BSI Standards Publication

Eurocode 8 — Design of structures for earthquake resistance

Part 5: Geotechnical aspects, foundations, retaining and underground structures

bsi.

National foreword

This British Standard is the UK implementation of EN 1998-5:2024. It supersedes BS EN 1998-5:2004, which will be withdrawn on 30 March 2028.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The first generation of EN Eurocodes was published between 2002 and 2007, with conflicting British Standards withdrawn in 2010.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UK adoptions of the first generation of EN Eurocodes will be withdrawn by BSI on 30 March 2028.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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Published by BSI Standards Limited 2024

ISBN 978 0 539 18322 1

ICS 91.010.30; 91.120.25

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 October 2024.

Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD EN 1998-5

NORME EUROPÉENNE

EUROPÄISCHE NORM September 2024

ICS 91.010.30; 91.120.25 Supersedes EN 1998-5:2004

English Version

Eurocode 8 - Design of structures for earthquake resistance - Part 5: Geotechnical aspects, foundations, retaining and underground structures

Eurocode 8 - Calcul des structures pour leur résistance au séisme - Partie 5 : Aspects géotechniques, fondations, soutènements et structures souterraines

Eurocode 8 - Auslegung von Bauwerken gegen Erdbeben - Teil 5: Geotechnische Aspekte, Gründungen, Stütz- und Untertagebauwerke

This European Standard was approved by CEN on 7 July 2024.

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

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Ref. No. EN 1998-5:2024 E

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European foreword

This document (EN 1998-5:2024) 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 1998-5:2004.

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 main changes compared to the previous edition are listed below:

— improved consistency with EN 1997;

— distinction between geotechnical systems and geotechnical structures;

— alignment of “basis of design” to the new concepts in EN 1998-1-1;

— derivation of seismic action for geotechnical systems/structures;

— water levels according to EN 1990;

— rules for capacity design of foundations;

— development of the displacement-based approach for all topics;

— development of models for soil-structure interaction;

— rules for analysis and verification of piles;

— new clauses on seismic action effects on underground structures (tunnels, large spaces, pipelines, etc.).

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 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 several 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
- New parts are under development, e.g. Eurocode for design of structural glass

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 characterized 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 cannot be verified when considering the effects of the seismic action, under which structures are assumed to respond in the nonlinear 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 1998-5

This document contains general requirements for the earthquake resistant design of geotechnical structures and geotechnical systems, including the definition of the seismic action, of the ground characteristics, general requirements for siting and foundations soils, design of foundation systems, retaining structures and underground structures, as well as rules for consideration of soil-structure interaction.

This document also contains provisions for the assessment of existing geotechnical structures and geotechnical systems.

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 1998-5

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

The national standard implementing EN 1998-5 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.

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 EN 1998-5 through notes to the following clauses:

4.2(3)	4.2(6)	4.3(3)	6.5(2)
6.5(3)	7.3.1(2)	9.4.2.1.3(7)	

National choice is allowed in EN 1998-5 on the application of the following informative annexes:

Annex A	Annex B	Annex C	Annex D
Annex E	Annex F	Annex G	Annex H
Annex I			

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 1998-5

(1) This document establishes general principles for the design and assessment of geotechnical systems in seismic regions. It gives general rules relevant to all families of geotechnical structures, to the design of foundations, retaining structures and underground structures and complements EN 1997-3 for the seismic design situation.

(2) This document contains the basic performance requirements and compliance criteria applicable to geotechnical structures and geotechnical systems in seismic regions.

(3) This document refers to the rules for the representation of seismic actions and the description of the seismic design situations defined in EN 1998-1-1 and provides specific definition of the seismic action applicable to geotechnical structures.

1.2 Assumptions

(1) The assumptions of EN 1990 apply to this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all 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*

EN 1997-1:2024, *Eurocode 7 — Geotechnical design — Part 1: General rules*

EN 1997-2:2024, *Eurocode 7 — Geotechnical design — Part 2: Ground properties*

EN 1997-3:—[2], *Eurocode 7 — Geotechnical design — Part 3: Geotechnical structures*

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

EN 1998-3:—[3], *Eurocode 8 — Design of structures for earthquake resistance — Part 3: Assessment and retrofitting of buildings and bridges*

ISO 80000, *Quantities and units*

[1] As impacted by EN 1990:2023/prA1:2024.
[2] Under preparation. Stage at the time of publication: FprEN 1997-3:2024.
[3] Under preparation. Stage at the time of publication: prEN 1998-3:2023.