LIGHTWEIGHT CONCRETE STRUCTURES WITH MINERAL REINFORCEMENT

Fabricability and structural performance of the filigree concrete components reinforced with continuous tailor-placed basalt fibers.

Basalt fibers and rebars

Consuming half of all materials used and producing a quarter of all emissions in the industry, the cement and concrete sectors play a critical role in meeting the Paris Agreement and decarbonizing the construction industry by 2050. This goal can only be achieved through joint action by all stakeholders at all levels, from cement to construction, along the entire value chain. Measures to reduce concrete demand at the construction level and the implementation of circular economy principles are assessed as the most straightforward scenario with the shortest implementation time and highest efficiency.

Casting of filigree fiber-reinforced concrete structure into sand formwork

Reduction of concrete consumption in structural elements can be achieved through the application of lightweight design principles. However, such filigree, usually geometrically complex structures require appropriate reinforcement strategies alternative to standard steel rebars. Among potential reinforcing materials, basalt fibers represent a great potential both technically and environmentally. They have higher strength than steel and are comparable to carbon and glass fibers, but with significantly less embodied energy. In addition, produced from basalt rock, they have a mineral base, enhancing recycling of concrete components at the end of their service life.

An open research question is the use of basalt fibers in filigree concrete structures that require their tailor placement along principle tensile trajectories. For this purpose, the fibers must be combined with an appropriate coating that provides rapid curing during application as well as protection from the alkaline environment of hydrated concrete. Thus, the objectives of the thesis include:

- investigation of fiber and coating formulations suitable for tailor placement, mechanical properties of fiber-coating compounds;
- experimental setup for tailored fiber placement;
- production of demonstration object to account for tailored fiber placement setup and prove fabrication related issues;
- experimental setup to account for alkali resistance of the tailored fiber composite reinforcement used in concrete construction;
- characterization of mechanical properties (exposed vs. non-exposed to alkali environment) to account for structural performance.

If you are interested, please apply to:

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