Super Light Architectures for Safe and Affordable Urban Electric Vehicles

Collaborative Project
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Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Final vehicle design

After the basic improvement of the BiW regarding static stiffness, dynamic behavior and crash performance presented in the last newsletter the consortium proceeded in further optimisation in the crash performance of the vehicle and the integration of all components into the vehicle structure, figure 1. Hence, the CAD-model of the vehicle contains also power train and battery, chassis (including locking system of the rear folding axle) and the door. The door of the car is different to other vehicles, since its follows a “tilt´n´turn” principle instead of the conventional hinge system. More details will be presented in the next newsletter.

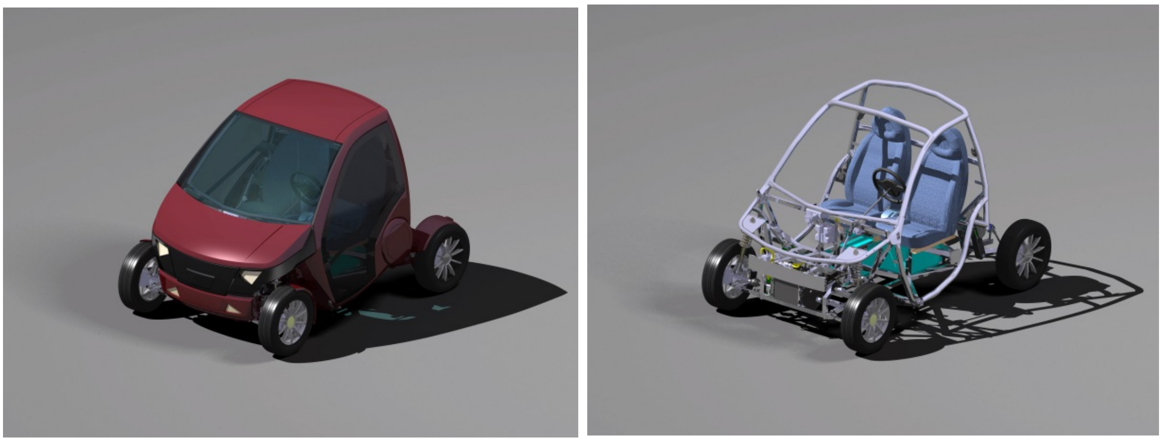

Figure 1: rendered view of final design with (left) and without (right) exterior panels

Measures in order to improve the crash performance aim to fulfil the requirements of the EuroNcap M1 protocol as well as other relevant crash situations. This incorporates slight changes in the forward compartment of the subframe and the replacement of the crash boxes made of aluminium with one of glass fiber reinforced plastics. The improved structure showed highly reduced values of intrusion into the passenger compartment at 64km/h against a deformable barrier with 40% overlap which is a giant leap compared to the starting point, figure 2.

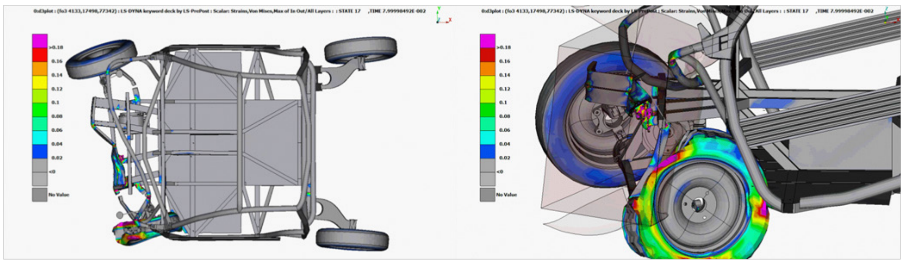

Figure 2: Deformation in the moment of maximum intrusion. Upper and lateral view

Besides the integrity of the passenger compartment the limitation of accelerations acting on the occupants is crucial for passenger safety. For this reason also the restrain and airbag systems have to be designed. Since this has to be determined before design freeze a virtual optimization of those systems with constraint of parameters of existing systems was conducted with the help of software package MADYMO.

Novel joining method: EMPT crimping

In consequence heat-intensive joining methods will be reduced within the URBAN-EV project. As an alternative, an innovative joining technology will be intensively utilized to join the tubular structure: electromagnetic pulse technology (EMPT). This technology is a non-contact high speed joining by forming process by generating a short time pulse magnetic field. The induced eddy currents generate a magnetic force (see Figure 2 left) strong enough to obtain plastic deformation in the tubes to be joined creating a strong link just by a crimpling effect.

The technology features a series of interesting advantages for automotive: first, it's purely cold nature (the assembly, once formed can seemingly gripped by hand), which totally eliminates the problems associated to heat affected areas (stress concentration, material inhomogeneities, distortions); secondly, unlike conventional welding methods, it doesn't require any auxiliary material, such as gases or filler; it is clean (no fumes and residues are generated) and fast (produced in microseconds). On the other hand, the contactless character of the process allows to create a more uniform crimpling pressure with neither the variation nor tool marks inherent to mechanical processes. Also, very important for the URBAN-EV multimaterial concept, the EMPT technology is especially suited for dissimilar materials joining (metal to metal or polymeric based material to metal), as it involves no chemical or metallurgical transformation (note the advantages for composite-metal joining derived of the no-heat basis of the technology).

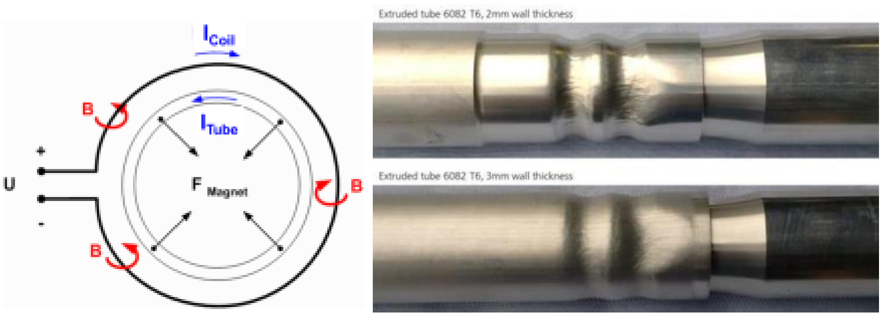

Figure 2: EMPT joining method – principle (left) and crimped coupon tests for determination of fatigue behaviour (right)

For qualification of applying this type of joining technology into vehicle manufacturing an extensive coupon test program was set up which included static and dynamic tests for the three main load cases tension, compression and bending. Two wall thicknesses (2 and 3 mm) at a certain outer diameter of 40 mm, comparable to the dimensions in the structure, were chosen for the coupons, figure 2 right. Tube and stub material was EN AW-6082-T6.

The results of this test program demonstrate a good durability of the EMPT-joints with a reliable performance applicable for URBAN-EV considering vehicle service loads including misuse and corrosion behaviour. Results of this investigation are planned to be presented at the "Fatigue design 2017".