Computational Mechanics Tools

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Abaqus nonlinearity assignment

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The Goal:

The goal of this assignment is to model a steel plate with a hole in the middle and plot the created stresses under compression and compare the results for elastic and different plastic forms. The same procedure is followed for a contact problem.

Tutorial 1

a) Plot the distribution of Von Mises stresses in the plate:

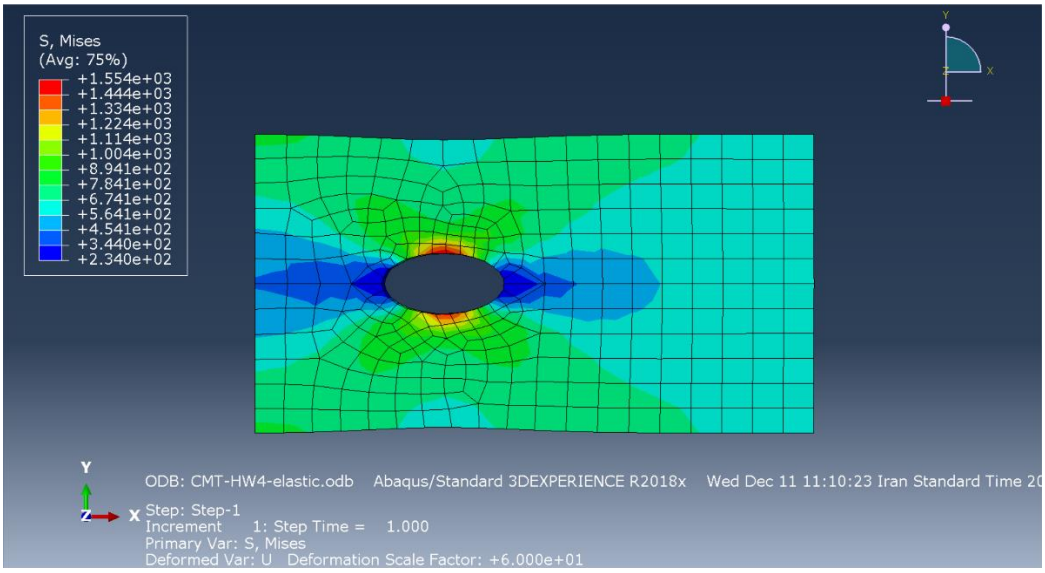


Fig1. The Von Mises stresses in the plate

b) Plot the force-displacement curve at the point set:

