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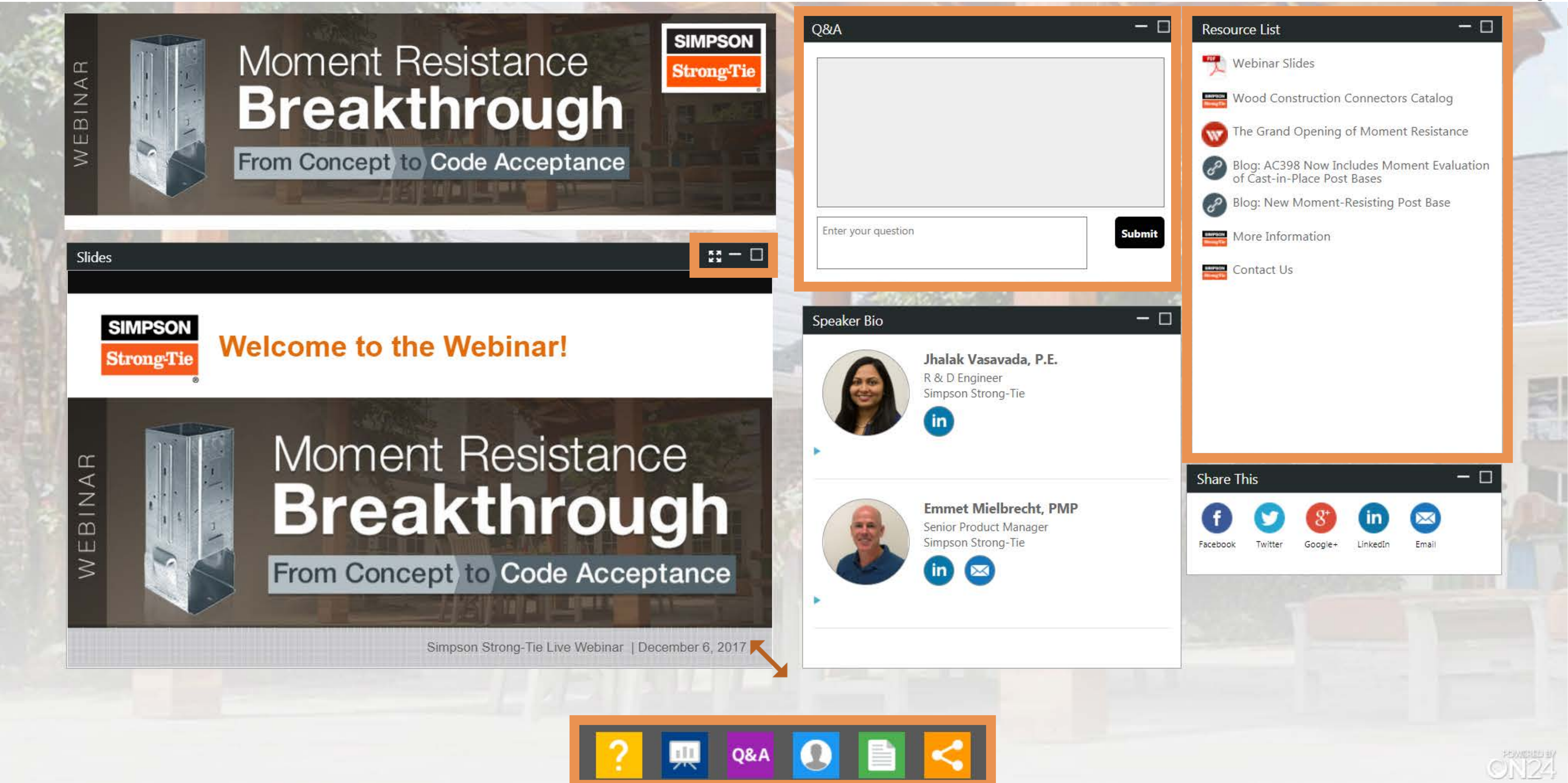

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Objectives

SIMPSON Strong-Tie

After this webinar, you should be able to:

- Identify key design features of the MPBZ moment post base
- Recognize the key code provisions of AC398 and ESR-3050
- Determine the deflection of a post using rotational stiffness of the MPBZ

Today’s Presenters

Emmet Mielbrecht

Senior Product Manager

Simpson Strong-Tie

Jhalak Vasavada, P.E.

R & D Engineer

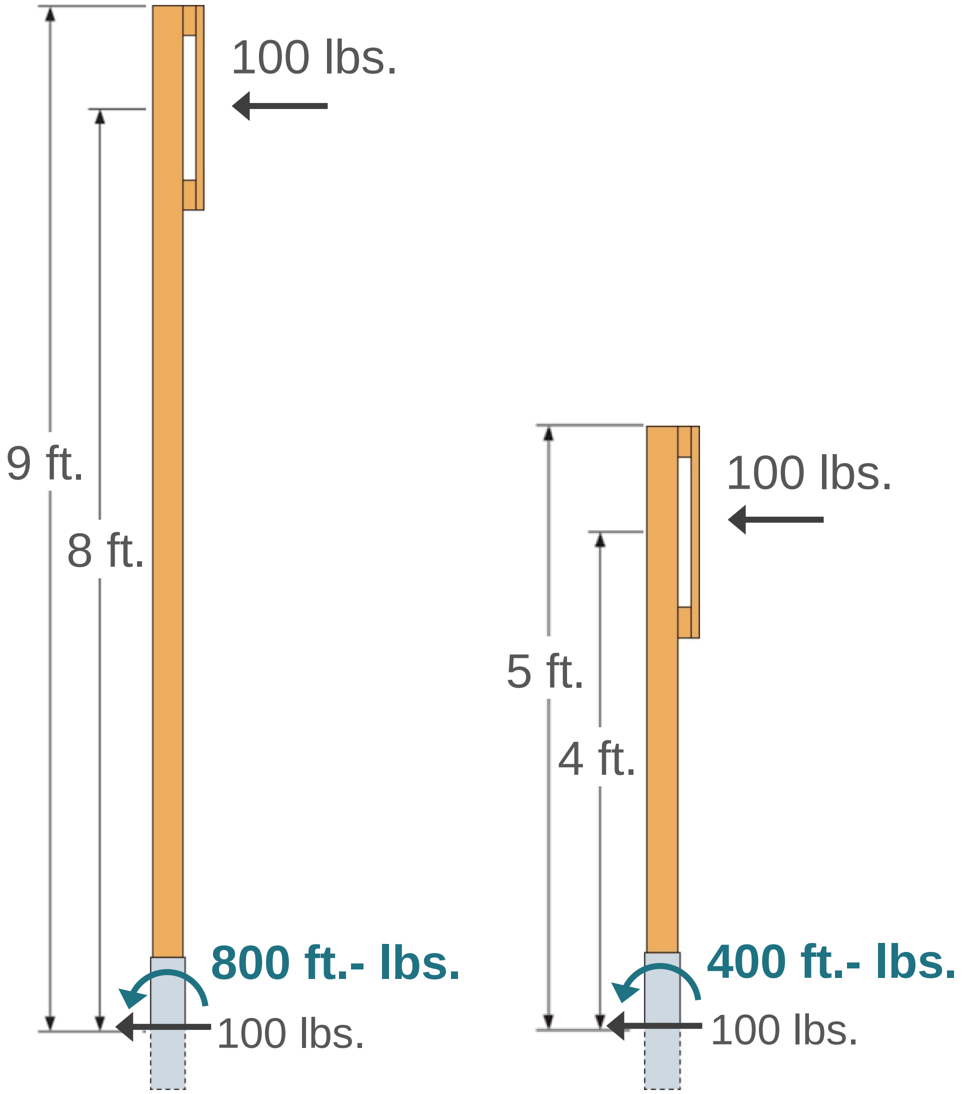
Simpson Strong-Tie

Agenda

Moment Resistance Breakthrough from Concept to Code Acceptance

Moment Forces

What is a moment post base?



Moment is the effect of a force that causes rotation

Moment (M) = Force (F) x distance (d)

Post Base History

SIMPSON Strong-Tie

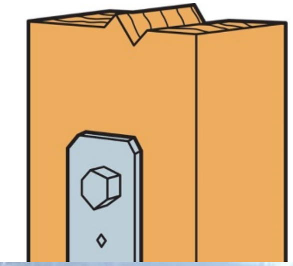
1964 **CB introduced**

1986 **Installation notes added to all post bases**

Not recommended for non top supported installation.

2004 **Clarified installation notes to all post bases**

Post bases do not provide adequate resistance to prevent members from rotating about the base and therefore are not recommended for non top-supported installations (such as fences or unbraced carports).



Other Bracing Techniques

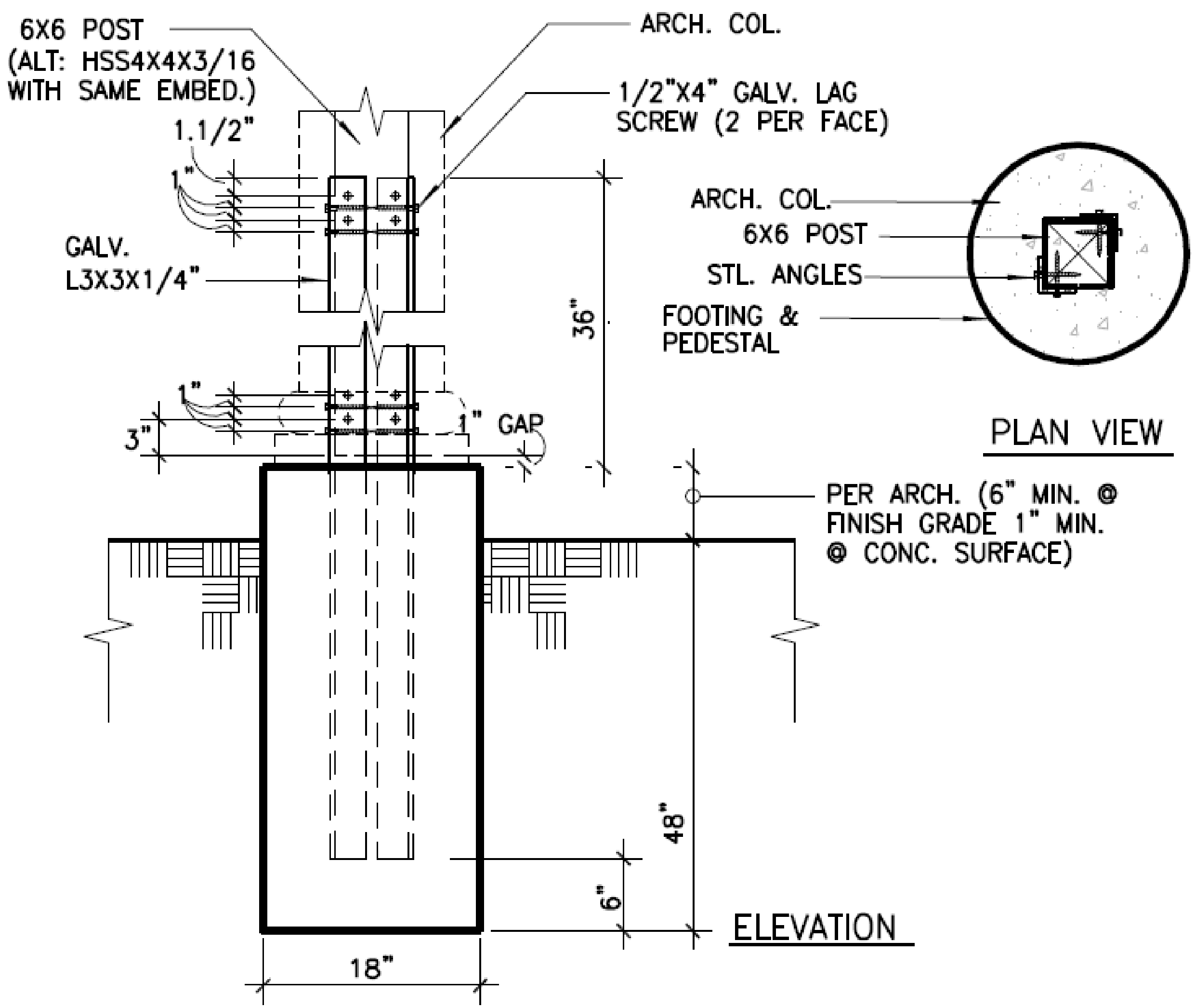
Other Bracing Techniques




What are they doing now?




