CAR BODY

Challenges for car body construction

Besides increasing demands on their safety, design and lightweight design, car bodies are now also marked by a growing diversity of models. Therefore, a variety of platform and construction set concepts are used. Not only does this increase the number of common parts, it also allows for diverse combinations of parts.

This leads to several new challenges for the construction of car bodies:
- Modularization of assembly groups
- Making production more flexible and adjusting it to required quantities
- Use of metal and non-metal lightweight materials
- Hybridization of car body materials and construction methods

Due to its interdisciplinary nature, the business unit car body of the Fraunhofer Automobile Production Alliance offers holistic approaches to solutions for these new challenges.

Innovative materials and semi-finished products

The material mix of car bodies is undergoing a fundamental change. For example, the amount of super-high strength and ultra-high strength steel increases with each new vehicle generation. Aluminum, magnesium and plastics as well as hybrid metal-plastic compounds are used more and more in addition to steel. This change in the material mix has an impact on component design, technology, process chain as well as joining and assembly technology.

References:
1. Metal-plastic material.
2. 5-axis-machining of a molding die.
3. Large press.
Toolmaking of the future

The use of lightweight materials and the increasing flexibility in production have a lasting impact on toolmaking. Therefore, tools and appliances are increasingly split into platform or construction set like parts in extremely large quantities and model or derivative specific parts in considerably smaller quantities. An essential requirement in all scenarios is the decrease of production time for forming tools and car body assembly facilities. The amount of manual labor in toolmaking, especially during the dryout, can be substantially decreased due to continuously improving methods in the simulated description of forming, joining and assembly processes. The introduction of clocked manufacturing as well as new and efficient processing strategies are further steps to decrease cycle times. New and more complex requirements for forming tools arise also in regard to their later use in stamping plants. The integration of extensive sensor and actuator technology increases the “intelligence” of tools, which makes tight production windows and individual reactions to process fluctuations possible.

Flexible construction of car bodies

The future of car body construction is characterized by higher demands on the flexibility of production facilities. Due to shorter model cycles and a greater variety of models, it will become increasingly important to have assembly facilities capable of handling multiple models. The possibility to react quickly to changing demands of the market is another requirement. Besides making hardware more flexible, control software is becoming increasingly important. Here again, the principles of Industry 4.0 provide the right approach to tackling this issue. In the future, fully flexible and self-configuring car body assembly facilities will be able to produce different derivatives simultaneously. Moreover, it will be possible to change models smoothly and produce previous as well as follow-up models in varying quantities in the same facility.

Joining technology is another aspect of car body construction. Established thermal joining processes, however, are no longer useable without constraint because of the increased use of different types of lightweight materials. Mechanical joining processes are therefore becoming more important. The energy input they need for each joint is considerably lower compared to welded joints of similar strength.

The energy efficient paint shop

Together with the construction of car bodies, painting consumes the most energy. The amount of required energy can be reduced significantly by using new and sustainable paint systems in connection with reduced processing and drying temperatures. Alternatively, using required drying processes strategically to profit from bake-hardening effects can lead to a better exploitation of the material potentials. This effect is also used for the adjustment of the final strength properties of innovative adhesive joints in the initial car body manufacturing process.