Universitat Politècnica de Catalunya
Numerical Methods in Engineering
Computational Mechanics Tools

Assignment 4

Plasticity in Abaqus

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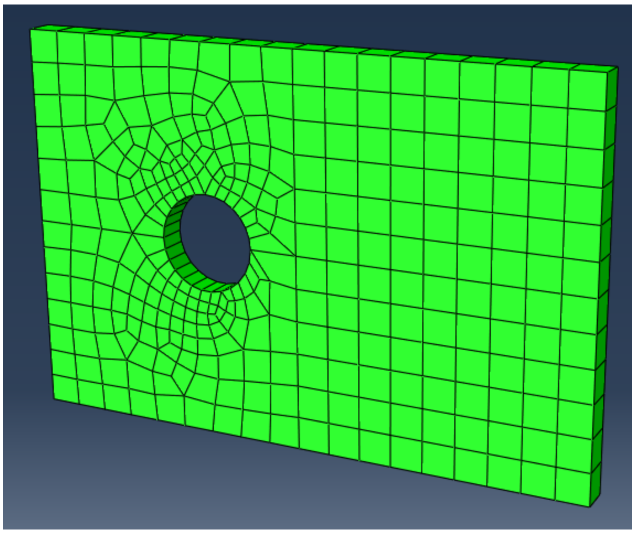
Contents

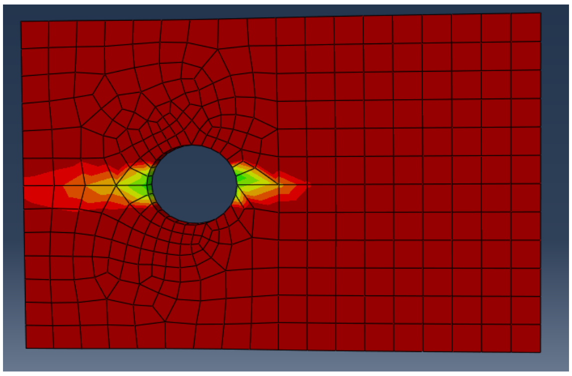
1 Plate with a hole

The following geometry was defined in Abaqus. The material is a steel with Elastic modulus of 2.1×10^5 MPa and a Poisson ratio of 0.25. Both left and right faces are streched 0.05 mm in each direction.

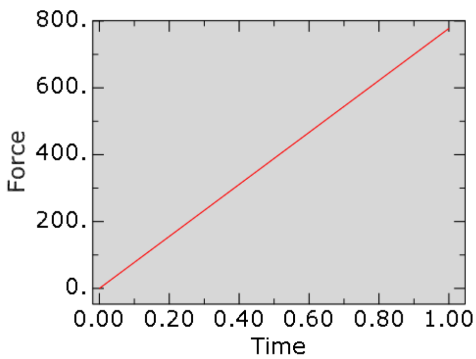


1.1 Elastic deformation

Figure 1 presents the results. The dark red area represents stresses beyond the yield point of 460 MPa. Deformations are scaled by 10.



(a) Deformed mesh.



(b) Force-time plot

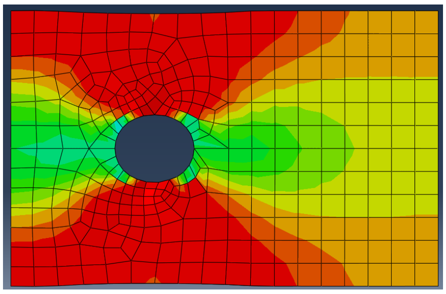
Figure 1: Results for the elastic material

Most of the domain is stressed beyond the yield point and therefore the solution is completely wrong. If we want an accurate solution, we must include plasticity into the equation. This is done in the next section.

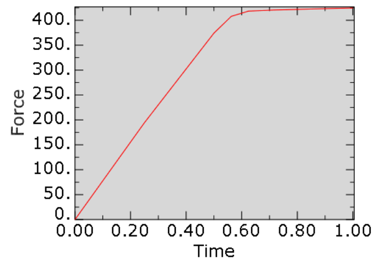
1.2 Plastic deformation

Figure 2 presents the results. The dark red area represents stresses beyond 520 MPa. Deformations are scaled by 10. Their plasticity is approximated by two yield points with two plastic strain coefficients.

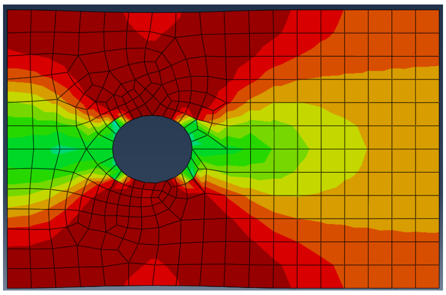
Case	Yield point 1	Plastic strain 1	Yield Point 2	Plastic strain 2
a	460 MPa	0	-	-
b	460 MPa	0	520 MPa	5×10^3 MPa
c	460 MPa	0	520 MPa	2×10^3 MPa



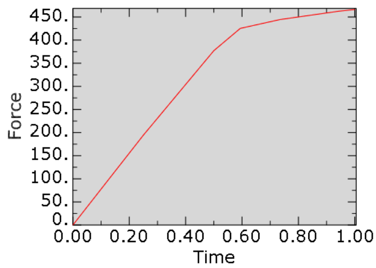
(a1) Defformed mesh and Von Misses Stress



