Design of a multi-functional semitrailer

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Introduction
Within Europe about 1000 milliard tonnes of load is transported by road [1]. Due to economic development within our community the amount still increases. This increase, however, is in conflict with the growing environmental awareness. Therefore, in order to decrease the emission of CO₂ and NOₓ, there is a need to: (1) increase the pay-load and utilization per ride, (2) reduce the fuel consumption of the tractor-semitrailer combination (Fig. 1).

Objectives
Increase of pay-load and utilization:
- Reducing the nett tar weight from ± 9 to 7 tonnes.
- Increasing the inner volume to 95 cubic metres.
- Introducing multi-functionality, i.e. increase of capacity utilization with 20 %.
Reduce the fuel consumption:
- Lowering the Cw-value (integration of side-skirts).
- Using the waste heat of the tractor and heat collected on top of the semitrailer for cooling.
- Increasing the pay-load significantly reduces the fuel consumption per load kilometre.

Design
Most of today’s semitrailers are based on a heavy steel chassis, with a non-supporting box. In case of a chassisless design, the supporting box is constructed from aluminium beam sections. The design solution for a multi-functional semitrailer optimized in weight, volume, multi-functionality and fuel consumption, might be a chassisless monocoque construction based on composite sandwich panels.

Materials
The optimal sandwich depends on the insulating properties of the foam-core in combination with the stiffness, strength and costs of the composite sandwich and its manufacturing process [2]. In the design the additional costs, however, should not exceed the overall economic savings.

Methods and Tools
For optimization of the design the following methods and tools are used:
- Integrated design methodology, i.e. structural optimization of each specific part and supporting aspects.
- Application of CAD, CAM and CAE tools (Fig. 2).
- Structural optimization tools.
- Use of absorption system and environmental benign air cycle processes for the cooling unit [3,4].

Fig. 1. Tractor-semitrailer combination.

Methods and Tools
For optimization of the design the following methods and tools are used:

Fig. 2. Stress distribution in finite element analysis.

Results
With the choice of the optimal design, material and manufacturing process, and the use of advanced design methods and tools, the transport business has the opportunity to transport goods more economical, serving, at the same time, our environment.

References: