Engineering Tripos Part 1A 2008/09, Paper 2 Structures and Materials

SECTION A – STRUCTURES

Answers

1. (a) $H_A = 80$ kN $\rightarrow$, $V_A = 400$ kN $\uparrow$, $H_B = 116$ kN $\leftarrow$
   (b) FOS = 2.44

2. (a) $T_{AB} = -W$, $T_{BC} = -W$, $T_{CD} = -W$, $T_{AC} = \sqrt{2}\,W$, $T_{AD} = 0$
   (b) $\delta_{CH} = (1+2\sqrt{2})WL/EA \rightarrow$

3. (a) $M_x = x^3/12 - 3x$
   (b) $v = -21.3/EI$ (where v is +ve upwards)

4. (a) $P_{cr\ x\text{-}x} = 36250$ kN, $P_{cr\ y\text{-}y} = 31990$ kN
   (b) $P_y = 31200$ kN

5. (a) (i) $\sigma_{hardwood} = 8.91$ MPa
   (ii) $\sigma_{softwood} = 5.94$ MPa
   (c) $\tau_{max} = 1.43$ MPa
   (d) $P_{max} = 5.4$ kN (stress in the softwood controls)

6. (a) $V_{BY} = 5/4W \uparrow$, $T = W/2$
   (c) $\delta_E = -WL^3/12EI + 3\sqrt{3}\,WL/2E_cA_c \downarrow$

JML, June, 2009

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SECTION B – MATERIALS

Answers

7. (b) 0.0156 mm

8. (a) III=A, II=B, I=C

9. (b) $100\left(1-\left(\frac{1}{2}\right)^{1/n}\right)$

11. (a) $E_T = \dfrac{t_g + t_c + t_m}{t_g/E_g + t_c/E_c + t_m/E_m}$, $E_L = \dfrac{t_g E_g + t_c E_c + t_m E_m}{t_g + t_c + t_m}$

12. Aluminium, stiffness limited with a mass of 6.5 g

Michael Sutcliffe, June 2009