Steel Structures: Design and Behavior, Charles G. Salmon and John E. Johnson, 1990

Example 7.7.1

Determine the elastic shear stress distribution on a W24x94 beam subjected to a service load shear force of 200 kips. Also compute the portion of the shear carried by the flange and that carried by the web.

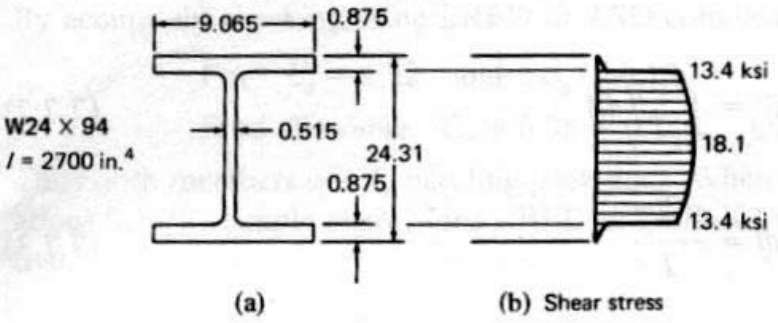

Figure 7.7.2 Example 7.7.1.

SOLUTION

(a) Stress at junction of flange and web.

$$V = 200 \text{ kips}$$

$$Q = 9.065(0.875)(12.155 - 0.4375) = 92.9 \text{ in.}^3$$

$$v = \frac{200(92.9)}{2700(0.515)} = 13.4 \text{ ksi (web)}, \qquad v = 0.76 \text{ ksi (flange)}$$

(b) Stress at neutral axis.

$$Q = 92.9 + (12.155 - 0.875)^2(0.515)(0.5) = 92.9 + 32.8 = 125.7 \text{ in.}^3$$

$$v = \frac{200(125.7)}{2700(0.515)} = 18.1 \text{ ksi}$$

(c) Shear carried by flanges and web. Using an approximate linear variation,

$$V(\text{flanges}) = 2\left(\tfrac{1}{2}\right)(0.76)(0.875)(9.065) = 6 \text{ kips}$$

$$V(\text{web}) = 200 - 6 = 194 \text{ kips}$$

In this case, 97% of the shear is carried by the web.

(d) Average shear stress f_v on web.

$$f_v = \frac{V}{dt_w} = \frac{200}{24.31(0.515)} = 16.0 \text{ ksi}$$

which is 11.6% below the maximum value. ■