Analysis of the durability of cementitious composites with glass fibre reinforcement for building applications

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Strength durability remains a topic of great concern within the glass fibre reinforced concrete (GRC) world, even though considerable literature has been made widely available with regards to this subject. In literature three main driving degradation mechanisms are generally recognised: (1) chemical attack of the glass fibres due to the alkaline nature of the matrix, (2) embrittlement due to the growth of hydration products in the vicinity of the reinforcing inclusions and (3) static fatigue. Some disagreement however still exists concerning the relative importance of these mechanisms within the whole of the degradation process. This has nonetheless led to on the one hand the development of more durable material combinations, and on the other hand several strength prediction models. These models can generally be divided into 2 main groups: the matrix densening models and the flaw growth models. For both approaches a considerable gap however still exists between theory and practice. No real guidelines are available until now for: testing, model calibration and model selection.

In this work focus was put on Textile Reinforced Concrete, a GRC material with great potential in the building industry. Due to the relative high fibre volume fractions that can be inserted in the concrete by means of reinforcement under the form of textiles, traditional steel reinforcements can be omitted, making the implementation of the strength durability issue in the design even more crucial. Therefore, in this work special attention was devoted to the implementation of strength durability in the design of TRC structures and structural components in general. All stages were analysed, going from:

(1) strength durability experiments and associated selection of the acceleration scheme (for rapid strength durability assessment), to
(2) calibration of the different candidate models,
(3) selection of the model that best approximates the available dataset,
(4) strength predictions in real climatic conditions and last but not least
(5) determination of the uncertainties introduced in the strength prediction by on the one hand the statistical distribution present on the (tensile) strength of the GRC-

material, and on the other hand the model calibration which is based on a limited set of accelerated ageing experiments.

The design methodology of TRC elements was closely analyzed and with the gathered knowledge, a first attempt was made to construct guidelines for the design of TRC structures.