SLOVENSKI STANDARD
SIST ENV 1996-3:2004

01-september-2004

Eurocode 6: Projektiranje zidanih konstrukcij - 3. del: Poenostavljene raļunske metode in enostavna pravila za zidane konstrukcije

Eurocode 6: Design of masonry structures - Part 3: Simplified calculation methods and simple rules for masonry structures

Eurocode 6: Berechnung und Ausführung von Mauerwerk - Teil 3: Vereinfachte Berechnungsmethoden und einfache Regeln für Mauerwerk

Eurocode 6: Calcul des structures en maçonnerie - Partie 3: Méthodes de calcul simplifiées

Ta slovenski standard je istoveten z: **ENV 1996-3:1999**

ICS:

91.010.30	Tehniļ ni vidiki	Technical aspects
91.080.30	Zidane konstrukcije	Masonry

SIST ENV 1996-3:2004 **en**

EUROPEAN PRESTANDARD
PRÉNORME EUROPÉENNE
EUROPÄISCHE VORNORM

ENV 1996-3

January 1999

ICS 91.010.30; 91.080.30

Descriptors: buildings, construction, masonry work, structures, computation

English version

Eurocode 6: Design of masonry structures - Part 3: Simplified calculation methods and simple rules for masonry structures

Eurocode 6: Calcul des structures en maçonnerie - Partie 3: Méthodes de calcul simplifiées

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This European Prestandard (ENV) was approved by CEN on 27 March 1998 as a prospective standard for provisional application.

The period of validity of this ENV is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the ENV can be converted into a European Standard.

CEN members are required to announce the existence of this ENV in the same way as for an EN and to make the ENV available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the ENV) until the final decision about the possible conversion of the ENV into an EN is reached.

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

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

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

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Foreword

Objectives and programme of the Eurocodes

(1) The structural Eurocodes comprise a group of standards for the structural and geotechnical design of buildings and civil engineering works.

(2) They cover execution and control only to the extent that it is necessary to indicate the quality of the construction products, and the standard of workmanship needed on and off site to comply with the assumptions of the design rules.

(3) Until the necessary set of harmonized technical specifications for products and the methods for testing their performance is available, some of the Structural Eurocodes will cover some of these aspects in informative annexes.

Background of the Eurocode programme

(4) The Commission of the European Communities (CEC) initiated the work of establishing a set of harmonized technical rules for the design of building and civil engineering works which would initially serve as an alternative to the different rules in force in the various member states and would ultimately replace them. These technical rules became known as the Structural Eurocodes.

(5) In 1990, after consulting their respective Members States, the CEC transferred the work of further development, issue and updating of the Structural Eurocodes to CEN, and the EFTA secretariat agreed to support the CEN work.

(6) CEN Technical Committee CEN/TC 250 is responsible for all Structural Eurocodes.

Eurocode programme

(7) Work is in hand on the following Structural Eurocodes, each generally consisting of a number of parts :

EN 1991 Eurocode 1 : Basis of design and actions on structures

EN 1992 Eurocode 2 : Design of concrete structures

EN 1993 Eurocode 3 : Design of steel structures

EN 1994 Eurocode 4 : Design of composite steel and concrete structures

EN 1995 Eurocode 5 : Design of timber structures

EN 1996 Eurocode 6 : Design of masonry structures

EN 1997 Eurocode 7 : Geotechnical design

EN 1998 Eurocode 8 : Design of structures for earthquake resistance

EN 1999 Eurocode 9 : Design of aluminium alloy structures.

(8) Separate sub-committees have been formed by CEN/TC 250 for the various Eurocodes listed above.

(9) This ENV 1996-3 is being published as a European Prestandard (ENV) with an initial life of three years.

(10) This prestandard is intended for experimental application and for the submission of comments.

(11) After approximately two years, CEN members will be invited to submit formal comments to be taken into account in determining future actions.

(12) Meanwhile feedback and comments on this prestandard should be sent to the Secretariat of CEN/TC 250/SC6 at the following address :

DIN
Burggrafenstrasse 6
10772 Berlin
Germany

or to your national standards organization.

National Application Documents (NADs)

(13) In view of the responsibilities of authorities in member countries for safety, health and other matters covered by the essential requirements of the Construction Products Directive (CPD), certain safety elements in this ENV have been assigned indicative values which are identified by ☐ ("boxed values").The authorities in each member country are expected to review the "boxed values" and may substitute alternative definitive values for these safety elements for use in national application.

(14) Some of the supporting European or International standards may not be available by the time this prestandard is issued. It is therefore anticipated that a National Application Document (NAD) giving any substitute definitive values for safety elements, referencing compatible supporting standards and providing guidance on the national application of this prestandard, will be issued by each member country or its standards organisation.

(15) It is intended that this prestandard is used in conjunction with the NAD valid in the country where the building and civil engineering work is located.

