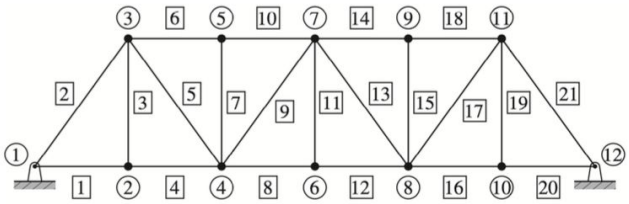
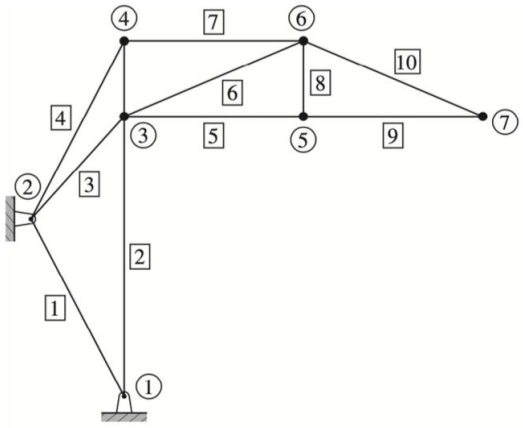
MAE 292 Spring 2020 Homework 5

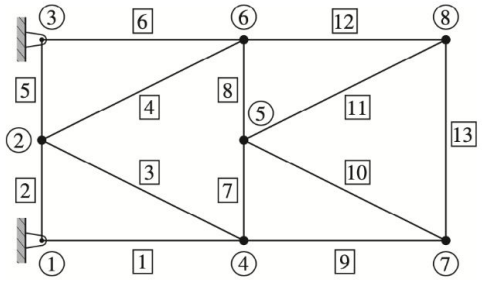
Due on May 28, 2020, at 11:59 PM

1. For each of the truss structures below, provide the following:
    a. The number of nodes.
    b. The number of elements.
    c. The displacement constraints.
    d. The size of the global stiffness matrix.



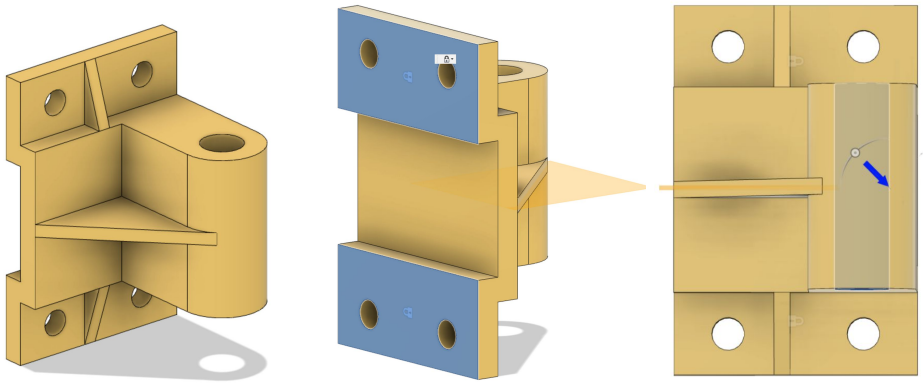
(a)





2. Perform the following FEA simulation on this part from HW 2:

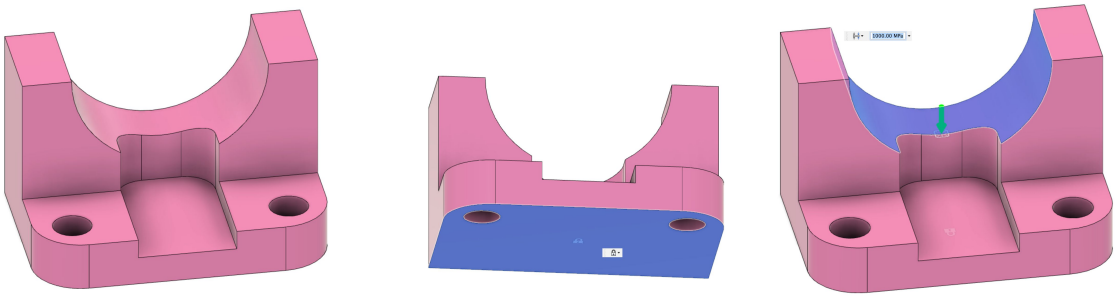
Constrain the part by the two base-plate surfaces and apply a 2E4N force within the bore hole directed down at a 45 degree angle as shown below. The material is steel.



