EN DS 231. Assignment #10

Date: 4/3/08, due 4/10/08

Pass-fail work

Problems: from Onouye, Chapters 9 & 10.

Note: Problems marked with an * have been altered with respect to the problem stated in the text. Multiframe4D may be used.

(15%)*Use A992 steel. The length has been changed to 9 ft.
Also use LRFD design method and the beam diagram to select a W10 (fully braced) knowing the distributed load is dead load and the point load is a live load. Check the shear stress and determine the deflection at the free end.

\( F_y = 50 \text{ ksi}, \gamma_L = 1.6, \gamma_D = 1.2, \phi_b = 0.9, \phi_v = 0.9 \) \hfill (LRFD)

(25%) Assuming A992 steel, select the most economical W10 section. Check the shear stress and determine the deflection at the free end. \((allowable \ stress \ design \ and \ deflection)\)

- \( F_b = 33 \text{ ksi} \)
- \( F_v = 20 \text{ ksi} \)
- \( E = 30 \times 10^3 \text{ ksi} \)

Partial answers to check with:

- **ASD design:** \( f_b = 30.7 \text{ ksi} \), \( f_v = 4.6 \text{ ksi} \), \( \Delta = 0.65 \text{ in.} \)
- **LRFD design:** \( M_u = 77.4 \text{ k-ft}, V_u = 14 \text{ k}, \phi V_n = 69.1 \text{ k}, \Delta = 0.79 \text{ in.} \)

Beam Design Moments (\( \phi_b = 0.9, C_b = 1, F_y = 50 \text{ ksi} \))

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(15%) *Use US customary units.

10.2.3 Determine the maximum critical length of a W10×54 (W250×80) column supporting an axial load of 250 kips (1.12×10^3 MN). E = 29×10^3 ksi (E = 200×10^3 MPa). *(Euler buckling formula)

Partial answers to check with:
L_x = 49 ft, L_y = 28.6 ft (make choice)

(25%) *10.2.4 An 8"-diameter timber pole is fixed into a large concrete footing at grade and is completely pin connected at its upper end. How high can the pole be and still just support a load of 25 kips? E = 1.0×10^6 psi. Solve this problem assuming the diameter is 203 mm and the load to be supported is 111 kN (E = 6.895×10^3 MPa). *(The SI values have been corrected.)(Euler buckling formula)

Partial answers to check with:
I_x = 201 in^4, K=0.7, L = 33.6 ft
I_x = 83.4×10^6 mm^4, L = 10.2 m

(20%) *Use metric units. (The SI values have been corrected.)

10.2.6 Determine the critical buckling load and stress for the W8×28 (W200×42) column shown, E = 29×10^3 ksi (E = 200×10^3 MPa). *(1 MPa = N/mm^2)(Euler buckling formula)

Partial answers to check with:
L_o/r_x = 90.5 and L_o/r_y = 118.7, P_cr-x = 1281 kN,
P_cr-y = 748 kN, f_cr = 141 MPa

Problem 10.2.6