SLOVENSKI STANDARD

SIST EN 1998-6:2005

01-oktober-2005

Evrokod 8: Projektiranje potresnoodpornih konstrukcij – 6. del: Stolpi, jambori, dimniki

Eurocode 8: Design of structures for earthquake resistance - Part 6: Towers, masts and chimneys

Eurocode 8: Auslegung von Bauwerken gegen Erdbeben - Teil 6: Türme, Maste und Schornsteine

Eurocode 8: Calcul des structures pour leur résistance aux séismes - Partie 6 : Tours, mâts et cheminées

Ta slovenski standard je istoveten z: **EN 1998-6:2005**

ICS:

91.010.30	Tehniļ ni vidiki	Technical aspects
91.060.40	Dimniki, jaški, kanali	Chimneys, shafts, ducts
91.120.25	Zaģļ ita pred potresi in vibracijami	Seismic and vibration protection

SIST EN 1998-6:2005 **en**

EUROPEAN STANDARD

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EUROPÄISCHE NORM

EN 1998-6

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English version

Eurocode 8: Design of structures for earthquake resistance - Part 6: Towers, masts and chimneys

Eurocode 8: Calcul des structures pour leur résistance aux séismes - Partie 6 : Tours, mâts et cheminées

Eurocode 8: Auslegung von Bauwerken gegen Erdbeben - Teil 6: Türme, Maste und Schornsteine

This European Standard was approved by CEN on 25 April 2005.

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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

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

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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FOREWORD

This European Standard EN 1998-6, Eurocode 8: Design of structures for earthquake resistance: Towers, masts and chimneys, has been prepared by Technical Committee CEN/TC 250 "Structural Eurocodes", the secretariat of which is held by BSI. CEN/TC 250 is responsible for all Structural Eurocodes.

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 2005 and conflicting national standards shall be withdrawn at latest by March 2010.

This document supersedes ENV 1998-3:1996.

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

Background of the Eurocode programme

In 1975, the Commission of the European Community decided on an action programme in the field of construction, based on article 95 of the Treaty. The objective of the programme was the elimination of technical obstacles to trade and the harmonisation of technical specifications.

Within this action programme, the Commission took the initiative to establish a set of harmonised technical rules for the design of construction works which, in a first stage, would serve as an alternative to the national rules in force in the Member States and, ultimately, would replace them.

For fifteen years, the Commission, with the help of a Steering Committee with Representatives of Member States, conducted the development of the Eurocodes programme, which led to the first generation of European codes in the 1980s.

In 1989, the Commission and the Member States of the EU and EFTA decided, on the basis of an agreement[1] between the Commission and CEN, to transfer the preparation and the publication of the Eurocodes to CEN through a series of Mandates, in order to provide them with a future status of European Standard (EN). This links *de facto* the Eurocodes with the provisions of all the Council's Directives and/or Commission's Decisions dealing with European standards (*e.g.* the Council Directive 89/106/EEC on construction products - CPD - and Council Directives 93/37/EEC, 92/50/EEC and 89/440/EEC on public works and services and equivalent EFTA Directives initiated in pursuit of setting up the internal market).

The Structural Eurocode programme comprises the following standards generally consisting of a number of Parts:

EN 1990 Eurocode: Basis of structural design

EN 1991 Eurocode 1: Actions on structures

[1] Agreement between the Commission of the European Communities and the European Committee for Standardisation (CEN) concerning the work on EUROCODES for the design of building and civil engineering works (BC/CEN/03/89).

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 structures

Eurocode standards recognise the responsibility of regulatory authorities in each Member State and have safeguarded their right to determine values related to regulatory safety matters at national level where these continue to vary from State to State.

Status and field of application of Eurocodes

The Member States of the EU and EFTA recognise that Eurocodes serve as reference documents for the following purposes:

– as a means to prove compliance of building and civil engineering works with the essential requirements of Council Directive 89/106/EEC, particularly Essential Requirement N°1 – Mechanical resistance and stability – and Essential Requirement N°2 – Safety in case of fire;

– as a basis for specifying contracts for construction works and related engineering services;

– as a framework for drawing up harmonised technical specifications for construction products (ENs and ETAs)

The Eurocodes, as far as they concern the construction works themselves, have a direct relationship with the Interpretative Documents[2] referred to in Article 12 of the CPD, although they are of a different nature from harmonised product standards[3]. Therefore, technical aspects arising from the Eurocodes work need to be adequately considered by CEN Technical Committees and/or EOTA Working Groups working on product standards with a view to achieving full compatibility of these technical specifications with the Eurocodes.

