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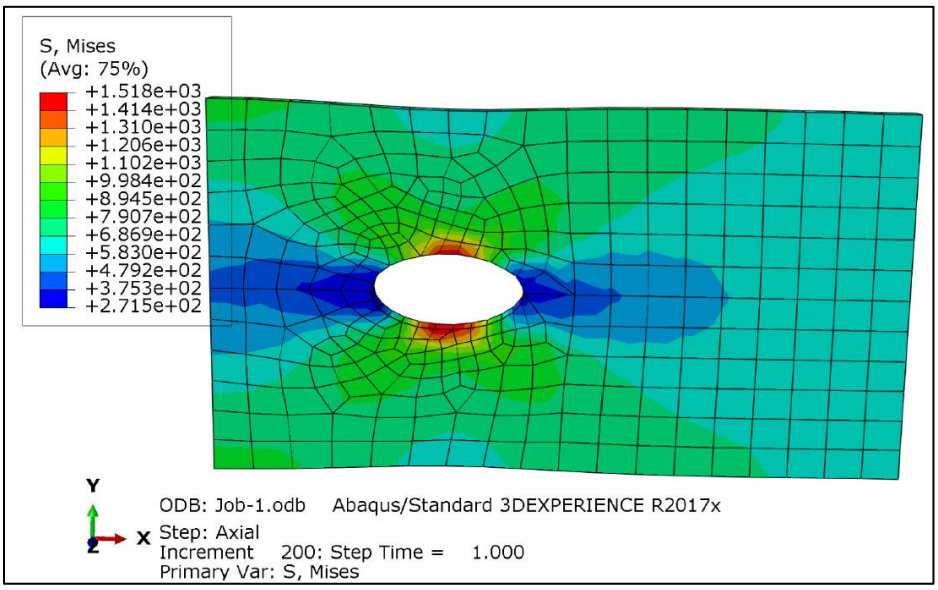
Tasks

1. calculate stresses on a steel plate with a hole, which is submitted to axial tensile force.
a) Plot the distribution of Von Mises stresses in the plate.
b) Plot the Force-displacement curve at the point-set.
c) Add the plastic properties (3 different cases presented in Slide 11 and compare the results. Discuss the differences in the Force-displacement curve for the three different cases.

Solution:
Following the steps given by the tutorial, the results are:
a) Von Mises stresses distribution



b) Force-displacement curve at the point-set.

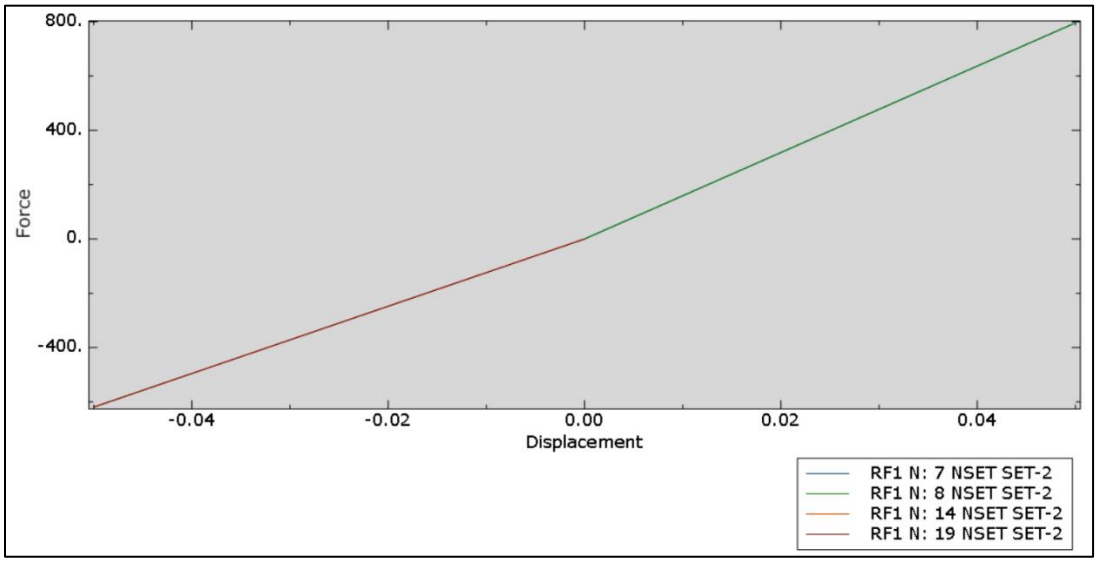


Figure 1 Force-Displacement plot for the nodes in Node Set 2

It is shown the linear behavior of the material. For the nodes 7 and 8 the reaction force is positive because these nodes are located to the right of the system of coordinates in the positive side of x. The contrary is for nodes 14 and 19.

