$L := 36\ ft$ $\quad E := 29000\ ksi$ $\quad r_x := 3.90\ in$ $\quad J := 0.0547\ in^4$

$G := 11000\ ksi$ $\quad I_y := 2.18\ in^4$ $\quad r_y := 0.785\ in$

$d := 9.87\ in - 0.210\ in = 9.66\ in$ $\quad a := 6.83\ in$

$$P_{ey1} := \frac{\pi^2\ E \cdot I_y}{L^2} = 3.34\ kip \qquad P_{ey2} := \frac{\pi^2\ E \cdot I_y}{\left(\frac{L}{2}\right)^2} = 13.37\ kip$$

$$P_T(a) := \frac{P_{ey1} \cdot \left(\frac{d^2}{4} + a^2\right) + G \cdot J}{a^2 + r_x^2 + r_y^2}$$

$a := 0.1\ in, 0.2\ in .. 24\ in$

TORSIONAL BRACING OF COLUMNS

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ABSTRACT: Many column bracing details employed in steel construction do not prevent twist, and subsequently, torsional buckling may control the column capacity. This mode of buckling is not adequately considered in design codes and is often overlooked. This paper documents a finite-element investigation of the torsional buckling behavior of columns with lateral bracing located at different points on the cross section. The location of the lateral bracing on the cross section has a significant effect on torsional buckling. Equations are developed for the stiffness and strength requirements of bracing to control torsional buckling. Details for torsional bracing are discussed and presented. A connection detail must be provided between the column and the brace that controls cross-sectional distortion. A design example illustrates the use of the bracing recommendations.

$$P_{ey} = \frac{\pi^2 E I_y}{L_T^2} \qquad (2)$$

E = modulus of elasticity; I_y = weak-axis moment of inertia; L_T = unbraced length for torsion; d = distance between flange centroids; G = shear modulus; J = torsional constant; and r_x and r_y = strong and weak axis radii of gyration, respectively.

When the location of intermediate lateral restraints are offset from the centroid, the torsional buckling capacity can be significantly different from that given by (1). Timoshenko and Gere (1961) give the following expressions for the torsional buckling capacity about an axis that is offset from the centroid by distances a and b as shown in Fig. 3:

$$P_T = \frac{P_{ey}[(d^2/4) + a^2] + GJ}{a^2 + r_x^2 + r_y^2} \qquad (3a)$$

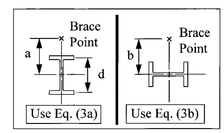

FIG. 3. Lateral Restraint Location