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The Potential of Bamboo as Building Material in Organic Shaped Buildings

Esti Asih Nurdiah*

Department of Architecture, Petra Christian University, Siwalankerto 121-131, Surabaya, 60236, Indonesia

Abstract

Bamboo has been widely known as a sustainable building material due to some reasons among others are bamboo can be easily cultivated and harvested in a relative short time and can be reused. Bamboo as building materials is easy to bend and lithe. Those characters are very suitable for organic shaped building construction. This paper attempts to discuss how bamboo is being used in organic shaped building. Several case studies are taken to describe the relation between shape, structure, construction and joint system. It will classify how bamboo is formed in curved thus result is an organic form. The paper result will show that bamboo can be a potential building material for organic shaped buildings and become an alternative building material other than steel and concrete.
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Keywords:

1. Introduction

The use of bamboo as building materials has occurred in a long period. Most of traditional houses in Indonesia and Asia use bamboo as building materials, both as structural and non-structural materials. The use of bamboo in traditional houses is due to the fact that bamboo grows abundantly in tropical rain forest. But after industrial era has begun the use of bamboo as building material become obsolete. Bamboo is considered as cheap and non-permanent

* Corresponding author. Tel.: +62-31-8439040; fax: +62-31-8417658.
E-mail address: estian@petra.ac.id

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materials. It is also considered as low-class material, even called as “the poor man timber” by many modern builder (Lobokivov, 2009). People tend to choose brick, concrete and steel as structural and construction materials for modern building.

But nowadays, after global warming and sustainability issues are emerged, bamboo as building materials is widely discussed and reviewed. Some architect and builder nowadays tend to choose bamboo for building material. High-quality woods for construction are rarely found nowadays because of deforestation. Wood also takes long time to regrow and ready to use as construction materials. Meanwhile bamboo can be harvested in a short time, which is between 3-5 years. When planting, bamboo also releases oxygen into the air, the ability that cannot be performed by industrial materials like steel, plastic and concrete. For the reasons, bamboo has been widely known as sustainable building materials.

Bamboo naturally grows in the forest but also can be cultivated in plantation. While the largest stock of bamboo grows in forest, it raises some important questions regarding resource ownership and management (Jansen, 2000). Local community in Asia usually plant bamboo around their village. In some remote village, bamboo grove is used as a fence or as boundary layer for the village. In this case, bamboo belongs to the community and it is free to use by the community.

1.1. The Property of Bamboo as Building Construction Material

Bamboo is basically a giant grass that comes from sub family *bambusoideae* and family *Poaceae* or *Gramineae*. Sub family *bambusoideae* comprises both woody and herbaceous bamboos with 1,575 species altogether (Bystriakova, et al, 2003). Bamboo naturally grows in groups. Its growth character can be divided into two types: monopodial and sympodial bamboo. Monopodial bamboo roots spread horizontally in a shallow depth of the soil. A new shoots are produced in a relative long distance from the parents’ plant. Monopodial bamboo is mostly found in temperate climate such as Japan, China and Korea. While sympodial bamboo roots grow very close to parents’ plant thus form a clump of many stems or canes. It mostly found in tropical climate such as Southeast Asia and South America (Anagal, et al, 2010, Widyowijatnoko, 2012).

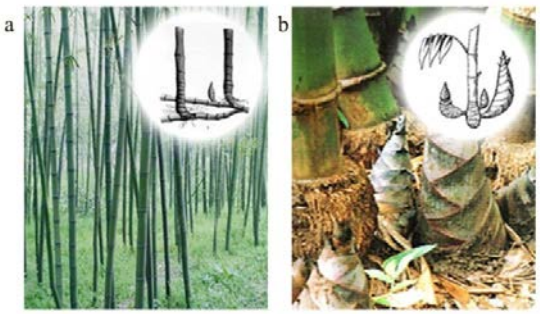

Fig. 1. (a) Monopodial bamboo; (b) Sympodial Bamboo.
Source: http://nbm.nic.in/types_of_bamboo.html

The characters of bamboo rods are round, segmented, jointed and hollow. Part of bamboo culms or stems consists of segments or internodes which are separated by diaphragm. The length and thickness of the internodes are varied; depend on the species and the environment. The structure anatomy of the internodes is determined by shape, size, and vascular bundles of bamboo culm. In the outer culm (peripheral zone), the vascular bundles are smaller while in the inner are bigger and fewer. The number of vascular bundles in bamboo culm is reduced from top to bottom, while the density in relatively in the same amount. Bamboo culm consists of 50% parenchyma, 40% fiber and 10% conducting tissue (Liese, 1998).

As construction materials, bamboo has a very strong fiber. The compressive strength of bamboo is two times higher than concrete, while the tensile strength is close to steel. Bamboo fiber has a shear stress that is higher than wood. Bamboo has wider span than wood. Bamboo also can be curved without breaking. Bamboo is considered as

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