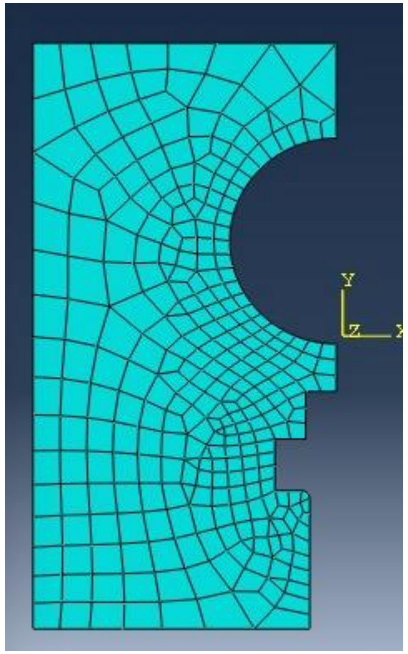
MAE 404/503: Finite Elements in Engineering
Project 03 – Individual Project
Harshal Rajesh Tingre. (ASU ID – 1226039050)



FEM model description:

Material Properties

The material used for this design is PMMA with properties assumed to be Young’s Modulus 3310 MPa and Poisson Ratio 0.35 - 0.40

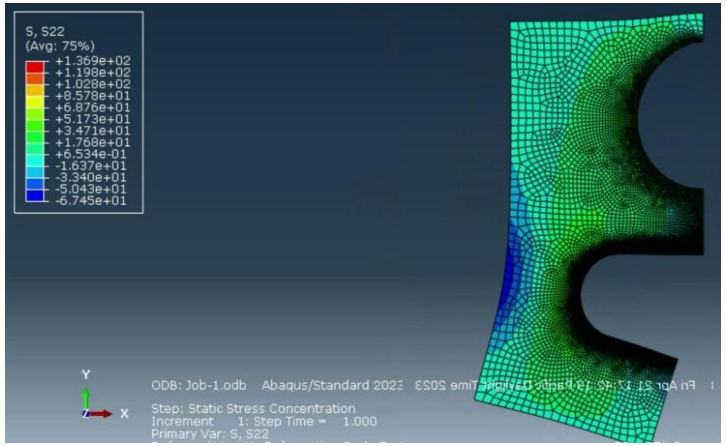
Mesh Details-

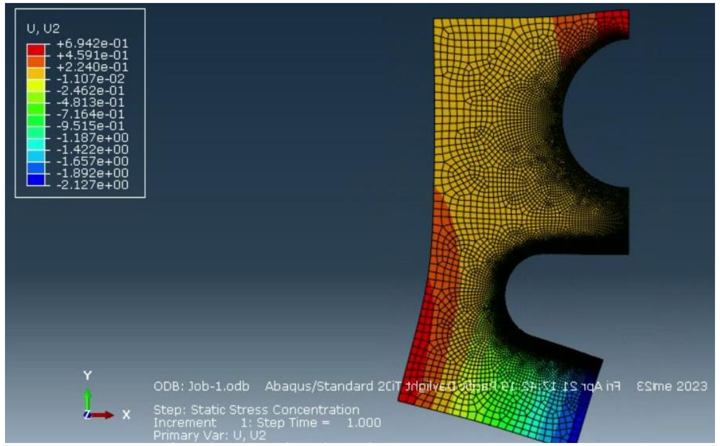
Nodes: 15804

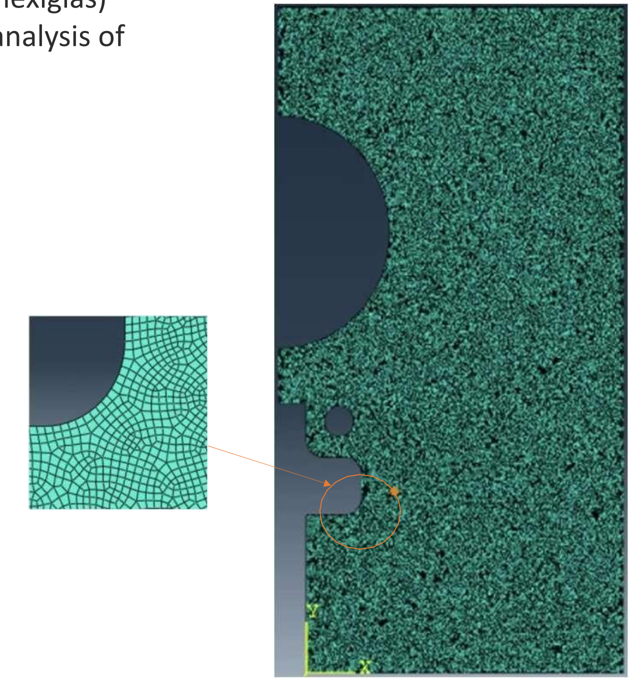
Elements: 15686

Element Type: 15115 linear quadrilateral elements of type CPS4R and 471 linear triangular elements of type CPS3.

(Old One) Overview:- Plate has a nominal thickness of 6.35mm and plate used for this question or this problem 74 ×74 . The material is PMMA (Plexiglas) with properties, Young's Modulus 1800 - 3000 MPa and Poisson Ratio 0.35 - 0.4. This plate is then subjected to a tension test. The modelling and analysis of the component is performed using Abaqus. For this problem one-half symmetry of the component was modeled.







The bolt notch has been changed from a conical shape to a semicircle to reduce the Max Principle stress. And a few sharp corners were given a fillet to smooth them out.

(which were not a problem last time).

Improvements/Corrections in the FEM modeling:

•The ‘cross’ part of the design has been chamfered to a radius of about 2 mm for each edge.

•The stress values from the original design compared to the modified design:

S22: Modified design: 39.06 MPa

U: Modified design: 1.0888 mm

The provided values do make sense. As the design of the mesh is changed

According to the previous model, the total predicted load for the model should have been increased gradually 700N ,900N, 1000N, 1200N,

The provided values do make sense. As the design of the mesh is changed to reduce the maximum principal stress, there is an increase in distance as the change in the surface area means the displacement of the design (in mm) also increases due to the lower stresses. Since the load is distributed at the top half of the hole, the design is bent in such a way that the top half is bent in a manner like that of a pulling force, while since the bolt side is encased, there is no change in the displacement but because it is encased, the bottom side also experiences a slight bend like that of a pulling force.

Summary:

After making the changes to the design as shown earlier, I got a predicted breaking load of 1200N for the full design assuming that the given design will fail at 39.06MPa.

Due to this difference in the loads, the percentage change in the loads is calculated as shown

Mesh Size	No. of Elements	Load (N)	Maximum Principal Stress (MPa)	Displacement (U2) (mm)
0.03	6757	1200	34.44	0.01069
0.04	9756	1200	37.08	0.01233
0.05	18658	1200	39.06	0.01856

Mesh Size	Load (N)	Max. Stress	Max. Strain
0.019	700	31.88	0.107
0.019	900	34.65	0.094
0.019	1000	37.87	0.084
0.019	1200	39.06	0.067