



Introduction

The production of the batteryboxbracket has been investigated as an example of the forming of thick sheet. This part is formed by DAF in three steps, one bending and two drawing steps, from a 5 mm thick blank. Finally some holes are punched into the batteryboxbracket (See background figure), which are needed to attach this part to the chassis of a truck with a bolt.

Objective

The first drawing step of the batteryboxbracket proved to be a critical process. Therefore the first production steps will be investigated using FEM simulations. A study of the influence of the drawing parameters, materials and tool modifications on the forming of this part will be beneficial for the design of similar parts in the future.

FEM simulations

Element type As the ratio between tool radius and sheet thickness ($\frac{R}{t}$) is small for this product the difference between shell and solid elements have been studied on a representative section of the product. Shell elements have been chosen for the simulation of the complete product as these elements give acceptable results and need much less calculation time.

Multiple steps The bending and springback of the blank is shown in Figure 1. These results are transferred to the first drawing step. Gravity and implicit dynamics are needed to close the curved blankholder (Figure 1). After the closure of the blankholder the

mesh is refined and the product is drawn.

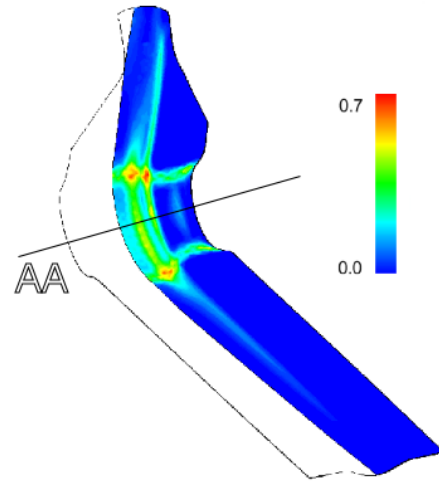


Figure 2: Damage D at lower surface (step 400).

Failure Experience from DAF tells that if this part fails, it will fail during the first draw at the outside of punch radius and not by necking. Therefore an FLD can not be used and fracture criteria (Eq. 1) are proposed. The fracture criterion of Oyane is capable of locating the correct critical position (Figure 2).

$$D = \int_0^{\bar{\epsilon}^p} f(\sigma, \dots) d\bar{\epsilon}^p$$

$$D = D_c \quad \text{for} \quad \bar{\epsilon}^p = \bar{\epsilon}_f^p \quad (1)$$

Future work

Experiments to determine the parameters of the fracture criteria are discussed at the moment. These parameters can be used to validate the simulations.

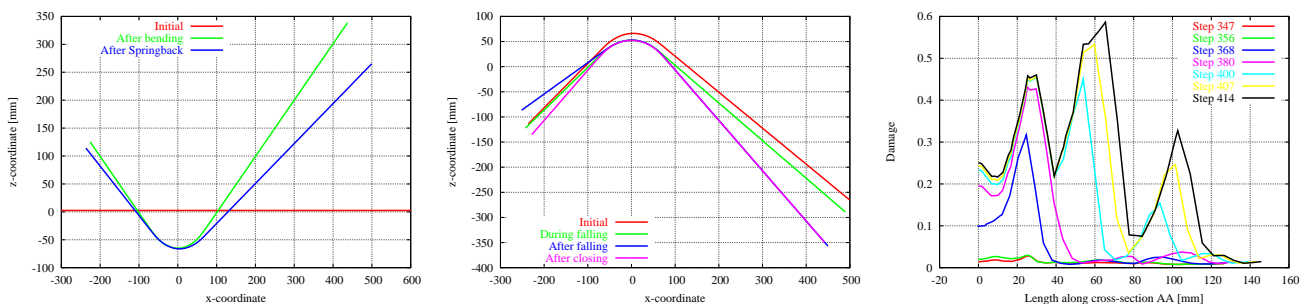


Figure 1: Product shape at symmetry-plane during bending (left) and closing (middle); Damage D along lower surface cross-section AA during first drawing (right).