# Sandwich joining

## Functional Sandwich Structures by hole-flanging with lost punches

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| **Editor** | Thiemo Germann M. Sc. |
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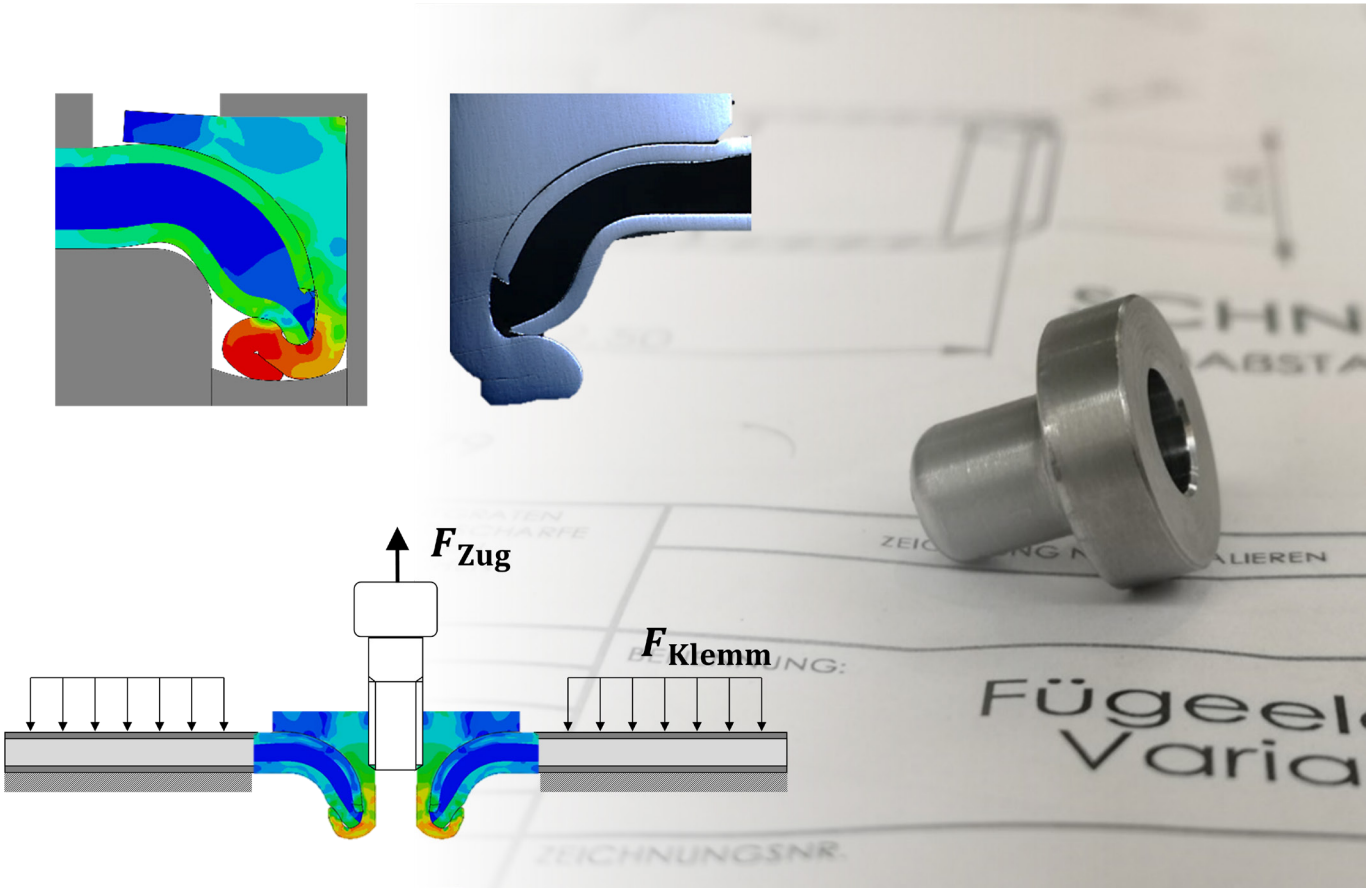
### Abstract

In the project, a joining element that meets the special requirements of a sandwich composite has been developed successfully. Numerical and experimental investigations were used to develop a process in which the joining element is inserted into the sandwich sheet during a collar pull. Subsequently, in a second process step, the joining element is formed around the sandwich collar and a form-fit and force-fit connection is generated. Thus, a material-specific appropriate introduction of the effective forces into the sandwich composite can be achieved. The developed shape allows tensile forces to be absorbed up to a load limit that is reached by the basic stiffness of the sandwich sheet. For the design of an M8 bolted connection, for example, this is > 2 kN.


### Project description

Sandwich sheets offer great potential in terms of lightweight construction, functional integration and vibration and noise behavior. A major challenge is the joining technology between sandwich sheets as well as to other components. The special requirements of a sandwich structure with regard to force transmission and parallel processes, such as loss of prestress due to creep of the core material, must be taken into account. As part of the previous project „Collar drawing of sandwich sheets“ (IGF project 18773N), the stiffening effect of collars in sandwich sheets was investigated. Based on this, the objective of the project is to develop a joining element for sandwich sheets that both has a collar as a stiffening element and represents a direct connection option for other components. The challenge is to develop a practical solution and to address the material-specific requirements in a targeted manner.




[1] Developed joining element, comparison between numerical simulation and micrograph (top left), manufactured prototype (right) and illustration of the investigation principle in validation (bottom left)


Institute for Production Engineering and Forming Machines – PtU
Prof. Dr.-Ing. Dipl.-Wirtsch.-Ing. Peter Groche | info@ptu.tu-darmstadt.de

## Results

Extensive numerical and experimental investigations identified various working mechanisms and requirements for the joining element to be developed. From this, a concept for the insertion of the joining element was successfully developed. The joining element is first placed on the collar and then formed around the collar. In this way, a force-fit and form-fit connection can be produced. The inserted joining element additionally has a threaded hole or a bolt with an external thread as a fastening point.

Practical investigations on an individually developed tool verified details of the process design and material selection. As a result, a process window for a successful forming process could be determined. Manufactured test specimens were evaluated in tensile tests in addition to extensive metallographic investigations. The tests showed that the developed joining element is capable of meeting common requirements for geometrically comparable rivet nuts for sheet metal joints. Using the example of a M8 reference, axial tensile forces >2 kN could be transmitted before a stability failure of the sandwich sheet became apparent. Due to a subsequent deformation of the joining element, further safety reserves for a good-natured failure behavior are given.

On the basis of the project results, it is possible with minor further developments to realize production-integratable, material-optimized joining element geometries for sandwich sheets. The goal of increasing the marketability of sandwich sheets has thus been achieved.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