

A car made of concrete – And it works!

A real car made of concrete – impossible? Not for the pupils of the Albert Einstein School, Ettlingen, Germany and students of building at the Karlsruhe University of Applied Sciences. Together they have designed and built a working concrete car!

Two years ago, the pupils of the Albert Einstein School and the Karlsruhe students had successfully completed their first project when they baptised the concrete canoe they had designed and built. At the time, one thing was already clear to all involved: their co-operation should continue, and with a much more ambitious project. Together they would design and build a concrete car, not just a body on wheels, but a complete, working vehicle with its own motor.

First they had to choose a suitable model. They went for the new BMW Z4 sports car, which at the time was not even on the market. So they had no copies or plans of the vehicle at their disposal. The pupils and students availed themselves of the brochures available at the time and took the dimensions from there.

The first step on the way to creating a concrete version of the Z4 on a scale 1:2 was to produce the formwork for

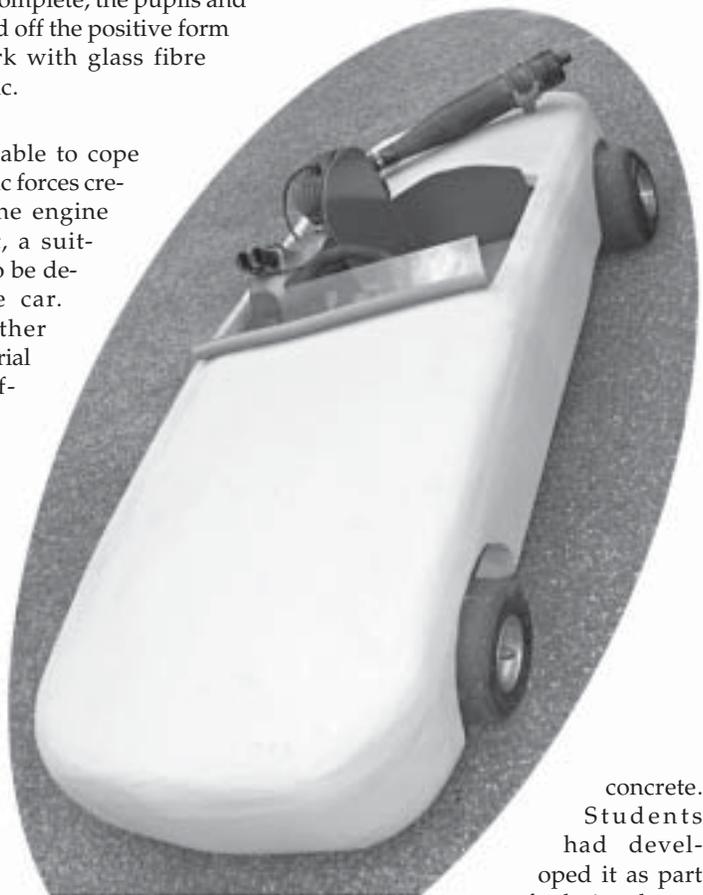
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the body shell, with the pupils imitating the contours of the BMW model using wooden slats. After the timber formwork was complete, the pupils and students finished off the positive form of the formwork with glass fibre reinforced plastic.

So as to be able to cope with the dynamic forces created by both the engine and movement, a suitable floor had to be designed for the car. Working together with their industrial partners, Bilfinger Berger AG, the young car constructors were able to produce a prestressed concrete slab with an area of 2×0.6 m and a thickness of only 8 cm, using the right prestressing technology.

Afterwards the formwork was transported to the public building material inspection station at the

Karlsruhe University of Applied Sciences and filled with high performance



The concrete car inspired by BMW Z4 sports car

concrete. Students had developed it as part of their theses working with the industrial partner Bilfinger Berger AG, in its central laboratory. In order to achieve

the desired compressive strength of more than 120 N/mm², the cast concrete slab was taken there once again, in order to apply the prestressing forces. This procedure ensures that no cracks develop in the slab even when subject to high stresses.

Meanwhile the pupils removed the glass fibre reinforced plastic formwork from the wooden mould of the car. Then the prestressed concrete slab could be inserted at the Karlsruhe University of Applied Sciences. Previously the project team had fastened the fine wire mesh to the lateral edges to connect the body to the chassis.

Another high tech product from the central laboratory at Bilfinger Berger AG was put into use : The students developed a fibre-reinforced, cement-bound high strength mortar for the body. This was hardened with plastic additives to increase the deformation capacity, so that in the end the body could be manufactured with a wall thickness of only 3 to 8 mm.

Two weeks after concreting, the elements were demoulded. Next came the assembly of the technical parts of the vehicle. A racing go-kart was completely taken apart, and the steering linkage, axle casing, engine mountings, seat and other parts were altered to fit the geometry of the concrete car. The last step was to build in the components and the motor, and then the concrete body could be mounted.

The background to this exercise is that it allows young people, who still do not have a training place, to be prepared for the beginning of their professional and working lives with a vocational preparation year. The Albert Einstein School in Ettlingen provides a wide range of occupations for this, including the building technology



The development team with their — probably unique — project

sector. “We want to encourage the pupils’ motivation by giving them a sense of achievement” said Harmut Frenser, Project Manager on the school’s side, “so that apart from the extensive teaching on offer at the school, they can carry out practical projects too”.

The industrial partners who took part also welcomed the idea of the project to involve pupils in their vocational preparation year. “The professional teams of industrial staff and engineers are part of the personnel in our company” stressed Stefan Linsel from Bilfinger Berger AG, “The practical work on the project meant that these professional teams were able to quickly learn how to work together freely, from which in the future all participants will profit in their everyday work”.

Development work in the central laboratory at Bilfinger Berger AG meant that the students were able to use their expertise and knowledge of scientific procedures gained at the University of Applied Sciences in developing high tech

building materials. “Besides the technical aspects, it is important not only to us but also to the schools and industry partners, that our students learn early on how to work efficiently and in a goal-oriented manner with other professional groups, thus improving their social skills” said Prof. Harald Garrecht, Project Leader for the University and Professor of the Architecture and Building Department. “We particularly want to thank Bilfinger Berger AG for their monitoring of the project, as well as Heidelberg Cement AG and Sud Zement Marketing GmbH for their financial support”.

For further information, please contact :

*Fachhochschule Karlsruhe
MoltkestraBe 30
76133 Karlsruhe, Germany
Tel: ++49 (0) 721 9251016
Fax: ++49 (0) 721 925 20 00
E-mail: pr@fh-karlsruhe.de
Internet: www.fh-karlsruhe.de*

