

METAL MORPHOSIS

Optimization of joining processes for new automotive metal-composite hybrid parts

DEMONSTRATOR

Car Bumper

www.R-group.si



PRESENTATION OF R-GROUP

Company R-group is engaged in the design and manufacture of products for the protection and safeguarding of the environment.

Our company was founded 25 years ago with a vision to design and manufacture ecology and nature friendly equipment and products.

We have 7 production plants in Slovenia, Bosnia, Montenegro, Serbia, Croatia, Macedonia

WE HAVE THREE MAIN DIVISIONS:

ECOLOGY AND ENGINEERING



- products for the regulation of drainage waters, of waste waters and regulation of water supply systems

WOOD PROTECTIVE COATINGS



- products for wood and metal protection

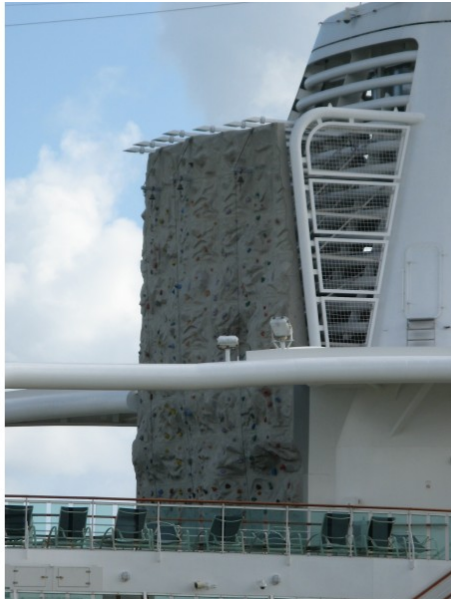
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NAUTICAL PROGRAM



- **Water and septic tanks**
- **for megayacht 25-50 m**

OTHER PRODUCTS:



Children playgrounds, climbing walls, products from GRP, FRP and composites

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The Context

The development of automotive industry, increased requirements for passengers safety, reducing the weight of vehicles, and consequently, reduced emissions and consumption. This is the main reason which makes composite material attractive for production. The bumper is used in cars to absorb impact energy at the start of crash. It is also transfer remaining forces to support body(chassis). Damage of a vehicle and injuries are reduce due this.

Higher car weight means more fuel consumption, emission and also increase of impact forces.

(1 kg more weight at 50 km/h results in 55 kg more impact force in an average car with weight 1500 kg)

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Composite materials are not just lighter, they also absorb more collision energy than other materials. Technologies, that are used in this production became commercially interesting due the price of input material start to decrease (carbon, aramid, resin, aluminium),

Comparison between composite and steel impact absorbtion:

DESCRIPTION	COMPOSITE	STEEL
Cross sectional area, A (mm ²)	40	40
Impact value ,I (J)	294	163
Impact energy (J/mm ²) (I/A)	7.35	4.07

Table 6.1 Experimental Result

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Traditional manufacturing processes of bumpers require high inputs costs of machinery, expensive forming tools, a large number of technological processes, and finally, additional corrosion protection for longer life of the product. Corrosion protection technology is also growing problem for our environment.



