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

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Revisions:

- Feb 28/20: new posting

AC10-3

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

Use a W profile.

For a trial section, calc. smallest area:

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

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

$A = 20100 \text{ mm}^2$ $\quad b = 310$ mm $\quad t = 25.1$ mm

$r_x = 139$ mm $\quad d - 2t = 277$ mm $\quad w = 15.5$ mm

$r_y = 78.9$ mm

i) check local buckling

flange: $\frac{b_{el}}{t} = \frac{310}{2 \times 25.1} = 6.18 \leq \frac{200}{\sqrt{345}} = 10.8$ O.K.

web: $\frac{h}{w} = \frac{277}{15.5} = 17.9 \leq \frac{670}{\sqrt{345}} = 36.1$ O.K.

ii) overall capacity

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

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

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

$n = 1.34$

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

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

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 $F_y = 345$ MPa)

Using row for $KL = 5000$ mm

Try W310 x 143 ($C_r = 3930$ for $L = 5000$, $F_y = 345$)

$A = 18\,200$ $\quad b = 309$ $\quad t = 22.9$

$r_x = 138$ $\quad d - 2t = 277$ $\quad w = 14.0$

$r_y = 78.6$

i) local buckling

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

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

ii) overall strength

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

$$F_e = \frac{\pi^2 \times 200\,000}{62.34^2} = 507.9 \text{ MPa}$$

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

$$n = 1.34$$

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

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

Use W310 x 143 ←

AC10-3 (continued)

The following sections would likely work & should be checked

	mass kg/m
W360 x 134	134
HSS 406x13 Class C	123