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Textile Fibre Composites in Civil Engineering

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Preface

The use of brittle materials with low tensile strength, such as concrete or masonry, has been known for thousands of years. The idea of embedding fibers in brittle materials, so that cracking does not lead to failure, is also not new. Thousands of years ago straw was added to clay bricks in order to make them tougher. Later on, techniques were devised to strengthen concrete that were based on the use of metallic reinforcement. In recent decades, various methods have been developed to replace the conventional steel reinforcement in concrete structures through the use of short fibers (e.g. steel, glass, or polymeric), with a recent development along these lines being the ultra-ductile concrete. Another development is the use of fiber reinforced polymers (FRP), which are typically made of long, continuous fibers (e.g. carbon, glass, aramid) in a polymeric matrix, which yield reinforcing elements such as bars, strips, and sheets, for the reinforcement, strengthening, or seismic retrofitting of new or existing concrete and masonry structures.

Considerations to combine continuous fibers with inorganic binders in the construction of new structures began in the 1980s, and the first research efforts were made in Germany in the 1990s, leading to the product known as textile reinforced concrete (TRC). This material consists of textiles made of long woven, knitted, or even unwoven fiber rovings in at least two directions, embedded in an inorganic fine-grained binder (typically—but not necessarily—cementitious).

In the early 2000s, the textile-based composites were used successfully in the field of strengthening and seismic retrofitting of concrete and masonry structures, in an attempt to solve problems associated with the use of polymeric resins in FRP products. At the beginning, these new "textile fiber composite" materials were given (in Europe) the name "textile reinforced concrete" (TRC) or "textile reinforced mortar" (TRM). Strictly speaking, the inorganic matrix is not classified as "concrete", due to the very small size of aggregates. More recently (in the USA), the materials were given the name "fabric reinforced cementitious matrix systems" (FRCM).

The introduction of textile fiber composites to the market have been accompanied with an extensive expansion of research on TRC or TRM or FRCMs. Many research units worldwide deal with topics relevant to new constructions, as well as to the retrofitting of existing ones. A wide variety of publications already demonstrate the worldwide interest in this innovative structural material, which is expected to grow rapidly.

The book provides a state-of-the-art review from leading experts in the field on the developments which have appeared over the last decade or so, on the use of textile fiber composites in structural engineering, with a focus on both new and existing concrete and masonry structures. The book reviews materials, production technologies,

fundamental properties, testing, design aspects, applications, and directions for future research and developments.

The book provides broad coverage of a wide range of topics and includes 18 contributions from leading experts in the field. The material is divided into four parts: Part one covers materials, production technologies, and manufacturing of textile fiber composites for structural engineering. Part two moves on to review testing, mechanical behavior, and durability aspects of textile fiber composites. Part three analyzes the structural behavior and design of textile reinforced concrete. This section includes a number of case studies providing thorough coverage of the topic. Finally, part four details the strengthening and seismic retrofitting of existing structures with textile-based composites. Chapters in this part investigate concrete and masonry structures, in addition to providing information on case studies and insight into future directions in the field.

Textile Fiber Composites in Civil Engineering is a key volume for researchers, academics, practitioners, and students working in civil and structural engineering and advanced construction materials, written by international experts and researchers in the field. Their great effort in providing excellent contributions is gratefully acknowledged.

Patras, Greece
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Thanasis C. Triantafillou

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