What are they doing now?

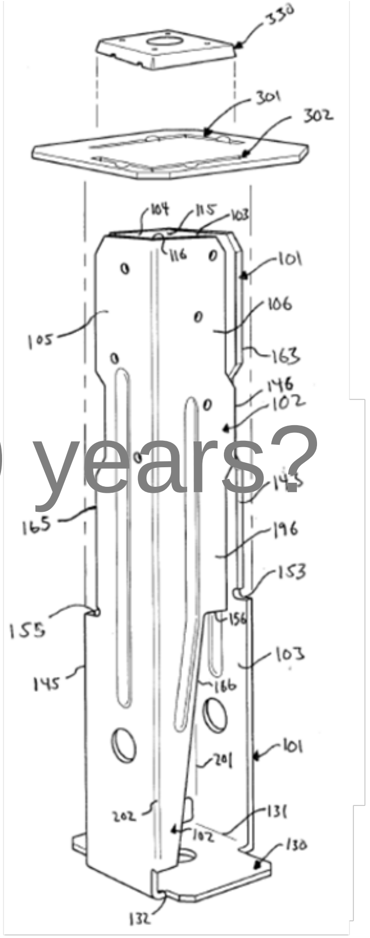


Moment Post Base History

What's been happening for the last 20 years?

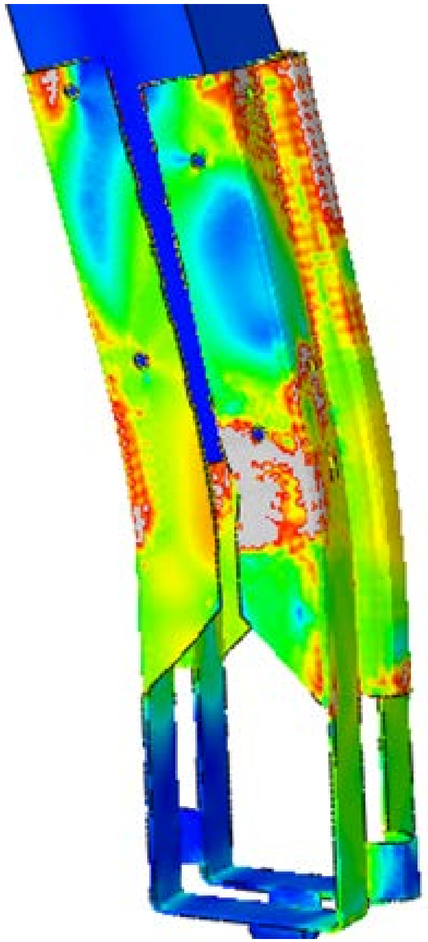
Prototype (1999)

Prototype (2001)

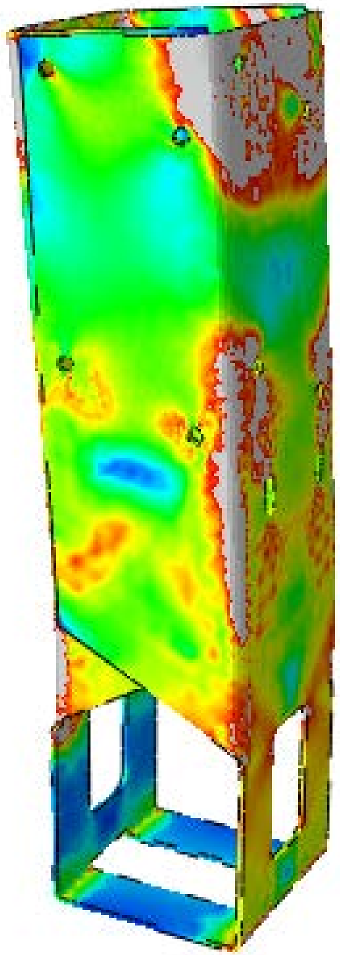


Prototype (2003)

