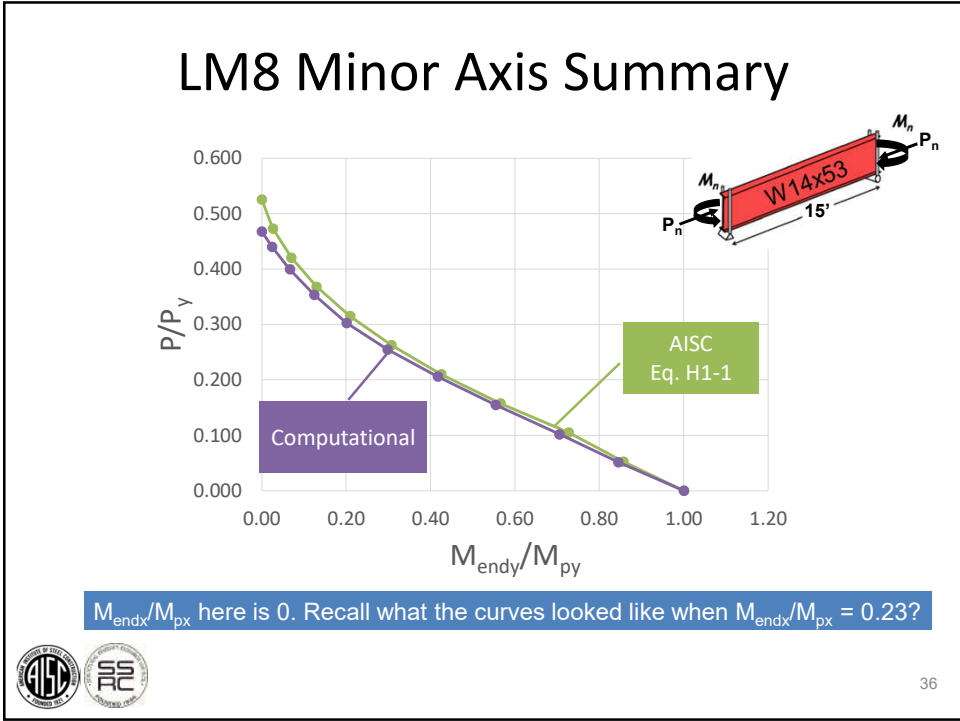
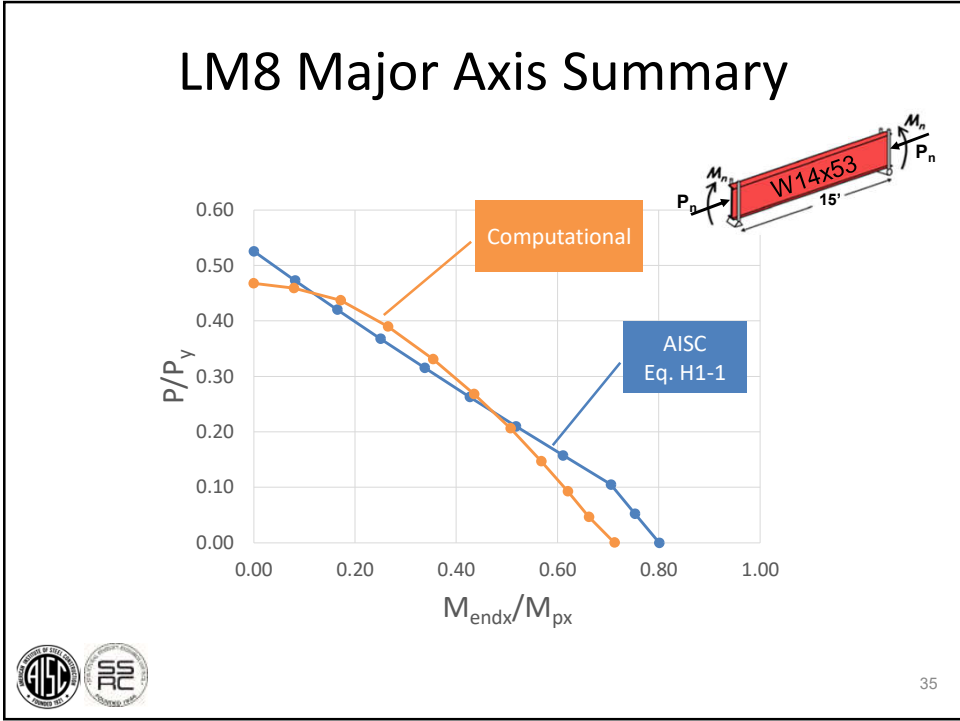
\*\*\*\* Deflected Shape: 2<sup>nd</sup>-Order Inelastic, Incr # 98, Applied Load Ratio = 0.97562 \*\*\*\*

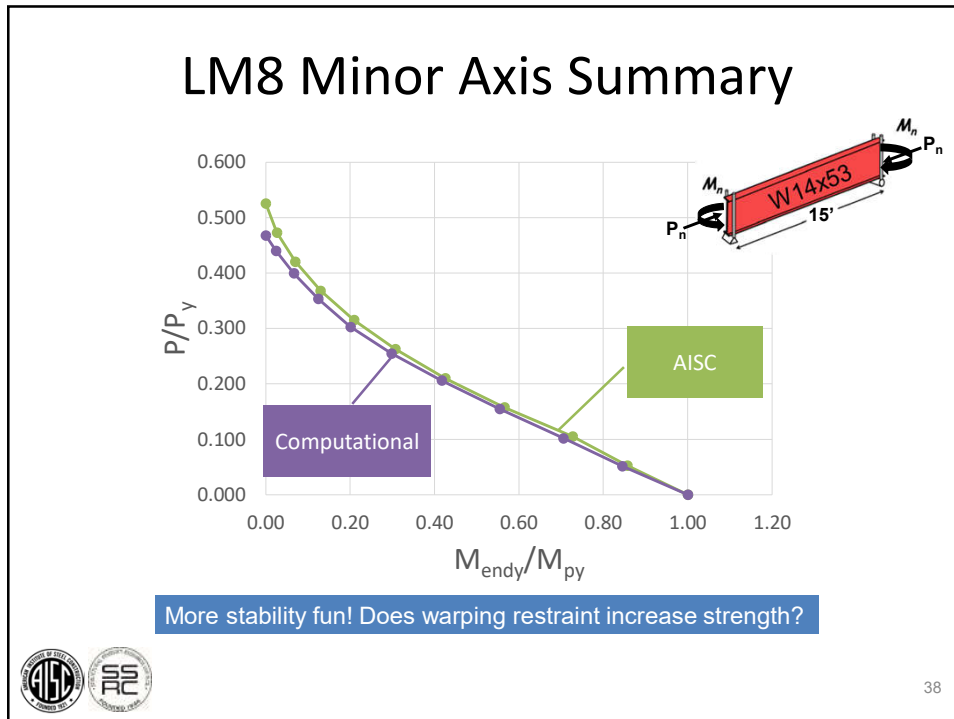
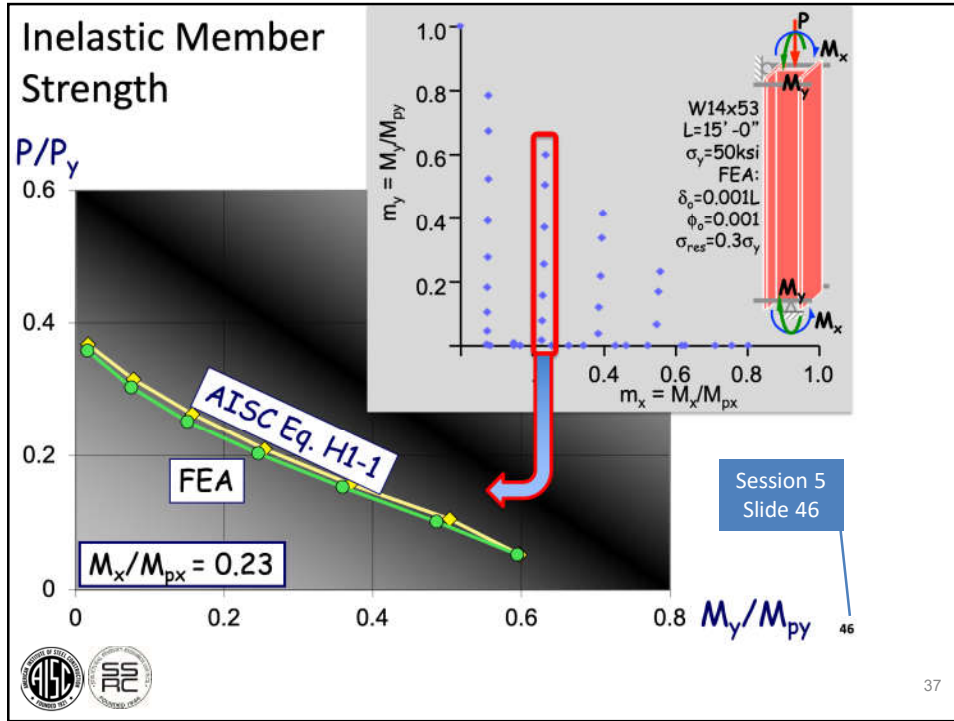
$P = 0.98 \cdot 164\text{ k} = 160.7\text{ k}$   
 $P/P_y = 160.7\text{ k} / 780\text{ k} = 0.206$

$M_{\text{endy}} = 0.98 \cdot 468\text{ k-in} = 459\text{ k-in}$   
 $M_{\text{endy}}/M_{py} = 459 / 1,100\text{ k-in} = 0.42$

Should there be a plastic hinge?