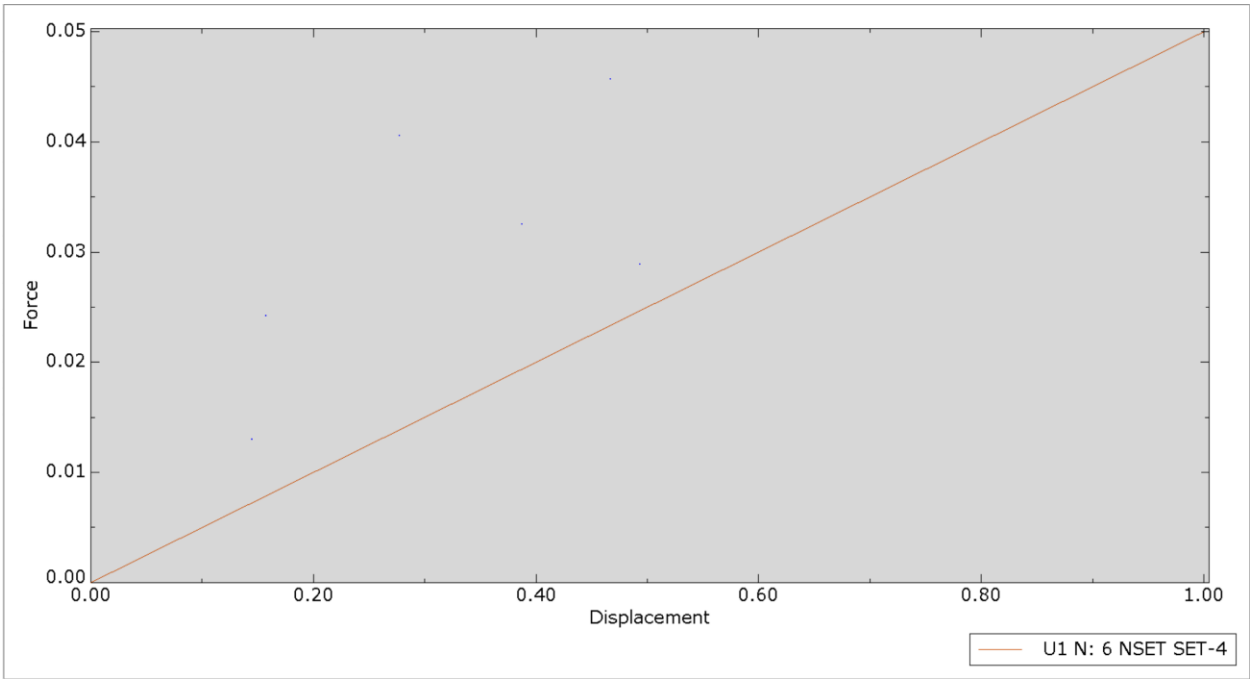
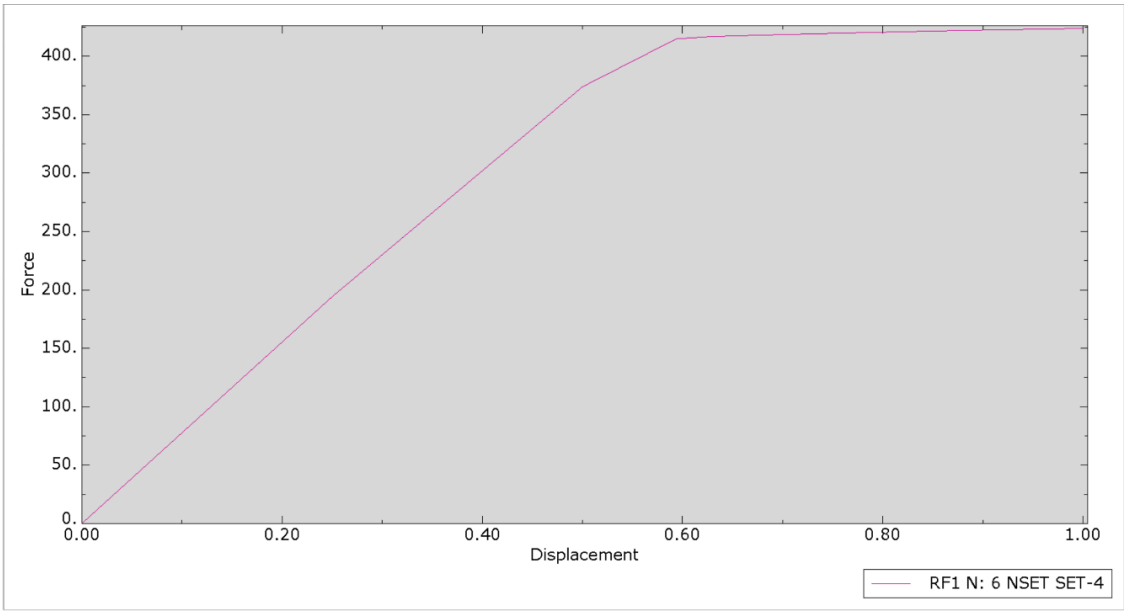
