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Course Description

August 7, 2017– Design of Bracing for Beams

This lecture will emphasize the design requirements for bracing of beam systems. Several design examples will demonstrate the effective use of the AISC Specification Appendix 6 provisions. These examples will include relative, nodal, and lean-on applications. The uses of the provisions covered in the Specification Appendix as well as modifications covered in the Specification Commentary will be addressed. The importance of brace connection details is emphasized.



Learning Objectives

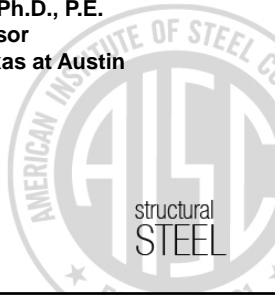
- Learn and understand the design requirements related to bracing beams.
- Gain an understanding of AISC Specification Appendix 6 requirements.
- Become familiar with designing for relative, nodal, and lean-on bracing applications.
- Understand bracing design through the use of design examples.



Fundamentals of Stability for Steel Design Session 8: Design of Bracing for Beams August 7, 2017



Presented by
Joseph A. Yura, Ph.D., P.E.
Emeritus Professor
University of Texas at Austin





There's always a solution in steel.



There's always a solution in steel.

Fundamentals of Stability for Steel Design

Session 8
Design of Bracing for Beams
Joseph A. Yura, Ph.D., P.E.

BEAM BRACING

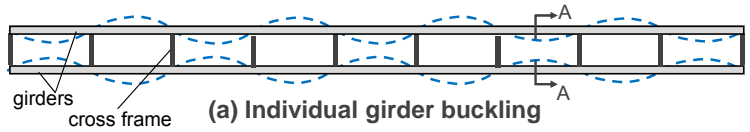
- Multiple girder systems
 - System buckling of narrow girder units
 - Lean-on bracing
- Bracing of single girders
 - Lateral brace behavior and design
 - Torsional brace behavior and design

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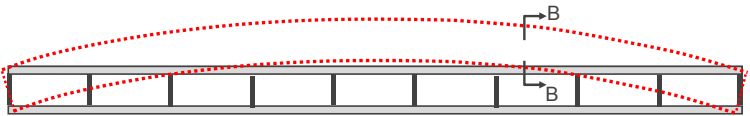
- Multiple girder systems
 - **System buckling of narrow girder units**

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TWIN GIRDER SYSTEMS - Plan View

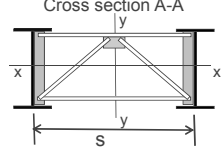


(a) Individual girder buckling

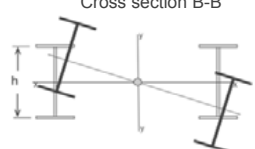


(b) Global system buckling : closely-spaced beams, long span

Cross section A-A



Cross section B-B



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SYSTEM TWIST

Total warping rigidity = $2E \left(\frac{h^2}{4} I_y + \frac{s^2}{4} I_x \right)$

Use with beam buckling formulas in Lectures 3 and 4

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TWIN GIRDER SYSTEM BUCKLING

$$M_{crs} = \frac{2\pi}{L} \sqrt{EI_y GJ + \frac{\pi^2 E^2 I_y (I_y h^2 + I_x s^2)}{4L^2}} \quad (\text{exact})$$

All section properties are for a single girder

Σ Girder Maximum Moments $\leq M_{crs}$

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TWIN GIRDER SYSTEM BUCKLING

$$M_{crs} = \frac{2\pi}{L} \sqrt{\cancel{EI_y GJ} + \frac{\pi^2 E^2 I_y (\cancel{I_y h^2} + I_x s^2)}{4L^2}} \quad (\text{exact})$$

$$M_{crs} = \frac{\pi^2 s E}{L^2} \sqrt{I_y I_x} \quad (\text{simple})$$

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TWIN GIRDER EXAMPLE

L = 170 ft

System Buckling Stress (ksi)			
Analysis Type	Girder Spacing S (in.)		
	80	109	150
FEA	21.31	28.56	38.68
Exact	21.40	28.73	39.21
Simple	20.70	28.22	38.83

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More Info on Global Buckling

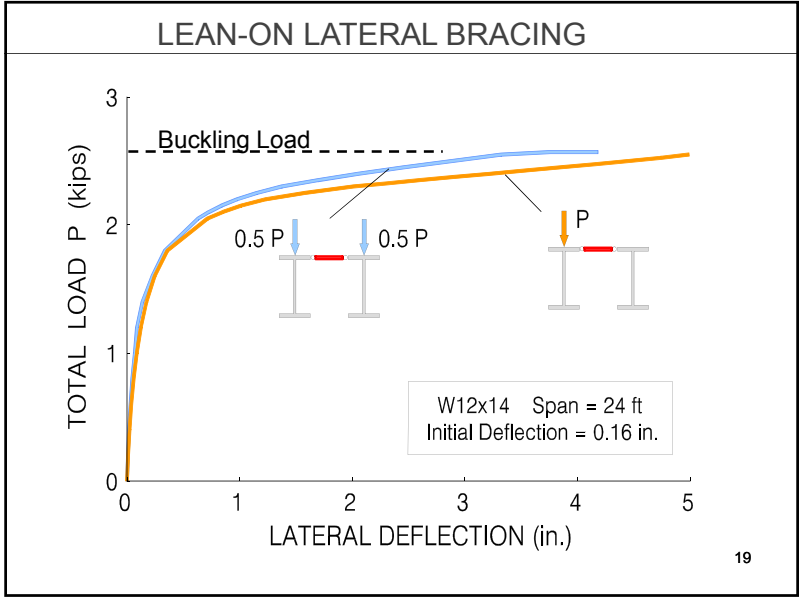
Improved capacity

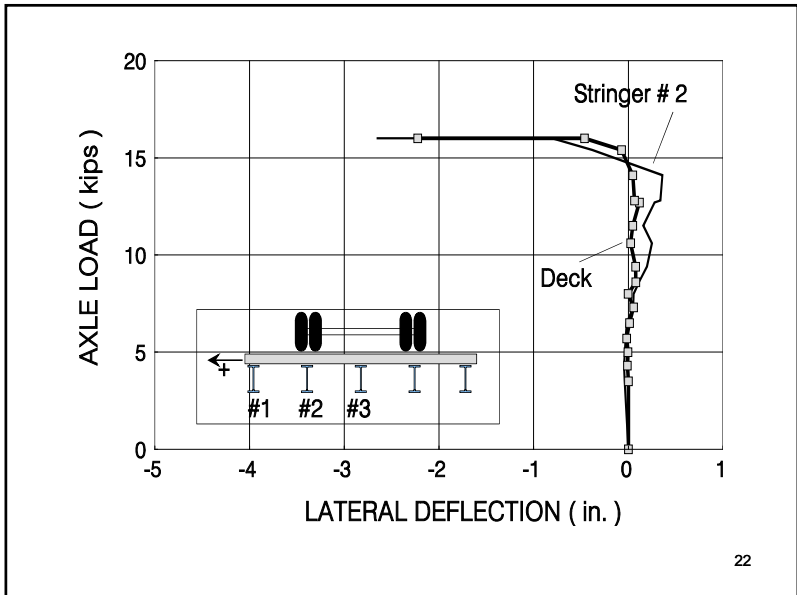
Similar to Lecture 2

Yura et al, (2008) "Global Lateral Buckling of I-Shaped Girder Systems", *J. Struct. Engrg.*, ASCE, Vol. 134, No. 9, pp. 1487-1494 17