Matters specific to this prestandard

(16) The scope of Eurocode 6 is defined in clause 1.1.1 of ENV 1996-1-1 and the scope of this ENV 1996-3 is defined in clause 1.1 of this Part 3. Additional parts of Eurocode 6 which are planned are indicated in clause 1.1.3 of ENV 1996-1-1.

(17) Section 4.5 of this ENV 1996-3, relating to unreinforced basement walls, replaces normative Annex E of ENV 1996-1-1.

1 General

1.1 Scope

(1)P This ENV 1996-3 provides either simplified calculation methods or simple rules to facilitate the design of the following unreinforced masonry walls, subject to certain conditions of application.

Simplified calculation methods are given for :

- walls subjected to vertical loading, including wind loading ;

- walls subjected to concentrated loads ;

- shear walls ;

- basement walls subjected to lateral earth pressure and vertical loads ;

- walls subjected to vertical loading where the height of the building does not exceed 3 storeys above ground level ;

- shear walls where the height of the building does not exceed 3 storeys above ground level.

Simple rules are given for :

- basement walls subjected to lateral earth pressure and vertical loads where the height of the building does not exceed 4 storeys above ground level ;

- non loadbearing internal walls.

(2) This ENV 1996-3 gives Principles and Application Rules for designing structures for specified requirements in respect of the aforementioned functions.

NOTE : The rules given in this ENV 1996-3 are consistent with those given in ENV 1996-1-1, but are more conservative in respect of the conditions and limitations of their use.

(3) This ENV 1996-3 applies only to those masonry structures, or parts thereof, that are described in ENV 1996-1-1 and ENV 1996-2.

(4) The simplified calculation methods given in this ENV 1996-3 are not applicable to the design for accidental situations.

1.2 Distinction between Principles and Application Rules

(1)P Depending on the character of the individual clausess, a distinction is made in this ENV 1996-3 between principles and application rules.

(2)P The principles comprise :

- general statements and definitions for which there is no alternative ;

- requirements and analytical models for which no alternative is permitted unless specifically stated.

(3)P The principles are defined by the letter P, following the clause number, for example,(1)P.

(4)P The application rules are generally recognised rules which follow the principles and satisfy their requirements. Alternative rules different from the application rules given in this ENV 1996-3 may be used provided that it is shown that the alternative rule accords to the relevant principles and has at least the same reliability.

(5)P The application rules are all clausess not indicated as being principles.

1.3 Assumptions

(1)P The assumptions stated in clause 1.3 of ENV 1996-1-1 also apply to this ENV 1996-3.

1.4 Definitions

1.4.1 General

(1)P Unless otherwise stated in the following, the terminology given in clause 1.4 of ENV 1996-1-1 and clause 1.5 of ENV 1996-2, shall apply to this Part.

1.4.2 Special terms used

(1)P Basement wall - A wall constructed partly or fully below ground level.

1.5 S.I. units

(1)P S.I. units in accordance with ISO 1000 shall be used.

1.6 Symbols

(1)P The symbols given in clause 1.6 of ENV 1996-1-1 also apply to this ENV 1996-3.
q_d is the design wind load on the wall per unit area of the wall.

2 Basis of design

2.1 General

(1)P The basis of design shall be in accordance with the principles given in Section 2 of ENV 1996-1-1 and this section 2.

2.2 Combination of actions

(1) The design value of a combination of actions for fundamental design situations shall be the larger value determined from the following expressions :

- considering only the most unfavourable variable action :

$$\Sigma\gamma_{G,j}\, G_{k,j} + \boxed{1,5}\, Q_{k,1} \qquad (2.1)$$

- considering all unfavourable variable actions

$$\Sigma\gamma_{G,j}\, G_{k,j} + \boxed{1,35}\, \Sigma Q_{k,i} \qquad (2.2)$$

Where :

$G_{k,j}$ is the characteristic value of permanent actions ;

$Q_{k,1}$ is the characteristic value of the most unfavourable variable action ;

$Q_{k,i}$ is the characteristic value of unfavourable variable actions ;

$\gamma_{G,j}$ is the partial safety factor for permanent actions, taken as 1,0 for favourable effects and 1,35 for unfavourable effects.

2.3 Partial safety factors for masonry

(1)P Partial safety factors for masonry are given in table 2.1, where the masonry unit categories I and II and category of execution A, B and C are defined in ENV 1996-1-1.

Table 2.1 : Partial safety factors for masonry (γ_M)

		γ_M for categories of execution :		
		A	B	C
Category of manufacturing control of units	I	1,7	2,2	2,7
	II	2,0	2,5	3,0

3 Materials

(1)P The material used in the masonry walls referred to in this ENV 1996-3 shall be in accordance with Section 3 of ENV 1996-1-1.

NOTE : A simplified calculation of the characteristic compressive strength of masonry, using the boxed values for K as given in ENV 1996-1-1, is provided at Annex D.

4 Design of unreinforced masonry walls using simplified calculation methods

4.1 General

(1)P The overall stability of the building, of which the wall forms a part, shall be in accordance with the requirements given in clause 4.1 of ENV 1996-1-1.

