SLOVENSKI STANDARD
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Nosilni odri - Zahtevane lastnosti in projektiranje

Falsework - Performance requirements and general design

Traggerüste - Anforderungen, Entwurf und Bemessung

Etaiements - Exigences de performance et méthodes de conception et calculs

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Falsework - Performance requirements and general design

Etaiements - Exigences de performance et méthodes de conception et calculs

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Foreword

This document (EN 12812:2008) 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of an identical text or by endorsement, at the latest by January 2009, and conflicting national standards shall be withdrawn at the latest by January 2009.

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 supersedes EN 12812:2004.

This European Standard is one of a package of standards that includes also EN 12810-1, EN 12810-2, EN 12811-1, EN 12811-2, EN 12811-3, EN 12813.

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, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

Most falsework is used:

— to carry the loads due to freshly poured concrete for permanent structures until these structures have reached a sufficient load bearing capacity;

— to absorb the loads from structural members, plant and equipment which arise during the erection, maintenance, alteration or removal of buildings or other structures;

— additionally, to provide support for the temporary storage of building materials, structural members and equipment.

This European Standard gives performance requirements for specifying and using falsework and gives methods to design falsework to meet those requirements. Clause 9 provides design methods. It also gives simplified design methods for falsework made of tubes and fittings. The information on structural design is supplementary to the relevant Structural Eurocodes.

The standard describes different design classes. This allows the designer to choose between more or less complex design methods, while achieving the same level of structural safety.

Provision for specific safety matters is dealt with in EN 12811-1 and other documents.

1 Scope

This European Standard specifies performance requirements and limit state design methods for two design classes of falsework.

It sets out the rules that have to be taken into account to produce a safe falsework structure.

It also provides information for falsework which is required to support a "permanent structure", or where the design or supply of falsework has to be commissioned.

This European Standard also gives information on foundations.

This European Standard does not specify requirements for formwork, although formwork may be a part of the falsework construction. Nor does it provide information on access and working scaffolds, which is given in EN 12811-1.

This European Standard does not provide information about site activities. It does not provide information about the use of some standardized products, including timber formwork beams conforming to EN 13377 and props conforming to EN 1065.

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 74-1, *Couplers, spigot pins and baseplates for use in falsework and scaffolds — Part 1: Couplers for tubes — Requirements and test procedures*

prEN 74-2, *Couplers, spigot pins and baseplates for use in falsework and scaffolds — Part 2: Special couplers — Requirements and test procedures*

EN 74-3, *Couplers, spigot pins and baseplates for use in falsework and scaffolds — Part 3: Plain base plates and spigot pins — Requirements and test procedures*

EN 1065:1998, *Adjustable telescopic steel props — Product specifications, design and assessment by calculation and tests*

EN 1090-2, *Execution of steel structures and aluminium structures - Part 2: Technical requirements for steel structures*

EN 1090-3, *Execution of steel structures and aluminium structures - Part 3: Technical requirements for aluminium structures*

EN 1990, *Eurocode — Basis of structural design*

EN 1991 (all parts), *Eurocode 1 — Actions on structures*

EN 1993-1-1:2005, *Eurocode 3: Design of steel structures - Part 1-1: General rules and rules for buildings*

EN 1997 (all parts), *Eurocode 7 — Geotechnical design*

EN 1998 (all parts), *Eurocode 8 — Design of structures for earthquake resistance*

EN 1999 (all parts), *Eurocode 9 — Design of aluminium structures*

EN 12810-1:2003, *Facade scaffolds made of prefabricated components — Part 1: Product specifications*

EN 12811-1:2003, *Temporary works equipment — Part 1: Scaffolds — Performance requirements and general design*

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

EN 12813, *Temporary works equipment - Load bearing towers of prefabricated components - Particular methods of structural design*

EN 13377, *Prefabricated timber formwork beams — Requirements, classification and assessment*

3 Terms and definitions

For the purposes of this document, the terms and definitions in EN 1993-1-1:2005 and the following apply.

