

Thin walled CFRP reinforced UHPC structures – towards efficiency in concrete engineering

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Abstract

The building industry and especially the concrete industry consumes a considerable part of the natural resources extracted from the lithosphere and is responsible for a big part of the waste generated worldwide. Thus, it is important to find alternative solutions to reduce the amount of materials required for the construction of structures. One possibility is to use high performance materials (HPM) like ultra-high performance concrete (UHPC) and reinforcement made of high performance composites like carbon fibre reinforced polymers (CFRP) to reduce the dimensions and thus the weight of concrete building components significantly. In addition, UHPC and the CFRP reinforcement have a higher durability compared to conventional concrete and reinforcing steel. The drawback of such HPM like UHPC and CFRP is that the production requires substantially more resources and energy than the conventionally used materials like normal strength concrete and reinforcing steel.

To the authors knowledge only vague assessments of the performance in direct comparisons for building components are available in literature. Thus, in the present paper it is analysed if the good mechanical properties justify the higher production effort. The first part of the present paper gives an overview about the environmental footprint of the building materials concrete with normal strength, reinforcement steel, UHPC and CFRP reinforcement. In a second step two examples of structural components, a T-beam and a slab element (Figure 1), designed and subsequently examined in comprehensive experimental investigations (bending tests and shear tests) are introduced. Finally, their ecologic performance is compared to conventionally steel reinforced concrete building components is analyzed.



Figure 1: CFRP reinforced T-beam (left) and slab-element (right)