ANALYSIS OF THE FORMING PROCESSES ACCOUNTING FOR ASYMMETRY OF ELASTIC RANGE

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The aim of the paper is to propose a new approach to the material description using the concept of Burzyński paraboloid yield surface with correction for initial anisotropy [1]. The correction takes into account the deviation of the determined experimentally yield surface from classical Huber-Mises yield condition for isotropic material. Finite element method is used for the simulation of sheet metal forming processes including cup drawing and stamping. Proper description of material properties is crucial for accurate analysis. In particular, the initial anisotropy and asymmetry of elastic range of considered materials play an important role in the adequate finite element simulation. For metal forming analysis many experimental tests are needed to obtain the proper description of metal sheets behaviour. There are some attempts to account for the elastic range asymmetry, e.g. [2], [3], [5]. However, according to our opinion, there is still lack of workable description of initial anisotropy, which could allow analysing effectively practical problems.

In the case of plane stress the yield surface is assumed in the following form [1], [4]:

(1) $$f = \sigma_1^2 + \sigma_3^2 - 2\lambda\sigma_1\sigma_3 + (k_c - k_r)(\sigma_1 + \sigma_3) - k_c k_r$$

where k_c, k_r are initial yield stress for compression and tension and λ is the correction coefficient introduce by Burzyński [1]. The return mapping algorithm was applied by numerical scheme formulation of the integration of elasto-plasticity equations. The problem of the cup drawing of the DP600 steel sheet is studied. The comparison with the results obtained from the simulation of similar forming process with application of Hill conditions for anisotropy sheet material was made.

Numerical simulation was performed with application of ABAQUS finite element program. The own UMAT was implemented for calculations.

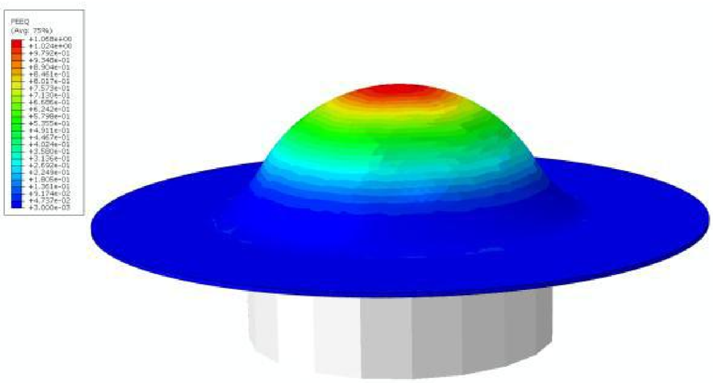

Fig. 1: The geometry and finite element mesh of sheet metal forming processes.

Fig. 2: The experimentally deformed shape of sheet metal

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