3.1
brace
component connecting two points of a structure to help stiffen it

3.2
design class
class that defines the extent of design for falsework

3.3
falsework
temporary support for a part of a structure while it is not self-supporting and for associated service loads

3.4
formwork
part of temporary works used to give the required shape and support to in-situ concrete

3.5
foundation
sub-structure needed to transmit loads into the ground

3.6
kentledge
material placed on a structure to provide stability by the action of its dead weight

3.7
imperfections
initial out of straightness (bow imperfection) or out of verticality (sway imperfection) of a structural component or of the structure used for calculations

NOTE 1 A bow imperfection can occur both in an individual member and in the complete tower or modular beam assembly. It arises because the member is not straight, is manufactured not straight or members are assembled out of alignment.

NOTE 2 These are the values for design purposes and may be more than the erection tolerance.

3.8
node
theoretical intersection point of members

3.9
sway
angular deflection of a column or other structure caused by the application of load

4 Design classes

4.1 General

The design shall be in accordance with one of the classes: A or B. Class B has two subclasses, B1 and B2, see 4.3 where the designer has to decide which subclass shall be applied.

4.2 Design class A

NOTE A Class A falsework is one which follows established good practice which may be deemed to satisfy the design requirements.

Class A covers falsework for simple constructions such as in situ slabs and beams.

Class A shall only be adopted where:

a) slabs have a cross-sectional area not exceeding 0,3 m^2 per metre width of slab;

b) beams have a cross-sectional area not exceeding 0,5 m^2;

c) the clear span of beams and slabs does not exceed 6,0 m;

d) the height to the underside of the permanent structure does not exceed 3,5 m.

The design for class A falsework shall be in accordance with the descriptive requirements in Clauses 5 and 7.

4.3 Design class B

Class B falsework is one for which a complete structural design is undertaken. Class B falsework is required to be designed in accordance with the relevant Eurocodes. There are separate additional provisions in this code for Classes B1 and B2 that are detailed below. Class B2 uses a simpler design method than Class B1 to achieve the same level of safety.

4.3.1 Class B1

The design shall be in accordance with the relevant Eurocodes (EN 1990, EN 1991 to EN 1999) and additionally with 9.1.1, 9.1.2.1, 9.1.3, 9.3.3 and 9.4.1 of the present standard.

NOTE It is assumed that the erection will be carried out to the level of workmanship appropriate for permanent construction, see EN 1090-2 and EN 1090-3 for metal structures.

4.3.2 Class B2

The design shall be in accordance with Clauses 5, 6, 7, 8 and 9, with the exception of 9.1.2.1, 9.3.3, 9.4.1, and with the relevant Eurocodes (EN 1991, EN 1990 to EN 1999). Where there is a conflict, the provisions of the present standard shall take precedence.

NOTE Attention is drawn to the simplified methods given in 9.3 and 9.4 and to the requirements for drawings and other documentation given in 9.1.2.

5 Materials

5.1 General

Only materials that have established properties and that are known to be suitable for the intended use shall be used.

5.2 Basic requirements for materials

5.2.1 Materials shall comply with European product Standards; where they do not exist national standards shall be used.

5.2.2 Where the relevant properties of materials and equipment cannot be obtained from the standards referred to in 5.2.1, their properties shall be established by testing (see 9.5.2).

5.2.3 Steel of deoxidation type FU (Rimming steel) shall not be used.

5.3 Weldability

The steel used shall be weldable, unless structural members and components are not intended to be welded. Welding shall be carried out in accordance with the requirements of EN 1090-2 and EN 1090-3.

The design shall not require any welding of aluminium to be undertaken on site.

6 Brief

The design shall be based on a brief containing all necessary data including information on erection, use, dismantling and loading.

NOTE 1 Concrete is a typical example of loading.

