

# ILNAS

Institut luxembourgeois de la normalisation  
de l'accréditation, de la sécurité et qualité  
des produits et services

**ILNAS-EN 1993-4-1:2007**

## **Eurocode 3 - Design of steel structures - Part 4-1: Silos**

Eurocode 3 - Bemessung und  
Konstruktion von Stahlbauten - Teil 4-1:  
Silos

Eurocode 3 - Calcul des structures en  
acier - Partie 4-1: Silos

**02/2007**



## National Foreword

This European Standard EN 1993-4-1:2007 was adopted as Luxembourgish Standard ILNAS-EN 1993-4-1:2007.

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ILNAS-EN 1993-4-1:2007  
EUROPEAN STANDARD **EN 1993-4-1**  
NORME EUROPÉENNE  
EUROPÄISCHE NORM  
February 2007

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ICS 65.040.20; 91.010.30; 91.080.10

Supersedes ENV 1993-4-1:1999

English Version

## Eurocode 3 - Design of steel structures - Part 4-1: Silos

Eurocode 3 - Calcul des structures en acier - Partie 4-1:  
Silos

Eurocode 3 - Bemessung und Konstruktion von  
Stahlbauten - Teil 4-1: Silos

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

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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 CEN Management Centre has the same status as the official versions.

CEN members are the national standards bodies of 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.



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

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## Contents

<b>Foreword</b>	<b>4</b>
<b>1 General</b>	<b>9</b>
1.1 Scope	9
1.2 Normative references	9
1.3 Assumptions	10
1.4 Distinction between principles and application rules	10
1.5 Terms and definitions	10
1.6 Symbols used in Part 4.1 of Eurocode 3	13
1.7 Sign conventions	15
1.8 Units	20
<b>2 Basis of design</b>	<b>20</b>
2.1 Requirements	20
2.2 Reliability differentiation	20
2.3 Limit states	21
2.4 Actions and environmental effects	22
2.5 Material properties	22
2.6 Geometrical data	22
2.7 Modelling of the silo for determining action effects	22
2.8 Design assisted by testing	22
2.9 Action effects for limit state verifications	23
2.10 Durability	24
2.11 Fire resistance	24
<b>3 Properties of materials</b>	<b>25</b>
3.1 General	25
3.2 Structural steels	25
3.3 Stainless steels	25
3.4 Special alloy steels	25
3.5 Toughness requirements	26
<b>4 Basis for structural analysis</b>	<b>27</b>
4.1 Ultimate limit states	27
4.2 Analysis of the structure of a shell silo	28
4.3 Analysis of the box structure of a rectangular silo	31
4.4 Equivalent orthotropic properties of corrugated sheeting	32
<b>5 Design of cylindrical walls</b>	<b>35</b>
5.1 Basis	35
5.2 Distinctions between cylindrical shell forms	35
5.3 Resistance of silo cylindrical walls	36
5.4 Special support conditions for cylindrical walls	59
5.5 Detailing for openings in cylindrical walls	64
5.6 Serviceability limit states	65
<b>6 Design of conical hoppers</b>	<b>66</b>
6.1 Basis	66
6.2 Distinctions between hopper shell forms	66
6.3 Resistance of conical hoppers	67
6.4 Considerations for special hopper structures	72
6.5 Serviceability limit states	73

<b>7</b>	<b>Design of circular conical roof structures</b>	<b>75</b>
7.1	Basis	75
7.2	Distinctions between roof structural forms	75
7.3	Resistance of circular conical silo roofs	75
<b>8</b>	<b>Design of transition junctions and supporting ring girders</b>	<b>77</b>
8.1	Basis	77
8.2	Analysis of the junction	80
8.3	Structural resistances	86
8.4	Limit state verifications	90
8.5	Considerations concerning support arrangements for the junction	92
<b>9</b>	<b>Design of rectangular and planar-sided silos</b>	<b>94</b>
9.1	Basis	94
9.2	Classification of structural forms	94
9.3	Resistance of unstiffened vertical walls	95
9.4	Resistance of silo walls composed of stiffened and corrugated plates	95
9.5	Silos with internal ties	100
9.6	Strength of pyramidal hoppers	100
9.7	Vertical stiffeners on box walls	102
9.8	Serviceability limit states	102
	<b>Annex A: [Informative]</b>	<b>104</b>
	<b>Simplified rules for circular silos in Consequence Class 1</b>	<b>104</b>
	A.1 Action combinations for Consequence Class 1	104
	A.2 Action effect assessment	104
	A.3 Ultimate limit state assessment	104
	<b>Annex B: [Informative]</b>	<b>111</b>
	<b>Expressions for membrane stresses in conical hoppers</b>	<b>111</b>
	<b>Annex C: [Informative]</b>	<b>113</b>
	<b>Distribution of wind pressure around circular silo structures</b>	<b>113</b>

## Foreword

This European Standard EN 1993-4-1, “Eurocode 3: Design of steel structures – Part 4-1: Silos”, 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 1993-4-1:1999.

