

**Eurocode 3: Design of steel structures**  
**Part 1-6: Strength and Stability of Shell Structures**

**Eurokoodeks 3: Teraskonstruksioonide projekteerimine**  
**Osa 1-6: Koorikkonstruksioonide tugevus ja stabiilsus**

## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

Käesolev Eesti standard  
EVS-EN 1993-1-6:2007+NA:2010 sisaldab Euroopa  
standardi EN 1993-1-6:2007 identset ingliskeelset  
teksti ning rahvuslikku lisa NA:2010.

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This Estonian Standard  
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EN 1993-1-6:2007 and the Estonian National Annex  
NA:2010.

This standard is ratified with an order of the Estonian  
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English Version

**Eurocode 3 - Design of steel structures - Part 1-6: Strength and  
Stability of Shell Structures**

Eurocode 3 - Calcul des structures en acier - Partie 1-6:  
Résistance et stabilité des structures en coque

Eurocode 3 - Bemessung und Konstruktion von  
Stahlbauten - Teil 1-6: Festigkeit und Stabilität von Schalen

This European Standard was approved by CEN on 12 June 2006.

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

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## Foreword

This European Standard EN 1993-1-6, Eurocode 3: Design of steel structures: Part 1-6 Strength and stability of shell structures, has been prepared by Technical Committee CEN/TC250 «Structural Eurocodes», the Secretariat of which is held by BSI. CEN/TC250 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of an identical text or by endorsement, at the latest by August 2007, and conflicting National Standards shall be withdrawn at latest by March 2010.

This Eurocode supersedes ENV 1993-1-6.

According to the CEN-CENELEC Internal Regulations, the National Standard 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 United Kingdom.

## National annex for EN 1993-1-6

This standard gives alternative procedures, values and recommendations with notes indicating where national choices may have to be made. Therefore the National Standard implementing EN 1993-1-6 should have a National Annex containing all Nationally Determined Parameters to be used for the design of steel structures to be constructed in the relevant country.

National choice is allowed in EN 1993-1-6 through:

- 3.1.(4)
- 4.1.4 (3)
- 5.2.4 (1)
- 6.3 (5)
- 7.3.1 (1)
- 7.3.2 (1)
- 8.4.2 (3)
- 8.4.3 (2)
- 8.4.3 (4)
- 8.4.4 (4)
- 8.4.5 (1)
- 8.5.2 (2)
- 8.5.2 (4)
- 8.7.2 (7)
- 8.7.2 (16)
- 8.7.2 (18) (2 times)
- 9.2.1 (2)P

## 1. General

### 1.1 Scope

(1) EN 1993-1-6 gives basic design rules for plated steel structures that have the form of a shell of revolution.

(2) This Standard is intended for use in conjunction with EN 1993-1-1, EN 1993-1-3, EN 1993-1-4, EN 1993-1-9 and the relevant application parts of EN 1993, which include:

Part 3.1 for towers and masts;  
Part 3.2 for chimneys;  
Part 4.1 for silos;  
Part 4.2 for tanks;  
Part 4.3 for pipelines.

(3) This Standard defines the characteristic and design values of the resistance of the structure.

- (4) This Standard is concerned with the requirements for design against the ultimate limit states of:
- plastic limit;
  - cyclic plasticity;
  - buckling;
  - fatigue.
- (5) Overall equilibrium of the structure (sliding, uplifting, overturning) is not included in this Standard, but is treated in EN 1993-1-1. Special considerations for specific applications are included in the relevant application parts of EN 1993.
- (6) The provisions in this Standard apply to axisymmetric shells and associated circular or annular plates and to beam section rings and stringer stiffeners where they form part of the complete structure. General procedures for computer calculations of all shell forms are covered. Detailed expressions for the hand calculation of unstiffened cylinders and cones are given in the Annexes.
- (7) Cylindrical and conical panels are not explicitly covered by this Standard. However, the provisions can be applicable if the appropriate boundary conditions are duly taken into account.
- (8) This Standard is intended for application to steel shell structures. Where no standard exists for shell structures made of other metals, the provisions of this standards may be applied provided that the appropriate material properties are duly taken into account.
- (9) The provisions of this Standard are intended to be applied within the temperature range defined in the relevant EN 1993 application parts. The maximum temperature is restricted so that the influence of creep can be neglected if high temperature creep effects are not covered by the relevant application part.
- (10) The provisions in this Standard apply to structures that satisfy the brittle fracture provisions given in EN 1993-1-10.
- (11) The provisions of this Standard apply to structural design under actions that can be treated as quasi-static in nature.
- (12) In this Standard, it is assumed that both wind loading and bulk solids flow can, in general, be treated as quasi-static actions.
- (13) Dynamic effects should be taken into account according to the relevant application part of EN 1993, including the consequences for fatigue. However, the stress resultants arising from dynamic behaviour are treated in this part as quasi-static.
- (14) The provisions in this Standard apply to structures that are constructed in accordance with EN 1090-2.
- (15) This Standard does not cover the aspects of leakage.
- (16) This Standard is intended for application to structures within the following limits:
- design metal temperatures within the range  $-50^{\circ}\text{C}$  to  $+300^{\circ}\text{C}$ ;
  - radius to thickness ratios within the range 20 to 5000.

**NOTE:** It should be noted that the stress design rules of this standard may be rather conservative if applied to some geometries and loading conditions for relatively thick-walled shells.

## 1.2 Normative references

- (1) 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.

EN 1090-2	<i>Execution of steel structures and aluminium structures – Part 2: Technical requirements for steel structures;</i>
EN 1990	<i>Basis of structural design;</i>
EN 1991	<i>Eurocode 1: Actions on structures ;</i>
EN 1993	<i>Eurocode 3: Design of steel structures:</i>
Part 1.1:	<i>General rules and rules for buildings;</i>
Part 1.3:	<i>Cold formed thin gauged members and sheeting;</i>
Part 1.4:	<i>Stainless steels;</i>
Part 1.5:	<i>Plated structural elements;</i>
Part 1.9:	<i>Fatigue strength of steel structures;</i>
Part 1.10:	<i>Selection of steel for fracture toughness and through-thickness properties;</i>
Part 1.12:	<i>Additional rules for the extension of EN 1993 up to steel grades S 700</i>
Part 2:	<i>Steel bridges;</i>
Part 3.1:	<i>Towers and masts;</i>
Part 3.2:	<i>Chimneys;</i>
Part 4.1:	<i>Silos;</i>
Part 4.2:	<i>Tanks;</i>
Part 4.3:	<i>Pipelines;</i>
Part 5:	<i>Piling.</i>

### 1.3 Terms and definitions

The terms that are defined in EN 1990 for common use in the Structural Eurocodes apply to this Standard. Unless otherwise stated, the definitions given in ISO 8930 also apply in this Standard. Supplementary to EN 1993-1-1, for the purposes of this Standard, the following definitions apply:

#### 1.3.1 Structural forms and geometry

##### 1.3.1.1 shell

A structure or a structural component formed from a curved thin plate.

##### 1.3.1.2 shell of revolution

A shell whose geometric form is defined by a middle surface that is formed by rotating a meridional generator line around a single axis through  $2\pi$  radians. The shell can be of any length.

##### 1.3.1.3 complete axisymmetric shell

A shell composed of a number of parts, each of which is a shell of revolution.

##### 1.3.1.4 shell segment

A shell of revolution in the form of a defined shell geometry with a constant wall thickness: a cylinder, conical frustum, spherical frustum, annular plate, toroidal knuckle or other form.