



BSI Standards Publication

Eurocode 8 — Design of structures for earthquake resistance

Part 3: Assessment and retrofitting of buildings and bridges

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National foreword

This British Standard is the UK implementation of EN 1998-3:2025. It supersedes BS EN 1998-3:2005, which will be withdrawn on 30 March 2028.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The first generation of EN Eurocodes was published between 2002 and 2007, with conflicting British Standards withdrawn in 2010.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UK adoptions of the first generation of EN Eurocodes will be withdrawn by BSI on 30 March 2028.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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Amendments/corrigenda issued since publication

Date

Text affected

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English Version

Eurocode 8 - Design of structures for earthquake resistance - Part 3: Assessment and retrofitting of buildings and bridges

Eurocode 8 - Calcul des structures pour leur résistance au séisme - Partie 3: Évaluation et renforcement des bâtiments et des ponts

Eurocode 8 - Auslegung von Bauwerken gegen Erdbeben - Teil 3: Beurteilung und Ertüchtigung von Gebäuden und Brücken

This European Standard was approved by CEN on 20 July 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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European foreword

This document (EN 1998-3:2025) 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 1998-3:2005.

EN 1998-3:2025 includes the following significant technical changes with respect to EN 1998-5:2005:

- clarification of knowledge level according to three criteria (geometry, materials, detailing);
- rewriting of analysis methods in line with EN 1998-1-1;
- verification using the displacement-based approach using local or global criteria;
- deformation criteria (yield and ultimate) of structural materials;
- resistance models for retrofitting introducing new methods of retrofit;
- all material partial factors γ_{Rd} unified based on the resistance distribution, depending on the knowledge level and calibrated for a target reliability;
- complete procedure for the force-based approach usable in low and moderate seismicity;
- normative clauses for concrete, steel, and masonry for assessment completely rewritten (whilst there were only informative annexes in the previous edition);
- new clause for timber buildings;
- new clause for bridges;
- addition of flowcharts for the application of the code.

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.

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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.

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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 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

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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 1998-3

This document was developed because:

- for many existing structures, seismic resistance was not considered during the original construction, whereas non-seismic actions were catered for, at least by means of traditional construction rules;
- seismic risk evaluations in accordance with present knowledge may indicate the need for retrofitting campaigns;
- damage caused by earthquakes may create the need for major repairs, associated with large costs.

The seismic situation covered in this document differs significantly from those encountered in non-seismic situations. This explains that, at this stage of development of the Eurocodes, the analysis methods and approaches for defining the partial factors differ in certain points from those given by the principles of EN 1990-2. However, the necessary correspondences, for example those related to material properties, are given in the appropriate Eurocodes and the differences do not constitute a hindrance in the development of projects.

Seismic risk mitigation policies may differentiate between “active” and “passive” seismic assessment and retrofitting programmes.

- “Active” programmes may require owners of certain categories of structures to meet specific deadlines for the completion of the seismic assessment and – depending on its outcome – of the retrofitting. The categories of structures selected to be targeted may depend on the associated seismic risk, which depends on hazard, site conditions and vulnerability, and/or on the consequence class and occupancy, or, finally on the perceived vulnerability of the structure (as influenced by type of material and construction, size, age of the structure and contemporary design code, etc.);
- “Passive” programmes associate seismic assessment – possibly leading to retrofitting – with other events or activities related to the use of the structure and its continuity, such as a change in use that increases occupancy or consequence class, remodelling above certain limits (as a percentage of the area or of the total value of the structure), repair of damage after an earthquake, etc.

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Therefore, this document only provides technical clauses. The choice to apply it to a certain type of structure depends on the choice of the Authority concerned or the Project Owner, depending on the risk mitigation approach considered.

The choice of the Limit States to be verified, as well as the return periods of the seismic action ascribed to the various Limit States, may depend on the adopted programme for assessment and retrofitting. The relevant requirements may depend on the cost of the retrofitting works to be undertaken, in relation with the final accepted risks. In “passive” programmes triggered by remodelling, the relevant requirements may graduate with the extent and cost of the remodelling work undertaken.

Unlike new structures, where the mechanical and physical properties of the materials can be prescribed at the time of the project, existing structures can only be partially known, depending on the reconnaissance carried out and the methods of investigation applied. Therefore, the assumed properties for the analysis of these structures are tainted by uncertainties, all the more important as the knowledge resulting from the survey is limited. The conclusions of the assessment, and of the eventual retrofitting design, consequently suffer from inherent uncertainty and there remains a low probability of failure, even when the provisions of this document have been met.

