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Bamboo structures — Bamboo culms — Structural design

Structures en bambou — Tiges de bambou — Conception des structures

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 165, *Timber structures*

This second edition cancels and replaces the first edition (ISO 22156:2004), which has been technically revised.

The main changes compared to the previous edition are as follows:

— adoption of design equations for material or component capacities for both members and joints;

— adoption of service classes and specific consideration of susceptibility to splitting;

— addition of Light Cement Bamboo Frame (LCBF) construction;

— addition of informative annexes addressing durability and representative details for connections and LCBF construction;

— removal of use of bamboo for reinforcing concrete or soil.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document provides a means of structural design for one- and two-storey building structures using full-culm round bamboo poles as the primary vertical and horizontal structural load resisting systems. This document addresses connection design, light cement bamboo frame shear panel design, and addresses issues of durability. Informative annexes provide means of achieving design and performance goals in these areas.

Bamboo structures — Bamboo culms — Structural design

1 Scope

This document applies to the design of bamboo structures whose primary load bearing structure is made of round bamboo or shear panel systems in which the framing members are made from round bamboo.

Except as indicated in Clause 12, this document applies to one- and two-storey residential, small commercial or institutional and light industrial buildings not exceeding 7 m in height.

This document is concerned only with requirements for mechanical resistance, serviceability and durability of bamboo structures.

This document permits an allowable load-bearing capacity design (ACD) and/or allowable stress design (ASD) approach for the design of bamboo structures. Allowable load-bearing capacity and allowable stress approaches may be used in combination in the same structure.

This document additionally recognises design approaches based on partial safety factor design (PSFD) and/or load and resistance factor design (LRFD) methods (5.11.1), previous established experience (5.11.2), or documented 'design by testing' approaches (5.11.3).

Other requirements, such as those concerning thermal or sound insulation, are not considered. Bamboo structures may require consideration of additional requirements beyond the scope of this document. Execution is covered to the extent that it impacts the quality of construction materials and products required to comply with the design requirements contained herein.

This document provides a number of modification factors, designated C_i. These are empirically derived factors, based on best available engineering judgement, that are believed to be universally applicable to bamboo materials that are appropriate for building construction. Parameters affecting bamboo material performance are many and are addressed explicitly through the use of experimentally determined characteristic values of strength and stiffness. Annex A provides a summary of the bases upon which the provisions of this document were developed.

This document does not apply to

— structures made of engineered bamboo products such as glue-laminated bamboo, cross-laminated bamboo, oriented strand, or densified bamboo materials,

— bamboo-reinforced materials where bamboo is not the primary load-bearing constituent. This includes bamboo-reinforced concrete, masonry and soil, or,

— scaffold structures constructed with bamboo.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 12122-1, *Timber structures — Determination of characteristic values — Part 1: Basic requirements*

ISO 12122-5, *Timber structures — Determination of characteristic values — Part 5: Mechanical connections*

ISO 12122-6, *Timber structures — Determination of characteristic values — Part 6: Large components and assemblies*

ISO 16670, *Timber structures — Joints made with mechanical fasteners — Quasi-static reversed-cyclic test method*

ISO 19624, *Bamboo structures — Grading of bamboo culms — Basic principles and procedures*

ISO 21581:2010, *Timber structures - Static and cyclic lateral load test methods for shear walls*

ISO 21887, *Durability of wood and wood-based products — Use classes*

ISO 22157, *Bamboo structures — Determination of physical and mechanical properties of bamboo culms — Test methods*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
assembly
multiple-culm assembly
structural member comprised of more than one bamboo culm constructed in such a fashion that the multiple culms together serve as a single structural member

3.2
bamboo culm
bamboo pole
single shoot of bamboo

Note 1 to entry: A culm is comprised of the entire unaltered bamboo cross section and is usually a hollow cylinder except at nodes.

3.3
cross sectional area
A
area of the section perpendicular to the direction of the longitudinal axis of the culm

3.4
ductility
μ
ratio of the experimentally determined ultimate displacement to the yield displacement

Note 1 to entry: The ratio is determined according to ISO/CD TR 21141[1)] for joints.

3.5
equilibrium moisture content
w_{EMC}
moisture content at which bamboo is neither gaining moisture from, nor losing moisture to, the environment

3.6
fibre saturation point
w_{FSP}
moisture content below which only water bound in the cell walls remains; i.e., condition in which there is no free water in the cell cavities

1) In preparation. Stage at the time of publication ISO/CD TR 21141:2021.