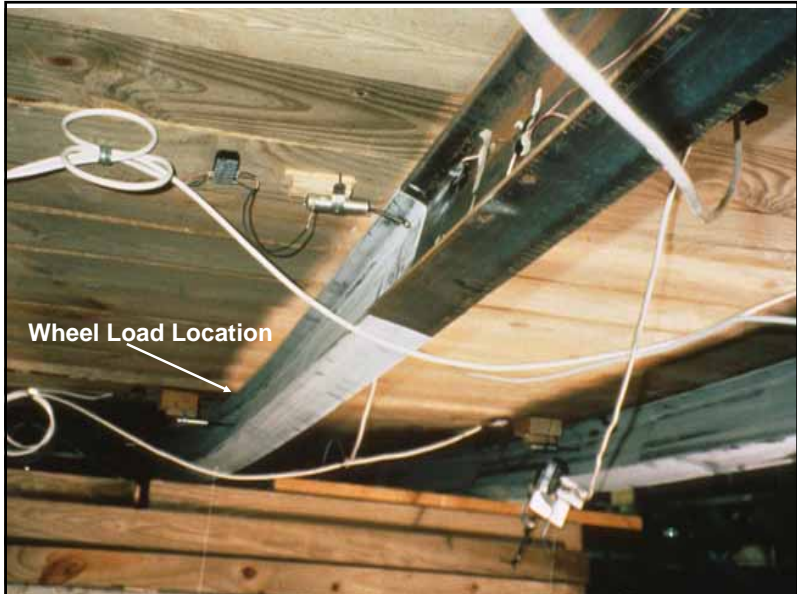
- Multiple girder systems
 - **Lean-on bracing**

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LEAN-ON BEAM SYSTEMS

- Beams that are interconnected by members without torsional restraint lateral-torsional buckle as a system :

$$\sum M_r \leq \sum M_{cr}$$

M_r = maximum moment in an individual beam
 M_{cr} = lateral-torsional buckling capacity of an individual beam assuming that the interconnection points are not brace points
- Check individual beams for buckling between the intersection points treated as brace points

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- Bracing of single girders
 - Lateral brace behavior and design
 - Torsional brace behavior and design

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BEAM BRACING

A successful bracing system prevents twist of the cross section

LATERAL BRACING of the compression flange will prevent twist since the tension flange would prefer to remain straight for simply-supported beams. For beams with inflection points both flanges must be laterally braced to prevent twist.

TORSIONAL BRACING prevents twist of the cross section at the brace location. The brace does not need to prevent lateral movement of the cross section to be successful.

An inflection point is not a brace point. Twist of the cross section is not prevented at the inflection point.

Bracing must have sufficient stiffness and strength

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TYPES OF BEAM BRACING

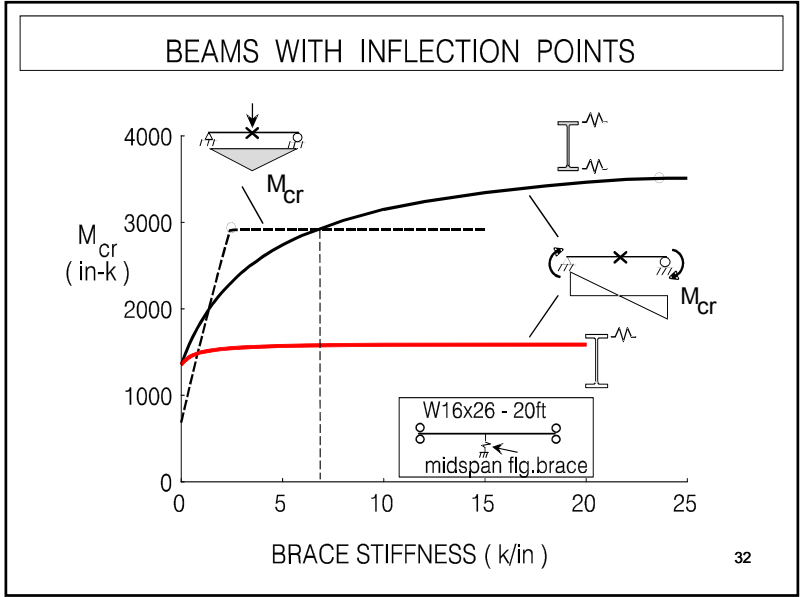
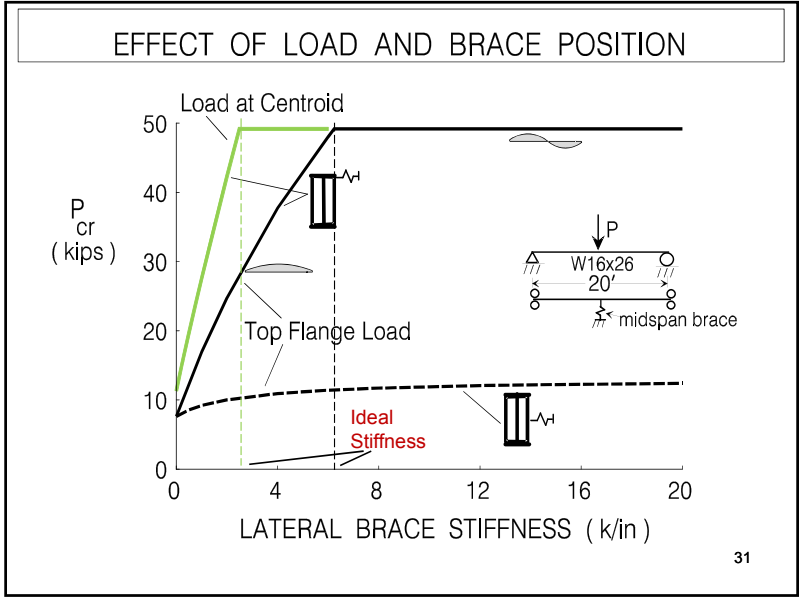
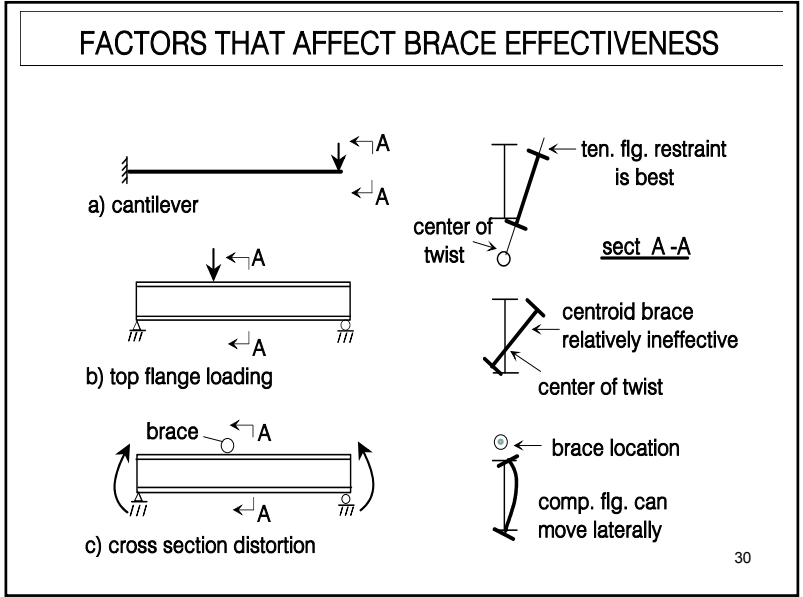
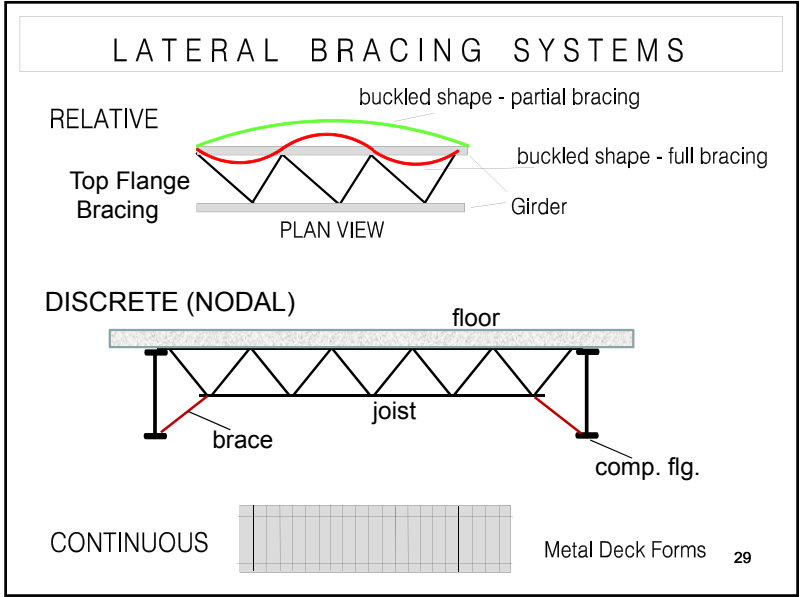
<u>LATERAL BRACING</u>	<u>TORSIONAL BRACING</u>
* <i>RELATIVE</i>	* <i>DISCRETE (NODAL)</i>
* <i>DISCRETE (NODAL)</i>	* <i>CONTINUOUS</i>
* <i>CONTINUOUS</i>	
* <i>LEAN - ON</i>	

