

12.44 (a) This portion of the problem asks that we determine whether or not a cylindrical specimen of aluminum oxide having a flexural strength of 300 MPa (43,500 psi) and a radius of 5 mm will fracture when subjected to a load of 7500 N in a three-point bending test; the support point separation is given as 15 mm. Using Equation 12.7b we will calculate the value of σ ; if this value is greater than σ_{fs} (300 MPa), then fracture is expected to occur. Employment of Equation 12.7b yields

$$\sigma = \frac{FL}{\pi R^3} = \frac{(7500 \text{ N})(15 \times 10^{-3} \text{ m})}{(\pi)(5 \times 10^{-3} \text{ m})^3} = 286.5 \times 10^6 \text{ N/m}^2 = 286.5 \text{ MPa} \quad (40,300 \text{ psi})$$

Since this value is less than the given value of σ_{fs} (300 MPa), then fracture is not predicted.

(b) The certainty of this prediction is not 100% because there is always some variability in the flexural strength for ceramic materials, and since this value of σ is relatively close to σ_{fs} then there is some chance that fracture will occur.