CARBCOMN: Advancing Low-Carbon Concrete for a Sustainable Future

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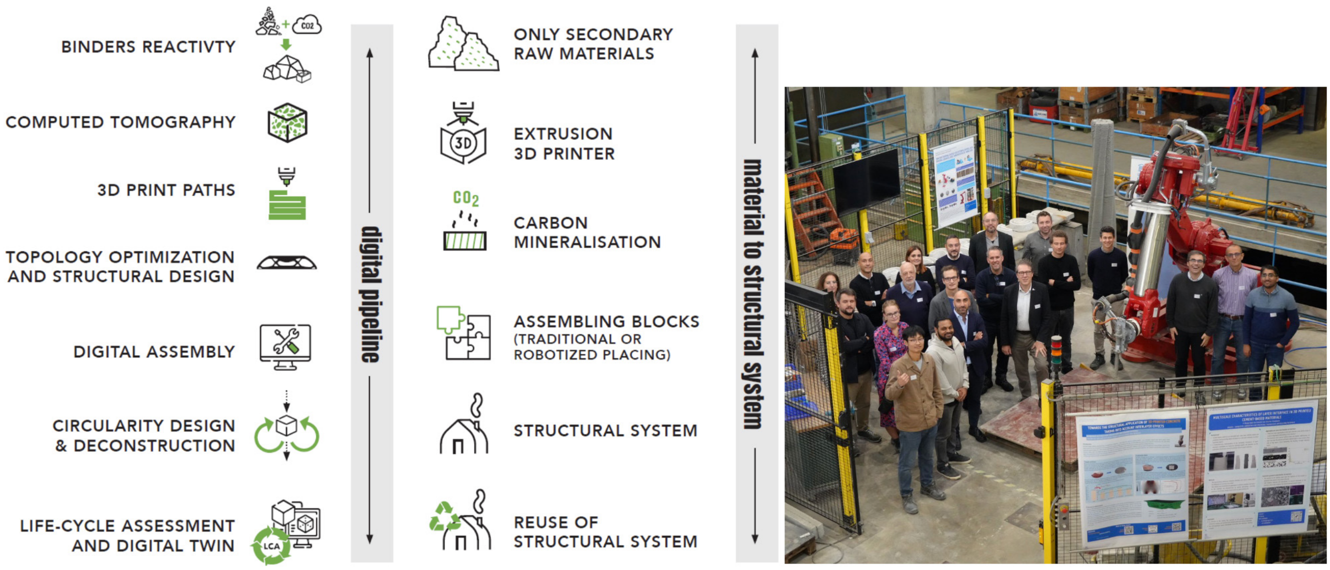
fib members Stijn Matthys (Ghent University, coordinator of CARBCOMN), Enzo Martinelli (TESIS), Christoph Czaderski (EMPA), Thanasis Triantafillou and Corina Papanikolaou (University of Patras), and Julien Michels (re-fer) played a key role in the CARBCOMN project ("CARBon-negative COMpression dominant structures for decarbonized and deconstructable CONcrete buildings").

Concrete remains the backbone of modern infrastructure, yet its environmental footprint—particularly from cement production—poses a significant challenge. The CARBCOMN project "CARBon-negative COMpression dominant structures for decarbonized and deconstructable CONcrete buildings" is a pioneering research initiative aimed at transforming the concrete industry by developing innovative 3D-printed ultra-low-carbon concrete and segmental construction practices that align with global sustainability goals. The project involves *fib* members Stijn Matthys (Ghent University, coordinator of CARBCOMN), Enzo Martinelli (TESIS), Christoph Czaderski (EMPA), Thanasis Triantafillou and Corina Papanikolaou (University of Patras), and Julien Michels (re-fer).

Launched under the Horizon Europe EIC (European Innovation Council) pathfinder programme, CARBCOMN brings together a consortium of 5 leading research institutions (Ghent University, Technical University Darmstadt, University of Patras, ETH Zürich, EMPA) and 6 industry partners (TESIS, Orbix, incremental3d, Mario Cucinella Architects, re-fer and Zaha Hadid Architects) across Europe. The project focuses on the development of an ultra-low-carbon concrete mixture, based on carbon curing technology, suitable for processing with extrusion-based additive manufacturing, producing discrete blocks out of it and employing them in an innovative structural system consisting of compression-dominant members. Carbon curing of concrete is ideally conceived as an ultra-low-carbon technology, as carbon sequestration is used to harden the concrete. Carbon-cured concrete is less compatible with traditional steel reinforcement, as it has not the necessary alkalinity to passivate the steel reinforcement in the concrete. By applying compression-dominant structures, either by using funicular shapes (compression-only structural forms) or by installing unbonded post-tensioning, this drawback can be avoided. By segmenting the compression-dominant structure, it can be constructed using 3D-printed concrete blocks with shapes optimized for design flexibility and efficient material use. This also enables the application of the blocks in structures designed to be deconstructed at the end of their life cycle. To handle the complex geometries and foster the design and production processes, an innovative digital pipeline is developed.



Using carbon sequestration to harden the concrete for widely used load-bearing structures will reduce embodied greenhouse gas emissions in an unprecedented way. The material design, incorporating recycled materials and by-products derived from other industrial processes (e.g. slags and ashes) will equally reduce raw material usage. The intrinsic durability properties by introducing a system that is not susceptible to rebar corrosion and is deconstructable will achieve both long service life and circularity, to further reduce the environmental impact of the built environment.

CARBCOMN also takes part in the DigiTrio portfolio, which unites ten ambitious projects funded under the same EIC pathfinder challenge "Digitalization for a Novel Triad of Design, Fabrication, and Materials", each exploring the transformative potential of digitalisation within the Architecture, Engineering, and Construction (AEC) sector.
For more information, visit the official website and follow CARBCOMN on social media channels through the links available on the website.

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