

# Statutory Regulations

In Europe there are currently no building regulations for the use of bamboo for building structures. Because bamboo is not a certified building material, special case approval must be sought from the respective building control authorities in each and every case. Regulations from other countries can, however, serve as a basis for obtaining permission. In most cases permission is granted based on prior laboratory tests of individual elements or on the basis of load tests.

The "AC162 Acceptance Criteria for Structural Bamboo", issued in March 2000 in California, set out how such tests on bamboo structures and their joints should be undertaken.

These criteria also stipulate a safety factor of 2.25, i.e. that the permissible load may not exceed the tested material strength divided by 2.25. Similarly, the criteria also prescribe that the length of a structural bamboo member may not be larger than 25 times its smallest cross-section.

Aside from this, the International Network on Bamboo and Rattan, INBAR, issued a 20-page set of general regulations in 2002. These detail how parameters such as moisture content, compressive strength, tensile strength and bending strength should be measured. In the "National Building Code of India. Part 6: Structural Design, Section 3: Timber and Bamboo", chapter "3B – Bamboo" lays down the permissible physical properties such as the strength of bamboo members and their joints for the different kinds of bamboo used in India.

The most detailed regulations for building with bamboo, which cover the use of *Guadua angustifolia Kunth*, the most common kind of bamboo used in Latin America, are available in Colombia. These govern the physical and mechanical properties of bamboo (ISO 22157-1), the seismic strengthening of guadua constructions (NSR-10), the harvesting, drying and preservation of guadua (NTC 5300 and 5301), the vegetative propagation of this kind of bamboo (NTC 5405), structural joints made with guadua (NTC 5407) and the terminology applied to guadua and its processes (NTC 5727).<sup>1</sup>

As part of the planning application submission for the ZERI Pavilion at the EXPO 2000 in Hanover, tests were undertaken at the FMPA materials testing laboratory in Stuttgart to determine the compressive and tensile strength of *Guadua angustifolia*. Tests showed that a 3.5 m long bamboo member with a 10 cm cross-section and 1.5 cm wall thickness can sustain a load of 70.4 kN (7040 kg). The tensile strength of the joint was measured as 140 kN (14 tons). These values were used for the structural calculations and recognised by the building control authorities.

A key contributory factor for obtaining planning permission was the fact that an identical prototype had been constructed in Manizales, Colombia, and subjected to initial load testing (5.2 and 5.3). In addition further tests were undertaken on the ZERI Pavilion in Hanover using more precise measuring methods (5.1).

For the design of an office in Darmstadt with a structural bamboo construction (see p. 130f.), values obtained in a materials testing laboratory were likewise used as a basis for structural calculations, and were in turn accepted for planning permission.

## Fire Performance

Because bamboo members are hollow, they represent a high fire risk. Nevertheless, the external layer of the bamboo canes contain a high concentration of silicates and are therefore not highly flammable. Tests conducted in association with the design of a façade of a car park building in Leipzig, Germany (see p. 128f.), established compliance with building material

class B2 (moderately flammable) according to the German DIN 4102. In such cases where the façade construction does not serve a structural function, it is not necessary to prove the fire resistance rating (e.g. F30). It is, however, important to prevent the transmission of fire from one storey to another, for example through the provision of a solid concrete upstand.



5.1



5.2



5.3

1.

- ISO 22157-1: 2004 "Determinación de las propiedades físicas y mecánicas del bambú."
- NSR-10: "Norma de Sismo Resistencia", chapter G12: "Estructuras de guadua", updated 2010.
- NTC 5300 "Cosecha y postcosecha de los culmos de *Guadua angustifolia Kunth*".
- NTC 5301 "Secado e inmunizado de los culmos de *Guadua angustifolia Kunth*".
- NTC 5405 "Propagación vegetativa de *Guadua angustifolia Kunth*".
- NTC 5407 "Uniones para estructuras construidas en *Guadua angustifolia Kunth*".
- NTC 5458 "Artesanías y muebles en *Guadua angustifolia Kunth*".
- NTC 5727 "Terminología de la guadua".