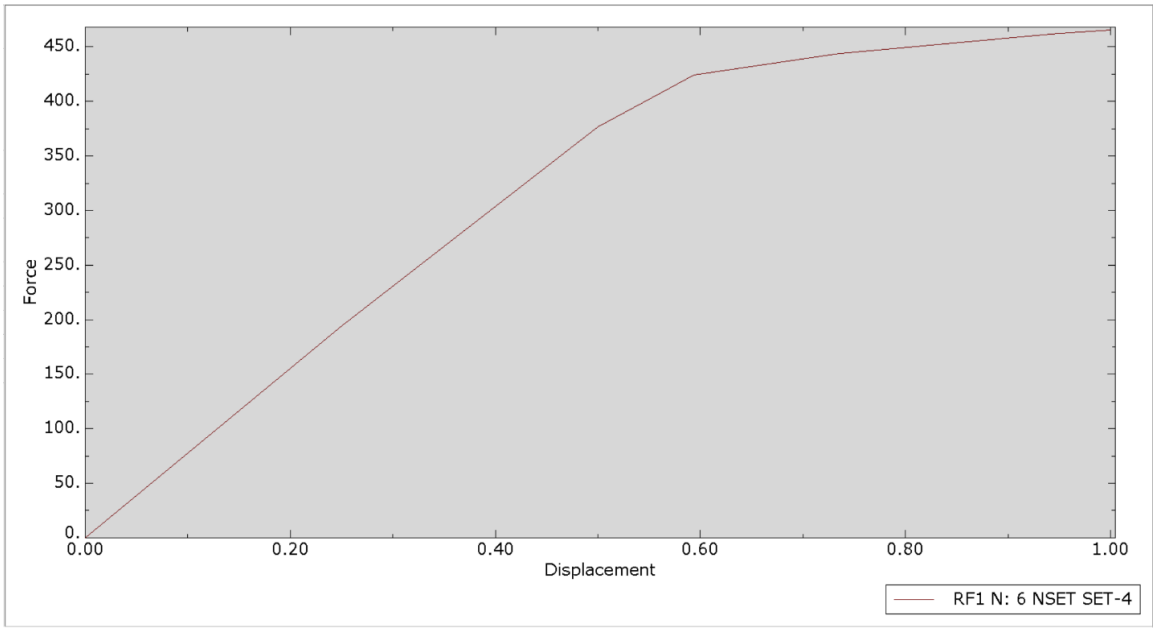


