FINAL EXAM

1) (35 POINTS)

Consider the 12" wide strip of glass illustrated in Figure 1. The glass is loaded only by a horizontal wind load of 24 psf (pounds per square foot). The 60 inch tall strip of glass is supported at the top and bottom by a horizontal window frame, which you may assume to act as a simple support (pin at the bottom and roller at the top). You may neglect the weight of the glass.

a) What are the support reactions at points A and B due to the wind load? (6 pts)

b) Draw the shear diagram due to the wind load. (6 pts)

c) Draw the moment diagram due to the wind load. (6 pts)

d) If the glass plate is solid with a thickness of ¼", what is the moment of inertia of the rectangular section which resists the wind loading? (4 pts)

e) What is the maximum bending stress in the glass due to the wind load? (4 pts)

f) What is the maximum lateral displacement of the glass due to the wind load? (5 pts)

g) Does this theoretical model serve as a good prediction of the structural behavior of a strip of glass in a square window under horizontal wind load? Why or why not? (4 pts)

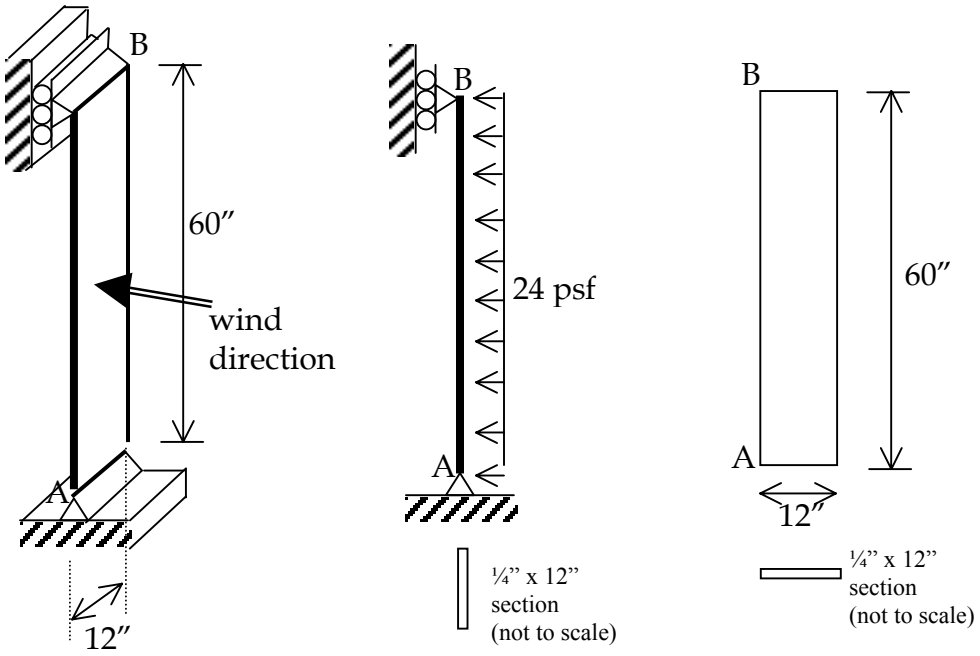


Figure 1.

2) (35 POINTS)

The truss illustrated in Figure 2 spans 15 feet between points A and B. Make the usual assumptions for truss analysis and neglect the self-weight of the truss.

a) What are the support reactions at A and B due to the vertical load of 60 kips? (6 pts)

b) Using either graphical or numerical methods, calculate the internal forces in all members of the truss. Present your solution as a sketch showing the internal bar forces. Label each force as tension or compression. (18 pts)

c) If the horizontal top chord of the truss is composed of one 8" x 8" hollow square steel box section with a wall thickness of ¼", what is the axial stress in this element? (4 pts)

d) By how much does the top chord change in length due to the applied load? (4 pts)

e) Suggest a design modification for this truss so that it uses less material for the given load and span. (3 pts)

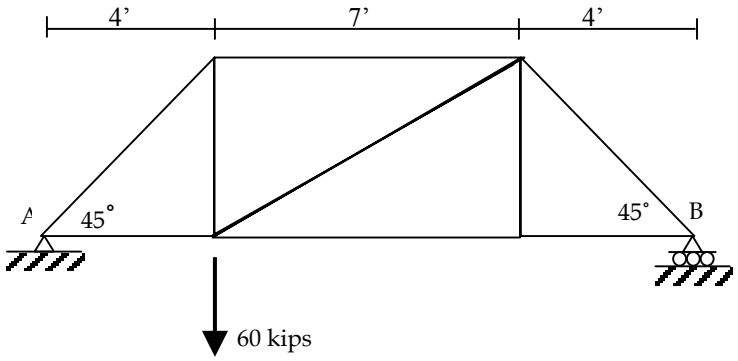
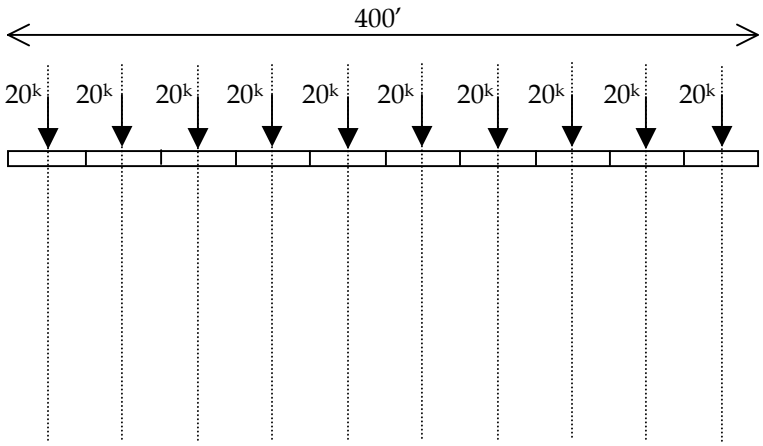


Figure 2.

3) (20 pts) A hanging cable supports a uniform load of 200 kips over a span of 400 feet. This load is divided into 10 point loads of 20 kips each which act on the cable at 20-foot intervals. (Note: the first load acts at a "half" interval, 10 feet from the cable support.) Label the problem using Bow's notation and use a graphical construction to find the form of the cable such that its maximum axial force is 230 kips under the uniform load of 200 kips. If the cable is made from a solid steel section with an allowable stress of 80 ksi, calculate the required diameter of the cable.

Scoring
Notation and load line (6 pts)
Pole location (5 pts)
Funicular polygon (5 pts)
Cable area (4 pts)



4) Sketch and briefly describe two ways to stiffen a tension roof (for example, the hanging cable of question #3) to restrain the roof from deforming under asymmetrical live loads. (5 pts)

5) Name two ways to reduce the environmental impact of a structural system. Support each suggestion with an example. The examples may be broad, such as a general design goal, or specific, such as a successful structure. (5 pts)