Aggregate Structure

Reusable aggregates requiring no binding agent, Stuttgart, Germany

Main authors

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Summary by the jury

Aggregates are ubiquitous in the concrete production industry, yet are rarely deployed in an unbound form. This materials research project from Stuttgart, Germany examines aggregate architectures made from injection-molding of designed, self-solidifying bioplastic granulates – an entirely novel branch of construction systems. The fact that structures can simply be poured, aggregated, disaggregated, and re-used in relatively short time-spans makes them a novel pioneering and outstanding approach in architectural construction technology. In this context, *Aggregate Structure* is a pilot project for a ground-breaking construction method using the potential of loose, designed granulates. The individual grains of these aggregates are geometrically defined to interlock and consequently require no additional binding agent. The *Aggregate Structure* is thus fully recyclable and can be rapidly poured into multiple spatial formations and adapt to almost any site constraints from urban to rural.

Appraisal by the jury

The proposed scheme was praised by the jury for its focus on multi-disciplinary research at the forefront of architecture, engineering, and materials science. The jury views the project as the first step of a laboratory experiment, potentially leading to the development of new construction systems. The suggested method of how to join individual parts to form large aggregate structures is especially promising.

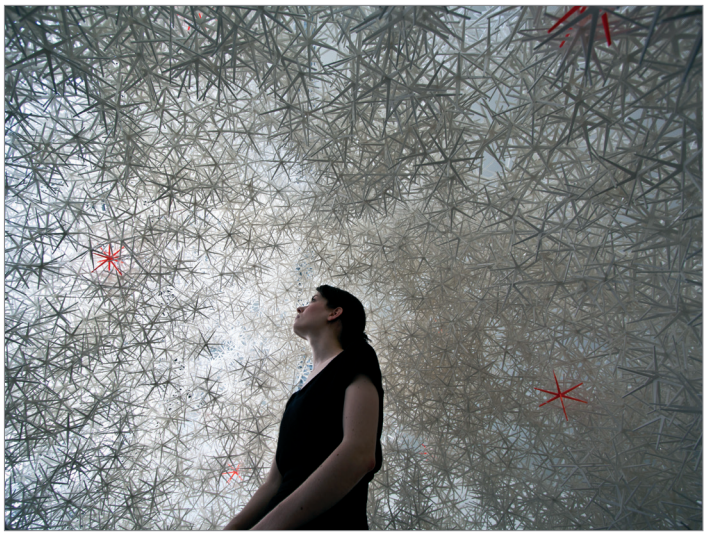

Image 1: An aggregate vault is made from a large number of designed particles, solidifying merely by frictional contact. The interlocking granules are poured over a formwork made of snow, ice, sand or a fluid designed aggregate. The load-bearing structure then makes up only 10-20% of the entire construction volume. Both structure and formwork are fully recyclable. The construction process itself is very rapid as the aggregate instantly stabilizes. (Copyright of all images: K. Dierichs, F. Fleissner, F. Meissner, A. Menges, M. Purvance, A. Schneider, University of Stuttgart)

Image 2: The aggregate structures are self-supporting and require no further binding agent. The construction process can be either low-tech manually or high-tech digitally controlled. Variances in density of the granulate allow for the variation of material properties, such as thermal insulation or luminance effects. The designed aggregate thus allows for functional grading of architectural performance criteria within one and the same material system.

Project data

Context	Materials, products and construction technologies
Client	Karola Dierichs
Background	Academic research
Planned start	January 2014

Further authors

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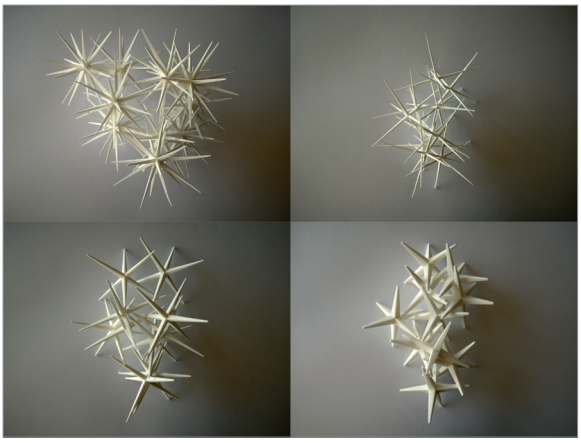

Image 3: Designed granulates – geometric types.