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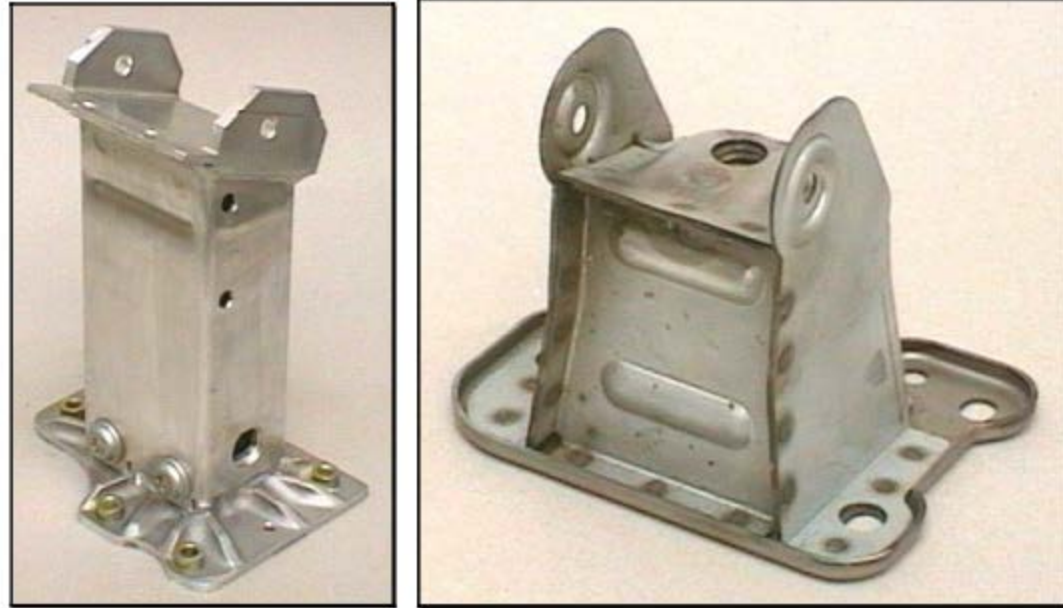
Front bumper of the Mercedes A Class model
(Photo: Constellium)



Extruded aluminium bumper beams
(Photo: Constellium)

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Crash box assembly with spot welding operation



Aluminium crash box produced from extruded profiles with a high pressure die cast aluminium baseplate (left) and a crash box made from steel sheets (right)

Our Solution

In our concept we used two materials that are difficult to join in an ordinary process, composite and Al. For the body of the absorber, we used two composites, carbon and aramid, the epoxy binder (we can also use polyurethane resin) and the elements of aluminum.

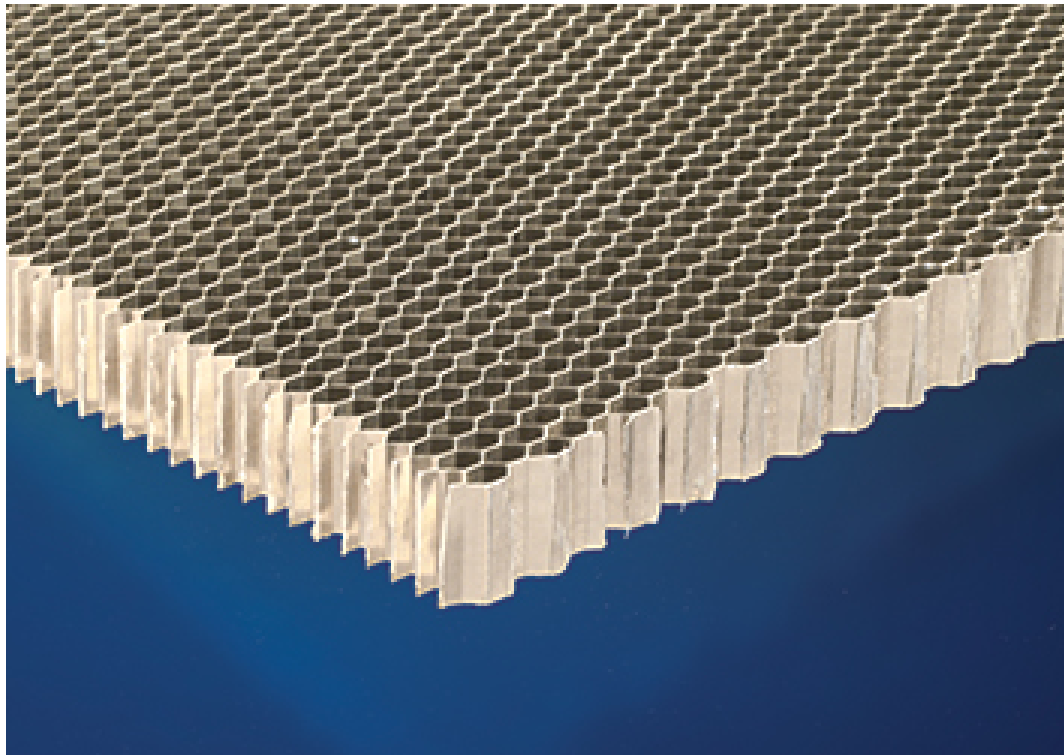
To improve the pressure characteristics of absorber it can be filled even with Al honeycomb.

