

ENDS 231. Practice Final Examination

Aids Allowed: Two marked 8.5" x 11" crib pages
(2 pages written on one side only
or 1 page written on both sides)

Silent **non-programmable** Calculator
Reference Formulas
(Provided at exam time)

Clearly show all your work and record your final answers with the units specified in the boxes.

Problem 1) Worth 45%

- A 12 ft beam with live and dead loading is shown in Figure 1a.
- The cross section geometry of the beam is shown in Figure 1c.
- The material is Giggium steel with $E = 32,000$ ksi, $F_b = 60$ ksi, $F_v = 35$ ksi, $F_y = 45$ ksi, and $F_u = 65$ ksi.
- The beam end connection is detailed in Figures 1d and 1e. The angle legs are 3/8" thick, with 7/8 in diameter bolts of A325-N and standard holes.
- The weld material is E70XX

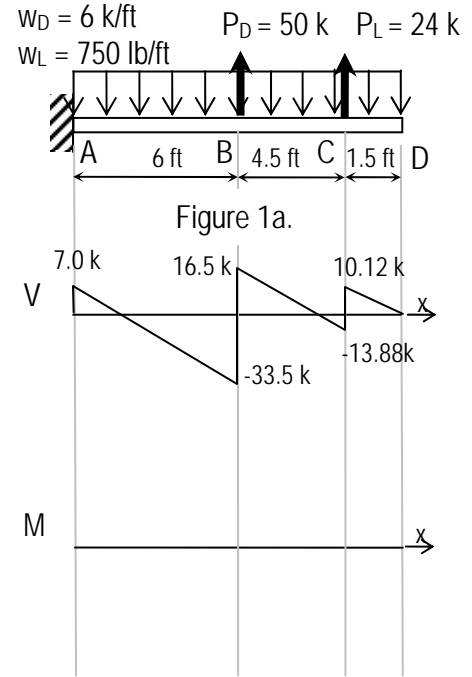


Figure 1b.

FIND:

- The completed bending moment diagram in Figure 1b, and M_{max} .
- The moment of inertia for the cross section by completing the chart of Figure 1f.
- The maximum bending stress in the beam.
- The maximum shear stress in the beam.
- The deflection at the free end D due to *live load only*.
- The number of bolts required for shear at the beam shear connection at end A .
- The bearing force allowed at the beam shear connection with 4 bolts.
- The minimum weld size required for shear for the angles to the column if the length on each angle is 1.5 in..

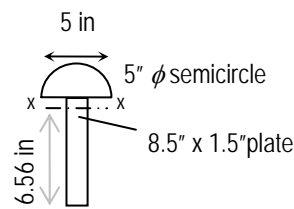


Figure 1c.

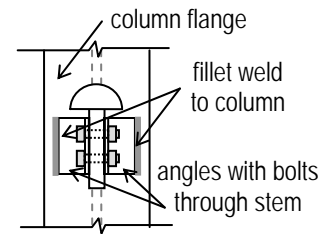


Figure 1d. (elevation)

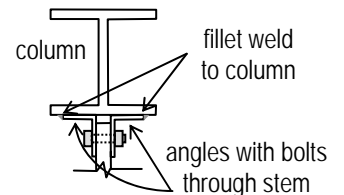


Figure 1e. (plan)

Figure 1f.		A (in ²)	I _x (in ⁴)	d _y (in)	Ad _y ² (in ³)
	semicircle				
	web	12.75	76.77	2.31	68.04

a)		b)	248.6 in ⁴	c)	
d)	2.9 ksi	e)	-2.02 in (up)	f)	1 bolt (0.28 required)
g)			0	Disclaimer: Answers have NOT been painstakingly researched.	

Problem 2) Worth 49%

- A parallel chord truss is shown in the Figure 2a has the following support reactions:
 $A_x = 100 \text{ lb}$, $A_y = 267.5 \text{ lb}$, $E = -267.5 \text{ lb}$.
- Wind load is considered.
- The truss is constructed with glu-lam lumber having $E = 1.85 \times 10^6 \text{ psi}$, $\alpha = 3.8 \times 10^{-6} / ^\circ\text{F}$, $F_c = 1700 \text{ psi}$ (no adjustment factors applied), allowable tension stress $F'_t = 1200 \text{ psi}$ (adjustment factors applied), and allowable bearing stress $F'_p = 650 \text{ psi}$ (adjustment factors applied).
- The truss is constructed with 5.125" x 10.5" timbers with $I_x = 109.9 \text{ in}^4$, and $I_y = 19.1 \text{ in}^4$.
- The bottom chord that is continuous the length of the truss is connected as shown in Figure 2b. The joints are considered pinned for analysis.
- The bottom chord is laterally braced at each end and across the span as show in Figure 2c.

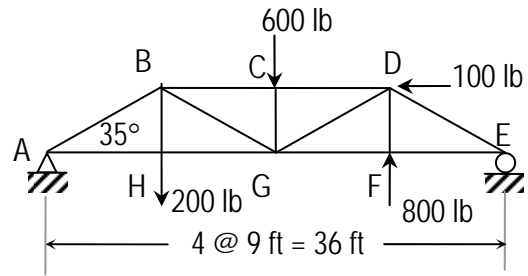


Figure 2a.

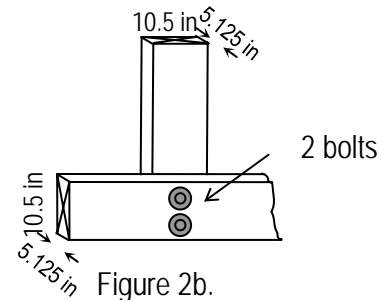


Figure 2b.

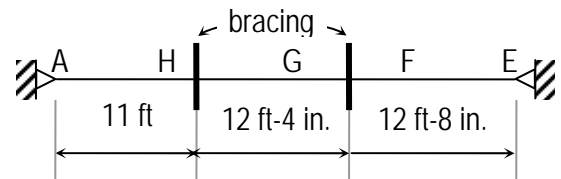


Figure 2c. (top view of bracing)

FIND:

- The member forces in AB and AH using the method of joints.
- The member forces in BG and BC using the method of sections.
- The minimum area required for member HG if the tension force is 6.3 kips.
- The stress value and type in member AB resulting *only* from a temperature decrease of 15° F if the member can only shorten by 0.003 inches.
- The critical value of F_{CE} for the lower chord.
- The allowable buckling load for the lower chord if C_p has been determined to be 0.310 for the weak axis and 0.167 for the strong axis.
- The minimum bolt diameter allowed with two bolts if the maximum tension force in either member in the connection is 7.5 kips and the hole is 1/16" larger than the bolt. (*hint –net area and bearing area are important*)

j)	j)	k)
l) 63.4 psi tension	m)	n) 24,444 lb
o) 1.13 in		

Problem 3) Worth 6% (conceptual questions)