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Zaļ asne konstrukcije za gradnjo ï 3. del: Preskusi nosilnosti

Temporary works equipment - Part 3: Load testing

Temporäre Konstruktionen für Bauwerke - Teil 3: Versuche zum Tragverhalten

Equipements temporaires de chantiers - Partie 3: Essais de charges

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Temporäre Konstruktionen für Bauwerke - Teil 3: Versuche zum Tragverhalten

This European Standard was approved by CEN on 14 September 2002.

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 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 Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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

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Contents

Foreword

This document (EN 12811-3:2002) has been prepared by Technical Committee CEN/TC 53 "Temporary works equipment", the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by May 2003, and conflicting national standards shall be withdrawn at the latest by May 2003.

This European Standard consists of the following parts under the general title: Temporary works equipment - :

Part 1: Performance requirements and general design

Part 2: Information on materials

Part 3: Load testing

Annexes A to C are informative.

This document includes a Bibliography.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies rules for load testing, documentation and evaluation of test results in the field of non mechanical temporary work items.

NOTE This standard is provided for use by all working groups of CEN/TC53 as a basis for standards which include testing. While this standard provides general rules, it is anticipated that where special requirements are necessary, they will be specified in the individual standard, for example the details of the test procedure.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 408, *Timber structures – Structural timber and glued laminated timber – Determination of some physical and mechanical properties.*

EN 789, *Timber structures – Test methods – Determination of mechanical properties of wood based panels.*

EN 10002-1, *Materials – Tensile testing – Method of tests (at ambient temperature).*

EN ISO 6506-1, *Metallic materials – Brinell hardness test – Part 1: Test method (ISO 6506-1:1999).*

EN ISO 6507-1, *Metallic materials – Vickers hardness test – Part 1: Test method (ISO 6507-1:1997).*

3 Terms and definitions

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

3.1
system
(e.g. scaffold system, trench lining system):

- set of interconnectable components, mostly purpose designed for the system and

- assessed set of system configurations and

- product manual

3.2
component
dismantable part of the system, e.g. a diagonal, a vertical frame

3.3
element
integral (e. g. welded) part of a component, e.g. a transom of a vertical frame

3.4
connection
device for the connection of components

3.5
configuration
particular arrangement of connected components by means of connections

3.6
system configuration
configuration of the system comprising a complete structure (e.g. a scaffold, a load bearing tower) or a representative section from it

3.7
standard set of system configurations
specified range of system configurations for the purpose of structural design and assessment

3.8
looseness
real (original) or fictitious (additional looseness resulting from the evaluation procedure) play of a connection between two components

3.9
cyclic loading test
tests in which the load is cycled several times through zero so that reversals of load and its effects occur in the test sample

3.10
hysteresis loops
resulting moment-rotation or the force-displacement curves from cycling loading tests

3.11
repeated loading tests
tests in which the load is applied and removed a number of times but is not reversed in sign

3.12
assessment
checking process establishing whether everything complies with the specified requirements

4 Typical test procedures

4.1 Basis

European standards for structural design shall be the basis of the structural design of temporary works, however when suitable calculation models do not exist in such standards, then testing shall be undertaken in place by calculation.

Tests may not be made simply to circumvent conservative assumptions made in the calculation models of the relevant standards.

4.2 Types of tests

A non-exhaustive list of typical tests is given in Table 1.

Table 1 — Typical kinds of tests

	Type of test	Item tested	Examples
1	load bearing capacity and stiffness	s,a,c	- connection device - modular node - horizontal plane
2	verification of the results of static calculation	s (in particular) a,c	- system configuration
3	checking the influence of cyclic loading on the characteristic structural behaviour	a,c,e	- connection device - modular node - horizontal plane
4	checking of the influence of repeated loading	a,c,e	- stair treads
5	checking of the usability in case of - repeated attaching - vibrations	a,c	- wedge connection - couplers
6	checking the influence of impact loading	a,c	- decking components and their supports - side protection components and their supports
s system configuration, a configuration, c component, e element			

5 General requirements for load testing

The load(s) and the relevant displacements or rotations shall be recorded at a sufficient number of steps during loading and unloading to define the deformation curves fully. A running plot of the principal deformation against load should be available during the test. For preference, the tests shall be carried out under displacement control. The rate of loading shall be slow enough to allow full development of plastic deformations.

The loading rate for static loading may be adjusted to the behaviour of the tested component or configuration, but shall not be more than 25 % of the estimated maximum load per minute. Similarly, the size of the load steps may be adjusted to the behaviour of the tested component or configuration, but each step shall not exceed 10 % of the maximum load. Load may be applied continuously, subject to the limit rate of loading outlined in Table 1, for cycling loading see 7.2.

6 Testing of materials

6.1 General

Material tests shall be carried out in order to determine the actual mechanical properties of the tested components or elements.

Tests on materials may be needed:

— to check, whether the used materials comply with the specifications given by the manufacturer;

— to determine parameters for the evaluation of test results.

