3.0 STRENGTH OF MATERIALS SOLUTIONS.

The assumption that a plane section normal to the reference axis before thermal loading remains normal to the deformed reference axis and plane after thermal loading, along with neglecting the effect on stress distribution of lateral contraction, lays the foundation of the approximate methods of strength of materials. The exact results obtained by the methods of quasistatic thermoelasticity show that the accuracy of the strength of materials solution improves with the reduction of depth-to-span ratio, if the variation of temperature along the length of the beam is smooth. As in the case of mechanical loads, a considerable error results in the vicinity of abrupt changes in the cross sections.

If the temperature is either uniform or linear along the length of the beam, the assumption of a plane section is valid, and the strength of materials method gives the same results as those given by the plane stress thermoelastic method.

Since the effect of lateral contraction is neglected, lateral axial stresses are zero; e.g., $\sigma_{yy} = \sigma_{zz} = 0$ in the case of a beam with x-axis as the reference plane.

3.0.1 Unrestrained Beam — Thermal Loads Only.

3.0.1.1 Axial Stress.

For an unrestrained beam (Fig. 3.0-1) the longitudinal stress (σ_{xx}) is given by

$$\sigma_{xx} = -\alpha ET + \frac{P_T}{A} + \left(\frac{I_y M_{T_z} - I_{yz} M_{T_y}}{I_y I_z - I_{yz}^2}\right) y + \left(\frac{I_z M_{T_y} - I_{yz} M_{T_z}}{I_y I_z - I_{yz}^2}\right) z \qquad (1)$$

where

$$T = T(x,y,z)$$

$$P_T = \int_A \alpha ET\,dA \qquad I_z = \int_A y^2\,dA$$

$$M_{T_z} = \int_A \alpha ET_y\,dA \qquad I_y = \int_A z^2\,dA$$

$$M_{T_y} = \int_A \alpha ET_z\,dA \qquad I_{yz} = \int_A yz\,dA \quad .$$

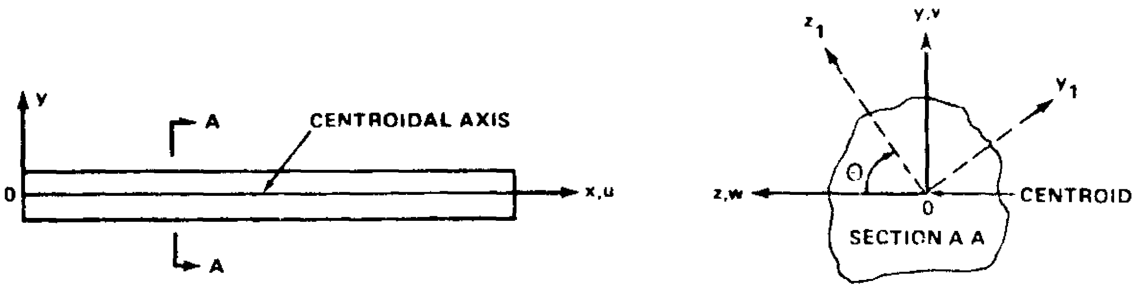


Figure 3.0-1. General unrestrained beam.

<u>CASE a.</u> The y-z axes are principal axes ($I_{yz} = 0$)

$$\sigma_{xx} = -\alpha ET + \frac{P_T}{A} + \frac{M_{T_z}}{I_z} y + \frac{M_{T_y}}{I_y} z \quad . \tag{2}$$

<u>CASE b.</u> The y-z axes are not principal axes. A new coordinate system y_1, z_1 is chosen which makes an angle θ with y-z axes such that

$$\tan\theta = -\frac{I_y M_{T_y} - I_{yz} M_{T_z}}{I_y M_{T_z} - I_{yz} M_{T_y}} \quad . \tag{3}$$

In the new coordinate system, which in general does not constitute principal axes, the z axis becomes the neutral axis, and equation (1) in this coordinate system reduces to

$$\sigma_{xx} = -\alpha ET + \frac{P_T}{A} + \frac{M_{T_{z_1}} y_1}{I_{z_1}} \quad , \tag{4}$$

where

$$M_{T_{z_1}} = \int_A \alpha ET (x_1 y_1 z_1) y_1 \, dA_1$$

$$I_{z_1} = \int_A y_1^2 \, dA_1 \quad .$$

3.0.1.2 Displacements.

Axial displacement $u(x,y,z)$ with respect to the $u(0,y,z)$ is given by

$$u(x,y,z) = u(0,y,z) + \frac{1}{E}\int_0^x \left[\frac{P_T}{A} + \left(\frac{I_y M_{T_z} - I_{yz} M_{T_y}}{I_y I_z - I_{yz}^2}\right) y + \left(\frac{I_z M_{T_y} - I_{yz} M_{T_z}}{I_y I_z - I_{yz}^2}\right) z\right] dx \quad . \tag{5}$$

The average displacement $u_{av}(x)$ of the cross section at a distance x is

$$u_{av}(x) = u_{av}(0) + \frac{1}{E}\int_0^x \frac{P_T}{A}\, dx \quad . \tag{6}$$

Displacements v and w of the reference axis $[v(x,y,z) = v(x,0,0)$; $w(x,y,z) = w(x,0,0)]$ are given by the following differential equations:

$$\frac{d^2v}{dx^2} = -\frac{1}{E}\left(\frac{I_y M_{T_z} - I_{yz} M_{T_y}}{I_y I_z - I_{yz}^2}\right) ,$$

$$\frac{d^2w}{dx^2} = -\frac{1}{E}\left(\frac{I_z M_{T_y} - I_{yz} M_{T_z}}{I_y I_z - I_{yz}^2}\right) . \tag{7}$$

If the y-z axes are principal, equations (7) reduce to

$$\frac{d^2v}{dx^2} = -\frac{M_{T_z}}{EI_z} ,$$

$$\frac{d^2w}{dx^2} = -\frac{M_{T_y}}{EI_y} . \tag{8}$$

In y_1-z_1 axes, defined by equation (3), equations (7) reduce to

$$\frac{d^2v}{dx^2} = -\frac{M_{T_{z_1}}}{EI_{z_1}}$$

$$\frac{d^2w_1}{dy^2} = 0 \qquad . \qquad (9)$$

3.0.2 Restrained Beam — Thermal Loads Only.

Considered henceforth in this paragraph are cases of beam cross sections having y-z axes for the principal axes.

The values P, M_y, and M_z are the axial force and bending moments at any cross section resulting from the external forces and the reactions to the restraints against thermal expansion; therefore, M_y and M_z depend only on the constraining moments and shears at the restraints.

$$M_z = M_{0_z} + V_{0_z} x \quad ,$$

$$M_y = M_{0_y} + V_{0_y} x \quad , \qquad (10)$$

where the sign convention on moments and shears and M_0 and V_0 are shown in Fig. 3.0-2.

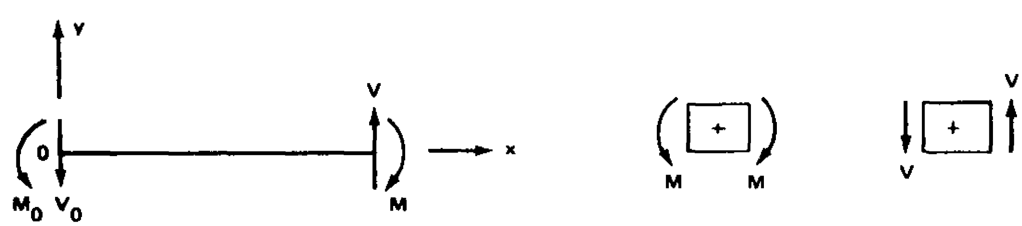


Figure 3.0-2. Sign convention of moments and shears.

The displacements v, w are given by

$$\frac{d^2v}{dx^2} = - \frac{M_{T_z} + M_z}{EI_z} ,$$

$$\frac{d^2w}{dx^2} = - \frac{M_{T_y} + M_y}{EI_y} . \tag{11}$$

Solutions of equations (11) for the special case described by equation (10) are

$$v(x) = - \int_0^x \int_0^{x_2} \frac{M_{T_z}(y_1)}{EI_z(x_1)} dx_1 \, dx_2 + C_{0_z} + C_{1_z} x - M_{0_z} \int_0^x \int_0^{x_2} \frac{dx_1}{EI_z(x_1)} dx_2$$

$$- V_{0_z} \int_0^x \int_0^{x_2} \frac{x_1}{EI_z(x_1)} dx_1 \, dx_2 ,$$

(12)

$$w(x) = - \int_0^x \int_0^{x_2} \frac{M_{T_y}(x_1)}{EI_y(x_1)} dx_1 \, dx_2 + C_{0_y} + C_{1_y} x - M_{0_y} \int_0^x \int_0^{x_2} \frac{dx_1 \, dx_2}{EI_y(x_1)}$$

$$- V_{0_y} \int_0^x \int_0^{x_2} \frac{x_1}{EI_y(x_1)} dx_1 \, dx_2 .$$

The bending moment and shear force at any cross section are

$$M_z = - EI_z \frac{d^2v}{dx^2} - M_{T_z} ,$$

$$M_y = - EI_y \frac{d^2w}{dx^2} - M_{T_y} , \tag{13}$$

$$V_z = \frac{dM_z}{dx} \; ; \; V_y = \frac{dM_y}{dx} .$$

Each of the two equations (12) has four unknowns, C_0, C_1, M_0, V_0, which are calculated from four boundary conditions, two at each end of a beam.

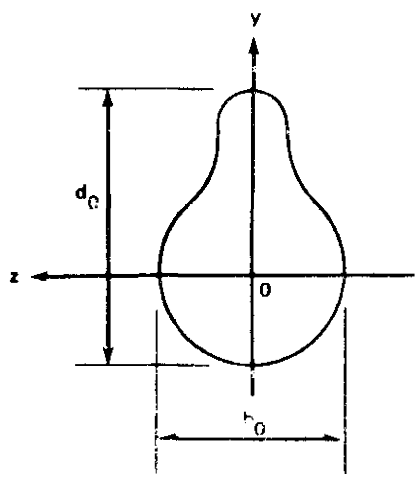
3.0.2.1 Evaluation of Integrals for Varying Cross Sections.

For a general cross section as shown in Fig. 3.0-3 the following notation is chosen:

$$b = b_0 h\ (x_1) \qquad h(x_1) = 1 + H\left(\frac{x}{L}\right) \quad ,$$

$$d = d_0 g\ (x_1) \qquad g(x_1) = 1 + G\left(\frac{x}{L}\right) \quad ,$$

where b_0 and d_0 are reference width and depth at $x = 0$; $x_1 = \dfrac{x}{L}$.



$$A = A_0 h(x_1)\ g(x_1)$$

$$I_z = I_{z_0} h(x_1)\ g^3(x_1)$$

$$I_y = I_{y_0} h^3(x_1)\ g(x_1)$$

Figure 3.0-3. General cross section.

