ENGINEERING MECHANICS 2009
National Conference with International Participation
Svratka, Czech Republic, May 11 – 14, 2009

pp. 1543–1544
Paper **#256**

COMPARISON OF STRAIN FIELDS OF CT SPECIMEN DETERMINED BY FEM AND BY TERMOPLASTIC MEASUREMENT

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Summary: *The aim of this paper is to present a study comparing plastic deformation of CT specimens by observed means of thermography and obtained by FEM calculation. The study is intended to be the first step in the investigation of evolution of plastic deformation of thin-walled structures in the vicinity of cracks.*

1. Introduction

During plastic deformation of metals is a significant part of the plastic work converted into the heat. Therefore temperature field observation associated with the heat emission can be used for analysis of density of plastic deformation. This data can be then used for elasto-plastic fracture mechanics investigation of the stress and strain field around the crack.

2. Experimental method

Advantage of the thermoplastic (Rittel 1998) observation in comparison to thermoelastic strain analysis (Huang at. al. 1990) is that it works with a higher temperature differences and therefore it does not require the most sensitive equipment.

A standard CT specimen extracted from the pipeline (ČSN Steel 11 535) was loaded in the tensile machine and the process was simultaneously recorded by thermo camera FLIR (Šperl 2008). Associated temperature field than was used as input data into FEA system ANSYS.

An example of temperature field generated during the test is shown in Figure 1.(left) False colors encode the temperature data. The release of the main contribution the heat in the vicinity of the notch is clearly seen. From the same image follows the necessity to thoroughly polish the specimen before test as the state of the surface controls temperature field and can lead to an obstruction of the relevant data.

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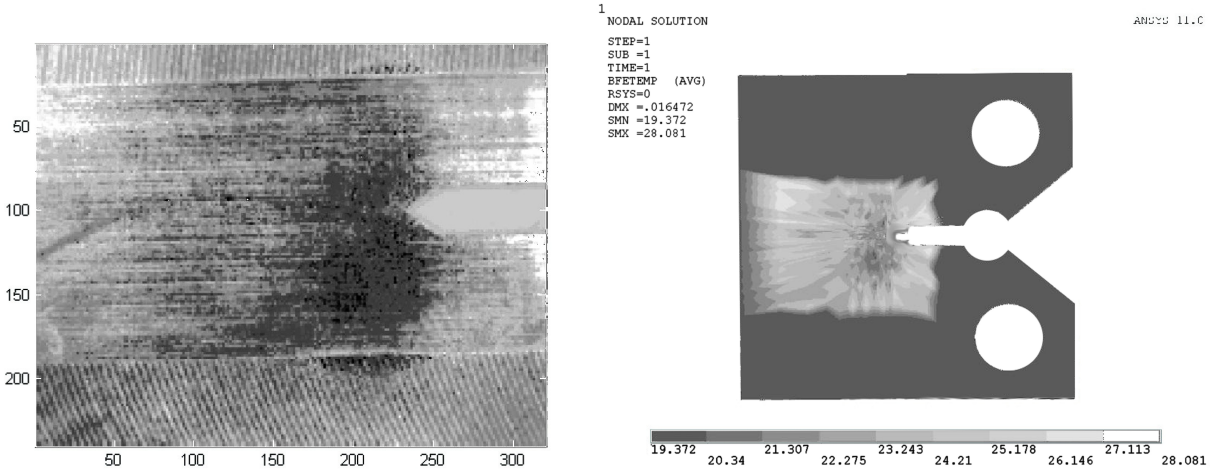

Figure 1. Left part: distribution of temperature in CT specimen during the test, right part: imported temperature field into FE model.

3. Conclusion

The distribution of plastic deformation obtained from thermal measurement (Fig. 1-right) was compared to the plastic strains calculated by FEM using strain-hardening data known for the specimen material. The qualitative agreement was obtained. Detailed analysis, refined mesh and better constitutive model would yield more profound correlation and are intended to be a subject of the further investigation.

4. Acknowledgement

This research has been carried out with support from institutional research plans AV0Z20710524 and MSM6840770043, Czech Grant Agency grant No. 103/09/2101.

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