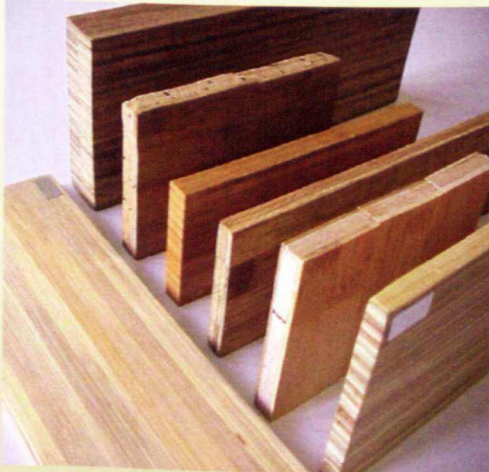
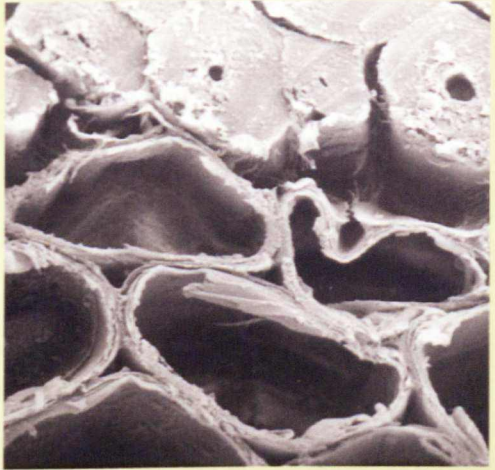


BAMBOO: PROPERTIES AND UTILIZATION

Razak Wahab, Othman Sulaiman, Mohd Tamizi Mustafa,
Norashikin Mohd Fauzi & Izyan Khalid

Editors: Rokiah Hashim & Shafiqur Rahman



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UNIVERSITI MALAYSIA SELATAN
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FOREWORD

This book was written with the aims of providing technical information to those involved in the bamboo industry and to the public on various aspects in the bamboo propagation, processing and utilization. Bamboo has many uses and has been closely associated to the daily activities of the rural communities in Malaysia as well as other part of the world all where they are found in abundant. Lately however, the role and importance of bamboo in the daily use are decreasing swallowed by modernization. Recognizing this, various efforts are made by the scientists and researchers to find new methods to take advantage of the diversity in the use of bamboo to be at par with life today.

In most aspects of bamboo utilization, they are often vulnerable to the attack of micro-organisms such as fungi (occurring at the level of moisture content above the fiber saturation point), insects, borers, termites and fungi. The service lives of bamboos are therefore subjected to their biological deterioration. The durability of bamboos and their products are dependent on the climatic conditions and the environment in which they are used. To overcome this problem the bamboo needs to be preserved in order to extend their service life.

This book was written in simple and plain English for easy understanding. It is divided into 13 chapters. Chapters 1, 2 and 3 describe the introduction to bamboo, distribution of bamboo and, bamboo structure and identification. Chapters 4 and 5 described propagation and cultivation techniques of bamboo, and the anatomical, fiber morphology and microstructure of bamboo.

Chapter 6 describes the physical and mechanical properties of the bamboo. Strength and resilience in the context of the natural structure of bamboo are also explained. Chapter 7 discussed the bamboo processing techniques. The durability and chemical constituents are presented in chapter 8. The bamboo biodegradation are discussed in details in chapter 9. Chapter 10 provides information on the ecological effects of the decay of bamboo. It also provides a detailed description of the types of fungi that are often associated with

bamboo. Contributory factor to the growth of fungi and fungal morphology of each attack is also clarified.

The bamboo microstructures are discussed in chapter 11. The ultrastructure before and after the bamboo are attack are viewed through the scanning electron microscope (SEM) and transmission electron microscopy (TEM). They provide in-depth information on the effects of the fungi and insects attacks especially on the physical and mechanical strength of bamboo.

Chapter 12 of this book describes in detail the method of control and the type of preservative used and its effectiveness to control fungal attack on bamboo and its products. This includes the traditional and chemical treatments applicable to bamboo. Information on the various products including some of the traditional and modern from bamboo can be found in chapter 13. These products include some of the traditional and modern products.

