

SVENSK STANDARD

SS-EN 16481:2014



Fastställt/Approved: 2014-11-27
Publicerad/Published: 2014-11-28
Utgåva/Edition: 1
Språk/Language: engelska/English
ICS: 91.060.30

Trätrappor – Bärande konstruktioner – Beräkningsmetod

Timber stairs – Structural design – Calculation methods



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EUROPEAN STANDARD

EN 16481

NORME EUROPÉENNE

EUROPÄISCHE NORM

June 2014

ICS 91.060.30

English Version

Timber stairs - Structural design - Calculation methods

Escaliers en bois - Conception de la structure - Méthodes
de calcul

Holztreppen - Bauplanung - Berechnungsmethoden

This European Standard was approved by CEN on 17 April 2014.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (EN 16481:2014) has been prepared by Technical Committee CEN/TC 175 “Round and sawn timber”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2014, and conflicting national standards shall be withdrawn at the latest by December 2014.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document takes into account the following standards:

- EN 1990;
- EN 1991-1-1;
- EN 1995-1-1.

This document is addressed for structural designers to design timber stairs from a common European method; it should be useful for SMEs as an alternative to testing where applicable.

This European Standard takes into account the current state of the art regarding safety concept, loading assumptions, determination of stress resultants, as well as dimensioning in the field of wood engineering.

The requirements and verification procedures essential for the verification of mechanical performance characteristics, serviceability and load-bearing capacity of stairs and their components are compiled and described in the following clauses.

The mechanical performance characteristics of stairs may be verified by using the following methods:

- testing of stairs as a whole or in part;
- mathematical verification on the basis of structural analysis following the principles of this European Standard;
- assessment based on experience: conventionally accepted performance (CAP) which should be defined in national documents.

All methods are equally valid.

This document needs to be read in conjunction with EN 15644.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard constitutes a frame standard for the design of timber stairs as well as wood and wood-based components used in stairs by calculation methods. Some calculation methods can be derived from testing results, for example CEN/TS 15680. This document specifies the design and the requirements for materials and components to be used in these calculation methods. It may be complemented by national application documents based on this European Standard.

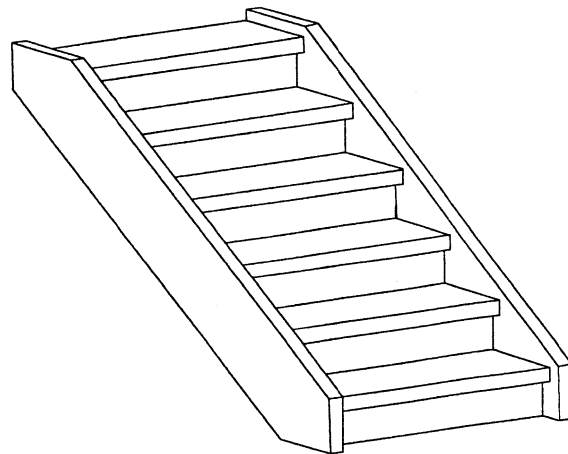
This European Standard applies to coated and uncoated components. This document covers load-bearing components such as strings, treads, risers, posts and guardrails. Requirements for a timber stair are defined in the product standard, EN 15644. This document does not cover stairs that contribute to the overall stability of the works or the strength of the structure.

This European Standard is valid for the verification of mechanical performance characteristics, usability and load-bearing capacity and their related durability. Other requirements, e.g. requirements for acoustic properties, are not covered by this European Standard.

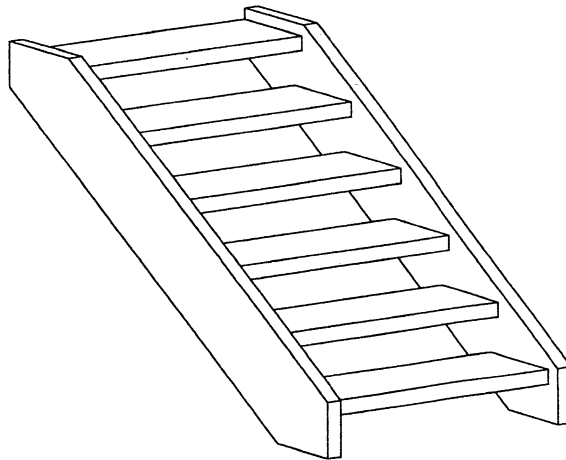
For the design, calculation and determination of not solely resting actions, additional requirements need to be taken into account (to be checked).

For the dimensioning with special reference to resistance to fire and earthquake/seismic action, additional requirements may be taken into account.

