SOLUTION (**3.44**)

(a) Use Eq. (3.57):

$$\sigma_c = 0.62[\frac{500(200\times10^9)^2}{4(0.025)^2}]^{\frac{1}{3}} = 1233\ MPa$$ ◀

(b) Apply Eqs. (3.55) and (3.54) for $r_1 = r_2 = r$ and $E_1 = E_2 = E$ to obtain the formula

$$\sigma_c = 0.617[\frac{PE^2}{r^2}]^{\frac{1}{3}}$$

Thus, $\sigma_c = 0.617[\frac{500(200\times10^9)^2}{(0.025)^2}]^{\frac{1}{3}} = 1959\ MPa$ ◀

SOLUTION (**4.15**)

Referring to Appendix B:

$$\sigma_1 = 162.4\ MPa \qquad \sigma_2 = 46.15\ MPa \qquad \sigma_3 = 1.468\ MPa$$

(a) Equation (4.1) yields

$$n = \frac{300}{162.4-1.468} = 1.86$$ ◀

(b) Equation (4.4b) gives

$$n^2 = \frac{2\sigma_{yp}^2}{(\sigma_1-\sigma_2)^2+(\sigma_2-\sigma_3)^2+(\sigma_3-\sigma_1)^2} = \frac{2(300)^2}{(116.25)^2+(44.682)^2+(160.932)^2}$$

or

$$n = 2.09$$ ◀

SOLUTION (**4.23**)

Table 4.3: $K_c = 23\sqrt{1000}\ MPa\sqrt{mm} \qquad \sigma_{yp} = 444\ MPa$

Note that the values of crack length a and plate thickness t satisfy Table 4.3.

Table 4.2:

$$\frac{a}{w} = \frac{25}{125} = 0.2 \qquad \lambda = 1.37$$

Equation (4.18), with n=1:

$$\sigma_{all} = \frac{K_c}{\lambda\sqrt{\pi a}} = \frac{23\sqrt{1000}}{(1.37)\sqrt{\pi(25)}} = 59.91\ MPa$$

Therefore

$$P_{all} = \sigma_{all}(wt) = 59.91(125\times25) = 187.2\ kN$$ ◀

Note, the nominal stress at fracture:

$$\sigma = \frac{P}{t(w-a)} = \frac{187.2(10^3)}{20(125-25)} = 93.6\ MPa < 444\ MPa$$