

Experimental study on structural performance of bamboo joints; Part 1 - Peg and dowel joints using steel fasteners and cement mortar infilling

Gian Karlo CABANAS*, S. Alireza BEHNEJAD, Mike MULHERON

Spatial Structures Research Centre, University of Surrey
Guildford, Surrey, GU2 7XH, United Kingdom.
giankarlo.cabanas@yahoo.com

Abstract

Bamboo in its natural culm form is a significantly more renewable material compared to timber and has the potential to transform sustainable construction. In developing countries, it has been widely used for traditional houses but a lack of structural building codes and engineered joint designs have limited its usage in modern structures. To tackle the latter issue, this paper presents Part 1 of an ongoing experimental study at the Spatial Structures Research Centre of the University of Surrey that is assessing the structural performance of bamboo joints. As shown in Figure 1a, a standard procedure was developed to study the mechanical responses of a bamboo peg and dowel joint design incorporating steel fasteners and cement mortar infilling. Multiple joints were constructed and mechanically tested for bending and cyclic loads using a testing rig shown in Figure 1b. Results show that the cement mortar infill successfully prevents unpredictable brittle failure of the joint and enables the steel eyebolt to govern the structural behaviour. Under bending, the joint has a semi-rigid response and deforms significantly in a ductile way without losing its rotational capacity. Cyclic loading/unloading tests also prove the suitability of the joint in hazard-prone areas as it exhibits a hysteretic response. There is also evidence of a correlation between moment capacity and culm diameter. As such, this paper demonstrates how despite the inherent unpredictability of the material, bamboo joints can be designed to behave more predictably. This research could, therefore, pave the way for further empirical testing, enabling for engineered bamboo joints to be incorporated into future structural codes.

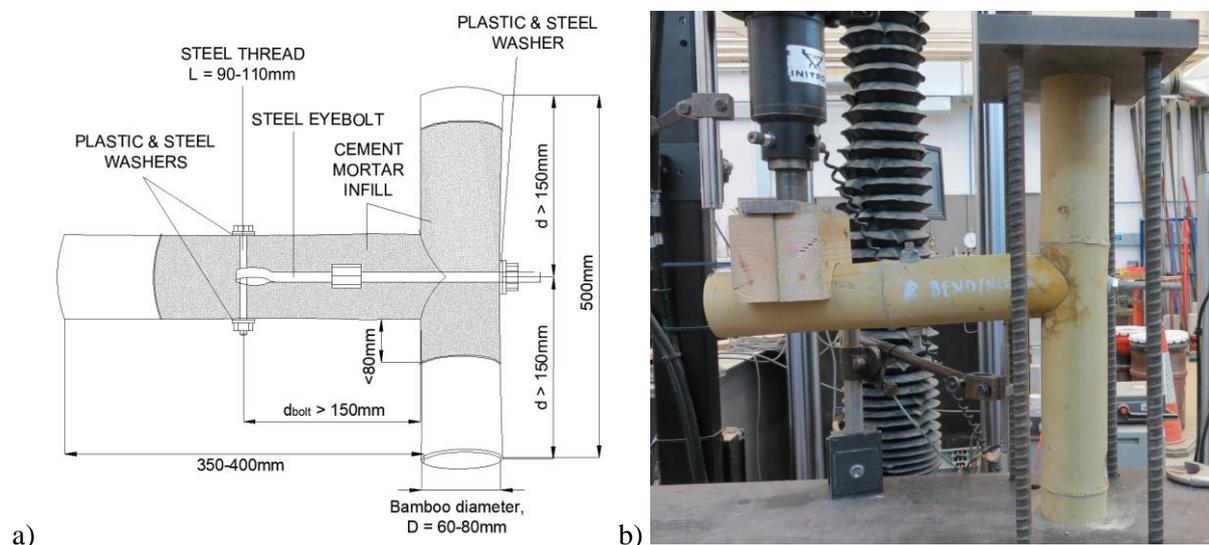


Figure 1: a) Standardised bamboo joint design with cement mortar infilling; b) Versatile testing rig for bending and cyclic loading

References

- [1] C. Davies, "Bamboo Joints," University of Bath, 2008.
- [2] S. Kaminski, A. Lawrence, D. Trujillo, I. Feltham and L. Lopez, "Structural use of bamboo Part 3 : Design values," *The Structural Engineer*, vol. 94, Issue 12, pp. 42–45, 2016.