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BSI Standards Publication

# Eurocode 1 — Actions on structures

Part 4: Silos and tanks

bsi.

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# National foreword

This British Standard is the UK implementation of EN 1991-4:2026. It supersedes BS EN 1991-4:2006, which will be withdrawn on 30 March 2028.

The UK participation in its preparation was entrusted to Technical Committee B/525/1, Actions (loadings) and basis of design.

A list of organizations represented on this committee can be obtained on request to its committee manager.

National choice is allowed in this standard where explicitly stated within notes. The National Annex to this standard contains the national choices to be used for buildings and civil engineering works constructed in the UK.

The first generation of EN Eurocodes was published between 2002 and 2007, with conflicting British Standards withdrawn in 2010. This document forms part of the second generation of EN Eurocodes.

The second generation of EN Eurocodes is expected to be published between 2023 and 2026. These documents are being published as soon as they are available. This is being done to enable users to prepare for the transition from the first generation to second generation of EN Eurocodes.

UK adoptions of the first generation of EN Eurocodes will be withdrawn by BSI on 30 March 2028. Until that date, the first generation documents should be considered as the applicable standards for buildings and civil engineering works constructed in the UK unless otherwise specified by the relevant authority or in the specification for a particular project.

This standard is intended to be used with its National Annex and other referenced documents, including other second generation Eurocodes, as an interdependent suite of documents.

While the use of provisions in this standard in conjunction with first generation Eurocodes is not precluded, it should be undertaken with care and should only be done when users are satisfied that it will not result in a lower level of reliability than the minimum level set in the first generation Eurocodes and associated UK National Annexes.

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© The British Standards Institution 2026
Published by BSI Standards Limited 2026

ISBN 978 0 539 22690 4

ICS 91.010.30; 91.040.01

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 March 2026.

**Amendments/corrigenda issued since publication**

| Date | Text affected |
|---|---|

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EUROPEAN STANDARD EN 1991-4

NORME EUROPÉENNE

EUROPÄISCHE NORM March 2026

ICS 91.010.30; 91.040.01 Supersedes EN 1991-4:2006

English Version

# Eurocode 1 - Actions on structures - Part 4: Silos and tanks

Eurocode 1 - Actions sur les structures - Partie 4 : Actions sur les silos et les réservoirs

Eurocode 1 - Einwirkungen auf Tragwerke - Teil 4: Einwirkungen auf Silos und Flüssigkeitsbehälter

This European Standard was approved by CEN on 28 December 2025.

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 CEN-CENELEC Management Centre or to any CEN member.

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Ref. No. EN 1991-4:2026 E

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# European foreword

This document (EN 1991-4:2026) 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 and has been assigned responsibility for structural and geotechnical design matters by CEN.

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 September 2027, and conflicting national standards shall be withdrawn at the latest by March 2028.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 1991-4:2006 and EN 1991-4:2006/AC:2012.

The main changes compared to the previous edition are listed below:

a) Introduction of Silo Fundamental Load Cases and Silo Special Load Cases to offer a simple approach for the design of silos with central filling and central discharge. Load modifying factors have been introduced to address specific situations and materials of different Flow Group ending up with characteristic loads.

b) A band load has been introduced to cover the effective transition loads. The band load is fixed for Mass Flow and free for Mixed Flow.

c) The application of Basis of Design for Silos and Tanks have been transferred to EN 1990-1:2023+A1:2026, Clause A.4 Application for silos and tanks.

d) The scope of silo loads has been extended by introducing rules for silos with internal inverted cone, rectangular silos with flexible walls, pressures in unsymmetrical conical hoppers, and eccentric discharge pressures in symmetrical hoppers.

e) The scope of tank loads has been extended to cover air and gas pressures.

The first generation of EN Eurocodes was published between 2002 and 2007. This document forms part of the second generation of the Eurocodes, which have been prepared under Mandate M/515 issued to CEN by the European Commission and the European Free Trade Association.

The Eurocodes have been drafted to be used in conjunction with relevant execution, material, product and test standards, and to identify requirements for execution, materials, products and testing that are relied upon by the Eurocodes.

The Eurocodes recognize the responsibility of each Member State and have safeguarded their right to determine values related to regulatory safety matters at national level through the use of National Annexes.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North

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Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkiye and the United Kingdom.

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# 0 Introduction

## 0.1 Introduction to the Eurocodes

The Structural Eurocodes comprise the following standards generally consisting of a number of Parts:

— EN 1990 Eurocode — Basis of structural and geotechnical design

— EN 1991 Eurocode 1 — 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 structures

— EN 19100 Eurocode 10 — Design of glass structures

— New parts are under development, e.g. Eurocode for design of fibre-polymer composite structures and design of tensioned membrane structures

The Eurocodes are intended for use by designers, clients, manufacturers, constructors, relevant authorities (in exercising their duties in accordance with national or international regulations), educators, software developers, and committees drafting standards for related product, testing and execution standards.

NOTE Some aspects of design are most appropriately specified by relevant authorities or, where not specified, can be agreed on a project-specific basis between relevant parties such as designers and clients. The Eurocodes identify such aspects making explicit reference to relevant authorities and relevant parties.

## 0.2 Introduction to the EN 1991 series

EN 1991 (all parts) specifies actions for the structural and geotechnical design of buildings, bridges and other civil engineering works, or parts thereof, including temporary structures, in conjunction with EN 1990-1 and the other Eurocodes.