NOTE 2 Adequate information about site conditions should be obtained and included in the brief. Particular points are:

- layout with levels, including adjacent structures;
- general appreciation of the parameters relating to wind load calculations for the local conditions;
- positions of services such as water pipes or electricity cables;
- requirements for access and safe working space;
- information about the ground conditions.

7 Design requirements

7.1 General

The structure shall be designed such that all the loads acting on it are carried into the subsoil or into a load-bearing sub-structure.

The available skill in erection and the ambient circumstances should be taken into account in the design.

Provision shall be made for the means of access for erection, use and dismantling. Reference shall be made to EN 12811-1.

The design should be based on concepts and details which ensure a practicable realization and which are straightforward for on site checks.

7.2 Thickness of material

7.2.1 Thickness of steel and aluminium components

The nominal thickness shall be not less than 2 mm.

7.2.2 Steel scaffold tubes

Loose steel tubes to which it is possible to attach couplers conforming to EN 74-1, prEN 74-2 and baseplates and spigots conforming to EN 74-3 shall be in accordance with EN 12811-1:2003, 4.2.1.2.

Tubes for incorporation in prefabricated components to which it is possible to attach couplers conforming to EN 74-1, prEN 74-2 and baseplates and spigots conforming to EN 74-3 shall be in accordance with EN 12811-1:2003, 4.2.1.3 and with EN 12810-1:2003, Table 2.

7.2.3 Aluminium scaffold tubes

Loose aluminium tubes to which it is possible to attach couplers conforming to EN 74-1, prEN 74-2 and baseplates and spigots conforming to EN 74-3 shall be in accordance with EN 12811-1:2003, 4.2.2.1.

7.3 Connections

7.3.1 Connection devices

Connections shall be designed such that they cannot be disconnected unintentionally when in use.

Vertical spigot connections between hollow sections in compression without additional means of fixing shall be deemed to be secure against unintentional disconnection if the overlapping length is not less than 150 mm.

7.3.2 Overlap of loose base jacks and head jacks with tube

The overlap length of the jack in the tube, l_0 (see 9.3.2), shall be either 25 % of the jack length, l_1, or 150 mm, whichever is the greater.

7.4 Flexibility of prefabricated support towers

A prefabricated support tower shall have a design capacity, R_d*, of 90 % of its normal design load bearing capacity, R_d, when a differential settlement, δ_s, has been imposed or when a thermal movement of the supported construction has caused a horizontal movement, δ_t (see Figure 1), which the tower shall accommodate.

The value of the settlement, δ_s, shall be the lesser of 5 mm and that calculated from Equation (1); the maximum value of the thermal movement shall be calculated from Equation (2) taking the lesser of the two values of δ_s from the previous examination.

$$\delta_s = 2{,}5 \times 10^{-3} \times l \leq 5 \text{ mm} \quad (1)$$

$$\delta_t = \delta_s \times h/l \quad (2)$$

where

R_d is the normal design value of the load bearing capacity;