a. Perform a stress analysis of this loading case. Provide an image of the Von Mises stress and identify regions of high-stress.
b. Provide the minimum safety factor of the part in this loading condition.
c. Add any features you want to the part to increase the safety factor as long as they maintain the locations of the bolt holes and the bore hole. Describe in words what changes you made.

3. Perform the following FEA simulation on this part from HW 2:

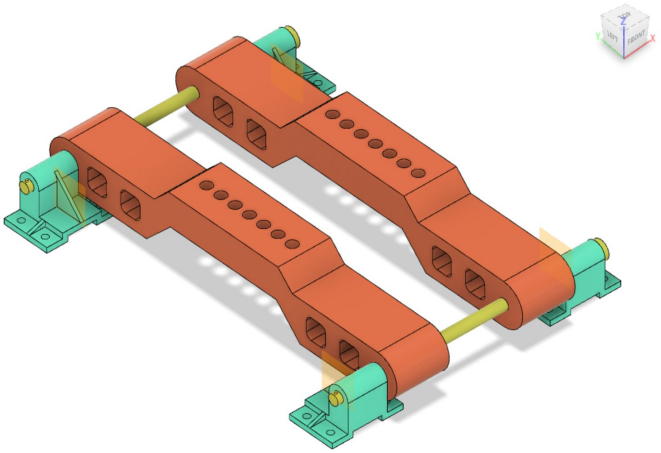
Constrain the part on the bottom surface as shown below. Apply a constant pressure load to the curved surface shown below, the pressure is 10 MPa. The material is steel.

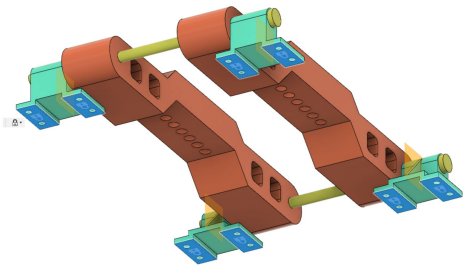


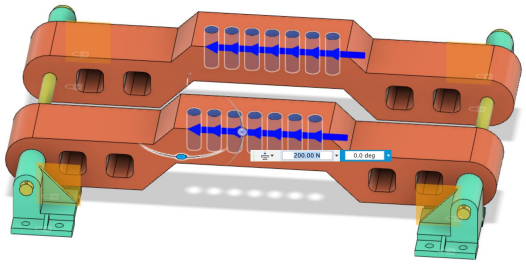
a. Perform a stress analysis of this loading case. Provide an image of the Von Mises stress and identify regions of high-stress.
b. Provide the minimum safety factor of the part in this loading condition.
c. Add any features you want to the part to increase the safety factor as long as they maintain the locations of the bolt holes and do not change the radius of the curved surface that the pressure load is applied to. Describe in words what changes you made.

4. Using the assembly from HW 2 perform the following analysis:

Constrain the assembly on the bottom surface as shown below. Apply a force load to the bolt holes in the +y-direction of 2E4N each. Apply a constant displacement constraint to the bolt holes of Ux = 0, Uz = 0, indicating these holes can only deform in the y direction.







a. What is the minimum safety factor of the design?
b. Identify which component of the assembly experiences the highest Von Mises stress.
c. Redesign any component necessary to bring the safety factor to above 5 for this loading condition.