Springback Analysis of Sheet Metals Regarding Material Hardening

M. Schikorra[a], R. Govindarajan[b], A. Brosius[c] and M. Kleiner[d]

University of Dortmund, Institute of Forming Technology and Lightweight Construction
Baroper Strasse 301, 44227 Dortmund, Germany

[a]schikorra@lfu.mb.uni-dortmund.de, [b]raja@lfu.mb.uni-dortmund.de,
[c]brosius@lfu.mb.uni-dortmund.de, [d]mkleiner@lfu.mb.uni-dortmund.de

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Abstract. The phenomenon of springback of thin-walled sheet metal parts after forming is a well known problem of forming technology in general, but particularly since the finite element simulation offers the opportunity to predict geometrical and material properties after forming. Irrespective of the intensive efforts in the previous years, a reliable and accurate prediction of springback deviations by use of the finite element simulation is still not possible. This paper deals with the numerical and experimental analysis of the springback effect itself, which dependents on the final stress states of a part after the forming process. Experimental investigations have been carried out to analyze geometrical accuracy in loaded and unloaded conditions to isolate the springback effect. Additional finite element simulations have been conducted in order to compare the experimental and numerical results and to determine the geometrical differences and their reasons.

Two experimental set-ups are being discussed: Air bending on the one hand, which offers good access to the specimen in the testing equipment, and draw bending on the other hand, which is characterized by a simple strain state, but also by strain reversal within the tests. Both experiments were carried out using DP600 and X5CrNi18.10 with three different sheet thicknesses and bend radii and were compared with according FE-models. An additional shear test experiment has been developed to characterize the material behavior of the tested sheet metals for strain reversal. Furthermore, the importance of the Bauschinger effect and usable hardening models were analyzed. This study intended to investigate reasons for insufficient form and dimensional accuracy between simulations and experiments after springback and to propose modeling methods to improve the accuracy.