Letting the temperature variation be represented by

$$T(x, y, z) = f(x_1)\ V(y, z) \quad ,$$

the necessary integrals become:

$$P_T = \int_A \alpha\, E T\, dA = \alpha E\, f(x_1)\, g(x_1)\, h(x_1) \int_{A_0} V\, dA_0 \quad ,$$

$$M_{T_y} = \int_A \alpha\, E T_z\, dA = \alpha E\, f(x_1)\, g(x_1)\, h(x_1) \int_{A_0} V z\, dA_0 \quad ,$$

$$M_{T_z} = \int_A \alpha\, E T_y\, dA = \alpha E\, f(x_1)\, g(x_1)\, h(x_1) \int_{A_0} V y\, dA_0 \quad ,$$

$$\int_0^x \frac{M_{T_y}}{EI_y}\, dx = \frac{\alpha}{I_{0_y}} \int_{A_0} V z\, dA_0 \int_0^{x_1} \frac{f(x_1)}{h^2(x_1)}\, dx_1 \quad ,$$

$$\int_0^x \frac{M_{T_z}}{EI_z}\, dx = \frac{\alpha}{I_{z_0}} \int_{A_0} V y\, dA_0 \int_0^{x_1} \frac{f(x_1)}{g^2(x_1)}\, dx_1 \quad ,$$

$$\int_0^x \frac{x\,dx}{EI_z} = \frac{1}{EI_{z_0}} \int_0^{x_1} \frac{x_1\, dx_1}{h(x_1)\, g^3(x_1)} \quad ; \quad \int_0^x \frac{dx}{EI_z} = \frac{1}{EI_{z_0}} \int_0^{x_1} \frac{dx_1}{h(x_1)\, g^3(x_1)} \; .$$

The integrals necessary to evaluate P_T, M_{T_y}, and M_{T_z} for a particular cross section and temperature distribution can be evaluated as follows:

Let

$$F_0 = \int_{A_0} V\, dA_0 \quad ,$$

$$F_{1_y} = \int_{A_0} V y\, dA_0 \quad ,$$

and

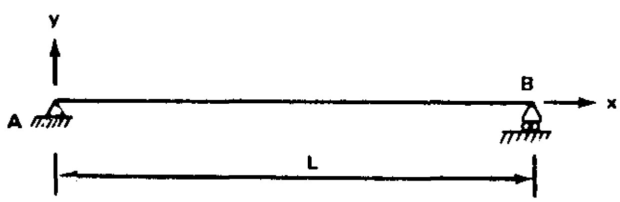
$$F_{1_z} = \int_{A_0} V z \, dA_0 \quad .$$

Then, letting $V(y, z) = V_{mn} y^n z^m$, which is a polynomial representation of the temperature variation in the y- and z-directions, F_0, F_{1_y}, and F_{1_z} can be evaluated for common shapes. Table 3.0-1 gives these evaluations for several common shapes and various values of m and n. Table 3.0-2 gives values of F_0 and F_{1_y} for rectangular, triangular, elliptic, and diamond cross sections when m = 0 and n = 0 - 5. Table 3.0-3 gives values of F_0 and F_{1_y} for several standard shapes for various values of m and n.

3.0.2.2 Restrained Beam Examples.

In the following examples, since deflection, moment and shear equations along the y- and z-directions are similar, only the results of the boundary value problem in the y-direction are given (i.e., m = 0).

I. Simply Supported Beam.



A. Boundary Conditions:

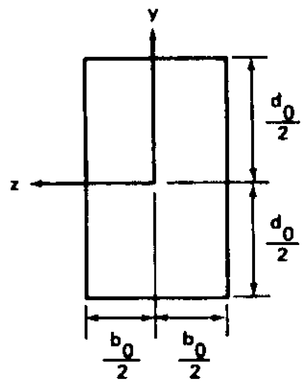
$$v = 0 \text{ @ } x = 0,\ L$$

$$M_z = -EI_z \frac{d^2v}{dx^2} - M_{T_z} = 0 \text{ @ } x = 0,\ L$$

$$V_0 = M_0 = 0 \quad .$$

TABLE 3.0-1. EXPRESSIONS FOR F_0, F_{1_y}, AND F_{1_z} FOR COMMON SHAPES.

RECTANGULAR



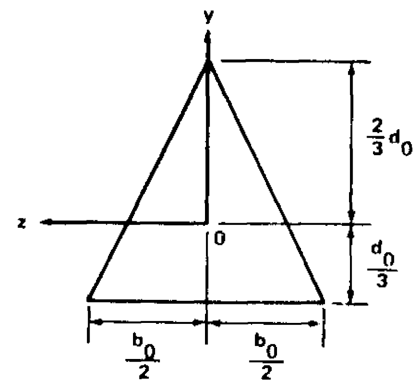
$$F_0 = \begin{cases} \dfrac{4V_{mn}}{(m+1)(n+1)} \left(\dfrac{b_0}{2}\right)^{m+1} \left(\dfrac{d_0}{2}\right)^{n+1} & m,\ n = 0, 2, 4, 6\ldots \\ 0 & m \text{ or } n = 1, 3, 5\ldots \end{cases}$$

$$F_{1_y} = \begin{cases} \dfrac{4V_{mn}}{(m+1)(n+2)} \left(\dfrac{b_0}{2}\right)^{m+1} \left(\dfrac{d_0}{2}\right)^{n+2} & m = 0, 2, 4\ldots \quad n = 1, 3, 5\ldots \\ 0 & m = 1, 3, 5, \ldots \quad n = 0, 2, 4, 6 \end{cases}$$

$$F_{1_z} = \begin{cases} \dfrac{4V_{mn}}{(m+2)(n+1)} \left(\dfrac{b_0}{2}\right)^{m+2} \left(\dfrac{d_0}{2}\right)^{n+1} & n = 0, 2, 4\ldots \quad m = 1, 3, 5\ldots \\ 0 & n = 1, 3, 5\ldots \quad m = 0, 2, 4\ldots \end{cases}$$

TABLE 3.0-1. (Continued)

TRIANGULAR



$$F_0 = \begin{cases} \dfrac{2V_{mn}}{(m+1)} \left(\dfrac{b_0}{2}\right)^{m+1} d_0^{\,n+1} \left[-\sum_{i=1}^{m+1} B_i + (-2)^{n+m+2} B_{m+2} \right] & m = 0, 2, 4 \\ 0 & m = 1, 3, 5 \end{cases}$$

where

$$B_i = \frac{(n+1)!}{(m+2-i)!} \cdot \frac{n!}{(n+i)!} \left(-\frac{1}{3}\right)^{n+i}$$

$$F_{1_y} = \begin{cases} \dfrac{2V_{mn}}{(m+1)} \left(\dfrac{b_0}{2}\right)^{m+1} d_0^{\,n+2} \left[-\sum_{i=1}^{m+2} C_i + (-2)^{n+m+3} C_{m+2} \right] & m = 0, 2, 4 \\ 0 & m = 1, 3, 5 \end{cases}$$

where

$$C_i = \frac{(m+1)!}{(m+2-i)!} \cdot \frac{(n+1)!}{(n+1+i)!} \left(-\frac{1}{3}\right)^{n+1+i}$$

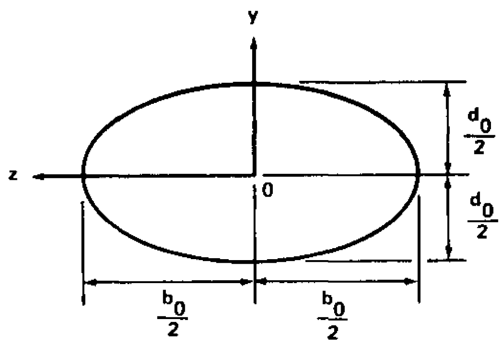
$$F_{1_z} = \begin{cases} 0 & m = 0, 2, 4 \ldots \\ \dfrac{2V_{mn}}{m+2} \left(\dfrac{b_0}{2}\right)^{m+2} d_0^{\,n+1} \left[-\sum_{i=1}^{m+3} D_i + (-2)^{n+m+3} D_{m+2} \right] & m = 1, 3, 5 \ldots \end{cases}$$

where

$$D_i = \frac{(m+2)!}{(m+3-i)!} \cdot \frac{n!}{(n+i)!} \left(-\frac{1}{3}\right)^{n+i}$$

TABLE 3.0-1. (Continued)

ELLIPTIC



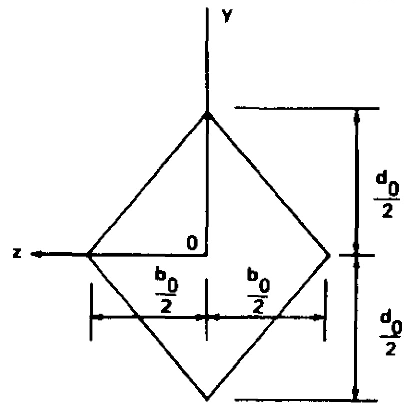
$$F_0 = \begin{cases} \dfrac{\pi V_{mn}}{m+1}\left(\dfrac{b_0}{2}\right)^{m+1}\left(\dfrac{d_0}{2}\right)^{n+1}(2)^{\frac{n}{2}}\ \dfrac{n!}{(n+m-1)!}\ \dfrac{(m+n-1)(m+n-3)\ldots(7)(5)(3)(1)}{(m+n+2)(m+n)\ldots(8)(6)(4)} & m, n\ 0, 2, 4, 6 \text{ and } m+n\ 0 \\ 0 & m \text{ or } n\ 1, 3, 5 \ldots \end{cases}$$

$$F_{1_y} = \begin{cases} \dfrac{\pi V_{mn}}{m+1}\left(\dfrac{b_0}{2}\right)^{m+1}\left(\dfrac{d_0}{2}\right)^{n+2}(2)^{\frac{m}{2}} \cdot \dfrac{(n+1)!}{(n+m)!} \cdot \dfrac{(n+m)(n+m-2)\ldots(7)(5)(3)(1)}{(n+m+3)(m+n+1)\ldots(8)(6)(4)} & m\ 0, 2, 4, 6 \quad n\ 1, 3, 5 \\ 0 & n\ 0, 2, 4, 6 \text{ or } m\ 1, 3, 5 \ldots \end{cases}$$

$$F_{1_z} = \begin{cases} \dfrac{\pi V_{mn}}{m+2}\left(\dfrac{b_0}{2}\right)^{m+2}\left(\dfrac{d_0}{2}\right)^{n+1}(2)^{\frac{m+1}{2}} \cdot \dfrac{n!}{(n+m)!} \cdot \dfrac{(n+m)(n+m-2)\ldots(7)(5)(3)(1)}{(m+n+3)(m+n+1)\ldots(8)(6)(4)} & m\ 1, 3, 5 \quad n\ 0, 2, 4 \\ 0 & n\ 1, 3, 5 \text{ or } m\ 0, 2, 4, 6 \end{cases}$$

TABLE 3.0-1. (Continued)

DIAMOND



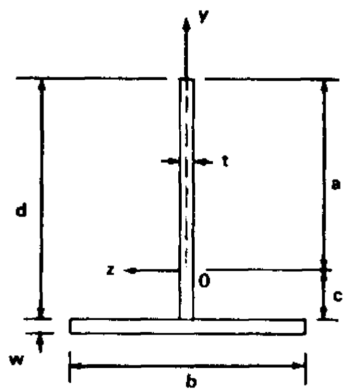
$$F_0 = \begin{cases} \dfrac{V_{mn}\, m!\, n!}{(n+m+2)!}\, 4 \left(\dfrac{b_0}{2}\right)^{m+1} \left(\dfrac{d_0}{2}\right)^{n+1} & m, n = 0, 2, 4 \ldots \\ 0 & m \text{ or } n = 1, 3, 5 \end{cases}$$

$$F_{1_y} = \begin{cases} \dfrac{4 V_{mn}\, m!(n+1)!}{(n+m+3)!} \left(\dfrac{b_0}{2}\right)^{m+1} \left(\dfrac{d_0}{2}\right)^{n+2} & m = 0, 2, 4, 6 \ldots \\ & n = 1, 3, 5 \ldots \\ 0 & m = 1, 3, 5 \ldots \text{ or } n = 0, 2, 4 \end{cases}$$

$$F_{1_z} = \begin{cases} \dfrac{4 V_{mn}\, (m+1)!\, n!}{(n+m+3)!} \left(\dfrac{b_0}{2}\right)^{m+2} \left(\dfrac{d_0}{2}\right)^{n+1} & m = 1, 3, 5 \ldots \\ & n = 0, 2, 4 \ldots \\ 0 & m = 0, 2, 4 \ldots \\ & n = 1, 3, 5 \ldots \end{cases}$$

TABLE 3.0-1. (Continued)

