BSI Standards Publication

Eurocode 8 — Design of structures for earthquake resistance

Part 4: Silos, tanks, pipelines, towers, masts and chimneys

bsi.

National foreword

This British Standard is the UK implementation of EN 1998-4:2025. It supersedes BS EN 1998-6:2005 and BS EN 1998-4:2006, which will be withdrawn on 30 March 2028.

The UK participation in its preparation was entrusted to Technical Committee B/525/8, Structures in seismic regions.

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The first generation of EN Eurocodes was published between 2002 and 2007, with conflicting British Standards withdrawn in 2010.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UK adoptions of the first generation of EN Eurocodes will be withdrawn by BSI on 30 March 2028.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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EUROPEAN STANDARD EN 1998-4

NORME EUROPÉENNE

EUROPÄISCHE NORM October 2025

ICS 91.010.30; 91.060.40; 91.120.25 Supersedes EN 1998-6:2005, EN 1998-4:2006

English Version

Eurocode 8 - Design of structures for earthquake resistance - Part 4: Silos, tanks, pipelines, towers, masts and chimneys

Eurocode 8 - Calcul des structures pour leur résistance au séisme - Partie 4: Silos, réservoirs, tuyauteries, tours, mâts et cheminées

Eurocode 8 - Auslegung von Bauwerken gegen Erdbeben - Teil 4: Silos, Tankbauwerke und Rohrleitungen, Türme, Maste und Schornsteine

This European Standard was approved by CEN on 20 July 2025.

This European Standard was corrected and reissued by the CEN-CENELEC Management Centre on 22 October 2025.

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN 1998-4:2025) 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 1998-4:2007 and EN 1998-6:2005.

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

- Merging of Part 4 and Part 6 of EN 1998 in one document and uniform normative structure for all clauses
- Redefinition of limit states and combination rules
- Improved consistency with EN 1992 and EN 1993 and clear separation from material-specific codes
- Silos: lateral force method considering vertical seismic actions
- Tanks: introduction of forced-based approach, incorporation of elevated tanks and tabulated values for hydrodynamic pressure functions in tanks
- Pipelines: design concepts and approaches for fault crossings and liquefaction and modelling approaches for soil-structure interaction in pipelines
- Towers, masts and chimneys: design without rotational spectra
- Simplification of damping approaches
- New combination rules of components for axisymmetric structures

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

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 EN 1998 (all parts)

EN 1998 (all parts) defines the rules for the seismic design of new buildings and other structures, as well as temporary ones, including geotechnical aspects.

EN 1998 (all parts) also defines the rules for the seismic assessment and retrofit of existing buildings and other structures.

EN 1998 (all parts) additionally covers the verification of structures in the seismic design situation during construction, when required.

For the design of structures in seismic regions, the provisions of EN 1998 (all parts) are to be applied in conjunction with the relevant provisions of EN 1990 to EN 1997 and EN 1999.

EN 1998 (all parts) applies to structures of consequence classes CC1, CC2 and CC3, as defined in EN 1990. The provisions in the Eurocodes do not entirely cover design rules needed for structures classified as CC4. For these structures, additional provisions to those given in the Eurocodes can be needed.

Given that seismic hazard is characterised by a significant uncertainty, a null seismic risk is not achievable in practice. Therefore, in Eurocode 8, the seismic action is represented in a conventional form, proportional in amplitude to earthquake ground motions likely to occur at a given location and

representative of their frequency content. This representation is not the prediction of a particular seismic movement, and such a movement could give rise to more severe effects than those of the seismic action considered, inflicting damage greater than the one described by the Limit States contemplated in EN 1998 (all parts).

In addition, engineering methods are associated with assumptions that may not be verified when considering the effects of the seismic action, under which structures are assumed to respond in the non-linear regime. Such uncertainties are taken into account according to the general framework of EN 1990, with a residual risk of underestimation of their effects.