Normally for metallic materials, the parameters to be determined are (see also 6.3.1):

— the yield stress or the proof stress;

— the tensile strength;

— the elongation.

Normally for timber based materials, the parameters to be determined are:

— bending strength;

— the density;

— moisture content.

6.2 Sampling

The samples shall be representative for the relevant properties and shall be cut, where possible, from tested items.

Where there is a significant variation in the material properties of similar items, samples should be taken from each tested item.

When testing configurations or components, samples shall be taken from all materials which can contribute to the failure or can cause the failure.

NOTE 1 A series of configuration tests could show the failure for one element; configuration tests with another batch could produce the failure for another element, owing to variations in material properties.

When sampling from the tested items, the samples shall be cut from parts where the preceding testing has no influence on the material test results. This means:

— the sample was not subjected to plastic deformations and that sustained elastic deformations were low during the test;

— the sample was not cut from a heat effected zone.

When the samples are taken from items which have not been tested they shall be of the same type and from the same batch as the tested elements.

In circumstances where the material properties differ significantly within the cross section, it is recommended that samples of the whole cross section are taken.

NOTE 2 For cold-formed sections or extruded materials, the properties can vary within the cross section.

When samples are not taken from each configuration or component tested, at least the following number of tests shall be carried out:

— metallic materials: 3 of each material;

— timber based materials: 5 of each grade.

6.3 Test methods

6.3.1 Metallic materials

For determining the mechanical properties, tensile tests shall be carried out in accordance with EN 10002-1.

In cases where the samples cannot be taken with standardised dimensions or when whole sections are tested, the length shall be three to five times the greatest cross-section dimension.

NOTE This requirement reduces the influence of the end sections.

If tensile tests are not possible (e. g. for smaller elements of cast iron), hardness tests shall be carried out in accordance with EN ISO 6506-1 for preference or EN ISO 6507-1.

In addition to testing samples of whole sections, tests may be carried out on stub columns in accordance with the recommendations of ENV 1993-1-3:1996, A.3.2.

6.3.2 Wood based materials

Tests for determining the mechanical properties shall be carried out in accordance with EN 408 or with EN 789.

7 Testing of configurations and components

7.1 General

Connections using wedges or bolts shall be assembled and dismantled three times before assembly for any test.

7.2 Tests to determine load bearing capacity, stiffness and looseness

7.2.1 General

Before loading to failure, cyclic loading shall be carried out in the following cases:

a) full cyclic loading (c_{full}) shall be carried out for configurations and components which are intended to subject to stress reversals to measure the characteristic structural behaviour (see 7.2.2.1).

b) limited cyclic loading (c_{lim}) shall be carried out for configurations and components which may exhibit looseness if not a) is required.

7.2.2 Cyclic loading

7.2.2.1 For full cyclic loading (c_{full}), tests shall be carried out over a load range of:

$$+1{,}0\times\frac{R_{\mathrm{k}}^{+}}{\gamma_{\mathrm{M}}\times\gamma_{\mathrm{F}}};\quad -1{,}0\times\frac{R_{\mathrm{k}}^{-}}{\gamma_{\mathrm{M}}\times\gamma_{\mathrm{F}}}$$

where

R_k^+ is the characteristic value of the resistance in positive load direction;

R_k^- is the characteristic value of the resistance in negative load direction;

γ_M is the partial safety factor for the resistance;

γ_F is the partial safety factor for the action.

At least, three cycles shall be made at this one load level. On completion of such loading, the load shall be increased in one load direction until failure occurs with some unloadings back to the zero level.

Since the characteristic resistances R_k are not known at the beginning of the tests estimated values for instance from pilot tests may be accepted.

At least five equal tests shall be carried out for each traced parameter.

A test may be made either with one load (or moment) or with combinations of loading to determine the interaction behaviour.

7.2.2.2 For limited cyclic loading (c_{lim}), three cycles shall be carried out over a load range of:

$$+0{,}1\times\frac{R_k^+}{\gamma_M\times\gamma_F};\quad -0{,}1\times\frac{R_k^-}{\gamma_M\times\gamma_F}$$

at first and then the load shall be increased to failure with some unloadings. At least five tests shall be carried out for each traced parameter.

7.3 Repeated loading

Repeated loading tests are required for configurations and components, where the load is essentially unidirectional and the load repetition is expected to be high.

The purpose of a repeated loading test is to check that the serviceability of the configuration or the component is not adversely affected when the sample is repeatedly loaded and unloaded a representative number of times.

For repeated loading tests, the number of load applications shall be determined on a rational basis by considering the anticipated life and the expected frequency of use.

As an example, 300 000 load applications would be appropriate for treads of stairways.

The load intensity shall be equal to the service load, or one that produces the same effects as the service load.

NOTE Normally, such tests are not required for temporary works equipment.

7.4 Vibration tests

Vibration tests are carried out on configurations, which may be susceptible to loosening when subject to frequent load reversals for example, those incorporating wedge connections.

Normally, such tests shall be carried out

— at a load intensity of: