Moms abt 0

$$F(\Delta + 0.05) = 2F\int_0^{0.2}[(-4.96 + 3.35 + 32.49s_2]ds_2 \text{ x } 0.05$$

$$+ F\int_0^{\pi} (-4.96 + 9.84 + 1.62 \sin\phi) * 0.05^2 * d\phi$$

or

$$(\Delta + 0.05) = 0.1\ (-1.61s_2 + 16.2s_2^2)_0^{0.2}$$

$$+ [0.0122\phi - 4.05E\text{-}3\cos\phi]_0^{\pi}$$

$$= 0.1(-0.322 + 0.65) + 0.0383 + 8.1E\text{-}3$$

$$\Delta = 0.0328 + 0.0464 = \underline{0.0792 \text{ m}}$$

10a. $F = W/2$

$$\& \ \tau = \frac{3W}{bd^3}\left(\frac{d^2}{4} - y^2\right)$$

$$SSE = \int \frac{\tau^2}{2G} \, d \, (vol)$$

$$= \frac{2}{2} \int \frac{9W^2}{Gb^2d^6} \left(\frac{d^2}{4} - y^2\right)^2 \ell b dy$$

$$SSE = 3W^2\ell/(20Gbd)$$

$$WD = \frac{1}{2} W\delta_s$$

$$\therefore \ \delta_s = 3W\ell/(10Gbd)$$

10b. $F_1 = W\ell_2/\ell$

$F_2 = W\ell_1/\ell$

$$SSE = \frac{2}{2} \int_0^{d/2} \frac{36W^2\ell_2^2}{Gb^2d^6\ell^2} \left(\frac{d^2}{4} - y^2\right)^2 b\ell_1 dy$$

$$+ \frac{2}{2} \int_0^{d/2} \frac{36W^2\ell_1^2}{Gb^2d^6\ell^2} \left(\frac{d^2}{4} - y^2\right) b\ell_2 dy$$

$$= 36 \frac{W^2}{Gb^2d^6\ell^2}.b(\ell_2^2\ell_1 + \ell_1^2\ell_2) \left(\frac{d^4y}{16} - \frac{d^2y^3}{6} + \frac{y^5}{5}\right)_0^{d/2}$$

$$= 36 \frac{W^2 \ (\ell_2^2\ell_1 + \ell_1^2\ell_2)}{60 \ Gbd\ell^2} = 36 \frac{W^2(\ell_1 + \ell_2)\ell_1\ell_2}{60Gbd\ell^2}$$

$$SSE = 3W^2\ell_1\ell_2/(5Gbd\ell)$$

10c.

$$@ \; x \;\; F = \frac{w\ell}{2} - wx = w(\ell/2 - x)$$

$$\tau = \frac{6F}{bd^3}\left(\frac{d^2}{4} - y^2\right)$$

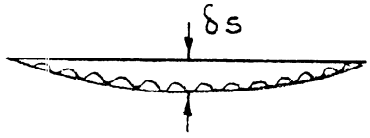
$$SSE = \frac{2 \times 2}{2}\int_0^{\ell/2}\int_0^{y} \frac{36F^2}{Gb^2d^6}\left(\frac{d^2}{4} - y^2\right).b \; dx \; dy$$

$$= \frac{72.bd^5}{Gb^2d^b.60} w^2 \int_0^{\ell/2}\left(\frac{\ell}{2} - x\right)^2 dx$$

$$= \frac{6w}{5Gbd}\int_0^{\ell/2}\left(\frac{\ell^2}{4} - \ell x + x^2\right) dx = \frac{6w}{5Gbd}\left(\frac{\ell^2 x}{4} - \frac{\ell x^2}{2} + \frac{x^3}{3}\right)$$

$$SSE = 6w\ell^3/(120Gbd)$$

$$WD = \frac{1}{2} \times w\ell \times \delta_s \frac{2}{3}$$



$$\therefore \; \delta_s = \underline{3w\ell^2/(20Gbd)}$$

CHAPTER 15

1a. 1-4 $\alpha = 60°$ $c = 0.5$ $s = 0.866$
$\ell = 1.155$ m

$$[k^\circ_{1\text{-}2}] = \frac{AE}{1.155}$$

$$\begin{array}{c} u_4^\circ \quad v_4^\circ \\ \left|\begin{array}{cc} 0.25 & 0.433 \\ 0.433 & 0.75 \end{array}\right| \begin{array}{c} u_4^\circ \\ v_4^\circ \end{array} \end{array}$$

$$= AE \begin{bmatrix} 0.216 & 0.375 \\ 0.375 & 0.649 \end{bmatrix}$$

2 - 4 $\alpha = 90°$ $c = 0$ $s = 1$
$\ell = 1$m

$$[k^\circ_{2\text{-}4}] = AE \begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix}$$