4.2 Simplified calculation method for walls subjected to vertical loading

4.2.1 Conditions for application

4.2.1.1 General conditions

(1)P For use of the simplified method the following conditions shall be complied with :

- the height of the building above ground level does not exceed 20 m ; for buildings with a sloping roof the average height of the ridge and the eaves may be taken as the building height ;

- the span of the floors supported by the walls does not exceed 7 m ;

- the span of the roof supported by the walls does not exceed 7 m , except in the case of timber or steel trussed roof construction where the span should not exceed 14 m ;

  NOTE : If the figures 7 m and 14 m are to be varied in an NAD, recalibration should be carried out.

- the clear storey height does not exceed 3 m ;

- the thickness of walls, acting as end supports to floors or roofs, that are subjected to wind loading, are the same at all storeys ;

- the characteristic values of the variable actions on the floors and the roof do not exceed 5,0 kN/m² ;

- no actions other than those listed are applied ;

- the walls are be laterally restrained by the floors and roof in the horizontal direction at right angles to the plane of the wall, either by the floors and roof themselves or by suitable methods e.g. ringbeams with sufficient stiffness ;

- the final creep coefficient of the masonry Φ_∞ does not exceed 2,0 ;

  NOTE : It has been assumed that the quality of execution does not led to an accidental eccentricity greater than $h_{ef}/450$.

(2) A further simplified calculation method, applicable to buildings not exceeding 3 storeys in height, is given in Annex A.

4.2.1.2 Additional conditions

(1)P For walls acting as end supports to floors (see figure 4.1), the simplified calculation method given in 4.2.2 may be applied only if :

$$l \leq 4{,}5 + 10\,t \quad \text{and} \quad l \leq 7 \qquad (4.1)$$

where :

l is the floor span, in metres ;

t is the actual thickness of the wall, or the loadbearing leaf of a cavity wall, acting as an end support, in metres.

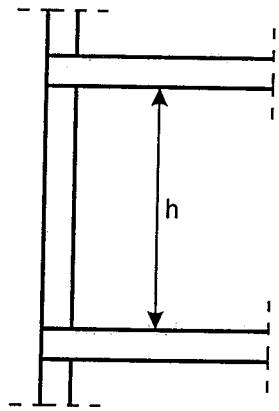

Figure 4.1 : Wall acting as end support

(2)P Walls acting as end supports to floors or roofs that are subjected to wind loading shall be designed according to 4.2.2 only if :

$$t \geq \frac{0{,}12\, q_d .h^2}{N_{Sd}} + 0{,}017\, h \qquad (4.2)$$

where :

h is the clear storey height, in metres ;

q_d is the design wind load on the wall per unit area of the wall, in kN/m² ;

N_{Sd} is the minimum design vertical load on the wall at the top storey, in kN/m ;

t is the actual thickness of the wall, or the loadbearing leaf of a cavity wall, acting as an end support, in metres.

(3) As an alternative to obtaining t from equation (4.2), t may be determined from the design method given in 4.1 of ENV 1996-1-3, provided that the minimum design vertical stress at the mid-height position of the top storey wall is 0,15 N/mm² or less and provided that neither major collapse nor total loss of stability of the building would result in the event of the failure of the top storey section of wall under consideration.

(4) If the method stated in clause (3) is adopted for the design of the wall then the vertical load resistance of the wall N_{Rd} should be derived from a presumed eccentricity at the ends of the wall of 0,4 t and a bearing depth of 0,2 t (see C1(3) & (4) of Annex C to ENV 1996-1-1).

4.2.2 Determination of design vertical load resistance of a wall

4.2.2.1 General

(1)P Under the ultimate limit state it shall be verified that :

$$N_{Sd} \leq N_{Rd}$$

where :

N_{Sd} is the design vertical load on the wall ;

N_{Rd} is the design vertical load resistance of the wall according to clause 4.2.2.2.

4.2.2.2 Design vertical load resistance

(1) The design vertical load resistance N_{Rd} may be determined from :

$$N_{Rd} = \frac{\Phi . f_k . A}{\gamma_M} \tag{4.3}$$

where :

Φ is the capacity reduction factor allowing for the effects of slenderness and eccentricity of the loading, obtained from 4.2.2.3 ;

f_k is the characteristic compressive strength of the masonry ;

is the partial factor for the material, obtained from 2.3 ;

A is the net area of the masonry, taking into account any openings.

(2) The characteristic compressive strength of the masonry, f_k, should be obtained from 3.6.2 of ENV 1996-1-1, or from use of a simplified approach.

NOTE : A simplified method for obtaining f_k is given in Annex D.

4.2.2.3 Capacity reduction factor

(1) The capacity reduction factor Φ may be determined from :

$$\Phi = 0{,}85 - 0{,}0011 \left(\frac{h_{ef}}{t_{ef}}\right)^2 \tag{4.4}$$