Lehrstuhl für Umformtechnik und Gießereiwesen (*utg*)
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Fiber Beads

Development of a numerical method for the design of fiber reinforced bead structures

Motivation

The stiffness of sheet metal parts can be enhanced by incorporating bead structures as the example of an oil trough in Fig. 1 shows. A positive side effect is the minimization of natural oscillations.

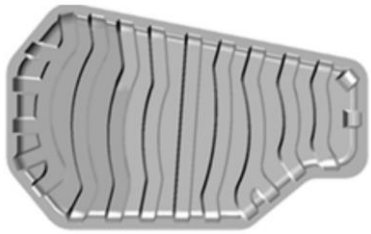

Fig. 1: Bead reinforced oil trough

Approach

In the project, a local application of unidirectional fiber-reinforced plastic (UD-FRP) in the upper belt area of the beads (see Fig. 2) is analysed.

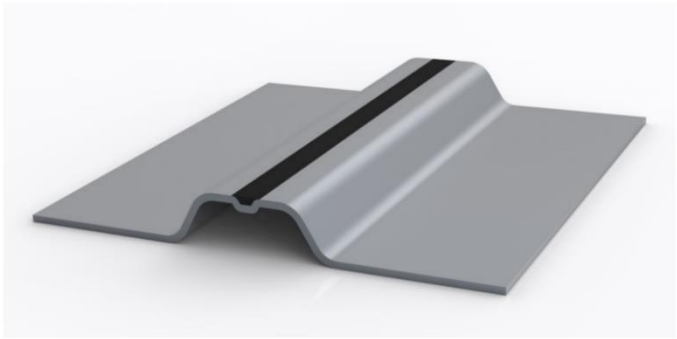

Fig. 2: Bead with UD-FRP strengthening in the upper area

Within the scope of the study steel and aluminium are investigated. The UD-FRP and the metal sheet will be joint by a laminating process. For this purpose, a method is to be developed to determine the optimum position and the degree of reinforcement adapted to a specific load case. Boundary conditions of the optimization process are the principal bending stress trajectories and manufacturing restrictions of the deep drawing process.

The lightweight construction potential lies in the fact that the loss of stiffness in the case of a reduction in wall thickness can be compensated by adding stiffening fibres. Furthermore, it is investigated whether a positive effect on the cohesion of the composite can be achieved by microstructuring of the surface via a chemical pre-treatment. In addition, the geometry of a bead with an undercut (see Fig. 3) is considered as a possible favourable bead geometry in case of a bending load.

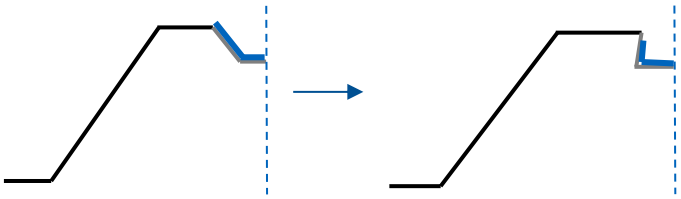

Fig. 3: Conventional bead geometry (left) and undercut bead geometry (right)

Objectives

The validation of the project results is carried out by numerical simulations (see Fig. 4) as well as by manufacturing of a demonstrator part. For this purpose, the deflection under load for a standard beaded component and a reinforced beaded component are compared.

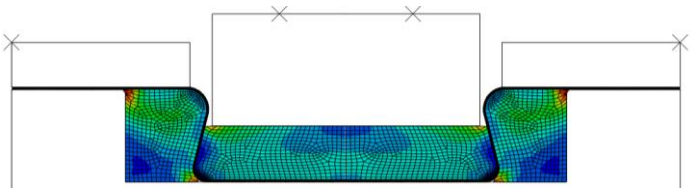

Fig. 4: Finite Element Simulation of the deep drawing process

Conclusion

Fiber bead structures can be applied cost-effectively to a wide range of part geometries. Therefore, they are a reliable method for reducing the component mass and optimizing the mechanical properties.

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