Improving carbon reinforced concrete components: with automated process monitoring

About this project

PrecastQuality

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Markets:

Material: Textile-reinforced concrete

This project is funded by the Technology Transfer Programme Leichtbau (TTP LB) of the Federal Ministry of Economics and Energy.

Technology Transfer Program Leichtbau

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Context

Carbon concrete is considered a promising high-performance material because it combines high strength with low material usage and thus enables considerable CO# savings. However, in order to realise this potential in practice, reliable production quality is required. To date, the processes in precast concrete plants have been heavily characterised by manual work steps and there is a lack of consistent standards for quality control. Even small deviations - for example when handling the sensitive carbon fibre reinforcement - can significantly reduce the performance of a component. Unlike in highly automated sectors such as the automotive industry, there are hardly any established procedures for continuous process monitoring in the construction industry. This not only makes it difficult to utilise the material's potential, but also to obtain approval for new construction methods. This is where the PrecastQuality project comes in: the researchers are transferring modern quality assurance methods to precast concrete plants and making them usable for carbon concrete.

Purpose

The project team is pursuing the goal of significantly increasing the production quality of carbon concrete components and reducing fluctuations in production. The researchers are developing an end-to-end, automated process monitoring system that covers all steps from reinforcement production to the concreting process and transport. To this end, the partners are developing a system that continuously records and analyses data and automatically adjusts any deviations. This creates a "digital shadow" of each component, which not only safeguards production, but also provides important information for later use. On this basis, components can be dimensioned leaner without compromising safety. This reduces the material requirements for concrete and reinforcement and contributes to a significant CO# reduction. In the long term, the results should pave the way for new standards and guidelines for the safe and resource-saving use of carbon concrete.

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Procedure

The scientists combine experimental investigations with digital methods. They are developing sensor concepts and data acquisition systems that map automated and manual steps in the precast plant. Testing machines continuously monitor the quality of the textile carbon reinforcement, while software models analyse the process data and prepare them as digital shadows of the components. At the same time, the team identifies the process parameters that have the greatest impact on quality and checks their effect. The results are fed into algorithms that automatically recognise and correct deviations.

The researchers are also investigating how the new quality assurance system can be integrated into existing regulations and what adjustments are necessary for authorisation procedures. They are validating their concepts under real conditions with pilot applications and trial productions - thus creating the basis for standardised quality assurance of carbon concrete components.

Funding duration:

Funding sign:	03LB2049	**Funding amount:**	EUR 1.6 million

Final report

Further websites foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB2049A - PrecastQuality in the federal funding catalogue

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Project coordination

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Lightweighting classification

	Realisation
Offer	
Products Parts and components, Software & databases	✓
Services & consulting	

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Lightweighting classification

	Realisation
Field of technology	
Design & layout Lightweight manufacturing	✓
Functional integration	
Measuring and testing technology Component and part analysis	✓
Modelling and simulation	
Plant construction & automation Automation technology	✓
Recycling technologies	
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology	
Forming	
Joining	
Material property alteration	
Primary forming	
Processing and separating	
Textile technology Knitting, laid web production	✓

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Lightweighting classification

	Realisation
Material	
Biogenic materials	
Cellular materials (foam materials)	
Composites Textile-reinforced concrete	✓
Fibres	
Functional materials	
Metals	
Plastics	
Structural ceramics	
(Technical) textiles	