The Eurocode standards provide common structural design rules for everyday use for the design of whole structures and component products of both a traditional and an innovative nature. Unusual forms of construction or design conditions are not specifically covered and additional expert consideration will be required by the designer in such cases.

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[2] According to Art. 3.3 of the CPD, the essential requirements (ERs) shall be given concrete form in interpretative documents for the creation of the necessary links between the essential requirements and the mandates for harmonised ENs and ETAGs/ETAs.

[3] According to Art. 12 of the CPD the interpretative documents shall:

a) give concrete form to the essential requirements by harmonising the terminology and the technical bases and indicating classes or levels for each requirement where necessary ;

b) indicate methods of correlating these classes or levels of requirement with the technical specifications, *e.g.* methods of calculation and of proof, technical rules for project design, etc. ;

c) serve as a reference for the establishment of harmonised standards and guidelines for European technical approvals.

The Eurocodes, *de facto*, play a similar role in the field of the ER 1 and a part of ER 2.

National Standards implementing Eurocodes

The National Standards implementing Eurocodes will comprise the full text of the Eurocode (including any annexes), as published by CEN, which may be preceded by a National title page and National foreword, and may be followed by a National annex.

The National annex may only contain information on those parameters which are left open in the Eurocode for national choice, known as Nationally Determined Parameters, to be used for the design of buildings and civil engineering works to be constructed in the country concerned, i.e:

– values and/or classes where alternatives are given in the Eurocode,

– values to be used where a symbol only is given in the Eurocode,

– country specific data (geographical, climatic, etc.), e.g. snow map,

– the procedure to be used where alternative procedures are given in the Eurocode.

It may also contain

– decisions on the use of informative annexes, and

– references to non-contradictory complementary information to assist the user to apply the Eurocode.

Links between Eurocodes and harmonised technical specifications (ENs and ETAs) for products

There is a need for consistency between the harmonised technical specifications for construction products and the technical rules for works[4]. Furthermore, all the information accompanying the CE Marking of the construction products which refer to Eurocodes shall clearly mention which Nationally Determined Parameters have been taken into account.

Additional information specific to EN 1998-6

For the design of structures in seismic regions the provisions of this standard are to be applied in addition to the provisions of the other relevant Eurocodes. In particular, the provisions of the present standard complement those of Eurocode 3, Part 3-1 " Towers and Masts " and Part 3-2 " Chimneys", which do not cover the special requirements for seismic design.

National annex for EN 1998-6

Notes indicate where national choices have to be made. The National Standard implementing EN 1998-6 shall have a National annex containing values for all Nationally Determined Parameters to be used for the design in the country. National choice is required in the following sections.

[4] see Art.3.3 and Art.12 of the CPD, as well as clauses 4.2, 4.3.1, 4.3.2 and 5.2 of ID 1.

Reference section	Item
1.1(2)	Informative Annexes A, B, C, D, E and F.
3.1(1)	Conditions under which the rotational component of the ground motion should be taken into account.
3.5(2)	The lower bound factor β on design spectral values, if site-specific studies have been carried out with particular reference to the long-period content of the seismic action.
4.1(5)P	Importance factors for masts, towers, and chimneys.
4.3.2.1(2)	Detailed conditions, supplementing those in 4.3.2.1(2), for the lateral force method of analysis to be applied.
4.7.2(1)P	Partial factors for materials
4.9(4)	Reduction factor ν for displacements at damage limitation limit state

1 GENERAL

1.1 Scope

(1) The scope of Eurocode 8 is defined in EN 1998-1:2004, **1.1.1** and the scope of this Standard is defined in **(2)** to **(4)**. Additional parts of Eurocode 8 are indicated in EN 1998-1:2004, **1.1.3**.

(2) EN 1998-6 establishes requirements, criteria, and rules for the design of tall slender structures: towers, including bell-towers, intake towers, radio and TV-towers, masts, chimneys (including free-standing industrial chimneys) and lighthouses. Additional provisions specific to reinforced concrete and to steel chimneys are given in Sections **5** and **6**, respectively. Additional provisions specific to steel towers and to steel guyed masts are given in Sections **7** and **8**, respectively. Requirements are also given for non-structural elements, such as antennae, the liner material of chimneys and other equipment.

NOTE 1 Informative Annex A provides guidance and information for linear dynamic analysis accounting for rotational components of the ground motion.

NOTE 2 Informative Annex B provides information and guidance on modal damping in modal response spectrum analysis.

NOTE 3 Informative Annex C provides information on soil-structure interaction and guidance for accounting for it in linear dynamic analysis.

NOTE 4 Informative Annex D provides supplementary information and guidance on the number of degrees of freedom and the number of modes of vibration to be taken into account in the analysis.