Al honeycomb is very light (20-60 kg/m³) and it has very high compression strength.

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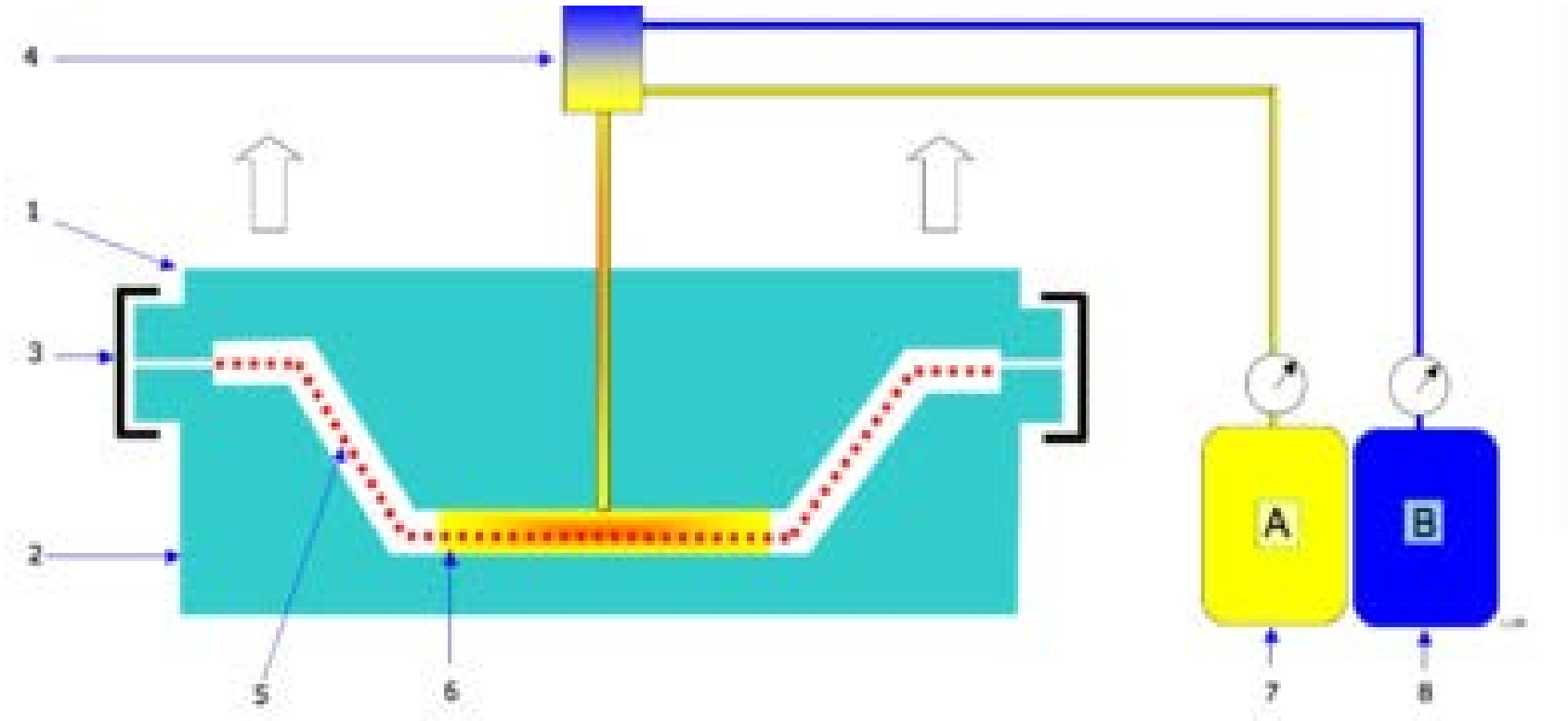
■ Al honeycomb

