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Paolo Beccarelli

Biaxial Testing for Fabrics and Foils

Optimizing Devices and Procedures



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Preface

This book is the result of 5 years of research focused on the progressive organisation of the expertise in technical textiles developed within numerous international companies and research institutions on the mechanical characterisation of architectural fabrics for structural applications. The research was supported by Politecnico di Milano and gave an essential contribution to the development of the new testing laboratory for technical textiles clusTEX.

The first objective of the research is the development of an exhaustive description of the current design practice and manufacturing techniques for membrane structures. The study considers the testing standards available, the materials employed, the software developed in this field and the modalities for fabrication and erection. The aim is to describe the critical aspects which characterise membrane structures in the current practice highlighting the central role of universities and testing laboratories in the improvement of the design and realisation of lightweight membrane structures.

In addition, the book analyses in detail the biaxial testing apparatus currently in use describing the advantages and critical aspects of each typology developed in-house by several testing laboratories due to the absence of standard commercial products for biaxial tests. Through a round-robin exercise it has been possible to understand the level of precision and comparability between the laboratories currently operating on the market and to compare the results with data available in the literature.

A section of the book describes in detail the technical issues faced during the development of a biaxial testing machine and the alternatives to minimise the inaccuracies and increase the flexibility of the testing rig without compromise to the economic feasibility of the project. On the basis of the experience and collaboration with several European laboratories, there have been developed a set of guidelines which present the main aspects to be considered in developing a testing protocol.

The last section of the book presents two recent applications of biaxial tests for advanced applications such as strain controlled tests and flexible solar cells. The example of a strain-controlled biaxial test aims to investigate the potential offered by new testing equipment and the controlling software in order to reproduce strain histories assigned to the central zone of the cruciform specimen. The example of a biaxial procedure applied to laminated lightweight, thin-film, organic solar cells and ETFE foils offers a groundbreaking example of the future applications for biaxial tests due to the increase of lightweight and flexible building products.

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