Numerical Modelling of Textile Reinforced Concrete

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ABSTRACT

The building construction industry is in need of a paradigm shift to sustainability. One way of dealing with this need is by exploring the use of alternative building materials, such as Textile Reinforced Concrete (TRC). TRC encompasses a fine-grained concrete matrix reinforced by multi-axial textile fabrics, which replaces the traditionally used steel reinforcement methods. Investigations of new materials are necessary in order to quantify its expected structural performance and integrity.

In this study, different ways of modeling TRC were explored using DIANA with the pre- and post-processor FX+. The developed models simulate the bending load capacity, as well as the fracture and cracking behaviour of thin TRC structures, namely thin beams and slabs, under one-way and two-way bending stress.

The numerical analysis consisted of non-linear modelling using 2D plane stress elements for a thin TRC beam and shell elements for a two-way TRC slab. In the 2-D model, textile reinforcement is defined as an equivalent bar with bond-slip using input based on pull-out tests from literature. As for the shell element model, the textile reinforcement is implemented as a grid and treated as embedded. Cracking of the cementitious matrix was modelled with a smeared rotating crack model, while a simplified bi-linear stress-strain law was assigned to the textile reinforcement. Ultimately, the numerical analyses were validated experimentally by means of four-point and point-load bending test results.