EN 1998 is subdivided in various parts:

- EN 1998-1-1, Eurocode 8 — Design of structures for earthquake resistance — Part 1-1: General rules and seismic action
- EN 1998-1-2, Eurocode 8 —Design of structures for earthquake resistance — Part 1-2: Buildings
- EN 1998-2, Eurocode 8 — Design of structures for earthquake resistance — Part 2: Bridges
- EN 1998-3, Eurocode 8 —Design of structures for earthquake resistance — Part 3: Assessment and retrofitting of buildings and bridges
- EN 1998-4, Eurocode 8 — Design of structures for earthquake resistance — Part 4 Silos, tanks, pipelines, towers, masts and chimneys
- EN 1998-5, Eurocode 8 —Design of structures for earthquake resistance — Part 5: Geotechnical aspects, foundations, retaining and underground structures

0.3 Introduction to EN 1998-4

This document provides specific requirements for earthquake resistant design of new on-ground and elevated silos, on-ground, elevated and underground tanks, above-ground and buried pipeline systems, towers, masts and chimneys and ancillary elements attached to these structures or in industrial facilities, which are additional to the ones in other Eurocodes.

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 1998-4

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

The national standard implementing EN 1998-4 can have a National Annex containing all national choices to be used for the design of buildings to be constructed in the relevant country.

When no national choice is given, the default choice given in this standard 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 the relevant parties.

National choice is allowed in EN 1998-4 through notes to the following clauses:

4.2(2)	4.2(3)	4.3(6)	4.3(7)
5.5.3(1)	6.12.3(1)	7.6.3(1)	8.5.3(1)

National choice is also allowed in EN 1998-4 on the application of the following informative annexes:

Annex B	Annex C	Annex D	Annex E
Annex F	Annex G	Annex M	

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.

1 Scope

1.1 Scope of EN 1998-4

(1) This document is applicable to the seismic design of on-ground and elevated silos, on-ground, elevated and underground tanks, above-ground and buried pipeline systems, towers, masts and chimneys and ancillary elements attached to these structures or in industrial facilities.

(2) Unless specifically stated, EN 1998-1-1 and EN 1998-5 apply.

(3) EN 1998-4 is applicable in complement to the other relevant Eurocodes.

NOTE This document contains only those provisions that, in addition to the provisions of the other relevant Eurocodes, are used for the design of new structures, as listed in (1), in seismic regions. EN 1998-4 complements in this respect the other Eurocodes.

1.2 Assumptions

(1) The assumptions of EN 1998-1-1 apply to this document.

(2) It is assumed that the changes in a) and b) will not take place during the construction phase or during the subsequent life span for all structures covered by EN 1998-4, unless proper justification and verification is provided:

a) substantial changes in the structural systems, supporting structures or attached ancillary elements listed in 1.1(1);

b) substantial changes of masses or mass distribution. This includes, in particular, changes in production, such as specific changes of filling loads, filling states and ancillary elements.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE See the Bibliography for a list of other documents cited that are not normative references, including those referenced as recommendations (i.e. in ‘should’ clauses), permissions (‘may’ clauses), possibilities ('can' clauses), and in notes.

EN 1990:2023,[1] *Eurocode — Basis of structural and geotechnical design*

prEN 1991-4:2024, *Eurocode 1 — Actions on structures — Part 4: Silos and tanks*

<std>EN 1998-1-1:2024, *Eurocode 8 — Design of structures for earthquake resistance — Part 1-1: General rules and seismic action*

prEN 1998-1-2:2023, *Eurocode 8 — Design of structures for earthquake resistance — Part 1-2: Buildings*

<std>EN 1998-5:2024, *Eurocode 8 — Design of structures for earthquake resistance — Part 5: Geotechnical aspects, foundations, retaining and underground structures*</std>

ISO 80000, *Quantities and units*

[1] As impacted by EN 1990:2023/prA1:2024.