c) Add the plastic properties (3 different cases presented in Slide 11 and compare the results. Discuss the differences in the Force-displacement curve for the three different cases.
Case A: isotropic, perfectly plastic, fy=460N/mm^2
Case B: isotropic, fy=460N/mm^2 at plastic strain=0 and fy=520N/mm^2 at plastic strain=0.005
Case C: isotropic, fy=460N/mm^2 at plastic strain=0 and fy=520N/mm^2 at plastic strain=0.002

The von mises stress for the cases A, B and C are:

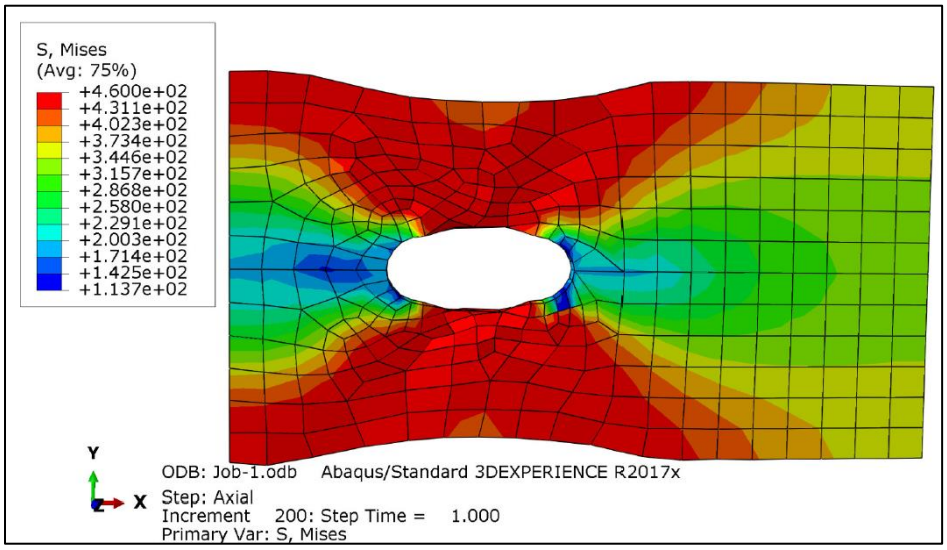


Figure 2 Von Mises distribution for the nodes in Node Set 2 with material perfectly plastic

