FEA Study of Bolt Cutouts in Plexiglass Plate (1st Report)

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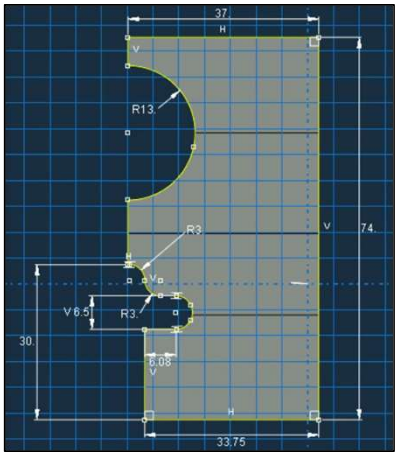
FEM Model Description (Base SI Units – N; mm; s; MPa):

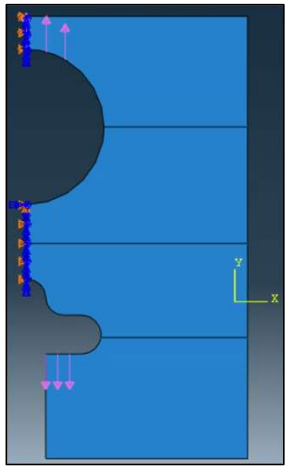
- 2D-Plate (Deformable, shell) modelled with ½ Symmetry along the Y-axis.
- Material Properties – E = 3310 MPa ; nu = 3.75.
- Solid Homogeneous section assigned with plane stress/strain thickness taken 6.35mm. Problem type assumed Plane Stress.
- Added a static, general step.
- **Mesh** : (For coarse) edge seeding of size 0.4 along the left inner curved edges, bias seeding along partitions and straight edges and global size 3 along the outer edges
- **Element type** – Plane stress family, Quad element of Quadratic order (QUAD8 elements – with no reduced integration) taken.
- **Element shape control** – Purely Quad elements under free technique taken for consistency of elements.
- **BC-1** : Y-direction roller support (X-sym) on the vertical edges where body connects to its symmetrical portion.
- **BC-2** : X-direction roller support (Y-sym) on the bottom point of the semi-circle
- **Load :** For same load(F) different tractions(t1 = dowel contact; t2 = washer contact) calculated. A1 = (total arc length of contact)*(thickness); A2 = (washer contact)*(thickness).

  t1 = F/A1 (+y – direc) ; t2 = F/A2(-y-direc)

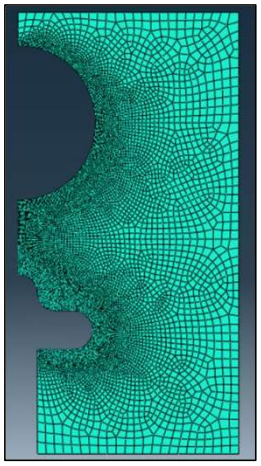
Mesh	Element size (Local seed – min size , Global seed – max)	No. of elements	Force (N)	Max. Principal Stress (Mpa)
Coarse	0.4, 3	2114	1200	55.35
Medium-1	0.2,2	7482	1200	55.26
Medium-2 (fine)	0.1, 2	15250	1200	55.22
Fine	0.05, 1.5	41165	1200	***55.22 (convergence)***



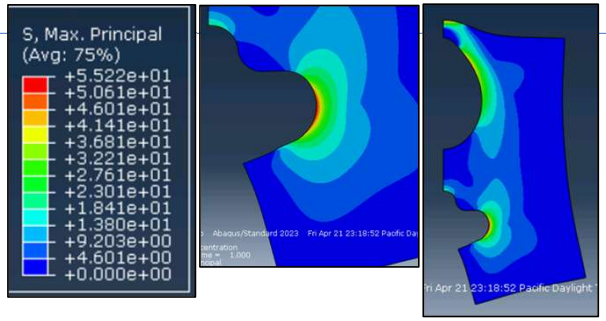
GEOMETRY



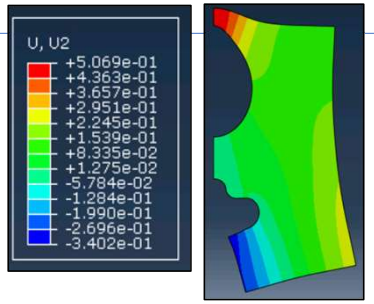
BC & LOADING



MESHING (fine)



PRINCIPAL STRESS IN Y - DIRECTION



Y - DISPLACEMENT

Results :

- Predicted breaking load - 1200 N as corresponding max. principal stress is 55.22 MPa (> 50 MPa).
- By using the median principal stress of 50 MPa as per Project 2 experiment results for different cases as true tensile strength. As most parts failed below stated 66MPa tensile strength.