

Torsion analysis for distributed torsion:

Distributed Torsion: $t_d := 50 \text{ plf}$

Ignore the lateral support for the torsional analysis.

Eccentricity: $\text{Off}_D := e_o$

$\text{Off}_D = 0.58 \text{ in}$

Eccentricity: $\text{Off}_L := e_o$

$\text{Off}_L = 0.58 \text{ in}$

Eccentricity: $\text{Off}_t := (36 \text{ in} + 2 \text{ in} + 0.5 \text{ d})$

$\text{Off}_t = 42.5 \text{ in}$

$$a := \sqrt{\frac{E_s \cdot C_w}{G_s \cdot J}}$$

$a = 16.7 \text{ in}$

$$K := \frac{L}{a}$$

$K = 8.16$

Normalized Warping Constant: $W_{n0} := .5 \cdot u \cdot h$

$W_{n0} = 6.97 \text{ in}^2$

$W_{n2} := .5 \cdot E_o \cdot h$

$W_{n2} = 3.45 \text{ in}^2$

Warping Statical Moment: $S_{w1} := .25 \cdot u^2 \cdot h \cdot t_f$

$S_{w1} = 2.31 \text{ in}^4$

$S_{w2} := .25 \cdot h \cdot b' \cdot t_f \cdot (b' - 2E_o)$

$S_{w2} = 1.74 \text{ in}^4$

$S_{w3} := \left| S_{w2} - .125 \cdot E_o \cdot h^2 \cdot t_w \right|$

$S_{w3} = 1.58 \text{ in}^4$

Statcal moment for a point in the flange directly above the web: $Q_f := .5 \cdot d \cdot t_f \cdot (b_f - t_w)$

$Q_f = 4.1 \text{ in}^3$

Statcal moment at mid depth of the section: $Q_w := .5 \cdot (h \cdot b_f \cdot t_f) + .125 \cdot (h - t_f)^2 \cdot t_w$

$Q_w = 8.40 \text{ in}^3$

Torsional load: $t := (w_b + w_{sl} + w_{ad}) \cdot \text{Off}_D + w_l \cdot \text{Off}_L + t_d \cdot \text{Off}_t$

$$t = 2.21 \frac{\text{kip} \cdot \text{in}}{\text{ft}}$$

For Case 4 from Appendix C:

$$\theta(z) := \frac{t \cdot a^2}{G_s \cdot J} \cdot \left[\frac{K^2}{2} \cdot \left[\frac{z}{L} - \left(\frac{z}{L} \right)^2 \right] + \cosh\left(\frac{z}{a}\right) - \tanh\left(\frac{K}{2}\right) \cdot \sinh\left(\frac{z}{a}\right) - 1 \right]$$

$$\theta'(z) := \frac{t \cdot a^2}{G_s \cdot J} \cdot \left[\frac{K^2}{2} \cdot \left(\frac{1}{L} - \frac{2 \cdot z}{L^2} \right) + \frac{1}{a} \cdot \sinh\left(\frac{z}{a}\right) - \tanh\left(\frac{K}{2}\right) \cdot \frac{1}{a} \cdot \cosh\left(\frac{z}{a}\right) \right]$$

$$\theta''(z) := \frac{t \cdot a^2}{G_s \cdot J} \cdot \left(\frac{-K^2}{L^2} + \frac{1}{a^2} \cdot \cosh\left(\frac{z}{a}\right) - \frac{1}{a^2} \cdot \tanh\left(\frac{K}{2}\right) \cdot \sinh\left(\frac{z}{a}\right) \right)$$

$$\theta'''(z) := \frac{t \cdot a^2}{G_s \cdot J} \cdot \left(\frac{1}{a^3} \cdot \sinh\left(\frac{z}{a}\right) - \frac{1}{a^3} \cdot \tanh\left(\frac{K}{2}\right) \cdot \cosh\left(\frac{z}{a}\right) \right)$$