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## LM8 More Fun With Computational Analysis!

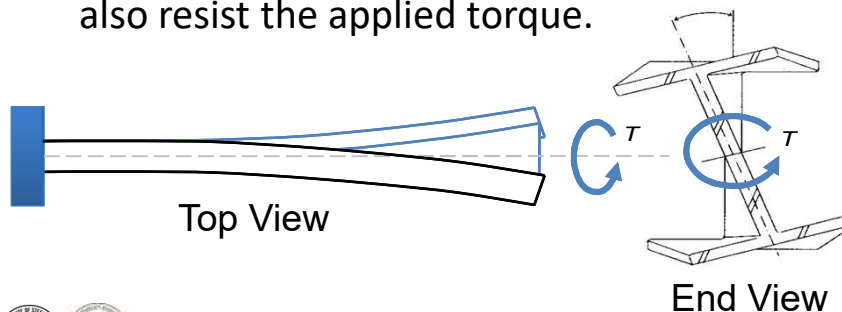
- Repeat computational strength study assuming
  - Warping continuous along length (no change)
  - Warping fixed at ends (change)
- Comment on conservatism of the AISC interaction equation



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## Warping Torsion

- Recall that torque  $T$  causing the twist in LTB also causes the flanges to bend in opposite directions. This “cross flange” bending can also resist the applied torque.



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## Warping Restraint – Major Axis Model

No Twist  
Warping Fixed
Axial Load  
Uniform Moment  
Minor Axis

W14x53, A992  
 $E = E_{tm}$ 
Warping  
Continuous

Imperfection  
perpendicular to  
plane of web  
GMNIA
 $L_b = 15'$

$P = 164$  k  
 $M_{endx} = 2254$  k-in
3D analysis

It's  
MASTAN2  
time!
Model NS24\_L6\_Example\_5

Recall ALR was 0.98 with warping free end conditions

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## LM8 Warping Restraint Computational

### Major Axis $P = 164$ k; $M_{endx} = 2,254$ k-in

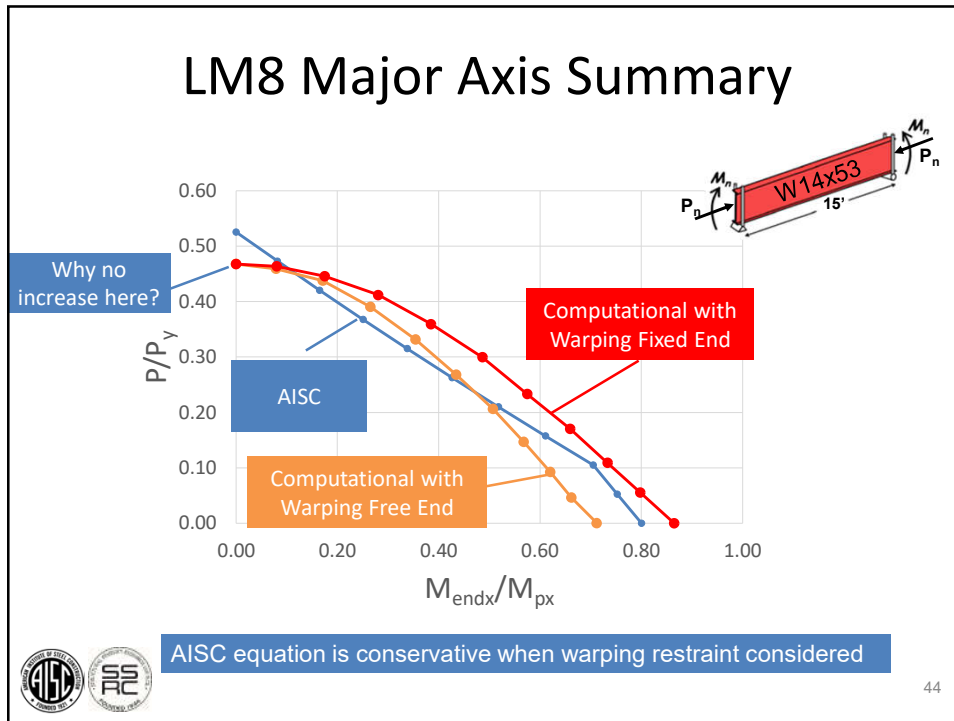
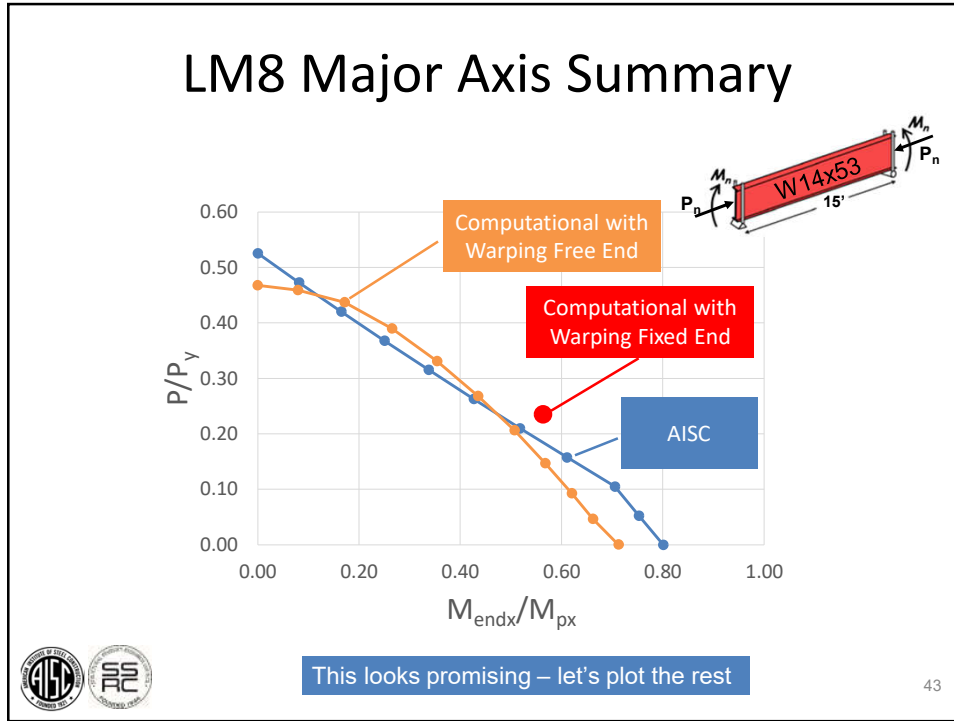
Warping free  
ALR= 0.98

$P = 1.11 * 164 \text{ k} = 182 \text{ k}$   
 $P/P_y = 182 \text{ k} / 780 \text{ k} = 0.23$

$M_{endx} = 1.11 * 2,254 \text{ k-in} = 2,502 \text{ k-in}$   
 $M_{endx}/M_{px} = 2,502 \text{ k-in} / 4,355 \text{ k-in} = 0.57$

Let's plot this point

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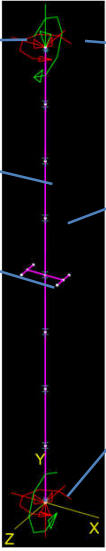
## Warping Restraint – Minor Axis Model

→ No Twist  
Warping Fixed

W14x53, A992  
 $E = E_{tm}$

Imperfection  
perpendicular to  
plane of web  
GMNIA

$P = 164 \text{ k}$   
 $M_{\text{endy}} = 468 \text{ k-in}$



Axial Load  
Uniform Moment  
Minor Axis



Warping  
Continuous

$L_b = 15'$

3D analysis

It's  
MASTAN2  
time!