T-SECTION

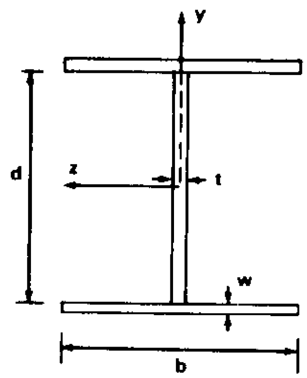


$$
F_0 = \begin{cases}
\dfrac{2V_{mn}}{(m+1)(n+1)} \left\{ \left(\dfrac{t}{2}\right)^{m+1} \left(a^{n+1} + c^{n+1} \right) + \left(\dfrac{b}{2}\right)^{m+1} \left[(c+w)^{n+1} - c^{n+1} \right] \right\} & m = 0, 2, 4, 6;\ n = 0, 2, 4, 6 \\
\dfrac{2V_{mn}}{(m+1)(n+1)} \left\{ \left(\dfrac{t}{2}\right)^{m+1} \left(a^{n+1} - c^{n+1} \right) - \left(\dfrac{b}{2}\right)^{m+1} \left[(c+w)^{n+1} - c^{n+1} \right] \right\} & m = 0, 2, 4, 6;\ n = 1, 3, 5 \ldots \\
0 & m = 1, 3, 5 \quad n = 0, 1, 2, 3
\end{cases}
$$

$$
F_{1y} = \begin{cases}
\dfrac{2V_{mn}}{(m+1)(n+2)} \left\{ \left(\dfrac{t}{2}\right)^{m+1} \left(a^{n+2} - c^{n+2} \right) + \left(\dfrac{b}{2}\right)^{m+1} \left[c^{n+2} - (c+w)^{n+2} \right] \right\} & m = 0, 2, 4;\ n = 0, 2, 4 \\
\dfrac{2V_{mn}}{(m+1)(n+2)} \left\{ \left(\dfrac{t}{2}\right)^{m+1} \left(a^{n+2} + c^{n+2} \right) + \left(\dfrac{b}{2}\right)^{m+1} \left[(c+w)^{n+2} - c^{n+2} \right] \right\} & m = 0, 2, 4;\ n = 1, 3, 5 \\
0 & m = 1, 3, 5 \quad n = 0, 1, 2, 3, 4
\end{cases}
$$

TABLE 3.0-1. (Continued)

I-SECTION



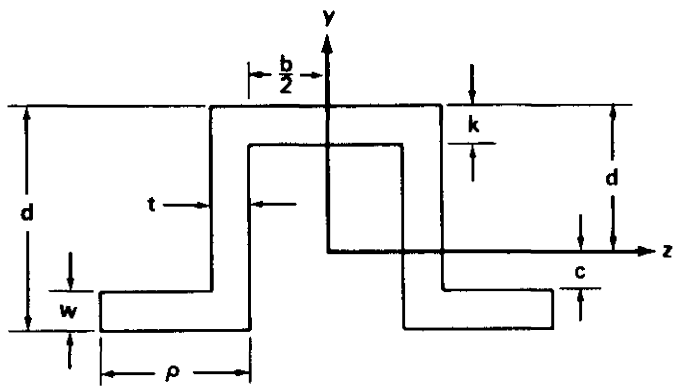
$$F_0 = \begin{cases} \dfrac{4V_{mn}\left(\dfrac{d}{2}\right)^{n+1}}{(m+1)(n+1)} \left\{ \left(\dfrac{t}{2}\right)^{m+1} + \left(\dfrac{b}{2}\right)^{m+1} \left[\left(\dfrac{1}{2} + \dfrac{w}{d}\right)^{n+1} - \left(\dfrac{1}{2}\right)^{n+1} \right] \right\} & m, n = \text{even} \\ 0 & m \text{ or } n = \text{odd} \end{cases}$$

$$F_{1_y} = \begin{cases} \dfrac{4V_{mn}\left(\dfrac{d}{2}\right)^{n+2}}{(m+1)(n+2)} \left\{ \left(\dfrac{t}{2}\right)^{m+1} + \left(\dfrac{b}{2}\right)^{m+1} \left[\left(\dfrac{1}{2} + \dfrac{w}{d}\right)^{n+2} - \left(\dfrac{1}{2}\right)^{n+2} \right] \right\} & m = \text{even},\ n = \text{odd} \\ 0 & m = \text{odd or } n = \text{even} \end{cases}$$

NOTE: z-Section can be approximated by I-Section with respect to its principal axes. The results above are applicable to this section.

TABLE 3.0-1. (Continued)

HAT-SECTION



$F_0 = 0$ $\qquad m = 1, 3, 5 \ldots$

$$= \frac{2V_{mn}}{(n+1)(m+1)} \left\{ \left[(-c)^{n+1} - (-c-w)^{n+1} \right] \left[\left(\frac{b}{2} + t + \rho \right)^{m+1} - \left(\frac{b}{2} + t \right)^{m+1} \right] + \left[a^{n+1} - (-c-w)^{n+1} \right] \left[\left(\frac{b}{2} + t \right)^{m+1} - \left(\frac{b}{2} \right)^{m+1} \right] + \left(\frac{b}{2} \right)^{m+1} \left[a^{n+1} - (a-k)^{n+1} \right] \right\}$$

$m = 0, 2, 4 \ldots$
$n = 0, 1, 2, 3, 4 \ldots$

$F_{1_y} = 0$ $\qquad m = 1, 3, 5 \ldots$

$$= \frac{2V_{mn}}{(n+2)(m+1)} \left\{ \left[(-c)^{n+2} - (-c-w)^{n+2} \right] \left[\left(\frac{b}{2} + t + \rho \right)^{m+1} - \left(\frac{b}{2} + t \right)^{m+1} \right] + \left[a^{n+2} - (-c-w)^{n+2} \right] \left[\left(\frac{b}{2} + t \right)^{m+1} - \left(\frac{b}{2} \right)^{m+1} \right] + \left(\frac{b}{2} \right)^{m+1} \left[a^{n+2} - (a-k)^{n+2} \right] \right\}$$

$m = 0, 2, 4 \ldots$
$n = 0, 1, 2, 3, 4 \ldots$

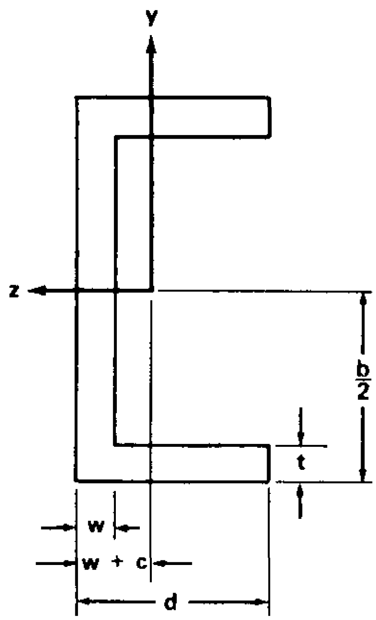
$F_{1_z} = 0$ $\qquad m = 0, 2, 4 \ldots$

$$= \frac{2V_{mn}}{(n+1)(m+2)} \left\{ \left[(-c)^{n+1} - (-c-w)^{n+1} \right] \left[\left(\frac{b}{2} + t + \rho \right)^{m+2} - \left(\frac{b}{2} + t \right)^{m+2} \right] + \left[a^{n+1} - (-c-w)^{n+1} \right] \left[\left(\frac{b}{2} + t \right)^{m+2} - \left(\frac{b}{2} \right)^{m+2} \right] + \left(\frac{b}{2} \right)^{m+2} \left[a^{n+1} - (a-k)^{n+1} \right] \right\}$$

$m = 1, 3, 5 \ldots$
$n = 0, 1, 2, 3, 4 \ldots$

TABLE 3.0-1. (Continued)

CHANNEL



$F_0 = 0.0$ $\qquad n = 1, 3, 5 \ldots$

$$= \frac{2V_{mn}}{(n+1)(m+1)} \left\{ \left[(c+w)^{m+1} - c^{m+1}\right] \left(\frac{b}{2}\right)^{n+1} + \left[c^{n+1} - (d-c-w)^{m+1}\right] * \left[\left(\frac{b}{2}\right)^{n+1} - \left(\frac{b}{2} - t\right)^{n+1}\right] \right\}$$

$n = 0, 2, 4 \ldots$
$m = 0, 1, 2, 3, 4, 5 \ldots$

$F_{1_y} = 0.0$ $\qquad n = 0, 2, 4 \ldots$

$$= \frac{2V_{mn}}{(n+2)(m+1)} \left\{ \left[(c+w)^{m+1} - c^{m+1}\right] \left(\frac{b}{2}\right)^{n+2} + \left[c^{m+1} - (d-c-w)^{m+1}\right] * \left[\left(\frac{b}{2}\right)^{n+2} - \left(\frac{b}{2} - t\right)^{n+2}\right] \right\}$$

$m = 0, 1, 2, 3, 4, 5 \ldots$
$n = 1, 3, 5 \ldots$

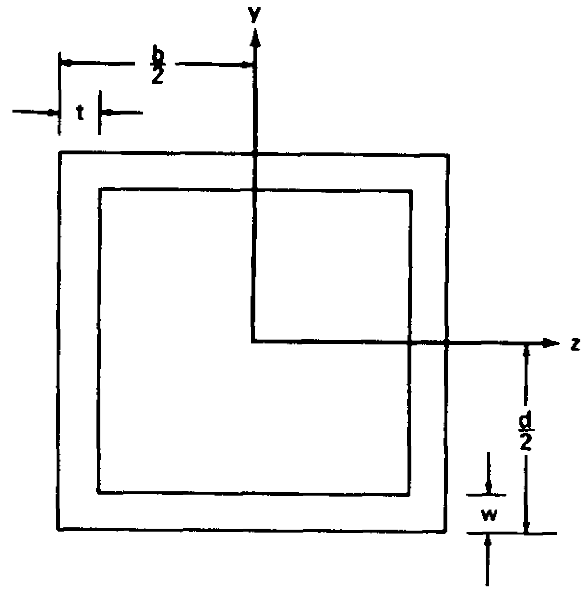
$F_{1_z} = 0.0$ $\qquad n = 1, 3, 5 \ldots$

$$= \frac{2V_{mn}}{(n+1)(m+2)} \left\{ \left[(c+w)^{m+2} - c^{m+2}\right] \left(\frac{b}{2}\right)^{n+1} + \left[c^{m+2} - (d-c-w)^{m+2}\right] * \left[\left(\frac{b}{2}\right)^{n+1} - \left(\frac{b}{2} - t\right)^{n+1}\right] \right\}$$

$n = 0, 2, 4 \ldots$
$m = 0, 1, 2, 3, 4, 5 \ldots$

TABLE 3.0-1. (Continued)

RECTANGULAR TUBE



$$F_0 = 0.0 \qquad n\ 1, 3, 5 \ldots$$

$$= 0.0 \qquad m\ 1, 3, 5 \ldots$$

$$\frac{4V_{mn}}{(n+1)(m+1)} \left\{ \left[\left(\frac{d}{2}\right)^{n+1} - \left(\frac{d}{2} - w\right)^{n+1} \right] \left(\frac{b}{2}\right)^{m+1} + \left(\frac{d}{2} - w\right)^{n+1} \left[\left(\frac{b}{2}\right)^{m+1} - \left(\frac{b}{2} - t\right)^{m+1} \right] \right\} \qquad \begin{matrix} n\ 0, 2, 4 \ldots \\ m\ 0, 2, 4 \ldots \end{matrix}$$

$$F_{t_y} = 0.0 \qquad n\ 0, 2, 4 \ldots$$

$$0.0 \qquad m\ 1, 3, 5 \ldots$$

$$\frac{4V_{mn}}{(n+2)(m+1)} \left\{ \left[\left(\frac{d}{2}\right)^{n+2} - \left(\frac{d}{2} - w\right)^{n+2} \right] \left(\frac{b}{2}\right)^{m+1} + \left(\frac{d}{2} - w\right)^{n+2} \left[\left(\frac{b}{2}\right)^{m+1} - \left(\frac{b}{2} - t\right)^{m+1} \right] \right\} \qquad \begin{matrix} n\ 1, 3, 5 \ldots \\ m\ 0, 2, 4 \ldots \end{matrix}$$