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Not forgetting, my wife Norhayati Senin, my sons Muhammad Husyaini, Muhammad Haziq, Muhammad Hakimi and only daughter Miza Hanisa who has inspired and motivated me to complete this book.

RAZAK WAHAB

CHAPTER 1

INTRODUCTION

There is a clear indication that we are compromising the ability of the future generations to meet their needs. This is indicated by the alarming level of deforestation in the world. We have indirectly restricts their possibility to take the timber products from the forest. Trees are extremely crucial for the global environment as they sequest carbon dioxide (CO₂), they are indispensable instruments to minimize the global warming and related issues. It is for this reason that has become crucial to find the alternatives to timber. Bamboo has the advantage of growing fast and the perfect material for the application range of industrial products. With the rapidly growing alternatives and renewable sources like bamboo, we can reduce pressure on forest trees, maintaining the natural environment and the needs of future generations.

Bamboo is one of the most valuable products of non-wood forest in Malaysia. It is a plant from the grass family (Gramineae) and sub-family of Bambusoidae. Almost all the bamboo species found in tropical regions under the type sympodial. Bamboo is a versatile plant and has a high commercial value, particularly among rural communities. In Malaysia, bamboo is use to making baskets, skewer, tongs for food, decorative items, incense, furniture, paper and pulp. Composite bamboo boards such as laminated bamboo products, panel and floor are getting attention from the public and local companies in recent years. Bamboo is often seen as timber for the poor. This term, however, is not accurate because in some aspects of the use of bamboo has the advantages of wood.

In Malaysia, bamboo thrives in areas with altitude from sea level to 1,000 m. It grows scattered on hill slopes, river cliffs, logged areas and open space lands (Ng and Noor, 1980). Bamboo is a plant unit with many advantages to be exploited to be used for the purpose mankind in the future. It has become the focus of research because it is easily renewable raw materials for its fast growing, attractive and unique appearance and toughness (Tewari, 1992) and bamboo can be found in vast areas throughout the world.

There are more than 70 genera of bamboo divided into about 1,450 species globally (Wong, 1995). Bamboo, which is capable of growing

up to 60 cm or more per day, is known as the fastest growing plant with high cellulose content so far (Farrelly, 1984). However, this outstanding growth rate is highly dependent on local soil and climatic conditions. Bamboos are of notable for their economic and cultural significance. They are in used extensively in everyday life as food source and are considered as highly versatile raw product.

The presence of 59 bamboo species representing 14 genera of which 34 of them are indigenous and the other 25 species are introduced as cultivation in Peninsular Malaysia (Wong, 1995). Holttum (1958) categorized Malaysian bamboo as either native, cultivated or forest bamboos. Forest bamboo species are found in abundance and are scattered all over the country. Calculated based from the Fourth National Forest Inventory (NFI 4), bamboo can be found in about 7% of the total forest area in Peninsular Malaysia (Mohd. Tamizi, 2005) and are commonly found growing gregariously in areas that have been destructed such as logged-over forest, degraded land, land fringing the forest, along river banks, on hillsides, and ridge tops (Holttum, 1958; Wong, 1995).

According to the Forestry Department inventory in 1981-82 (Kamaruzaman, 1992), each ha of forest area in Peninsular Malaysia consisted an average of 95.5 culms of the natural forests of bamboo and 118.3 culm for replanting forests. This number shows there were 587 million culm of bamboos in Peninsular Malaysia. However, only 6000 tons being undertaken with the trade value of nearly RM 3 million (Razak, 2006). This means that only 362,139 culms bamboo (the bamboo culms of length 6 m has an average weight of 6 kg) used by the local bamboo industry. This value is extremely small compared to total world trade of bamboo was estimated at more than USD 4 billion each year (Razak, 2006; Anon, 2002). Figures 1.1 and 1.2 showed the bamboo growing in the wild and in the plantation respectively.

The bamboo industry in Malaysia is still lagging behind when compared to the other members of the ASEAN countries such as Thailand, Philippines and Indonesia. Most of the production of bamboo products in Malaysia are focused on the domestic market. The export of bamboo products which amounted to approximately USD 0.08 million a year.



Figure 1.1: Bamboos are found naturally growing wild in the forest.



Figure 1.2: Forest managed of the naturally growing bamboo (*Gigantochloa scortechnii*) in Nami, Kedah.