Model NS24\_L6\_Example\_6

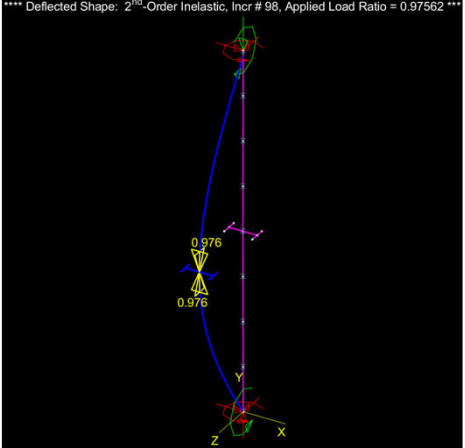



Recall ALR was 0.98 with warping free end conditions

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## LM8 Warping Restraint Computational Minor Axis $P = 164 \text{ k}; M_{\text{endy}} = 468 \text{ k-in}$



\*\*\*\* Deflected Shape: 2<sup>nd</sup>-Order Inelastic, Incr # 98, Applied Load Ratio = 0.97562 \*\*\*\*



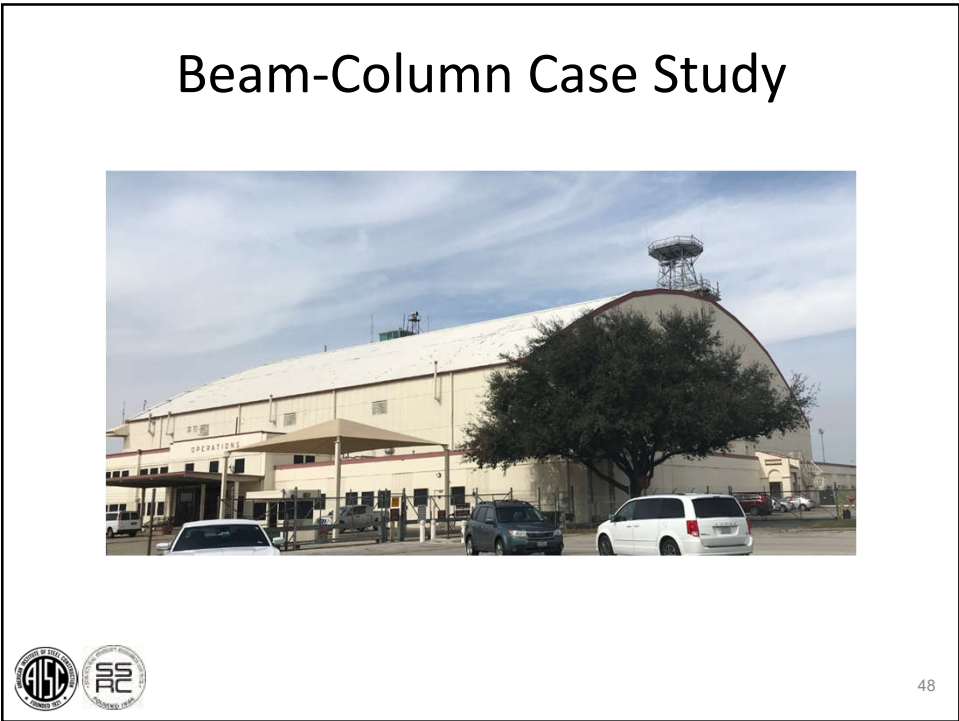
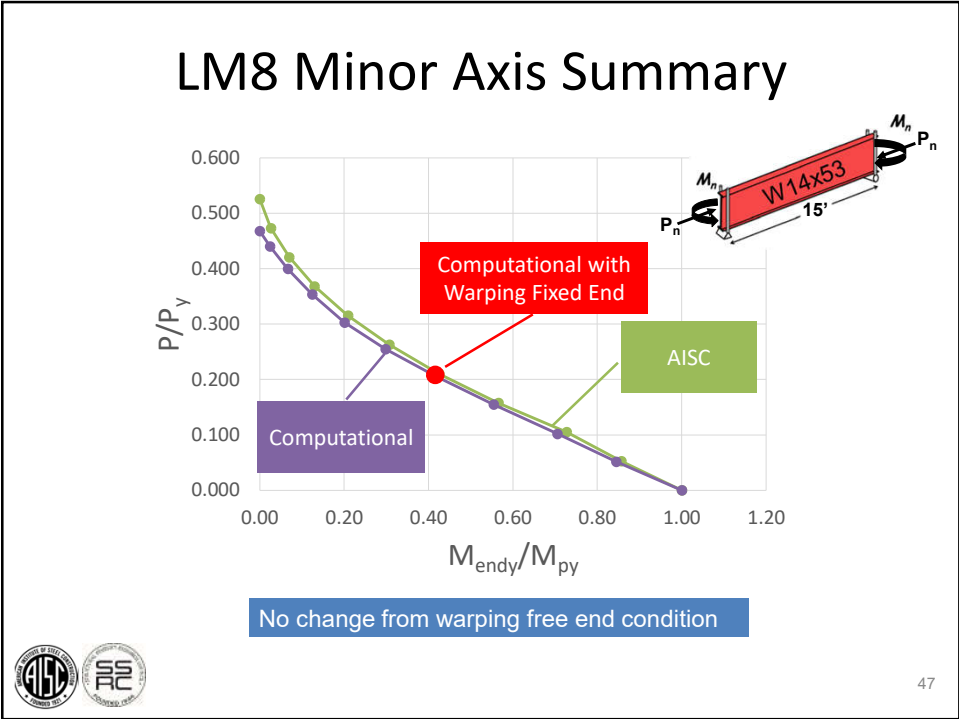
$P = 0.98 \cdot 164 \text{ k} = 160.7 \text{ k}$   
 $P/P_y = 160.7 \text{ k} / 780 \text{ k} = 0.206$

$M_{\text{endy}} = 0.98 \cdot 468 \text{ k-in} = 459 \text{ k-in}$   
 $M_{\text{endy}}/M_{py} = 459 \text{ k-in} / 1,100 \text{ k-in} = 0.42$

Let's plot this point

46



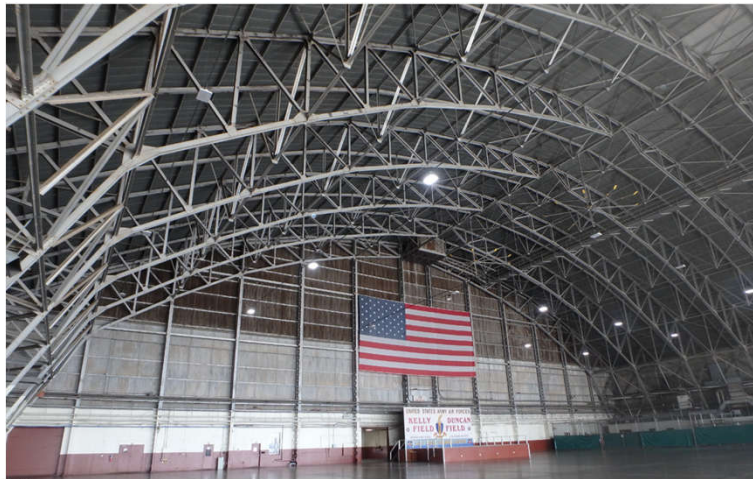
## Port San Antonio Hangar

- Fire protection retrofit
  - Wet system
  - Foam system
  - Water risers and laterals to be supported by east wall wind columns
- Structure built in 1940