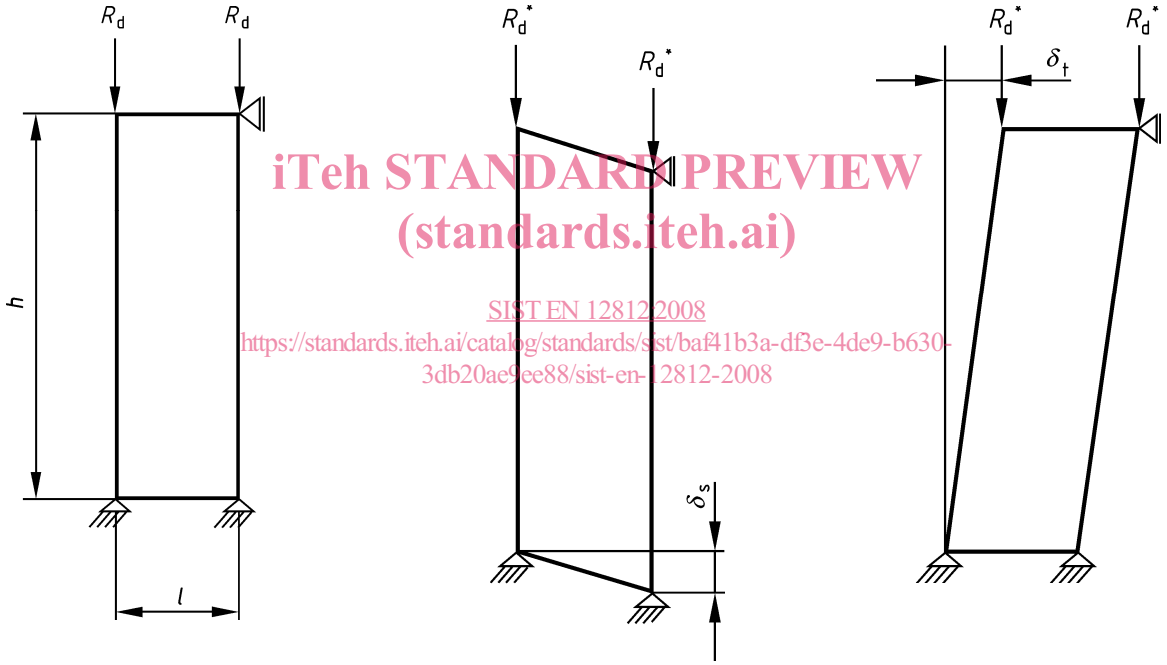
R_d^* is the design value of the load bearing capacity after differential settlement or thermal movement has occurred;

h is the overall height of the tower in millimetres;

l is the horizontal base of the support tower in millimetres;

δ_s is the differential settlement;

δ_t is the horizontal movement caused by temperature.



a) Theoretical system b) Differential settlement c) Thermal movement

NOTE See 7.4 for symbol definitions.

Figure 1 — Relative deformations due to differential settlement or thermal movement

7.5 Foundation

7.5.1 Basic requirements for foundations

The structure shall be supported directly from one or more of the following:

— a sub-structure provided for the purpose;

- the surface of the existing ground, e.g. rock;
- a partly excavated and prepared surface, e.g. in soil;
- a structure which already exists;
- foundation according to 7.5.2.

Except where the conditions described in 7.5.2 apply, design shall follow the Eurocodes taking account of the expected life of the structure.

7.5.2 Support without any embedment in the ground

For a spread foundation, topsoil shall always be removed.

The foundation shall not be placed directly on such a levelled surface without embedment unless all of the following conditions are met:

- the foundation is made secure against degradation by surface water and ground water during the life of the falsework;

  NOTE 1 This may be done by providing drainage or protecting the surface with a concrete skin.

- it is known that frost is not likely to occur, which might affect permeable ground during the life of the falsework;

- either the support of the foundation is within 8 % of horizontal or, if the average slope exceeds 8 %, there is provision to transmit any component of force down the slope either to a thrust block or by other means, dissipating the force to the ground;

- in the case of cohesive soils, and where the distance to the edge is large, provision is made for drainage below the foundation slab;
- in the case of non-cohesive soils, the ground water level is not likely to rise to within 1 m of the bottom of the structure;

  NOTE 2 The object of this limitation is to keep settlement to a sufficiently low value.

- lateral shear capacity is verified.

7.5.3 Support from an existing permanent structure

The resistance of the permanent structure to the applied loads from the falsework shall be verified.

7.5.4 Stacked squared members

Stacked members consisting of rectangular timber elements or comparable components may be used:

- for the support construction for load bearing towers;
- for the height adjustment of the base-construction in combination with the foundation.

In each case, stacked members shall be placed crosswise, and the base area shall be enlarged with every layer from top to bottom. The support construction for load bearing towers shall cover the whole cross-section of the tower (Figure 2a).