Chair of Metal Forming and Casting
TUM School of Engineering and Design
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Failure Assessment of Bending Operations with Pre-strechted Sheets (3D-BFLC)

Motivation

Many sheet metal parts go through a bending operation during the manufacturing process. Compared to deep-drawing operations, the prediction of failure in beige operations cannot be predicted with a forming limit curve from the Nakajima or Marciniak experiment. Due to the small bending radii and the associated strong curvature, the failure only occurs with significantly higher strains. Likewise, the failure is not caused by a local constriction, but by damage to the outer areas of the sample.

The introduction of pre-strains in the material leads to a development of texture and damage. Since this damage depends on the direction, changing the direction of the load leads to increased damage. If such pre-stretched samples are subsequently bent, the sample may fail unexpectedly.

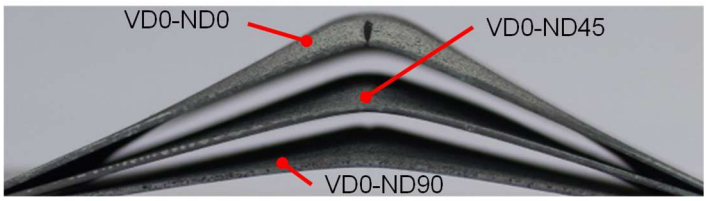

Figure 1: Influence on the bending angle.

Goals

Within the scope of this research project, the influence of the pre-stretch and the direction of loading on different materials are to be investigated. These results serve as a database for a phenomenological model to predict material failure in bending operations with pre-stretched sheets. This should increase the accuracy of the prediction and reduce the training time for tools.

By avoiding costly and time-consuming tool adjustment loops, the use of personnel, machinery, tools, and materials will be reduced, which leads to an increase in the competitiveness of small and medium-sized enterprises (SMEs). By minimizing entrepreneurial risks, the planned research project can also increase process reliability during ongoing production operations, thereby reducing production downtime and scrap during series manufacturing. Predicting failure in bending operations with pre-stretched sheets allows for better utilization of material potential for the specific application, which in turn translates into reduced material consumption.

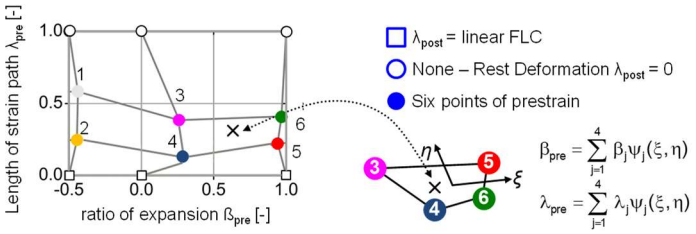

Figure 2: The structure of the meta-model.

The insights gained from this research project allow SMEs to compare the strains occurring in their components with the experimentally determined data obtained from this project. This enables them to analyze the manufacturability even without implementing the methodology in simulation programs. Particularly for progressive dies, which involve various forming and bending operations, such an approach provides an additional assurance in process design.

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