3a. Problem Set 1

Objectives:Create an idealization of an existing structure of your choice; assess the
safety of a structure.If you have questions, please come to office hours. See the syllabus for scheduled times. Parts 1
and 2 may be handwritten. Question 3 should be typed.

1. Calculating Reactions

- a. The Tower Bridge in London is an example of a simply-supported bridge. Draw a diagram idealizing the structural system as a single-span between the two towers (spaced 200' apart) (10 points).
- b. Given your idealization, calculate the reactions at the supports (points A and B) due to a 6 kip vehicle located 80 ft from A (20 points).



2. Analyzing Safety

Until 2010, the CN Tower in Toronto was the tallest building in the world. Using the dimensions found on the following page, analyze the loads and safety factor for this structure.

- a. If the horizontal wind load is a uniformly distributed load of 3 kips/ft from the base to the top, calculate the total horizontal load (in kips) acting on the monument. (10 points)
- b. Estimate the dead load of the structure. (5 points)
- c. Compute the reactions (horizontal $-F_H$, vertical $-F_V$ and moment -M) at the base of the monument due to the wind load and the dead load (10 points)
- d. Assume the area of the base is 1,721.7 ft². The allowable concrete stress is 4000 psi. The total vertical stress under dead and wind loads at the base of the tower can be computed as:

$$\sigma = \frac{F_V}{A} + \frac{M(\frac{h}{2})}{\frac{1}{36}bh^3}$$

Compare this stress to the allowable stress to compute the factor of safety under the combined loads. (10 points)

- e. Do you think the structure is safe enough? Why or why not? (5 points)
- **3.** Short answer questions. Questions *a* and *b* refer to <u>Developments in Structural Form</u>, Ch. 1 and Ch. 2, assigned last week. Question *c* refers to <u>Disasters by Design</u>, Ch. 2, assigned for this week. Answer each question with a short paragraph (three-five sentences) written in your own words. (30 points)
 - a. What is the difference between dynamic and static loads? Be sure to use your own words.

167'

- b. Explain the idea behind a catenary structure.
- c. What are some of the social and economic consequences of a natural hazard? Please provide specific examples from one of the case studies you read.

CN Tower Information Volume = 1,344,634 ft³ H = 1181 ft. 5 in. Tower Contents • 6 elevators + 1 stair case (12,000 k) • Structural/reinforcing steel (11,200 k) • Concrete weight is 0.15 k/ft³ Base Geometry • Base idealized as an equilateral triangle • b = 167' • h = 94.6'

b