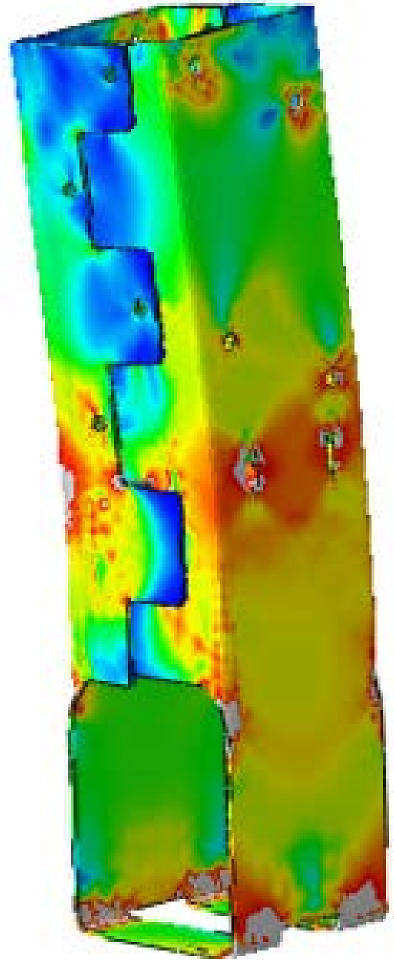
FEA Testing – Post Design



Spilt

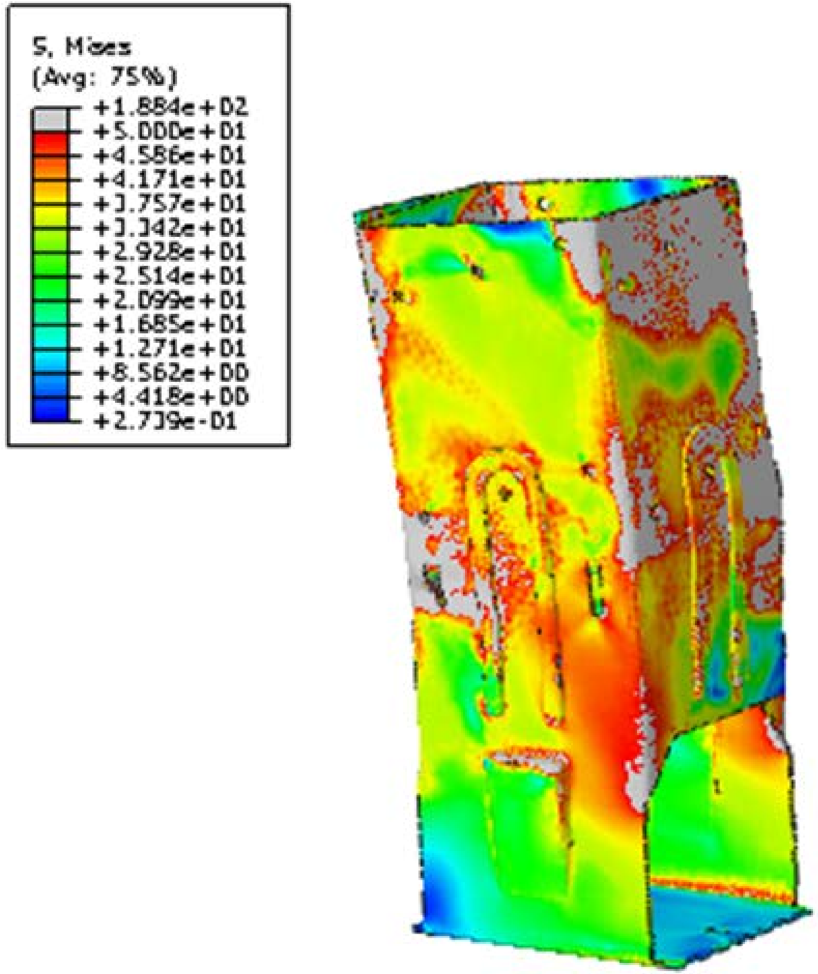


Full Overlap

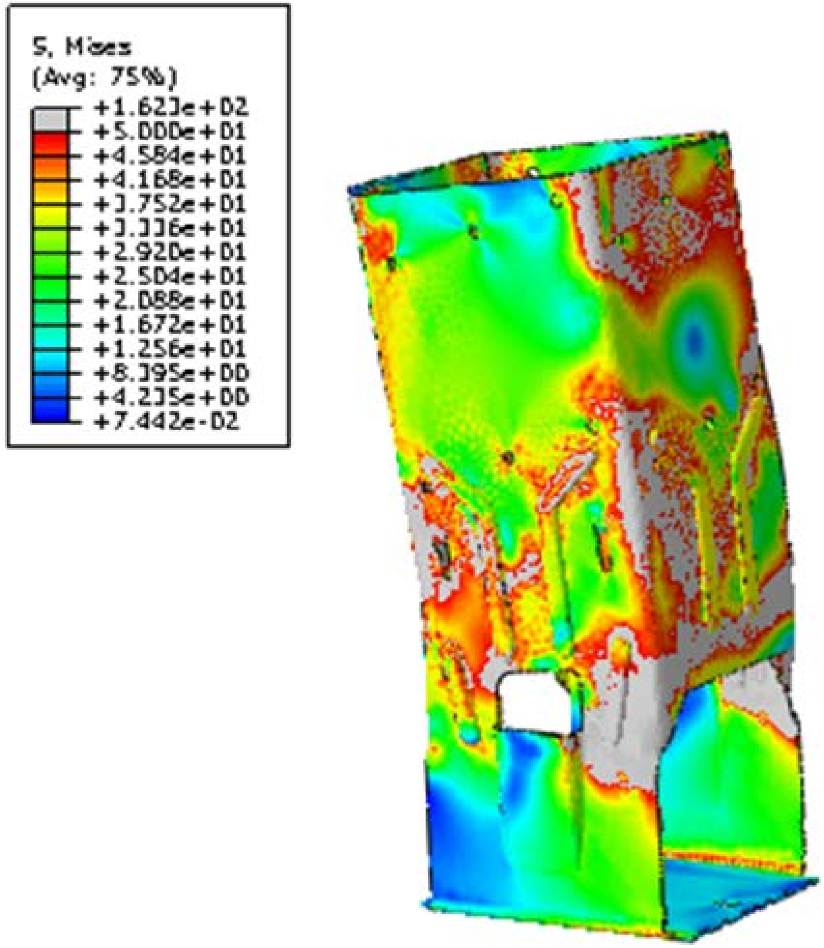


Cookie-Cut

FEA Testing - Embossments



Large Embossment



Flow Hole

FEA Testing - Embossments

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Large Embossment

Flow Hole

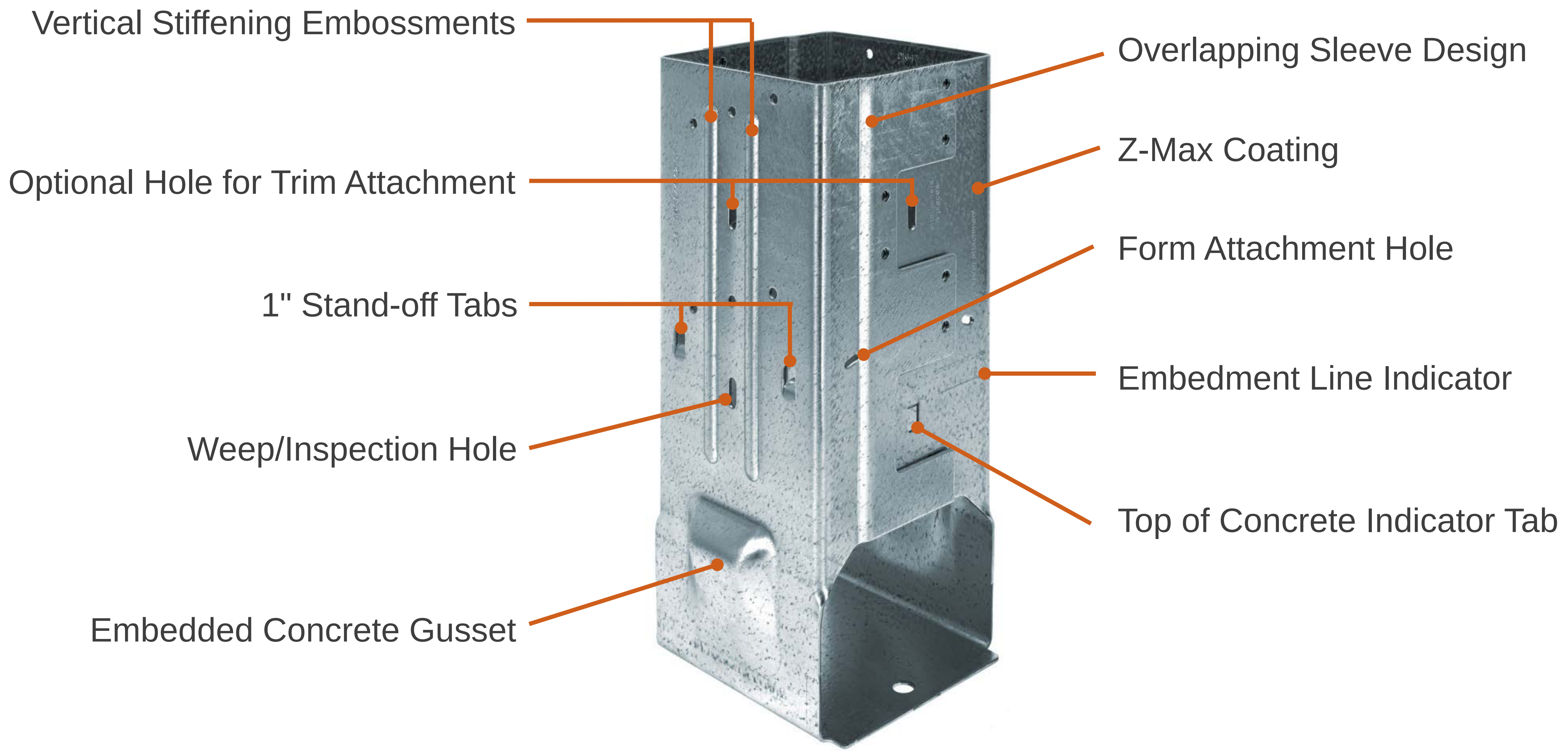
MPBZ Moment Post Base

MPB44Z - 2017

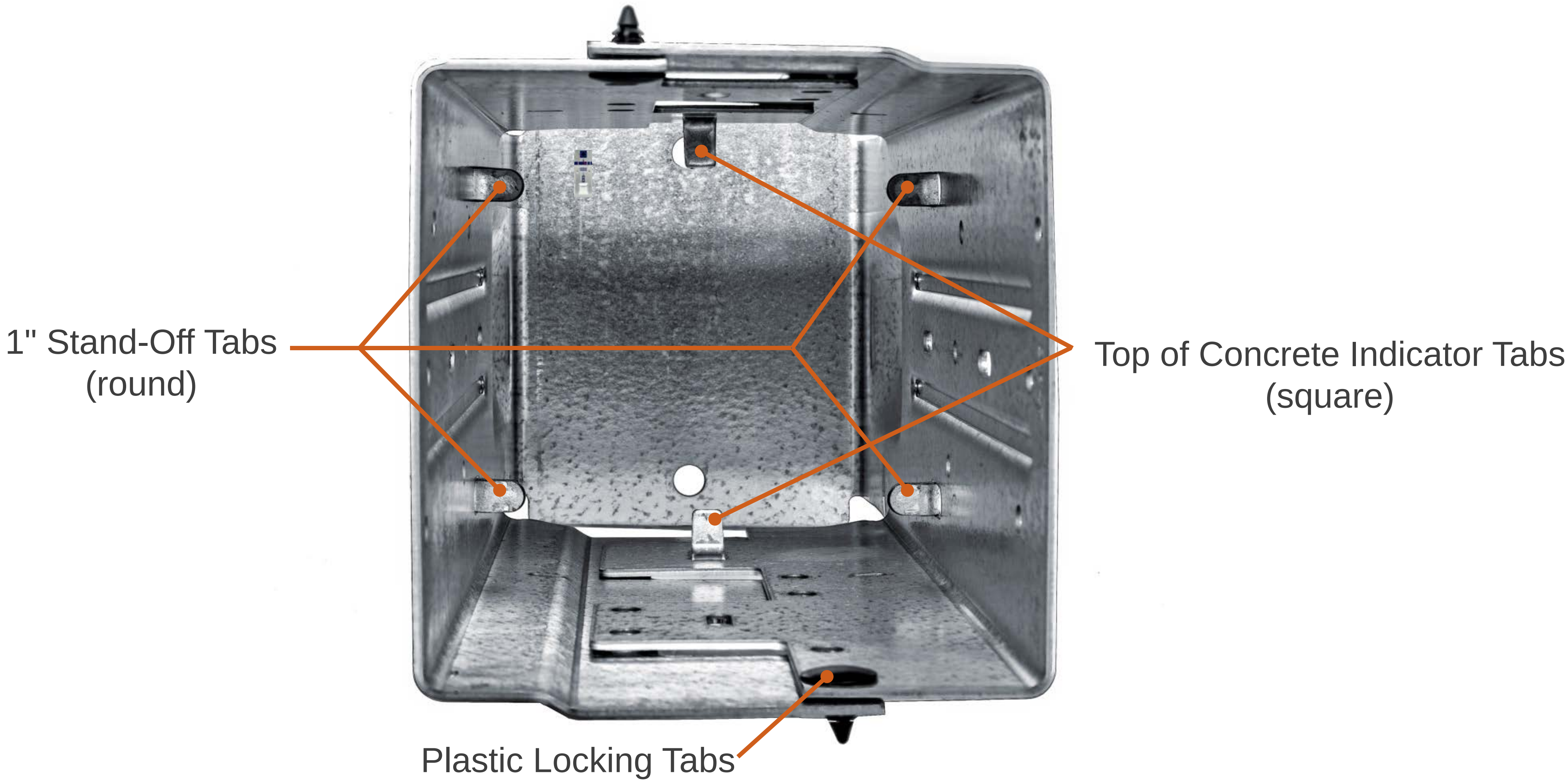
MPB66Z - 2017

MPB88Z - 2018

MPBZ Features and Benefits

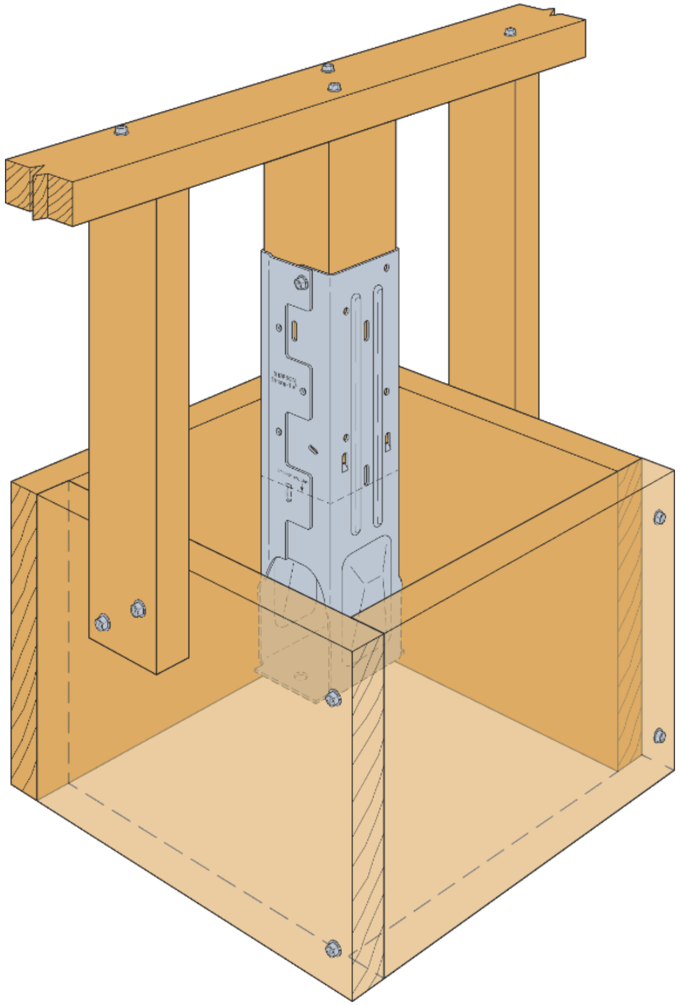


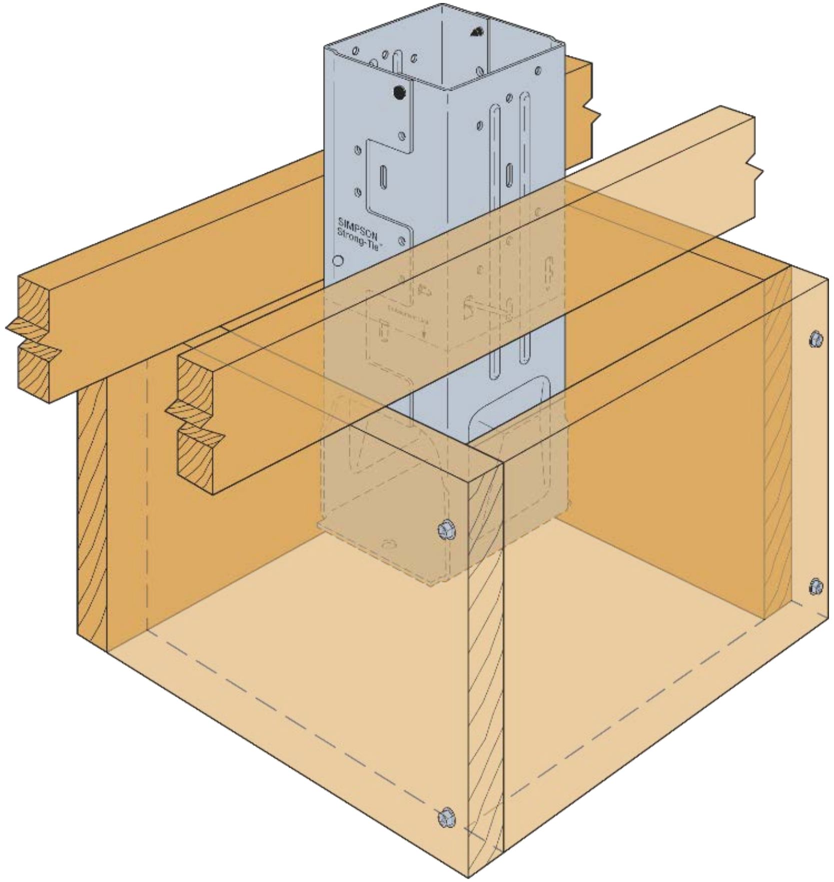
MPBZ Features and Benefits (Top View)



