

Selective cement activation – new possibilities for additive manufacturing in construction

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Abstract

Recent developments in additive manufacturing methods for the construction industry have opened up new possibilities for the design and production of building elements. Among the many types of suitable materials, the use of concrete has become prevalent, in part, due to its already well understood material properties and low cost. Various digital fabrication methods have been developed to create concrete structural components which can be optimized regarding load bearing capability or building physics while at the same time reducing the amount of waste produced.

The majority of projects worldwide focus on the so-called extrusion method where objects are produced by depositing individual strands of fresh concrete. With this process large scale elements can be constructed in a relatively short time without requiring any formwork. However, the resulting objects are limited in their geometric freedom.

Alternatively, by the process known as selective binding, certain areas of a layer of a dry granular material can be hardened with the use of a binder. By adding subsequent layers a complete, three-dimensional object can be created encased in, and simultaneously supported by, the unbound material. Using this method, intricate objects with a high degree of geometric freedom can be produced. For construction purposes this can be achieved by the process of selective cement activation, where the dry cement binder is mixed with a sand aggregate and activated by applying water to the layer.

Although building speed and material strength has been a limiting factor for this type of manufacturing method, previous work by the authors has demonstrated its potential for application in construction [1, 2]. Now, new research and development regarding the process and its parameters has shown how these limitations can be overcome. The presentation and full paper will present innovations on the topic of selective cement activation and discuss new possibilities for additively manufactured concrete building elements.

References

- [1] D. Lowke, D. Weger, K. Henke, D. Talke, S. Winter, C. Gehlen, 3D-Drucken von Betonbauteilen durch selektives Binden mit calciumsilikatbasierten Zementen: Erste Ergebnisse zu betontechnologischen und verfahrenstechnischen Einflüssen, in: P.D.- I.H.-M. Ludwig (Ed.), Tagungsbericht “19. Internationale Baustofftagung”, Weimar, 2015.
- [2] D. Lowke, E. Dini, A. Perrot, D. Weger, C. Gehlen, and B. Dillenburger, “Particle-bed 3D printing in concrete construction - Possibilities and challenges,” *Cement and Concrete Research*, vol. 112, pp. 50-65, 2018.