Fig2. Force-Displacement curve for the set

c) Add the plastic properties (3 different cases in slide 11) and compare the results. Discuss the differences in the force-displacement curve for the three cases:





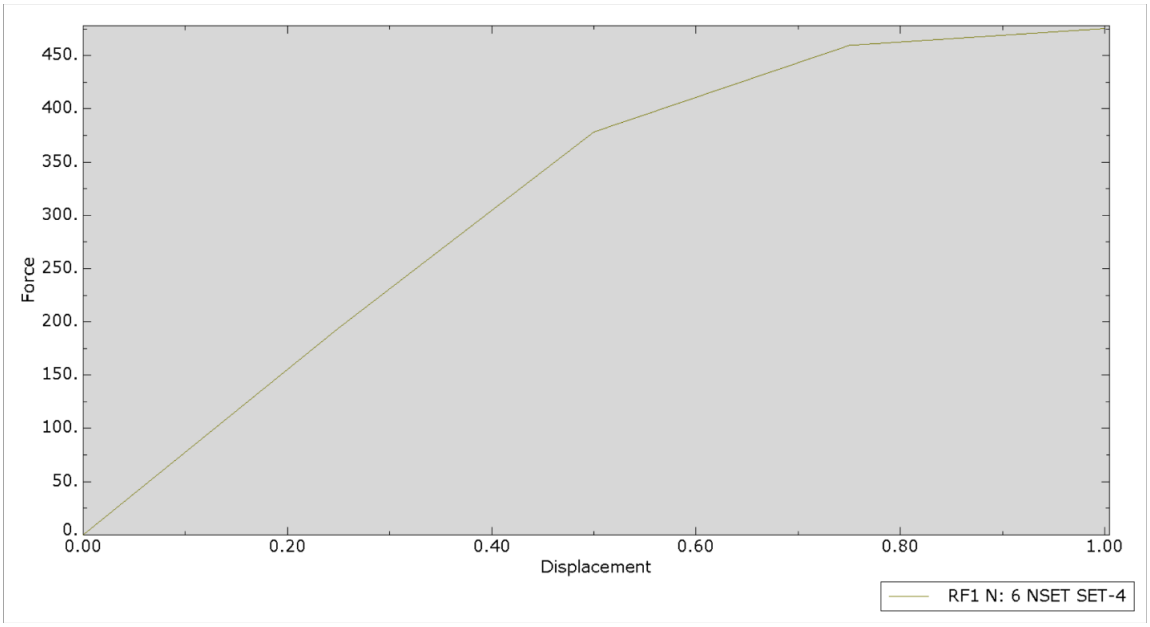


Fig3. The force-displacement curves for the plasticity cases

The first difference that we see between the elastic and the plastic cases is that the force-displacement curve for the elastic case is linear and in the plasticity cases from the point of the yield stress the curve changes and this depends on how we define the plasticity curve. If we only define one point the curve continues as a line again but in case, we define more points for the plasticity curve it converges to the real polynomial curve that we expect it to form. We can see that in the three plasticity cases the difference is in the second point of the plastic section when we change the plastic strain the location for the second point changes.

Tutorial 2

a) Plot the Von Mises stresses on the deformed shape with an amplification of 10.

