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Development of a cost-effective production process for sandwich structures for vehicle construction

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INTRODUCTION

Sandwich structures have a high potential for weight reduction due to their inherent strength and stiffness, even at very low weight [ZEN1997]. In automotive applications, they can also exhibit excellent energy absorption [BRU2017].

In validation project "Development of a cost-effective production process for sandwich structures for vehicle construction", which received funding by the Helmholtz Gesellschaft (HGF), automated manufacturing processes were developed for the production of sandwich components. In one of these processes, inserts with screw-on points were integrated into the sandwich components during the manufacturing process in order to subsequently ensure quick and easy assembly. The geometry of the components originates from the body of the Safe Light Regional Vehicle (SLRV) research vehicle, which was developed at the DLR Institute of Vehicle Concepts. The SLRV is a Lightweight research vehicle with fuel cell drive train and a body in sandwich construction. Its energy consumption is around half that of a conventional car, which is largely due to its lightweight sandwich construction. The manufacturing processes developed aim to enable a cost-effective production and assembly of such a body in sandwich construction.

RESULTS AND CONCLUSIONS

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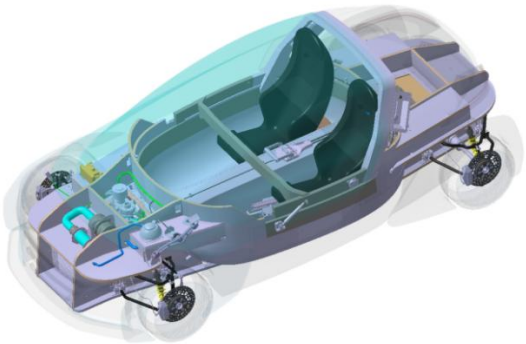


Figure 1 – body in white of the SLRV research vehicle

The development of the SLRV's body in white, which is entirely made of sandwich materials (Figure 1) has shown several advantages of sandwich construction for vehicles.

The use of Sandwich materials led to a very light structure, (body weight 115 kg, with further optimisation approx. 90 kg possible). The inherent strength and stiffness of sandwich panels also enable a design with simple component geometries and relatively few components.
Testing of the body in white on the basis of a US-NCAP full frontal crash showed high energy absorption during crash and no intrusion into the passenger compartment.
On the other hand, there are several challenges with the production and assembly of sandwich structures, especially with regards to the joining technology.
For one, welding is not possible since it would damage the core material. Connections between the panels are therefore made using glued angle profiles. In this project, the application of those profiles has been automated, using a specialized robot in order reduced the required labour.
Furthermore, connection points for the attachment of components to sandwich panels must be machined and locally reinforced (Figure 2). Applying this reinforcement for every attachment point is fairly complex and time consuming [MIH2009].

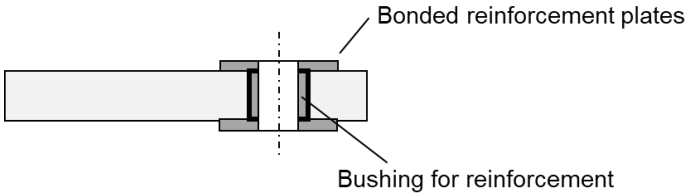


Figure 2: Reinforcement of an attachment point on a sandwich panel

The solution that was investigated in this project was the integration of such attachment points into the sandwich panels, during the production of the panels. Components can then simply be attached to the panels by screws. In order to enable a high productivity, the process for the production of these panels was automated. Low cost solutions were used for the automation equipment, in order to keep investment low and make this production method attractive for smaller companies.

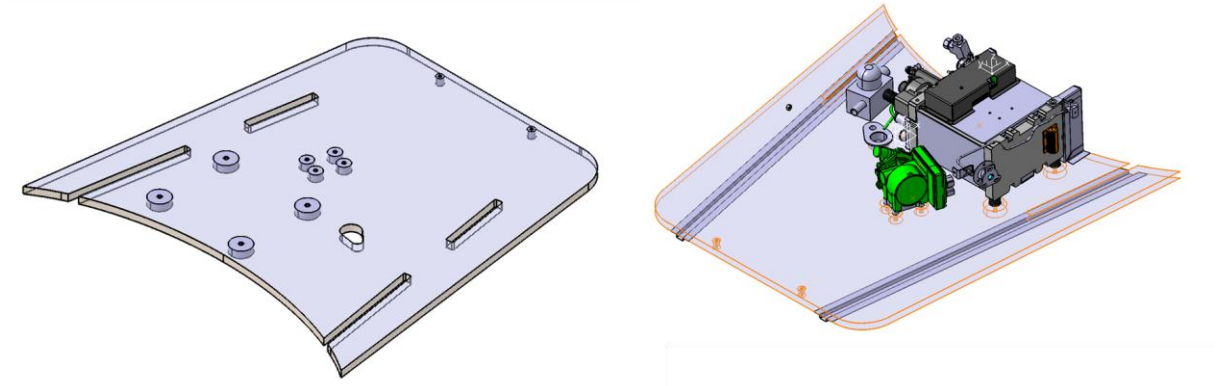


Figure 3: Sandwich part with integrated attachment points

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