

INFLUENCE OF RATE DEPENDENT PLASTICITY ON AN SHEET METAL BENDING PROCESS

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ABSTRACT

The high demands on precision and quality of industrial sheet metal forming processes are increasing steadily. Therefore, more and more effects concerning the machines but also the material behaviour of the workpiece must be considered. Here, we consider an automatic panel bender of Salvagnini Maschinenbau GmbH [1]. In this application, it turned out that the speed of bending is a relevant influence factor.

Goal of this work is to estimate the influence of strain rate on bending forces and the shape of the bent profile. In a previous work [2], an analytic model in the framework of Bernoulli-Euler beam theory for the bending of a cantilever with elasto-plastic behaviour has been presented, dimensionless influence parameters have been derived, and it has been shown that the influence parameters obtained by linear beam theory are also relevant for the nonlinear industrial application involving large deformations. To include the strain rate dependency, the beam model now has been extended to elasto-visco-plastic behaviour. Besides the plastic deformations also the elastic ones are important, since the springback angle must be known exactly to achieve the required accuracy. To represent this effect, Hollomon's equation [3] was extended by an elastic term. Additionally, the strain rate sensitivity is considered according to [4].

With this beam model, numerical studies have been performed, in which forces, and deflections have been analysed for small deformations. Finally, the results of beam theory have been compared with 3D-Finite Element computations. A very good coincidence turned out. The results also show that the strain rate has a significant influence on deformations and forces. The outcome of the present study will be used to consider the strain rate as an additional parameter in the digital twin of the automatic panel bender [1].

REFERENCES

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