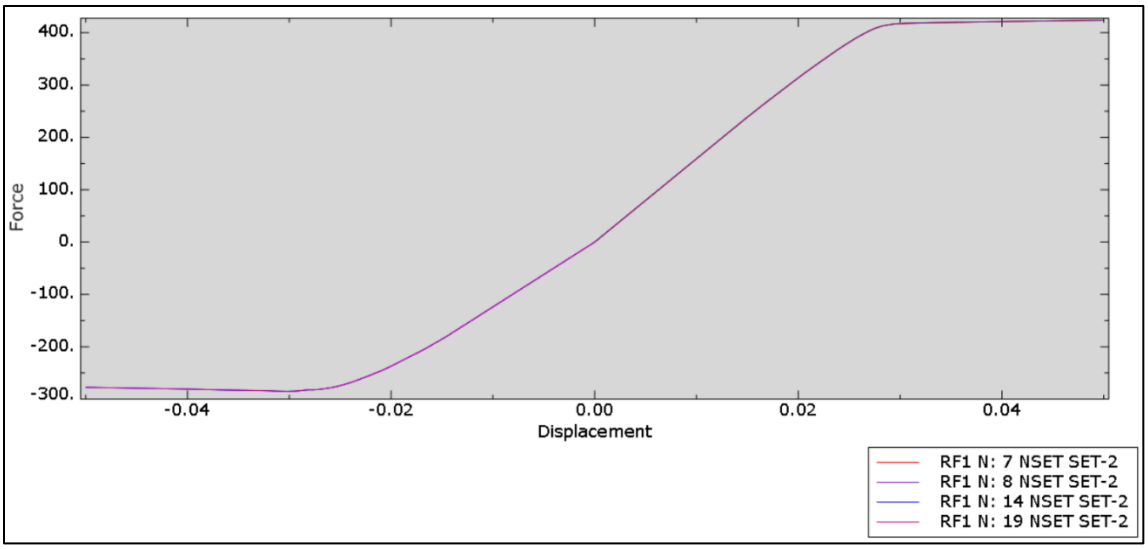


Figure 3 Force-Displacement plot for the nodes in Node Set 2, material perfectly plastic

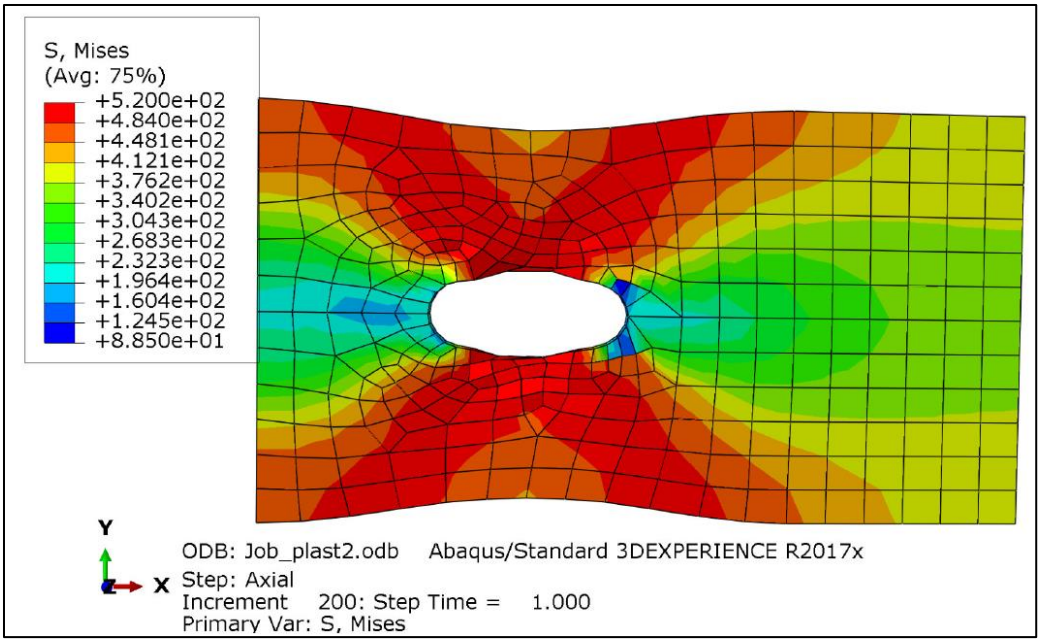


Figure 4 Von Mises distribution for the nodes in Node Set 2 with material perfectly with hardening

