Deutsches Zentrum
DLR für Luft- und Raumfahrt

Handout

Novel Vehicle Structures from Multifunctional Materials

Composite Sandwich Underbody

Composite B-Frame replacing B-Pillar

Wing Mirror Integraded Indicator

Function Integration

Function integration in context of design issues describes the aim to aggregate multiple useful functionalities in as few parts as possible. Integrated structures lead to reduced assembly and joining efforts and to much better and efficient use of the structures material in many cases. The customer's value is not directly given by the number of integrated functionalities, but the aggregation of functionalities offers additional benefits such as reduced weight, reduced life cycle costs and increased range of application. Although the integration of multiple functionalities is part of almost each design recommendation, clear instructions how to conduct lightweight design are hardly given. Focusing on fiber reinforced plastics (FRP) the aggregation of multiple functions gains growing importance. Regarding high-performance structures, mainly carbon fiber reinforced plastics (CFRP) are used. After substituting metal components by composite structures in the recent years, the integration of multiple functions is the next challenge for engineers striving for highly efficient structures. New materials with superior properties are a prerequisite for technological innovations. Especially the integration of new functionalities is the key to further enhance the competitiveness and application range of composite materials. The collaborative research on composite materials within interdisciplinary and international teams is focused on the following areas:

- Integration of new functionalities
- Improvement of properties
- Advancement of processability
- Provision of reliable material data
- Qualification of new structural concepts

Automotive Applications

A novel approach to reduce weight and cost in automotive car body design is a robust composite sandwich underbody integrating structural members for enhanced side crash performance, seat fasteners as well as fluid and energy ducting elements, etc. Further advantages are a minimum use of expensive carbon fibers due to the sandwich design at increased comfort regarding noise transmission and thermal insulation. A fully automated cost-effective manufacturing process chain using the resin transfer molding (RTM) procedure has been developed. Metal car designs have reached a high level of maturity. Further potentials are seen especially with extremely lightweight carbon fiber reinforced composites (CFRP) integrated into multi-material designs. An essential component replacing the former B-pillar in a Rib and Space-Frame car concept is the B-rib using a novel mechanical principle to meet the side impact crash requirements. A weight reduction of up to 35% with significantly increased safety and overall performance compared to the steel reference was achieved. Within the automotive industry, light systems have gained an increasing importance in the past years. Beside improved lighting, the design of illumination systems becomes one key-issue for car manufacturers or their suppliers. Due to an integral manufacturing process in one single part using a closed silicone mold, the LED indicator provides a smooth aerodynamic surface. Therefore, no further assembly is needed. Replacing conventional materials by CFRP and integrated indicator LEDs, an effective weight saving of about 20% compared to the genuine part was achieved.

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