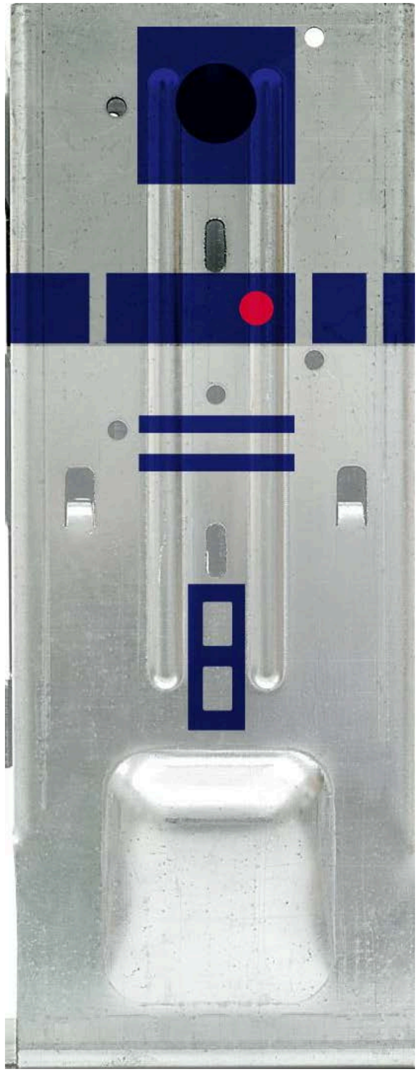
MPBZ Installation

MPBZ Installation





This isn’t the droid you are looking for



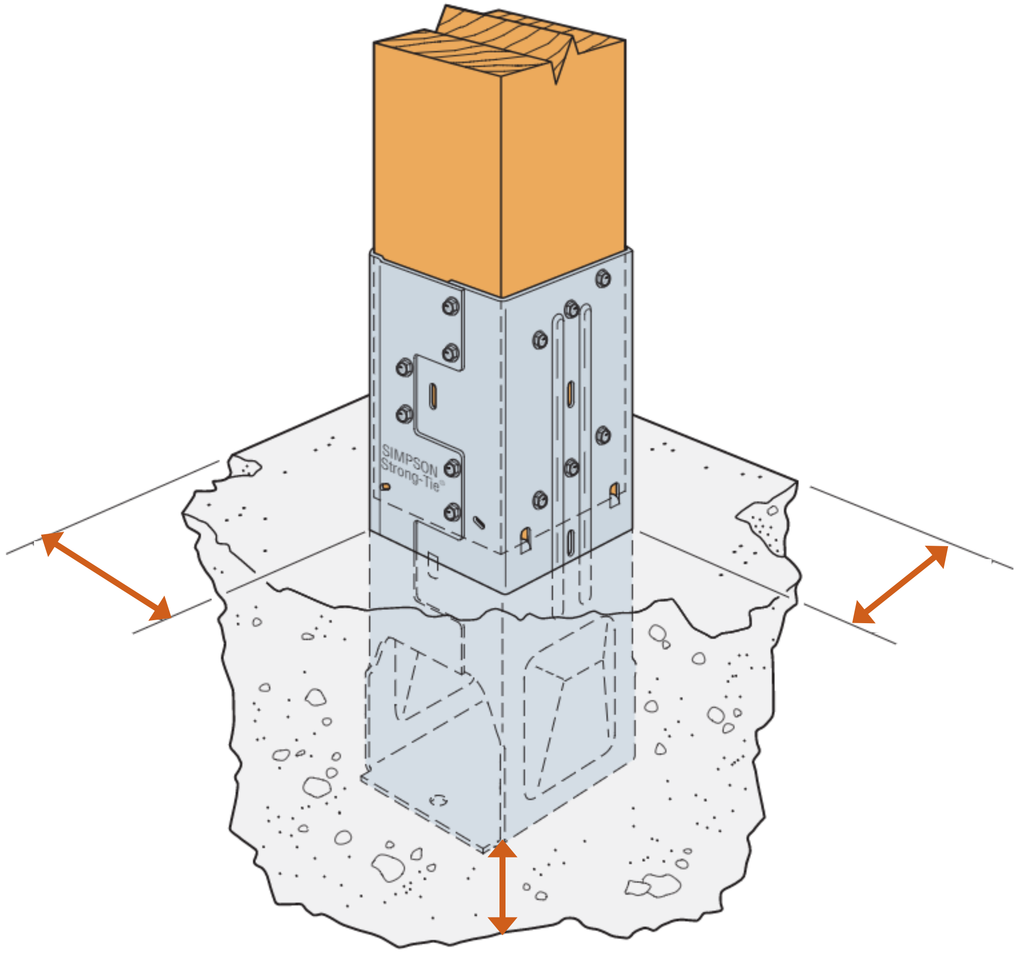
MPBZ Technical Information

Allowable Load Table

Model No.	Nominal Column Size	Dimensions (in.)			Simpson Strong-Tie SDS Screws	Concrete Allowable Loads						Wood Assembly Allowable Loads (DF/SP)			Rotational Stiffness K (in.-lb./rad.)
						Uplift (lb.)		Lateral F_1 (lb.)		Moment M (ft.-lb.)		Download (100) (lb.)	Download (160) (lb.)	Moment M (ft.-lb.) (160)	
		W_1 / W_2	D	H		Non-Cracked	Cracked	Non-Cracked	Cracked	Non-Cracked	Cracked				
						Wind and Seismic Design Category A&B									
MPB44Z	4x4	3 9/16	7¼	7¼	(16) ¼" x 2½"	4,900	3,990	1,825	1,280	1,410	985	6,240	6,410	1,540	2,510,000
MPB66Z	6x6	5 9/16	7¼	7¼	(24) ¼" x 2½"	5,815	5,815	3,545	2,480	2,800	1,960	9,360	10,855	3,730	3,950,000
						Seismic Design Category C–F									
MPB44Z	4x4	3 9/16	7¼	7¼	(16) ¼" x 2½"	4,785	3,350	1,535	1,075	1,180	830	6,240	6,410	1,540	2,510,000
MPB66Z	6x6	5 9/16	7¼	7¼	(24) ¼" x 2½"	5,815	5,815	2,980	2,085	2,055	1,645	9,360	10,855	3,730	3,950,000

MPBZ Technical Information

SIMPSON Strong-Tie



Minimum side cover

- **4"** for MPB44Z
- **5"** for MPB66Z

Minimum bottom cover

- **3"** minimum per ACI 318 for concrete exposure "cast against and permanently in contact with ground"

Code-Compliant Calculations

SIMPSON Strong-Tie®

Moment capacity – per recently updated AC398 (approved at June 2017 hearing)

$$M = \frac{\phi \text{ x } (F \text{ x } D) \text{ x } (1 - K \text{ x } COV) \text{ x } R_d \text{ x } R_{cr} \text{ x } (R_c \text{ or } R_s)}{\alpha}$$

ϕ = Strength reduction factor in accordance w/ ACI 318

K = Statistical constant

COV = Coefficient of variation of test results

R_d = Seismic Reduction factor

R_{cr} = Cracked concrete strength reduction factor

R_c = Concrete strength reduction factor

R_s = Steel strength reduction factor

α = Conversion factor from LRFD to ASD

Load Rating Moment

SIMPSON Strong-Tie®

Testing Criteria:

- AC 13 – Post to Base Connection
- AC398 – Post Base Anchorage

Model No.	Nominal Column Size	Dimensions (in.)			Simpson Strong-Tie SDS Screws	Limit States ASD Loads							
						M1				M2			
		W_1 / W_2	D	H		Non-Cracked	Assembly	Calculation (Wood)	Calculation (Steel)	Non-Cracked	Assembly	Calculation (Wood)	Calculation (Steel)
Wind and Seismic Design Category A& B													
MPB44Z	4x4	3 9/16	7 1/4	7 1/4	16	1408	1540	4363	4100	1804	1630	4363	3005
MPB66Z	6x6	5 9/16	7 1/4	7 1/4	24	2798	3730	7427	9620	3412	3770	7427	7310
Seismic Design Category C–F													
MPB44Z	4x4	3 9/16	7 1/4	7 1/4	16	1182	1540	4363	4100	1441	1630	4363	3005
MPB66Z	6x6	5 9/16	7 1/4	7 1/4	24	2055	3730	7427	9620	2437	3770	7427	7310

Code-Compliant Calculations

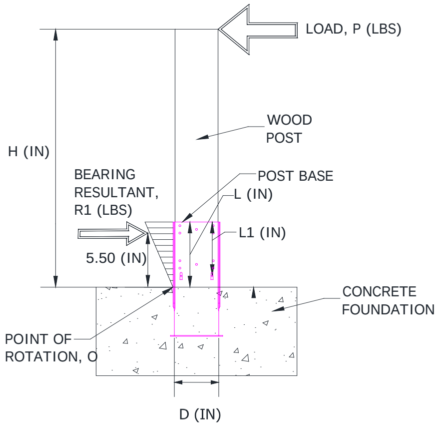
SIMPSON Strong-Tie®

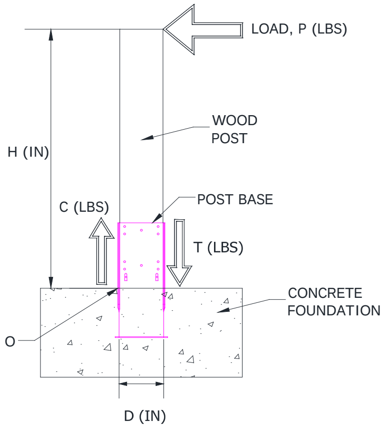
Calculations:

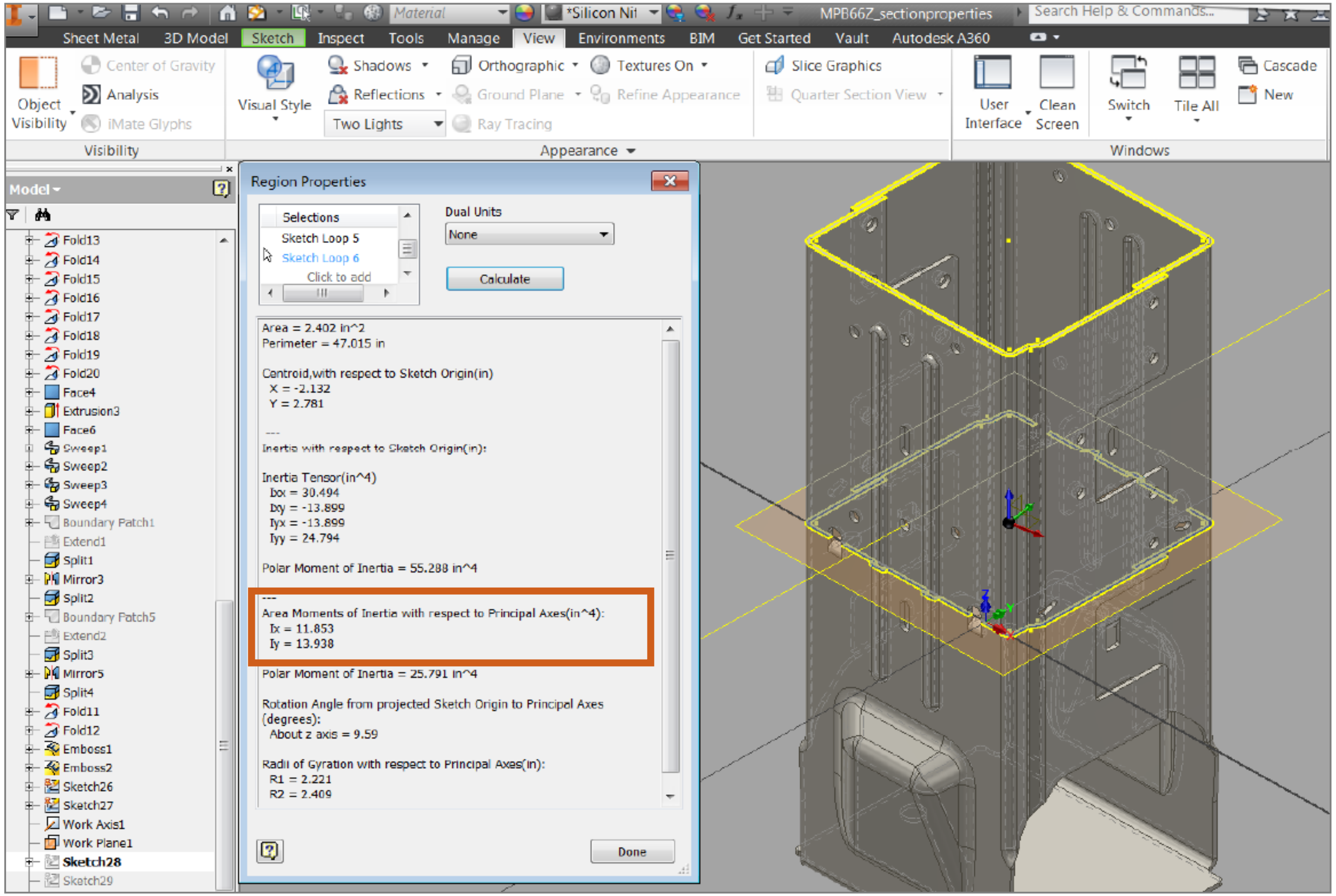
- NDS Fastener Calcs + F'c Perp.
- Moment of Steel Section