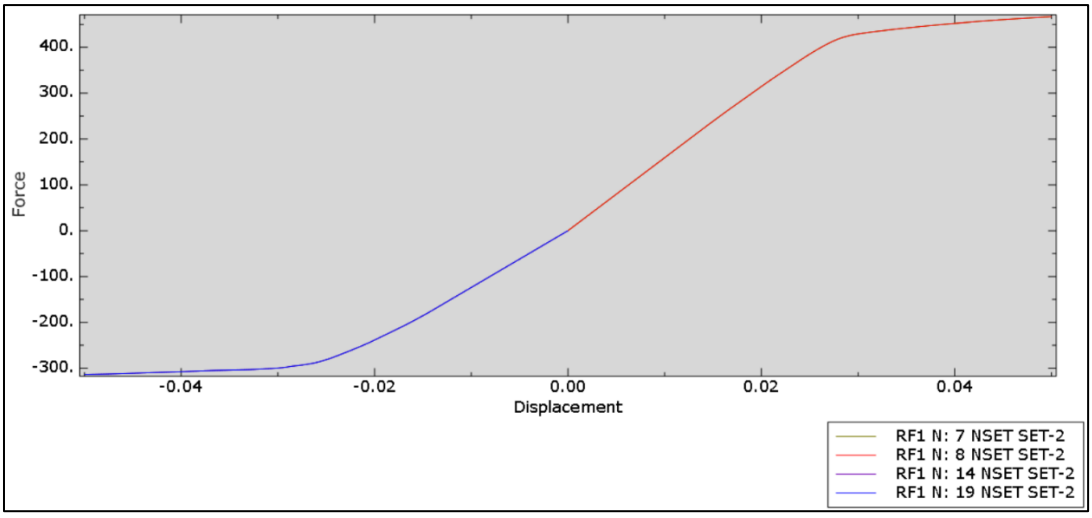


Figure 5 Force-Displacement plot for the nodes in Node Set 2, material perfectly with hardening

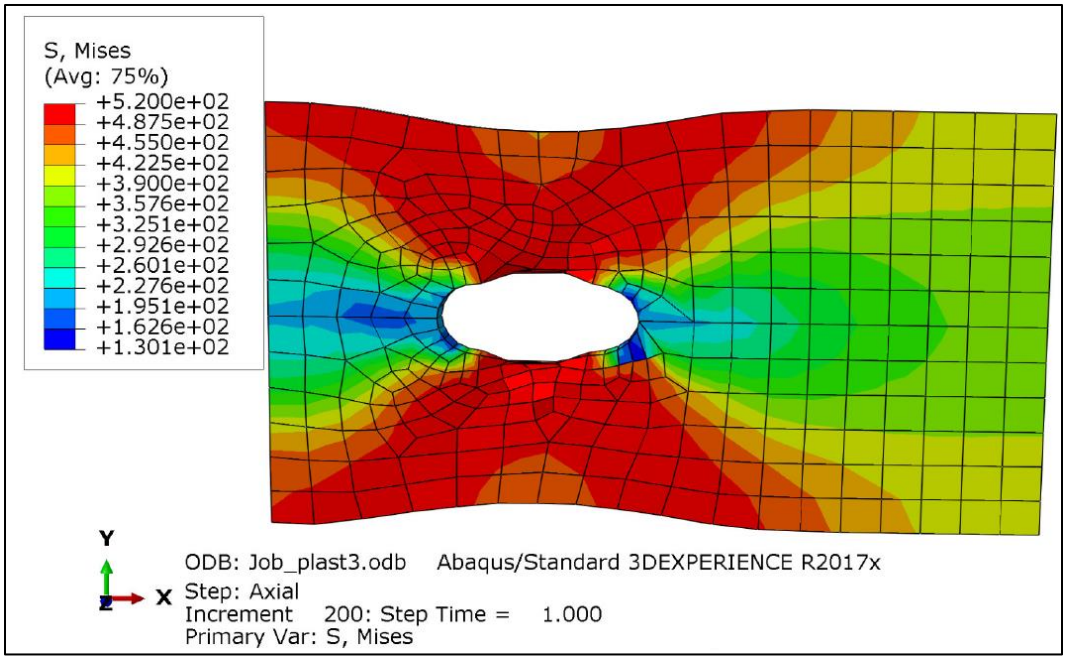


Figure 6 Von Mises distribution for the nodes in Node Set 2 with material perfectly with hardening 2

