

LICENSING OPPORTUNITY

ETH transfer – Linking Science and Business

Smart dynamic casting of complex shaped concrete structures

Keywords

Complex concrete structures, Non-standard casting techniques, Formwork, Slipforming, Digital fabrication, Smart Dynamic Casting, Rheological properties, Concrete admixtures, Sustainable construction

Summary

The overall concept of Smart Dynamic Casting (SDC) is to produce geometrically complex concrete structures without the need of a custom made formwork. SDC does so by using a flexible or a rigid formwork, attached to a 6-axis robotic arm which forms the concrete during the time when it changes from a soft to a hard material.

Background

Reinforced concrete is one of the preferred materials for realizing complex structures, since almost any shape can be achieved when poured into a formwork, for which purpose alone 3.4 billion tonnes of cement were produced in 2011 for making concrete. Yet concrete itself is only half the picture, since formwork itself represents 35–60% of the overall costs of concrete

structures. This ultimately represents a significant source of waste, as all formwork is discarded sooner or later, contributing to a generally increasing production of waste worldwide.

Invention

Smart Dynamic Casting explores the well-known construction method of slipforming, in which concrete is poured into a delimited formwork, which moves by the use of hydraulic jacks at a speed set according to the hardening rate of concrete. In SDC the typical hydraulic jacks are replaced by a 6-axis robotic arm. The robotic arm enables to dynamically form the concrete during the time when it changes from a soft to a hard material, which radically expands the architectural design space for slipforming. Concrete is being subsequently placed into a formwork with a specific geometrical cross section, flexible or rigid. The robot moves in a predefined trajectory at a rate that is adjusted to the hardening kinetics of the concrete through a feedback system (fig.1).

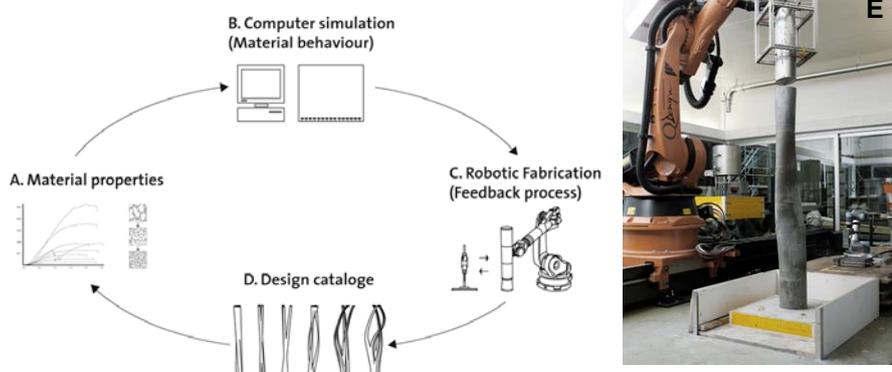


Fig. 1: Material Properties (A) are measured (B) the data is sent to (C) which controls the slip velocity of a predefined trajectory in regards to the material properties, (D) generating non-standard concrete structures. The Smart Dynamic Casting Robot (E).

Patent Status

- Patent pending

Features & Benefits

- Flexible production system to produce a large variation of architectural structures
- No requirement for custom made formwork / additional scaffolding
- Sustainable and waste-free construction technique
- Efficient initial setup and fully automated and digitally controlled process

Field of Application

- Pre-fabrication of non-standard concrete structures
- On-site fabrication of non-standard concrete structures / elements (long term perspective)

References & Institute

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- ETH Zurich institutes:
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