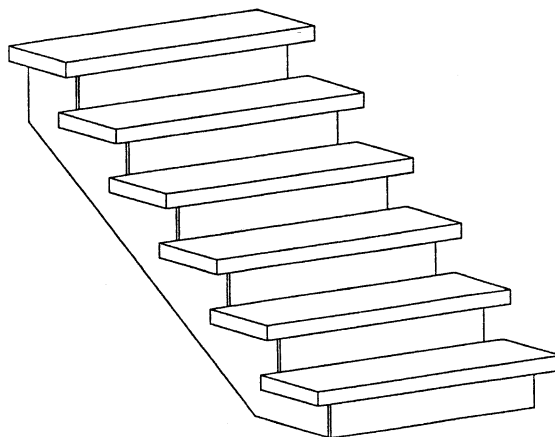
Without further verification, the methods in this European Standard are valid for different types of stair structures and their components, as illustrated in Figure 1:



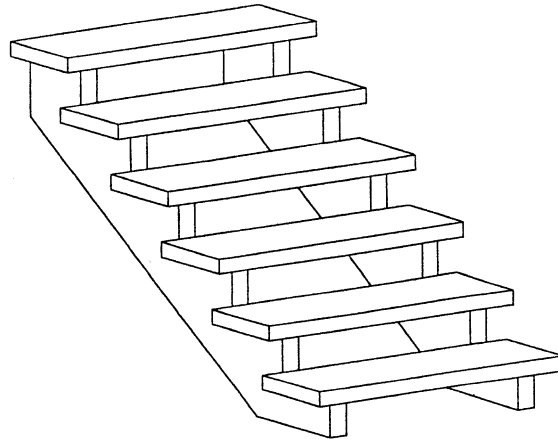
a) Stair with closed string and riser



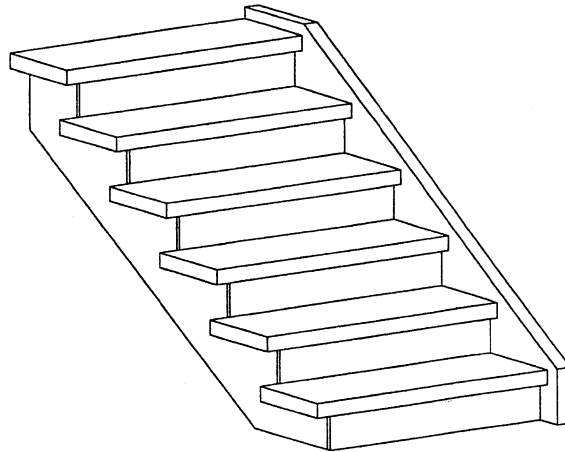
b) Stair with closed string without riser



c) Stair with cut strings and riser



d) Stair with cut strings without riser



e) Combination of stairs with closed string and cut string with or without riser

Figure 1 — Types of stair structures and their components

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 338, *Structural timber — Strength classes*

EN 1990, *Eurocode — Basis of structural design*

EN 1991-1-1:2002, *Eurocode 1: Actions on structures — Part 1-1: General actions — Densities, self-weight, imposed loads for buildings*

EN 1993-1-1, *Eurocode 3: Design of steel structures — Part 1-1: General rules and rules for buildings*

EN 1995-1-1, *Eurocode 5: Design of timber structures — Part 1-1: General — Common rules and rules for buildings*

NOTE Eurocode includes its National Application Documents (NAD).

EN 14076, *Timber stairs — Terminology*

EN 15644, *Traditionally designed prefabricated stairs made of solid wood — Specifications and requirements*

EN ISO 80000-1, *Quantities and units — Part 1: General (ISO 80000-1)*

3 Terms and definitions, formula symbols and SI-units

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1990, EN 1995-1-1 and EN 14076 and the following apply.

NOTE The general terms used in the context of actions and resistance as well as terms referring to the safety concept are given in EN 1990.

The specific valid terms used in the field of wood construction are found in EN 1995-1-1.

Specific terms regarding stair construction are given in EN 14076.

3.1.1

cross-bracing

tie-bars

system designed to provide torsional restraint to strings

EXAMPLE Screws, nails, glues.

3.2 Notation of formula symbols

In most cases, the notation of formula symbols consists of a main symbol (main indicator) and one or more subscript indicators. The following list defines the most common notations. Explanations of further notations either follow immediately the formula in which they appear or are described in the accompanying text.

α	pitch
γ	partial safety factor for loads
φ_x	torsional angle around the x-axis
φ_y	torsional angle around the y-axis
φ_z	torsional angle around the z-axis
γ_M	partial safety factor for a material property
Ψ_0	combination coefficient
A	cross-sectional area
A_y	cross-sectional shear area in the direction of the y-axis
A_z	cross-sectional shear area in the direction of the z-axis
$A_{\text{cross-bracing}}$	cross-sectional area of the cross-bracing
A_{string}	calculated cross-sectional area of the string