



BSI Standards Publication

Eurocode 3: Design of steel structures

Part 1-9: Fatigue

This is a preview of BS EN 1993-1-9:2025. [Click here to purchase the full version from the ANSI store.](#)

National foreword

This British Standard is the UK implementation of EN 1993-1-9:2025. It supersedes BS EN 1993-1-9:2005, which will be withdrawn on 30 March 2028.

The UK participation in its preparation was entrusted to Technical Committee CB/203, Design & execution of steel structures, and Technical Committee B/525/10, Bridges.

A list of organizations represented on these committees can be obtained on request to their committee managers.

BSI, as a member of CEN, is obliged to publish EN 1993-1-9:2025 as a British Standard. However, attention is drawn to the fact that during the development of this European Standard, the UK committees voted against its approval. The UK committees submitted a negative vote due to their following concerns:

- It is the opinion of the UK committees that the revised presentation of the fatigue resistance curves between BS EN 1993-1-9:2005 and this standard could cause designers to neglect high cycle fatigue. In this standard, dashed lines are used to illustrate stress ranges below the constant amplitude fatigue limit $\Delta\sigma_D$ to emphasize that users only need to consider that portion of the curve for cases with variable amplitude loading when at least one stress range exceeds $\Delta\sigma_D$. BS EN 1993-1-9:2005 emphasized that users could only neglect stress ranges below $\Delta\sigma_D$ if they had constant amplitude loading or all stress ranges within variable amplitude loading were below $\Delta\sigma_D$. The UK committees advise users that in civil and building engineering structures in the UK, the incidence of constant amplitude loading is extremely rare. The UK committees believe this standard's use of dashed lines in this way has the potential to be unclear, as their opinion is that this is not consistent with the illustration of fatigue resistance curves in other design standards for metal structures, including BS EN 1999-1-3:2023.
- The UK committees note that there are numerous differences in the wording of term definitions in this standard compared to corresponding terms in BS EN 1999-1-3:2023.
- The geometric stress concentration effect resulting from joints between structural members where there is a lack of axial continuity through the joint is not addressed in the basic conditions requiring nominal stress to be modified by the stress concentration factor. It is the opinion of the UK committees that this is a fundamental fatigue design issue and requires proper consideration by designers.
- It is the opinion of the UK committees that the stated weld quality requirements (see Subclause 8.2 and Tables 10.1 to 10.13) are inadequate for some of the higher detail weld categories for safe life design.

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.

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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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EUROPÄISCHE NORM

March 2025

ICS 91.010.30; 91.080.13

Supersedes EN 1993-1-9:2005, EN 1993-1-9:2005/AC:2009

English Version

Eurocode 3: Design of steel structures - Part 1-9: Fatigue

Eurocode 3: Calcul des structures en acier - Partie 1-9:
FatigueEurocode 3: Bemessung und Konstruktion von
Stahlbauten - Teil 1-9: Ermüdung

This European Standard was approved by CEN on 29 December 2024.

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.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of 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 United Kingdom.



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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 1993-1-9:2025) has been prepared by Technical Committee CEN/TC 250 “Structural Codes”, 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 1993-1-9:2005 and EN 1993-1-9:2005/AC:2009.

EN 1993-1-9:2025 includes the following significant technical changes with respect to EN 1993-1-9:2005 and EN 1993-1-9:2005/AC:2009:

- reorganization to achieve improvements in clarity and to accommodate to the new structure of all Eurocodes;
- alignment of terms with EN 1990:2002, extension of definitions, introduction of distinction between concepts and methods;
- adaptation of partial factors to three consequence classes from EN 1990:2002;
- elimination of misinterpretations in calculation of nominal stresses, in particular for welds; inclusion of rules on calculation of nominal stresses in bolts and rods; inclusion of guidance on the calculation of nominal stresses in preloaded bolts and rods subject to tension; inclusion of stress concentration factors k_t ;
- elimination of gaps for calculation of hot spot stresses, strongly linked with the development of prEN 1993-1-14:2022;
- inclusion of method for calculation of effective notch stresses, also linked with the development of prEN 1993-1-14:2022;
- inclusion of sets of fatigue resistance curves for normal stresses, for hot spot stresses and for effective notch stresses;
- update and extension or inclusion of detail category tables for all stress calculation methods;
- inclusion of recommendations for welded joints subjected to High Frequency Mechanical Impact (HFMI) treatment for nominal stress method.

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.

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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
- 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 1993 (all parts)

EN 1993 (all parts) applies to the design of buildings and civil engineering works in steel. It complies with the principles and requirements for the safety and serviceability of structures, the basis of their design and verification that are given in EN 1990 – Basis of structural design.

EN 1993 (all parts) is concerned only with requirements for resistance, serviceability, durability and fire resistance of steel structures. Other requirements, e.g. concerning thermal or sound insulation, are not covered.