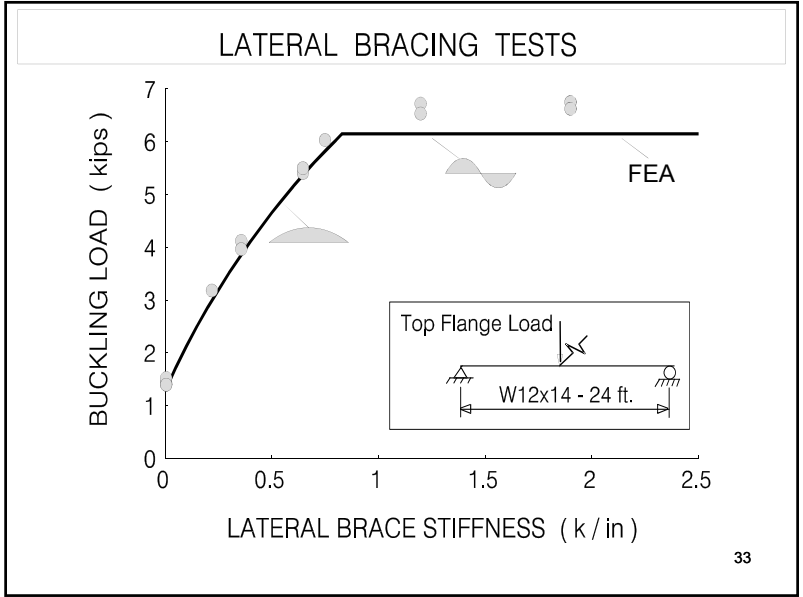
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- Bracing of single girders
 - **Lateral brace behavior and design**

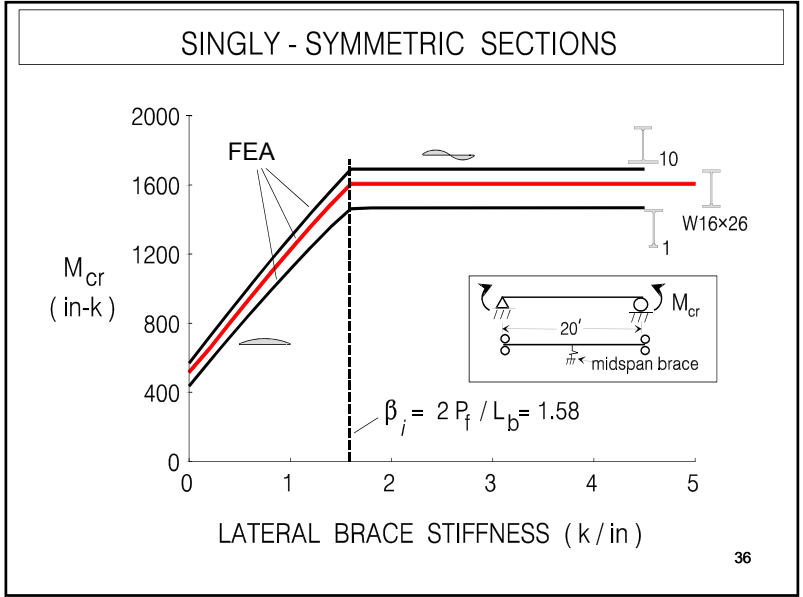
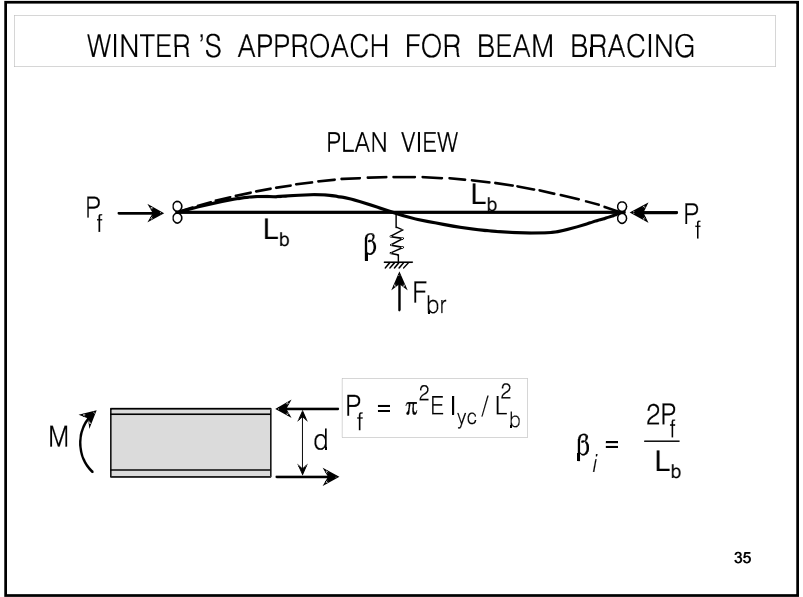
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- ### LATERAL BRACING DESIGN FACTORS
- NUMBER OF BRACES
 - BRACE POSITION
 - Place at or near the flange
 - Top and bottom braces needed for compression on both flanges
 - LOAD POSITION
 - Top flange loading is the worst
 - MOMENT DIAGRAM
 - Consider the C_b modification factor
- 34



LATERAL BRACING REQUIREMENTS - FULL BRACING

STIFFNESS:

$$\beta_L^* = 2 N_i P_f C_{bb} C_L C_d / L_b$$

From Lecture 7

1.0 - relative bracing

4 - (2/n) discrete bracing

$\pi^2 E I_{yc} / L_b^2$

$1 + (1.2/n)$

$1 + (M_s / M_1)^2$
double curv

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LATERAL BRACING REQUIREMENTS - FULL BRACING

STIFFNESS:

$$\beta_L^* = 2 N_i P_f C_{bb} C_L C_d / L_b$$

From Lecture 7

1.0 - relative bracing

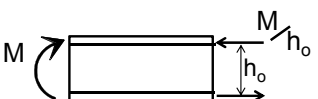
4 - (2/n) discrete bracing

$\pi^2 E I_{yc} / L_b^2$

$1 + (1.2/n)$

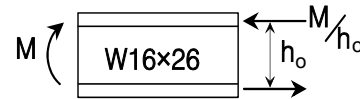
$1 + (M_s / M_1)^2$
double curv

Another practical option for the compressive force



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APPROXIMATE COMPRESSIVE FLANGE FORCE



L_b	M_{cr}	$P_f = \pi^2 E I_{yc} / L_b^2$	M / h_o	$\frac{M / h_o}{P_f}$
ft	k-in	kips	kips	
5	6035	381	393	1.03
10	1640	95.3	107	1.12
15	817	42.4	53.3	1.26

