Manufacturing topological interlocking blocks via concrete 3D-printing

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Abstract.
3D concrete printing has the potential to reduce costs and construction time and improve material efficiency enormously. For modular construction, the principle of topological interlocking of three-dimensional non-convex blocks can be applied without the use of binders. Interlocking blocks are produced with 3D printed concrete and used for demountable slab or bridge structures. These building sections can be dismantled after the utilisation phase and used elsewhere. During use, the elements have a material saving of 55%. In this study, the mathematical generation of the design of these interlocking blocks is first discussed, followed by their validation in manufacturing by 3D printing of concrete. The interlocking property and the 3D printing technique both have in common the focus on the interface as a material design concept. The contact surfaces of two neighbouring blocks are decisive for the interlocking, which must be part of the path-finding algorithm. Several different blocks geometry were printed and the variety of combinations tested. A suitable design was selected for mass production. High precision is required to assemble the blocks into a panel system. To ensure the interlocking of the printed blocks, a special path for 3D printing is proposed. A slab is prepared by assembling the printed blocks and holding them together with a braced frame. The slab is completely captured with digital image correlation during loading.

Keywords: Digital Concrete; 3D Concrete Printing; interlocking; modular construction; digital image correlation