

CIVE 3205  
Example AC10-3  
Axially Loaded Columns  
Column - Selection

Feb. 28, 2020

N.M. Holtz

Revisions:

- . Feb 28/20: new posting

### AC10-3

2/4

Select a column to carry  $C_f = 4000 \text{ kN}$   
as an axially loaded pin ended col.  $L = 4900 \text{ mm}$   
 $K = 1.0$  A992 steel  $F_y = 345 \text{ MPa}$ .

Use a W profile.

For a trial section, calc. smallest area:

$$A_{\text{reqd}} > \frac{C_f}{\phi F_y} = \frac{4000 \times 10^3}{0.9 \times 345} = 12880 \text{ mm}^2$$

Typical W column sections are W310 & W360  
(sometimes W200 or W250) and roughly  
square in cross section (b & d roughly equal).

Try W310 x 158

$$A = 20100 \text{ mm}^2$$

$$r_x = 139 \text{ mm}$$

$$r_y = 78.9 \text{ mm}$$

$$b = 310 \text{ mm} \quad t = 25.1 \text{ mm}$$

$$d - 2t = 277 \text{ mm} \quad w = 15.5 \text{ mm}$$

i) check local buckling

$$\text{flange: } \frac{b_{\text{el}}}{t} = \frac{310}{2 \times 25.1} = 6.18 \leq \frac{200}{\sqrt{345}} = 10.8 \quad \text{o.k.}$$

$$\text{web: } \frac{h}{w} = \frac{277}{15.5} = 17.9 \leq \frac{670}{\sqrt{345}} = 36.1 \quad \text{o.k.}$$

ii) overall capacity

$$\left(\frac{KL}{r}\right)_{\text{max}} = \frac{K_y L_y}{r_y} = \frac{1.0 \times 4900}{78.9} = 62.10$$

$$F_e = \frac{\pi^2 \times 200000}{62.10^2} = 511.9$$

$$\lambda = \sqrt{\frac{345}{511.9}} = 0.8210$$

$$n = 1.34$$

$$C_r = 0.9 \times 20100 \times 345 \times \left(1 + 0.8210^{2.68}\right)^{-1/1.34}$$

$$C_r = 4416 \text{ kN}$$

10% overdesign - try smaller section.

AC10-3 (continued.)

Use Handbook Factored Axial Compressive Resistance tables (green pages 4-21 to 4-113) to select trial section.  
(Note: values in table are for  $F_y = 345 \text{ MPa}$ )

Using row for  $KL = 5000 \text{ mm}$

Try  $W310 \times 143$  ( $C_r = 3930$  for  $L=5000, F_y=345$ )  
 $A = 18200$   
 $r_x = 138$   $b = 309$   $t = 22.9$   
 $r_y = 78.6$   $d - 2t = 277$   $w = 14.0$

i) local buckling

$$\text{flange: } \frac{b_{el}}{t} = \frac{309}{2 \times 22.9} = 6.75 < 10.8 \quad \text{O.K.}$$

$$\text{web: } \frac{h}{w} = \frac{277}{14.0} = 19.8 < 36.1 \quad \text{O.K.}$$

ii) overall strength

$$\frac{KL}{r} = \frac{1.0 \times 4900}{78.6} = 62.34$$

$$F_e = \frac{\pi^2 \times 200000}{62.34^2} = 507.9 \text{ MPa}$$

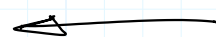
$$\lambda = \sqrt{\frac{345}{507.9}} = 0.8242$$

$$n = 1.34$$

$$C_r = 0.9 \times 18200 \times 0.345 \left( 1 + 0.8242^{2.68} \right)^{-1/1.34}$$

$$= 3987 < 4000 \quad \text{but O.K. (0.3\% under)}$$

Use  $W310 \times 143$



# AC10-3 (continued)

4/4

The following sections would likely work & should be checked

	<u>mass kg/m</u>
W360 x 134	134
HSS 406 x 13 Class C	123