3.6-4 Select an American Standard Channel shape for the following tensile loads: dead load = 54 kips (240 kN), live load = 80 kips (356 kN), and wind load = 53 kips (236 kN). The connection will be with longitudinal welds. Use an estimated shear lag factor of $U = 0.85$. (In a practical design, once the member was selected and the connection designed, the value of U would be computed and the member design could be revised if necessary.) The length is 17.5 ft (5,300 mm). Use $F_y = 50$ ksi (345 MPa) and $F_u = 65$ ksi (450 MPa).

$L = 17.5\,ft(12in/ft) = 210\,in$

LRFD LC#4 $1.2D + W + L = 1.2(54^k) + 53^k + 80^k = 197.8^k$ *

LC#2 $1.2D + 1.6L = 1.2(54k) + 1.6(80k) = 192.8^k$

REQ. $A_g = \frac{P_u}{0.9F_y} = \frac{197.8^k}{0.9(50ksi)} = 4.3956\,in^2$

REQ $A_e = \frac{P_u}{0.75F_u} = \frac{197.8^k}{0.75(65ksi)} = 4.0574\,in^2$

$A_e = UA_g$

$A_g = A_e/U$

$= \frac{4.0574in^2}{0.85}$

$\cong 4.7734\,in^2$

REQ $r_{min} = \frac{L}{300} = \frac{210in}{300} = 0.700\,in$

TRY C10x20 $A_g = 5.87\,in^2$

$A_g > REQ\,A_g$ ✓

$A_e = UA_g = (0.85)(5.87in^2)$

$= 4.99\,in^2 > REQ.\,A_e$ ✓

$r_{min} = 0.690\,in \sim> REQ\,r_{min}$ (OK?)

USE C10x20

ASD LC #6 $D + 0.75L + 0.75(0.6W)$

$= 54^k + 0.75(80^k) + 0.75(0.6)(53^k)$

$P_a = \underline{137.85^k}$

$$\text{REQ. } A_g = \frac{P_a}{0.6F_y} = \frac{137.85^k}{0.6(50ksi)} = 4.5950\,in^2$$

$$\text{REQ } A_e = \frac{P_a}{0.5F_u} = \frac{137.85^k}{0.5(65ksi)} = 4.2415\,in^2$$

$$A_g = \frac{A_e}{U} = \frac{4.2415\,in^2}{0.85} = 4.9900\,in^2$$

REQ $r_{min} = 0.700$

TRY C10 x 20 $A_g = 5.87\,in^2$

- $A_g > \text{REQ } A_g$ ✓
- $A_e = U A_g = 0.85(5.87\,in^2)$
  $= 4.99\,in^2 > \text{REQ } A_e$ ✓
- $r_{min} = 0.690\,in \rightsquigarrow \text{REQ } r_{min}$ (OK?)

USE C10 x 20