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.

## 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 1980’s.

In 1989, the Commission and the Member States of the EU and EFTA decided, on the basis of an agreement<sup>1)</sup> between the Commission and CEN, to transfer the preparation and the publication of the Eurocodes to the 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:

EN1990	Eurocode: Basis of structural design
EN1991	Eurocode 1: Actions on structures
EN1992	Eurocode 2: Design of concrete structures
EN1993	Eurocode 3: Design of steel structures
EN1994	Eurocode 4: Design of composite steel and concrete structures
EN1995	Eurocode 5: Design of timber structures

<sup>1)</sup> 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).

EN1996	Eurocode 6: Design of masonry structures
EN1997	Eurocode 7: Geotechnical design
EN1998	Eurocode 8: Design of structures for earthquake resistance
EN1999	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<sup>2)</sup> referred to in Article 12 of the CPD, although they are of a different nature from harmonised product standards<sup>3)</sup>. 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.

### **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. :

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<sup>2)</sup> 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.

<sup>3)</sup> 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.

- 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 application of informative annexes,
- 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<sup>4)</sup>. Furthermore, all the information accompanying the CE Marking of the construction products which refer to Eurocodes should clearly mention which Nationally Determined Parameters have been taken into account.

### **Additional information specific to EN1993-4-1**

EN 1993-4-1 gives design guidance for the structural design of silos.

EN 1993-4-1 gives design rules that supplement the generic rules in the many parts of EN 1993-1.

EN 1993-4-1 is intended for clients, designers, contractors and relevant authorities.

EN 1993-4-1 is intended to be used in conjunction with EN 1990, with EN 1991-4, with the other Parts of EN 1991, with EN 1993-1-6 and EN 1993-4-2, with the other Parts of EN 1993, with EN 1992 and with the other Parts of EN 1994 to EN 1999 relevant to the design of silos. Matters that are already covered in those documents are not repeated.

Numerical values for partial factors and other reliability parameters are recommended as basic values that provide an acceptable level of reliability. They have been selected assuming that an appropriate level of workmanship and quality management applies.

Safety factors for 'product type' silos (factory production) can be specified by the appropriate authorities. When applied to 'product type' silos, the factors in 2.10 are for guidance purposes only. They are provided to show the likely levels needed to achieve consistent reliability with other designs.

### **National Annex for EN1993-4-1**

This standard gives alternative procedures, values and recommendations for classes with notes indicating where national choices may have to be made. Therefore the National Standard implementing EN 1993-4-1 should have a National Annex containing all Nationally Determined Parameters to be used for the design of buildings and civil engineering works to be constructed in the relevant country.

National choice is allowed in EN 1993-4-1 through:

- 2.2 (1)
- 2.2 (3)

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<sup>4)</sup> 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.



- 2.9.2.2 (3)
- 3.4 (1)
- 4.1.4 (2) and (4)
- 4.2.2.3 (6)
- 4.3.1 (6) and (8)
- 5.3.2.3 (3)
- 5.3.2.4 (10), (12) and (15)
- 5.3.2.5 (10) and (14)
- 5.3.2.6 (3) and (6)
- 5.3.2.8 (2)
- 5.3.3.5 (1) and (2)
- 5.3.4.3.2 (2)
- 5.3.4.3.3 (2) and (5)
- 5.3.4.3.4 (5)
- 5.3.4.5 (3)
- 5.4.4 (2), (3) and (4)
- 5.4.7 (3)
- 5.5.2 (3)
- 5.6.2 (1) and (2)
- 6.1.2 (4)
- 6.3.2.3 (2) and (4)
- 6.3.2.7 (3)
- 7.3.1 (4)
- 8.3.3 (4)
- 8.4.1 (6)
- 8.4.2 (5)
- 8.5.3 (3)
- 9.5.1 (3) and (4)
- 9.5.2 (5)
- 9.8.2 (1) and (2)
- A.2 (1) and (2)
- A.3.2.1 (6)
- A.3.2.2 (6)
- A.3.2.3 (2)
- A.3.3 (1), (2) and (3)
- A.3.4 (4)