Stress-Strain Behavior

12.41 (a) For this portion of the problem we are asked to compute the flexural strength for a spinel specimen that is subjected to a three-point bending test. The flexural strength (Equation 12.7a) is just

$$\sigma_{fs} = \frac{3F_f L}{2bd^2}$$

for a rectangular cross-section. Using the values given in the problem statement,

$$\sigma_{fs} = \frac{(3)(350 \text{ N})(25 \text{ x } 10^{-3}\text{ m})}{(2)(9.0 \text{ x } 10^{-3}\text{ m})(3.8 \text{ x } 10^{-3}\text{ m})^2} = 101 \text{ MPa} \quad (15,200 \text{ psi})$$

(b) We are now asked to compute the maximum deflection. From Table 12.5, the elastic modulus (E) for spinel is 260 GPa (38×10^6 psi). Also, the moment of inertia for a rectangular cross section (Figure 12.32) is just

$$I = \frac{bd^3}{12}$$

Thus,

$$\Delta y = \frac{FL^3}{48E \left(\dfrac{bd^3}{12} \right)} = \frac{FL^3}{4Ebd^3}$$

$$= \frac{(310 \text{ N})(25 \text{ x } 10^{-3}\text{ m})^3}{(4)(260 \text{ x } 10^9 \text{ N/m}^2)(9.0 \text{ x } 10^{-3}\text{ m})(3.8 \text{ x } 10^{-3}\text{ m})^3}$$

$$= 9.4 \text{ x } 10^{-6} \text{ m} = 9.4 \text{ x } 10^{-3} \text{ mm} \quad (3.9 \text{ x } 10^{-4} \text{ in.})$$