This document addresses only the structural aspects of seismic assessment and retrofitting, which may correspond to a single component of a broader strategy for seismic risk mitigation. The conditions under which seismic assessment of individual buildings or bridges – possibly leading to retrofitting – may be required are beyond the scope of this document. This document will apply once the requirement to assess a particular structure has been established, in the situation where this structure is dynamically independent of the neighbouring ones. This document may be applied also when the structure is connected to other structures not explicitly modelled, provided that the structural interaction may be neglected, or it is considered in the model through equivalent constraints and/or added masses.

In cases of low seismic action class (see EN 1998-1-1:2024, 4.1(6)), this document may be adapted to local conditions by appropriate National Annexes. The concept of risk-based assessment may be adopted in this context, in particular by countries in low seismicity areas.

In seismic retrofitting situations, qualitative verifications for the identification and elimination of major structural defects are very important and should not be discouraged by the quantitative analytical approach proper to this part of Eurocode 8. Preparation of documents of more qualitative nature is left to the initiative of the relevant authorities.

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 1998-3

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 1998-3 can have a National Annex containing all national choices to be used for the assessment and retrofitting of buildings and bridges in the relevant country.

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

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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 1998-3 through notes to the following clauses:

4.1(2)	4.1(3)	5.2(1)	5.4.4(1)
8.2.4.1(2)	8.5.1.1(3)	8.5.1.1(4)	8.5.1.2(2)
8.5.2.1(3)	8.5.2.2(3)	8.6.4.3(4)	9.2.4.1(4)
9.5.2.1(2)	9.5.2.1(3)	9.5.2.1(4)	9.5.2.1(5)
9.5.3.2(1)	9.5.4.1(1)	9.5.7.1(2)	10.2.1(3)
A.3(2)			

National choice is also allowed in EN 1998-3 on the application of the following informative annexes:

Annex A	Annex B	Annex C	Annex D
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.

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1 Scope

1.1 Scope of EN 1998-3

(1) This document is applicable to the assessment and retrofitting of buildings and bridges in seismic regions, namely as given in a) to c):

- a) to provide criteria for the assessment of the seismic performance of existing individual buildings and bridges;
- b) to describe the procedure to be followed in selecting necessary corrective measures;
- c) to set forth criteria for the design of retrofitting measures (i.e. design, structural analysis including intervention measures, final dimensioning of structural parts and their connections to existing structural members).

NOTE 1 For the purposes of this document, retrofitting covers both the seismic upgrading (e.g. strengthening or adding a passive system) of undamaged structures and the repair and possible upgrading of earthquake-damaged structures.

NOTE 2 Only the most common retrofit techniques are covered in this document. This does not exclude the use of other techniques, which can be developed in each country, based on the strengthening principles of this document.

NOTE 3 Annex D gives flowcharts for the application of this document.

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

(3) Reflecting the performance requirements of EN 1998-1-1:2024, 4.1, this document covers the seismic assessment and retrofitting of buildings and bridges made of the more commonly used structural materials: concrete, steel and composite, timber and masonry.

NOTE Annexes B and C contain additional guidance related to the assessment of timber and masonry structures, respectively, and to their retrofitting when necessary.

(4) This document is intended for the assessment of individual structures, to decide on the need for structural intervention and to design the retrofitting measures that may be necessary. It is not intended for the vulnerability assessment of populations or groups of structures in seismic risk evaluations for various purposes (e.g. for determining insurance risk, for setting risk mitigation priorities, etc.).

(5) This document provides (in its material-specific Clauses 8 to 11) criteria for the verification of the more common retrofitting techniques currently in use.

(6) This document gives specific rules for the assessment and retrofitting relevant to existing buildings and bridges of consequence classes CC1, CC2 and CC3, as defined in EN 1990:2023, 4.3.

(7) Although the provisions of this document are applicable to all common categories of buildings and bridges, the seismic assessment and retrofitting of monuments and heritage structures often requires different types of provisions and approaches, depending on the nature of the monuments and heritage structures.

1.2 Assumptions

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

(2) The provisions of this document assume that the data collection and tests are performed by experienced personnel and that the engineer responsible for the assessment, the possible design of the retrofitting and the execution of work has appropriate experience of the type of structures being upgraded or repaired.

(3) It is assumed that inspection procedures, checklists and other data-collection procedures will be documented and filed and referred to in the assessment/design documents.