

**CEE2201 Spring 2010 Exam 1**

Name \_\_\_\_\_

Closed Book

Closed Notes

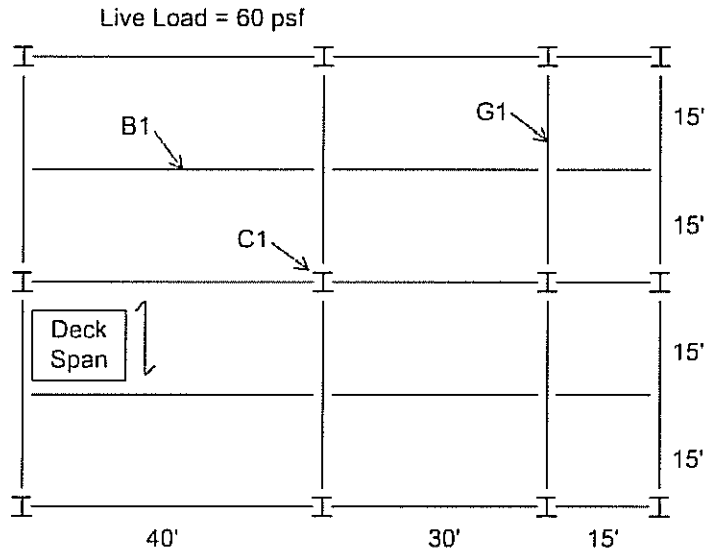
3" x 5" Note card is allowed, Calculator is allowed.

100 points are possible

Answer all questions to the best of your ability. Attach extra sheets as necessary. **Show your work!**

**Problem 1.**

Find a reduced live load for the members indicated below (B1, G1, and C1). **(15 points)**



FLOOR PLAN

Figure 1. Floor plan for Problem 1

**Problem 2.**

A water tower is being designed for a location in southern Michigan. The engineer in charge of the project has asked you for some quick calculations to find the approximate lateral design load for this structure as a single force ( $F$ ) applied to the tank of the structure. You want to know if wind load or seismic load will control.

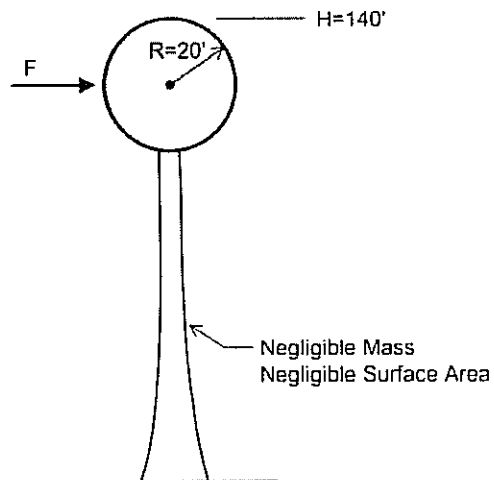


Figure 2. Water tower used in Problem 2.

- a) Find the lateral force that you would apply to the tank due to wind. You know that the bulk of the surface area of the water tower is in the tank, thus you will only consider the area of the tank as receiving wind load. You approximate  $q_z = q_h = 25$  psf and  $GC_p$  on the windward side is 0.8 and  $GC_p$  on the leeward side is -0.5. **(10 points)**  
(Hint: the area of a circle is  $\pi R^2$ .)

- b) Find the equivalent lateral force due to seismic load of the empty tank. The weight of the empty tank ( $W$ ) is 500 kips. Assume that the mass of the tower is negligible. You have already found the spectral response acceleration coefficients ( $S_{DI} = 0.080g$ ,  $S_{DS} = 0.128g$ ) and determined that the structure falls into Seismic Design Category B. The period ( $T$ ) of the structure with the tank empty is 0.45 s. Use  $R = 8$  and  $I = 1.25$ . Which controls, wind or seismic load? **(20 points)**  
(Hint: the force  $F$  due to seismic load will be equal to the base shear.)

- c) Now consider the tank with water in it. Take the seismic weight of the full tank to be 2600 kips. The period ( $T$ ) of the structure is now 0.2 s. What is the seismic load based on the full tank? Does this load control over wind load? **(10 points)**

**Problem 3.**

Find axial forces in member **BC** in the truss below. Indicate tension or compression. **(20 points)**

(Hint: Save time; use the correct truss solution method.)

(Hint: Save time; choose the point(s) that you sum moments around very carefully.)

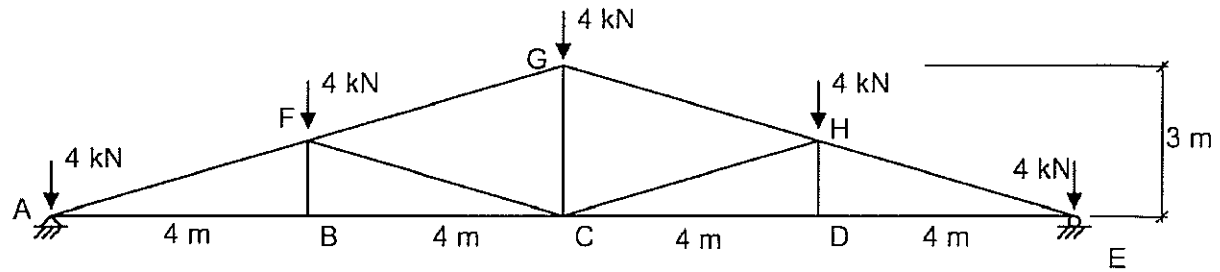


Figure 3. Roof truss for Problem 3.

