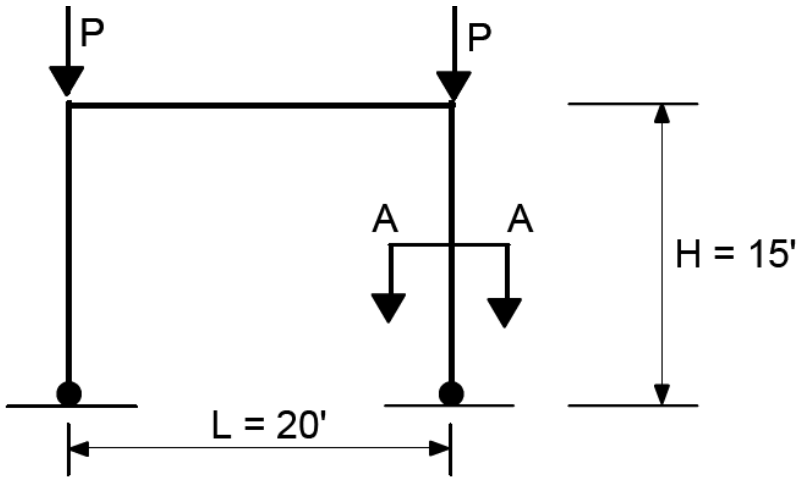
AISC ASD-89 Example 002

WIDE FLANGE MEMBER UNDER COMPRESSION

EXAMPLE DESCRIPTION

The column design features for the AISC ASD-89 code are checked for the frame shown below. This frame is presented in the *Allowable Stress Design Manual of Steel Construction*, Ninth Edition, 1989, Example 3, Pages 3-6 and 3-7. The column *K* factors were overwritten to a value of 2.13 to match the example. The transverse direction was assumed to be continuously supported. Two point loads of 560 kips are applied at the tops of each column. The ratio of allow axial stress, F_a, to the actual, f_a, was checked and compared to the referenced design code.

GEOMETRY, PROPERTIES AND LOADING



Member Properties	Loading	Geometry
W12X120	P = 560 kips (D)+(L)	Span, L = 20 ft
F_y = 50 ksi		Height, H = 15 ft
E = 29000 ksi		

TECHNICAL FEATURES TESTED

- Section compactness check (compression)
- Member compression capacity

RESULTS COMPARISON

Independent results are taken from *Allowable Stress Design Manual of Steel Construction*, Ninth Edition, 1989, Example 3, Pages 3-6 and 3-7.

Output Parameter	ETABS	Independent	Percent Difference
Compactness	Compact	Compact	0.00%
Design Axial Stress, f_a (ksi)	15.86	15.86	0.00%
Allowable Axial Stress, F_a (ksi)	16.47	16.47	0.00%

COMPUTER FILE: AISC ASD-89 EX002

CONCLUSION

The results show an exact comparison with the independent results.

HAND CALCULATION

Properties:

Material: A36 Steel

E = 29,000 ksi, F_y = 36 ksi

Section: W12x120:

b_f = 12.32 in, t_f = 1.105 in, d =13.12 in, t_w=0.71 in

A = 35.3 in^2

r_x=5.5056 in

Member:

K = 2.13

L = 15 ft

Loadings:

P = 560 kips

Design Axial Stress:

$$f_a = \frac{P}{A} = \frac{560}{35.3}$$

$$\boxed{f_a = 15.86\,\text{ksi}}$$

Compactness:

Localized Buckling for Flange:

$$\lambda = \frac{b_f}{2t_f} = \frac{12.32}{2 \bullet 1.105} = 5.575$$

$$\lambda_p = \frac{65}{\sqrt{F_y}} = \frac{65}{\sqrt{36}} = 10.83$$

$\lambda < \lambda_p$, No localized flange buckling

Flange is Compact.

Localized Buckling for Web:

$$\frac{f_a}{F_y} = \frac{15.86}{36} = 0.44$$

$$\lambda = \frac{d}{t_w} = \frac{13.12}{0.71} = 18.48$$

Since $\frac{f_a}{F_y} = 0.44 > 0.16$

$$\lambda_p = \frac{257}{\sqrt{F_y}} = \frac{257}{\sqrt{36}} = 42.83$$

$\lambda < \lambda_p$, No localized web buckling

Web is Compact.

Section is Compact.

Member Compression Capacity

$$\frac{KL_x}{r_x} = \frac{2.13 \bullet (15 \bullet 12)}{5.5056} = 69.638$$

$$C_c = \sqrt{\frac{2\pi^2 E}{F_y}} = \sqrt{\frac{2\pi^2 \bullet 29000}{36}} = 126.099$$

$$\frac{\frac{KL_x}{r_x}}{C_c} = \frac{69.638}{126.099} = 0.552$$

$$\frac{KL_x}{r_x} < C_c$$

$$F_a = \frac{\left\{1.0 - \frac{1}{2}\left(\frac{KL_x/r_x}{C_c}\right)^2\right\}F_y}{\frac{5}{3} + \frac{3}{8}\left(\frac{KL_x/r_x}{C_c}\right) - \frac{1}{8}\left(\frac{KL_x/r_x}{C_c}\right)^3}$$

$$F_a = \frac{\left\{1.0 - \frac{1}{2}(0.552)^2\right\} \bullet 36}{\frac{5}{3} + \frac{3}{8}(0.552) - \frac{1}{8}(0.552)^3}$$

$$\boxed{F_a = 16.47 \text{ ksi}}$$