SLOVENSKI STANDARD
oSIST prEN 15113-1:2005

01-marec-2005

Navpiļ ni opaģi ï 1. del: Zahtevane lastnosti, sploġna zasnova in ocena

Vertical formwork - Part 1: Performance requirements, general design and assessment

Vertikale Schalungen - Teil 1: Leistungsanforderungen, Entwurf, Konstruktion und Bewertung

Systemes de coffrages verticaux pour le béton - Exigences de performance, étude en général et évaluation

Ta slovenski standard je istoveten z: prEN 15113-1

ICS:

91.220	Gradbena oprema	Construction equipment

oSIST prEN 15113-1:2005 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 15113-1

December 2004

ICS

English version

Vertical formwork - Part 1: Performance requirements, general design and assessment

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 53.

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Foreword

This document (prEN 15113-1:2004) has been prepared by Technical Committee CEN/TC 53 “Temporary works equipment”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

Introduction

The purpose of this European Standard is to sets out performance requirements for vertical formwork and to provide a safe place of work with safe access suitable for the work being done. These are substantially independent of the materials of which the vertical formwork is made. The standard is intended to be used as the basis for enquiry and design.

As a number of options are given to suit different applications, a choice has to be made between the various alternatives within this European Standard. All other requirements would be in an associated job specification.

Based on these requirements, a set of rules can be drawn up for a particular type of equipment. These may be standard for general use, or specially prepared for a particular job.

This European Standard includes rules for structural design, which are of particular relevance to vertical formworks of certain materials.

This standard does not cover the use of materials conforming to EN or ISO standards not still valid.

For access and working facilities for operatives, reference should be made to the requirements of EN 12811-1 but this standard also gives more specific details which will be needed in some cases.

1 Scope

This part of standard sets out the significant parameters which are relevant to the provision of formwork for all types of vertical concrete faces. For most parameters, it gives ranges of values from which a choice has to be made.

It also gives some additional parameters for factory made panels which are part of a system and are assembled to create vertical formwork. Several groups are used to form a classification.

It gives guidance on design by the limit state method.

It does not specify the micro quality of the form face or any of the parameters of the concrete face which will be revealed when the formwork is removed.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 39, *Loose Steel tubes for tube and couplers scaffold – Technical delivery conditions*.

EN 74-1, *Couplers, spigots and base-plates for use in falsework and scaffolds – Part 1: Couplers for tubes - Requirements and test procedures*.

EN 12811-1, *Temporary works equipment – Part 1: Scaffolds – Performance requirements and general design*.

EN 12811-2, *Temporary works equipment – Part 2: Information on material*.

EN 12811-3, *Temporary works equipment – Part 3: Load testing*.

EN 131-1, *Ladders; terms, types, functional sizes*.

EN 131-2, *Ladders; requirements, testing, marking*.

EN 338, *Structural timber – Strength classes*.

EN 789, *Timber structures – Tests methods – Determination of the mechanical properties of wood*.

EN 10219-1, *Cold formed welded structural hollow sections of non-alloy and fine grain steels – Part 1: Technical delivery requirements*.

EN 10219-2, *Cold formed welded structural hollow section of non-alloy and fine grain steels – Part 2: Tolerances, dimensions and sectional properties*.

EN 10240, *Internal and/or external protective coatings for steel tubes - Specification for hot dip galvanized coatings applied in automatic plants*.

ENV 1991-1, *Eurocode 1: Basis of design and actions on structures – Part 1: Basis of design*.

ENV 1991-2-4, *Eurocode 1: Basis of design and actions on structures – Part 2.4 : Wind actions*.

ENV 1993-1-1, *Eurocode 3: Design of steel structures – Part 1-1: General rules and rules for buildings*.

ENV 1993-1-3, *Eurocode 3: Design of steel structures – Part 1-3: General rules - Supplementary rules for cold formed thin gauge members and sheeting*.

ENV 1995-1-1, *Eurocode 5: Design of timber structures – Part 1-1: General rules and rules for buildings*.

ENV 1999-1-1:1998, *Eurocode 9: Design of aluminium structures – Part 1-1: General rules - General rules and rules for buildings*.

3 Terms and definitions

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

See standard EN 12811-1 for the definitions of other terms.

3.1
tie
tension device balancing the forces from opposing formwork assemblies. It may also provide a means of controlling the distance apart of the assemblies. A common example of a tie assembly comprises:

— a rod;

— a spacer unit for controlling the spacing;

— a type of nut to transfer the force between rod and plate;

— a plate for spreading the load.