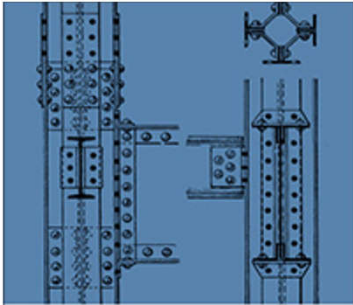
49

## East Wall Elevation

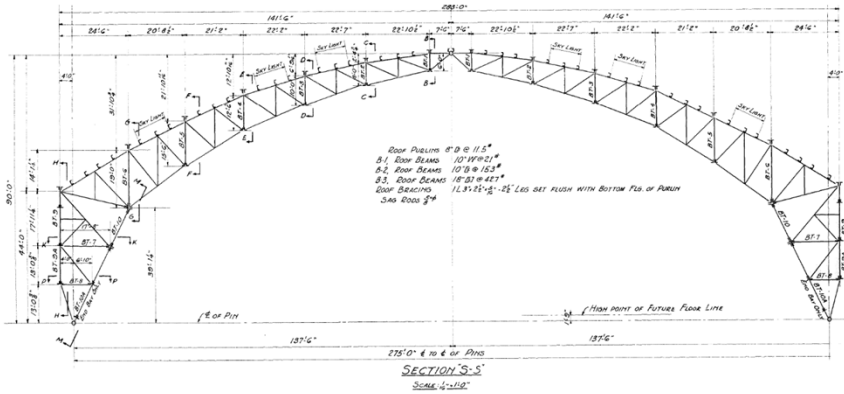


50

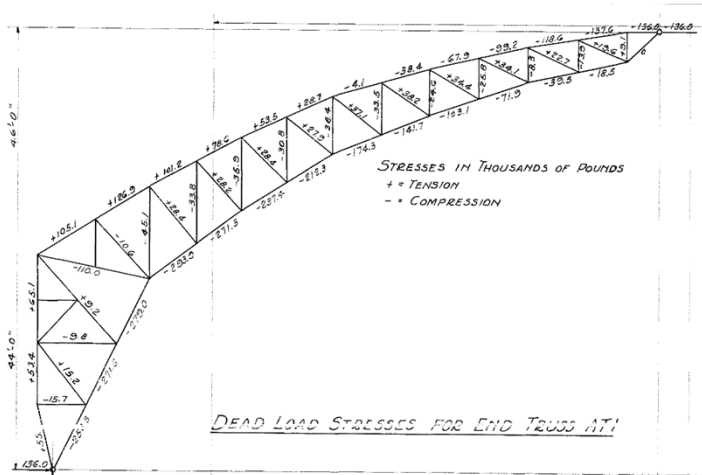
# Condition Assessment Drawing Validation



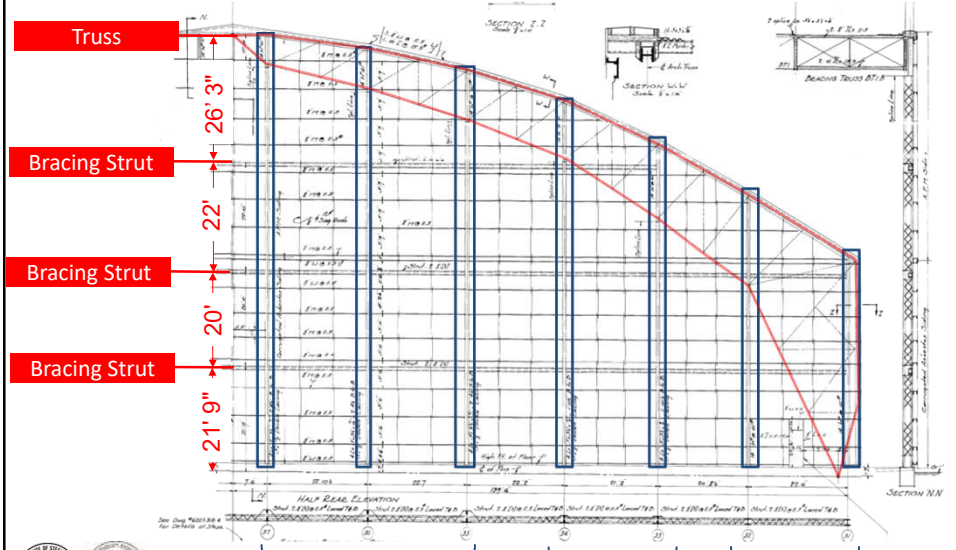
# Main Truss



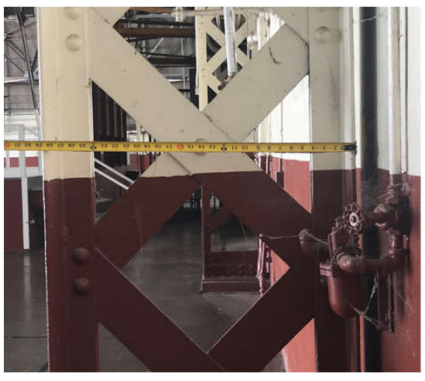
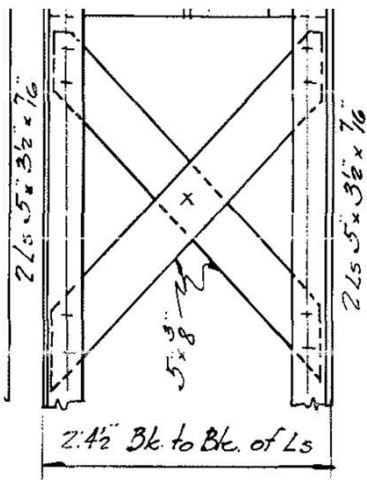
# Ron's Undergrad Course Final Exam



# East Wall Wind Columns

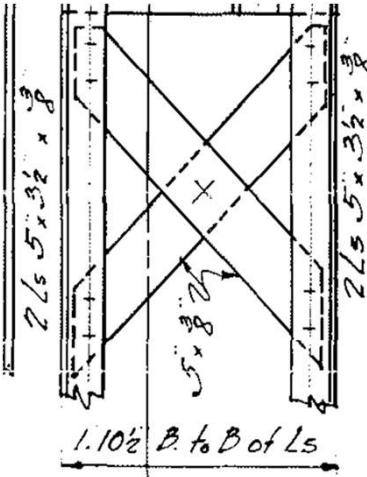


### Built-Up Type 1 Column (Biggest)



55

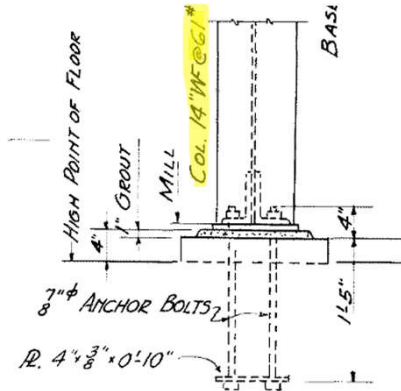
### Built-Up Type 2 Column (Big)



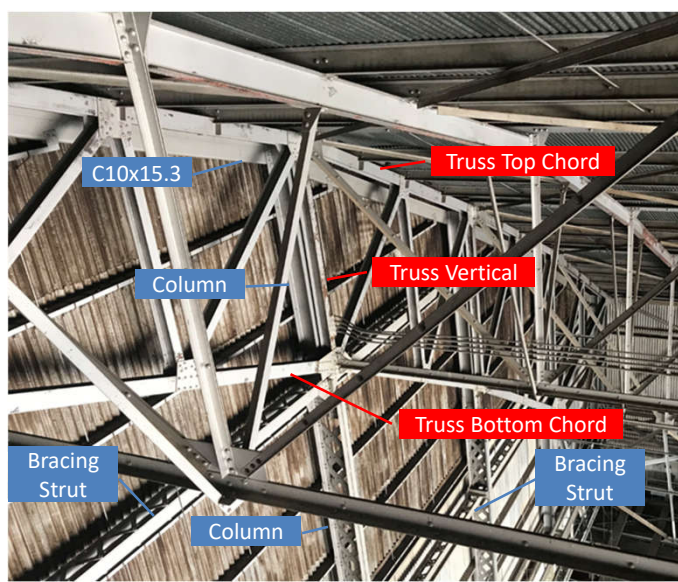
56



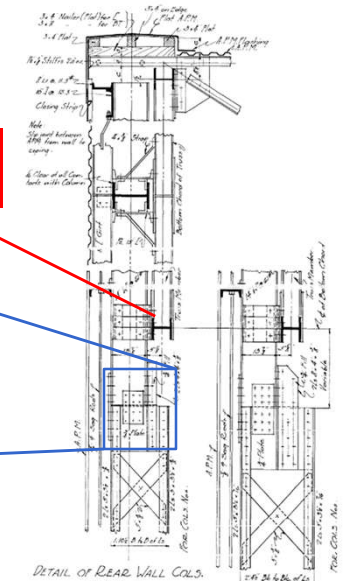
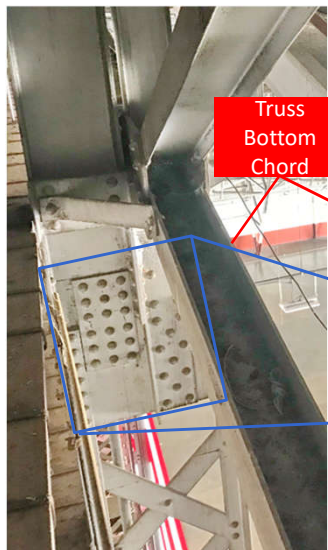
# Rolled Shape Type 3 Column (Not as Big)



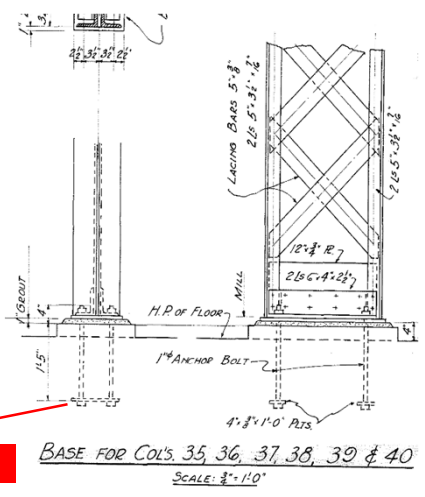
# Column Top



### Column Top



### Column Base



4' x 4' x 12' Concrete Footing

BASE FOR COLS 35, 36, 37, 38, 39 & 40  
 SCALE: 3/8" = 1'-0"



NOTE: Bottom of all Footings to be 13'-0" below present Grade.