$$M_n = SF_y$$

$$M_a = \frac{M_n}{\Omega_b} \quad \Omega_b = 1.67$$

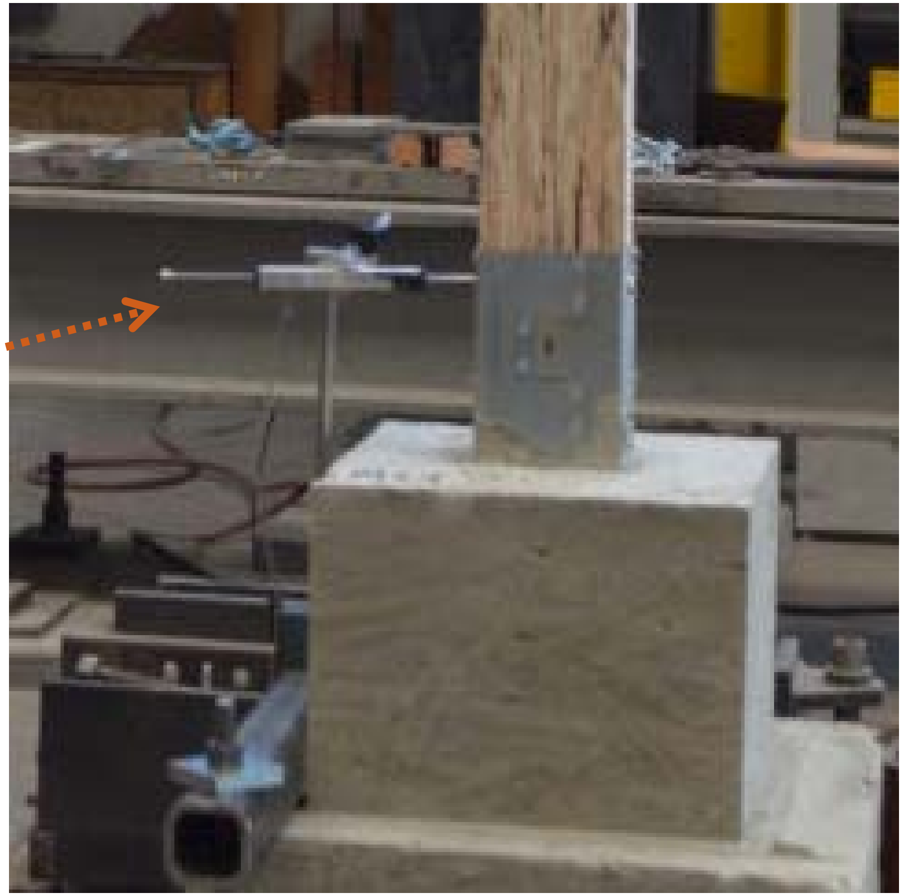






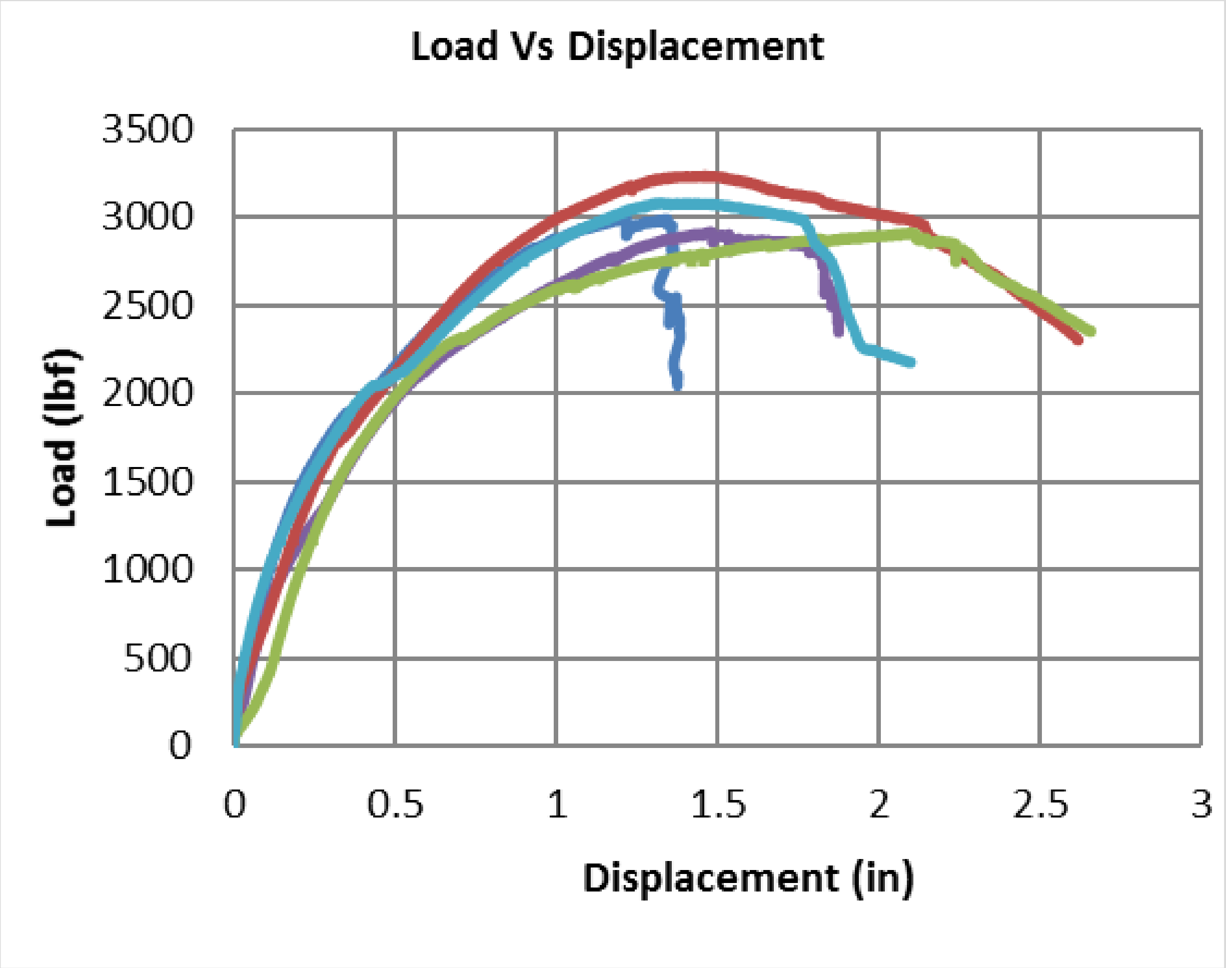
Test Verification – AC398


Test Setup


Deflection gauge

Test Verification – AC398

Failure

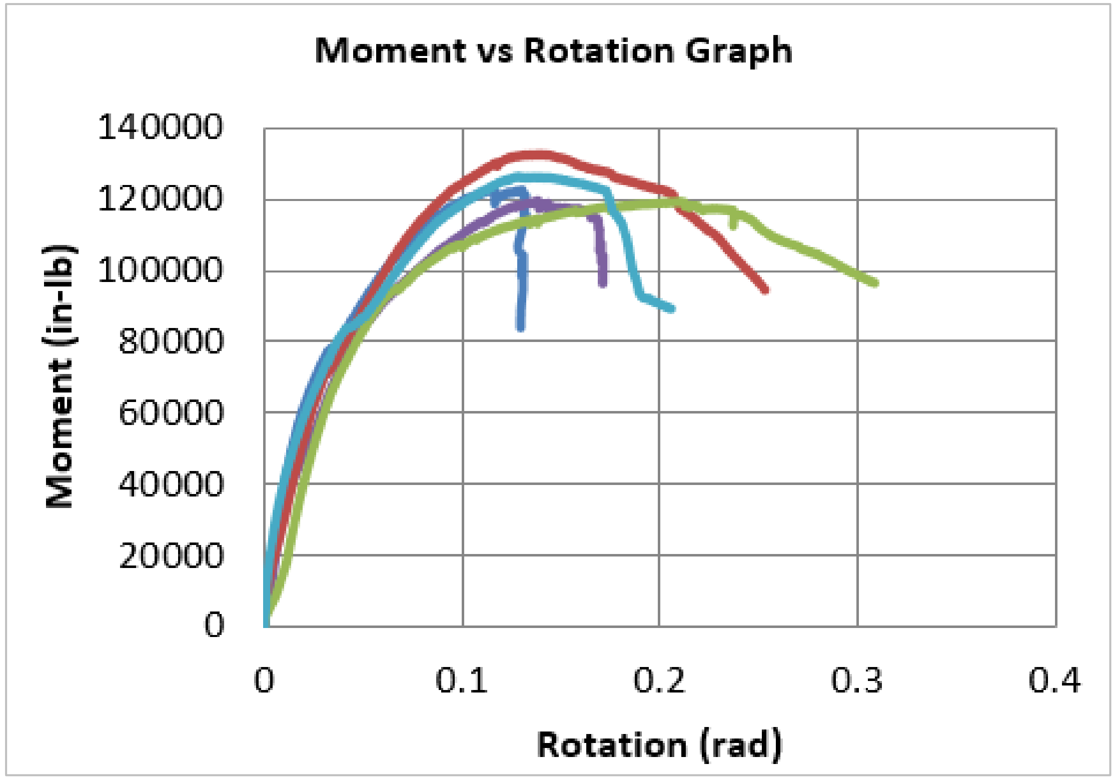


Test Verification – AC13

SIMPSON Strong-Tie

Test Setup – M1

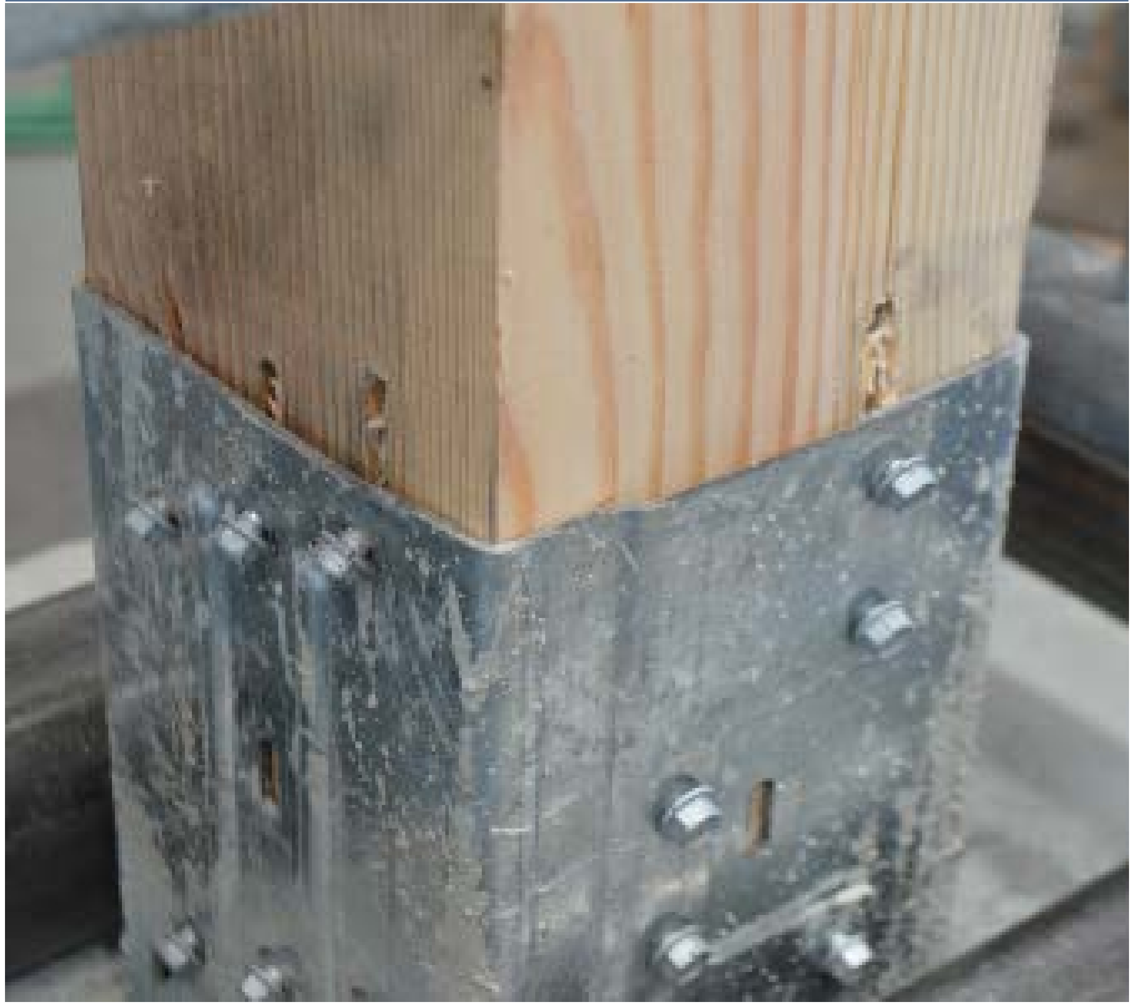
Failure



Test Verification – Download

Test Setup	Failure
	

Test Verification – Uplift – AC13

Test Setup	Failure
	

Test Verification – AC398 Uplift Test

Test Setup

Failure

Test Verification – AC398 Lateral Test

