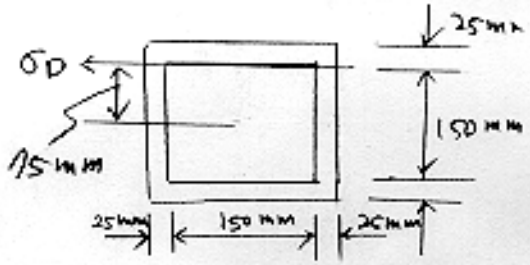
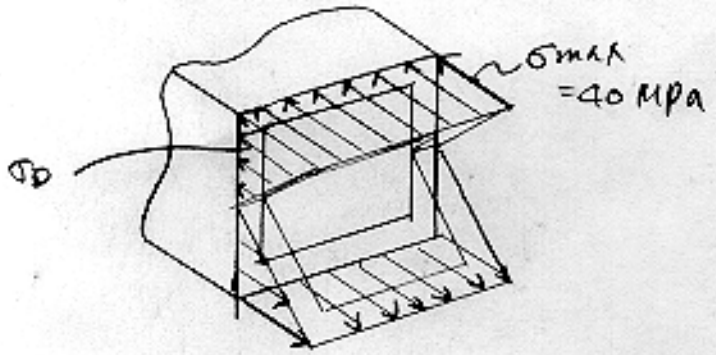
6-39



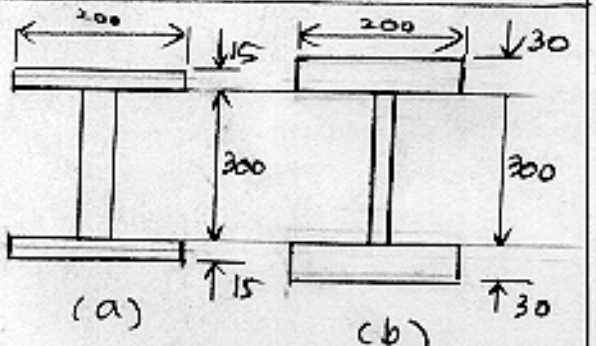
$$I = \frac{1}{12}(0.2)(0.2^3) - \frac{1}{12}(0.15)(0.15^3)$$
$$= 91.1458(10^{-6})\ m^4$$

$$\sigma = \frac{My}{I};\quad 30(10^6) = \frac{M(0.015)}{91.1458(10^{-6})}$$
$$M = 36458\ N\cdot m = 36.5\ kN\cdot m$$

$$\sigma_{max} = \frac{My}{I} = \frac{36458(0.1)}{91.1458(10^{-6})} = 40\ MPa$$



6-42



$$I_a = \frac{1}{12}(0.2)(0.33^3) - \frac{1}{12}(0.17)(0.3^3)$$
$$= 0.21645(10^{-3})\ m^4$$

$$I_b = \frac{1}{12}(0.2)(0.36^3) - \frac{1}{12}(0.185)(0.3^3)$$
$$= 0.36135(10^{-3})\ m^4$$

Bending stress; $\sigma = \frac{My}{I}$

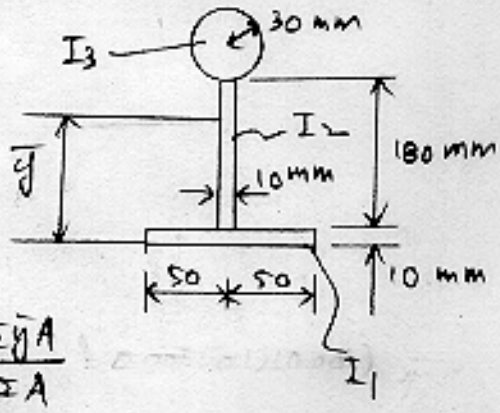
$$(\sigma_{max})_a = \frac{150(10^3)(0.165)}{0.21645(10^{-3})} = 114.3\ MPa$$

$$(\sigma_{max})_b = \frac{150(10^3)(0.18)}{0.36135(10^{-3})} = 74.7\ MPa$$

So, section (b) causes the least amount of bending stress.

$$\%\ \text{of Effectiveness} = \frac{114.3 - 74.7}{74.7} \times 100$$
$$= 53.0\ \%$$

6-53



$$\bar{y} = \frac{\Sigma \bar{y} A}{\Sigma A}$$
$$= \frac{0.005(0.1)(0.001) + 0.1(0.18)(0.01) + 0.247(\pi)(0.03^2)}{(0.1)(0.01) + (0.18)(0.01) + \pi(0.03^2)}$$
$$= 0.143411\ (m)$$

$$I = I_1 + I_2 + I_3$$
$$= \frac{1}{12}(0.1)(0.01^3) + (0.1)(0.001)(0.1434 - 0.005)^2$$
$$+ \frac{1}{12}(0.01)(0.18^3) + (0.01)(0.18)(0.1434 - 0.1)^2$$
$$+ \frac{1}{4}\pi(0.03^4) + \pi(0.03^2)(0.22 - 0.1434)^2$$
$$= 44.64(10^{-6})\ m^4$$

$$\sigma_{max} = \frac{My}{I} = \frac{40(10^3)(0.1434)}{44.64(10^{-6})} = 129\ MPa$$