EN 1991 does not cover the specific requirements of actions for seismic regions. Provisions related to such requirements are given in EN 1998 (all parts), which complement and are consistent with EN 1991.

EN 1991 is also applicable to existing structures for:

— structural assessment,

— strengthening or repair,

— change of use.

NOTE 1 In these cases additional or amended provisions can be necessary.

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EN 1991 is also applicable for the design of structures where materials or actions outside the scope of the other Eurocodes are involved.

NOTE 2 In this case additional or amended provisions can be necessary.

EN 1991 is subdivided into various parts:

— EN 1991-1-1 Eurocode 1 — Actions on structures — Part 1-1: Specific weight of materials, self-weight of construction works and imposed loads for buildings

— EN 1991-1-2 Eurocode 1 — Actions on structures — Part 1-2: Actions on structures exposed to fire

— EN 1991-1-3 Eurocode 1 — Actions on structures — Part 1-3: Snow Loads

— EN 1991-1-4 Eurocode 1 — Actions on structures — Part 1-4: Wind Actions

— EN 1991-1-5 Eurocode 1 — Actions on structures — Part 1-5: Thermal Actions

— EN 1991-1-6 Eurocode 1 — Actions on structures — Part 1-6: Actions during execution

— EN 1991-1-7 Eurocode 1 — Actions on structures — Part 1-7: Accidental actions

— EN 1991-1-8 Eurocode 1 — Actions on structures — Part 1-8: Actions from waves and currents on coastal structures

— EN 1991-1-9 Eurocode 1 — Actions on structures — Part 1-9: Atmospheric icing

— EN 1991-2 Eurocode 1 — Actions on structures — Part 2: Traffic loads on bridges and other civil engineering works

— EN 1991-3 Eurocode 1 — Actions on structures — Part 3: Actions induced by cranes and machines

— EN 1991-4 Eurocode 1 — Actions on structures — Part 4: Silos and tanks

### 0.3 Introduction to EN 1991-4

This document gives guidance for the evaluation of actions for the structural design of silos and tanks.

### 0.4 Verbal forms used in the Eurocodes

The verb “shall” expresses a requirement strictly to be followed and from which no deviation is permitted in order to comply with the Eurocodes.

The verb “should” expresses a highly recommended choice or course of action. Subject to national regulation and/or any relevant contractual provisions, alternative approaches could be used/adopted where technically justified.

The verb “may” expresses a course of action permissible within the limits of the Eurocodes.

The verb “can” expresses possibility and capability; it is used for statements of fact and clarification of concepts.

### 0.5 National annex for EN 1991-4

National choice is allowed by this standard where explicitly stated within notes. National choice includes the selection of values for Nationally Determined Parameters (NDPs).

The national standard implementing this document can have a National Annex containing all national choices to be used for the design of buildings and civil engineering works to be constructed in the relevant country.

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When no national choice is given, the default choice given in this document is to be used.

When no national choice is made and no default is given in this document, the choice can be specified by a relevant authority or, where not specified, agreed for a specific project by appropriate parties.

National choice is allowed in this document through notes to the following clauses:

4.1(2) 5.5.17(2)

National choice is allowed in this document on the application of the following informative annexes:

Annex A Annex B Annex F Annex G

The National Annex can contain, directly or by reference, non-contradictory complementary information for ease of implementation, provided it does not alter any provisions of the Eurocodes.

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# 1 Scope

## 1.1 Scope of EN 1991-4

(1) This document provides rules for calculating actions for the structural design of silos and tanks.

NOTE 1 Silos are used for the storage of particulate solids. Tanks are used for the storage of liquids.

NOTE 2 For limitations on rules for silos given in this document, see 1.3.

NOTE 3 For limitations on rules for tanks given in this document, see 1.4.

(2) This document includes some provisions for actions on silo and tank structures that are not only associated with the stored particulate solids or liquids (e.g. the effects of thermal differentials) but substantially affected by them.

NOTE Liquid loads on tanks are very precisely defined. Many loads on silos are not known with great precision. This document provides guidance for many practical situations for which very limited certain knowledge is available, and the information is derived from the limited experimental and analytical information available, coupled with conclusions drawn from failure investigations. The information is not based on a sound statistical treatment of experimental data.

(3) This document is intended for use with concrete, steel, aluminium, timber and FRP storage structures.

NOTE FRP is the standard acronym for fibre reinforced polymer materials.

(4) This document is also applicable for the structural assessment of existing silos and tanks, unless otherwise specified by the relevant authority or, if not specified, agreed between the relevant parties for the specific project.

NOTE 1 Changes in filling or discharge arrangements, changes in the wall friction of inner surfaces, or in the use of the silo, including storage of different particulate solids, can be reasons for assessing existing silos.

NOTE 2 Differentiation of the liquid stored can be a reason for assessing existing tanks.

## 1.2 Assumptions

(1) The assumptions of EN 1990-1 apply.

(2) This document is intended to be used in conjunction with EN 1990-1, with the other parts of EN 1991, EN 1992, EN 1993, EN 1995, EN 1997, EN 1998 and EN 1999 where relevant to the design of silos and tanks.

## 1.3 Limitations on silos

### 1.3.1 Geometrical limitations

(1) The following geometrical limitations apply to the design rules for silos and silo batteries (see 3.2.59 and 3.2.60) covered by this document:

- the silo planform cross-section shapes are limited to those shown in Figure 1.1c.

NOTE 1 Further information concerning planform cross-section geometries is given in Clause 7.