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Technology: RTM process



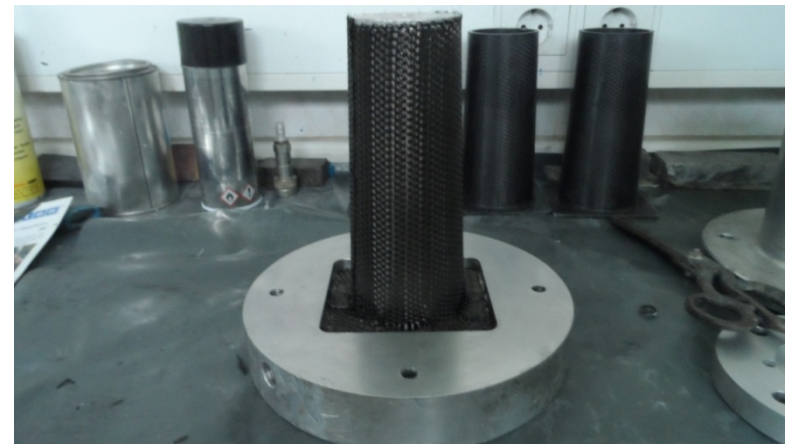
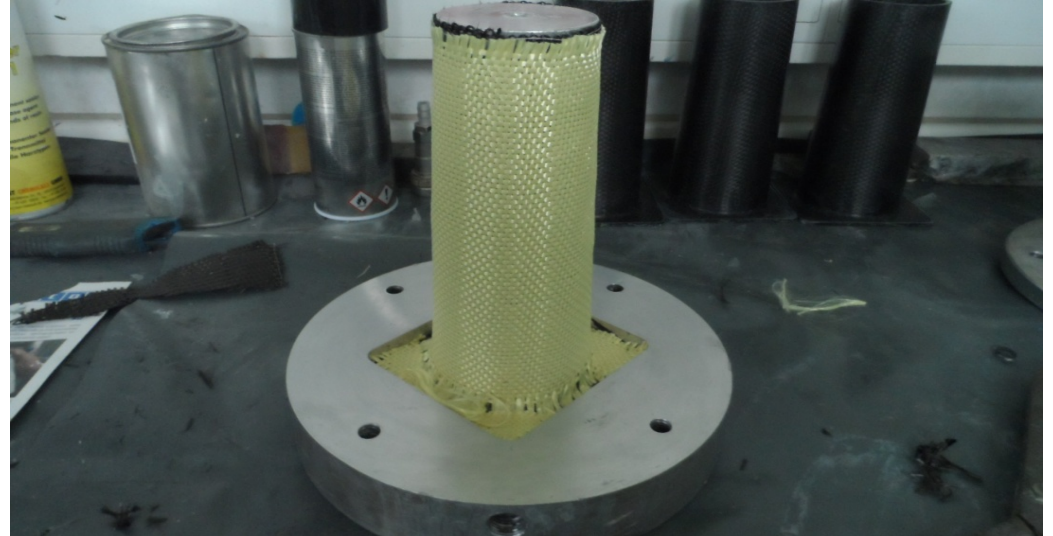
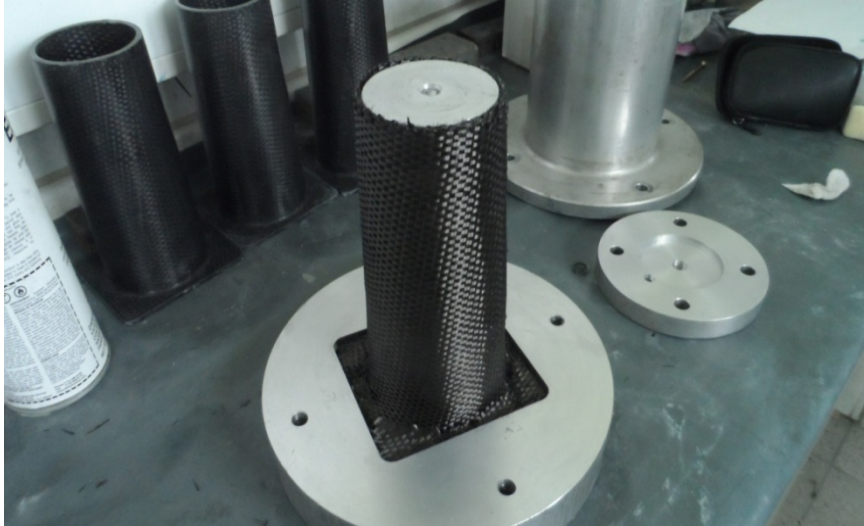
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For the production of absorber body, the method of the RTM (resin transfer molding) in a mold of aluminium was used. The mold is loaded with layers of carbon and aramid, closed and heated up to 60°C. Chamber, when the resin is, pressurized to 0.3-0.5 MPa push resin into the mold, as long as epoxy displace all the air out of the mold. After several minutes, the mold is open and it is prepare for the new cycle.