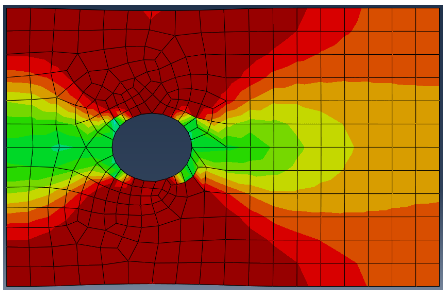
(a2) Force-time plot for case A



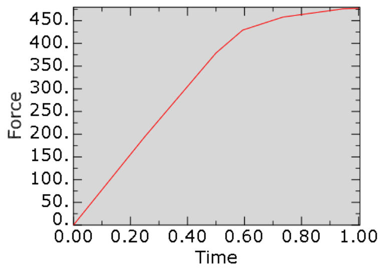
(b1) Defformed mesh and Von Misses Stress



(b2) Force-time plot for case B



(c1) Defformed mesh and Von Misses Stress

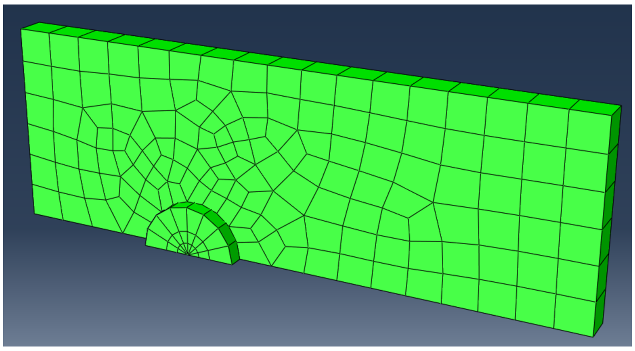


(c2) Force-time plot for case C

Figure 2: Deformation plots for all three cases

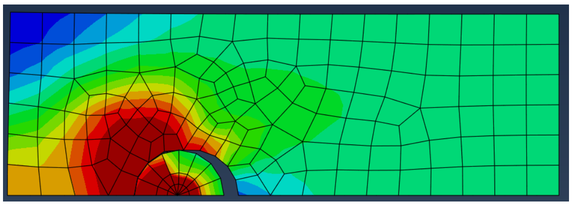
2 Plate and pin

The following geometry was defined in Abaqus. The material is a steel with Elastic modulus of 2.1×10^5 MPa and a Poisson ratio of 0.25. The pin axis is locked in place and the right face is pulled 0.1 mm to the right. A symmetry boundary condition is imposed on the bottom faces.

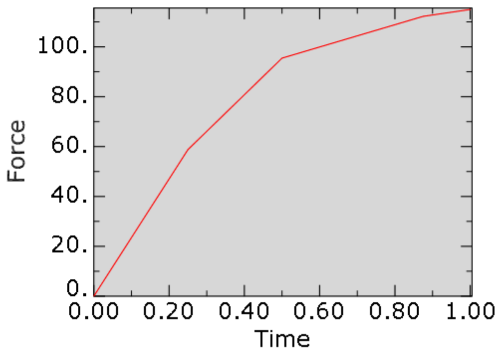


2.1 Elastic deformation

Figure 1 presents the results. The dark red area represents stresses beyond the yield point of 460 MPa. Deformations are scaled by 10.



(a) Deformed mesh.



(b) Force-time plot

Figure 3: Results for the elastic material

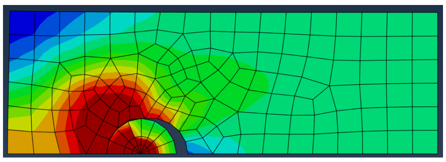
2.2 Plastic deformation

Figure 2 presented the results. The dark red area represents stresses beyond 520 MPa. Deformations are scaled by 10. Their plasticity is approximated by two yield points with two plastic strain coefficients.
For the pin:

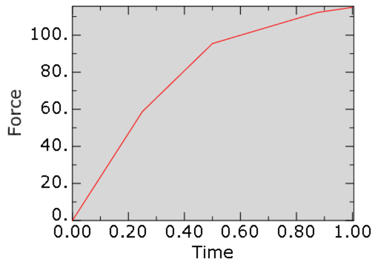
Case	Yield point 1	Plastic strain 1	Yield Point 2	Plastic strain 2
a	900 MPa	0	1000 MPa	2×10^3 MPa
b	320 MPa	0	400 MPa	5×10^3 MPa

For the plate:

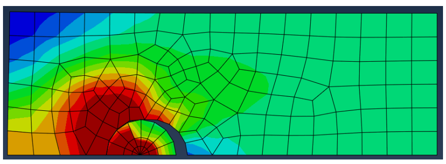
Case	Yield point 1	Plastic strain 1	Yield Point 2	Plastic strain 2
both	460 MPa	0	520 MPa	5×10^3 MPa



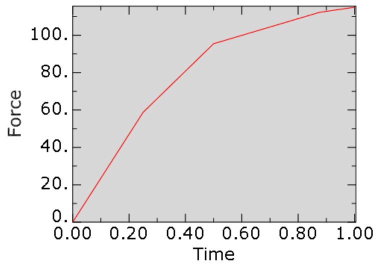
(a1) Defformed mesh and Von Misses Stress



(a2) Force-time plot for case A



(b1) Defformed mesh and Von Misses Stress



(b2) Force-time plot for case B

Figure 4: Deformation plots both cases

Both plots show the stress in the symmetry plane, not on the boundary closest to the viewpoint.
All in all, it apears that the results do not vary much if at all from the elastic case, for this particular geometry and boundary conditions.