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Textile Fibre Composites in Civil Engineering

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Thanasis Triantafillou



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Contents

List of contributors	xi
Preface	xiii
Woodhead Publishing Series in Civil and Structural Engineering	xv
Part One Materials, Production Technologies and Manufacturing of Textile Fibre Composites for Structural and Civil Engineering	1
1 Manufacturing of textiles for civil engineering applications	3
<i>T. Gries, M. Raina, T. Quadflieg and O. Stolyarov</i>	
1.1 Introduction	3
1.2 Yarn structures	4
1.3 Planar textile structures	9
1.4 Three-dimensional textile structures	16
1.5 Coating of textiles	19
1.6 Conclusions and future trends	21
References	22
2 Mineral-based matrices for textile-reinforced concrete	25
<i>V. Mechtcherine, K. Schneider and W. Brameshuber</i>	
2.1 Introduction	25
2.2 Overview of matrix compositions for TRC	27
2.3 Testing properties of fresh TRC matrices	29
2.4 Basic properties of hardened TRC matrices	31
2.5 Alternative binder systems for TRC	33
2.6 Modification of TRC matrices by short fiber	38
2.7 Summary	40
Acknowledgments	41
References	41
3 Manufacturing methods for textile-reinforced concrete	45
<i>W. Brameshuber</i>	
3.1 Introduction	45
3.2 Casting	45
3.3 Laminating	48
3.4 Spraying/shotcreting	50
3.5 Spinning	53

3.6	Extruding	55
3.7	Summary	57
	References	59
Part Two Testing, Mechanical Behaviour and Durability Aspects of Textile Fibre Composites Used in Structural and Civil Engineering		61
4	Bonds in textile-reinforced concrete composites	63
	<i>A. Peled</i>	
4.1	Introduction	63
4.2	Characterization and modelling of bonding	66
4.3	Multifilament yarns	75
4.4	Bonding in a fabric	91
4.5	Summary	95
	References	95
5	Textile fiber composites: Testing and mechanical behavior	101
	<i>B. Mobasher</i>	
5.1	Introduction	101
5.2	Tension tests	102
5.3	Role of microstructure	105
5.4	Interface characterization	109
5.5	Correlation of tensile and flexural properties	122
5.6	High-speed tensile tests	130
5.7	Flexural impact	138
	References	147
6	Durability of structures made of or strengthened using textile-reinforced concrete	151
	<i>V. Mechtcherine</i>	
6.1	Introduction	151
6.2	Characteristic loads and exposures	153
6.3	Basics of durability estimation and design	153
6.4	Characteristic material properties to predict long-term durability and service life	159
6.5	Summary	165
	Acknowledgments	166
	References	166
7	Fire resistance of textile fiber composites used in civil engineering	169
	<i>L. Bisby</i>	
7.1	Introduction	169
7.2	Fire resistance	170
7.3	Fiber response to elevated temperatures	173
7.4	Matrix response to elevated temperatures	174

7.5	Textile-fiber composite response to elevated temperatures	175
7.6	Fire resistance of TRC structures	177
7.7	Fire resistance of textile-reinforced strengthening systems for concrete and masonry	178
7.8	Summary, knowledge gaps and research recommendations	182
	References	183
	Part Three Textile Reinforced Concrete: Structural Behaviour, Design and Case Studies	187
8	Textile-reinforced concrete: Design models	189
	<i>J. Hegger and N. Will</i>	
8.1	Introduction	189
8.2	Factors to consider in the dimensioning methods	189
8.3	Dimensioning approach considering normal force and bending	195
8.4	Summary	206
	References	206
9	Textile-reinforced concrete: Structural behavior	209
	<i>R. Chudoba and A. Scholzen</i>	
9.1	Introduction	209
9.2	Effect of strain-hardening behavior on structural response	210
9.3	Case study: Hypar-shell	213
9.4	Case study: Barrel-vault shell	218
9.5	Further aspects of structural behavior	223
9.6	Conclusions	224
	References	225
10	Applications of textile-reinforced concrete in the precast industry	227
	<i>C.G. Papanicolaou</i>	
10.1	Introduction	227
10.2	Exterior cladding systems and façades	227
10.3	Sandwich elements	231
10.4	Other applications	237
10.5	Summary and future trends	238
	References	241
11	Optimum design of textile-reinforced concrete as integrated formwork in slabs	245
	<i>C.G. Papanicolaou and I.C. Papantoniou</i>	
11.1	Introduction	245
11.2	Conceptual design	246
11.3	Design considerations and assumptions	247
11.4	Design equations	249

