Prestressed carbon concrete for bridges: durable and resource-saving construction

About this project

OptiCarboLiz

Prestressed carbon concrete for bridges: durable and resource-saving construction

Markets:

Material: Carbon fibres, Thermoplastics, Yarns, rovings, Carbon-fiber reinforced plastics (CFRP), Textile-reinforced concrete

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Technology Transfer Program Leichtbau

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Context

The need for new infrastructure is growing worldwide. Concrete construction causes enormous amounts of CO#, especially in cement production. In order to reduce the impact on the climate, resource-saving and low-emission alternatives are needed. Carbon concrete construction offers a promising approach. Thanks to the corrosion resistance and high strength of carbon fibre reinforced plastic (CFRP), the same or higher load-bearing capacities are possible with significantly less concrete volume compared to conventional steel reinforcement.

The load-bearing behaviour of long-span structures such as bridges or large ceiling elements in particular can be significantly improved if the prestressing strands - bundles of several fibre strands, similar to a rope - are made of CFRP. In this way, very slender structures can be realised, which makes a significant contribution to weight and concrete savings. In order to achieve the required load-bearing capacities, these strands must be securely and permanently anchored in the concrete. Conventional CFRP strands, however, require long anchoring areas, which until now has been associated with cost-intensive anchoring systems and high concrete requirements. In order to be able to use carbon concrete economically, efficiently and in a way that conserves resources, new and practical technological approaches are needed for the design of the strands and their anchoring. This is where the OptiCarboLiz project comes in.

Purpose

The OptiCarboLiz project team has set itself the goal of redesigning the entire manufacturing process for CFRP prestressed concrete elements - with a focus on applications in bridge construction. To this end, the researchers are developing efficient processes for production, prestressing and anchoring. They combine the advantages of carbon concrete construction with the outstanding material and tensile mechanical properties of prestressed fibre strands and exploit their full performance potential.

This makes it possible to realise lean and integral construction methods that require less concrete, achieve a longer service life and at the same time reduce production costs. The result is a resource-saving and economical solution for the production of prestressed concrete elements and structures that is both sustainable and cost-efficient.

Using the example of prestressed prefabricated bridge girders, the researchers want to demonstrate the high economic and ecological potential and prove the practical suitability of this innovative technology.

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Procedure

The team is developing new types of CFRP strands and technologies for their production, pretensioning and anchoring. The basis for this is formed by specially profiled carbon fibre strands that are bundled into pre-stressable strands.

The researchers are testing and optimising the production of the strands using a laboratory-scale production facility. In addition to stranding the individual, profiled carbon fibre strands, they are developing a suitable impregnation method for the carbon bundles and integrating it into the production process. The optimal impregnation ensures that the fine individual fibres hold together firmly and thus form a stable internal bond. At the same time, it binds the individual fibre strands together to form a robust strand, which secures the outer bond. In addition, the impregnation protects the material from environmental influences and makes the strand easy to handle in the subsequent manufacturing process.

At the same time, the project team is analysing the material properties along the entire process chain and investigating how individual influencing variables affect the overall system. The findings are being incorporated into an automated, continuous manufacturing process.

In addition, the project participants are designing a compact anchoring system that can be used flexibly for various clamping methods. A design model shows how particularly light and slender bridge girders can be safely planned and realised with the new overall system.

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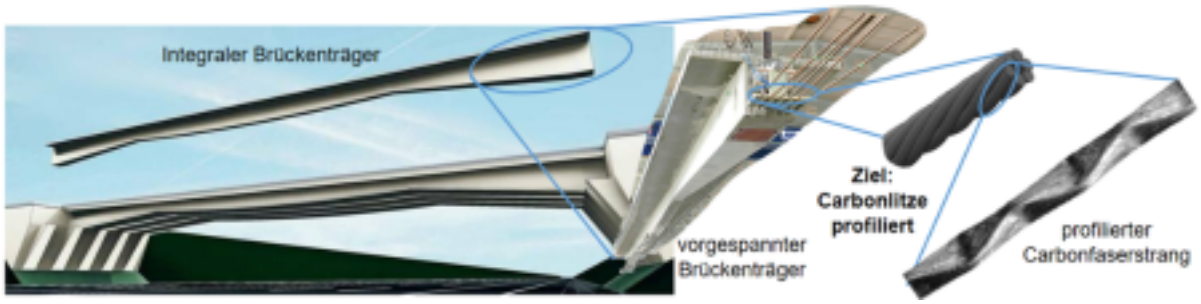

Funding duration:

Funding sign: 03LB3092 **Funding amount:** EUR 1.2 million

Final report

Further websites foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB3092A - OptiCarboLiz in the federal funding catalogue

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Project coordination

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English (EN){{ Projektpartner }}

Lightweighting classification

	Realisation
Offer	
Products Machines and plants, Materials	✓
Services & consulting	

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Lightweighting classification

	Realisation
Field of technology	
Design & layout Hybrid structures	✓
Functional integration	
Measuring and testing technology	
Modelling and simulation	
Plant construction & automation Plant construction	✓
Recycling technologies	
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology	
Forming	
Joining	
Material property alteration	
Primary forming	
Processing and separating	
Textile technology Textile surface treatment and finishing	✓

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Lightweighting classification

	Realisation
Material	
Biogenic materials	
Cellular materials (foam materials)	
Composites Carbon-fiber reinforced plastics (CFRP), Textile-reinforced concrete	✓
Fibres Carbon fibres	✓
Functional materials	
Metals	
Plastics Thermoplastics	✓
Structural ceramics	
(Technical) textiles Yarns, rovings	✓