SIMPSON Strong-Tie

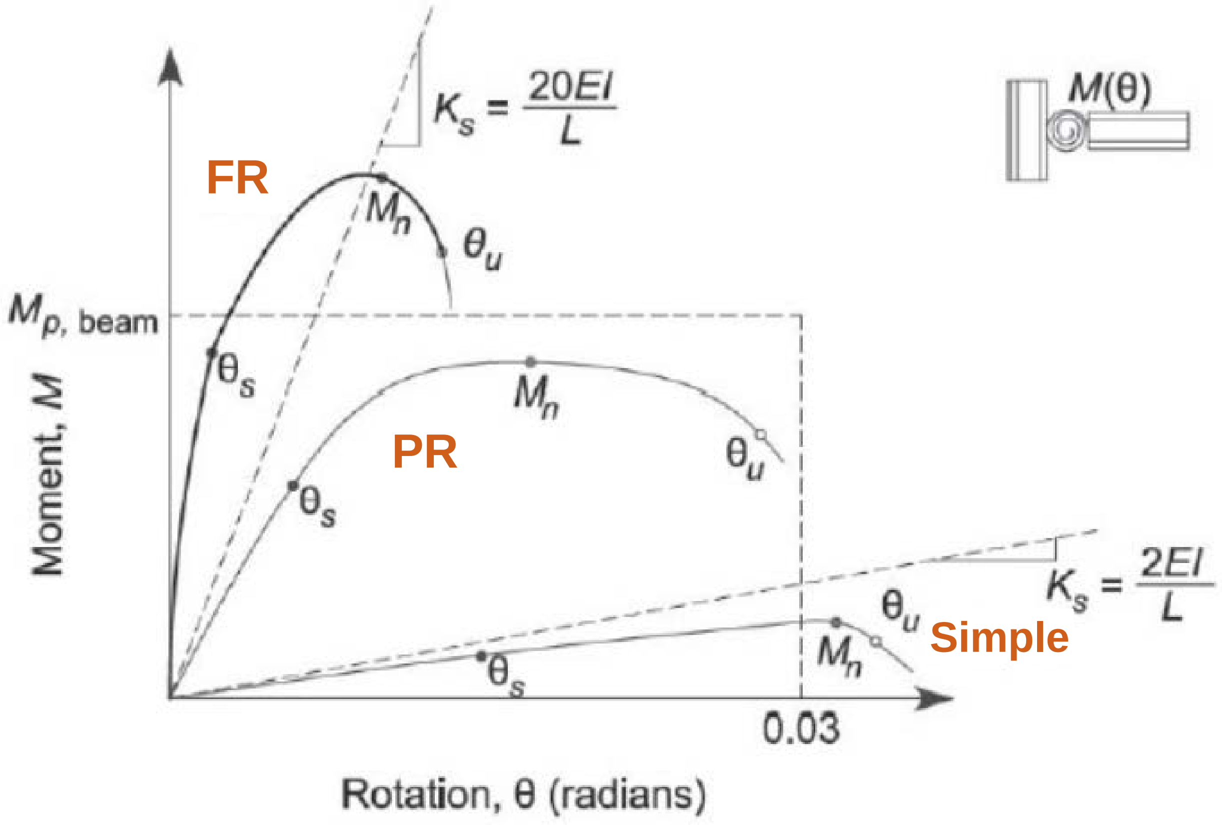
Test Setup

Failure

POLL QUESTION

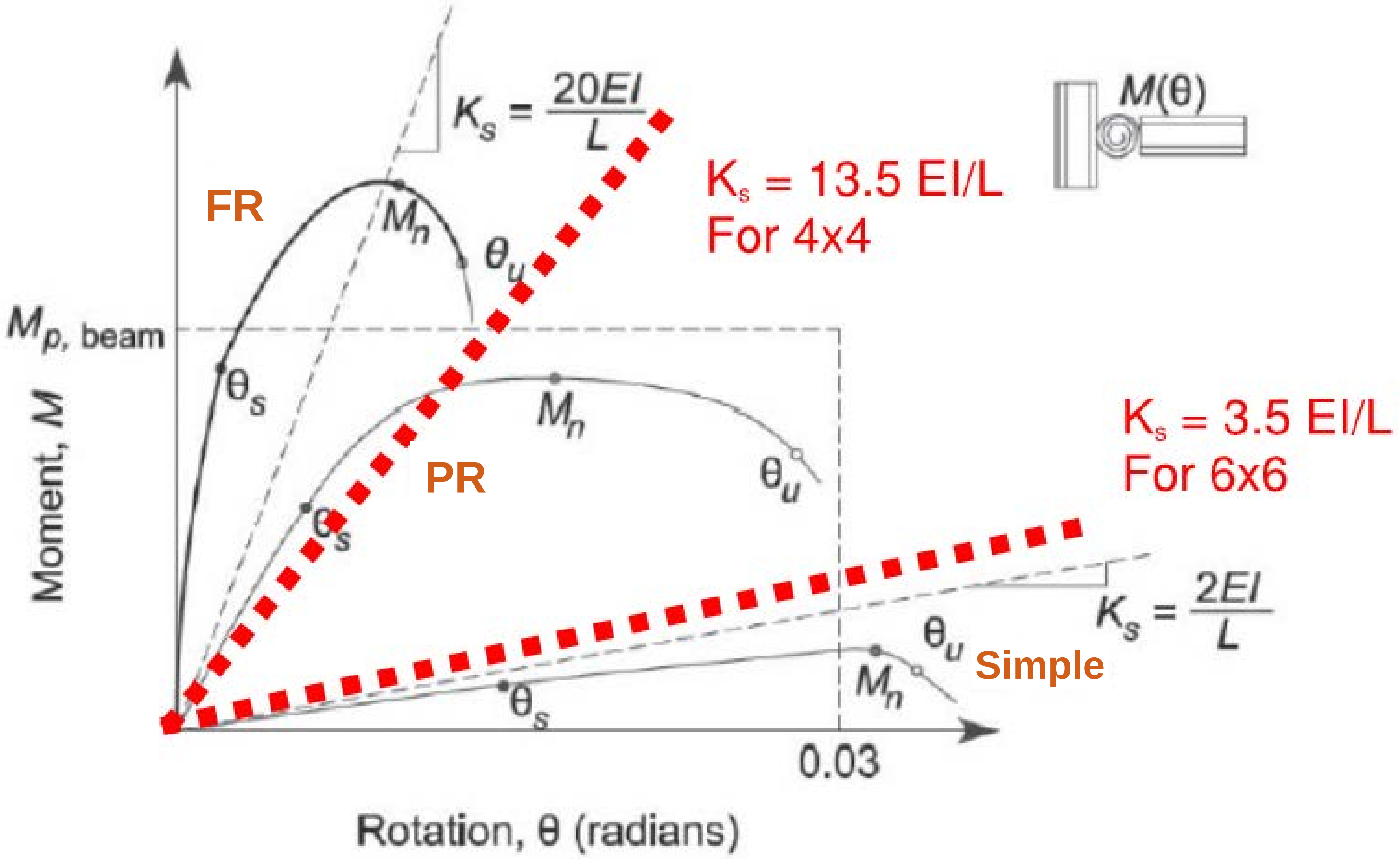
How would you classify a connection that utilizes MPBZ moment post base?

a) Fully Restrained (FR)
b) Partially Restrained (PR)
c) Simple Connection



Answer: Partially Restrained (PR)

Connections that utilize the MPBZ moment post base are classified as Partially Restrained (PR) .



Rotational Stiffness

$M = F \times D$

Δ_t = Total deflection

$= \{FD^3/3EI\} + \{Mh/K\}$

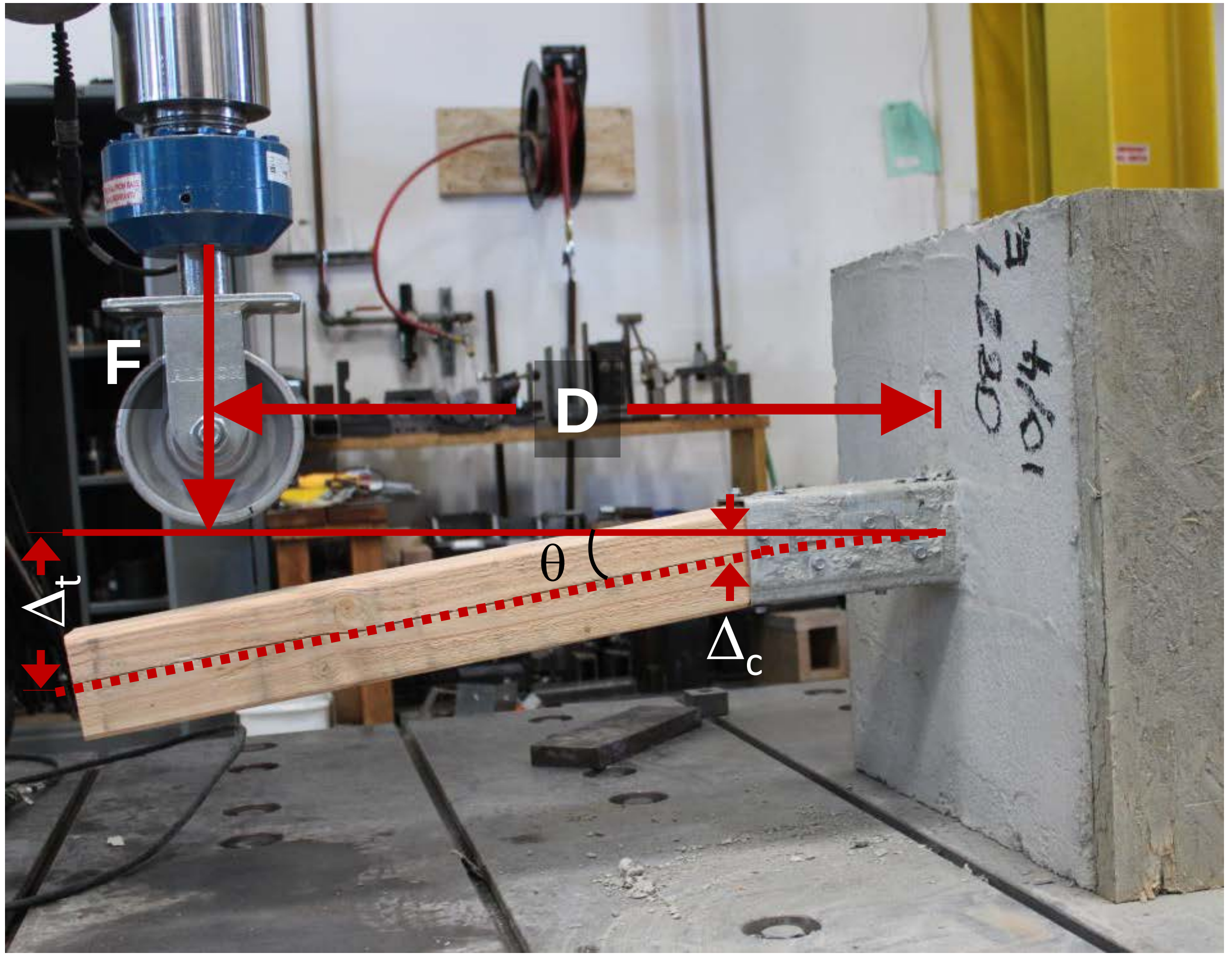
K = Rotational stiffness of connector (in-lb/rad)