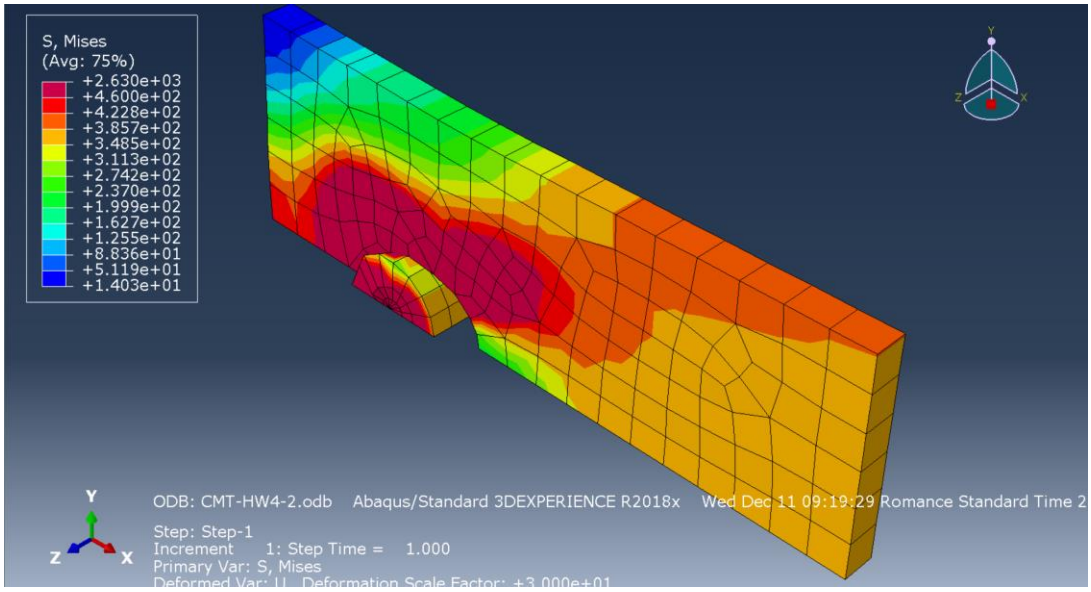


Fig4. The Von Mises stresses in the elastic case

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

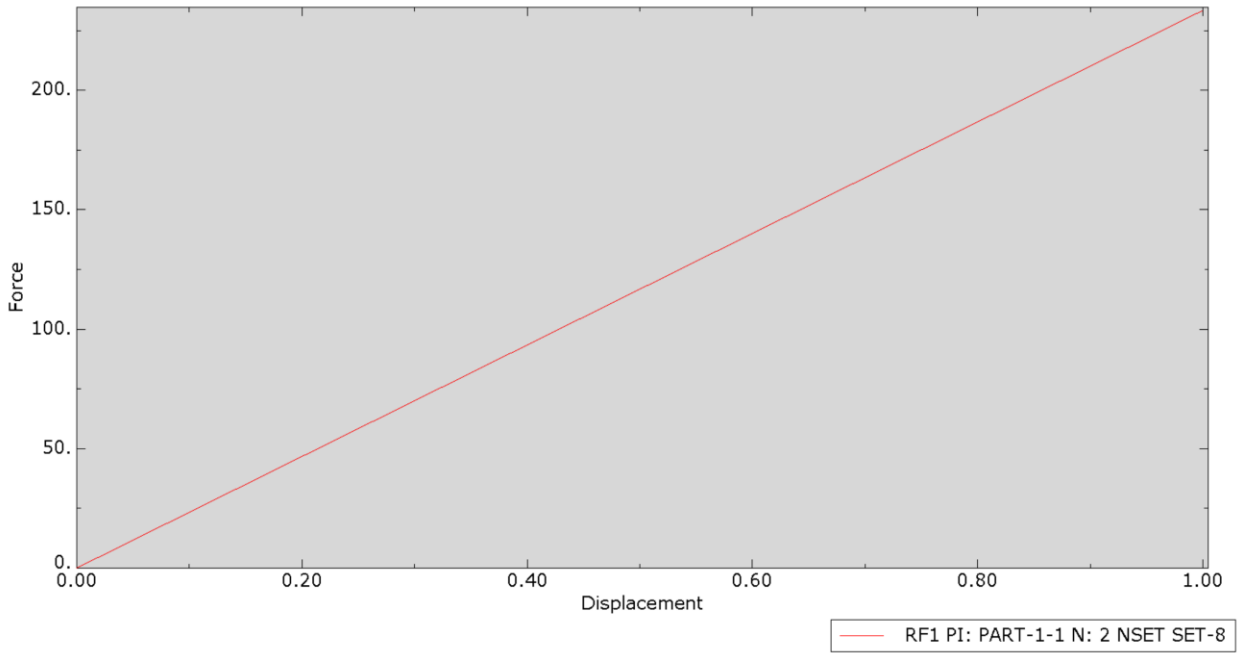


Fig5. The force-displacement curve at the point-set

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

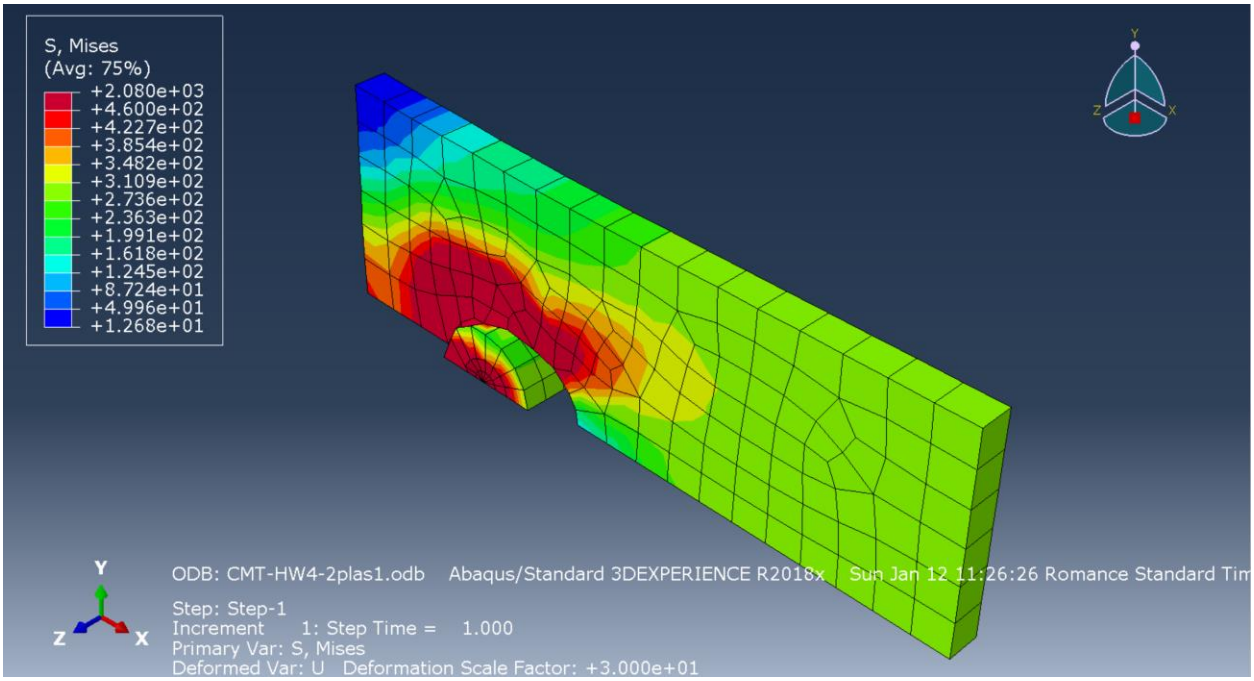


Fig6. The Von-Mises stresses with plasticity for the plate

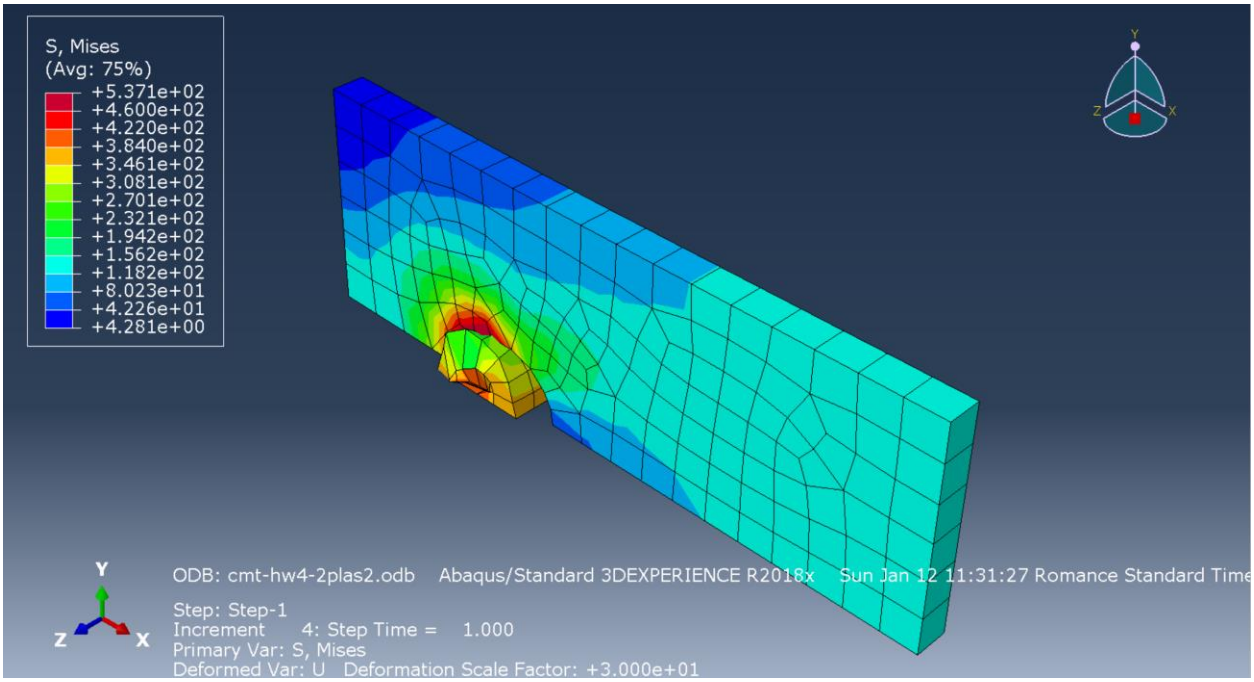


Fig7. The Von-Mises stresses with plasticity for the pin

By comparing the three figures and the stresses created in each one we can see that the first difference between the elastic and the plate with plasticity is that in the elastic the stresses created are in the same range but much bigger area of the plate has crossed the stress limit that we have put, in the plate with the plasticity we can see that only in the area near the pin the stresses have crossed our expected limits and this is logical because when we define plasticity it means that the plate is not going to act linearly so the stresses don't rise in the whole plane. In the case with the plastic pin we can see that the stresses created in the plate are much lower than the other two cases and except in a small area near the pin everywhere else the stresses are below the limit, the reason for this is that because the pin has a lower yield strain and its plastic the main deformation happens in the pin as we can see and because of the pin deformation the stresses created in the plate are much lower than the other two cases.