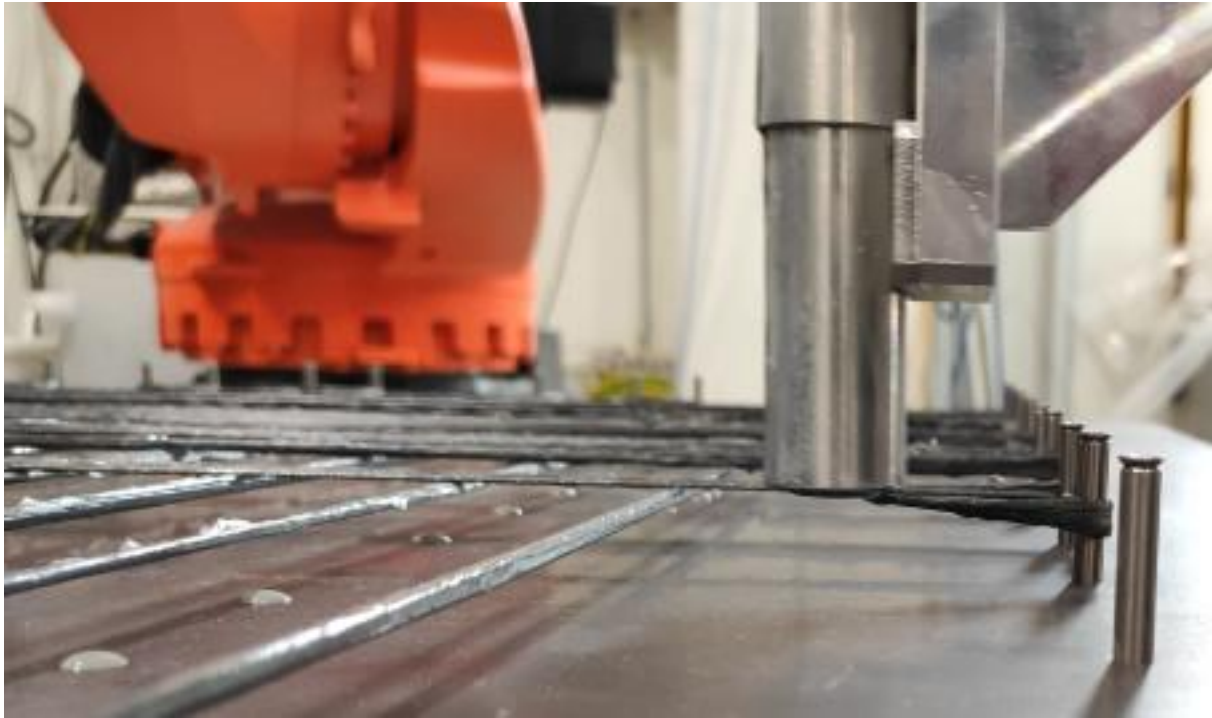


Using carbon fibres in concrete construction: Efficient reinforcement through automated production

About this project



3DHyBeBe

Using carbon fibres in concrete construction: Efficient reinforcement through automated production

Markets: 

Material: Carbon fibres, Nonwovens, mats, Textile-reinforced concrete, Others (Mineral-impregnated Carbon Fibre (MCF))

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

[Technology Transfer Programme Leichtbau](#)

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Context

The construction industry is responsible for a large proportion of global CO₂ emissions, particularly through the production of concrete. More material is often used than is actually necessary for the load-bearing capacity of a structure. Traditional steel reinforcements lead to high weight and increased resource utilisation.

In addition, these are still mainly assembled and installed manually. There has hardly been any digitalisation and automation of processes in the construction industry to date. Lightweight construction technologies, such as the use of carbon fibres, offer a more environmentally friendly solution here. On the one hand, these materials are lighter, more efficient and more durable than conventional metallic reinforcements and therefore enable resource savings in concrete consumption. Secondly, the processes for reinforcement production are to be automated in future. This will enable the efficient and cost-effective production of carbon fibre reinforcements for concrete components.

Purpose

In the 3DHyBeBe research project, the project team aims to develop an automated manufacturing solution that enables the precise and cost-effective use of carbon fibres as reinforcement in concrete construction. The key to the solution lies in combining construction robotics and efficient production. Through the targeted, robot-assisted placement of the fibres, the researchers want to increase the load-bearing capacity of the concrete components and simultaneously optimise the use of materials.

The results of the research project should reduce the consumption of resources and significantly improve the carbon footprint of concrete components. A key challenge here is to create a solution that is scalable and economically feasible so that it can represent a sustainable alternative to conventional steel reinforcement in concrete construction.

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Procedure

The research team is initially concentrating on developing an algorithm that determines the ideal course of the fibres depending on the structural requirements of the component. In this way, the carbon fibres are optimally designed to absorb tensile forces in the component. The researchers translate these calculations into control commands for a special production machine that enables the fibres to be precisely integrated into the concrete material. The prototype developed in the project includes a production line for the fibre reinforcement and an articulated arm robot for the automated implementation of the reinforcement structures.

The basis for reinforcement production is the optimised composition of the materials. The project team combines carbon fibres with various matrices to ensure the bond to the concrete. On the one hand, the researchers are investigating a cement-based matrix for use in conventional, cement-based concretes. Secondly, a geopolymer matrix - a synthetic material that offers many advantages in terms of processing and high resistance to chemical influences. The aim is to improve the transmission of forces between the reinforcement and concrete.

The demonstrative production of reinforcement structures shows that the method reduces material consumption by around a third, while at the same time ensuring technical and economic feasibility.

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Funding duration:

Funding sign: 03LB3043

Funding amount: EUR 600 thousand

Final report

Further websites

foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB3043A - 3DHyBeBe in the federal funding catalogue

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Project coordination

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English (EN){ { Projektpartner } }



Lightweighting classification

Realisation

Offer

Products

Parts and components, Materials



Services & consulting

Engineering



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Lightweighting classification	
	Realisation
Field of technology	
Design & layout Hybrid structures	✓
<i>Functional integration</i>	
Measuring and testing technology Component and part analysis, Materials analysis	✓
Modelling and simulation Optimisation, Materials	✓
Plant construction & automation Automation technology, Robotics	✓
<i>Recycling technologies</i>	
Manufacturing process	
<i>Additive manufacturing</i>	
<i>Coating (surface engineering)</i>	
Fibre composite technology Casting (concrete)	✓
<i>Forming</i>	
<i>Joining</i>	
<i>Material property alteration</i>	
<i>Primary forming</i>	
<i>Processing and separating</i>	
Textile technology Nonwoven & mats production	✓

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Lightweighting classification	
	Realisation
Material	
<i>Biogenic materials</i>	
<i>Cellular materials (foam materials)</i>	
Composites Textile-reinforced concrete, Others (Mineral-impregnated Carbon Fibre (MCF))	✓
Fibres Carbon fibres	✓
<i>Functional materials</i>	
<i>Metals</i>	
<i>Plastics</i>	
<i>Structural ceramics</i>	
(Technical) textiles Nonwovens, mats	✓