PROJECT FINAL REPORT
Publishable Summary

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Name of the scientific representative of the project's co-ordinator, Title and Organisation:
Name: Mette Glavind
Title: Vice President, MSc, PhD
Organization: Danish Technological Institute
Tel: +45 72 20 22 20
E-mail: meg@teknologisk.dk
Project website[Fejl! Bogmærke er ikke defineret.] **address:** www.tailorcrete.com

4.1 Final publishable summary report

Executive Summary

The main goal of TailorCrete is to develop and demonstrate an industrialised process for producing unique, tailor-made concrete structures using a radically new and cost effective approach. The concept involves both on-site and pre-fabricated elements and both load-carrying and facade elements. TailorCrete combines the knowledge resources of architects, designers, concrete technologists, civil and structural engineers, robot experts with the practical experiences of key players in the construction sector in a 4-year collaborative research project. The digital design research activities have resulted in reports – investigating the opportunities with complex shapes in new digital architecture – and innovative designs of all prototypes and full-scale demonstrators. The designs of these structures incorporate and demonstrate all the technologies developed by the TailorCrete project. To enable a seamless data flow from file to factory, a digital design tool has been developed. The design system is developed on top of an existing host platform, a widely used CAD program, available on the market today. It consist of a real time design tool, a formwork planning tool and a fabrication tool which allows the user to export fabrication data for different fabrication. Automation technology activities have been focused on both processing of the reinforcement and on milling formwork for casting concrete. Using robot technology methods to fabricate non-standardized formwork and reinforcement have been developed.

The shape and the surface texture of a TailorCrete structure may vary from very complex to less complex and a final TailorCrete structure may contain elements characterized by both these phenomena. Thus, three different formwork systems being applicable to cope with these different demands have been developed: Multi-edge Formwork (for less complex structural parts, Wax Formwork and Milled Formwork (both for complex structural parts). A thorough analysis and tests of possible reinforcement solutions that fulfil the TailorCrete requirements as regards automation and complex shapes has been carried out. It has been concluded that traditional reinforcement cannot be excluded. Often, the traditional reinforcement will be combined with other reinforcement types, where steel fibres seem to be the best solution but also glass fibres, polymer fibres and textile reinforcement are considered realistic. A crucial factor for the casting of complicated structures is the availability of a robust SCC (Self Compacting Concrete) being able to fill out all corners of the formwork without vibration. A rheological approach based on CFD (Computational Fluid Dynamics) was selected for simulation of the form filling process. The work has also focused on surface appearance related to particular the form-filling process. The results and experiences learned have resulted in two guidelines for casting and mix design. To demonstrate the applicability of the TailorCrete process, full scale prototype demonstrations have been carried out. These demonstrations are crucial to be able to make a realistic validation of the technologies developed in TailorCrete. The main full scale demonstrator has been cast in Denmark during the early spring 2014. Assessment of the TailorCrete concept has been performed by life cycle assessments of cost, sustainability, safety and aesthetics. After analyzing the whole life cycle of a concrete structure, from the design to the demolishing phase, the main conclusion is that the TC technologies and systems affect dominantly the design and the construction phases. The full exploitation of TailorCrete results may depend upon possible barriers in existing codes and standards. Work has been undertaken to determine if the relevant standards and codes contained obstacles for the TailorCrete Concept. The work covers the three areas of

formwork, reinforcement and self-compacting concrete. The review of the current standards and codes has resulted in recommendations for and subsequent modifications of the research work during the project period.