### Bracing Struts

Plan view of column to strut connection

61

### New Piping on East Wall

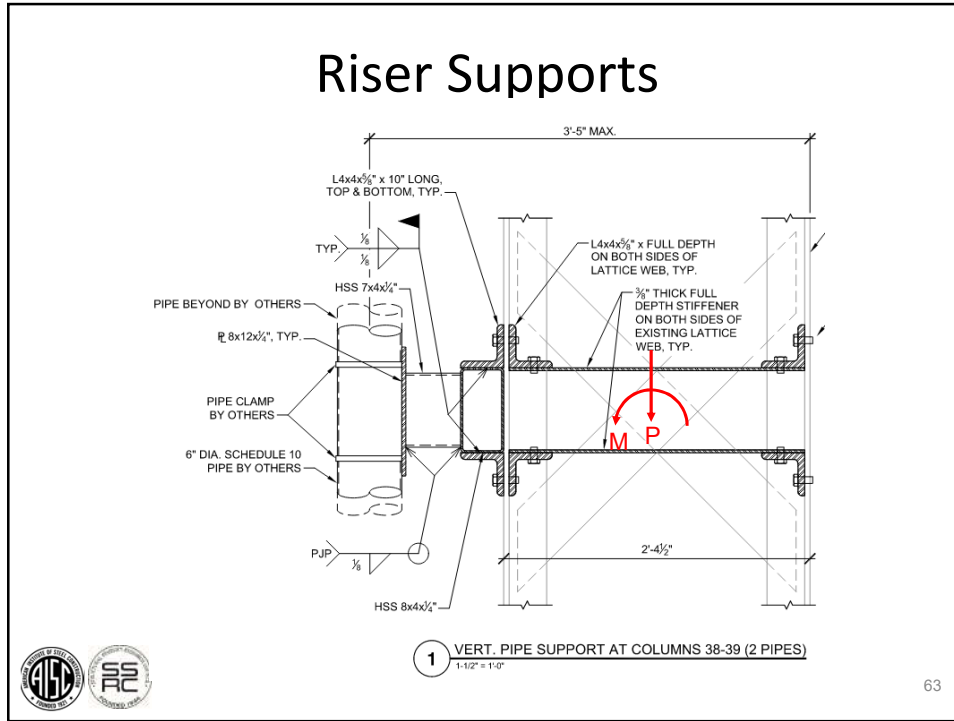
8" Dia. Risers

6" Dia. Laterals

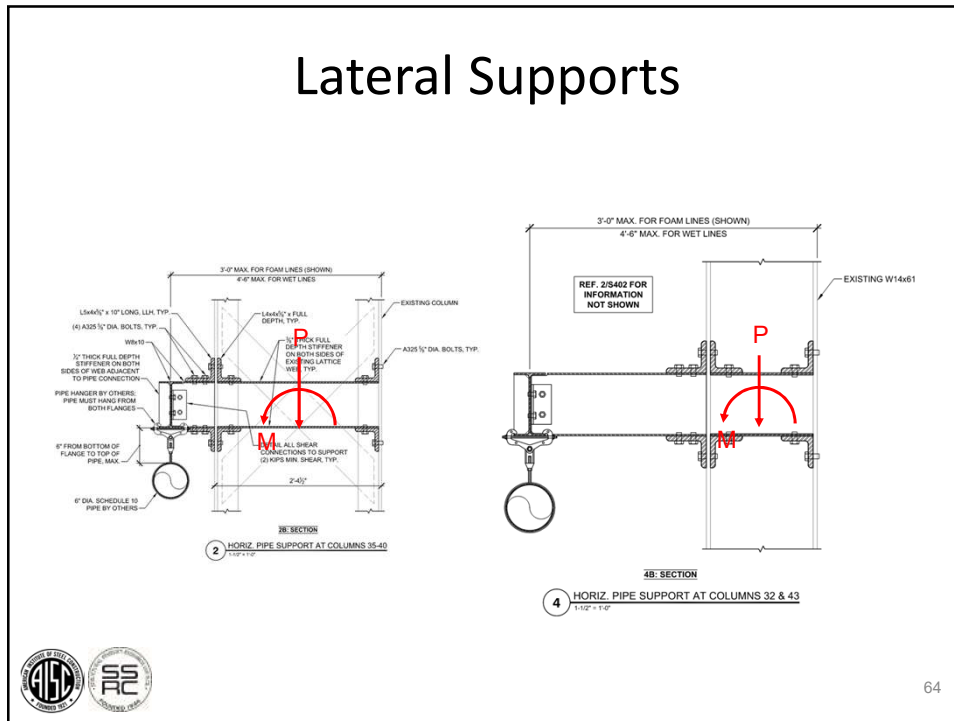
1 HANGAR EAST WALL ELEVATION

62



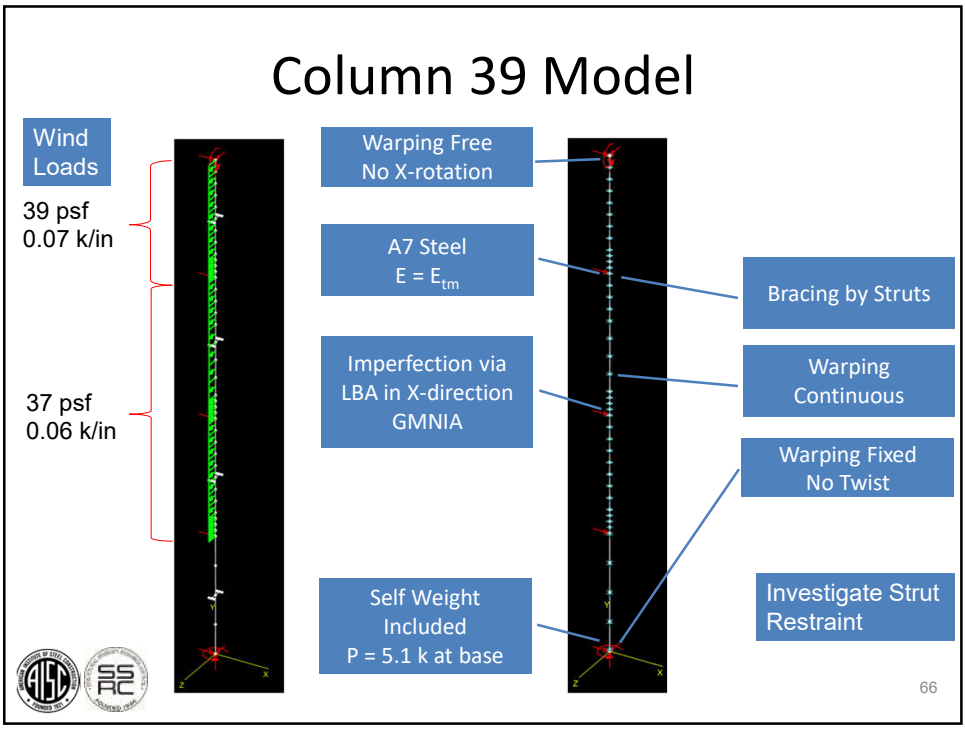
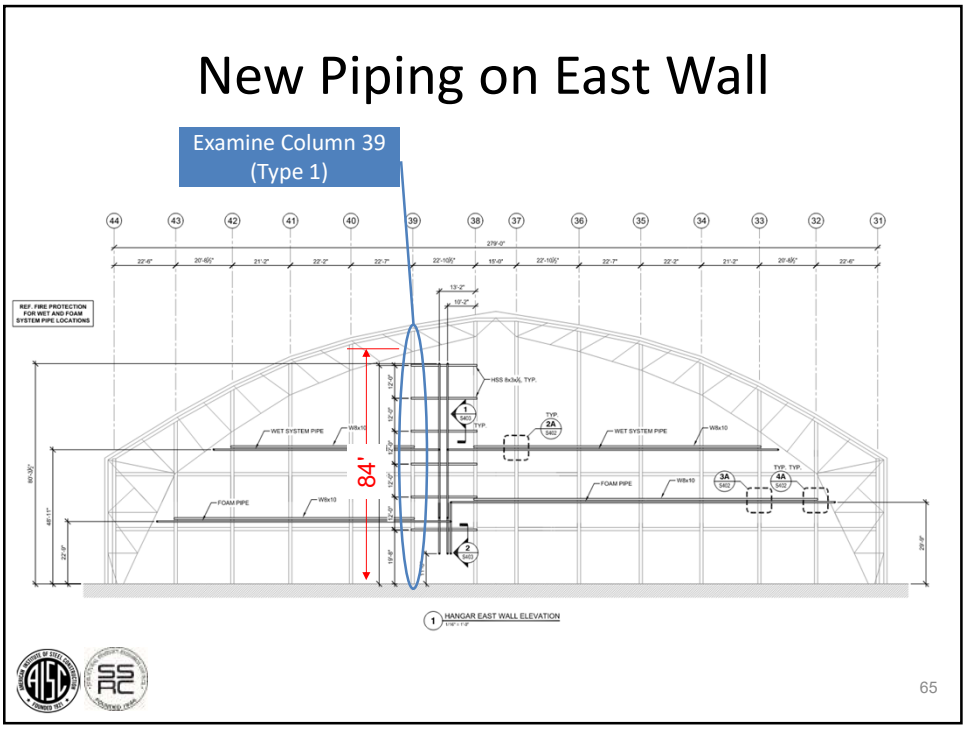