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SIMPLIFIED BRACING REQUIREMENTS

STIFFNESS :

$$\beta_L^* = 2 N_i P_f C_{bb} C_L C_d / L_b$$

4 - (2/n) discrete bracing

$1 + (1.2/n)$
top flg loading

n	1	2	3	4	5	6
$2 N_i C_L$	8.8	9.6	9.3	9.1	8.9	8.8

say 10

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LATERAL BRACING – LRFD RECOMMENDATIONS

	<u>Relative</u>	<u>Nodal</u>
<u>Stiffness</u> $\phi = 0.75$	A6-6 $\beta_L = 4M_r C_d / \phi L_b h_o$	A6-8 $\beta_L = 10M_r C_d / \phi L_b h_o$ max. moment
<u>Strength</u>	A6-5 $F_{br} = 0.008M_r C_d / h_o$ 1.0 – single curvature 2.0 – double curvature	A6-7 $F_{br} = 0.02 M_r C_d / h_o$
$\Delta_o = 0.002 L_b$		

Note: The required bracing spacing, L_q , can be substituted for the actual spacing, L_b .

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DISCRETE BEAM BRACING - Gravity plus Uplift Wind

The rafter of an industrial building frame is braced along the top flange by purlins spaced at 5 ft interval. The uplift load condition produces compression on the bottom flange and three angle braces are proposed to stabilize the rafter. Check the detail shown. $F_y = 50$ ksi.

From F5-4 for LTB of the rafter at 83 k' with $C_b = 1.0$.

$$83 \times 12 = 0.9(67.9)(1.0) \frac{\pi^2(29000)(1.54)^2}{L_q^2}$$

$$L_q = 17.0'$$

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DISCRETE BEAM BRACING - Gravity plus Uplift Wind

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$$L_q = 17.0'$$

A6-8 and A6-7

$$\beta_L = 10(83)/(0.75)(17.0)24.38 = 2.67 \text{ k/in}$$

$$F_{br} = 0.02 (83 \times 12) 1.0 / 24.38 = 0.82 \text{ k}$$

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Brace Stiffness

The angle braces are supported by the continuous purlins that span 25' between rafters. The effect of the purlin stiffness must be considered when evaluating the stiffness of the brace system

Purlin stiffness: $M = 28.5F$, $L = 25 \times 12 - 30 = 270''$

$$M/\theta = 2 \times 2EI/L = 4(29000)12.6/270 = 5410 \text{ k-in}$$

$$F/\Delta = M/(\theta(28.5)^2) = 6.66 \text{ k/in}$$

Treat as rigid unit

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Brace Stiffness

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 $F/\Delta = M/(\theta(28.5)^2) = 6.66 \text{ k/in}$
 Treat as rigid unit $\theta = \Delta/28.5$
 Angle stiffness: $\frac{0.297(29000)}{39.7} \cos^2\theta = 124 \text{ k/in}$
 Brace stiffness: $(1/6.66) + (1/124) = (1/\beta) : \beta = 6.32 > 2.67 \text{ k/in OK}$

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Brace Strength (E5-1)
 $F_y = 50 \text{ ksi} \quad KL/r = 32 + 1.25(103) = 161 : \phi F_{Cr} = 8.72 \text{ ksi}$
 $L/r_x = 103 \quad \phi P_n = 8.72(0.297) = 2.59 \text{ k} > 0.82/\cos\theta = 1.09 \text{ k OK}$

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Polling Question 1

True or False:

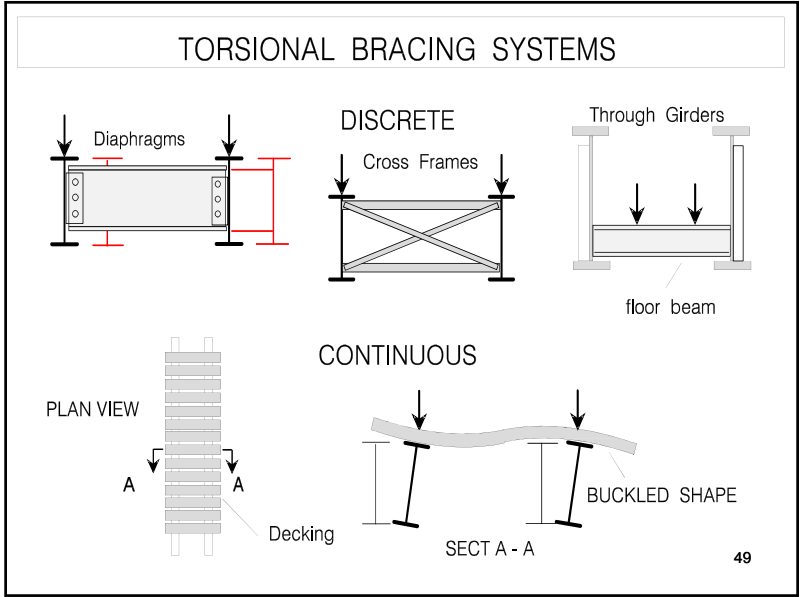
For a cantilever beam, the best location for a lateral brace at the free end is the top tension flange.

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- Bracing of single girders
 - **Torsional brace behavior and design**

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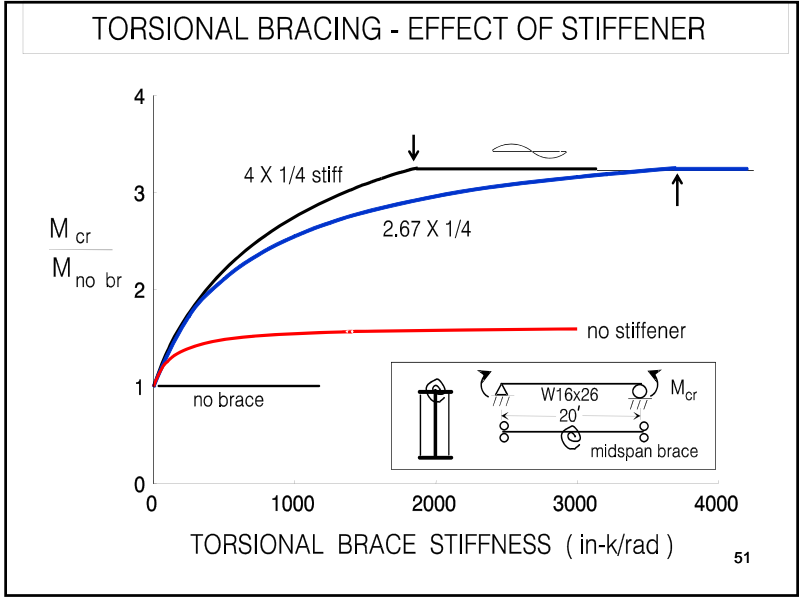