3.2
vertical formwork
a structure with a surface not more than 5° out of plumb intended to contain fluid concrete ; this includes any supports such as ties or props necessary to meet the requirements of this standard

Typical elements are :

— panels each comprising a frame (work) and a surface to contain the concrete;

— sheeting material supported by framing equipment;

— devices to keep the formwork vertical;

— devices to keep it in position and to stop it overturning;

— fixing and connecting devices, for assembly or for lifting;

— platform with side protection and access.

3.3
form skin
contact area with the concrete

3.4
system
a set of components necessary for the assembly of the formwork, the great part of which were conceived to connect directly by means of purpose designed connections or connecting devices

3.5
concrete surface specification
the requirements specified by the building or structure owner for the surface, such as position, dimensional tolerances and quality

3.6
lifting point
a point for attaching lifting gear for handling

3.7
gap between two form faces
distance between two form faces put side by side

3.8
platform
one ormore platform units in one level within a bay

3.9
platform unit
unit (prefabricated or other wise) that supports a load on its own and which forms the platform or part of the platform and may form a structural part of the working area

3.10
Side protection
set of components forming a barrier to protect people from the risk of falling and to retain materials

3.11
gate
element of protection against falling from height from the working platform, articulated for allowing access to it, reconstituting automatically the continuity of the protection at any time

3.12
lifting gear
equipment usually interposed between the crane hook and formwork

3.13
base Jack
base plate, which has a means of vertical adjustement

3.14
raking shore for stability and adjustment
device positioned at an angle behind formwork for adjusting plumb

3.15
stability prop
linear component fixed significantly above the foot of the formwork and at the other end to an anchorage significantly away from the face of the formwork and intended to prevent the formwork overturning

3.16
stability equipment
device related to a formwork or a pair of formworks ensuring the stability under external action, without anchorage on an external point

3.17
horizontal connection
device ensuring the connection of the two vertical edges of two adjacent formworks

3.18
vertical connection
device ensuring the connection of two horizontal edges of two superimposed formworks

4 Materials

4.1 General

Materials shall fulfil the requirements given in EN Standards, where design data are provided. Information for the most commonly used materials are given in prEN 12811-2. Material used shall be sufficiently robust and durable to withstand normal working conditions.

Materials shall be free from any impurities and defects, which may affect their satisfactory use.

Protecting coating for components, when required, shall fulfil prEN 12811-2, chapter 8

NOTE When further use is made of old materials, the properties should justify the application of relevant design and fabrication rules with the same safety level of materials defined in EN or ISO Standards.

4.2 Specified Material requirements

4.2.1 Steel

4.2.1.1 General

— Steels of deoxidation type FU (rimming steels) shall not be used (see EN 12811-2);

— yield stress ≥ 235 N/mm^2.

4.2.1.2 Form skin

Any steel fulfilling the requirements in 4.2.1.1 can be used for form skin (TBD).

NOTE Oil or equivalent coating should be used to inhibit rust.

4.2.1.3 Tubes for incorporation in formwork components

See paragraphs 4.2.1.2 and 4.2.1.3 in EN 12811, part 1.

4.2.1.4 Side protection

See paragraph 4.2.1.4 in EN 12811, part 1.

4.2.1.5 Components

See paragraph 4.2.1.5 in EN 12811, part 1.

4.2.1.6 Frame and other components

See paragraph 4.2.1.6 in EN 12811, part 1.

4.2.2 Aluminium alloys

4.2.2.1 General

For aluminium allays see chapter 6 in pr EN 12811-2

4.2.2.2 Form skin

Without protection against the concrete, aluminium alloys should not be used for from skin

4.2.2.3 tubes for incorporation in formwork components

See paragraphs 4.2.2.1 and 4.2.2.2. in EN 12811-Part 1.

4.2.2.4 side protection

See paragraph 4.2.2.3 in EN 12811, part 1.

4.2.2.5 Platform components

See paragraph 4.2.2.4 in EN 12811, part 1.

4.2.3 Timber and timber based materials

4.2.3.1 General

See paragraph 7 in pr EN 12811, part 2.

4.2.3.2 Platform

See paragraph 7 in pr EN 12811, part 2.

4.2.4 Other materials

Any other material which can meet the general requirements established in this standard may be used. In that case, the material properties and the structural requirements shall be established by testing.

5 General requirements

5.1 Structural requirements which also relative to product classification

5.1.1 General

The strength and deviation are the principal requirements for assembled formwork and values commonly used are given in 5.1.2 and 5.1.3. These two parameters form the basis of system formwork classification for which the requirements are given in Annex D.

5.1.2 Concrete pressure classes

The formwork shall be strong enough to resist the concrete pressure, without permanent deflection. Suggested values are :20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150.

