ENGINEERING TRIPOS PART IIB 2012

4D10 STRUCTURAL STEELWORK

Where the datasheets have been used to read factors in the following, there may be some margin of error either way in the numerical answers.

1a) Without props, max permissible span is 2.3 m, so props are needed (for a max span of 4.1m).

1b) Total factored load 40.6 kN/m, moment due to applied loads 508 kNm, xp = 48.8mm, design moment 550.5 kNm, 67 pairs of studs, each pair placed in a trough.

1c) Total shear force on each bolt = 96.2 kN, use M24 bolts.

2a) Kc = 0.78, Aeff = 6213 mm^2, Ieff = 148.3 X 10^6 mm^4.

2b) Npl = 2.206 MN, lambda = 0.85, DS1 gives chi = 0.63, and limiting axial force of 1.39 MN, which is larger than 900 MN applied.

2c) 2.83 X 10^6 cycles (using true, not effective area, and remembering graph is of force, not stress, profile).

3c) Web fraction = 0.223, Npl = 2101 kN, Mpl = 180.4 kNm, Ncr = 234.2 kN, lambda_major = 0.36 (chi = 0.94), lambda_minor = 0.62 (chi = 0.78), Nmajor = 1975 kN, Nminor = 1639 kN, Mlt = 732.2 kNm, lambda = 0.5 (chi = 0.92), Mmax = 167.0 kNm.

4a) MB = 233.5 kNm, MC = 291.5 kNm, psi = 0.8, Cunequal = 0.92, Mlt = 367.5 kNm. Mpl = 412.8 kNm, Mcr = 399.5 kNm, lambda_lt = 1.02 (chi = 0.6), Mmax = 247.7 kNm.

4b) MB = -MC = 291.5 kNm, Mcr = 612.5 kNm, lambda_lt = 0.82 (chi = 0.71), Mmax = 293 kNm.

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