63

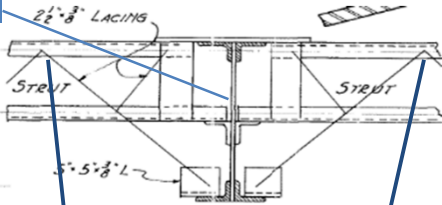


64





## Bracing Strut Restraint on Column



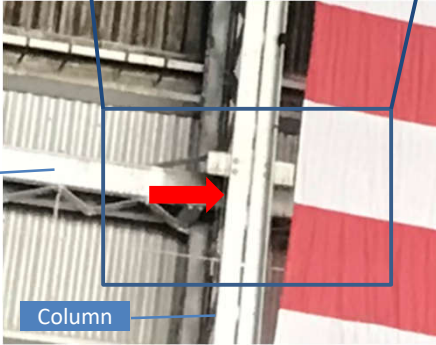
Column

2x8 LACING

STRUT

5x5x8 L


Plan view of column to strut connection





Bracing Strut

Column

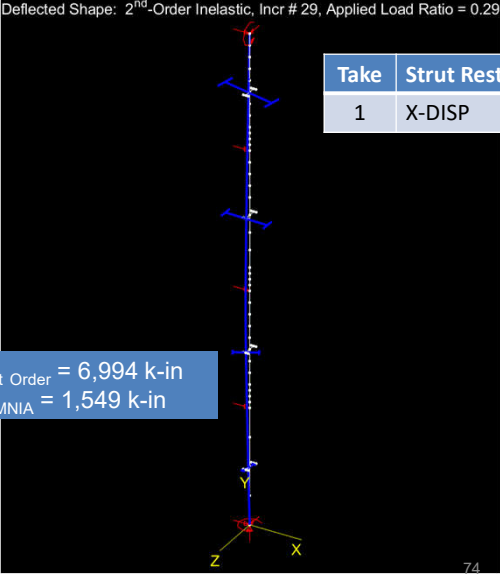
Take 1 – Bracing Strut Restrains X-Disp.





67



## Column 39 Model- Take 1

Deflected Shape: 2<sup>nd</sup>-Order Inelastic, Incr # 29, Applied Load Ratio = 0.29



Take	Strut Restraint	ALR
1	X-DISP	0.29

$M_{1st\ Order} = 6,994\ k-in$   
 $M_{GMNIA} = 1,549\ k-in$



74
68

### Column 39 Model - Take 2

Warping Free

Wind Load

A7  
 $E = E_{tm}$

Imperfection via LBA in X-direction GMNIA

Self Weight Included  
 $P = 5.1 \text{ k}$  at base

Bracing by Struts  
X-Disp, Rot-Y

Warping Continuous

Warping Fixed

69

### Bracing Strut Restraint on Column

Column

2x2x8 LACING

STRUT

STRUT

5x5x8 L

Plan view of column to strut connection

Bracing Strut

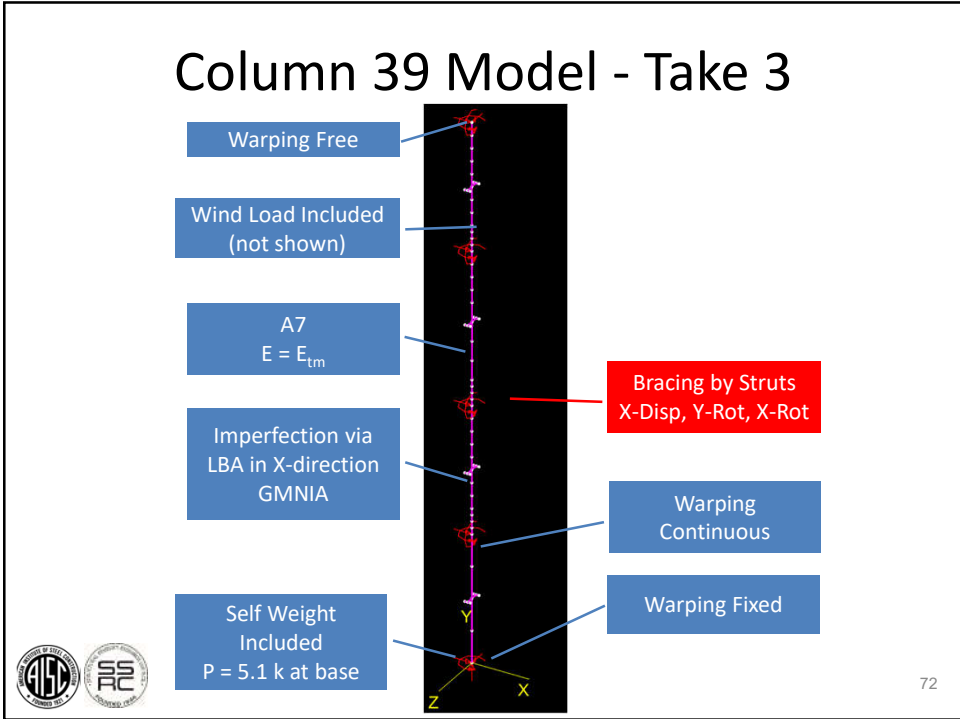
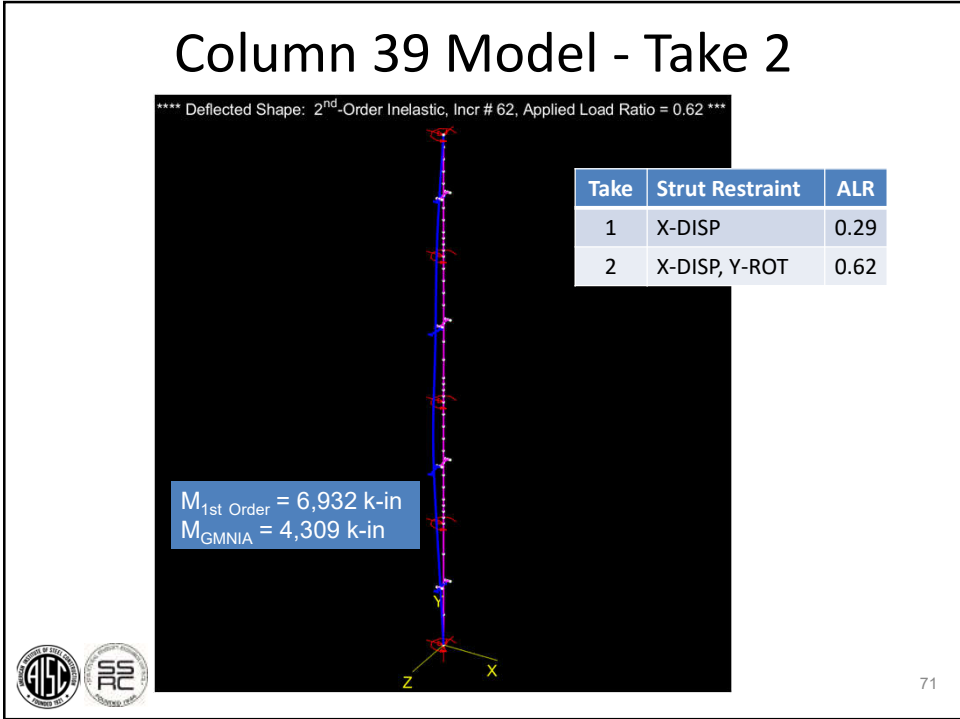
Column

Take 2 - Bracing Strut Restrains X-Disp., Y-Rot.

