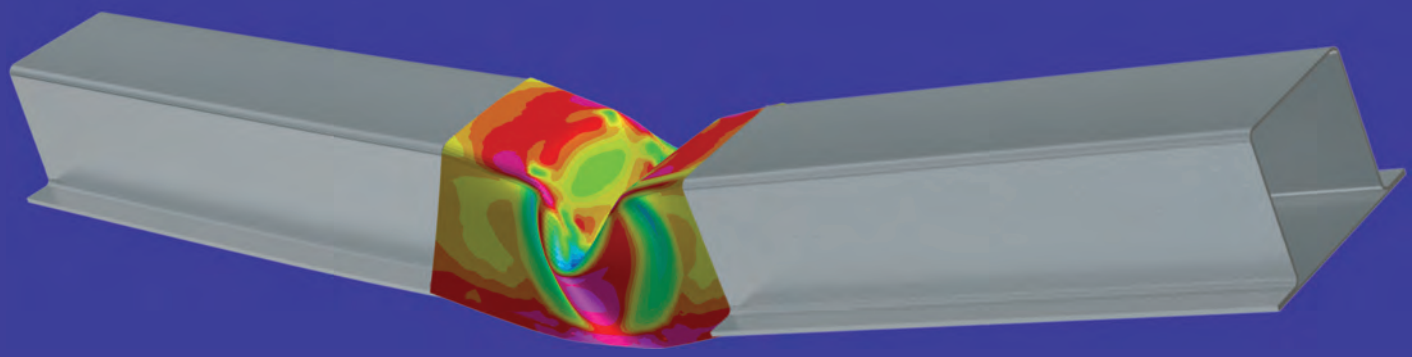
Fraunhofer IWS Dresden

FRAUNHOFER-INSTITUT FÜR WERKSTOFF- UND STRAHLTECHNIK IWS



COMPONENT DESIGN

Load adapted component design and innovative material application

Motivation

An optimal construction concerning lightweight and loading capacity needs to be optimally configured with regard to geometry and material. New materials, surface treatments, composites and especially innovative joining technologies require previous numerical simulations for an ideal component design. Hence design engineers depend on numerical tools (Finite element method software) to simulate the behavior of complex structures experiencing different loading types (static, dynamic, thermo-mechanical etc.)

Core competences

In addition to the main business fields such as materials characterization and developments of laser-assisted technologies, Fraunhofer IWS Dresden also provides the calculation and design of components subject to their operating loads. By using both implicit and explicit FEM-Software it is possible to solve very different problems, e.g. the calculation of eigenfrequencies of fiber-reinforced plastics or an analysis of the energy absorption capacity of crash elements in hybrid sheet structures. We we are able to provide expertise and knowledge in component design, particularly in the sectors of automotive and rail vehicle engineering (car body, powertrain) as well as aero-space engineering (thin-walled fuselage panels).

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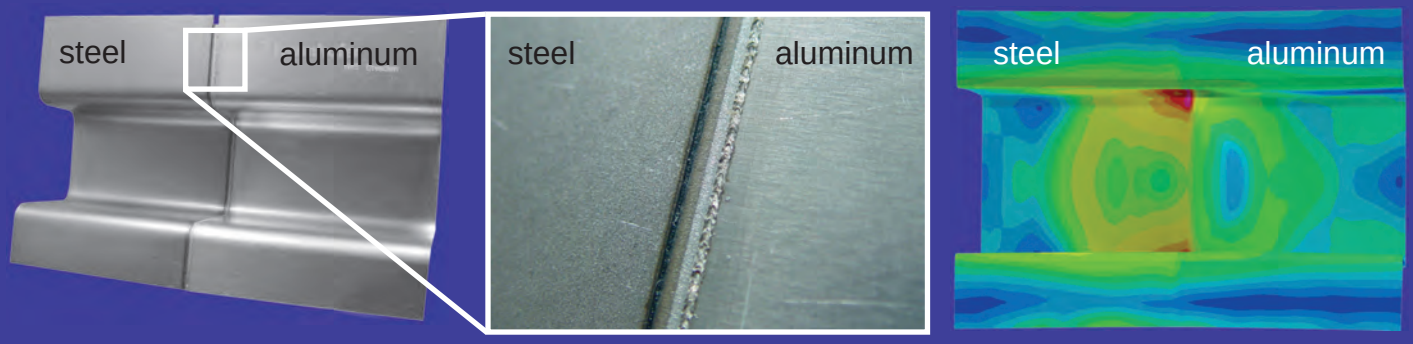

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Metallic hybrid structures

In the area of metallic hybrid structures Fraunhofer IWS offers material and load-oriented design of components, e.g. steel-aluminum-profiles (Fig. 1).

The manufacturing is performed by various processes, such as the web-slot-connection or by implementing a transition joint produced by laser induction roll plating. To calculate a structure in multi-material design it is essential to perform numerical simulations, in particular to consider the joint properties between different metals.

1 Hybrid profile (steel-aluminum) with transition joint (left) and its structural analysis (right)

Design of laser-welded powertrain components

The distortion of laser-welded powertrain components can affect the load-bearing behaviour in a very negative way. Due to the direct cooperation with the process development at the institute, we can effectively tailor the joining process in our numerical tools to represent the reality.

By performing a thermo-mechanical simulation (combination of a temperature field analysis and a mechanical calculation) it is possible to solve distortion and residual stresses resulting from the process and their influence on the part during operation. By the help of a FEM-analysis, optimal welding parameters as well as an ideal component design can be determined with regard to the manufacturing process and the operating loads (Fig. 2).

Local laser treatment of steel car body components

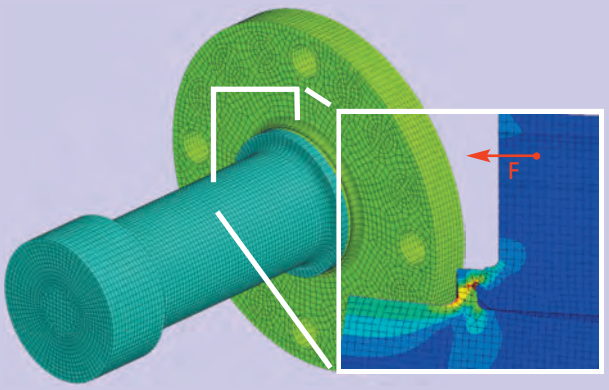
The principle of the local laser treatment is based on the local hardening of steel sheet components in high-load zones using a laser.

FEM crash-simulation helps to compute an optimal load-adapted position of local laser treatments (Fig. 3)

- to increase the crash absorption energy,
- to reduce the mass of the components,
- to regulate the failure behaviour.

Furthermore, metallographical research and material testing of base material as well as locally treated material provide mandatory data as input for numerical simulations.

Stress distribution during service in a laser welded powertrain component



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Simulation of a compression-crash test of steel tubes with and without local laser treatments

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