Due to the closed system, the release of harmful emissions into the environment is minimal. An intermediate element between the absorber and the bumper itself is a piece of milling or cast aluminium.

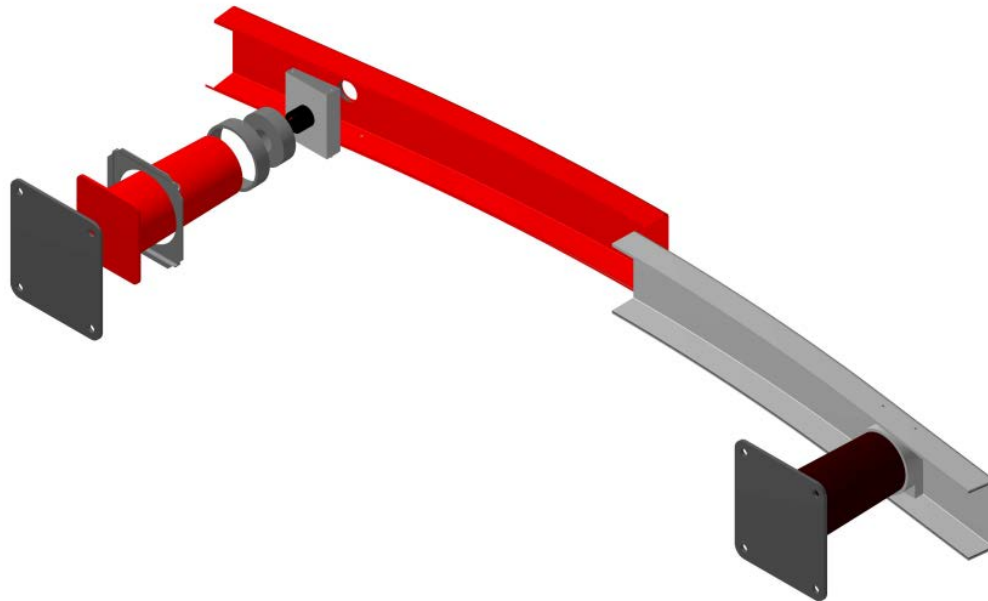
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Technology: RTM - Inserting of carbon and aramid layers in the mold