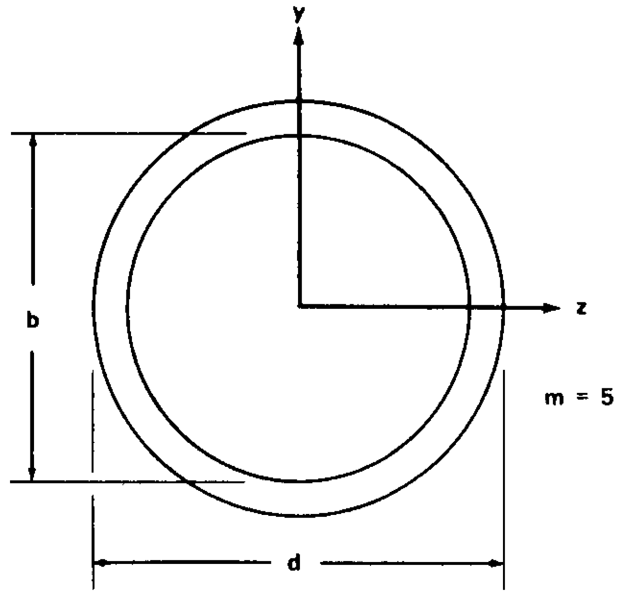
$$F_{t_z} = 0.0 \qquad n\ 1, 3, 5 \ldots$$

$$0.0 \qquad m\ 0, 2, 4 \ldots$$

$$\frac{4V_{mn}}{(n+1)(m+2)} \left\{ \left[\left(\frac{d}{2}\right)^{n+1} - \left(\frac{d}{2} - w\right)^{n+1} \right] \left(\frac{b}{2}\right)^{m+2} + \left(\frac{d}{w} - w\right)^{n+1} \left[\left(\frac{b}{2}\right)^{m+2} - \left(\frac{b}{2} - t\right)^{m+2} \right] \right\} \qquad \begin{matrix} n\ 0, 2, 4 \ldots \\ m\ 1, 3, 5 \ldots \end{matrix}$$

TABLE 3.0-1. (Concluded)

CIRCULAR TUBES



$F_0 \quad 0.0 \qquad n\ 1, 3, 5 \ldots$

$= 0.0 \qquad m\ 1, 3, 5$

$$= \frac{4V_{mn}}{m+1}\left[\left(\frac{d}{2}\right)^{m+n+2} - \left(\frac{b}{2}\right)^{m+n+2}\right]\left[\frac{1}{n+1} - \frac{m+1}{2(n+3)} + \frac{(m+1)(m-1)}{8(n+5)} - \frac{(m+1)(m-1)(m-3)}{48(n+7)} + \frac{(m+1)(m-1)(m-3)(m-5)}{384(n+9)}\right]$$

$n\ 0, 2, 4 \ldots$
$m\ 0, 2, 4$

$F_{1_y} \quad 0.0 \qquad n\ 0, 2, 4 \ldots$

$= 0.0 \qquad m\ 1, 3, 5$

$$\frac{4V_{mn}}{m+1}\left[\left(\frac{d}{2}\right)^{m+n+3} - \left(\frac{b}{2}\right)^{m+n+3}\right]\left[\frac{1}{n+2} - \frac{m+1}{2(n+4)} + \frac{(m+1)(m-1)}{8(n+6)} - \frac{(m+1)(m-1)(m-3)}{48(n+8)} + \frac{(m+1)(m-1)(m-3)(m-5)}{384(n+10)}\right]$$

$n\ 1, 3, 5 \ldots$
$m\ 0, 2, 4$

$F_{1_z} = 0.0 \qquad n\ 1, 3, 5 \ldots$

$0.0 \qquad m\ 0, 2, 4$

$$= \frac{4V_{mn}}{m+2}\left[\left(\frac{d}{2}\right)^{m+n+3} - \left(\frac{b}{2}\right)^{m+n+3}\right]\left[\frac{1}{n+1} - \frac{m+2}{2(n+3)} + \frac{(m+2)m}{8(n+5)} - \frac{(m+2)(m)(m-2)}{48(n+7)} + \frac{(m+2)(m)(m-2)(m-4)}{384(n+9)}\right]$$

$n\ 0, 2, 4 \ldots$
$m\ 1, 3, 5$

TABLE 3.0-2. VALUES OF F_0 AND F_{1_y} FOR FOUR COMMON SHAPES

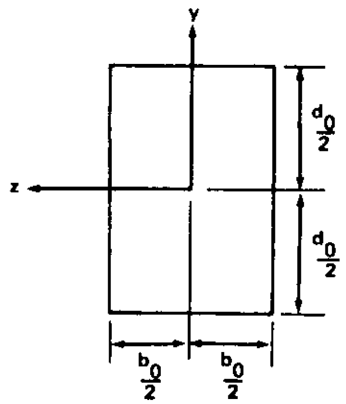
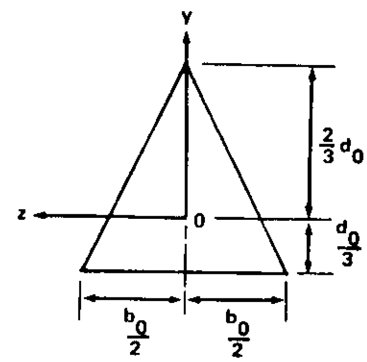
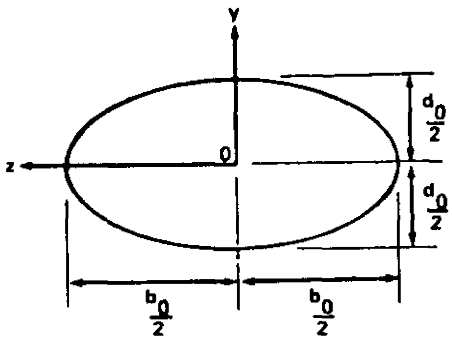
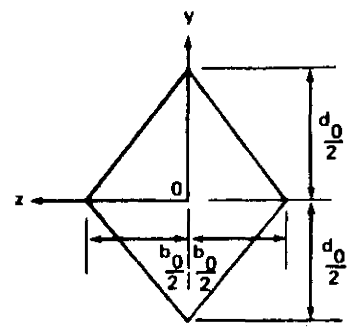
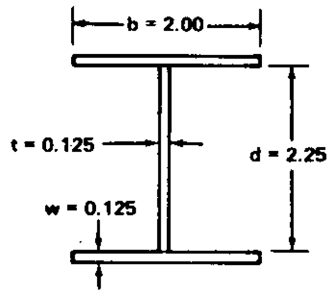
RECTANGULAR			TRIANGULAR		
					
m=0			m=0		
n	F_0	F_{1_y}	n	F_0	F_{1_y}
0	$b_0 d_0 V_{00}$	0	0	$\frac{1}{2} b_0 d_0 V_{00}$	0
1	0	$\frac{1}{12} b_0 d_0^3 V_{01}$	1	0	$\frac{1}{36} b_0 d_0^3 V_{01}$
2	$\frac{1}{12} b_0 d_0^3 V_{02}$	0	2	$\frac{1}{36} b_0 d_0^3 V_{02}$	$\frac{1}{270} b_0 d_0^4 V_{03}$
3	0	$\frac{1}{80} b_0 d_0^5 V_{03}$	3	$\frac{1}{270} b_0 d_0^4 V_{03}$	$\frac{1}{270} b_0 d_0^5 V_{03}$
4	$\frac{1}{80} b_0 d_0^5 V_{04}$	0	4	$\frac{1}{270} b_0 d_0^5 V_{04}$	$\frac{2}{7(243)} b_0 d_0^6 V_{04}$
5	0	$\frac{1}{448} b_0 d_0^7 V_{05}$	5	$\frac{2}{7(243)} b_0 d_0^6 V_{05}$	$\frac{31}{56(729)} b_0 d_0^7 V_{05}$

TABLE 3.0-2. (Concluded)

ELLIPTIC	DIAMOND
	

m=0			m=0		
n	F_0	F_{1_y}	n	F_0	F_{1_y}
0	$\pi\, b_0 d_0\, V_{00}$	0	0	$\frac{1}{2}\, b_0 d_0\, V_{00}$	0
1	0	$\frac{\pi\, b_0 d_0^3}{32}\, V_{01}$	1	0	$\frac{1}{48}\, b_0 d_0^3\, V_{01}$
2	$\frac{1}{32}\pi\, b_0 d_0^3\, V_{02}$	0	2	$\frac{1}{48}\, b_0 d_0^3\, V_{02}$	0
3	6	$\frac{\pi}{128}\, b_0 d_0^5\, V_{03}$	3	0	$\frac{1}{480}\, b_0 d_0^5\, V_{03}$
4	$\frac{\pi}{128}\, b_0 d_0^5\, V_{04}$	0	4	$\frac{1}{480}\, b_0 d_0^5\, V_{04}$	0
5	0	$\frac{15\,\pi}{32(256)}\, b_0 d_0^7\, V_{05}$	5	0	$\frac{1}{28(120)}\, b_0 d_0^7\, V_{05}$

TABLE 3.0-3. VALUES OF F_0 AND F_{1_y} AND F_{1_z} FOR COMMON SECTIONS.

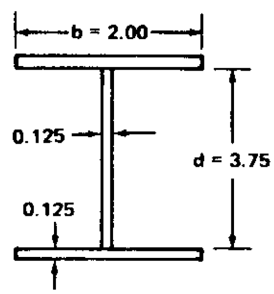


$$F_0 = \frac{1}{V_{mn}} \int V\,dA_0$$

m \ n	0	2	4	6
0	0.531	0.207	0.121	0.093
2	0.084	0.030	0.011	0.004
4	0.050	0.018	0.006	0.002
6	0.036	0.013	0.004	0.002

$$F_{1_y} = \frac{1}{V_{mn}} \int Vy\,dA_0$$

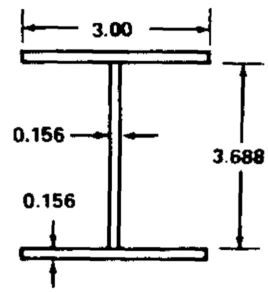
m \ n	1	3	5	7
0	0.207	0.121	0.093	0.084
2	0.030	0.011	0.004	0.001
4	0.018	0.006	0.002	0.001
6	0.013	0.004	0.002	0.001



m \ n	0	2	4	6
0	0.719	0.784	1.379	3.117
2	0.084	0.079	0.075	0.073
4	0.050	0.047	0.044	0.042
6	0.036	0.034	0.032	0.030

m \ n	1	3	5	7
0	0.784	1.379	3.117	8.152
2	0.079	0.075	0.073	0.076
4	0.047	0.044	0.042	0.039
6	0.034	0.032	0.030	0.028

TABLE 3.0-3. (Continued)

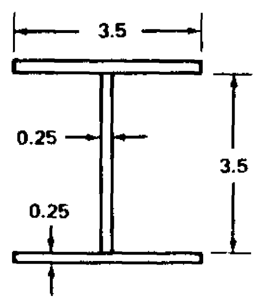


$$F_0 = \frac{1}{V_{mn}} \int V\, dA_0$$

m \ n	0	2	4	6
0	1.043	1.085	1.731	3.603
2	0.352	0.326	0.303	0.285
4	0.474	0.438	0.405	0.376
6	0.762	0.704	0.652	0.605

$$F_{1_y} = \frac{1}{V_{mn}} \int Vy\, dA_0$$

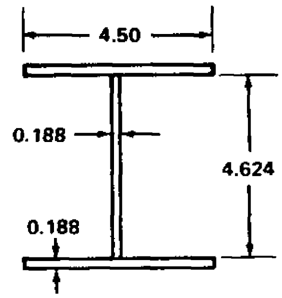
m \ n	1	3	5	7
0	1.085	1.731	3.603	8.892
2	0.326	0.303	0.285	0.277
4	0.438	0.405	0.376	0.350
6	0.704	0.652	0.605	0.563



m \ n	0	2	4	6
0	1.750	1.663	2.323	4.198
2	0.898	0.791	0.705	0.639
4	1.641	1.445	1.279	1.139
6	3.590	3.160	2.798	2.492

m \ n	1	3	5	7
0	1.663	2.323	4.198	9.096
2	0.791	0.705	0.639	0.600
4	1.445	1.279	1.139	1.021
6	3.160	2.798	2.492	2.232

TABLE 3.0-3. (Continued)

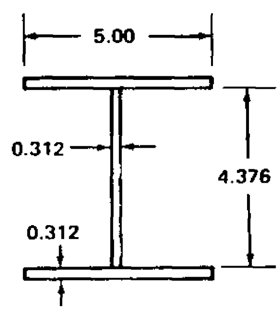


$$F_0 = \frac{1}{V_{mn}} \int V\, dA_0$$

m \ n	0	2	4	6
0	1.715	2.774	6.745	21.551
2	1.430	2.072	3.014	4.416
4	4.336	6.279	9.110	13.245
6	15.681	22.705	32.942	47.892

$$F_{1_y} = \frac{1}{V_{mn}} \int Vy\, dA_0$$

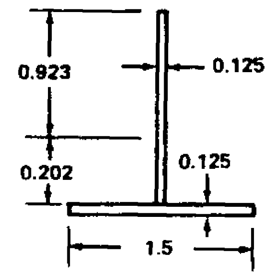
m \ n	1	3	5	7
0	2.774	6.745	21.551	82.620
2	2.072	3.014	4.416	6.584
4	6.279	9.110	13.245	19.295
6	22.705	32.942	47.892	69.767



m \ n	0	2	4	6
0	2.925	4.325	9.228	25.533
2	3.261	4.488	6.237	8.783
4	12.188	16.766	23.199	32.289
6	54.408	74.845	103.564	144.135

m \ n	1	3	5	7
0	4.325	9.228	25.533	85.468
2	4.488	6.237	8.783	12.697
4	16.766	23.199	32.289	45.199
6	74.845	103.564	144.135	201.741

