ARCH 331. Assignment #8

Date: 3/10/16, due 3/24/16

Pass-fail work

Problems: supplemental problems (8A, etc.) and from Onouye Chapters 9 & 10

Notes: Problems marked with an * have been altered with respect to the problem stated in the text. Multiframe or other methods may be used for V & M diagrams and maximums when the method is not specified.

**Supporting a floor is to be a glue-lam member.**

(20%) *9.1.2* The single overhang beam uses a 4"×12 S45 (100×300 mm) Douglas fir-larch No. 1 member. Determine the maximum bending stress developed. Is it safely designed? (Fb = 1300 psi or 8.97 MPa) Most economical member to use assuming a self weight of 10 lb/ft, normal load duration (Cd = 1), tabulated stresses of Fb = 2000 psi and Fr = 250 psi, E = 1.7 x 10^6 psi. Calculated and locate the maximum deflection due only to the 400 lb/ft for the member found.

*Use superpositioning with the Beam Diagrams and Formulas to get support reactions and to construct the V & M diagrams.*

(timber strength design and deflection)

Partial answer to check with: Sreq’d ≥ 26.4 in.3, Areq’d ≥ 9.8 in.2, and Δ > 0.273 in.

(35%) *9.1.22* Design a Douglas fir-larch No. 1 beam to support the load shown. Assume a 7-day live load (construction) duration. (timber beam design)

\[
\begin{align*}
F_b &= 1300 \text{ psi} \\
F_r &= 85 \text{ psi} \\
E &= 1.6 \times 10^6 \text{ psi} \\
\gamma &= 32 \text{ lb/ft}^3 \\
\Delta_{allow(LL)} &= L/360 \\
\Delta_{allowed(LL+DL)} &= L/240
\end{align*}
\]

Partial answers to check with:

Sreq’d ≥ 221.1 in.3, Areq’d ≥ 91.4 in.2. First trial self weight ≈ 23 lb/ft. (Expect more trials). Final sections may have S > 230 in.3 and Δ(LL) ≈ 0.3-0.4 in., and Δ(LL+DL) ≈ 0.5-0.6 in.

(20%) 10.4.3 Determine the axial load capacity of a 6 3/4"×10 1/2" glu-lam column with an area A = 70.88 in.2, assuming lateral bracing about the weak axis at the midheight level. Assume pin connections top and bottom in both directions of buckling. (Fb = 1650 psi; E’ = 915.3 x 10^6 psi)

Assume the critical load duration is for one-day live load (wind).

(timber column analysis)

Partial answers to check with:

(CD = 1.33) F’c = 1080 psi, Pa = 77.1 k

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(20%) *10.4.6 Determine the minimum size column (Southern pine
dense No. 1) required to support an axial load of $P = 25 \text{kips} = 12.5 \text{kips}$
assuming an effective column length $L_e = 16 \text{ ft}$. Assume the load
duration is normal. For Southern pine dense No.1,
$E''_{min} = 584 \times 10^3 \text{ psi}$, and the tabulated compressive stress parallel to
the grain, $F_c = 975 \text{ psi}$. (timber column design)

Partial answers to check with: $F'_c = 351 \text{ psi}$, $A_{req'd} \geq 35.6 \text{ in}^2$ and a section MUST satisfy
this requirement

(5%) 8A) Determine the minimum size square column of Douglas Fir Larch, No. 1 grade to support
an axial load of 30 k for an effective length of 12 ft under snow load.
(timber column design charts)

Partial answers to check with: possible capacities {3.7 k, 17.6 k, 47.3 k}