NOTE 5 Informative Annex E gives information and guidance for the seismic design of Masonry chimneys.

NOTE 6 Informative Annex F gives supplementary information for the seismic performance and design of electrical transmission towers.

(3) The present provisions do not apply to cooling towers and offshore structures.

(4) For towers supporting tanks, EN 1998-4 applies.

1.2 Normative References

1.2.1 Use

(1)P 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).

1.2.2 General reference standards

(1) EN 1998-1:2004, **1.2.1** applies.

1.2.3 Additional reference standards for towers, masts and chimneys

(1) EN 1998-6 incorporates other normative references cited at the appropriate places in the text. They are listed below:

EN 1990 Basis of structural design – Annex A3: Application for towers and masts.

EN 1992-1-1 Design of concrete structures – General rules and rules for buildings

EN 1992-1-2 Design of concrete structures – Structural fire design

EN 1993-1-1 Design of steel structures – General rules and rules for buildings

EN 1993-1-2 Design of steel structures – Structural fire design

EN 1993-1-4 Design of steel structures – Stainless steel

EN 1993-1-5 Design of steel structures – Plated structural elements

EN 1993-1-6 Design of steel structures – Strength and stability of shell structures

EN 1993-1-8 Design of steel structures – Design of joints

EN 1993-1-10 Design of steel structures – Selection of material for fracture toughness and through thickness properties

EN 1993-1-11 Design of steel structures – Design of structures with tension components made of steel

EN 1993-3-1 Design of steel structures – Towers and masts

EN 1993-3-2 Design of steel structures – Chimneys

EN 1994-1-1 Design of composite steel and concrete structures – General rules and rules for buildings

EN 1994-1-2 Design of composite steel and concrete structures – Structural fire design

EN 1998-1 Design of structures for earthquake resistance – General rules, seismic actions and rules for buildings

EN 1998-5 Design of structures for earthquake resistance – Foundations, retaining structures and geotechnical aspects.

EN 1998-2 Design of structures for earthquake resistance – Bridges.

EN 13084-2 Free-standing chimneys – Concrete chimneys

EN 13084-7 Free-standing chimneys – Product specification of cylindrical steel fabrications for use in single-wall steel chimneys and steel liners.

1.3 Assumptions

(1)P The general assumptions of EN 1990:2002, **1.3** and EN 1998-1:2004, **1.3**(2)P, apply.

1.4 Distinction between principles and application rules

(1) EN 1990:2002, **1.4** applies.

1.5 Terms and definitions

1.5.1 General terms and definitions

(1) EN 1998-1:2004, **1.5.1** and **1.5.2** apply.

(2) The definitions in EN 1993-3-1, **1.5** and EN 1993-3-2, **1.5** apply.

1.5.2 Further terms and definitions used in EN 1998-6

angle tower

transmission tower used where the line changes direction by more than 3^o in plan. It supports the same kind of loads as the tangent tower

dead-end towers (also called anchor towers)

transmission tower able to support dead-end pulls from all the wires on one side, in addition to the vertical and transverse loads

tangent tower

transmission tower used where the cable line is straight or has an angle not exceeding 3^o in plan. It supports vertical loads, a transverse load from the angular pull of the wires, a longitudinal load due to unequal spans, and forces resulting from the wire-stringing operation, or a broken wire

telescope joint

joint between tubular elements without a flange, the internal diameter of one being equal to the external diameter of the other

transmission tower

tower used to support low or high voltage electrical transmission cables

trussed tower

tower in which the joints are not designed to resist the plastic moment of the connected elements

1.6 Symbols

1.6.1 General

(1) EN 1998-1:2004, **1.6.1** and **1.6.2** apply.

(2) For ease of use, further symbols, used in connection with the seismic design of towers, masts and chimneys, are defined in the text where they occur. However, in addition, the most frequently occurring symbols used in EN 1998-6 are listed and defined in **1.6.2**.

1.6.2 Further symbols used in EN1998-6

E_{eq} equivalent modulus of elasticity;

M_i effective modal mass for the i-th mode of vibration;

R^{θ} ratio between the maximum moment in the spring of an oscillator with rotation as its single-degree-of-freedom, and the rotational moment of inertia about the axis of rotation. The diagram of R^{θ} versus the natural period is the rotation response spectrum;

R^{θ}_x, R^{θ}_y, R^{θ}_z rotation response spectra around the x, y and z axes, in rad/s^2;

γ unit weight of the cable;

σ tensile stress in the cable;

$\bar{\xi}_j$ equivalent modal damping ratio of the j-th mode.

1.7 S.I. Units

(1)P EN 1998-1:2004, **1.7**(1)P applies.

(2) EN 1998-1:2004, **1.7**(2) applies.