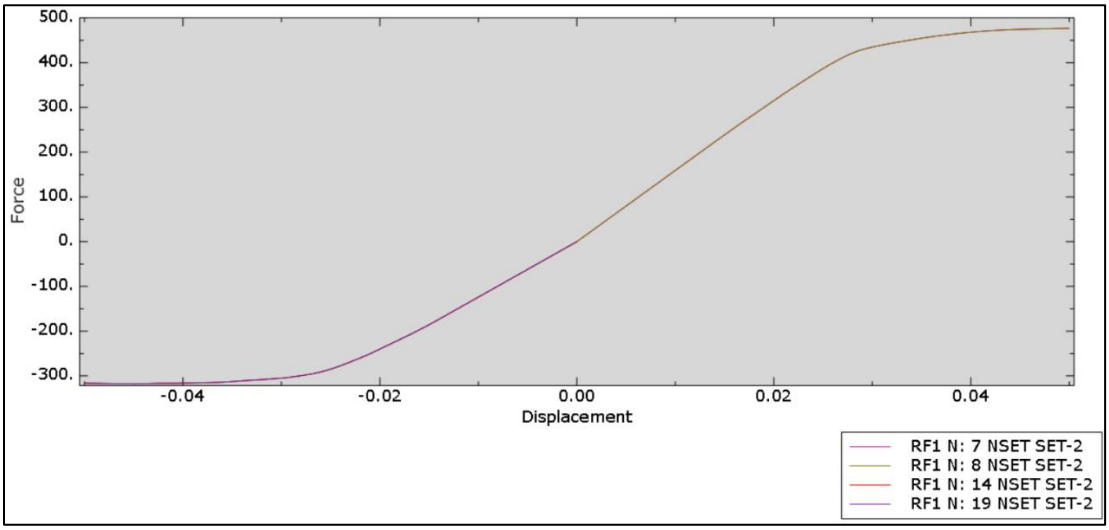


Figure 7 Force-Displacement plot for the nodes in Node Set 2, material perfectly with hardening 2

Conclusions

It is shown how the plastic property of the material limit the force that are computed in the nodes. It is because the yield stress conditioned the model's resistance, creating large displacements when strength is exceeded.

2. model the contact between a fixed pin and a plate, which is pulled at one of its ends.

a) Plot the distribution of Von Mises stresses on the deformed shape with an amplification factor of 10. Set scale of stresses between 0-460 MPa and make that stresses over this limit are plotted in dark red as shown in Slide 27.

b) Plot the Force-displacement curve for the horizontal reaction at the point-set.

c) Add the plastic properties to the two materials, one for the plate, and another one for the pin according to Slide 28 and compare the results with the elastic case.

