UNIVERSITY OF CALIFORNIA BERKELEY
Department of Civil Engineering
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Structural Engineering,
Mechanics and Materials
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Mechanics of Structures (CE130N)
Lab 5

1 Objective

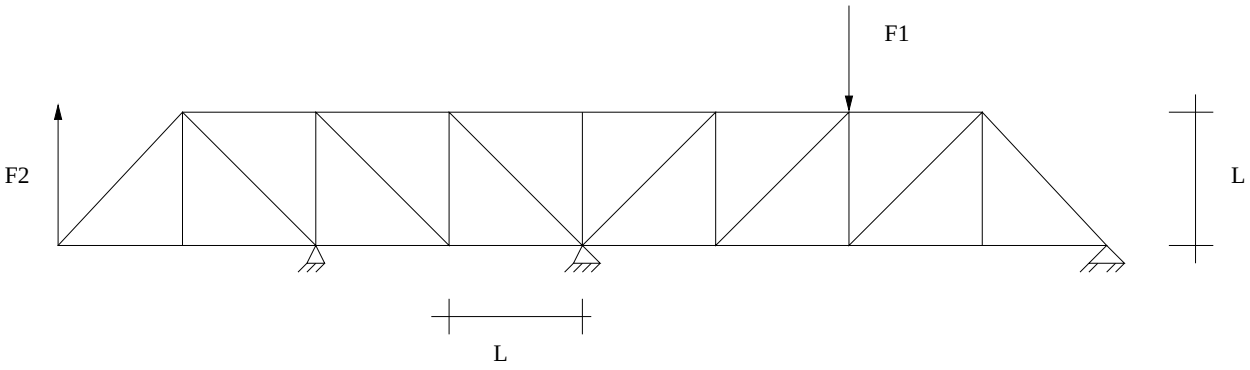
In this lab you will use your completed assignment from Lab 4 to solve a truss design question. There is also an extra credit question which is optional.

2 Problem 1

Consider the truss shown below. Assume that $L = 2$ ft, the bars are all solid round stock mild steel ($E = 30 \times 10^6$ psi), the upper bars have diameter 0.75 in, the lower bars have diameter 1.0 in and the diagonal and vertical bars have diameter 0.5 in. Assume that $F_1 = 2.0F_2 > 0$.

1. Find the smallest value of F_2 at which a bar in the truss reaches the yield stress $\sigma_Y = 40$ ksi.
2. Find the deflections at the locations of the applied loads when yield first occurs.
3. Which bar yields first?

Answers must be reported correctly to 3 significant digits to receive full credit.

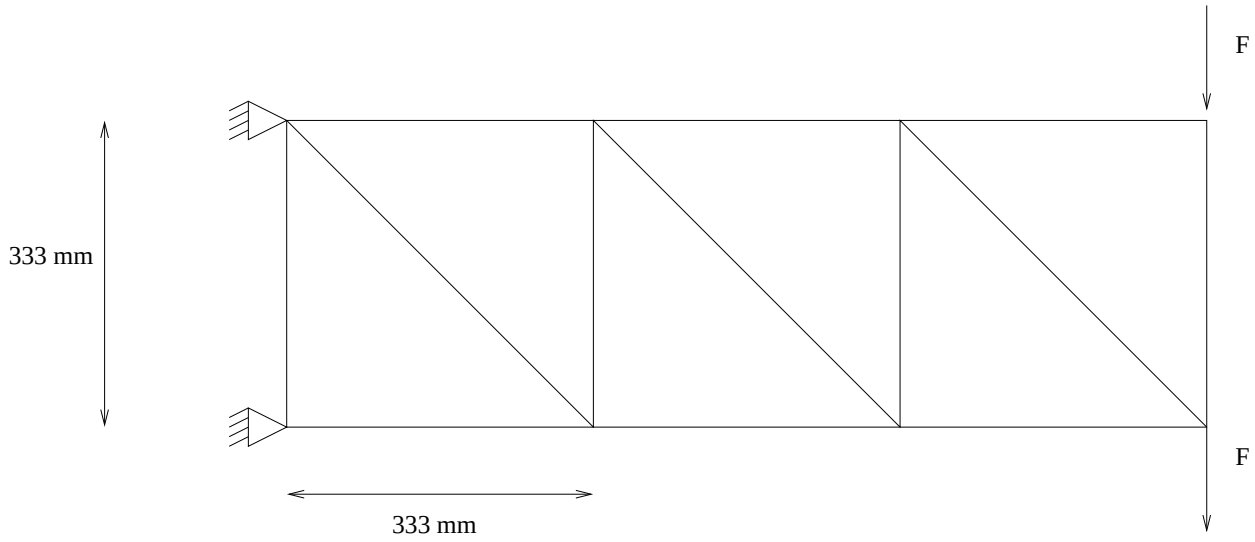


Hints:

1. See the Lab 3 handout for a synopsis of the truss equations.
2. The problem is linear and thus you can exploit superposition if you want.

3 Problem 2: Extra Credit

Consider the truss shown below, where all bars have modulus $E = 100\ \mathrm{kN/mm^2}$ and area $A = 100\ \mathrm{mm^2}$. Assume that $F = 500\ \mathrm{N}$. First, compute the state of the stress in the truss and observe that the forces in the upper and lower bars are increasing from the right to the left. Now try and redesign the truss so that the forces in the upper and lower bars are approximately uniform. Do this by moving only the free nodes while keeping the length of the structure at $999\ \mathrm{mm}$. The supports should also remain fixed.



Hints:

1. Just as in a beam you can think of the "internal moment" in this system as being linear.
2. This "internal moment" is primarily carried by the forces in the upper and lower cords.