Engineering Tripos Part IIA, 2005

Paper 3D3 Structural Materials and Design

Answers

1. (a) (i) L_{max} (deflection) = 10.04 m
L_{max} (strength) = 9.69 m ** strength limit most critical
(ii) L_{max} (deflection) = 6.05 m ** deflection limit most critical
L_{max} (strength) = 9.04 m

(b) (i) V_{max} (primary) = 405 kN, V_{max} (secondary) = 135 kN
(ii) M_{max} (primary) = 844 kNm, M_{max} (secondary) = 101 kNm
(iv) the maximum shear force in the primary beam remains the same
the maximum shear force in the secondary beam reduces to 106.9kN

2. (a) (i) ϕ_f = 3.41
(ii) ϕ_f = 7.15

(c) (i) M_c = 209 kNm, lateral torsional buckling
(ii) χ_{LT} = 0.66

3. (b) (i) in compression ; need A_{stot} = 2750 mm^2
in tension; need A_{stot} = 2500 mm^2 , compression requirement controls
e.g. four 32 mm diameter bars
(ii) M_U = 136.8 kNm, $N_U \approx 0$ kN, almost case of pure bending

4. (b) (i) Mode *c* , R_d = 3032 kN
Mode *f*, R_d = 2368 kN **controls, therefore need 5 bolts
(ii) In both cases mode *b* is more critical

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