11.5	Formulation of optimum (minimum cost) design	261
11.6	Summary and future trends	273
	References	273
12	Textile-reinforced concrete: Selected case studies	275
	<i>M. Raupach and C. Morales Cruz</i>	
12.1	Loadbearing and self-supporting new building structures with prefabricated textile-reinforced concrete	275
12.2	Strengthening of steel-reinforced concrete structures	282
12.3	Repair and restoration with TRC	286
12.4	Future applications of TRC	293
12.5	Conclusion	298
	References	298
 Part Four Strengthening and Seismic Retrofitting of Existing Structures: Structural Behaviour, Design and Case Studies		301
13	Strengthening of existing concrete structures: Concepts and structural behavior	303
	<i>T. Triantafillou</i>	
13.1	Introduction	303
13.2	Flexural strengthening	305
13.3	Shear strengthening	309
13.4	Confinement of axially loaded concrete	313
13.5	Seismic retrofitting by improving plastic hinge behavior	315
13.6	Seismic retrofitting of infilled reinforced concrete frames	318
13.7	Summary	320
	References	321
14	Strengthening of existing concrete structures: Design models	323
	<i>E. Müller, S. Scheerer and M. Curbach</i>	
14.1	Preliminary note	323
14.2	Bending strengthening	324
14.3	Shear strengthening	333
14.4	Torsional strengthening	341
14.5	Column strengthening	353
14.6	Conclusion	357
	Acknowledgments	357
	References	357
15	Strengthening of existing masonry structures: Concepts and structural behavior	361
	<i>T. Triantafillou</i>	
15.1	Introduction	361
15.2	Textile-reinforced mortar system	362

15.3	Mechanical properties	363
15.4	Intervention requirements and strengthening rationale	364
15.5	Structural modeling	365
15.6	Design of retrofitting for seismic applications	366
15.7	Strengthening of masonry walls for out-of-plane loads	366
15.8	Strengthening of masonry walls for in-plane loads	368
15.9	Strengthening of curved masonry elements	371
15.10	Confinement of masonry columns	372
15.11	Summary	373
	References	374
16	Strengthening of existing masonry structures: Design models	375
	<i>T. Triantafyllou</i>	
16.1	Introduction	375
16.2	General safety principles	375
16.3	Safety verifications	376
16.4	Strengthening of masonry walls for out-of-plane loads	378
16.5	Strengthening of masonry walls for in-plane loads	382
16.6	Strengthening of curved masonry elements: Arches, barrel vaults, domes	385
16.7	Confinement of masonry columns	386
16.8	Summary	388
	References	388
17	Strengthening of existing structures: Selected case studies	389
	<i>D. Bournas</i>	
17.1	Introduction	389
17.2	Concrete strengthening case studies	389
17.3	Masonry strengthening case studies	402
17.4	Future trends	409
17.5	Source of further information and advice: Design codes	409
	Acknowledgments	410
	References	410
18	Thin TRC products: Status, outlook, and future directions	413
	<i>A.E. Naaman</i>	
18.1	Introduction: Summary	413
18.2	Status report	413
18.3	Matrix and reinforcement: Compatibility for a successful composite	419
18.4	Cost considerations: Fiber volume fraction versus weight fraction	422
18.5	The case for 3D textiles	426
18.6	Ultra-high performance cement matrices in thin cement composites	430

18.7	Summing up: Mechanical performance	431
18.8	Summing up: Functions and applications	432
18.9	Suggested research needs and directions for successful thin TRC products	433
	Acknowledgments	435
	References	435
	Index	441

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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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