



Nonconventional and Vernacular Construction Materials

Characterisation, Properties
and Applications

Edited by Kent A. Harries and Bhavna Sharma

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K.A. Harries, B. Sharma



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Preface

Safety in the built environment is a fundamental right.¹ While adequate shelter is perhaps the most critical aspect of a community infrastructure, the lack of stable infrastructure is often cited as the primary barrier to sustainable development. Indeed, it is suggested that “sustainable development” may be largely unattainable to all but the wealthiest and most advanced global communities.² Sustainable development is most commonly defined as that which “meets the needs of the present without compromising the ability of future generations to meet their own needs...”³ What is often omitted from this definition, however, are the lines that immediately follow: “...It contains within it two key concepts: (1) the concept of needs, in particular the essential needs of the world’s poor, to which overriding priority should be given; and (2) the idea of limitations imposed by the state of technology and social organization on the environment’s ability to meet present and future needs.” It is the challenge of coupling both global and regional sustainability practices with social equity that lies at the heart of the grand engineering and social challenges of the 21st century. Nonconventional and vernacular construction materials are one aspect of addressing these challenges and bringing sustainable development within reach of the entire global community.

There is considerable interest—if judged by the proliferation of journal articles in recent years—in the modern engineering application of nonconventional materials (NOCMAT). Often this interest is driven by the interests of sustainable engineering and/or the newer trends toward “engineering for humanity” and “social entrepreneurship.” Nonetheless, there are few repositories of such information. In English, a few international conferences (the NOCMAT series being one of the oldest) and regionally focused journals dominate the literature. Some work makes its way into archival journals, but typically such articles are at the periphery of the journal focus and are often included based on their “sustainability” credentials. This volume aims to fill this significant gap in the available literature and should serve as an important resource for engineers, architects, academics, and students interested in nonconventional materials.

¹ 1948 United Nations *Universal Declaration of Human Rights* reiterated in the 1994 United Nations *Special Rapporteur’s Report to the United Nations Commission on Human Rights*.

² Silbergliitt, R. et al. (2006) “The Global Technology Revolution 2020, In-Depth Analyses Bio/Nano/Materials/Information Trends, Drivers, Barriers, and Social Implications.” *Report TR-303-NIC*, Rand Corporation, 314 pp.

³ World Commission on Environment and Development (1987) *Our Common Future*. Oxford University Press. [so-called Brundtland report.]

The focus of this volume is the materials science and modern structural engineering (and some architectural) applications of ancient, vernacular, and nonconventional building materials. Such materials are defined to include relatively unprocessed naturally occurring materials and processed or engineered materials developed from the natural material. Chapters focus on individual construction materials and address both material characterization and structural applications. Each chapter reflects the current state of the art in terms of the modern use and engineering of the material. For ease of reference and use, the volume is divided into four parts.

Part I provides an introduction to nonconventional and vernacular materials, exploring their role in both social and engineering contexts. Chapter 1 places vernacular construction methods in a modern social context. Chapter 2 considers the historic context of these materials and describes the development of their formal study, while Chapter 3 looks to future needs and applications.

Part II focuses on natural fibers. Chapter 4 describes natural fiber-reinforced cementitious composites, while Chapter 5 considers non-cementitious “bio-composites.” Chapter 6 describes straw bale construction, which has been gaining traction in diverse communities around the globe.

Part III focuses on nonconventional concrete and masonry materials. Chapter 7 describes the state of the art in natural ash- and waste-based concrete. Chapters 8 through 11 describe various masonry practices: dry stack and pressed brick (Chapter 8), unfired clay (Chapter 9), and adobe (Chapter 10). Nonconventional aspects of stone masonry construction are described in Chapter 11.

Part IV covers nonconventional forest products. Chapter 12 considers nonconventional timber materials in construction. Chapter 13 introduces full-culm (pole) bamboo materials, while Chapter 14 describes full-culm bamboo construction. Engineered bamboo materials are described in Chapter 15. Finally, Chapter 16 introduces a thoroughly modern nonconventional method of construction: paper tubes.

It is hoped that this volume will prove instructive and educational while serving as an important resource for engineers, architects, academics, and students interested in nonconventional materials.

The editors would like to thank all contributing authors for their outstanding work and for maintaining our ambitious schedule for this volume. Thanks are due all at Elsevier, in particular Project Managers Alex White, Kate Hardcastle, and Charlotte Cockle who kept the editors in line throughout this process.

Finally, the editors would like to dedicate this book to the memory of our friend, colleague, and collaborator, Ms. Gayatri Kharel, who provided the opportunity for us both to delve deeper into this field than we may have imagined.

Kent A. Harries, Pittsburgh
Bhavna Sharma, Bath
January 2016

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