Bamboo-concrete Composite Slabs

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Summary

Bamboo is a natural material that is highly sustainable and has very favourable material properties, specifically high longitudinal strength and low density. This paper presents a new concept for the use of bamboo that specifically exploits its high tensile strength. Half-shells of bamboo rods are covered by concrete to form a composite beam or slab where the bamboo is used in tension and the concrete in compression. The paper discusses the main concepts, analyses, lab tests and possible applications of these novel elements.

Keywords: bamboo, concrete, composite slabs, nonlinear analysis, experimental testing

1. Introduction

Bamboo is a natural material classified in the grass family, similar to wheat, sugarcane, and rice. Many different species exist as illustrated in Fig. 1 and it is a highly sustainable material not only because it is a plant, but also because it exhibits rapid growth. This growth rate can be as fast as 120 cm per day, but it is usually in the range of 10-40 cm per day [6]. Depending on the bamboo, the diameter can vary between a few millimeters to 30cm [2]. Bamboo grows mainly in the tropical regions of the world, as is shown in Fig. 2. Guadua bamboo was used for the testing discussed in this paper, which is one of 25 Columbian species of giant bamboo. Guadua can grow to a height of 30m with diameters between 10 and 15cm. The high sustainability of bamboo is coupled with very favourable material properties, specifically high longitudinal strength and low density.

Fig. 1: Various species of bamboo [1]

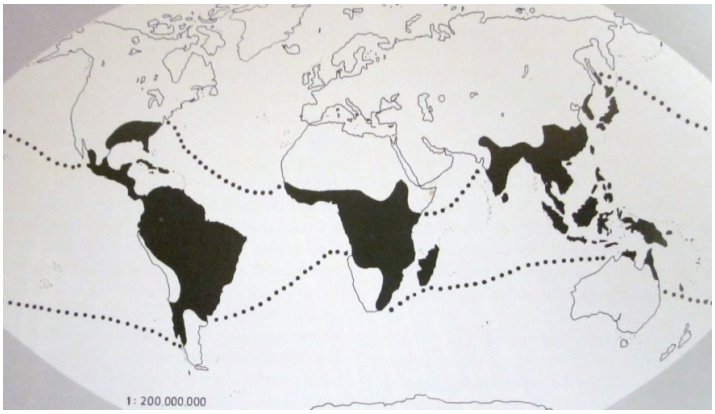

Fig. 2: Global distribution of bamboo [3]

The tensile strength of bamboo can be of a similar magnitude to that of structural steel. Table 1 gives the typical material properties of bamboo compared with timber. The density of air-dried bamboo ranges from 600 to 800 kg/m^3 [2].

This paper presents a new concept for the use of bamboo that specifically exploits its high tensile strength. Half-shells of bamboo rods are covered by concrete to form a composite beam or slab where the bamboo is used in tension and the concrete in compression. In the proposed

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