UNIVERSITY OF MARYLAND

Department of Civil and Environmental Engineering

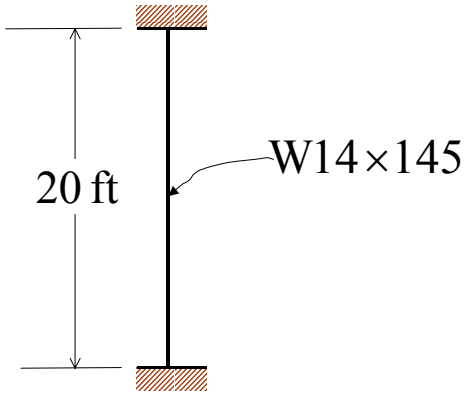
College Park Campus

Wednesday 20, 2002

SOLUTION to QUIZ #3

ENCE 355 – Introduction to Structural Design **NAME:**_____

Determine the design strength of the compression member shown in the figure using the LRFD Specification and a steel with F_y = 50 ksi.



***** SOLUTION *****

Using a W14 × 145, the following properties can be obtained from the LRFD Manual:

$A_g = 42.7 \text{ in}^2$

$r_x = 6.33$ in

$r_y = 3.98$ in ← Controls (smaller)

K = 0.65 from Table 1 (two fixed supports), therefore,

$$KL = 0.65(20) = 13 \text{ ft}$$

$$\frac{K_y L_y}{r_y} = \frac{12 \times 13}{3.98} = 39.20$$

Using Table 3-50 of the LRFD Manual (Part 16) and by interpolation, the design compressive strength can be obtained as follows:

$$\begin{array}{cc} 39 & 38.0 \\ 39.20 & \phi_c F_{cr} \\ 40 & 37.8 \end{array} \Rightarrow \frac{\phi_c F_{cr} - 38.0}{37.8 - 38.0} = \frac{39.20 - 39}{40 - 39} \Rightarrow \phi_c F_{cr} = 37.96 \text{ ksi}$$

Therefore, the design compressive strength is

$$P_u = \phi_c P_n = (\phi_c F_{cr}) A_g = 37.96(42.7) = \boxed{1{,}621 \text{ kips}}$$

Formulas, Tables, and Figures

Table 1

Buckled shape of column is shown by dashed line	(a)	(b)	(c)	(d)	(e)	(f)
Theoretical K value	0.5	0.7	1.0	1.0	2.0	2.0
Recommended design value when ideal conditions are approximated	0.65	0.80	1.2	1.0	2.10	2.0
End condition code	Rotation fixed and translation fixed					
	Rotation free and translation fixed					
	Rotation fixed and translation free					
	Rotation free and translation free					

Source: Load and Resistance Factor Design Specification for Structural Steel Buildings, December 27, 1999 [Chicago: AISC]

$$P_u = \phi_c P_n = \phi_c F_{cr} A_g$$