
Timber structures — Review of design standards

Structures en bois — Revue des normes de calculs

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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. www.iso.org/directives

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The committee responsible for this document is ISO/TC 165, *Timber structures*.

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Introduction

In the 1980s ISO Technical Committee 165 prepared and circulated a draft International Standard based on a Structural Timber Design Code that was put together by a Working Group of CIB (International Council for Building Research Studies and Documentation). The stated purpose of the ISO/TC 165 draft and the CIB code was to “provide an agreed background for the national committees and international bodies responsible for formulating timber design standards, to ensure a reasonable and consistent quality of timber structures.” Neither document included safety factors, partial coefficients, or loads, since they were considered to be the responsibility of national authorities.

Engineering material design standards demonstrate compliance with the structural requirements of building codes; therefore, they have a special relationship to national codes and related legal considerations and are even called “codes” in many places. Design standards provide regulatory bodies with information needed to protect public safety.

The standards also provide a mechanism for adopting advances in structural modelling, material behaviour science, reliability and other subjects. They are vehicles for introducing research into practice. They are also a means for receiving feedback and modifying design requirements based on practical experiences.

Beyond this, design standards also create a framework for specifications of construction products. This provides a context for recognition and approval of structural initiatives using referenced products.

In 2006 ISO/TC 165 prepared a business plan that identified “standards to support harmonization of design and building codes internationally” as a Committee priority. Around the same time, an ISO/TC 165 Framework document included design requirements on the list of work areas, although it did not specify what those requirements might include.

ISO/TC 165, at its 25th meeting in 2011, reviewed a report on current national design standards for timber and international design standards for other construction materials. The committee concluded that, at this time, there was not sufficient interest to undertake development of a structural timber design standard. However, the information provided was deemed to be a valuable resource that should be formally retained for use by ISO/TC 165 and member bodies in future development of timber design standards.

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Timber structures — Review of design standards

1 Scope

This Technical Report documents the findings of a review of design standards undertaken by ISO/TC 165 to assess how an ISO International Standard for the design of timber structures might be developed and whether development of such an International Standard should be initiated.

NOTE [Annex A](#) summarizes the factors considered and the activity of the TC leading to the preparation of this Technical Report.

2 Current and draft ISO design standards

The five structural design standards and technical reports shown in the following table are published ISO structural design documents. They provide a selection of different approaches for review to help understand what is involved in preparing an international design standard and what the end product might look like.

Designation	Title
ISO/TR 11069:1995	<i>Aluminium structures — Material and design — Ultimate limit state under static loading</i>
ISO 10721-1:1997	<i>Steel structures — Part 1: Materials and design</i>
ISO 9652-2:2000	<i>Masonry — Part 2: Unreinforced masonry design by simple rules</i>
ISO 15673:2005	<i>Guidelines for the simplified design of structural reinforced concrete for buildings (ISO/TC 71)</i>
ISO 22156:2004	<i>Bamboo — Structural Design (ISO/TC 165)</i>

2.1 Basis for design

All structural design standards are based on a design philosophy that defines the relationship between load requirements and material resistances. International standard committees make basic choices on ground rules, leading to different design approaches in these standards.

Most of the reviewed ISO documents are established in Limit States Design format. It is instructive to see how the limit states are defined in each document, influenced to some extent by material-specific considerations. Limit States Design format also includes partial coefficients in the calculation of loading and resistance, and these factors are handled differently (or are unspecified) in the documents.

Although quantified reliability is implied by Limit States Design philosophy, none of the documents quantify reliability targets or indices. The overall view is that the subject is too dependent on regional conditions and applications to be defined in an international standard and so is left to the discretion of the adopting country or region.

Serviceability Limit States are even more dependent on regional cases and conditions than Strength or Ultimate Limit States, and are largely left out of these documents.

[Annex B](#) of this report provides a short summary for the reviewed documents.

2.2 Scope and limitations

In each of the reviewed ISO documents, the scope and limitations give an indication of intended purpose and audience. Since the general aim of material design standards is to facilitate engineering design of structures, the target audience is taken to be the professional community qualified in this practice.

In some cases, the scope of a standard is limited to make the task more manageable, or to make room for design aids such as rules-of-thumb or other tools for the purpose of design simplification. Simplification can be a particular priority where the primary audience is very diverse or is located in countries that do not have existing national standards for the purpose at hand.

It should be noted, however, that simplifying assumptions or design aids do not necessarily result in “simple” standards. There is always a need for professional engineering knowledge and interpretation of design requirements. In other words, scope limitations do not necessarily diminish the need for complete structural design.