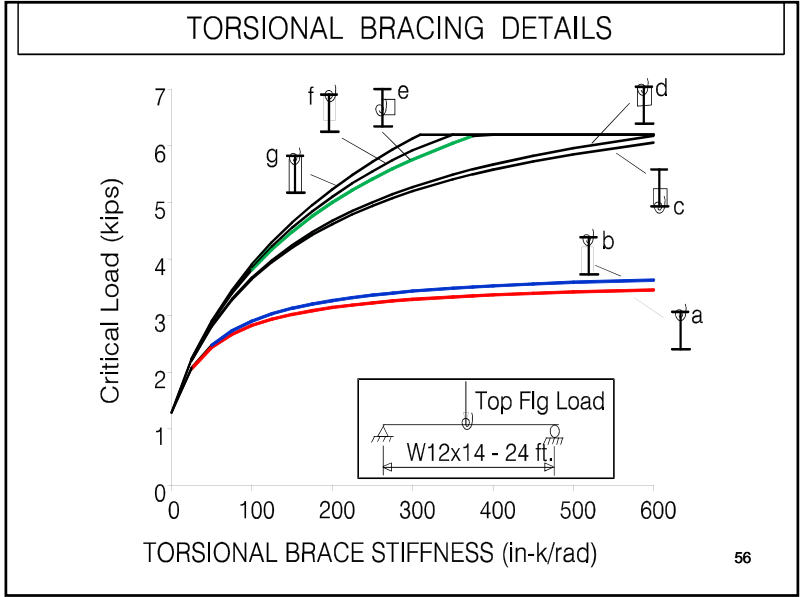
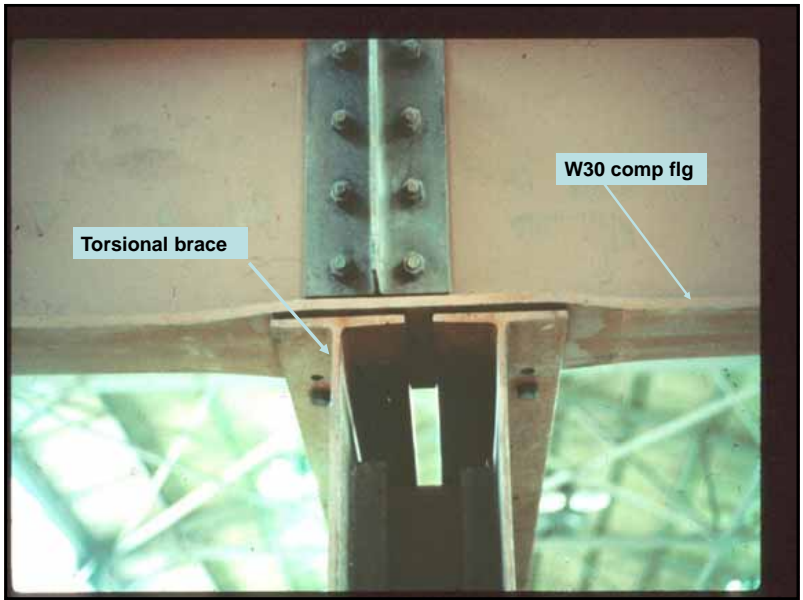


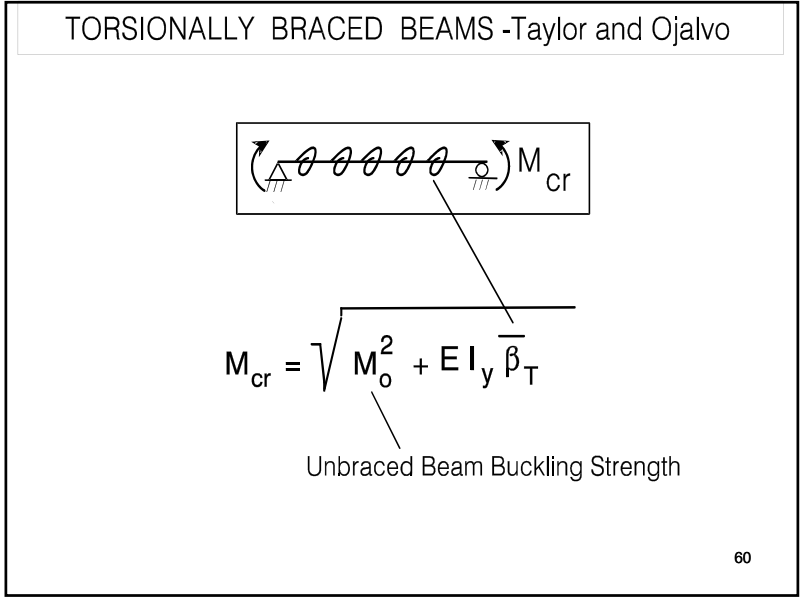
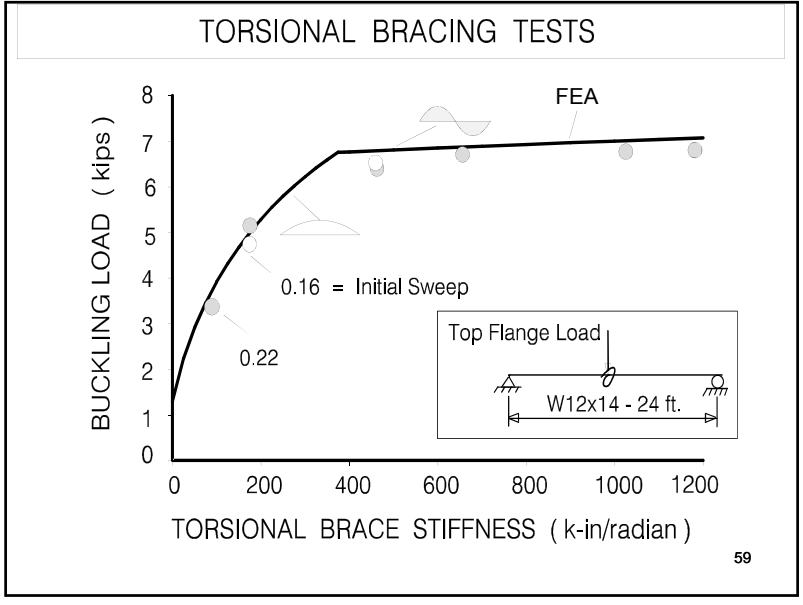
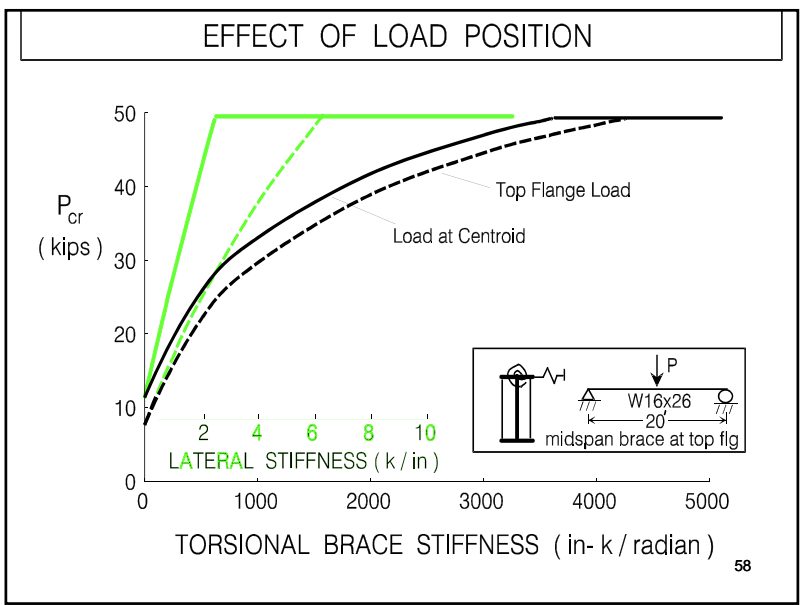
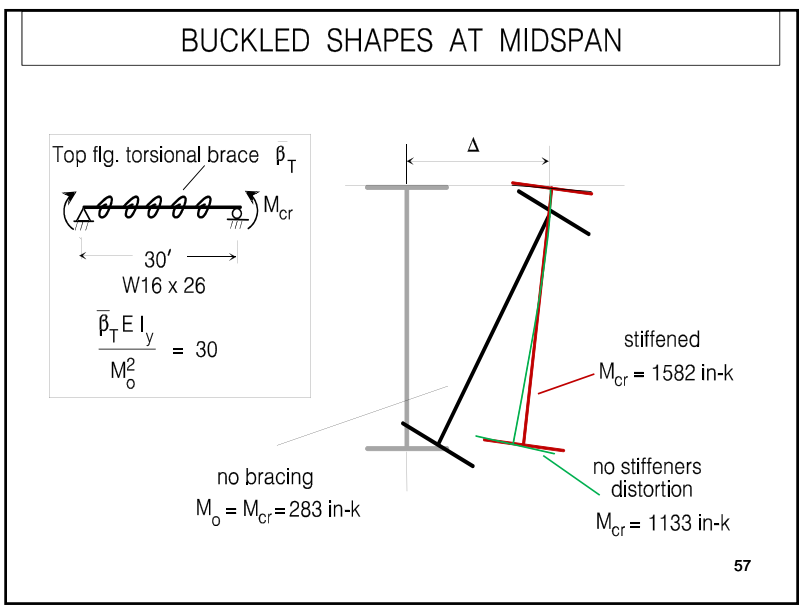
SECTION IS FULLY BRACED AT A LOCATION