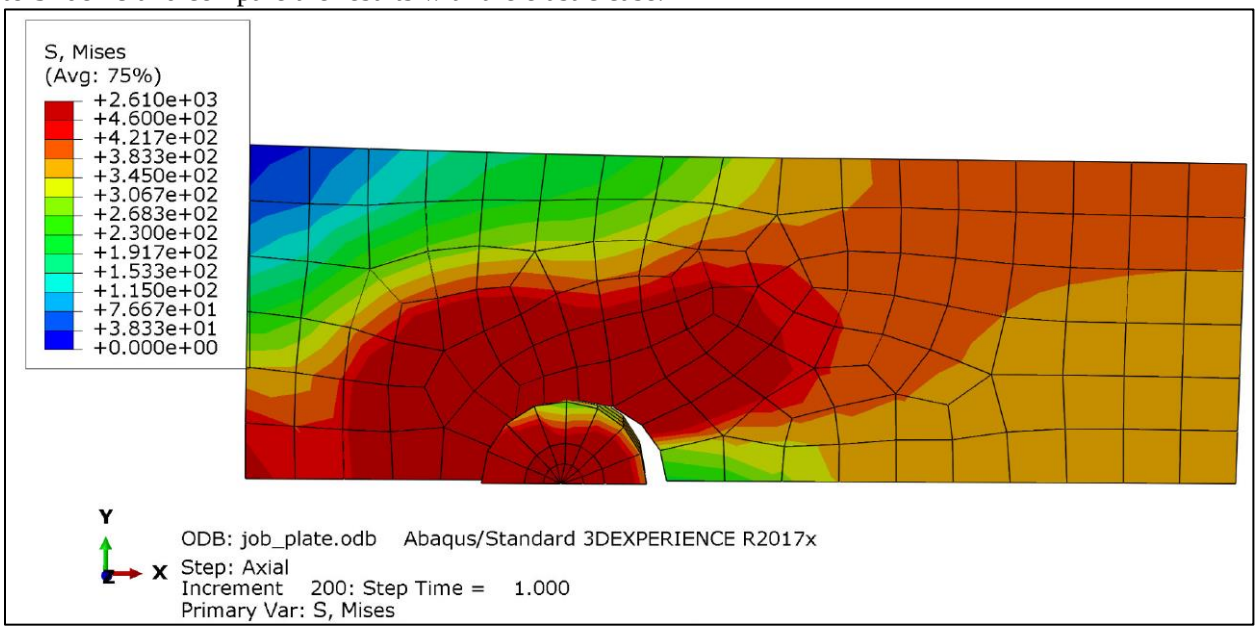


Figure 8 Von Mises distribution for the Plate with elastic material

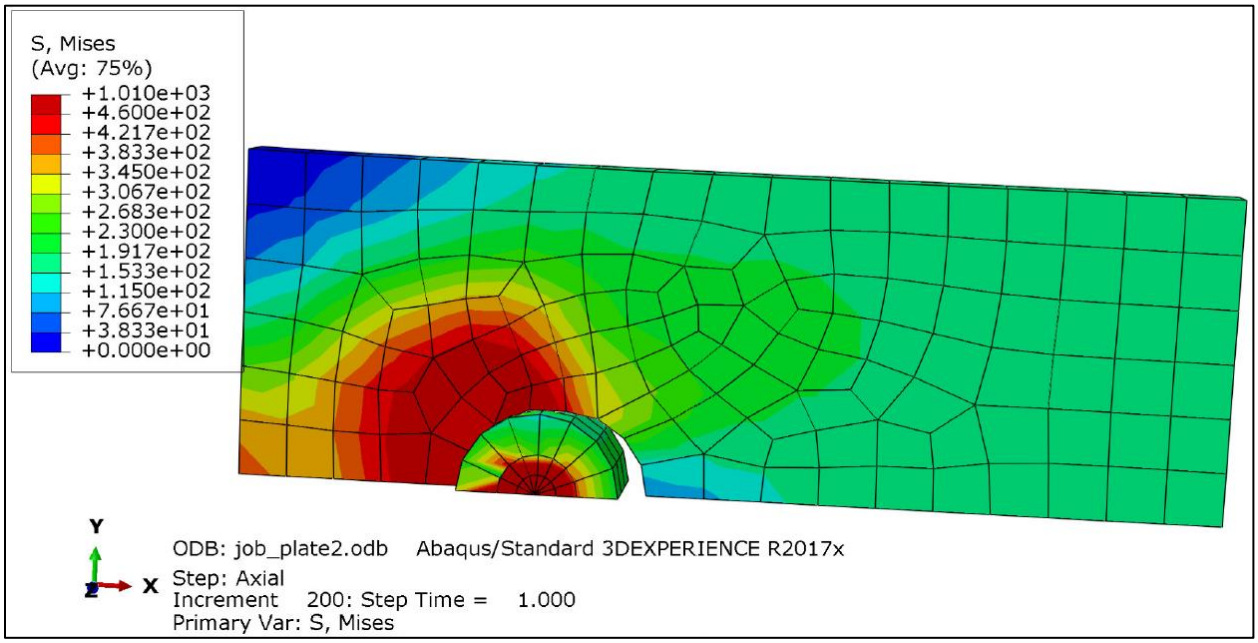


Figure 9 Von Mises distribution for the Plate with elastic and plastic material – case 1

