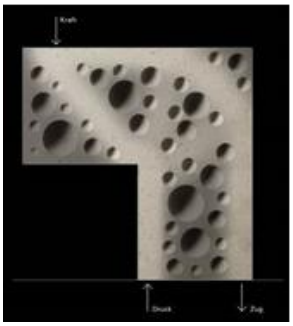
Application of Augmented Reality to Fabricate Functionally Graded Concrete Components



The idea of Functionally Graded Concrete (FGC) is based on designing the interior of concrete components with the aim of achieving significant mass savings while maintaining all structural and functional requirements. For this purpose, cavities are created in the structural component by inserting mineral hollow bodies. The aim is to show how resource consumption and emissions in construction can be significantly reduced.

Augmented reality (AR) has been demonstrated to improve on- and off-site processes by equipping human laborers with digital information for tasks such as fabrication, quality control, and remote collaboration with enhanced quality, complexity and precision.

In the context of this work, the application of AR to the fabrication and integration of FGC-components shall be investigated. The process shall include (but not limited to) the precise placement of hollow bodies, reinforcement elements and markings for FGC-components, as well as a live registration of the process steps and supervision through a digital environment.

First, research into the state-of-the-art use of augmented reality in various construction stages and related digital modelling environments shall be conducted, with a focus on concrete building construction. Furthermore, a bi-directional workflow is to be established that connects AR execution with a digital model. Registration of the placed geometry should be addressed to enable live monitoring and checking of the construction process. The planned workflow shall be validated and demonstrated experimentally through small-scale case studies. A field test on a construction project is intended.

The work involves the application of CAD Software and programming languages like Python and C#. Existing knowledge in these areas is necessary. Experience with computer vision or AR is favored. Thesis supervision, writing, and examination will be carried out in English.

Work program:

- Literature and state of the art research
- Outline and setup of the intended CAD-AR workflow
- Demonstration through case studies
- Compilation and evaluation of the results

Contact persons:
ILEK: M.Sc. Benedikt Strahm
E: benedikt.strahm@ilek.uni-stuttgart.de

ICD: M.Sc. Xiliu Yang
E: xiliu.yang@icd.uni-stuttgart.de