IF TWIST IS PREVENTED

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TORSIONALLY BRACED BEAMS

$$M_{cr} = \sqrt{C_{bu}^2 M_o^2 + \frac{C_{bb}^2 E I_y \bar{\beta}_T}{C_T}} \leq M_p \text{ or } M_s$$

unbraced capacity

top flange loading = 1.2

$\bar{\beta}_T = \frac{\beta_T \times n \text{ braces}}{\text{span length}}$

cross section distortion
 $\frac{1}{\beta_T} = \frac{1}{\beta_{Tb}} + \frac{1}{\beta_{sec}}$

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$$\frac{1}{\beta_T} = \frac{1}{\beta_{Tb}} + \frac{1}{\beta_{sec}} \quad \beta_T = \text{System Stiffness}$$

(C-A-6-12)

$\beta_{Tb} = \frac{\beta_T}{1 - \frac{\beta_T}{\beta_{sec}}}$

$\beta_{Tb} = \text{X-frame or Diaphragm Stiffness}$
 $\beta_{sec} = \text{Web Distortional Stiffness}$

$\beta_{Tb} = \frac{\beta_T}{1 - \frac{\beta_T}{\beta_{sec}}}$

(A-6-10)

NOTE: The system stiffness is less than or at best equal to the smaller of the brace or web stiffness.

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TORSIONAL BRACING - CROSS SECTION DISTORTION

stiffener at least 3/4 depth

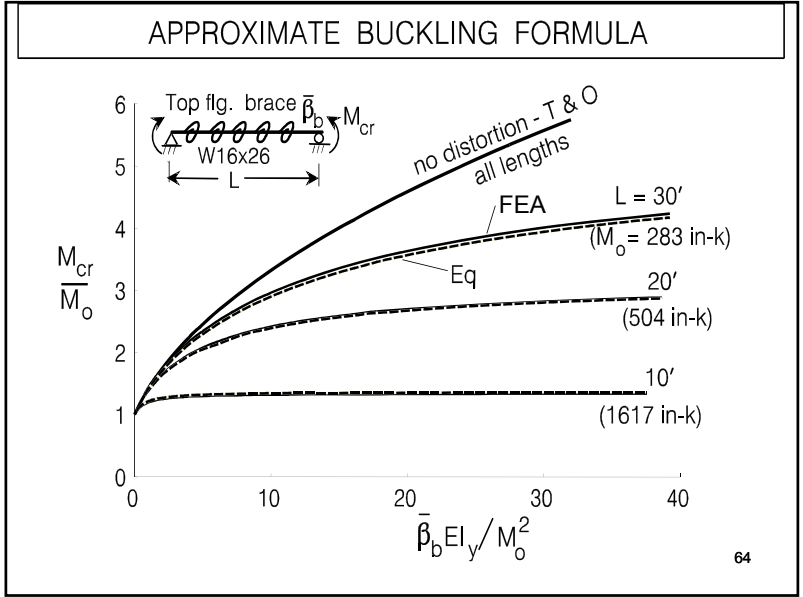
Torsional Brace

Effective Web Width for Distortion

$$\beta_{sec} = \frac{3.3 E}{h} \left(\frac{t_w^3}{12} (N + 1.5 h) + \frac{t_s^3 b_s^3}{12} \right)$$

use 1 in. for continuous bracing

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DIAPHRAGM BRACE STIFFNESS

Diaphragms
or Decks

$$\beta_b = \frac{6 E I_b}{S}$$

Through Girders

$$\beta_b = \frac{2 E I_b}{S}$$

Use if diaphragm is at midheight or closer to the compression flange

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CROSS FRAME STIFFNESS

TENSION SYSTEM

$$\theta = \frac{\Delta + \Delta_b}{h_b} \quad M = F h_b$$

$$\beta_b = M / \theta = \frac{E s^2 h_b^2}{\frac{2 L_c^3}{A_c} + \frac{s^3}{A_h}}$$

Other Geometries
in Reference

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Recent Tests: Cross Frame Specimens

Battistini et al(2016), J. of Bridge Engrg.,ASCE, Vol 21, No.6

Single Angle X-Frame

Double Angle Z-Frame
(Double Angle Struts)

Double Angle Z-Frame
(Single Angle Struts)

Single Angle K-Frame


Square Tube Z-Frame

Stiffness: Test vs. Analytical vs. FEA

Type of Cross Frames	Test Results	Analytic Solution	Error %	Line Element Solution	Error %
Single Angle X-Frame	872,000	1,579,000	82%	1,572,000	81%
Single Angle K-Frame	760,000	1,189,000	56%	1,191,000	55%
Unequal Leg Angle X-Frame	1,451,000	1,609,000	53%	1,614,000	53%
Double Angle Z (Single Struts)	597,000	907,000	52%	905,000	52%
Double Angle Z (Double Struts)	1,182,000	1,152,000	-2.5%	1,152,000	-2.5%
Square Tube Z-frame	658,000	649,000	-1%	647,000	-2%

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The reduction in the stiffness is due to the bending caused by the eccentric connection

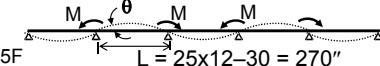
Reduce stiffness 50 % for eccentric connections

What about the angle brace in the earlier lateral brace example?

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Brace Stiffness

The angle braces are supported by the continuous purlins that span 25' between rafters. The effect of the purlin stiffness must be considered when evaluating the stiffness of the brace system



Purlin stiffness: $M/\theta = 2 \times 2EI/L = 4(29000)12.6/270 = 5410 \text{ k-in}$

$F/\Delta = M/(\theta(28.5)^2) = 6.66 \text{ k/in}$

Treat as rigid unit $\theta = \Delta/28.5$

Angle stiffness: $\frac{0.297(29000)}{39.7} \cos^2\theta = \frac{62}{124} \text{ k/in}$

Brace stiffness: $(1/6.66) + (1/124) = (1/\beta) : \beta = \frac{6.32}{6.01} > 2.67 \text{ k/in OK}$

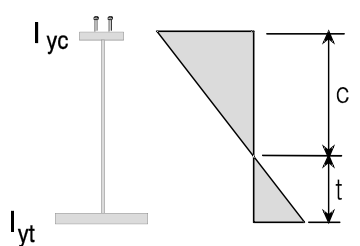
Brace Strength (E5-1)

$F_y = 50 \text{ ksi}$ $KL/r = 32 + 1.25(103) = 161 : \phi F_{cr} = 8.72 \text{ ksi}$

$L/r_x = 103$ $\phi P_n = 8.72(0.297) = 2.59 \text{ k} > 0.82/\cos\theta = 1.09 \text{ k OK}$

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SINGLY - SYMMETRIC GIRDERS

$$M_{cr} = \sqrt{C_{bu}^2 M_o^2 + \frac{C_{bb}^2 E I_y \bar{\beta}_T}{C_T}} \leq M_p \text{ or } M_s$$


$$I_{eff} = I_{yc} + \frac{t}{c} I_{yt}$$

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DEVELOPMENT OF DESIGN RECOMMENDATIONS

$$M_{cr} = \sqrt{\cancel{(C_{bu} M_o)^2} + \frac{C_{bb}^2 E I_{eff} \bar{\beta}_T}{2 C_T}}$$

