

Evaluation of connection in two-story X-brace configuration of Ordinary Concentrically Braced Frame (OCBF) - CBFEM

Strength of Elements in Compression

The available strength of connecting elements in compression for the limit states of yielding and buckling shall be determined as follows:

(a) When $KL/r \leq 25$

$$P_n = F_y A_g$$

$$\phi = 0.90 \text{ (LRFD)} \quad \Omega = 1.67 \text{ (ASD)}$$

(b) When $KL/r > 25$, the provisions of Chapter E apply.



(J4-6)

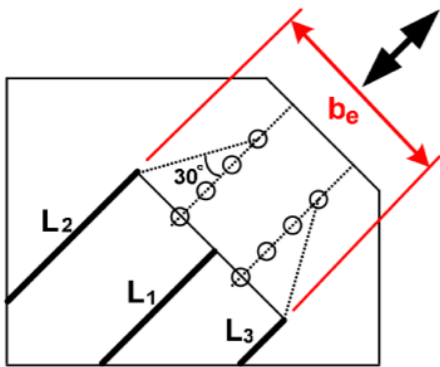


Figure 2.4-2: Gusset plate diagram indicating Thornton lengths (Tsai and Hsiao 2008)

B

Check of gusset plate for buckling at the Whitmore section

1. Evaluation of buckling according to AISC (AISC 360-16)

Global

Steel Fy	AISC Method	Critical buckling factor
36 ksi	LRFD	$\alpha_{cr} > 12.7$
50 ksi	LRFD	$\alpha_{cr} > 9.16$
36 ksi	ASD	$\alpha_{cr} > 21$
50 ksi	ASD	$\alpha_{cr} > 15$

Local

AISC Method	Critical buckling factor
LRFD	$\alpha_{cr} > 3$ – Member plates $\alpha_{cr} > 4$ – Connection plates (i.e. bracket plates)
ASD	$\alpha_{cr} > 4.5$ – Member plates $\alpha_{cr} > 6$ – Connection plates (i.e. bracket plates)

Slenderness limit ratio for non slender connecting plates $\frac{L_c}{r} = 25$

$$F_e = \frac{\pi^2 E}{(L_c/r)^2} = \frac{\pi^2 (29,000 \text{ ksi})}{(25)^2} = 458 \text{ ksi}$$

$$\alpha_{cr} = \frac{F_e}{F_y} = \frac{458}{36} = 12.7$$

12

2. Evaluation of Buckling in IDEA StatiCa Connection (Linear Buckling Analysis)



a. One Side Restraint/connected

a. Global Buckling (Global Limit factors applies)

Critical Buckling factor in CBFEM more than recommended global limit factor by AISC

Critical Buckling factor in CBFEM less than recommended global limit factor by AISC

Connection is safe for buckling

Ways to increase the buckling factor in CBFEM or AISC

1. Increase gusset plate thickness or
2. Stiffen the members in connection with stiffeners or / and doubler plates.

b. Two / Three sides restrained or connected

b. Local Buckling (Local Limit factors applies)

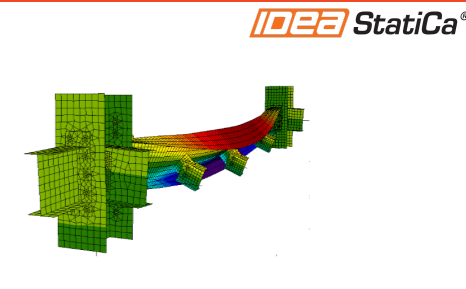
Critical Buckling factor in CBFEM more than recommended local limit factor by AISC

Critical Buckling factor in CBFEM less than recommended local limit factor by AISC

Connection is safe for buckling

Issue with buckling of local member plate or in thin walled / hollow section members

Use IDEA StatiCa Member [Non-Linear Buckling Analysis]



Local buckling of joint

Loads	Shape	Factor
> Design Loads	1	4.43
	2	4.48
	3	7.65

