Super Light Architectures for Safe and Affordable Urban Electric Vehicles

Collaborative Project
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Project newsletter

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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)	
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Manufacturing of vehicle structure

The main design concept of the vehicle car body is a space frame using extruded aluminium tubes with round and rectangular shape, hydroformed tubes, cast parts made of aluminium and magnesium alloys, figure 1. The passenger compartment is designed as tubular frame (blue) applying the EMPT-Technology for joining the different structural parts. The subframe (orange) ensuring satisfactorily crash characteristics and was designed applying rectangular tubes with conventional welding technology. All tubes, rectangular and round, consist of extruded profiles made of EN AW-6082-T6 aluminium alloy. A special feature in this setup is the use of structural thermoplastics as part of the crash absorbers with high specific energy absorption capability (to be reported later). This behaviour is crucial having only less space for absorbing enough energy during crash.

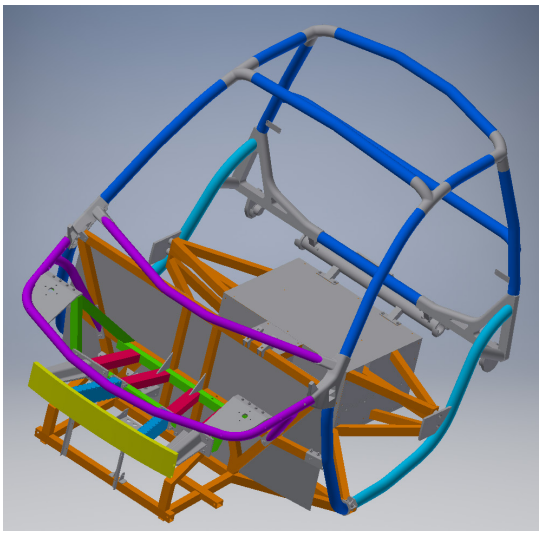

Fig. 1: Body in White structure: different types of tube profiles (coloured) and other elements like castings, structural thermoplastics and sheets (grey)

Extruded tubes

All tubes of upper frame and three rectangular shaped tubes of the lower subframe were produced exclusively for this project at an industrial extrusion press. At manufacturing special attention had to be put on tolerances meeting the requirements for the EMPT crimping process and economically feasible extrusion process.

After the production of the profiles up to 240 m length depending on the volume of application in the structure, they have to be prepared for assembly. While at the rectangular tubes simple trimming with constant angles produces the particular sections, figure 2 left, the circular shaped tubes had to be bended before assembly. The minimum bending radius was 150 mm, which resulted in a bending radius/tube diameter ratio of 3:1.

Afterwards each of the tubes is cut to the right length corresponding to CAD data. At intersections where two elements of the space frame will be joined without the presence of a

node a suitable three dimensional boundary had to be machined onto end of the relevant tube, figure 2 right.

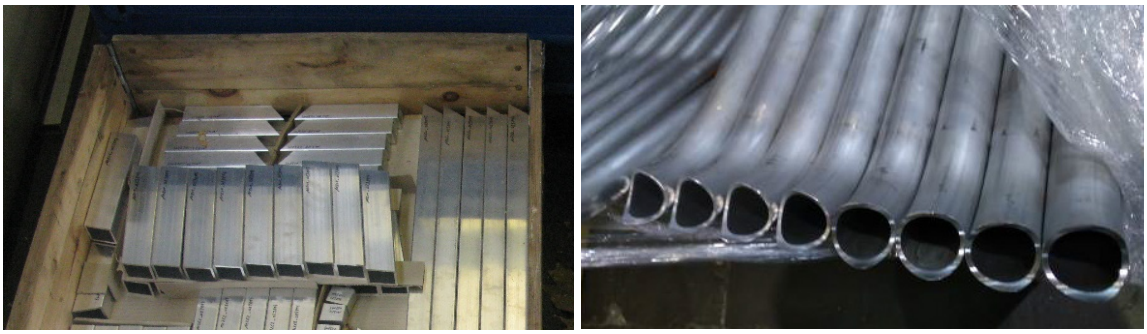

Fig 2: Trimmed elements of rectangular shaped tubes (left), bended and machined circular shaped tubes (right)

Hydroformed tubes

One special feature in the space frame is the doubled bended section at the bottom of the passenger compartment, turquois colored profile in figure 1. Since a sensitivity analysis revealed, that the stiffness of the passenger compartment frame and the crashworthiness is significantly determined by this section, a variable cross section along the profile was needed to be produced by the tube hydroforming process.

These tubes consist of EN AW-6082, too. Tube Hydro Forming is a technology shaping the tubes by the pressure of water inside. Due to the constant water pressure of about 1500 bar all over in the tube there is no elastic return. Seamless extruded tubes had to be used in order to avoid cracks at existing longitudinal weld seam inevitable in conventional extrusion of single- and multi-chambered profiles like the other elements of the vehicle structure.

For shaping the tubes two dies were needed. The first one is a preform die in order to bend the straight tubes and to fit them in the second die, which is the one for the final contour, figure 3 left)

Fig. 3: Hydroforming die fitted to the Schuler press (left), hydroformed tube (right)

After the hydroforming process the parts were treated T6 and then verified with a 3D Faro scanner in order to check the conformity of the shape to the drawing and finally machined in order to match the joining parts, figure 3 right.