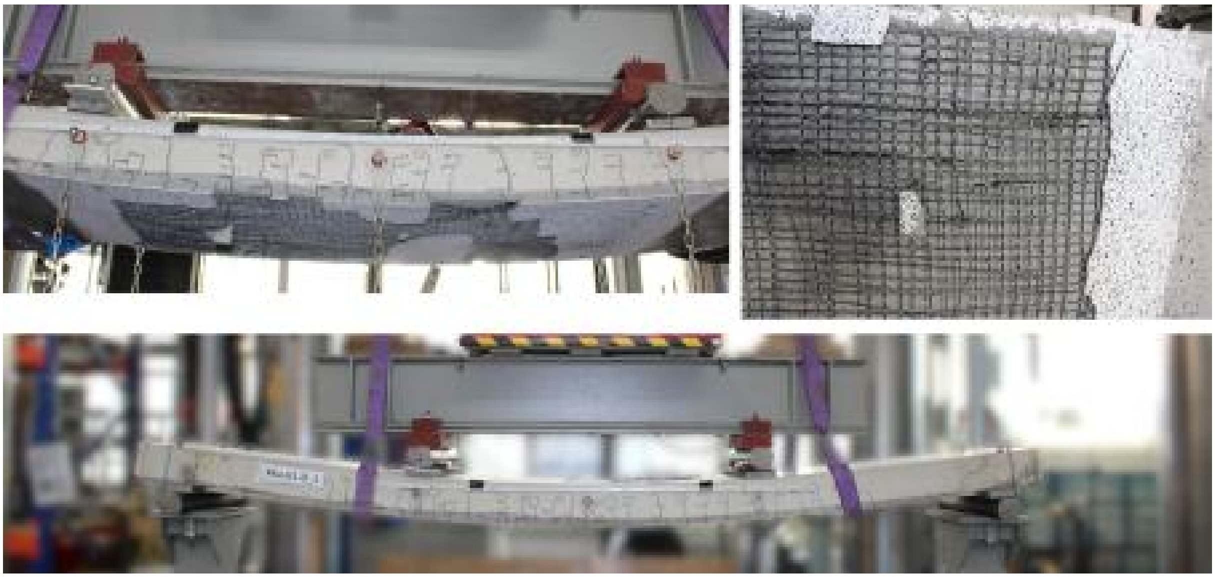
Creating planning security: standardised rules for the use of carbon concrete

About this project



CRC-BoDeM

Creating planning security: standardised rules for the use of carbon concrete

Markets:

Material: Glass fibres, Carbon fibres, Thermoset plastics, Thermoplastics, Glass-fiber reinforced plastics (GFRP), Carbon-fiber reinforced plastics (CFRP), 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 combines concrete with a corrosion-free, non-metallic reinforcement made of carbon fibres. As this does not rust, a thinner concrete cover is sufficient. This means that components with smaller cross-sections and a lower dead weight can be produced. This reduces the amount of material and energy used in production and transport, reduces CO# emissions and creates leeway in terms of load-bearing capacity and design. The construction method is suitable for new builds as well as for the renovation or reinforcement of existing structures.

The decisive technical factor is the bonding effect between the carbon reinforcement and the concrete, on which cracking, deformation and durability depend. However, there are no recognised design and implementation rules for widespread use. Planners are therefore often dependent on special authorisations, so-called approvals in individual cases. At the same time, practitioners need reliable criteria for safety in extreme cases - the ultimate limit state (ULS) - and function in everyday life - the serviceability limit state (SLS). This is where the CRC-BoDeM research project comes in, in order to anchor carbon concrete in standards for construction practice and bring it into widespread use.

Purpose

The project partners enable the safe and economical use of carbon concrete in buildings. Planners should be able to use carbon concrete in both new buildings and existing structures without the need for time-consuming approvals in individual cases. To this end, the project team is defining standardised, binding and manufacturer-independent rules for design and execution. Specifically, the researchers define permissible crack widths, deformations and stresses as well as the necessary requirements for minimum concrete cover, anchoring of the bending tension and shear force reinforcement and lap joints. An overlap joint is the overlapping arrangement of two reinforcements via which tensile forces are transferred without coupling. The rules determine the required overlap length.

The partners are preparing the results for incorporation into a guideline of the German Committee for Reinforced Concrete (DAfStb), which has been introduced by the building authorities. The rules are based on parameters that are not tied to a specific reinforcement product and cover different surfaces and cross-sectional shapes. This means that new product variants can be included in the regulations without having to redo the basic verifications. This enables the construction industry to plan and design in a universally valid manner, eliminating the need for time-consuming approvals in individual cases - which increases planning reliability and speeds up construction projects.

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Procedure

The project partners set up a staged test programme with small and large-format test specimens. They produce test specimens and vary the reinforcement surface and geometry, the concrete cover and the lengths for anchoring and overlapping. In different constellations, they measure the deformation of the test specimens and the force transmission between the reinforcement and concrete.

Innovative measurement methods are used. Digital image correlation (DIC) - an optical measurement method - records deformations and crack patterns over a large area. Fibre-optic sensors record strains in concrete and reinforcement over length and time. From this measurement data, the team derives characteristic relationships for bond, crack spacing, crack width and deformations and calibrates design models for practical use as well as rules for structural design.

The researchers use large-format, realistic components to test the behaviour under normal practical loads. At the same time, the recyclability of the non-metallic reinforcements is being analysed. The partners are preparing the results for inclusion in the DAfStb guidelines for new construction and for the reinforcement of components, which have been introduced by the building authorities. In this way, they are creating clear design rules and concrete detailed specifications for planning practice.

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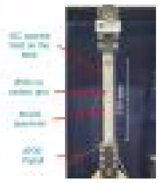 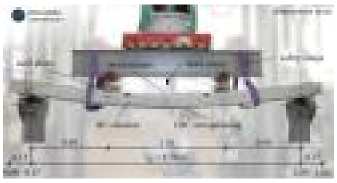 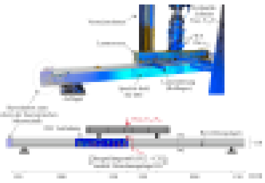 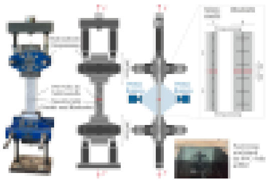

 

Funding duration:

Funding sign:	03LB5009	**Funding amount:**	EUR 1 million

Final report

www.tib.eu/de/suchen/id/datacite:03a1e41a7578027800594a6878f3ed44ae675ea1/CRC-BoDeM-Verformung-und-Rissbildung-im-Carbonbetonbau?cHash=e3d14fd9a9070de24aea72af44911c6e - Final report TIB Hannover

Further websites

foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB5009A - CRC-BoDeM in the federal funding catalogue

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Project coordination

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English (EN){{ Projektpartner }}

A. Frauenrath Recycling GmbH

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Lightweighting classification

	Realisation
Offer	
Products Materials	✓
Services & consulting	
Field of technology	
Design & layout Lightweight manufacturing	✓
Functional integration	
Measuring and testing technology	
Modelling and simulation Loads & stress, Materials	✓
Plant construction & automation	
Recycling technologies Recycling	✓
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology	
Forming	
Joining	
Material property alteration	
Primary forming	
Processing and separating	
Textile technology	

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Lightweighting classification

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