Maximum Moment, M_r

Stiffness :

$$\bar{\beta}_T = \frac{2.4 M_r^2}{C_{bb}^2 E I_{eff}} = \frac{\beta_T n}{L}$$

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DEVELOPMENT OF DESIGN RECOMMENDATIONS

$$\beta_T = \frac{2.4 L M_r^2}{n C_b^2 E I_y}$$

Strength: $M_{br} = \theta \beta_T$ - take $\theta = 0.002 L_b/h$

$$M_{br} = \frac{0.005 L M_r^2 L_b}{n C_b^2 E I_y h} \quad (C-A-6-8)$$

This was further simplified – See AISC Commentary for details

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TORSIONAL BRACING - LRFD RECOMMENDATIONS

STIFFNESS: $\beta_T = \frac{2.4 M_r^2 L}{\phi n E I_y C_{bb}^2} \quad (A-6-11)$

STRENGTH: $M_{br} = F_{br} h_b = \frac{0.024 M_r L}{n C_{bb} L_b} \quad (A-6-9)$

ASSUMES INITIAL TWIST = $\frac{L_b}{500h}$ — brace spacing
— beam depth

Note: The required bracing spacing, L_q , can be substituted for the actual spacing, L_b .

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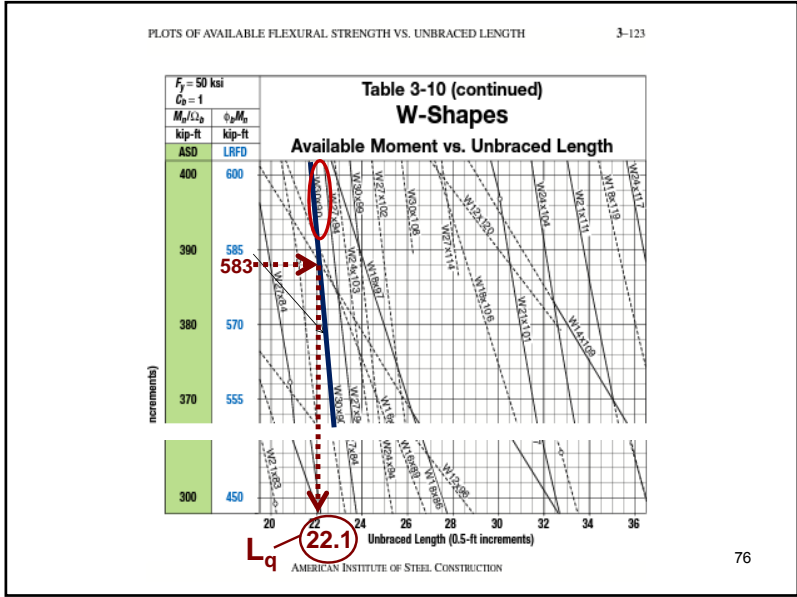
TORSIONAL BEAM BRACING

glass (no diaphragm)

The grillage supports glass roof panels subjected to uniform load. The maximum beam moments are:
 (W12x40) $M_r = 45 \text{ k}' < \phi M_n = 97 \text{ k}'$ ($L_b = 30', C_b = 1.14$)
 (W30x90) $M_r = 583 \text{ k}' > \phi M_n = 144 \text{ k}'$ ($L_b = 60', C_b = 1.14$)
 \therefore the W30x90 needs bracing from the W12x40

From p.3-123, AISC Manual, $L_q = 22.1'$ for $\phi M_n = 583 \text{ k}'$

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Brace Requirements

$F_y = 50 \text{ ksi}$

(A6-11) $\beta_T = \frac{2.4(60 \times 12)(583 \times 12)^2}{0.75(11)(29000)(115)(1.0)^2} = \underline{3074 \text{ in-k/rad}}$

(A6-9) Use $L_q = 22.1'$ instead of $L_b = 5'$
 $C_b = 1.0$

$M_{br} = \frac{0.024(583)60}{11(1.0)22.1} = \underline{3.45 \text{ k}'}$

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Try W12x40 as bracing - assume that the shear tab connection can act as a moment connection for the small M_{br}

$\beta_{Tb} = 6EI/L = 6(29000)307/(30 \times 12) = \underline{148,400 \text{ in-k/radian}}$

(A6-12) $\beta_{sec} = \frac{3.3(29000)}{28.92} \left(\frac{1.5(28.92)(0.47)^3}{12} + 0 \right)$

$= \underline{1242} < 3074 \text{ in-k/rad} \therefore \text{need web stiffeners (or thicker web)}$

78

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(C-A-6-12) $\frac{1}{3074} = \frac{1}{148,400} + \frac{1}{\beta_{sec}}$: required $\beta_{sec} = 3140 \text{ in-k/rad}$

Assume 3/8 thick stiffener -

$3140 = \frac{3.3(29000)}{28.92} \left(\frac{1.5(28.92)(0.47)^3}{12} + \frac{0.375(b_s)^3}{12} \right)$; $b_s = 2.63 \text{ in}$

- use 4x3/8 full-depth one-sided stiffener for connection

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Brace strength: The bolted connection to the coped W12x40 can provide moment capacity as the bolts come in contact with the web when the beam tries to rotate.

$\phi M_n = 0.9 S F_y$ where S is the section modulus of the web in the connection zone

$\phi M_n = 0.9(50)(9.5)^2(0.295)/6(12) = 16.6 \text{ k-ft}$

$\phi M_n > M_{br} = 3.45 \text{ k-ft OK}$

Because of hole clearance, some rotation, θ_b , may occur before flexural resistance can be developed. Check increase in brace force.

Say $\theta_b = (2/16") \div 6" = 0.0208$ $\theta_o = 0.002(22.1 \times 12)/28.92 = 0.0183$

$M_{br} = 3.45 \left(\frac{0.0208 + 0.0183}{0.0183} \right) = 7.37 < 16.6 \text{ k-ft, still OK}$

80



Minimum Web Thickness to Eliminate the Web Stiffeners

(C-A-6-12) $\frac{1}{3074} = \frac{1}{148,400} + \frac{1}{\beta_{sec}}$: required $\beta_{sec} = 3139 \text{ in-k/rad}$

(A6-12) $3139 = 3.3(29000)(1.5 t_w^3)/12 \therefore \text{approx. min } t_w = 0.640 \text{ in}$
W30x148 ($t_w = 0.650 \text{ in}$)

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Minimum Web Thickness to Eliminate the Web Stiffeners

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W30x148 ($t_w = 0.650 \text{ in}$)

Try W30x124, $t_w = 0.585 \text{ in}$, $\phi M_n \text{ unbraced} = 284 \text{ k}'$ ($M_r = 583 \text{ k}'$)

Account for unbraced buckling strength :

Replace M_r^2 with $(M_r^2 - (\phi M_n)^2)$ (AISC C-A-6-7)

$\beta_T = 3074 (583^2 - 284^2) / 583^2 = 2344 \text{ in-k/rad}$

(C-A-6-12) $\frac{1}{2344} = \frac{1}{148,400} + \frac{1}{\beta_{sec}}$: required $\beta_{sec} = 2381 \text{ in-k/rad}$

(A6-12) $2381 = 3.3(29000)(1.5 t_w^3)/12 \therefore \text{min } t_w = 0.583 < 0.585 \text{ in}$

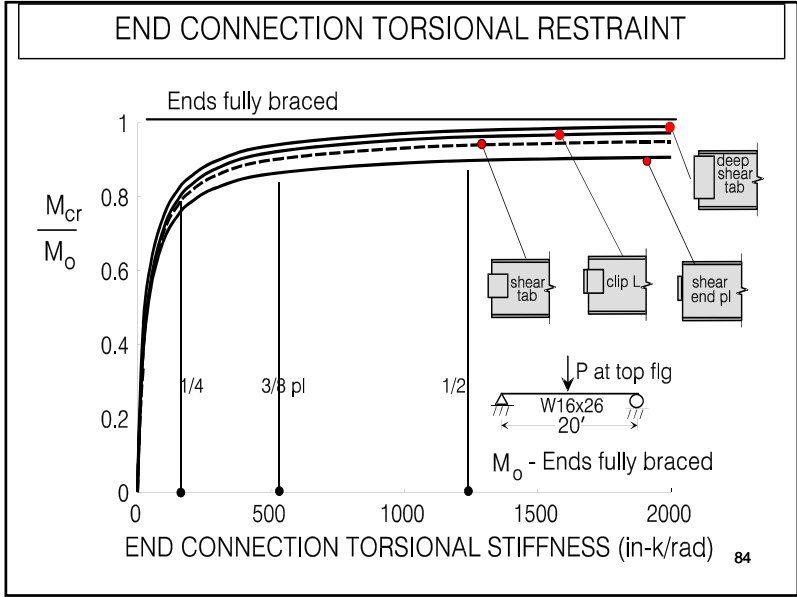
OK 82

Polling Question

To be effective, a torsional brace system must

- be attached near the compression flange
- prevent lateral movement and twist
- have a web stiffener
- limit distortion
- all of the above

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SUMMARY

- ◆ Closely-spaced long-span beams can buckle as a unit
- ◆ Beam braces can be designed to either prevent movement of the compression flange(s) or twist of the cross section
- ◆ Braces must have adequate stiffness in addition to strength
- ◆ Distortion of the cross section must be controlled for effective torsional bracing

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CHAPTER 12

BRACING

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Individual Webinar Registrants

CEU/PDH Certificates
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!



Individual Webinar Registrants

CEU/PDH Certificates

Within 2 business days...

- New 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 all 8 sessions.



8-Session Registrants

Final Exam

The final exam will be issued on August 14.

The final exam must be submitted by August 28 at 8:00 AM EDT.



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

Quiz and Attendance records: Posted Tuesday mornings.
www.aisc.org/nightschool - click on Current Course Details.

Reasons for quiz:

- EEU – must take all quizzes and final to receive EEU
- 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.



8-Session Registrants


Access to the recording: Information for accessing the recording will be emailed to you by this Wednesday. The recording will be available for three weeks. For 8-session registrants only. EMAIL COMES FROM NIGHTSCHOOL@AISC.ORG.

CEUs/PDHS – If you watch a recorded session you must take AND PASS the quiz for CEUs/PDHS.



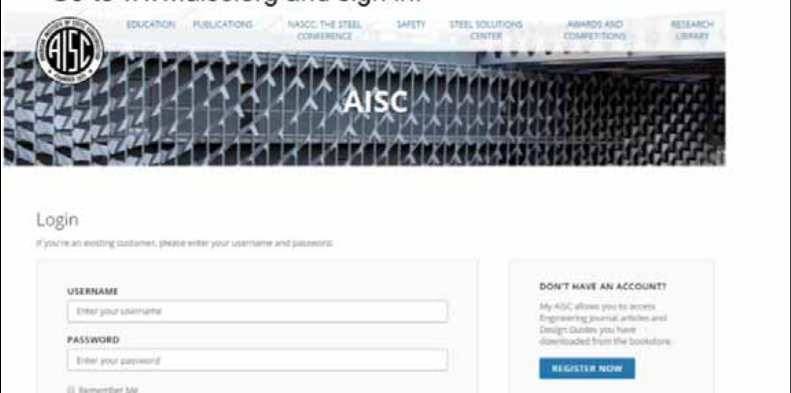
Night School Resources for 8-session package Registrants

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



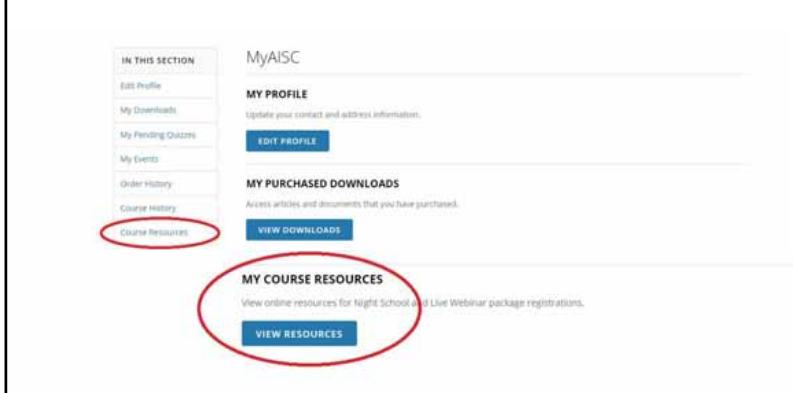
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Go to www.aisc.org and sign in.



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Night School Resources for 8-session package Registrants

Course Resources

Event	Start Date
NIS 13 8-Session Package-Night School 13 - Design of Industrial Buildings	2/20/2017 7:00:00 PM
NIS 14 8-Session Package-Night School 14 - Fundamentals of Stability	8/5/2017 7:00:00 PM

Night School Resources for 8-session package Registrants

Night School 13: Design of Industrial Buildings

8-SESSION PACKAGE RESOURCES

Event	Date	Handouts	Video	Quiz	Attendance
NIS13 - Design Criteria	3/7/2017 7:00:00 PM	Available	Webinar	Final Score 30	Pending
NIS13 - Beams: Considerations	2/6/2017 7:00:00 PM	Available	Available 02/08/2017 8am EST	Available 02/08/2017 8am EST	Pending
NIS13 - Lateral Load Systems and Details	2/14/2017 7:00:00 PM	Available	Available 02/15/2017 8am EST	Available 02/15/2017 8am EST	Pending
NIS13 - Preliminary Design Procedures	2/21/2017 7:00:00 PM	Available	Available 02/15/2017 8am EST	Available 02/15/2017 8am EST	Pending
NIS13 - Crane Girder Design and Frame Analysis	3/5/2017 7:00:00 PM	Available	Available 03/08/2017 8am EST	Available 03/08/2017 8am EST	Pending
NIS13 - Profile Member and Connector Design	3/13/2017 7:00:00 PM	Available	Available 03/13/2017 8am EST	Available 03/13/2017 8am EST	Pending
NIS13 - Transfer Crane Girders & Longitudinal Bay Bracing Det	3/13/2017 7:00:00 PM	Available	Available 03/13/2017 8am EST	Available 03/13/2017 8am EST	Pending
NIS13 - Building Entrance and Racking Design	4/5/2017 7:00:00 PM	Available	Available 04/05/2017 8am EST	Available 04/05/2017 8am EST	Pending
NIS13 - Final Exam	4/10/2017 7:00:00 PM	Available	Available 04/10/2017 8am EST	Available 04/10/2017 8am EST	Pending

Night School Resources for 8-session package Registrants

- Weekly “quiz and recording” email.
- Weekly updates of the master Quiz and Attendance record found at www.aisc.org/night-school. Scroll down to Quiz and Attendance records.
 - Updated on Tuesday mornings.

Night School Resources for 8-session package Registrants

- Webinar connection information:
 - Found in your registration confirmation/receipt.
 - Reminder email sent out Monday mornings.
- Link to handouts also found here.



There's always a solution in steel.

Thank You

Please give us your feedback!
Survey at conclusion of webinar.

The AISC logo is a circular emblem with the text "AMERICAN INSTITUTE OF STEEL CONSTRUCTION" around the top edge and "FOUNDED 1921" at the bottom. In the center, the letters "AISC" are prominently displayed in a stylized font, with the words "structural STEEL" written below them.