$= M/\theta$

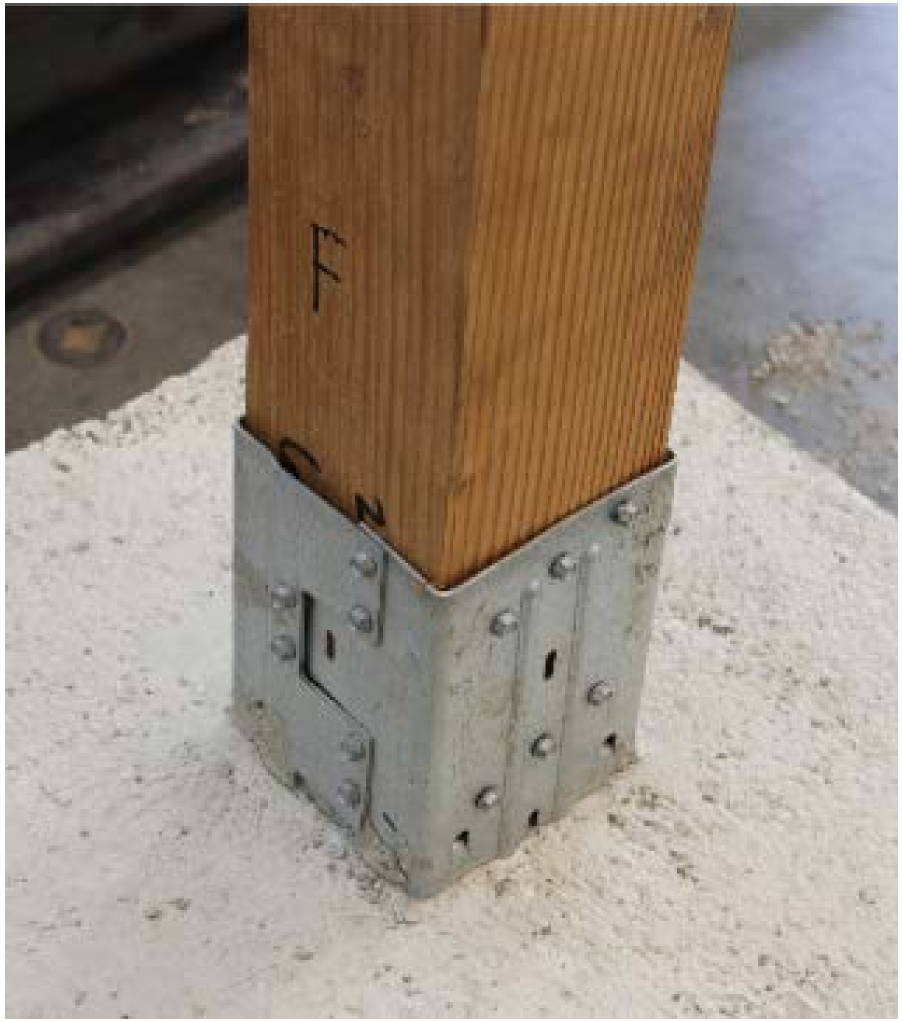
θ = Connector rotation (radians)

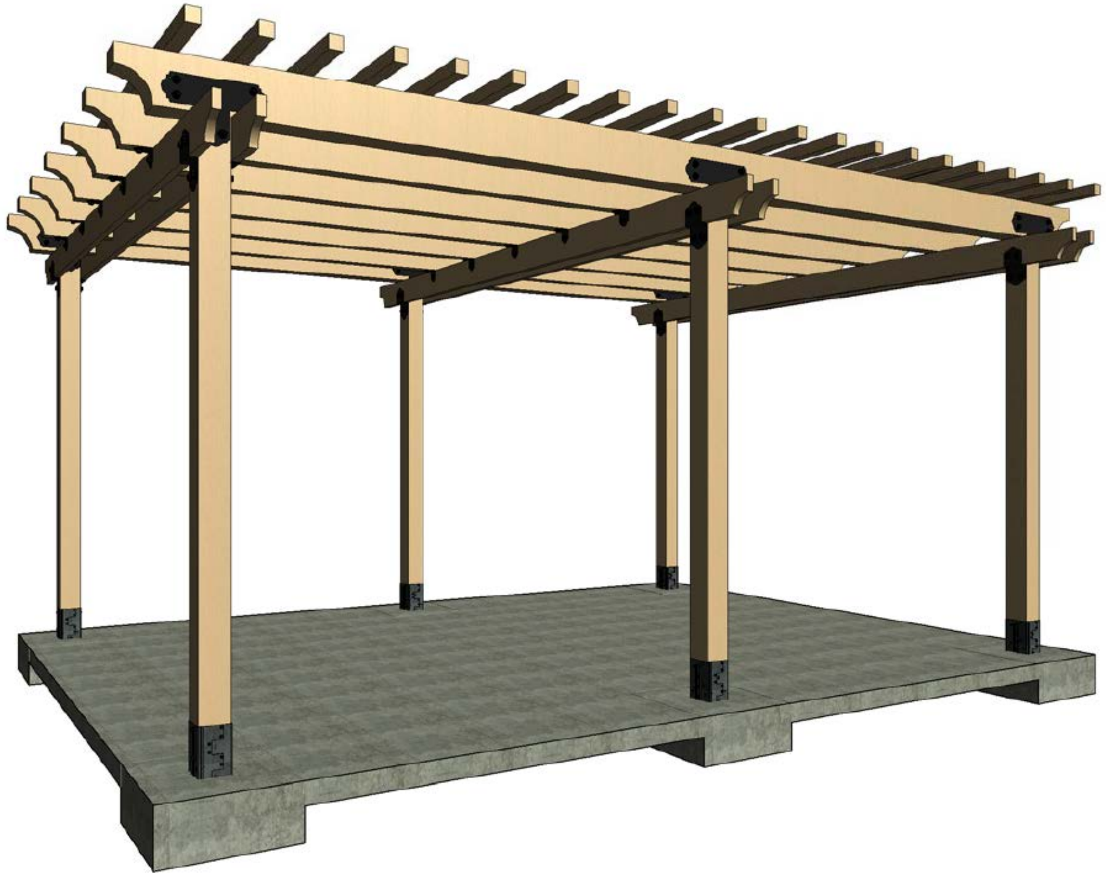
$= \Delta_c / h_c$

h_c = Height where displacement is measured (in)



Wood Shrinkage





MPBZ

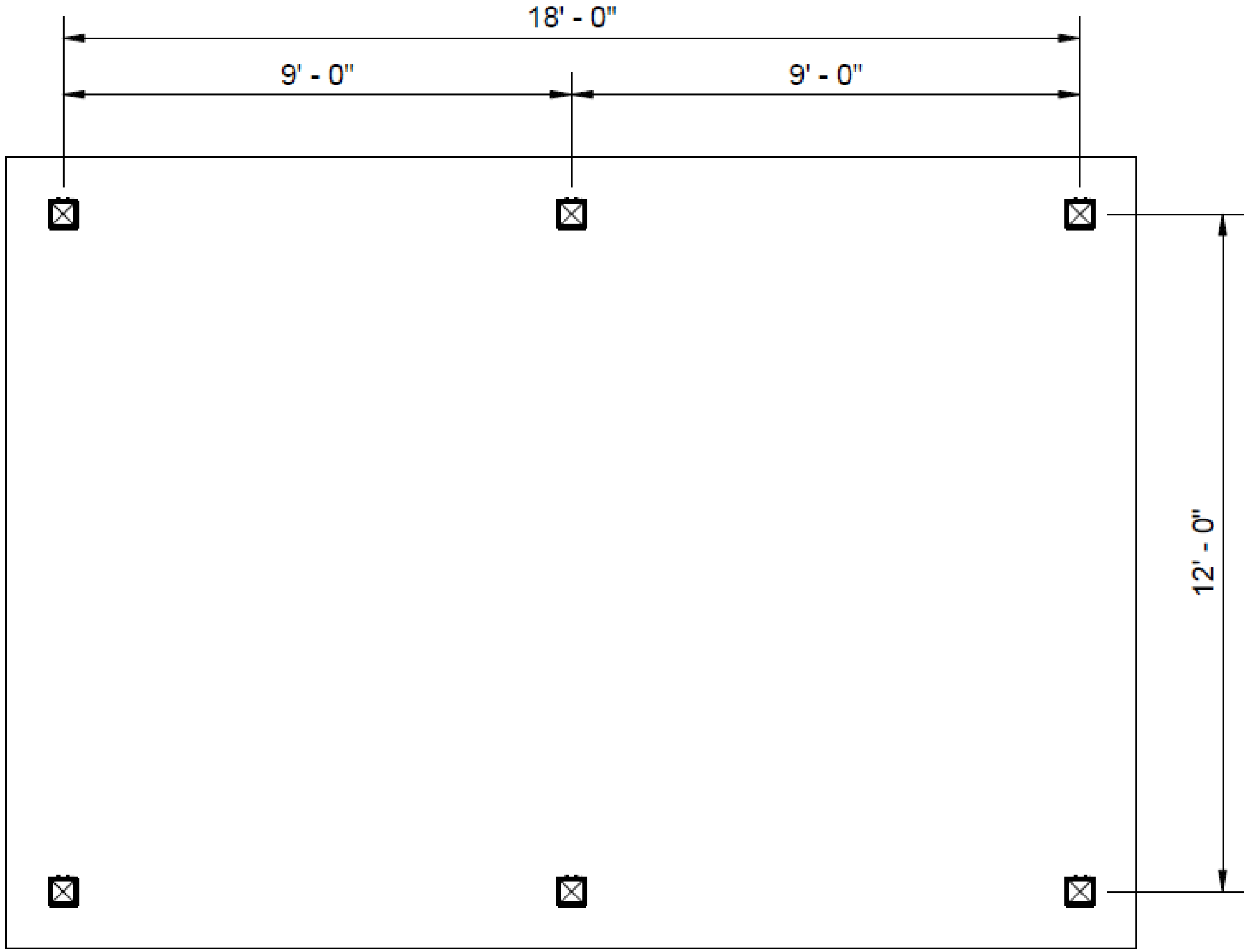
Pergola Design Example

MPBZ Design Example

Loading	
Beams	4.5 psf
Purlins	2.5 psf
Misc	1.0 psf
Total	**8.0 psf**

Dimensions	
Depth	18 ft
Width	12 ft
Height	9 ft (column height)

Column Weight	8 plf
Total Columns	6



MPBZ Design Example

ASCE 7-10

12.8 EQUIVALENT LATERAL FORCE PROCEDURE

12.8.1 Seismic Base Shear

The seismic base shear, V, in a given direction shall be determined in accordance with the following equation:

$$V = C_s W \quad (12.8\text{-}1)$$

where

C_s = the seismic response coefficient determined in accordance with Section 12.8.1.1

W = the effective seismic weight per Section 12.7.2

12.8.1.1 Calculation of Seismic Response Coeff cient

The seismic response coefficient, C_s, shall be determined in accordance with Eq. 12.8-2.

$$C_s = \frac{S_{DS}}{\left(\frac{R}{I_e}\right)} \quad (12.8\text{-}2)$$

where

S_{DS} = the design spectral response acceleration parameter in the short period range as determined from Section 11.4.4 or 11.4.7

R = the response modification factor in Table 12.2-1

I_e = the importance factor determined in accordance with Section 11.5.1

The value of C_s computed in accordance with Eq. 12.8-2 need not exceed the following:

$$C_s = \frac{S_{D1}}{T\left(\frac{R}{I_e}\right)} \quad \text{for} \quad T \le T_L \quad (12.8\text{-}3)$$

$$C_s = \frac{S_{D1} T_L}{T^2\left(\frac{R}{I_e}\right)} \quad \text{for} \quad T > T_L \quad (12.8\text{-}4)$$

MPBZ Design Example

SIMPSON Strong-Tie

Seismic Weight

W = 8.0 psf x 18 ft x 12 ft + 9/2 ft x 8 plf x 6

W = 1,944 lbs

Seismic Base Shear

V = C_sW (ASCE 7-10 Eq 12.8-1)

$$C_s = \frac{S_{DS}}{R/I_e}$$

(ASCE 7-10 Eq 12.8-2)