3-4 $\alpha = 150°$ $c = -0.866$ $s = 0.5$
$\ell = 2$m

$$[k_{3\text{-}4}] = AE \begin{bmatrix} 0.375 & -0.217 \\ -0.217 & 0.125 \end{bmatrix}$$

$$[K_{11}] = AE \begin{bmatrix} 0.591 & 0.158 \\ 0.158 & 1.774 \end{bmatrix}$$

$$\{q_F\} = \begin{Bmatrix} -6 \\ 8 \end{Bmatrix}$$

or

$$AE \begin{bmatrix} 0.591 & 0.158 \\ 0.158 & 1.774 \end{bmatrix} \begin{Bmatrix} u_4^\circ \\ v_4 \end{Bmatrix} = \begin{Bmatrix} -6 \\ 8 \end{Bmatrix}$$

$$\begin{Bmatrix} u_4^\circ \\ v_4^\circ \end{Bmatrix} = \frac{1}{AE} \begin{bmatrix} 1.774 & -0.158 \\ -0.158 & 0.591 \end{bmatrix} \begin{Bmatrix} -6 \\ 8 \end{Bmatrix}$$

$$(0.591 \times 1.774 - 0.158^2)$$

$$= \frac{1}{AE} \begin{bmatrix} 1.733 & -0.154 \\ -0.154 & 0.577 \end{bmatrix} \begin{Bmatrix} -6 \\ 8 \end{Bmatrix}$$

$$\begin{Bmatrix} u_4^\circ \\ v_4^\circ \end{Bmatrix} = \frac{1}{AE} \begin{Bmatrix} -11.63 \\ 5.54 \end{Bmatrix}$$

1-4

$$u_4 = (0.5 \;\; 0.866) \frac{1}{AE} \begin{Bmatrix} -11.63 \\ \\ 5.54 \end{Bmatrix}$$

$$= -1.0174/AE$$

$$F_{1-4} = \frac{-1.0174}{AE} \frac{AE}{1.155}$$

$$F_{1-4} = \underline{-0.88 \text{ kN}}$$

2-4

$$u_4 = (0 \quad 1) \frac{1}{AE} \begin{Bmatrix} -11.63 \\ \\ 5.54 \end{Bmatrix}$$

$$= 5.54/AE$$

$$F_{2-4} = \underline{5.54 \text{ kN}}$$

3-4

$$u_4 = (-0.866 \quad 0.5)\ \frac{1}{AE}\begin{Bmatrix} -11.63 \\ \\ 5.54 \end{Bmatrix}$$

$$= 12.84/AE$$

$$F_{3-4} = \frac{12.84}{AE} \times \frac{AE}{2} = \underline{6.42\ kN}$$

(Round off errors)

1b.

1-4

$\alpha = -30°$ $\quad c = 0.866$ $\quad s = -0.5$
$\ell = 2$

$$[k_{1-4}°] = AE\begin{bmatrix} 0.375 & -0.217 \\ -0.217 & 0.125 \end{bmatrix}$$

2-4

$\alpha = -60°$ $\quad c = 0.5$ $\quad s = -0.866$
$\ell = 1.155$

$$[k_{2-4}°] = AE\begin{bmatrix} 0.216 & -0.375 \\ -0.375 & 0.649 \end{bmatrix}$$

3-4
$\alpha = -135°$ $\quad c = -0.707$ $\quad s = -0.707$
$\ell = 1.414$

$$[k_{3-4}^{\circ}] = AE \begin{bmatrix} 0.354 & 0.354 \\ 0.354 & 0.354 \end{bmatrix}$$

$$[K_{11}] = AE \begin{bmatrix} 0.945 & -0.238 \\ -0.238 & 1.128 \end{bmatrix}$$

$$[K_{11}]^{-1} = AE \begin{bmatrix} 1.118 & 0.236 \\ 0.236 & 0.936 \end{bmatrix}$$

$$\{q_F\} = \begin{Bmatrix} 4 \\ -8 \end{Bmatrix}$$

$$\begin{Bmatrix} u_4^{\circ} \\ v_4^{\circ} \end{Bmatrix} = \frac{1}{AE} \begin{Bmatrix} 2.584 \\ -6.544 \end{Bmatrix}$$

<u>1-4</u>

$$u_4 = (0.866 - 0.5) \frac{1}{AE} \begin{Bmatrix} 2.584 \\ -6.544 \end{Bmatrix}$$

$$= 5.51/AE$$

$$F_{1-4} = \underline{2.755 \text{ kN}}$$

2-4

$$u_4 = (0.5 \; - \; 0.866) \; \frac{1}{AE} \begin{Bmatrix} 2.584 \\ \\ -6.544 \end{Bmatrix}$$

$$= 6.959/AE$$

$$F_{2-4} = \underline{6.025 \text{ kN}}$$

3-4

$$u_4 = (-0.707 \quad -0.707) \; \frac{1}{AE} \; \{2.584 \; - \; 6.544\}$$

$$= 2.8/AE$$

$$F_{3-4} = \underline{1.98 \text{ kN}}$$