## 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 designed, injection-molded granulates, which self-solidify and can be made from either bio- or recycled-plastics. Designed granulates are 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 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.

### Project data

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### Further authors

Acknowledgement

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. (ICD 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. (ICD Stuttgart)
Image 3: Designed granulates – geometric types. (ICD Stuttgart)

Image 4: Flow and stabilization test of designed granulate. (ICD Stuttgart)

Image 5: Construction process designed granulates and ice formwork. (ICD Stuttgart)

Image 6: Robotic pouring of designed granulates. (ICD Stuttgart)

Image 7: Discrete element simulation of aggregate architecture. (ICD/ITM Stuttgart)

Image 8: Discrete element simulation of excavation. (ICD Stuttgart, ITASCA Minneapolis)

Image 9: 3-dimensional scan of an aggregate vault. (ICD/IIGS Stuttgart)

Image 10: Spatial configuration of aggregates. (ICD Stuttgart)