

Engineering Tripos Part IIA, 2007

Paper 3D3 Structural Materials and Design

Answers

1. (b) (i) secondary beam V_{max} (bearing) = 501 kN, V_{max} (shear) = 942 kN
so bearing controls and maximum force is 501 kN
primary beam - $V_{applied}$ = 62.6 kN, $T_{applied}$ (top bolt) = 35.9 kN
connection is adequate
(ii) M_{max} = 22.5 kNm, $V_{applied}$ = 43.8 kN, $T_{applied}$ (top bolt) = 57.1 kN
2. (a) (i) L_{max} (strength) = 21.5m, L_{max} (deflection) = 27.3m
 \therefore strength controls - L_{max} = 21.5 m
(ii) L_{max} (strength) = 13.1m, L_{max} (deflection) = 14.3m
 \therefore strength controls - L_{max} = 13.1 m
(b) (ii) max spacing of restraints \approx 3.5 m
3. (a) P = 61.7 kN
(b) P = 71.0 kN
(c) $V_{Rd,maxc}$ = 187 kN, $V_{Rd,s}$ = 200 kN \therefore concrete capacity controls - V_{allow} = 187 kN
4. (b) (i) failure in C24 - $R = f_{h,1,d} \cdot t_1 \cdot d$, failure in C16 - $R = 2 f_{h,2,d} \cdot t_2 \cdot d$
(ii) t_1 = 133 mm, R_{max} = 23.7 kN
(c) (i) h_{shear} = 241 mm, $h_{flexure}$ = 255 mm, k_{crit} likely to be < 1 but not significantly so

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