TABLE 3.0-3. (Continued)

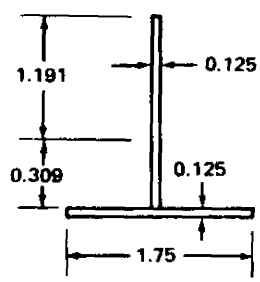


$$F_0 = \frac{1}{V_{mn}} \int V \, dA_0$$

m \ n	0	1	2	3	4
0	0.328	0.001	0.046	0.019	0.018
2	0.035	-0.009	0.003	-0.001	0
4	0.012	-0.003	0.001	0	0
6	0.005	-0.001	0	0	0

$$F_1 = \frac{1}{V_{mn}} \int Vy \, dA_0$$

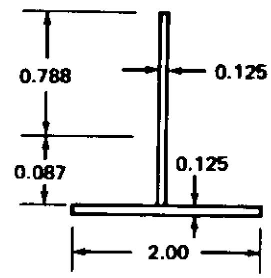
m \ n	0	1	2	3	4
0	0.001	0.046	0.019	0.018	0.013
2	-0.009	0.003	-0.001	0	0
4	-0.003	0.001	0	0	0
6	-0.001	0	0	0	0



m \ n	0	1	2	3	4
0	0.406	0.001	0.102	0.051	0.064
2	0.056	-0.021	0.008	-0.003	0.001
4	0.026	-0.010	0.004	-0.001	0.001
6	0.014	-0.005	0.002	-0.001	0

m \ n	0	1	2	3	4
0	0.001	0.102	0.051	0.064	0.058
2	-0.021	0.008	-0.003	0.001	0
4	-0.010	0.004	-0.001	0.001	0
6	-0.005	0.002	-0.001	0	0

TABLE 3.0-3. (Continued)

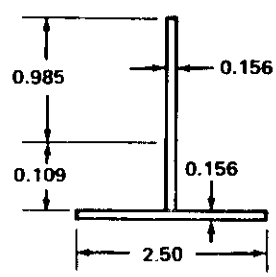


$$F_0 = \frac{1}{V_{mn}} \int V \, dA_0$$

m \ n	0	1	2	3	4
0	0.359	0.001	0.026	0.011	0.008
2	0.083	-0.012	0.020	0	0
4	0.050	-0.007	0.001	0	0
6	0.036	-0.005	0.001	0	0

$$F_1 = \frac{1}{V_{mn}} \int Vy \, dA_0$$

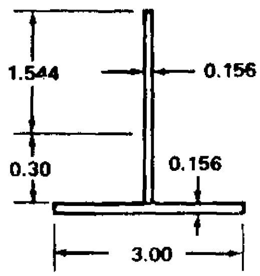
m \ n	0	1	2	3	4
0	0.001	0.026	0.011	0.008	0.005
2	-0.012	0.020	0	0	0
4	-0.007	0.001	0	0	0
6	-0.005	0.001	0	0	0



m \ n	0	1	2	3	4
0	0.561	0.002	0.064	0.034	0.030
2	0.203	-0.038	0.008	-0.001	0
4	0.190	-0.036	0.007	-0.001	0
6	0.213	-0.040	0.008	-0.002	0

m \ n	0	1	2	3	4
0	0.002	0.064	0.034	0.030	0.024
2	-0.038	0.008	-0.001	0	0
4	-0.036	0.007	-0.001	0	0
6	-0.040	0.008	-0.002	0	0

TABLE 3.0-3. (Continued)

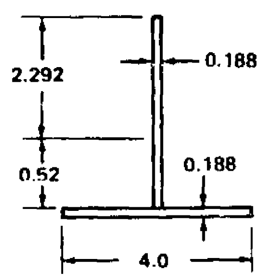


$$F_0 = \frac{1}{V_{mn}} \int V \, dA_0$$

m \ n	0	1	2	3	4
0	0.756	0.002	0.261	0.195	0.284
2	0.352	-0.132	0.051	-0.019	0.008
4	0.474	-0.179	0.069	-0.027	0.011
6	0.762	-0.288	0.110	-0.043	0.017

$$F_1 = \frac{1}{V_{mn}} \int Vy \, dA_0$$

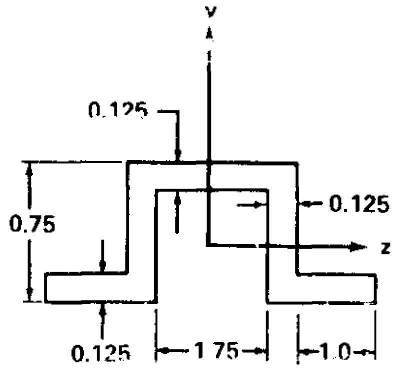
m \ n	0	1	2	3	4
0	0.002	0.261	0.195	0.284	0.348
2	-0.132	0.051	-0.019	0.008	-0.002
4	-0.179	0.069	-0.027	0.011	-0.004
6	-0.288	0.110	-0.043	0.017	-0.007



m \ n	0	1	2	3	4
0	1.281	0.007	1.049	1.115	2.492
2	1.004	-0.614	0.383	-0.233	0.156
4	2.406	-1.478	0.914	-0.570	0.358
6	6.875	-4.222	2.612	-1.629	1.023

m \ n	0	1	2	3	4
0	0.007	1.049	1.115	2.492	4.471
2	-0.614	0.383	-0.233	0.156	-0.081
4	-1.478	0.914	-0.570	0.358	-0.226
6	-4.222	2.612	-1.629	1.023	-0.647

TABLE 3.0-3. (Continued)



$$F_0 = \frac{1}{V_{mn}} \int V \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.656	0.734×10^{-3}	0.55×10^{-1}	0.165×10^{-2}	0.559×10^{-2}	0.31×10^{-3}
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.894	-0.152	0.659×10^{-1}	-0.135×10^{-1}	0.627×10^{-2}	-0.125×10^{-3}
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.172×10^{1}	-0.449	0.148	-0.409×10^{-1}	0.14×10^{-1}	-0.393×10^{-2}
5	0.0	0.0	0.0	0.0	0.0	0.0

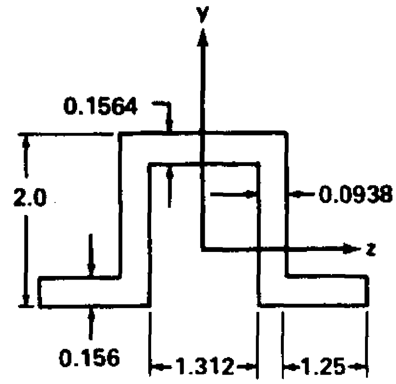
$$F_{1_y} = \frac{1}{V_{mn}} \int V y \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.734×10^{-3}	0.55×10^{-1}	0.165×10^{-2}	0.559×10^{-2}	0.34×10^{-3}	0.612×10^{-3}
1	0.0	0.0	0.0	0.0	0.0	0.0
2	-0.152	0.66×10^{-1}	-0.135×10^{-1}	0.627×10^{-1}	-0.125×10^{-2}	0.638×10^{-3}
3	0.0	0.0	0.0	0.0	0.0	0.0
4	-0.449	0.148	-0.409×10^{-1}	0.14×10^{-1}	-0.393×10^{-2}	0.139×10^{-2}
5	0.0	0.0	0.0	0.0	0.0	0.0

$$F_{1_z} = \frac{1}{V_{mn}} \int V z \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.639	-0.155	0.581×10^{-1}	-0.138×10^{-1}	0.561×10^{-2}	-0.13×10^{-2}
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.158×10^{1}	-0.451	0.141	-0.413×10^{-1}	0.134×10^{-1}	-0.397×10^{-2}
4	0.0	0.0	0.0	0.0	0.0	0.0
5	0.455×10^{1}	-0.134×10^{1}	0.406	-0.123	0.384×10^{-1}	-0.119×10^{-1}

TABLE 3.0-3. (Continued)



$$F_0 = \frac{1}{V_{mn}} \int V \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.972	-0.901 × 10^{-2}	0.603	0.161	0.517	0.289
1	0.0	0.0	0.0	0.0	0.0	0.0
2	1.	-0.534	0.554	-0.273	0.352	-0.121
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.209 × 10^1	-0.148 × 10^1	0.118 × 10^1	-0.838	0.694	-0.476
5	0.0	0.0	0.0	0.0	0.0	0.0

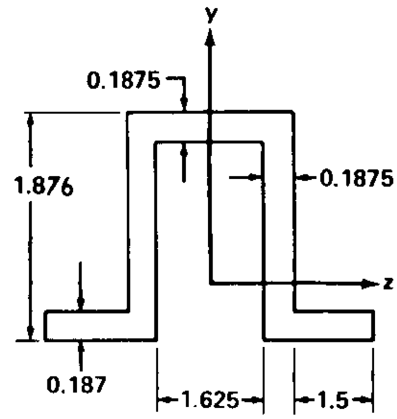
$$F_{1_y} = \frac{1}{V_{mn}} \int V y \, dA_0$$

m \ n	0	1	2	3	4	5
0	-0.901 × 10^{-2}	0.603	0.161	0.517	0.289	0.514
1	0.0	0.0	0.0	0.0	0.0	0.0
2	-0.534	0.554	-0.273	0.352	-0.121	0.247
3	0.0	0.0	0.0	0.0	0.0	0.0
4	-0.148 × 10^1	0.118 × 10^1	-0.838	0.694	-0.476	0.422
5	0.0	0.0	0.0	0.0	0.0	0.0

$$F_{1_z} = \frac{1}{V_{mn}} \int V z \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.82	-0.565	0.487	-0.305	0.304	-0.155
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.2 × 10^1	-0.149 × 10^1	0.115 × 10^1	-0.854	0.67	-0.493
4	0.0	0.0	0.0	0.0	0.0	0.0
5	0.572 × 10^1	-0.431 × 10^1	0.327 × 10^1	-0.248 × 10^1	0.19 × 10^1	-0.145 × 10^1

TABLE 3.0-3. (Continued)



$F_0 \quad \frac{1}{V_{mn}} \int V \, dA_0$

m \ n	0	1	2	3	4	5
0	0.157×10^{1}	0.335×10^{-1}	0.798	0.23	0.584	0.326
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.248×10^{1}	-0.109×10^{1}	0.111×10^{1}	-0.445	0.602	-0.142
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.777×10^{1}	-0.486×10^{1}	0.36×10^{1}	-0.227×10^{1}	0.178×10^{1}	-0.106×10^{1}
5	0.0	0.0	0.0	0.0	0.0	0.0

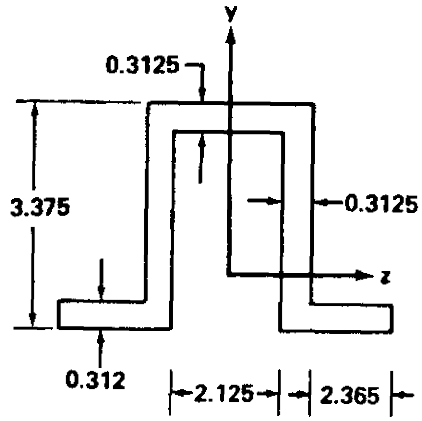
$F_{1_y} \quad \frac{1}{V_{mn}} \int V y \, dA_0$

m \ n	0	1	2	3	4	5
0	0.335×10^{-1}	0.798	0.23	0.584	0.326	0.502
1	0.0	0.0	0.0	0.0	0.0	0.0
2	-0.109×10^{1}	0.111×10^{1}	-0.445	0.602	-0.142	0.37
3	0.0	0.0	0.0	0.0	0.0	0.0
4	-0.486×10^{1}	0.36×10^{1}	-0.227×10^{1}	0.178×10^{1}	-0.106×10^{1}	0.921
5	0.0	0.0	0.0	0.0	0.0	0.0