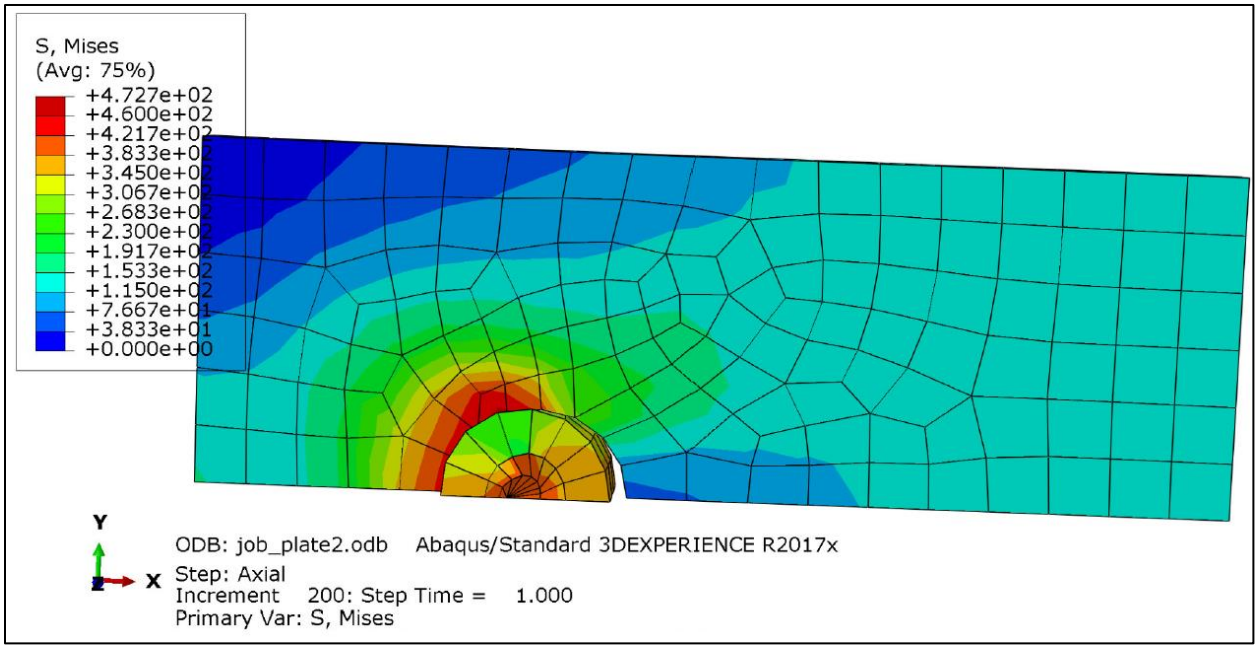


Figure 10 Von Mises distribution for the Plate with elastic and plastic material – case 2

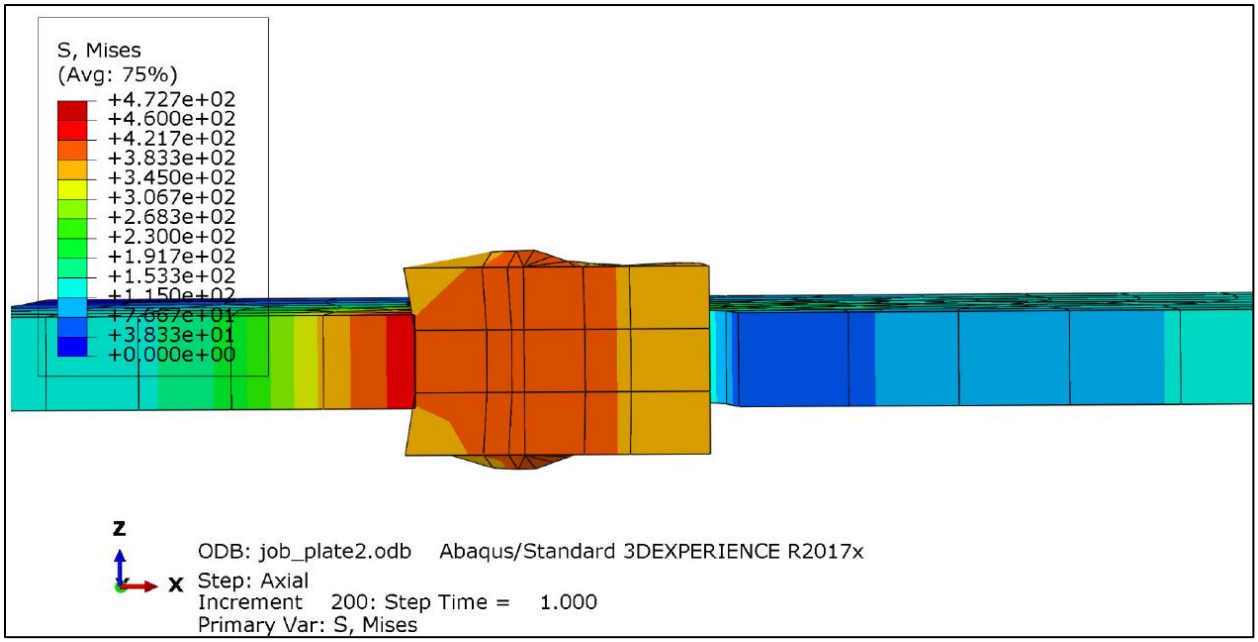


Figure 11 Von Mises distribution for the Plate with elastic and plastic material – case 2 deformation of the pin