ENDS 231. Assignment #9

Date: 11/1/07, due 11/8/07

Problems: from Onouye, Chapter 9.
Note: Problems marked with a * have been altered with respect to the problem stated in the text. Multiframe4D may be used for V & M diagrams.

(30%) 9.1.11 Two steel plates (A572, $F_y = 50$ ksi) are welded together to form an inverted T-beam. Determine the maximum bending stress developed. Also determine the maximum shear stress at the neutral axis (N.A.) of the cross-section and at the intersection where the stem joins the flange. (flexural and shear stress)

Partial answers to check with: $\bar{y} = 3.07\text{ in from bottom},$
\[ I_x = 112.6\text{ in}^4, \quad f_b = 27.6 \text{ksi}, \]
\[ f_{v\text{-max}} = 1.37 \text{ksi}, \quad (Q_{na} = 17.6 \text{ in}^3), \]
\[ f_{v\text{-joint}} = 1.20 \text{ksi} \quad (Q = 15.44 \text{ in}^3). \]

Problem 9.1.11

(30%) *9.1.14 A lintel beam 12' long is used in carrying the imposed loads over a doorway opening. Assuming that a built-up box beam is used with a 12" overall depth as shown, determine the maximum bending stress and shear stress developed.

* Also determine the required pitch spacing for the bottom 2x4 with 1 nail each side (2) with a shear capacity of 300 lb.

Problem 9.1.14

Partial answers to check with: $\bar{y} = 6.71\text{ in}, \quad I_x = 496.2\text{ in}^4, \quad f_b = 1168 \text{ psi}, \quad f_v = 195 \text{ psi}$
\[ (Q = 53.8 \text{ in}^3), \quad p = 5.3 \text{ in.} \quad (Q = 31.3 \text{ in}^3) \]

Note: The negative area method is quicker for finding $I_x.$
(40%)*9.1.22 Design a Douglas fir–larch No. 1 beam to support the load shown. (*stress design and deflection*)

\[
F_b = 1300 \text{ psi} \\
F_v = 85 \text{ psi} \quad \gamma \approx 32 \text{ lb/ft}^3 \text{ for Douglas fir} \\
E = 1.6 \times 10^6 \text{ psi} \\
\Delta_{allow(L/L)} = L/360
\]

Partial answers to check with:
\[S_{x:req'} = 207 \text{ in.}^3, A_{req'} = 99 \text{ in}^2. \text{ With one possible selection, the self weight is} \]
\[\approx 25 \text{ lb/ft}, \text{ new } S_{req'} \approx 214 \text{ in.}^3, A_{req'} \approx 103 \text{ in}^2. \text{ } \Delta_{LLL} \approx 0.2 \text{ in.}\]