— Each represents the working concrete pressure Q^k in KN/m^2 considered as a uniformly distributed load.

5.1.3 Flatness tolerance / deflection

5.1.3.1 Flatness tolerances

The loaded formwork shall deviate from a true plane by not more than the values given in Figure 2 or as otherwise specified. The deviation is the sum of manufacturing (see X.) or material tolerances, assembly tolerances and deflection caused by the concrete pressure, see 6.3. Figure 3 gives examples, $\delta 1$ and $\delta 2$, how to measure deviations.

The maximum value of steps (or offsets), see Figure 4, is controlled by the lowest deflection value, which for group 5 to 7 is shown at the left and side of Figure 1.

Particular attention should be drawn in the pressure specification to any requirements more stringent than group 6.

Table 2 gives the data on which Figure 2 is based.

Table 1 — Flatness tolerances

Column	1	2	3	4	5	6
Group	Applicable to	Point deviations (limit values), in mm, for distance between measuring points, in m, up to				
		0,1	1[1)]	4[1)]	10[1)]	15[1)]
5	non surface-finised walls, unplastered ceilings	5	10	15	25	30
6	surface-finished walls and ceilings, e.g. plastered walls, wall coverings, suspended ceilings.	3	5	10	20	25
7	as group 6, but complying with more stringent requirements	2	3	8	15	20
1) Intermediate values shall be taken from Figure 2 and 3, and rounded to the nearest mm.						

5.1.3.2 Fabrication tolerances

Table 1 describes 4 different classes of fabrication tolerances for one panel.

Table 2 — Tolerances on one formwork panel the measures are in millimetres

Description		Classes			
		A	B	C	D
Straightness of edge members: — in elevation — in side elevation	 a b	 ± 1 ≤ 2	 ± 1,5 ≤ 3	 ± 2 ≤ 5	 ± 3 ≤ 6
Length of edges	L(c,d)	+0 $-(1+\frac{1}{4000}L)$	+1 $-(2+\frac{1}{2000}L)$	+1 $-(3+\frac{1}{1500}L)$	+2 $-(4+\frac{1}{1000}L)$
Difference between two diagonals	h1 - h2 c ≥ d	$1+\frac{1}{4000}C$	$2+\frac{1}{2000}C$	$3+\frac{1}{1500}C$	$4+\frac{1}{1000}C$

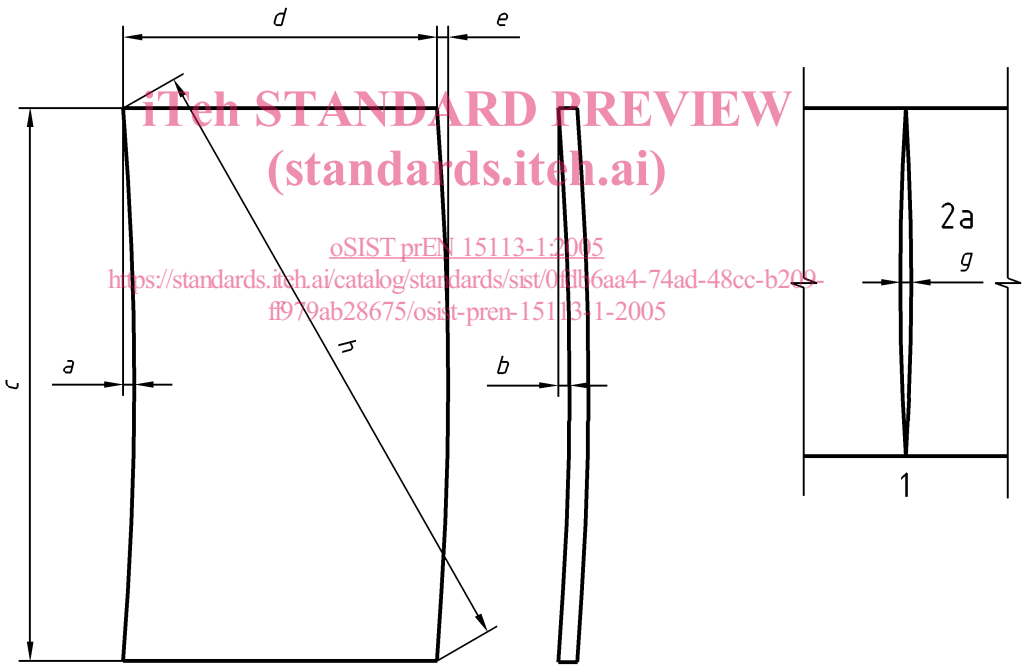

Figure 1 — Explanation of symbols for tolerance of system panel dimensions