$F_{1_z} \quad \frac{1}{V_{mn}} \int V z \, dA_0$

m \ n	0	1	2	3	4	5
0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.19×10^{1}	-0.118×10^{1}	0.93	-0.529	0.485	-0.221
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.728×10^{1}	-0.494×10^{1}	0.345×10^{1}	-0.234×10^{1}	0.168×10^{1}	-0.113×10^{1}
4	0.0	0.0	0.0	0.0	0.0	0.0
5	0.327×10^{2}	-0.224×10^{2}	0.154×10^{2}	-0.107×10^{2}	0.745×10^{1}	-0.52×10^{1}

TABLE 3.0-3. (Continued)



$$F_0 = \frac{1}{V_{mn}} \int V \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.425×10^{1}	0.604×10^{-1}	0.668×10^{1}	0.331×10^{1}	0.157×10^{2}	0.159×10^{2}
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.318×10^{2}	-0.112×10^{2}	0.197×10^{2}	-0.149×10^{2}	0.337×10^{2}	-0.159×10^{2}
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.959×10^{2}	-0.109×10^{3}	0.142×10^{3}	-0.164×10^{3}	0.223×10^{7}	-0.246×10^{3}
5	0.0	0.0	0.0	0.0	0.0	0.0

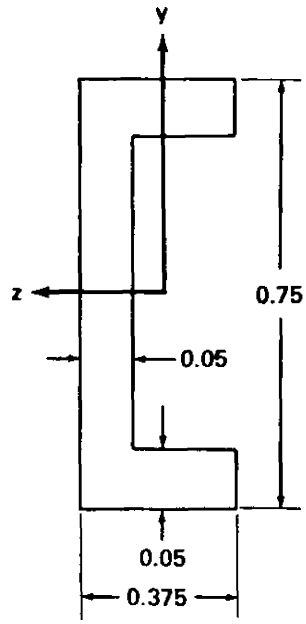
$$F_{1_y} = \frac{1}{V_{mn}} \int V y \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.604×10^{-1}	0.668×10^{1}	0.331×10^{1}	0.157×10^{2}	0.159×10^{2}	0.440×10^{2}
1	0.0	0.0	0.0	0.0	0.0	0.0
2	-0.112×10^{2}	0.197×10^{2}	-0.149×10^{2}	0.337×10^{2}	-0.159×10^{2}	0.657×10^{2}
3	0.0	0.0	0.0	0.0	0.0	0.0
4	-0.109×10^{3}	0.142×10^{3}	-0.164×10^{3}	0.223×10^{3}	-0.246×10^{3}	0.365×10^{3}
5	0.0	0.0	0.0	0.0	0.0	0.0

$$F_{1_z} = \frac{1}{V_{mn}} \int V z \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.106×10^{2}	-0.122×10^{2}	0.164×10^{2}	-0.177×10^{2}	0.269×10^{2}	-0.246×10^{7}
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.911×10^{2}	-0.111×10^{3}	0.137×10^{3}	-0.168×10^{3}	0.212×10^{3}	-0.259×10^{3}
4	0.0	0.0	0.0	0.0	0.0	0.0
5	0.914×10^{3}	-0.112×10^{4}	0.138×10^{4}	-0.17×10^{4}	0.212×10^{4}	-0.264×10^{4}

TABLE 3.0-3. (Continued)



$F_0 \quad \frac{1}{V_{mn}} \int V \, dA_0$

m \ n	0	1	2	3	4	5
0	0.174×10^{-1}	0.0	-0.709×10^{-3}	0.0	-0.156×10^{-3}	0.0
1	-0.375×10^{-5}	0.0	-0.248×10^{-3}	0.0	-0.366×10^{-4}	0.0
2	-0.307×10^{-3}	0.0	-0.598×10^{-4}	0.0	-0.792×10^{-5}	0.0
3	-0.925×10^{-4}	0.0	-0.134×10^{-4}	0.0	-0.17×10^{-5}	0.0
4	-0.226×10^{-4}	0.0	-0.297×10^{-5}	0.0	-0.371×10^{-6}	0.0
5	-0.527×10^{-5}	0.0	-0.665×10^{-6}	0.0	-0.826×10^{-7}	0.0

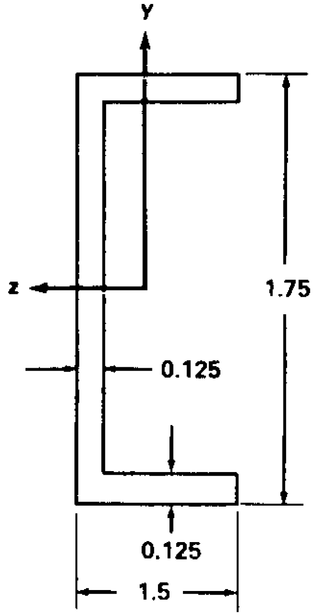
$F_{1_y} \quad \frac{1}{V_{mn}} \int V y \, dA_0$

m \ n	0	1	2	3	4	5
0	0.0	-0.709×10^{-3}	0.0	-0.156×10^{-3}	0.0	-0.23×10^{-4}
1	0.0	-0.248×10^{-3}	0.0	-0.366×10^{-4}	0.0	-0.486×10^{-5}
2	0.0	-0.598×10^{-4}	0.0	-0.792×10^{-5}	0.0	-0.101×10^{-5}
3	0.0	-0.134×10^{-4}	0.0	-0.17×10^{-5}	0.0	-0.214×10^{-6}
4	0.0	-0.297×10^{-5}	0.0	-0.371×10^{-6}	0.0	-0.464×10^{-7}
5	0.0	-0.665×10^{-6}	0.0	-0.826×10^{-7}	0.0	-0.103×10^{-7}

$F_{1_z} \quad \frac{1}{V_{mn}} \int V z \, dA_0$

m \ n	0	1	2	3	4	5
0	-0.375×10^{-5}	0.0	-0.248×10^{-3}	0.0	-0.366×10^{-4}	0.0
1	-0.307×10^{-3}	0.0	-0.598×10^{-4}	0.0	-0.792×10^{-5}	0.0
2	-0.925×10^{-4}	0.0	-0.134×10^{-4}	0.0	-0.17×10^{-5}	0.0
3	-0.226×10^{-4}	0.0	-0.297×10^{-5}	0.0	-0.371×10^{-6}	0.0
4	-0.527×10^{-5}	0.0	-0.665×10^{-6}	0.0	-0.826×10^{-7}	0.0
5	-0.122×10^{-5}	0.0	-0.151×10^{-6}	0.0	-0.188×10^{-7}	0.0

TABLE 3.0-3. (Continued)



$$F_0 \quad \frac{1}{V_{mn}} \int V \, dA_0$$

n / m	0	1	2	3	4	5
0	0.885×10^{-1}	0.0	-0.303×10^{-1}	0.0	-0.318×10^{-1}	0.0
1	0.175×10^{-1}	0.0	-0.319×10^{-1}	0.0	-0.269×10^{-1}	0.0
2	-0.118×10^{-1}	0.0	-0.292×10^{-1}	0.0	-0.223×10^{-1}	0.0
3	-0.223×10^{-1}	0.0	-0.254×10^{-1}	0.0	-0.183×10^{-1}	0.0
4	-0.246×10^{-1}	0.0	-0.215×10^{-1}	0.0	-0.15×10^{-1}	0.0
5	-0.235×10^{-1}	0.0	-0.182×10^{-1}	0.0	-0.125×10^{-1}	0.0

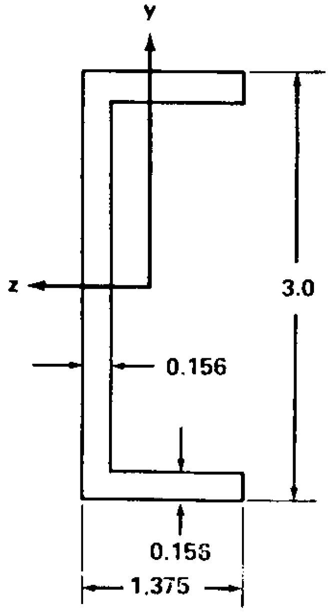
$$F_{1_y} \quad \frac{1}{V_{mn}} \int V y \, dA_0$$

n / m	0	1	2	3	4	5
0	0.0	-0.303×10^{-1}	0.0	-0.318×10^{-1}	0.0	-0.246×10^{-1}
1	0.0	-0.311×10^{-1}	0.0	-0.269×10^{-1}	0.0	-0.197×10^{-1}
2	0.0	-0.292×10^{-1}	0.0	-0.223×10^{-1}	0.0	-0.157×10^{-1}
3	0.0	-0.254×10^{-1}	0.0	-0.183×10^{-1}	0.0	-0.127×10^{-1}
4	0.0	-0.215×10^{-1}	0.0	-0.15×10^{-1}	0.0	-0.103×10^{-1}
5	0.0	-0.182×10^{-1}	0.0	-0.125×10^{-1}	0.0	-0.847×10^{-2}

$$F_{1_z} \quad \frac{1}{V_{mn}} \int V z \, dA_0$$

n / m	0	1	2	3	4	5
0	0.175×10^{-1}	0.0	-0.319×10^{-1}	0.0	-0.269×10^{-1}	0.0
1	-0.118×10^{-1}	0.0	-0.292×10^{-1}	0.0	-0.223×10^{-1}	0.0
2	-0.223×10^{-1}	0.0	-0.254×10^{-1}	0.0	-0.183×10^{-1}	0.0
3	-0.246×10^{-1}	0.0	-0.215×10^{-1}	0.0	-0.15×10^{-1}	0.0
4	-0.215×10^{-1}	0.0	-0.182×10^{-1}	0.0	-0.125×10^{-1}	0.0
5	-0.212×10^{-1}	0.0	-0.154×10^{-1}	0.0	-0.104×10^{-1}	0.0

TABLE 3.0-3. (Continued)



$F_0 \quad \frac{1}{V_{mn}} \int V \, dA_0$

m \ n	0	1	2	3	4	5
0	0.231	0.0	-0.128	0.0	-0.50	0.0
1	-0.19×10^{-3}	0.0	-0.184	0.0	-0.448	0.0
2	-0.54×10^{-1}	0.0	-0.167	0.0	-0.363	0.0
3	-0.598×10^{-1}	0.0	-0.14	0.0	-0.291	0.0
4	-0.542×10^{-1}	0.0	-0.116	0.0	-0.238	0.0
5	-0.471×10^{-1}	0.0	-0.973×10^{-1}	0.0	-0.198	0.0

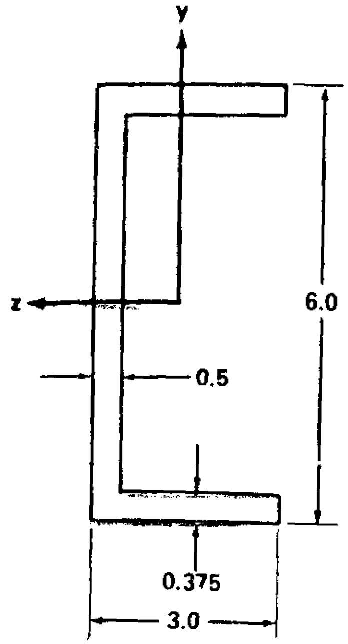
$F_{1_y} \quad \frac{1}{V_{mn}} \int V y \, dA_0$

m \ n	0	1	2	3	4	5
0	0.0	-0.128	0.0	-0.50	0.0	-0.123×10^{1}
1	0.0	-0.184	0.0	-0.448	0.0	-0.977
2	0.0	-0.167	0.0	-0.363	0.0	-0.76
3	0.0	-0.14	0.0	-0.291	0.0	-0.601
4	0.0	-0.116	0.0	-0.228	0.0	-0.487
5	0.0	-0.073×10^{-1}	0.0	-0.198	0.0	-0.406

$F_{1_z} \quad \frac{1}{V_{mn}} \int V z \, dA_0$

m \ n	0	1	2	3	4	5
0	-0.19×10^{-3}	0.0	-0.184	0.0	-0.448	0.0
1	-0.54×10^{-1}	0.0	-0.167	0.0	-0.363	0.0
2	-0.598×10^{-1}	0.0	-0.14	0.0	-0.291	0.0
3	-0.542×10^{-1}	0.0	-0.116	0.0	-0.238	0.0
4	-0.471×10^{-1}	0.0	-0.473×10^{-1}	0.0	-0.198	0.0
5	-0.407×10^{-1}	0.0	-0.831×10^{-1}	0.0	-0.168	0.0

TABLE 3.0-3. (Continued)



$$F_0 \quad \frac{1}{V_{mn}} \int V \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.161×10^1	0.0	-0.197×10^1	0.0	-0.388×10^2	0.0
1	0.375×10^{-3}	0.0	-0.852×10^1	0.0	-0.812×10^2	0.0
2	-0.149×10^1	0.0	-0.171×10^2	0.0	-0.144×10^3	0.0
3	-0.349×10^1	0.0	-0.31×10^2	0.0	-0.253×10^3	0.0
4	-0.681×10^1	0.0	-0.562×10^2	0.0	-0.451×10^3	0.0
5	-0.128×10	0.0	-0.103×10^3	0.0	-0.826×10^3	0.0

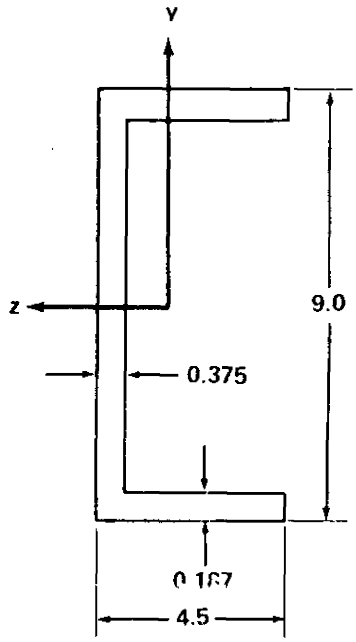
$$F_{1_y} \quad \frac{1}{V_{mn}} \int V y \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.0	-0.197×10^1	0.0	-0.388×10^2	0.0	-0.388×10^3
1	0.0	-0.852×10^1	0.0	-0.812×10	0.0	-0.695×10^3
2	0.0	-0.171×10^2	0.0	-0.144×10^3	0.0	-0.118×10^4
3	0.0	-0.31×10^2	0.0	-0.253×10^3	0.0	-0.204×10^4
4	0.0	-0.562×10^2	0.0	-0.451×10^3	0.0	-0.364×10^4
5	0.0	-0.103×10^3	0.0	-0.826×10^3	0.0	-0.663×10^4

$$F_{1_z} \quad \frac{1}{V_{mn}} \int V z \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.375×10^{-3}	0.0	-0.852×10^1	0.0	-0.812×10^2	0.0
1	-0.149×10^1	0.0	-0.171×10^2	0.0	-0.144×10^3	0.0
2	-0.349×10^1	0.0	-0.31×10^2	0.0	-0.253×10^3	0.0
3	-0.681×10^1	0.0	-0.562×10^2	0.0	-0.451×10^3	0.0
4	-0.128×10^2	0.0	-0.103×10^3	0.0	-0.826×10^3	0.0
5	-0.243×10^3	0.0	-0.193×10^3	0.0	-0.154×10^4	0.0

TABLE 3.0-3. (Continued)



$$F_0 \quad \frac{1}{V_{mn}} \int V \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.222×10^1	0.0	0.302	0.0	-0.16×10^3	0.0
1	-0.165×10^{-1}	0.0	-0.301×10^2	0.0	-0.706×10^3	0.0
2	-0.414×10^1	0.0	-0.102×10^1	0.0	-0.207×10^4	0.0
3	-0.146×10^2	0.0	-0.3×10^3	0.0	-0.589×10^4	0.0
4	-0.45×10^2	0.0	-0.884×10^3	0.0	-0.172×10^5	0.0
5	-0.137×10^3	0.0	-0.267×10^4	0.0	-0.52×10^5	0.0

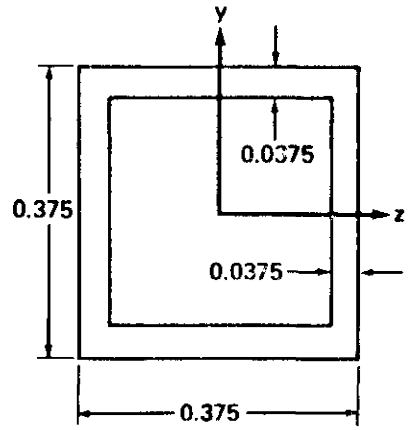
$$F_{1_y} \quad \frac{1}{V_{mn}} \int V y \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.0	0.302	0.0	-0.16×10^3	0.0	-0.149×10^4
1	0.0	-0.301×10^2	0.0	-0.706×10^3	0.0	-0.147×10^5
2	0.0	-0.102×10	0.0	-0.207×10^4	0.0	-0.409×10^5
3	0.0	-0.3×10^3	0.0	-0.589×10^4	0.0	-0.115×10^6
4	0.0	-0.884×10^3	0.0	-0.172×10^5	0.0	-0.335×10^6
5	0.0	-0.267×10^4	0.0	-0.52×10^5	0.0	-0.101×10^7

$$F_{1_z} \quad \frac{1}{V_{mn}} \int V z \, dA_0$$

m \ n	0	1	2	3	4	5
0	-0.165×10^{-1}	0.0	-0.301×10^2	0.0	-0.706×10^3	0.0
1	-0.414×10^1	0.0	-0.102×10^1	0.0	-0.207×10^4	0.0
2	-0.146×10^2	0.0	-0.3×10^3	0.0	-0.589×10^4	0.0
3	-0.45×10^2	0.0	-0.884×10^3	0.0	-0.172×10^5	0.0
4	-0.137×10^3	0.0	-0.267×10^4	0.0	-0.52×10^5	0.0
5	-0.426×10^3	0.0	-0.829×10^4	0.0	-0.161×10^6	0.0

TABLE 3.0-3. (Continued)



$F_0 \quad \frac{1}{V_{mn}} \int V \, dA_0$

m \ n	0	1	2	3	4	5
0	0.506×10^{-1}	0.0	$0.973 \times 10^{-[illegible]}$	0.0	0.256×10^{-4}	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.973×10^{-3}	0.0	0.142×10^{-4}	0.0	$0.339 \times 10^{-[illegible]}$	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.256×10^{-4}	0.0	0.339×10^{-6}	0.0	$0.767 \times 10^{-[illegible]}$	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0

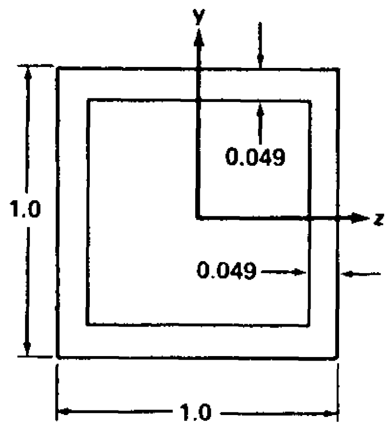
$F_{1_y} \quad \frac{1}{V_{mn}} \int V y \, dA_0$

m \ n	0	1	2	3	4	5
0	0.0	0.973×10^{-3}	0.0	0.256×10^{-1}	0.0	0.726×10^{-6}
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.142×10^{-4}	0.0	0.339×10^{-6}	0.0	0.913×10^{-8}
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.339×10^{-6}	0.0	0.767×10^{-8}	0.0	0.2×10^{-9}
5	0.0	0.0	0.0	0.0	0.0	0.0

$F_{1_z} \quad \frac{1}{V_{mn}} \int V z \, dA_0$

m \ n	0	1	2	3	4	5
0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.973×10^{-3}	0.0	0.142×10^{-4}	0.0	0.339×10^{-6}	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.256×10^{-4}	0.0	0.339×10^{-6}	0.0	0.767×10^{-8}	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0
5	0.726×10^{-6}	0.0	0.915×10^{-8}	0.0	0.2×10^{-9}	0.0

TABLE 3.0-3. (Continued)



$F_0 \quad \frac{1}{V_{mn}} \int V\,dA_0$

n / m	0	1	2	3	4	5
0	0.186	0.0	0.282×10^{-1}	0.0	0.577×10^{-2}	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.282×10^{-1}	0.0	0.32×10^{-2}	0.0	0.585×10^{-3}	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.577×10^{-2}	0.0	0.585×10^{-3}	0.0	0.1×10^{-4}	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0

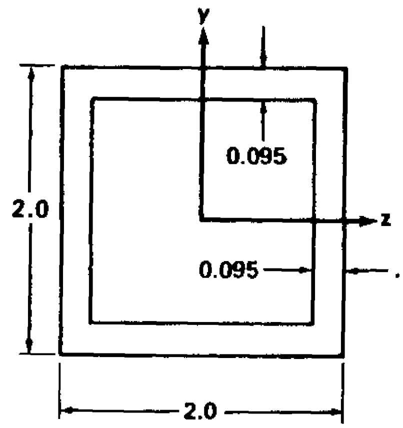
$F_{1_y} \quad \frac{1}{V_{mn}} \int Vy\,dA_0$

n / m	0	1	2	3	4	5
0	0.0	0.282×10^{-1}	0.0	0.577×10^{-2}	0.0	0.125×10^{-2}
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.32×10^{-2}	0.0	0.585×10^{-3}	0.0	0.12×10^{-3}
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.585×10^{-3}	0.0	0.1×10^{-4}	0.0	0.198×10^{-4}
5	0.0	0.0	0.0	0.0	0.0	0.0

$F_{1_z} \quad \frac{1}{V_{mn}} \int Vz\,dA_0$

n / m	0	1	2	3	4	5
0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.282×10^{-1}	0.0	0.32×10^{-2}	0.0	0.585×10^{-3}	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.577×10^{-2}	0.0	0.585×10^{-3}	0.0	0.1×10^{-4}	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0
5	0.125×10^{-2}	0.0	0.12×10^{-3}	0.0	0.198×10^{-1}	0.0

TABLE 3.0-3. (Continued)



$F_0 \quad \frac{1}{V_{mn}} \int V \, dA_0$

n / m	0	1	2	3	4	5
0	0.724	0.0	0.439	0.0	0.36	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.439	0.0	0.2	0.0	0.147	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.36	0.0	0.147	0.0	0.101	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0

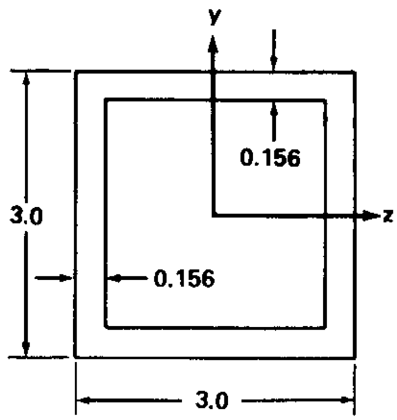
$F_{1_y} \quad \frac{1}{V_{mn}} \int V y \, dA_0$

n / m	0	1	2	3	4	5
0	0.0	0.439	0.0	0.36	0.0	0.314
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.2	0.0	0.147	0.0	0.12
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.147	0.0	0.101	0.0	0.798×10^{-1}
5	0.0	0.0	0.0	0.0	0.0	0.0

$F_{1_z} \quad \frac{1}{V_{mn}} \int V z \, dA_0$

n / m	0	1	2	3	4	5
0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.439	0.0	0.2	0.0	0.147	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.36	0.0	0.147	0.0	0.101	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0
5	0.314	0.0	0.12	0.0	0.798×10^{-1}	0.0

TABLE 3.0-3. (Continued)



$$F_0 = \frac{1}{V_{mn}} \int V \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.177×10^1	0.0	0.24×10^1	0.0	0.44×10^1	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.24×10^1	0.0	0.244×10^1	0.0	0.4×10^1	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.44×10^1	0.0	0.4×10^1	0.0	0.615×10^1	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0

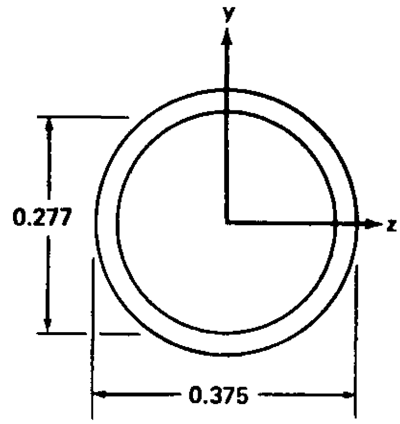
$$F_{1_y} = \frac{1}{V_{mn}} \int V y \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.0	0.24×10^1	0.0	0.44×10^1	0.0	0.856×10^1
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.244×10^1	0.0	0.4×10^1	0.0	0.732×10^1
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.4×10^1	0.0	0.615×10^1	0.0	0.109×10^2
5	0.0	0.0	0.0	0.0	0.0	0.0

$$F_{1_z} = \frac{1}{V_{mn}} \int V z \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.24×10^1	0.0	0.244×10^1	0.0	0.4×10^1	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.44×10^1	0.0	0.4×10^1	0.0	0.615×10^1	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0
5	0.856×10^1	0.0	0.732×10^1	0.0	0.109×10^2	0.0

TABLE 3.0-3. (Continued)



$$F_0 = \frac{1}{V_{mn}} \int V \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.508×10^{-1}	0.0	0.712×10^{-3}	0.0	0.154×10^{-4}	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.679×10^{-3}	0.0	0.466×10^{-5}	0.0	0.647×10^{-7}	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.143×10^{-4}	0.0	0.7×10^{-7}	0.0	0.809×10^{-9}	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0

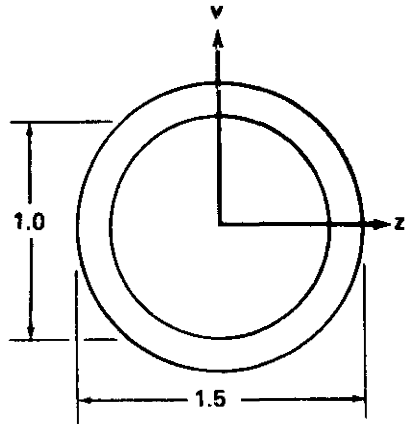
$$F_{1_y} = \frac{1}{V_{mn}} \int V y \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.0	0.712×10^{-3}	0.0	0.154×10^{-4}	0.0	0.382×10^{-6}
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.466×10^{-5}	0.0	0.647×10^{-7}	0.0	0.113×10^{-8}
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.7×10^{-7}	0.0	0.809×10^{-9}	0.0	0.131×10^{-10}
5	0.0	0.0	0.0	0.0	0.0	0.0

$$F_{1_z} = \frac{1}{V_{mn}} \int V z \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.679×10^{-3}	0.0	0.466×10^{-5}	0.0	0.647×10^{-7}	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.143×10^{-4}	0.0	0.7×10^{-7}	0.0	0.809×10^{-9}	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0
5	0.339×10^{-6}	0.0	0.117×10^{-8}	0.0	0.87×10^{-11}	0.0

TABLE 3.0-3. (Continued)



$$F_0 = \frac{1}{V_{mn}} \int V \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.994	0.0	0.208	0.0	0.688×10^{-1}	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.199	0.0	0.208×10^{-1}	0.0	0.447×10^{-2}	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.64×10^{-1}	0.0	0.484×10^{-2}	0.0	0.876×10^{-3}	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0

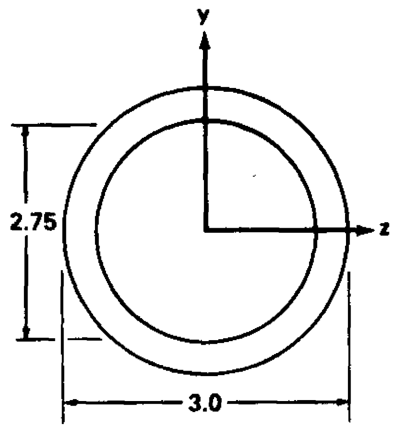
$$F_{1_y} = \frac{1}{V_{mn}} \int V y \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.0	0.208	0.0	0.688×10^{-1}	0.0	0.264×10^{-1}
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.208×10^{-1}	0.0	0.447×10^{-2}	0.0	0.123×10^{-2}
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.484×10^{-2}	0.0	0.876×10^{-3}	0.0	0.224×10^{-3}
5	0.0	0.0	0.0	0.0	0.0	0.0

$$F_{1_z} = \frac{1}{V_{mn}} \int V z \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.199	0.0	0.208×10^{-1}	0.0	0.497×10^{-2}	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.64×10^{-1}	0.0	0.484×10^{-2}	0.0	0.876×10^{-3}	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0
5	0.234×10^{-1}	0.0	0.127×10^{-2}	0.0	0.149×10^{-3}	0.0

TABLE 3.0-3. (Continued)



$$F_0 = \frac{1}{V_{mn}} \int V \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.114×10^1	0.0	0.122×10^1	0.0	0.196×10^1	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.116×10^1	0.0	0.593	0.0	0.597	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.183×10^1	0.0	0.647	0.0	0.53	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0

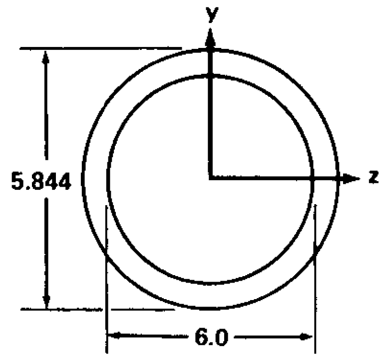
$$F_{1_y} = \frac{1}{V_{mn}} \int V y \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.0	0.122×10^1	0.0	0.196×10^1	0.0	0.352×10^1
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.593	0.0	0.597	0.0	0.744
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.647	0.0	0.53	0.0	0.598
5	0.0	0.0	0.0	0.0	0.0	0.0

$$F_{1_z} = \frac{1}{V_{mn}} \int V z \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.116×10^1	0.0	0.593	0.0	0.597	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.183×10^1	0.0	0.647	0.0	0.53	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0
5	0.313×10^1	0.0	0.769	0.0	0.398	0.0

TABLE 3.0-3. (Continued)



$F_0 \quad \frac{1}{V_{mn}} \int V \, dA_0$

m \ n	0	1	2	3	4	5
0	0.147×10^1	0.0	0.664×10^1	0.0	0.452×10^2	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.634×10^1	0.0	0.136×10^2	0.0	0.58×10^2	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.42×10^2	0.0	0.628×10^2	0.0	0.216×10^3	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0

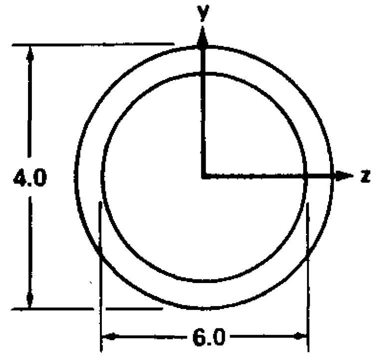
$F_{1_y} \quad \frac{1}{V_{mn}} \int V y \, dA_0$

m \ n	0	1	2	3	4	5
0	0.0	0.664×10^1	0.0	0.452×10^2	0.0	0.342×10^3
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.136×10^2	0.0	0.58×10^2	0.0	0.304×10^3
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.628×10^2	0.0	0.216×10^3	0.0	0.102×10^4
5	0.0	0.0	0.0	0.0	0.0	0.0

$F_{1_z} \quad \frac{1}{V_{mn}} \int V z \, dA_0$

m \ n	0	1	2	3	4	5
0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.634×10^1	0.0	0.136×10^2	0.0	0.58×10^2	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.42×10^2	0.0	0.628×10^2	0.0	0.216×10^3	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0
5	0.304×10^3	0.0	0.314×10^3	0.0	0.682×10^3	0.0

TABLE 3.0-3. (Continued)



$$F_0 = \frac{1}{V_{mn}} \int V \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.159×10^2	0.0	0.533×10^2	0.0	0.282×10^3	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.508×10^2	0.0	0.851×10^2	0.0	0.293×10^3	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.262×10^3	0.0	0.317×10^3	0.0	0.918×10^3	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0

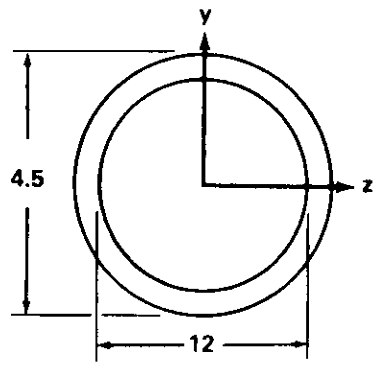
$$F_{1_y} = \frac{1}{V_{mn}} \int V y \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.0	0.533×10^2	0.0	0.282×10^3	0.0	0.173×10^4
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.851×10^2	0.0	0.293×10^3	0.0	0.129×10^4
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.317×10^3	0.0	0.918×10^3	0.0	0.375×10^4
5	0.0	0.0	0.0	0.0	0.0	0.0

$$F_{1_z} = \frac{1}{V_{mn}} \int V z \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.508×10^2	0.0	0.851×10^2	0.0	0.293×10^3	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.262×10^3	0.0	0.317×10^7	0.0	0.918×10^7	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0
5	0.154×10^4	0.0	0.133×10^4	0.0	0.25×10^4	0.0

TABLE 3.0-3. (Concluded)



$$F_0 = \frac{1}{V_{mn}} \int V \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.934×10^1	0.0	0.166×10^3	0.0	0.446×10^4	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.159×10^3	0.0	0.135×10^4	0.0	0.225×10^5	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.414×10^4	0.0	0.244×10^5	0.0	0.332×10^6	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0

$$F_{1_y} = \frac{1}{V_{mn}} \int V y \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.0	0.166×10^3	0.0	0.446×10^4	0.0	0.133×10^6
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.135×10^4	0.0	0.225×10^5	0.0	0.465×10^6
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.244×10^5	0.0	0.332×10^6	0.0	0.619×10^7
5	0.0	0.0	0.0	0.0	0.0	0.0

$$F_{1_z} = \frac{1}{V_{mn}} \int V z \, dA_0$$

m \ n	0	1	2	3	4	5
0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.159×10^3	0.0	0.135×10^4	0.0	0.225×10^5	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.414×10^4	0.0	0.244×10^5	0.0	0.332×10^6	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0
5	0.118×10^6	0.0	0.481×10^6	0.0	0.412×10^7	0.0

B. Results:

$$v(x) = -\int_0^x \int_0^{x_2} \frac{M_{T_z}(x_1)}{EI_z(x_1)} \, dx_1 \, dx_2 + \frac{x}{L} \int_0^L \int_0^{x_2} \frac{M_{T_z}(x_1)}{EI_z(x_1)} \, dx_1 \, dx_2$$

$$v(x) = \frac{\alpha F_1}{I_{0_z}} \left(\frac{x}{L} I_1 - I_{1_x} \right) L^2 \quad .$$

where

$$I_1 = \int_0^1 \int_0^1 \frac{f(x_1)}{g^2(x_1)} \, dx_1 \, dx_2 \quad \text{and} \quad I_{1_x} = \int_0^x \int_0^{x_2} \frac{f(x_1)}{g^2(x_1)} \, dx_1 \, dx_2$$

$$u_{av}(x) = \frac{1}{E} \int_0^x \frac{1}{A} \int_A \alpha ET \, dA \, dx = \frac{\alpha F_0 L}{A_0} \int_0^{x_1} f(x_1) \, dx_1$$

$$M_z(x) = 0$$

$$\sigma_{xx} = -\alpha ET + \frac{P_T}{A} + \left(\frac{M_{T_y} + M_y}{I_y} \right) + \left(\frac{M_{T_z}}{I_z} \right) y \quad .$$

M_y may or may not be zero, depending upon the boundary condition.

If end B is hinged, then

$$u_{av}(x) = 0 \quad ,$$

$$V_0 = M_0 = 0 \quad ,$$

$v(x)$ = same as above,

$$\sigma_{xx} = -\alpha ET + \left(\frac{M_{T_y} + M_y}{I_y} \right) + \left(\frac{M_{T_z}}{I_z} \right) y \quad ,$$

axial force $P = \int_A \alpha ET \, dA$.