**Koc University**
**MECH 303 Machine Elements**
**Term Project**

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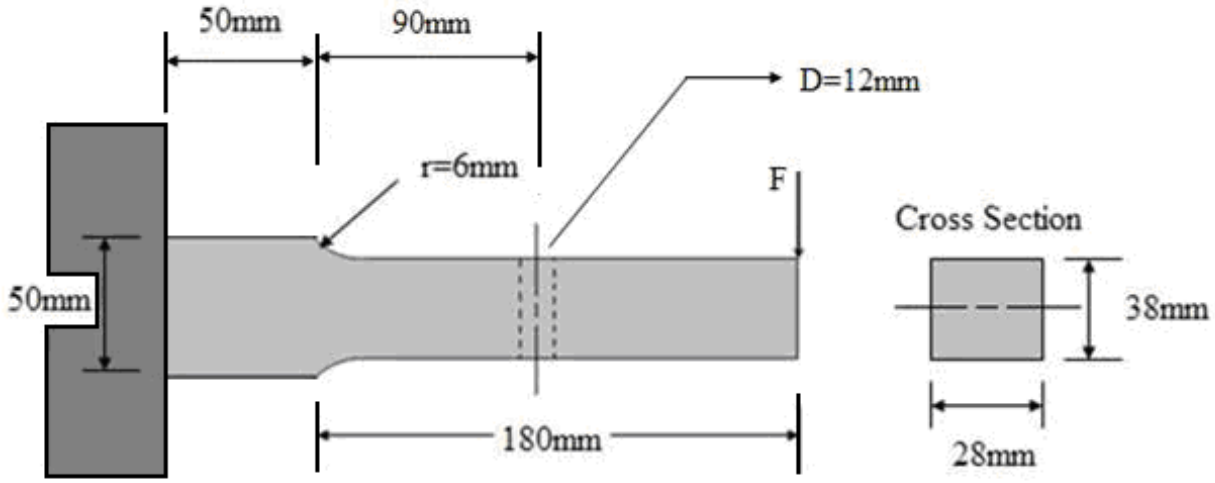


**Figure 1**

In this project, you are asked to perform a failure analysis of a rectangular cantilever beam that has a traverse hole as shown in the figure. The details of the required analysis are given below:

- Develop a 3D model of the cantilever beam and the supporting plate using a *CAD package* or *ANSYS* modeling utility and then conduct the failure analysis using *ANSYS* finite element modeling (FEM) package.
- Assume that the back face of the supporting plate is fixed as a boundary condition. Determine the maximum deflection and stress values using *ANSYS* for the applied force of F = 4500N and the fillet radius of r=6mm. Calculate the factor of safety of the design for the given force magnitude and then estimate the maximum allowable force that can be applied to the structure. Compare your ANSYS results with the ones obtained from the analytical solution. Change the mesh size and repeat the same analysis, show the results on a compact graph, comment on the effect of mesh size on the results.
- Determine the effect of changing fillet radius on the results of your static analysis. Construct a graph of geometric stress concentration factor versus (r/d) and then compare your plot with the one given in Figure E-9 of the text book.
- Perform a dynamic failure analysis of the beam under fully reversed loading with a force magnitude of 5000N. Calculate the factor of safety of design for N = 100000 cycles. Construct the S-N curve for the data given below. Compare your ANSYS results with the results obtained from the analytical solution.
- Perform a modal analysis and find the mode shapes and frequencies of the beam.

Material properties:
Material: 1060 Carbon Steel (quenched and tempered at 1000 F)
Surface Finish: Ground
Reliability: 99%
Temperature: 200 $^0$C
Poisson's Ratio (PR) = 0.3
E = 200 GPa
Density = 7800 kg/m$^3$