EN 1993 is subdivided in various parts:

- EN 1993-1, *Design of steel structures — Part 1: General rules and rules for buildings*;
- EN 1993-2, *Design of steel structures — Part 2: Bridges*;
- EN 1993-3, *Design of steel structures — Part 3: Towers, masts and chimneys*;
- EN 1993-4, *Design of steel structures — Part 4: Silos and tanks*;
- EN 1993-5, *Design of steel structures — Part 5: Piling*;
- EN 1993-6, *Design of steel structures — Part 6: Crane supporting structures*;

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- EN 1993-7,¹ *Design of steel structures — Part 7: Sandwich panels.*

EN 1993-1 in itself does not exist as a physical document, but as a document series that comprises the following 14 separate parts, the basic part being EN 1993-1-1:

- EN 1993-1-1, *Design of steel structures — Part 1-1: General rules and rules for buildings;*
- EN 1993-1-2, *Design of steel structures — Part 1-2: Structural fire design;*
- EN 1993-1-3, *Design of steel structures — Part 1-3: Cold-formed members and sheeting;*
NOTE Cold-formed hollow sections supplied according to EN 10219 are covered in EN 1993-1-1.
- EN 1993-1-4, *Design of steel structures — Part 1-4: Stainless steel structures;*
- EN 1993-1-5, *Design of steel structures — Part 1-5: Plated structural elements;*
- EN 1993-1-6, *Design of steel structures — Part 1-6: Strength and stability of shell structures;*
- EN 1993-1-7, *Design of steel structures — Part 1-7: Plate assemblies with elements under transverse loads;*
- EN 1993-1-8, *Design of steel structures — Part 1-8: Joints;*
- EN 1993-1-9, *Design of steel structures — Part 1-9: Fatigue;*
- EN 1993-1-10, *Design of steel structures — Part 1-10: Material toughness and through-thickness properties;*
- EN 1993-1-11, *Design of steel structures — Part 1-11: Tension components;*
- EN 1993-1-12, *Design of steel structures — Part 1-12: Additional rules for steel grades up to S960;*
- EN 1993-1-13, *Design of steel structures — Part 1-13: Beams with large web openings;*
- EN 1993-1-14, *Design of steel structures — Part 1-14: Design assisted by finite element analysis.*

All subsequent parts numbered EN 1993-1-2 to EN 1993-1-14 treat general topics that are independent from the structural type like structural fire design, cold-formed members and sheeting, stainless steels, plated structural elements, etc.

All subsequent parts numbered EN 1993-2 to EN 1993-7 treat topics relevant for a specific structural type like steel bridges, towers, masts and chimneys, silos and tanks, piling, crane supporting structures, etc. EN 1993-2 to EN 1993-7 refer to the generic rules in EN 1993-1 and supplement, modify or supersede them.

0.3 Introduction to EN 1993-1-9

EN 1993-1-9 gives specific design rules for verification of the fatigue design situation of steel structures. It is intended to be used with EN 1990, EN 1991 and EN 1993-1. Matters that are already covered in those documents are not repeated. The focus in EN 1993-1-9 is on design rules that supplement, modify or supersede the equivalent provisions given in EN 1993-1.

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.

¹ Under preparation. Stage at the time of publication: prEN 1993-7.

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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 1993-1-9

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 1993-1-9 can have a National Annex containing all national choices to be used for the design of steel structures 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 1993-1-9 through notes to the following clauses:

4(6)	5(4)	5(6)	6.1(3)
6.2(3)	7.1(5)	8.2(1) – 2 choices	8.3.2(1)
9.1(1)	B.2(3)	B.2(4)	C.2(6)
F.2(2)	F.2(5)	F.3.2(1)	F.4.2.1(3)

National choice is allowed in EN 1993-1-9 on the application of the following Informative Annexes:

Annex D	Annex E	Annex F	Annex G
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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 1993-1-9

(1) EN 1993-1-9 gives design methods for the verification of the fatigue design situation of steel structures.

NOTE Steel structures consist of members and their joints. Each member and joint can be represented as a constructional detail or as several of the latter.

(2) Design methods other than the stress-based methods, such as the notch strain method or fracture mechanics methods, are not covered by EN 1993-1-9.

(3) EN 1993-1-9 only applies to structures made of all grades of structural steels and products within the scope of EN 1993-1 (all parts), in accordance with the provisions noted in the detail category tables or annexes.

(4) EN 1993-1-9 only applies to structures where execution conforms to EN 1090-2.

NOTE Supplementary execution requirements are indicated in the detail category tables.

(5) EN 1993-1-9 applies to structures operating under normal atmospheric conditions and with sufficient corrosion protection and regular maintenance. The effect of seawater corrosion is not covered.

(6) EN 1993-1-9 applies to structures with hot dip galvanizing in accordance with the provisions noted in the detail category tables or annexes.

(7) Microstructural damage from high temperature ($> 150^{\circ}\text{C}$) that occurs during the design service life is not covered.

(8) EN 1993-1-9 gives guidance of how to consider post-fabrication treatments that are intended to improve the fatigue resistance of constructional details.

1.2 Assumptions

(1) Unless specifically stated, EN 1990, EN 1991 (all parts) and EN 1993-1 (all parts) apply.

(2) The design methods given in EN 1993-1-9 are applicable if:

- the execution quality is as specified in EN 1090-2, and
- the construction materials and products used are as specified in the relevant parts on EN 1993 (all parts), or in the relevant material and product specifications.

(3) The design methods of EN 1993-1-9 are generally derived from fatigue tests on constructional details with large scale specimens that include effects of geometrical and structural imperfections from material production and execution (e.g. the effects of tolerances and residual stresses from welding).