Note: Maximums C_s per Eq 12.8-3 & 12.8-4 do not govern

S_{DS} = 1.008 g Livermore, CA Site Class D, Risk Category I

I_e = 1 Importance Factor

R = 1.5

C_d = 1.5

Ω_o = 1.5

ASCE 7-10 Table 12.2-1 Cantilever Columns, Timber Frames

V = C_sW

V = 1.008 /1.5 x W

0.672 x 1,944

1,305 lbs LRFD Base Shear

V_{ASD} = 915 lbs ASD Base Shear

MPBZ Design Example

Column Loads		
P =	8.0 psf DL 20 psf LL	x 9-ft tributary x 12-ft span / 2
P =	432 lb DL 1080 lb LL	
V =	915 lb / 6 columns 152.5 lbs	ASD Design Force
M =	9 ft x 152.5 lb/col 1,375 ft-lb	

MPBZ Design Example

Model No.	Nominal Column Size	Dimensions (in.)			Simpson Strong-Tie SDS Screws	Concrete Allowable Loads						Wood Assembly Allowable Loads (DF/SP)			Rotational Stiffness K (in.-lb./rad.)
						Uplift (lb.)		Lateral F_1 (lb.)		Moment M (ft.-lb.)		Download (100) (lb.)	Download (160) (lb.)	Moment M (ft.-lb.) (160)	
		W_1 / W_2	D	H		Non-Cracked	Cracked	Non-Cracked	Cracked	Non-Cracked	Cracked				
Wind and Seismic Design Category A&B															
MPB44Z	4x4	3 9/16	7 1/4	7 1/4	(16) 1/4" x 2 1/2"	4,900	3,990	1,825	1,280	1,410	985	6,240	6,410	1,540	2,510,000
MPB66Z	6x6	5 9/16	7 1/4	7 1/4	(24) 1/4" x 2 1/2"	5,815	5,815	3,545	2,480	2,800	1,960	9,360	10,855	3,730	3,950,000
Seismic Design Category C–F															
MPB44Z	4x4	3 9/16	7 1/4	7 1/4	(16) 1/4" x 2 1/2"	4,785	3,350	1,535	1,075	1,180	830	6,240	6,410	1,540	2,510,000
MPB66Z	6x6	5 9/16	7 1/4	7 1/4	(24) 1/4" x 2 1/2"	5,815	5,815	2,980	2,085	2,055	1,645	9,360	10,855	3,730	3,950,000

MPBZ Design Example

MPBZ66Z Design Loads	
Seismic Design Category D-F	
Cracked Concrete	
P_{allow} =	9,360 lb (C_d = 1.00)
	10,855 lb (C_d = 1.60)
V_{allow} =	2,085 lb
M_{allow} =	1,645 ft-lb

Interaction Ratio

$P / P_{allow} + V / V_{allow} + M / M_{allow} < \mathbf{1.0}$

432 / 10,855 + 152.5 / 2,085 + 1,375 / 1,645

0.04 + 0.073 + 0.836

0.949 < 1.0 ✓

MPBZ Design Example

SIMPSON Strong-Tie

Deflection Evaluation

Deflection = Post Bending Deflection + Top of Post Deflection Due to Rotation about the base

$\Delta_{bending} = \frac{Fh^3}{3EI}$

F = 152.5 lbs
h = 9 ft
E = 1,600,000 psi
I = 76.26 in^4

$\Delta_{bending} =$ **0.525 in**

$\Delta_{rotation} = (M / K) \times h$

M = 1,375 ft-lb
K = 3,950,000 in-lb/radian

1,375 ft-lb (x12) / 3,950,000 in-lb/radian x 9 ft x 12-in/ft

0.451 in

$\Delta_{total} = \Delta_{bending} + \Delta_{rotation}$

0.525 in + 0.451 in

0.976 inches

$\Delta =$ (0.976 / 0.70) x C_d — $C_d = 1.5$

2.09 in — Amplified Deflection at LRFD Level

$\Delta_{allow} =$ 0.02 x h_x — $h_x = h = 9$ ft

2.16

2.09 in < 2.16 in ✓

12.8.7 P-Delta Effects

P-delta effects on story shears and moments, the resulting member forces and moments, and the story drifts induced by these effects are not required to be considered where the stability coefficient (θ) as determined by the following equation is equal to or less than 0.10:

$$\theta = \frac{P_x \Delta I_e}{V_x h_{sx} C_d} \quad (12.8\text{-}16)$$

where

P_x = the total vertical design load at and above Level x (kip or kN); where computing P_x, no individual load factor need exceed 1.0

Δ = the design story drift as defined in Section 12.8.6 occurring simultaneously with V_x (in. or mm)

I_e = the importance factor determined in accordance with Section 11.5.1

V_x = the seismic shear force acting between Levels x and $x-1$ (kip or kN)

h_{sx} = the story height below Level x (in. or mm)

C_d = the deflection amplification factor in Table 12.2-1

MPBZ Design Example

SIMPSON Strong-Tie

Check P-Δ Effects

$$\theta = \frac{P\Delta I_e}{V_x h_{sx} C_d}$$

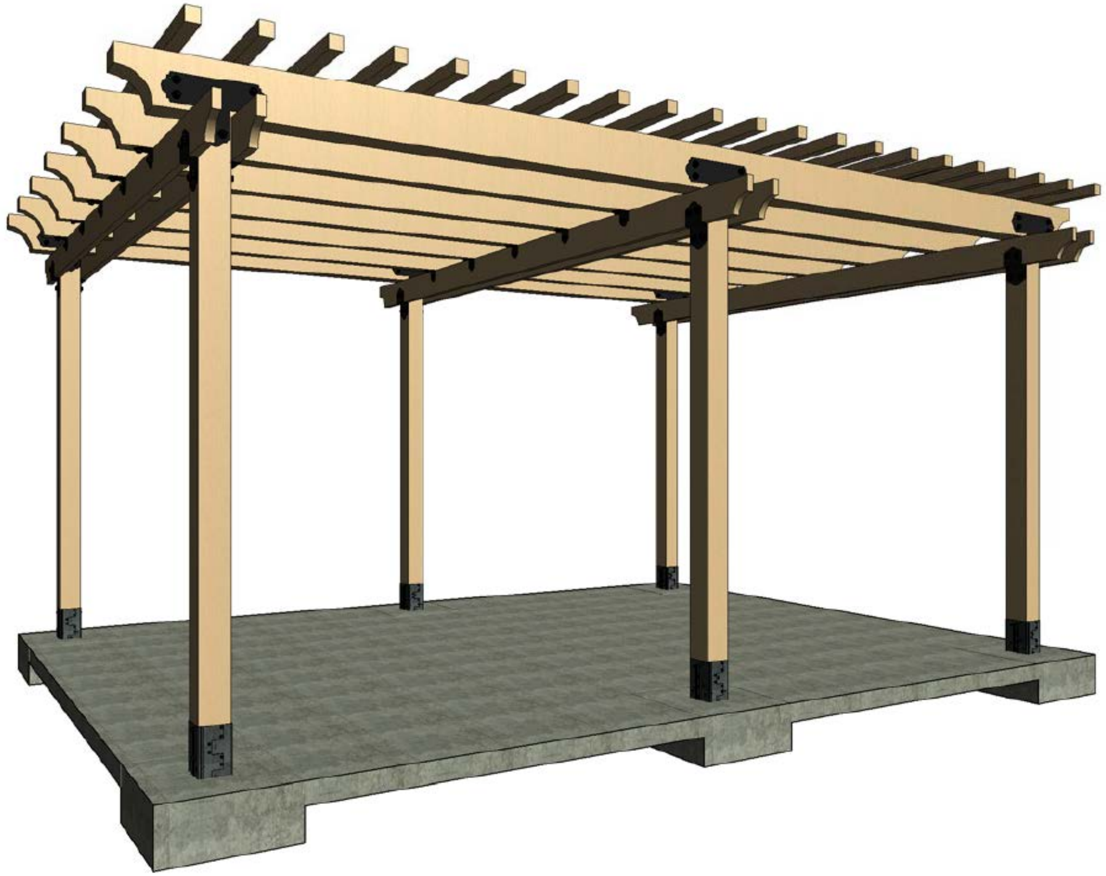
ASCE 12.8.7 Eq 12.8-6

P	=	1,944 lb total vertical load above the level
Δ	=	2.09 in
I_e	=	1 Importance Factor
V_x	=	1,305 lb (LRFD)
h_{sx}	=	9 ft
C_d	=	1.5

$$\theta = \frac{1{,}944 \times 2.09 \times 1}{1{,}305 \times 9 \times 12 \times 1.5}$$

$$\theta = \mathbf{0.019 < 0.1}$$ ✓

So P-Δ check not required



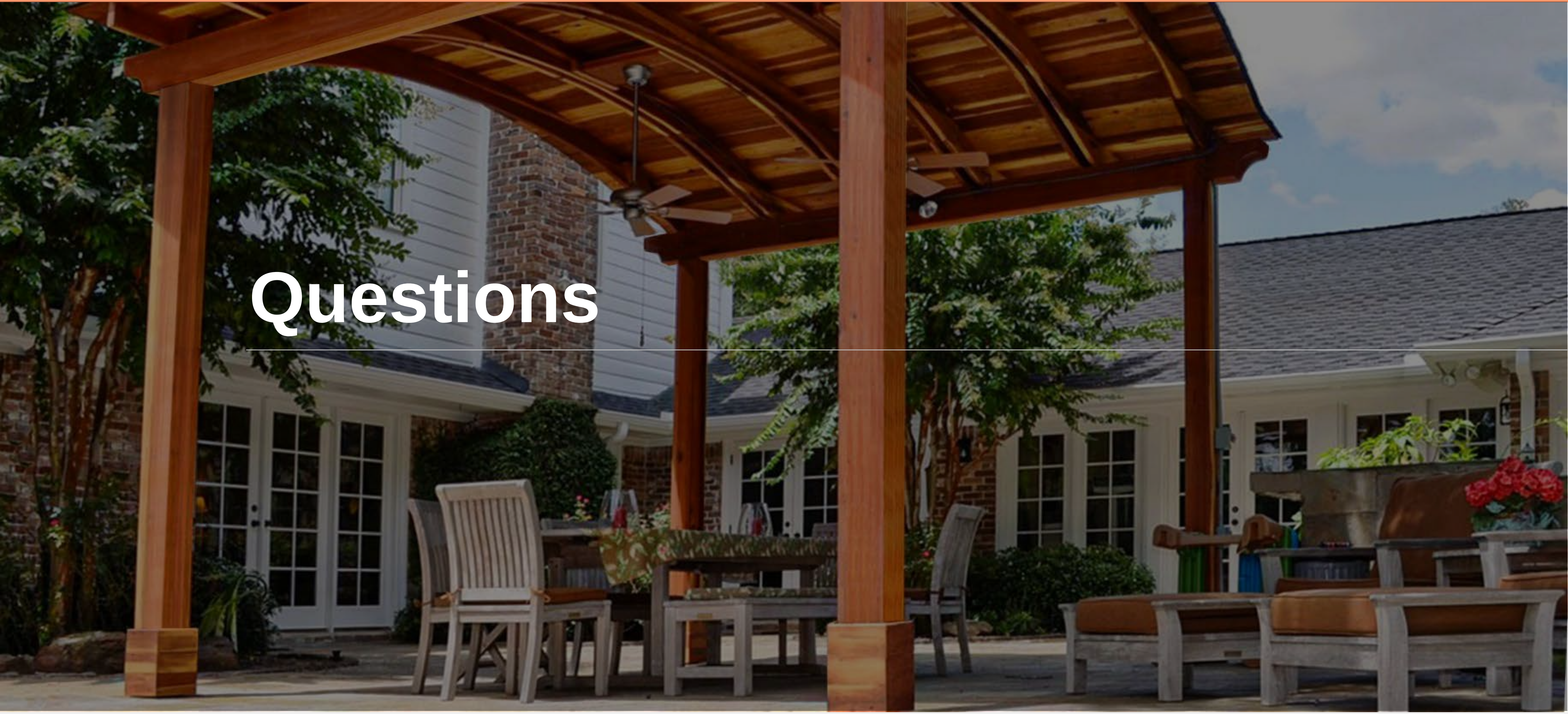
Are you ready to use MPBZ on your next project?

More Information

1. Download the MPBZ informational flier from the Resources panel

2. Get the 2017 Wood Construction Connectors catalog, and more technical info at strongtie.com/mpbz

3. Fill out your webinar survey evaluation and let us know if you'd like to have your local Simpson Strong-Tie representative help you find solutions for your next project.



Questions