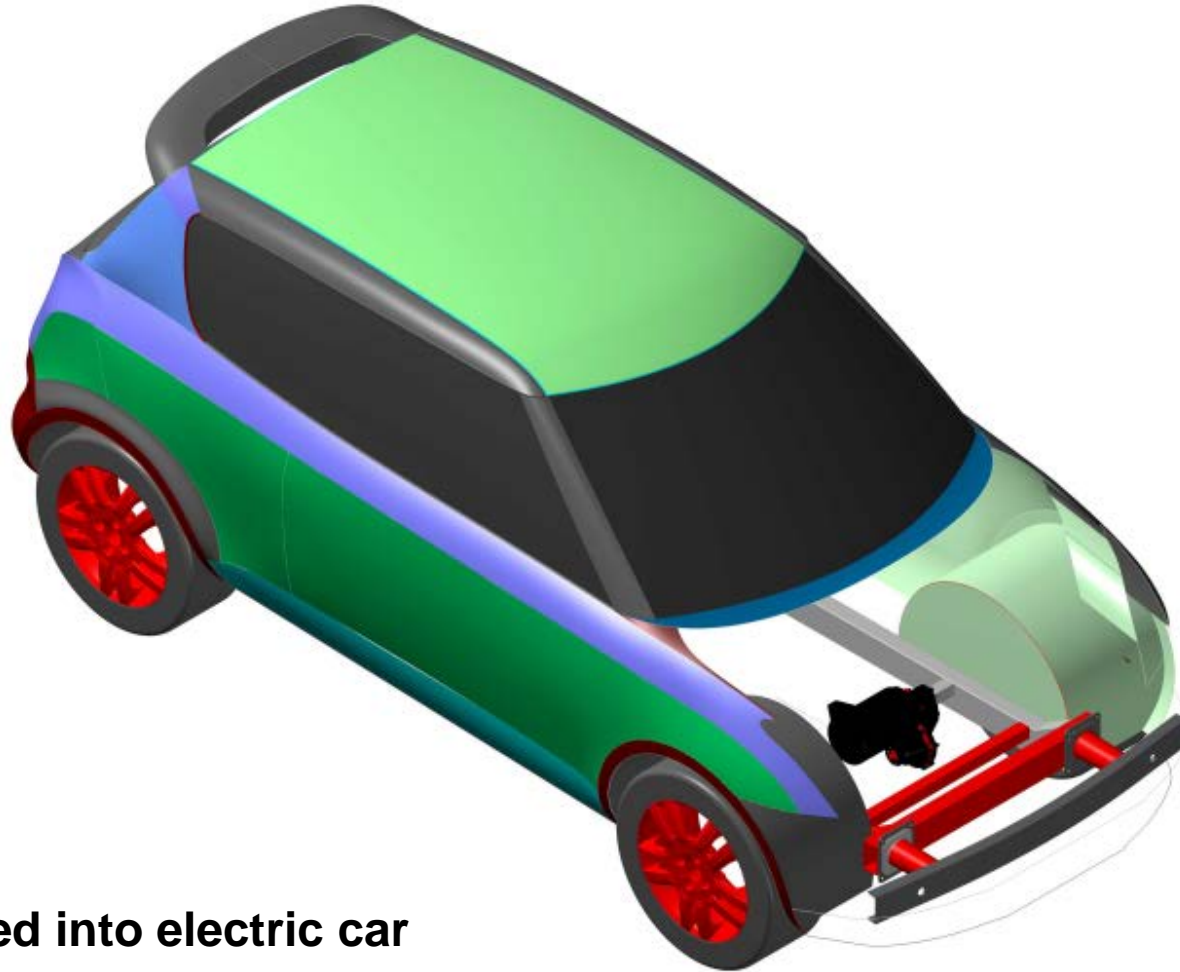


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This not only increases safety but also simplifies many production operations, enhancing cost efficiency, gives more stability and less fragility. The weight of the entire product is at least 50 % lower than at the conventional product. Main advantage of our system is that the same absorber with different mounting plate can be used for different types of cars.



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Bumper integrated into electric car

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Special thanks to all partners in this project!

R-Group d.o.o.

