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SENSITIVITY ANALYSIS OF SMALL PUNCH TEST

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Abstract: *Small Punch Test (SPT) is used to determine current values of basic mechanical properties from a tiny piece of material. This non-standard type of test is preferred if there is shortage of material for samples. It is common for example when testing components of nuclear power plants, turbines, rotors, etc. It is an indirect computational task to obtain the mechanical properties from SPT. One of possible approaches to obtain yield stress and ultimate strength is the use of an inverse numerical simulation. There is a need to define the important variables that will substantially influence the inverse simulation.*

Keywords: ***SPT, FEM, sensitivity analysis***

We are trying to simulate a real experiment with the help of finite element model (FEM). Our goal is to achieve computationally an identical force-deflection response, which is recorded from the experiment.

Very ductile austenitic steel 316L is investigated in our case. Specimens were made from rolled plate with a thickness of 20mm. Nine specimens were cut from the plate for uniaxial smooth tensile test. Average results of tensile tests in various directions of the plate are in Figure 1.

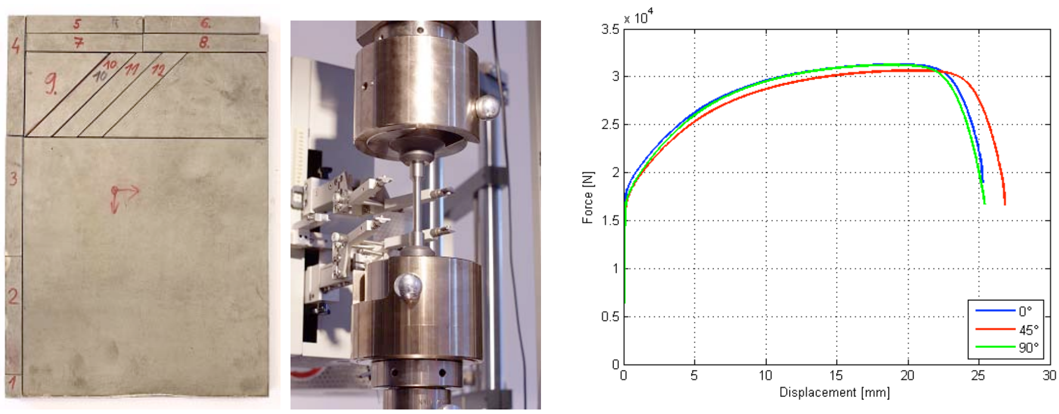

Fig. 1: Plate for the samples (left), sample (middle), uniaxial test results (right)

SPT samples were made from used tensile specimen's heads. In cooperation with Material & Metallurgical research Ltd. Ostrava, five penetration tests were performed in each of the directions. Experimental results are displayed in Figure 2.

Geometry of FE model is identical to the experiment assembly. Tools were modelled as "Rigid Body" and axisymmetrical FE model was used.

Sensitivity analysis was focused on the variables affecting the test. True stress – strain curve is the input to the elastic-plastic material model. The results show, that the maximum reaction force of SPT lies in the extrapolated part of curve which is obtained from uniaxial tensile test. This is the reason why to pay close attention to the calibration of the true stress-strain curve.

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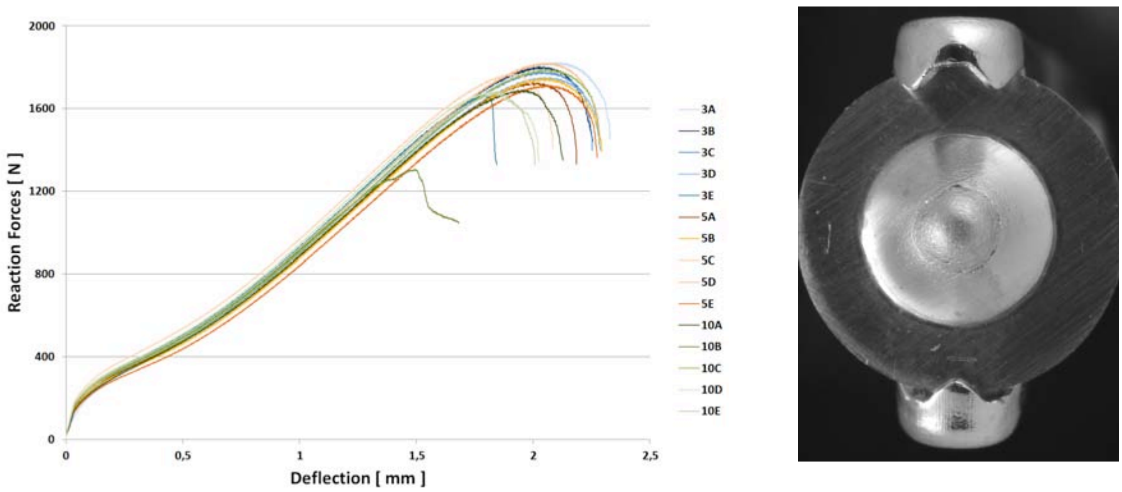

Fig. 2: SPT experiments

The value of Coulomb's friction coefficient plays a dominant role in the second part of test, as can be seen in Figure 2. Effect of sample thickness dispersion is seen in Figure 2, too. It is not easy to keep the prescribed thickness tolerance. This is due to small dimension of specimen and mostly handmade samples.

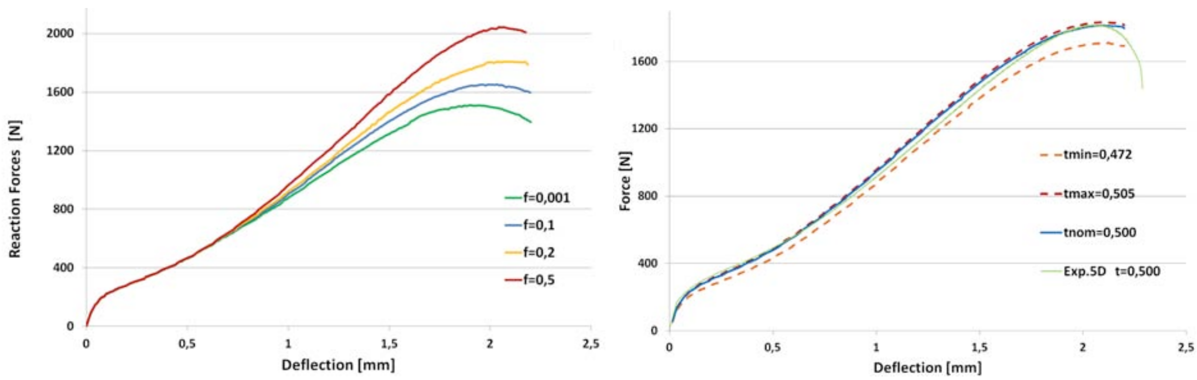

Fig. 3: Influence of friction coefficient variability (left), effect of thickness variability (right)

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