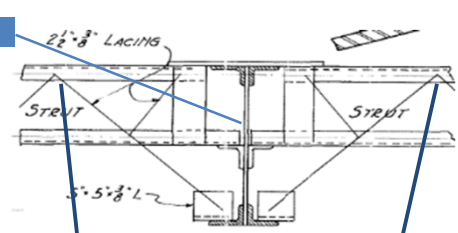
It's MASTAN2 time!

70





## Bracing Strut Restraint on Column



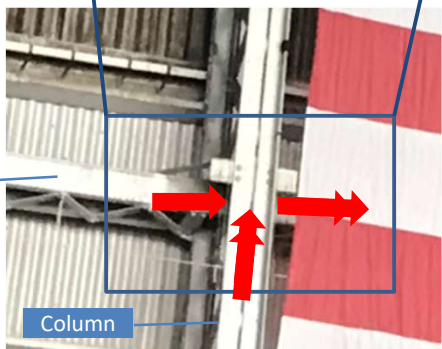
Column

2x8 LACING

STRUT

5x5x8 L


Plan view of column to strut connection





Bracing Strut

Column

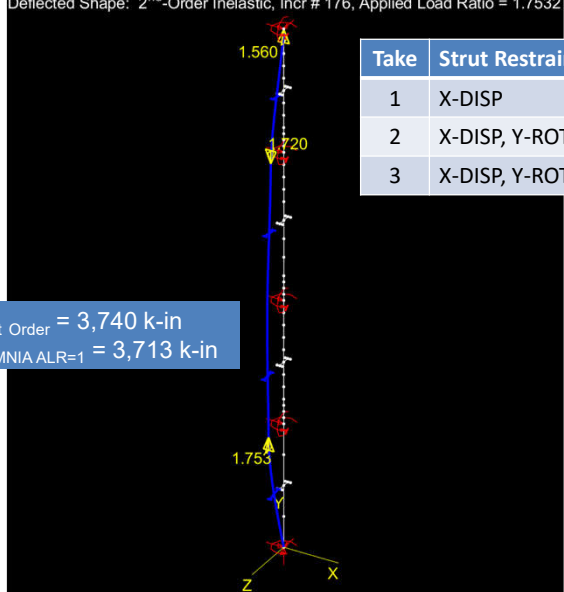
Take 3 - Bracing Strut Restrains X-Disp., Y-Rot. X-Rot.





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## Column 39 Model - Take 3

Deflected Shape: 2<sup>nd</sup>-Order Inelastic, Incr # 176, Applied Load Ratio = 1.7532



1.560

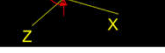
1.720



1.753

Take	Strut Restraint	ALR
1	X-DISP	0.29
2	X-DISP, Y-ROT	0.62
3	X-DISP, Y-ROT, X-ROT	1.75

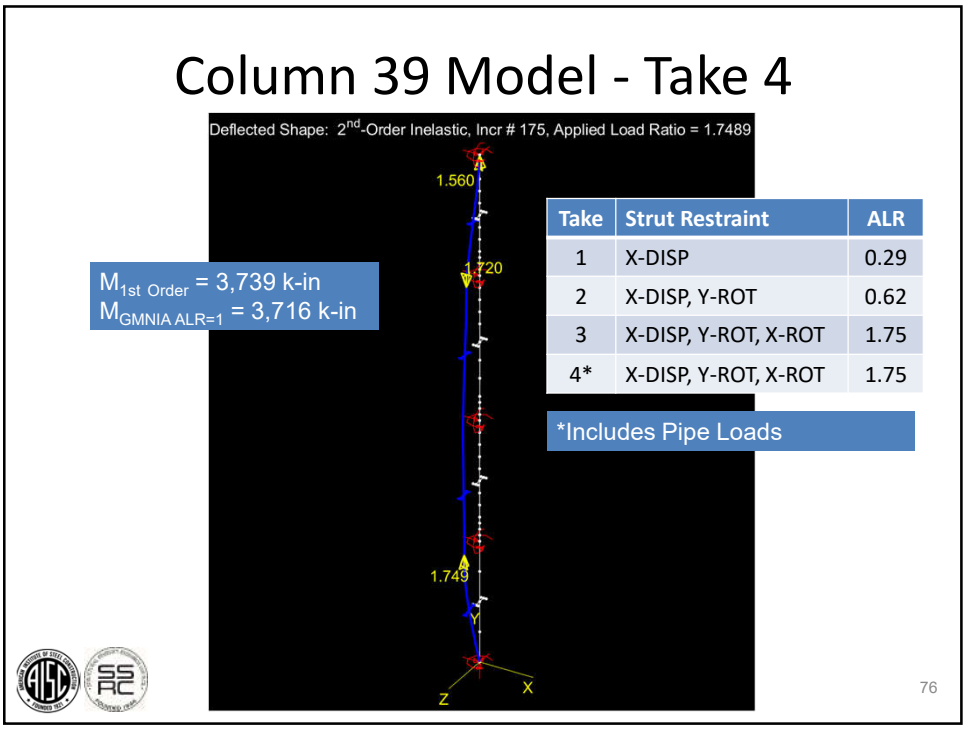
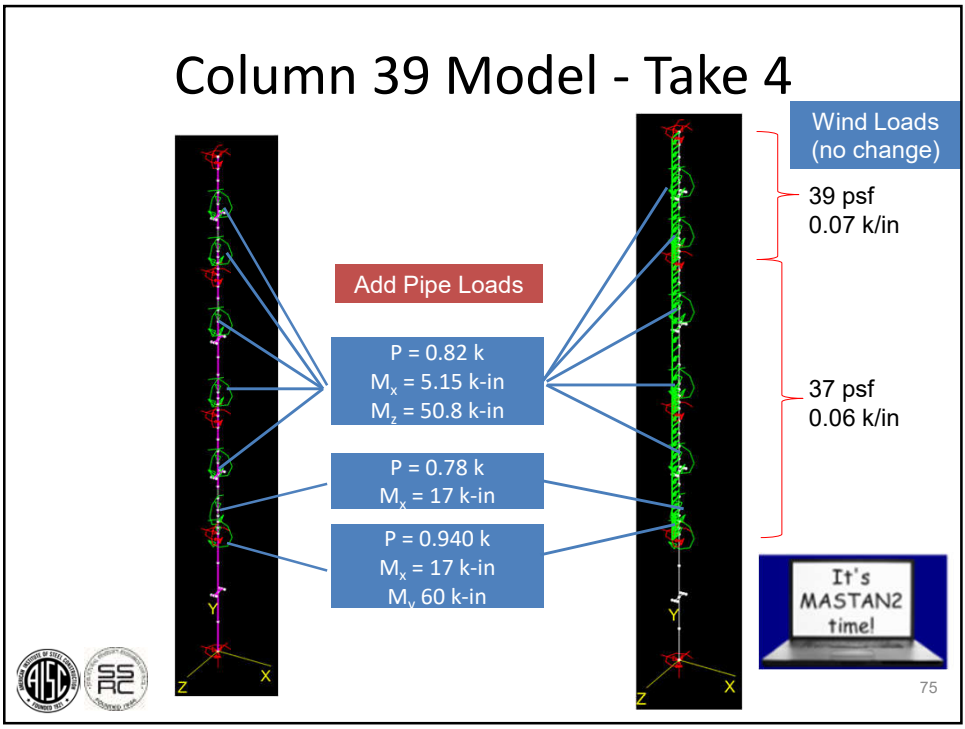
$M_{1st\ Order} = 3,740\ k-in$

$M_{GMNIA\ ALR=1} = 3,713\ k-in$





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## Other Potential Sources of Stability

Some ROTX Fixity at Base

Struts provide some translation restraint in Z-direction

Struts provide some warping restraint

Exterior cladding load provides some help for windward load case

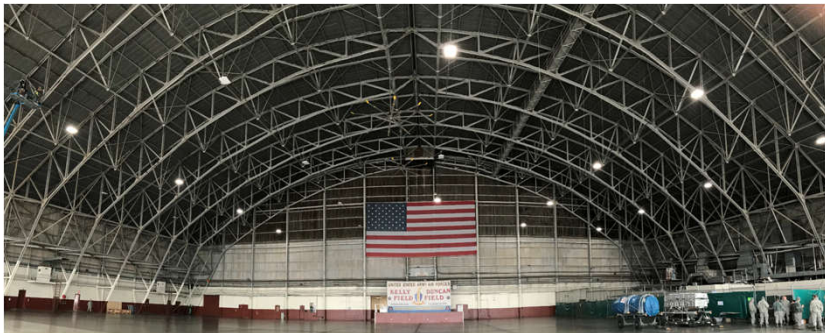
77

## Summary

- Understanding behavior is key to knowing how and when to use computational modelling
- Assess sources of stability model and reasonably apply them
- Know where your model is conservative and unconservative to assess its relative accuracy
- Perform thorough existing structure evaluation to assess condition and drawing accuracy – See session 4 slides for documents AISC provides



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**AISC** | Questions?