In some cases, the limitations may be defined in terms of the geometry or layout of structures; in other cases, limitations are defined by the extent or application of design requirements (see [Annex B](#) for examples).

2.3 Standard or guide

Some of the ISO documents under review are written to guide as well as to standardize design requirements. Some put more emphasis on the guidance, others on the normative function.

Design shortcuts are provided in some cases where a more comprehensive design procedure would result in smaller sections. This is generally the role of a handbook or guide rather than a Standard; however, in the case of an international standard, there may be no handbook or guide to consult. Design shortcuts are included to simplify or facilitate the presentation, or to ensure that a requirement is not overlooked or misinterpreted.

Terminology used in the documents to express mandatory or non-mandatory actions can provide a clue as to which provisions are intended to “advise” or “guide” practice rather than “regulate” it. From an implementation standpoint, standards written in mandatory language with specific quantifiable requirements are easier to enforce. But this is difficult to achieve in a standard that is intended to be applied across national boundaries (see [Annex B](#) for examples).

2.4 Rules-based or engineered approach

The reviewed ISO documents, like most material design standards, are intended for use by engineers and are typically formulated on the basis of principles and assumptions that lead to calculated design solutions.

Prescriptive rules-based standards, on the other hand, are sometimes written for a non-engineering audience and are formulated to be carried out without further structural analysis or calculations. In the process, rules-based standards can yield more conservative solutions than would result from a fully engineered approach. Also, rules-based approaches are limited in applicability due to assumptions that don't fit all cases.

From time to time, a rules-based engineering standard is developed for one of a number of reasons, such as: a) to illustrate a particular type of structural design problem and solution, b) to provide a readily-enforceable document for building regulators, or c) to provide a baseline for acceptable solutions.

Most standards combine elements of prescriptive and performance-based standards writing, and some include provision for interpolating or extrapolating beyond the scope of rules-based provisions. Standards can be placed on a scale ranging from fully-engineered to rules-based provisions (see [Annex B](#) for examples).

2.5 Material specifications

Before a product can be utilized in design, it must be clearly defined and the structural performance characteristics of the product defined. Product definition is generally done through material specifications and performance characteristics established by testing and evaluation protocols.

Design standards provide a framework for referencing standards for construction products because it is preferable to make normative references to specification or testing standards for this purpose. International standards have special challenges in this area.

Although ISO material specification and testing standards are referenced where available, the general trend in the reviewed documents seems to be to recognize that national material standards are at least as likely to be used and are referenced as well. This is done even though the specifications and the related properties may be based on standard dimensions and grade qualities that may not be recognized in all countries (see [Annex B](#)).

A further complication is the number of proprietary structural products that have emerged in recent years. Proprietary products can play a significant role in current design practice, which can vary regionally and over time. Generally such products have not been addressed specifically in the reviewed ISO standards.

Unless the design standard is to become an omnibus standard addressing many different subjects, it is preferable to have a separate referenceable standard to deal with basic material properties and the development of characteristic values. This helps to relieve the design standard from the need to address many material specification issues.

2.6 Load provisions

Load requirements are the domain of national building codes and standards, and it seems counterproductive for an international ISO design standard to specify load provisions incompatible with those that are already in use in interested countries. Complete load requirements include the factors or coefficients that are used to calculate load actions, as well as parameters or references for specified loads.

Nevertheless, some aspects of load requirements are inseparable from the design provisions in these standards. Examples include the limitations to application of a standard, load interaction effects. In the case of timber or timber-based products, there is also the special duration of load effect that ties load and resistance effects together.

Lateral load design complicates design standards significantly, and some standards avoid the topic entirely. Others provide partial lateral load design requirements ([Annex B](#)).

The ISO TC responsible for Bases of Design, TC 98, has developed a number of load standards, some of which are referenced in the design standards as listed below.

ISO 15673 (concrete) references:

ISO 4354, *Wind actions on structures*

ISO 2103, *Loads due to use and occupancy in residential and public buildings*

ISO 2633, *Determination of imposed floor loads in production buildings and warehouses*

ISO 3010, *Basis for design of structures — Seismic actions on structures*

ISO 4355, *Bases for design of structures — Determination of snow loads on roofs*

ISO/TR 11069 (aluminium) references:

ISO 2394, *General principles on reliability for structures*

ISO 3898, *Bases for design of structures — Notations — General symbols*

ISO 8930, *General principles on reliability for structures — List of equivalent terms*

ISO 10721-1 (steel) references:

ISO 2394, *General principles on reliability of structures*

ISO 3898, *Bases for design of structures — Notations — General symbols*