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EUROCODE 3: DESIGN OF STEEL STRUCTURES - PART 4-1: SILOS, TANKS AND PIPELINES - SILOS

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EUROPEAN PRESTANDARD

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English version

Eurocode 3: Design of steel structures - Part 4-1: Silos, tanks and pipelines - Silos

Eurocode 3: Calcul des structures en acier - Partie 4-1: Silos, réservoirs et canalisations - Silos

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

This European Prestandard (ENV) was approved by CEN on 25 December 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

Ref. No. ENV 1993-4-1:1999 E

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Foreword

Objectives 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 is necessary to indicate the quality of the construction products, and the standard of the workmanship, needed to comply with the assumptions of the design rules.

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

Background to 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 works 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 Member 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 provisions for earthquake resistance of structures;

EN 1999 Eurocode 9 Design of aluminium structures.

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

(9) This Part 4-1 of ENV 1993 is being published by CEN 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 on this Prestandard to be taken into account in determining future actions.

(12) Meanwhile feedback and comments on this Prestandard should be sent to the Secretariat of Sub-committee CEN/TC 250/SC 3 at the following address:

BSI Standards
British Standards House
389 Chiswick High Road
London W4 4AL
England

or to your national standards organisation.

National Application Documents (NADs)

(13) In view of the responsibilities of the 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 necessary supporting European or International Standards might 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 in which the building or civil engineering work is located.

Matters specific to this Prestandard

(16) The list of parts of ENV 1993 that are currently envisaged is:

ENV 1993-1-1 General rules and rules for buildings;

ENV 1993-1-2 Supplementary rules for structural fire design;

ENV 1993-1-3 Supplementary rules for cold formed thin gauge members and sheeting;

ENV 1993-1-4 Supplementary rules for stainless steels;

ENV 1993-1-5 Supplementary rules for planar plated structures without transverse loading;

ENV 1993-1-6 Supplementary rules for the strength and stability of shell structures;

ENV 1993-1-7 Supplementary rules for the strength and stability of planar plated structures loaded transversely;

ENV 1993-2 Steel bridges;

ENV 1993-3-1 Towers and masts;

ENV 1993-3-2 Chimneys;

ENV 1993-4-1 Silos;

ENV 1993-4-2 Tanks;

ENV 1993-4-3 Pipelines;

ENV 1993-5 Piling;

ENV 1993-6 Crane supporting structures,

ENV 1993-7 Marine and maritime structures;

ENV 1993-8 Agricultural structures.

(17) 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.

1 General

1.1 Scope

(1)P Part 4.1 of Eurocode 3 provides principles and application rules for the structural design of steel silos of circular or rectangular plan-form, being free standing or supported.

(2)P This part is concerned only with the requirements for resistance and stability of steel silos. For other requirements (such as operational safety, functional performance, fabrication and erection, quality control, details like man-holes, flanges, filling devices, outlet gates and feeders etc.), see ENV....##

(3)P Provisions relating to special requirements of seismic design are provided in ENV 1998-4, which complements or adapts the provisions of Eurocode 3 specifically for this purpose.

(4) The design of supporting structures for the silo are dealt with in ENV 1993-1-1. The supporting structure is deemed to consist of all structural elements beneath the bottom flange of the lowest ring of the silo, see figure 1.1.

(5) Foundations in reinforced concrete for steel silos are dealt with in ENV 1992 and ENV 1997.

(6) Numerical values of the specific actions on steel silos to be taken into account in the design are given in ENV 1991-4 Actions in Silos and Tanks. Additional rules for silo actions are given in annex A to this Part 4.1 of Eurocode 3.

(7)P This Part 4.1 does not cover:
- resistance to fire;
- silos with internal subdivisions and internal structures;
- silos with capacity less than 10 tonnes;
- cases where special measures are necessary to limit the consequences of accidents.

(8) The circular planform silos covered by this Prestandard are restricted to axisymmetric structures, but the actions on them may be unsymmetrical, and their supports may induce forces in the silo that are not axisymmetrical.

1.2 Distinction between principles and application rules

(1)P Depending on the character of the individual paragraphs, a distinction is made in this Part between principles and application rules.

(2)P The principles comprise:
- general or definitive statements for which there is no alternative;
- requirements and analytical models for which no alternative is permitted unless specifically stated.

(3) The principles are identified by the letter P following the paragraph number.

(4)P The application rules are generally recognised rules that follow the principles and satisfy their requirements. Alternative design rules different from the application rules given in the Eurocode may be used, provided that it is shown that the alternative rule accords with the relevant principles and has at least the same reliability.

(5) In this Part the application rules are identified by a number in brackets, as in this paragraph.

1.3 Normative references

This European Prestandard incorporates, by dated and undated reference, provisions from other standards. 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 the European