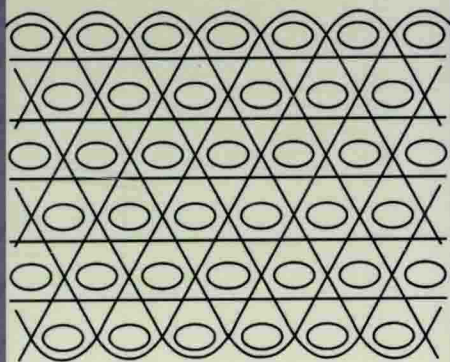


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# **Woven textile structure**

## Theory and applications

B. K. Behera and P. K. Hari



The Textile Institute

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# Woven textile structure

Theory and applications

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115 **Woven textile structure**

*B. K. Behera and P. K. Hari*



Engineering fabrics deals with the application of science to reveal the relationships between the raw material, process and the finished product to achieve desired functional or aesthetic effects in the fabric. The success of fabric engineering depends on reliable objective measurements, prediction and control of fabric quality and performance attributes. The prediction of fabric quality and performance attributes requires an efficient methodology to model the inherent non-linear relationships between fibre, yarn and fabric properties. The science of mechanics has provided the ability to predict quantitatively the mechanical performance of structures, but has rarely been applied to textile materials. Various mathematical models, such as geometrical and mechanistic models, based on forces in the fabric, energy minimization principles and empirical relationships between variables, can be used for the analysis of textile structures and processes to explain the underlying principles and predict fabric properties and behavior. Understanding the theoretical relationships between fabric parameters enables the fabric designer to play with different fibers, yarn tex, threads per centimeter and weave to vary texture and other fabric properties. These relationships provide simplified formulae to facilitate calculations which are of value for cloth engineering, problems of structure and mechanical properties.

The authors bring together expertise in fabric structure, mechanical properties of fabric, structure-property relationships and basic principles of design engineering as a tool to support product development, within the framework of fabric structural mechanics. This book is the culmination of teaching, research and methodology in presenting principles and applications related to structure of woven fabrics developed over several years at the Indian Institute of Technology (IIT) Delhi, India. It aims to give readers a good foundation in this area through an in-depth understanding of the principles of physical and mechanical properties of woven textile structures. It is designed as a textbook for graduates and postgraduates in textile technology and also as a reference book for research. The concepts and applications have been demonstrated by liberal use of examples. The book gives a flavor of the basics and builds up to predictive modeling of some fabric properties. The



book is broad-ranging in covering the physical and mechanical properties of the fabric, the fabric making-up process and applications in newer and emerging areas like sports, e-textiles, etc. SI units have been used throughout the book. Each chapter gives an abstract of the contents and is concluded, wherever possible, with how the contents can be used and applied in practical situations.

The book is broadly divided into four sections: Part I Fundamentals of woven fabric structure, Part II Mechanics of woven fabric structure, Part III Design engineering of woven fabrics and Part IV Practical applications. The first four chapters in Part I present the fundamentals of woven fabric structure and some derivatives including some special structures. They discuss the concept of a maximum weavability limit, crimp interchange phenomena, the mechanisms of fabric shrinkage and soft computing applications to predict fabric parameters using the relationship between fabric parameters based on geometrical models. Part II deals with mechanical properties of woven structure in which behavior of fabric under various kinds of deformations is discussed. In Part III, the concept of design engineering, fundamentals of modeling and simulation, modeling methodologies and soft computing application for prediction of fabric properties are described to enable textile researchers to understand the application of various methods for product engineering. Chapters in Part IV demonstrate how fundamental knowledge of theory of fabric structure can be helpful for practical applications in developing fabrics of special construction and achieving various performance characteristics in processing and use.

We wish to thank many students in the Textile Department, IIT Delhi for their unstinting support in making this endeavor a reality. We also owe our indebtedness to many others who are not mentioned for their indirect contribution in enhancing our knowledge and giving support. We would like to acknowledge Ms Kathryn Picking, Mr Francis Dodds and Woodhead Publishing Limited for their encouragement and assistance. Professor Hari would like to thank his wife Usha for the support and encouragement to take up this benevolent task for contribution of experience to textile technology. It is hoped that this book will fill the vacuum in the literature on woven structures since the last book on structural mechanics of fibres, yarn and fabrics was published in 1969. We welcome suggestions for any errors that may have crept into the book inadvertently.

B. K. Behera  
P. K. Hari



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