## Single-Session Registrants

### CEU / PDH Certificates

- You will receive an email on how to report attendance from: [registration@aisc.org](mailto: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!



## 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.



## 8-Session Registrants

### CEU / PDH Certificates

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



## 8-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 [night school@aisc.org](mailto:night school@aisc.org).)
- Reasons for quiz:
  - EEU – You must take all quizzes and the final exam to receive EEU.
  - PDHs – If you watch a recorded session, you must pass quiz for PDHs.
  - Reinforce what you learn in the lectures and get more out of the course!

### 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.

## 8-Session Registrants

### Course Resources

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

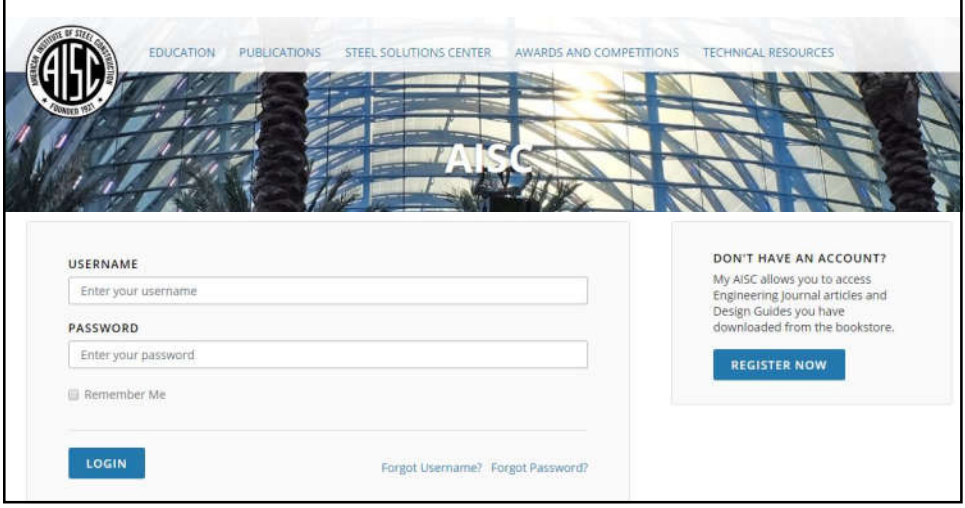


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Steel.

## 8-Session Registrants

### Course Resources

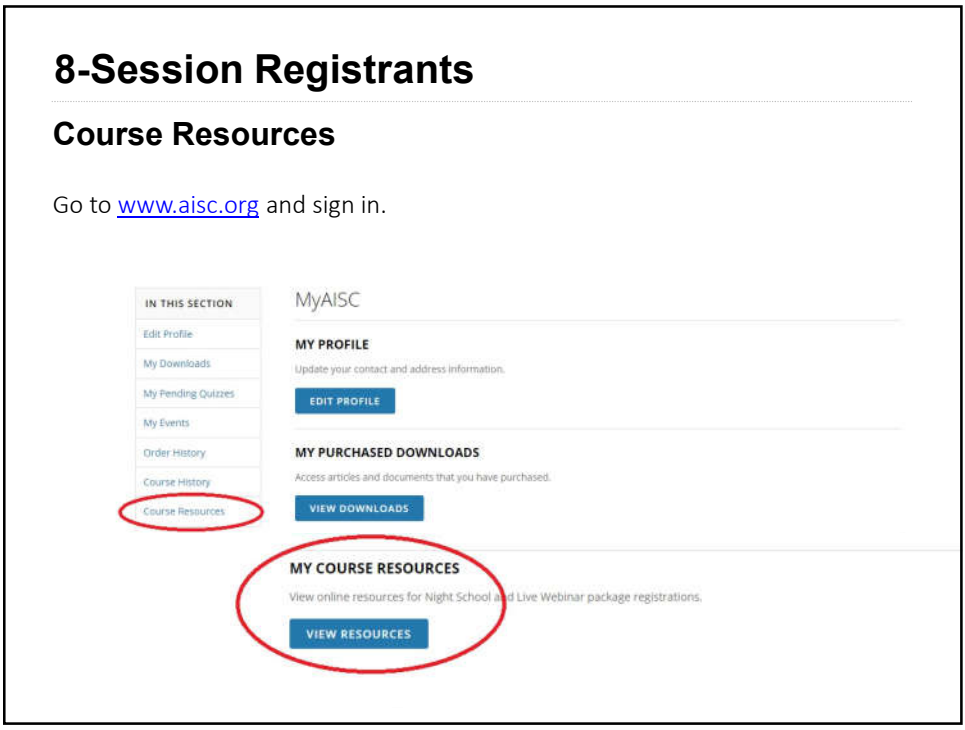
Go to [www.aisc.org](http://www.aisc.org) and sign in.



## 8-Session Registrants

### Course Resources

Go to [www.aisc.org](http://www.aisc.org) and sign in.



## 8-Session Registrants

### Course Resources

Event	Start Date
Seismic Design in Steel	1/1/1900 12:00:00 AM
4-Session Package-Design of Facade Attachments	3/9/2019 1:00:00 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 8-Session Package-Night School 17- Design of Facade Attachments	7/18/2018 7:00:00 PM
NS 18 8-Session Package-Night School 18- Steel Construction: Mill Top 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	8/9/2019 7:00:00 PM
8-Session Package-Seismic Design in Steel - Concepts & Examples	7/16/2018 1:30:00 PM

## 8-Session Registrants

### Course Resources

#### Night School 24: Modern Methods for Learning Structural Stability

##### 8-SESSION PACKAGE RESOURCES

Event	Date	Handouts	Video	Quizzes	Attendance
NS24.1 - Compression Members - The Fundamentals	Oct 6 2020 7:00PM EDT	<a href="#">Handouts</a>	Available 10/06/2020 5:00PM EDT	Available 10/06/2020 5:00PM EDT	Pending
NS24.2 - Compression Members - Practical Considerations	Oct 13 2020 7:00PM EDT	<a href="#">Handouts</a>	Available 10/13/2020 5:00PM EDT	Available 10/13/2020 5:00PM EDT	Pending
NS24.3 - Behavior of Flexural Members - The Fundamentals	Oct 20 2020 7:00PM EDT	<a href="#">Handouts</a>	Available 10/22/2020 5:00PM EDT	Available 10/22/2020 5:00PM EDT	Pending
NS24.4 - Flexural Members - Practical Considerations	Oct 27 2020 7:00PM EDT	<a href="#">Handouts</a>	Available 10/29/2020 5:00PM EDT	Available 10/29/2020 5:00PM EDT	Pending
NS24.5 - Stability of Beam-Columns - The Fundamentals	Nov 10 2020 7:00PM EST	<a href="#">Handouts</a>	Available 11/12/2020 5:00PM EST	No longer available	Pending
NS24.6 - Stability of Beam-Columns - Practical Consideration	Nov 17 2020 7:00PM EST	<a href="#">Handouts</a>	Available 11/19/2020 5:00PM EST	No longer available	Pending
NS24.7 - Behavior of Structural Systems - The Fundamentals	Dec 1 2020 7:00PM EST	<a href="#">Handouts</a>	Available 12/03/2020 5:00PM EST	No longer available	Pending
NS24.8 - Structural Systems - Practical Considerations	Dec 8 2020 7:00PM EST	<a href="#">Handouts</a>	Available 12/10/2020 5:00PM EST	No longer available	Pending
NS24 - Final Exam	N/A			No longer available	





**AISC** | Thank you.



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