Appendix D Example 2 – Falsework Beam – Bi-Axial Bending – Canted ≤ 2%

This example demonstrates how to calculate maximum bending stress in beams canted less than or equal to two percent. Refer to *Falsework Manual (FW),* Section 5-4.04, *Bi-Axial Bending.*

Given Information

Span = 48 Ft Member W 14 x 176

Cross Slope = 2% I_{x-x} = 2140 in^4 I_{y-y} = 838 in^4

d = 15.2 in b_f = 15.7 in.

Uniform Load W

Total Section:

Loading for stress calculations:

Load A = Dead Load (**FW 3-2.01**) + Beam Weight + LL **(FW 3-2.02- min 20 psf)**

Load A = Concrete (160 lb/ft^3) + Beam (176 lb/ft) + LL (20 lb/ft^2) = 1420 lb/ft

Loading for deflection calculation:

Load B = Concrete only (150 lb/ft^3) (**FW 3-2.01)**

Load B = Concrete only (150 lb/ft^3) = 1000 lb/ft (for calculating beam deflection)

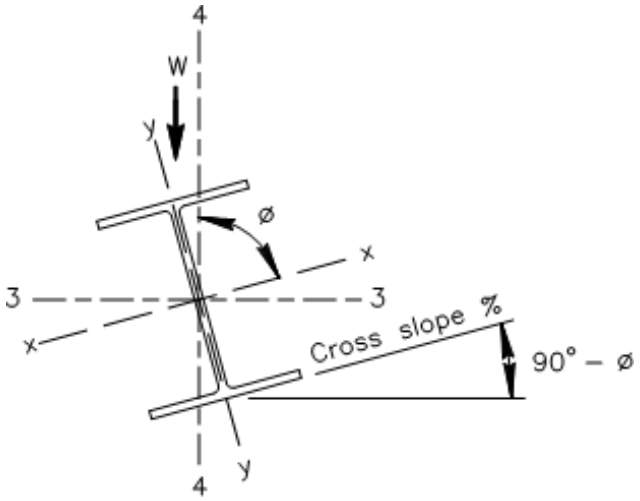
Bottom slab and stems:

Loading for horizontal calculation (when canted > 2%)

Load C = Concrete DL of Soffit Slab + Girder Stems

Load C = Concrete (150 lb/ft^3) = 649 lb/ft

Assume lateral bracing is adequate so that F_b = 22,000 psi **(FW 5-4.04)** maximum of the Standard Specifications is not exceeded.



$\emptyset = 90^\circ - \tan^{-1}$ (cross slope)

$= 90^\circ - \tan^{-1}\left(\frac{2.00}{100}\right) = 88.85^\circ$

$y = \frac{d}{2} = \frac{15.2 \text{ inches}}{2} = 7.60$ inches

$x = \frac{b_f}{2} = \frac{15.7 \text{ inches}}{2} = 7.85$ inches

Check Bending and Deflection

Check bending using Load A:

$$M = \frac{WL^2}{8} = \frac{1420\frac{lb}{ft}(48\ Ft)^2}{8} = 408{,}960 \text{ ft-lbs} = 4{,}907{,}520 \text{ in-lbs}$$

$$f_b = M\left[\frac{y}{I_{x-x}}\sin\emptyset + \frac{x}{I_{y-y}}\cos\emptyset\right]$$ **(FW 5-4.04A-1)**

$$f_b = 4{,}907{,}520\left(\frac{7.60}{2140}\sin 88.85^\circ + \frac{7.85}{838}\cos 88.85^\circ\right) = 18{,}348 \text{ psi}$$

18,348 psi < 22,000 psi allowable **OK**

Check deflection about the 3-3 axis, using Load B:

$$\Delta_{3-3} = \frac{5WL^4}{384EI_{3-3}} = \frac{5\left(1000\ {}^{Lb}/_{Ft}\right)(48\ Ft)^4\left(1728\ {}^{In^3}/_{Ft^3}\right)}{384\ (30 \times 10^6\ psi)(I_{x-x}\sin^2\emptyset + I_{y-y}\cos^2\emptyset)}$$

$$= \frac{5(1000)(48)^4\ (1728)}{384\ (30 \times 10^6)\ (2140\ \sin^2 88.85 + 838\ \cos^2 88.85)}$$

$= 1.86$ In. $< \frac{L}{240} = \frac{(48)(12)}{240} = 2.40$ Inches allowable **OK**