Image 4: Flow and stabilization test of designed granulate.

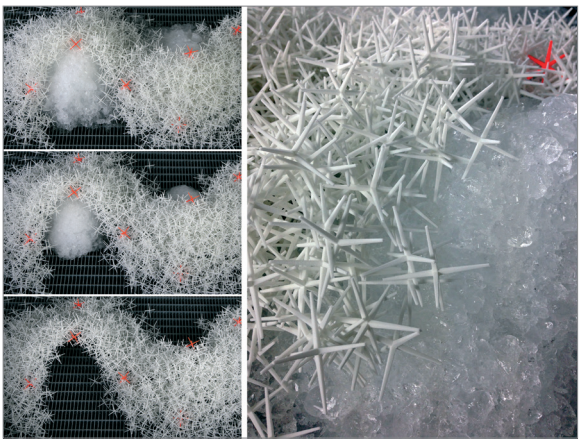

Image 5: Construction process designed granulates and ice formwork.

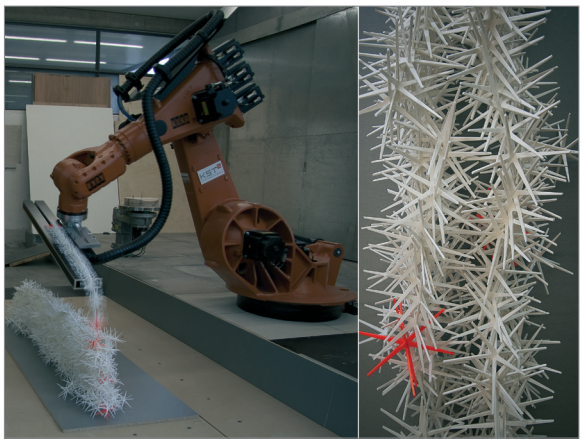

Image 6: Robotic pouring of designed granulates.

Image 7: Discrete element simulation of aggregate architecture.

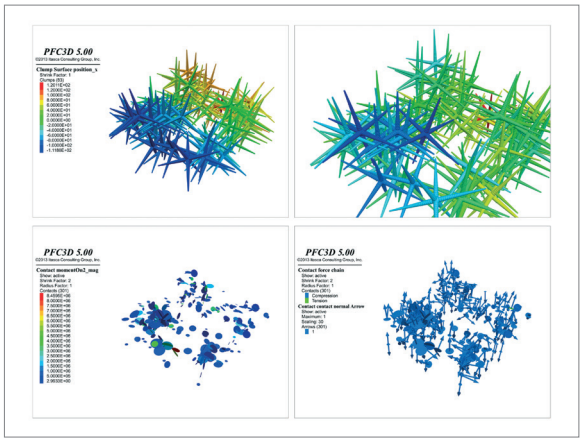

Image 8: Discrete element simulation of excavation.

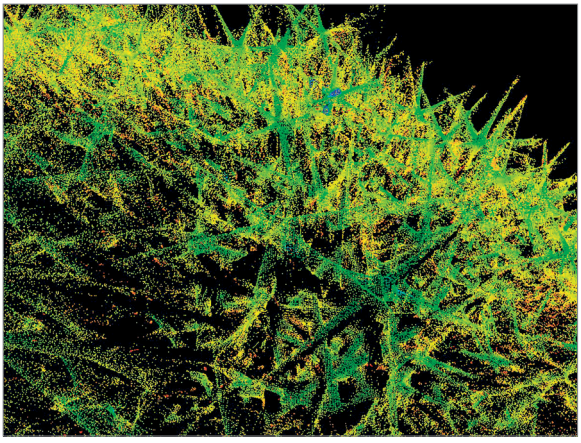

Image 9: 3-dimensional scan of an aggregate vault.

Image 10: Spatial configuration of aggregates.