**Problem 4.**

Find the shear and moment diagrams for this frame. Include both the horizontal beam member and the sloped member. You do not have to draw a diagram for any axial forces that may exist. **(25 points)**

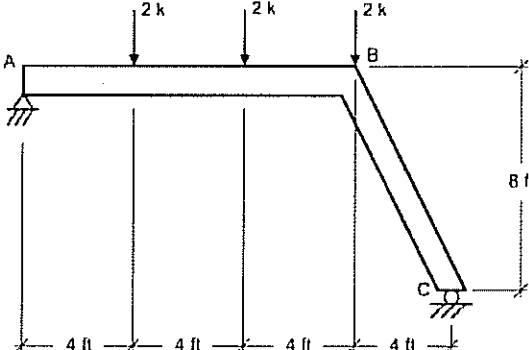


Figure 4. Frame to be analyzed in Problem 4.

Useful Tables From ANCE 7-05 for CEE310

**Table 4-2**  
Live Load Element Factor ( $K_{LE}$ )

Interior Columns	4
Exterior Columns without cantilever slabs	4
Edge Columns with cantilever slabs	3
Corner Columns with cantilever slabs	2
Edge Beams without cantilever slabs	2
Interior Beams	2
Other members	1

**Table 4-3**  
Site Coefficient, Short-Term ( $K_s$ )

Site Class	$S_s \leq 0.25$	$S_s = 0.5$	$S_s = 1.0$	$S_s \geq 1.25$
A	0.80	0.80	0.80	0.80
B	1.00	1.00	1.00	1.00
C	1.20	1.20	1.20	1.20
D	1.60	1.60	1.60	1.60
E	2.00	2.00	2.00	2.00
F	2.50	2.50	2.50	2.50

**Table 4-4**  
Occupancy Category

I	0.80
II	1.00
III	1.10
IV	1.20

**Table 4-5**  
Thermal Factor ( $C_t$ )

Unheated Structures	1.0
1.2	1.2

**Table 4-6**  
Exposure Factor ( $C_e$ )

Windy Site	0.7
Non-windy Site	1.0
Sheltered Site	1.3

**Table 4-7**  
Slope Factor ( $C_s$ )

Flat roof	1.0
1.0	1.0

**Table 4-8**  
All Levels

Occupancy Category	I
Structures representing low risk to human life	I
e.g., agricultural facilities	I
minor storage facilities	I
Structures and in categories I, II, or IV	I
Buildings representing substantial hazard to human life (e.g., parking garages)	II
e.g., schools, day-care centers, auditoriums, jails, nursing homes	II
Buildings representing substantial economic impact or disruption if damaged	II
e.g., power generation stations, water and sewage treatment facilities, telecom	II
Buildings designated as essential facilities	IV
e.g., hospitals, fire, rescue, and police stations, emergency shelters, designated emergency response stations, and national defense facilities	IV

**Table 4-9**  
Exposure Factor ( $C_e$ )

Exposure Factor ( $C_e$ )	0.85
0.85	0.85

**Table 6-1**  
Exposure Category

Urban Centers	B
Suburban and wooded areas	B
Open terrain, some obstructions	C
Beachfront property	D

**Table 6-2**  
Exposure Factor ( $K_d$ )

Exposure B	0.85
Exposure C	1.00
Exposure D	1.25

**Table 6-3**  
Directionality Factor ( $K_d$ )

Directionality Factor ( $K_d$ )	0.85
0.85	0.85

**Table 6-4**  
Directionality Factor ( $K_d$ )

Directionality Factor ( $K_d$ )	0.85
0.85	0.85

**Table 6-5**  
External Pressure Coefficient ( $C_{pe}$ )

External Pressure Coefficient ( $C_{pe}$ )	0.85
0.85	0.85

**Table 11-1**  
Importance Factor ( $I$ )

I	1.00
II	1.25
III	1.50
IV	1.75

**Table 11-2**  
Site Coefficient, Short-Term ( $K_s$ )

Site Class	$S_s \leq 0.25$	$S_s = 0.5$	$S_s = 1.0$	$S_s \geq 1.25$
A	0.80	0.80	0.80	0.80
B	1.00	1.00	1.00	1.00
C	1.20	1.20	1.20	1.20
D	1.60	1.60	1.60	1.60
E	2.00	2.00	2.00	2.00
F	2.50	2.50	2.50	2.50

**Table 11-3**  
Occupancy Category

I	0.80
II	1.00
III	1.10
IV	1.20

**Table 11-4**  
Thermal Factor ( $C_t$ )

Unheated Structures	1.0
1.2	1.2

**Table 11-5**  
Slope Factor ( $C_s$ )

Flat roof	1.0
1.0	1.0

**Table 11-6**  
All Levels

Occupancy Category	I
Structures representing low risk to human life	I
e.g., agricultural facilities	I
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e.g., schools, day-care centers, auditoriums, jails, nursing homes	II
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e.g., power generation stations, water and sewage treatment facilities, telecom	II
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e.g., hospitals, fire, rescue, and police stations, emergency shelters, designated emergency response stations, and national defense facilities	IV

**Table 11-7**  
Exposure Factor ( $C_e$ )

Exposure Factor ( $C_e$ )	0.85
0.85	0.85

**Table 11-8**  
External Pressure Coefficient ( $C_{pe}$ )

External Pressure Coefficient ( $C_{pe}$ )	0.85
0.85	0.85

**Table 11-9**  
Site Coefficient, Short-Term ( $K_s$ )

Site Class	$S_s \leq 0.25$	$S_s = 0.5$	$S_s = 1.0$	$S_s \geq 1.25$
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B	1.00	1.00	1.00	1.00
C	1.20	1.20	1.20	1.20
D	1.60	1.60	1.60	1.60
E	2.00	2.00	2.00	2.00
F	2.50	2.50	2.50	2.50

**Table 11-10**  
Occupancy Category

I	0.80
II	1.00
III	1.10
IV	1.20