10 (contd) $\therefore M_P/bw^2 = \frac{1}{4}(1-0.2)^2 S_y = 0.16 S_y$

Inserting values:

	(a)	(b)	(c)
M_E/bw^2	239	179	120
M_P/bw^2	96	128	160
$\therefore M_F/bw^2$ from (4).	96	121	106

The failure load of (b) is higher than both (a) & (c), so change not warranted.

11. Determine operating pressure & compare with failure pressure based on R6.

$\sigma = pD/2t \leq S_y/n$

$\therefore P_{actual} = 2S_y t/nD = 2\times 500\times 24/2.5\times 850 = 11.3$ MPa.

ELASTIC $K_{Ic} = \sigma_E Y\sqrt{\pi a}$ where $\sigma_E = p_E D/2t$

$\therefore p_E = 2K_{Ic}t/DY\sqrt{\pi a}$

where $Y = 0.990$ based upon

$\alpha = \frac{10}{24} = 0.417$; $\beta = \frac{10}{20} = 0.5$

$\therefore p_E = 2\times 50\times 24/850\times 0.990\sqrt{\pi\times 0.010} = 16.1$ MPa

PLASTIC From the graph $\sigma_P/S_y = 0.75$ corresponding to $\alpha = 0.417$, $\beta = 0.5$ — so, with $S_y = 500$ MPa

$p_P = 2\sigma_P t/D = 2(0.75\times 500)\times 24/850 = 21.2$ MPa

From eq (4) the failure pressure will be 14.3 MPa and so safety factor is $14.3/11.3 = 1.26$

If $K_{Ic} \rightarrow 35$ MPa$\sqrt{m}$, then elastic failure pressure will drop to $(35/50)\times 16.1 = 11.3$ MPa

Fairly obviously we have failure here as $\sigma_F = 10.6$ MPa < 11.3, the operating pressure.

12. From (5a): $da/dN = \frac{C\Delta K^n}{[1-(\hat{K}/K_c)^n]}$

$\therefore C\int_1^2 dN = \int_1^2 \frac{1-(\hat{K}/K_c)^n}{\Delta K^n}da$; $\alpha = a/w$

where $\hat{K} = \hat{\sigma}Y\sqrt{\pi w\alpha}$, $\Delta K = \Delta\sigma Y\sqrt{\pi w\alpha}$ } where $Y = Y(\alpha)$ and α is instantaneous normalised size

$K_c = \hat{\sigma}Y_c\sqrt{\pi w\alpha_c}$ α_c is critical from R6 analysis

$\therefore C N_{12} = \frac{w}{(\Delta\sigma\sqrt{\pi w})^n}\int_1^2\left[(Y\sqrt{\alpha})^{-n} - (Y_c\sqrt{\alpha_c})^{-n}\right]d\alpha$

and $C = (da/dN)_o/\Delta K_o^n$

Rearranging:

$$\frac{N_{12}}{w}\left(\frac{da}{dN}\right)_o\left(\frac{\Delta\sigma\sqrt{\pi w}}{\Delta K_o}\right)^n = \int_1^2 (Y\sqrt{\alpha})^{-n}d\alpha - (Y_c\sqrt{\alpha_c})^{-n}(\alpha_2-\alpha_1)$$

QED