ENDS 231. Practice Final Examination

Aids Allowed: Two marked 8.5" x 11" crib pages   Silent ***non-programmable*** calculator
(2 pages written on one side only   Reference Formulas
or 1 page written on both sides)   (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.
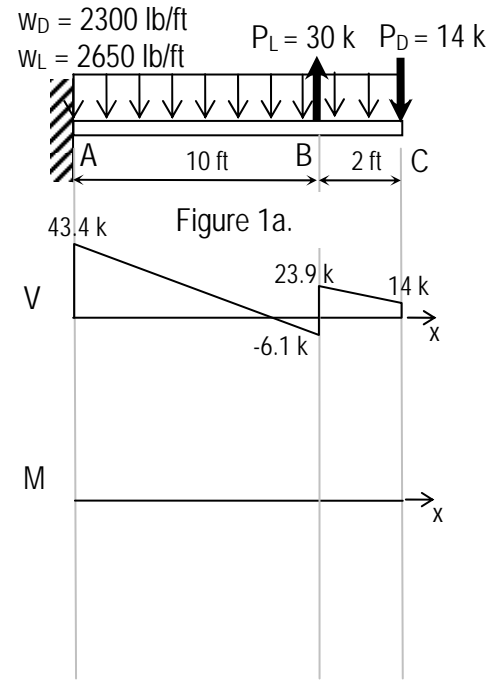
- The weld material is E70XX.

FIND:

a) The completed bending moment diagram in Figure 1b, and M_{max}.

b) The moment of inertia for the cross section by completing the chart of Figure 1f.

c) The maximum bending stress in the beam.

d) The maximum shear stress in the beam.

e) The deflection at the free end *D* due to *live load only*.

f) The number of bolts required for shear at the beam shear connection at end A.

g) The bearing force allowed at the beam shear connection when 4 bolts are used.

h) The minimum weld size required for shear for the angles to the column if the length on each angle is 3.5 in.
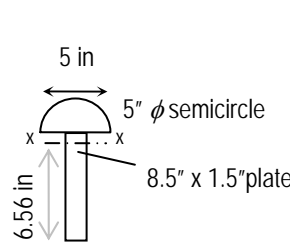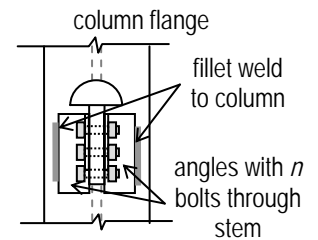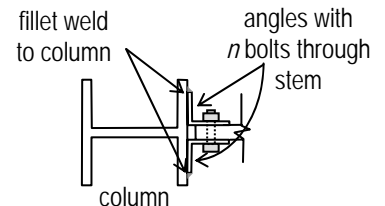

Figure 1a.

Figure 1b.

Figure 1c.

Figure 1d. (elevation)

Figure 1e. (plan)

	A (in²)	I_x (in⁴)	d_y (in)	$Ad_y{}^2$ (in³)
semicircle				
web	12.75	76.77	2.31	68.04

Figure 1f.

a)		b)	248.5 in⁴	c)	
d)	3.7 ksi	e)	-1.33 in (up)	f)	2 bolts (1.7 required)
g)	204.9 k	h)		**Disclaimer:** Answers have **NOT** been painstakingly researched.

Problem 2)   Worth 45%

Figure 2a.

- A parallel chord truss is shown in the Figure 2a has the following support reactions:
  $A_x = 100$ lb, $A_y = 267.5$ lb, $E = -267.5$ lb.

- Wind load is considered.

- The truss is constructed with glu-lam lumber having $E = 1.85 \times 10^6$ psi, $\alpha = 3.8 \times 10^{-6}$ /°F, $F_c = 1700$ psi (*no adjustment factors applied*), allowable tension stress $F'_t = 1200$ psi (adjustment factors applied), and allowable bearing stress $F'_p = 650$ psi (adjustment factors applied).

n bolts

Figure 2b.

- The truss members are 3.125 in. x 6 in. with $I_x = 56.25$ in^4, and $I_y = 15.25$ in^4.

- The bottom chord that is continuous the length of the truss is connected as shown in Figure 2b.

- The top chord that is continuous is laterally braced at each end and across the span as show in Figure 2c. The ends are considered to be pinned.
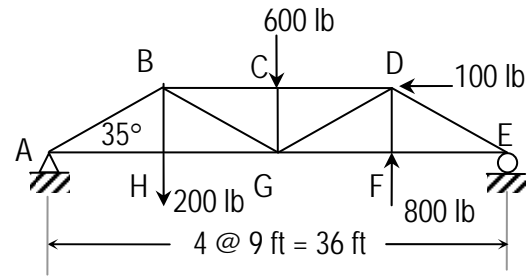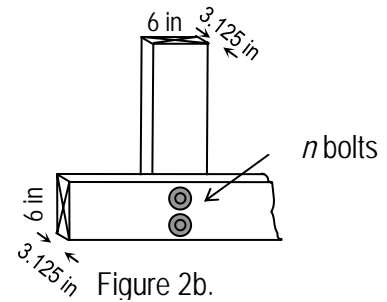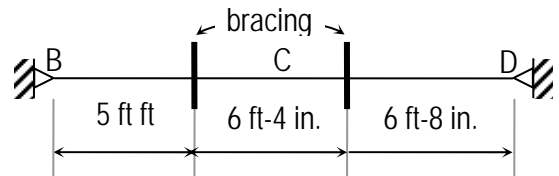

Figure 2c. (top view of bracing)

FIND:

i) The member forces in <u>AB and AH</u> using the method of joints.

j) The member forces in <u>BG and BC</u> using the method of sections.

k) The minimum area required for member <u>HG</u> if the tension force is 6.3 kips.

l) The stress value and type in member AB resulting from a temperature decrease of 15° F (with no loading) if the member can only shorten by 0.003 inches.

m) The critical value of F_{CE} for the upper chord and the ratio used to find C_p.

n) The allowable buckling load for the lower chord if C_p has been determined to be 0.403 for the weak axis and 0.214 for the strong axis.

o) The minimum number of 5/8 in. diameter bolts required and their arrangement for the connection shown in Figure 2b if the maximum tension force in either member is 7.5 kips and the bolt holes are ¾" in diameter.

j)	j)	k)
l) 63.3 psi in tension	m)	n) 10.9 k

o)   6 bolts in 2 rows of 3   (≤ 5.3 net tension & ≥ 5.9 bearing)

Disclaimer: Answers have NOT been painstakingly researched.

Problem 3)   Worth 10%   (conceptual questions)