SLOVENSKI STANDARD
oSIST prEN 1991-1-5:2023

01-maj-2023

Evrokod 1 - Vplivi na konstrukcije - 1-5. del: Toplotni vplivi

Eurocode 1 - Actions on structures - Part 1-5: Thermal actions

Eurocode 1 - Einwirkungen auf Tragwerke - Teil 1-5: Allgemeine Einwirkungen - Temperatureinwirkungen

Eurocode 1 - Actions sur les structures - Partie 1-5 : Actions thermiques

Ta slovenski standard je istoveten z: **prEN 1991-1-5**

ICS:

91.010.30 Tehnični vidiki Technical aspects

oSIST prEN 1991-1-5:2023 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 1991-1-5

March 2023

ICS 91.010.30

Will supersede EN 1991-1-5:2003

English Version

Eurocode 1 - Actions on structures - Part-1-5: General actions - Thermal actions

Eurocode 1 - Actions sur les structures - Partie 1-5: Actions générales - Actions thermiques

Eurocode 1 - Einwirkungen auf Tragwerke - Teil 1-5: Allgemeine Einwirkungen - Temperatureinwirkungen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 250.

If this draft becomes a European Standard, 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.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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

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European foreword

This document (prEN 1991-1-5:2023) 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 document is currently submitted to the CEN Enquiry.

This document will supersede EN 1991-1-5:2005.

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.

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 structure*

— 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 >

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 1991

(1) EN 1991 provides the actions to be considered for the structural design of buildings, bridges and other civil engineering works, or parts thereof, including temporary structures, in conjunction with EN 1990 and the other Eurocodes.

(2) The actions on structures, including in some cases geotechnical structures in conjunction with EN 1997 as appropriate, provided in EN 1991 are intended to be applied in conjunction with the other Eurocodes for the verification of safety, serviceability and durability, as well as robustness of structures, including the execution phase.

(3) The application of this document for the verifications mentioned in (2) follows the limit state principle and is based on the partial factor method, unless explicitly prescribed differently.

(4) EN 1991 does not cover actions for structures in seismic regions, unless explicitly prescribed by EN 1998. Provisions related to such requirements are given in EN 1998, which complements and is consistent with EN 1991.

(5) EN 1991 is also applicable to existing structures for their:

— structural assessment,

— retrofitting (strengthening, repair) design,

— assessment for changes of use.

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

(6) EN 1991 is applicable to the design of structures where materials or actions outside the scope of the other Eurocodes are involved.

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

0.3 Introduction to EN 1991-1-5

EN 1991-1-5 gives design guidance for thermal actions arising from climatic and operational conditions on buildings and civil engineering structures.

Information on thermal actions induced by fire is given in EN 1991-1-2.

EN 1991-1-5 is intended for clients, designers, contractors and relevant authorities.

EN 1991-1-5 is intended to be used with EN 1990, the other Parts of EN 1991 and EN 1992 to 1999 for the design of structures.

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 1991-1-5

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 1991-1-5 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 standard is to be used.

When no national choice is made and no default is given in this standard, 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 1991-1-5 through notes to the following clauses:

7.3 (1) NOTE 1	8.1.3.3 (5) NOTE	8.1.6 (1) NOTE
7.3 (2) NOTE 1	8.1.4 (2) NOTE	8.2 (3) NOTE
7.3 (3) NOTE	8.1.4 (3) NOTE	8.2 (4) NOTE
7.3 (5) NOTE	8.1.4.2 (2) NOTE 1	8.2 (5) NOTE
7.3 (6) NOTE	8.1.4.2 (2) NOTE 2	9.3 (2) NOTE
8.1.1 (1) NOTE 2	8.1.4.3 (2) NOTE 1	9.3 (3) NOTE
8.1.3.1 (2) NOTE	8.1.4.3 (2) NOTE 3	9.3 (4) NOTE
8.1.3.2 (1) NOTE	8.1.4.4 (2) NOTE	A.2 (2) NOTE 1
8.1.3.2 (5) NOTE	8.1.4.5 (1) NOTE	A.2 (2) NOTE 3
8.1.3.3 (2) NOTE	8.1.5 (1) NOTE	B.2 (1) NOTE 1
8.1.3.3 (3) NOTE	8.1.5 (2) NOTE	

National choice is allowed in EN 1991-1-5 on the application of the following informative annex:

— Annex C (informative) Temperature profiles in buildings and other construction works

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 1991-1-5

(1) EN 1991-1-5 gives principles and rules for calculating thermal actions on buildings, bridges and other structures including their structural members. Principles needed for cladding and other attachments of buildings are also provided.

(2) This Part describes the changes in the temperature of structural members. Characteristic values of thermal actions are presented for use in the design of structures which are exposed to daily and seasonal climatic changes.

(3) This Part also gives principles for changes in the temperature of structural members due to the paving of hot asphalt on bridge decks.

(4) This Part also provides principles and rules for thermal actions acting in structures which are mainly a function of their use (e.g. cooling towers, silos, tanks, warm and cold storage facilities, hot and cold services, etc.).

NOTE Supplementary guidance for thermal actions on chimneys is provided in EN 13084-1.

1.2 Assumptions

The assumptions given in FprEN 1990:2022, 1.2 apply to EN 1991-1-5.

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.

FprEN 1990:2022, *Eurocode — Basis of structural and geotechnical design*

ISO 2394, *General principles on reliability for structures*

ISO 3898:2013, *Bases for design of structures — Names and symbols of physical quantities and generic quantities*

ISO 8930, *General principles on reliability for structures — Vocabulary*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this European Standard, the definitions given in FprEN 1990:2022, ISO 2394, ISO 3898:2013 and ISO 8930 and the following apply.

3.1.1
thermal actions
those actions on a structure or a structural member that arise from the changes of temperature fields

3.1.2
shade air temperature
temperature measured by thermometers placed in a “Stevenson screen” (an instrument shelter which is ventilated and protected from the solar radiation)

3.1.3
maximum shade air temperature
T_{max}
value of maximum shade air temperature with an annual probability of exceedance of 0,02 (equivalent to a mean return period of 50 years), based on the maximum hourly values recorded

3.1.4
minimum shade air temperature
T_{min}
value of minimum shade air temperature with an annual probability of exceedance of 0,02 (equivalent to a mean return period of 50 years), based on the minimum hourly values recorded

3.1.5
initial temperature
T_0
temperature of a structural member at the relevant stage of its restraint (completion) which should be taken into account during the design to consider movements and /or restraining effects

3.1.6
cladding
parts of the building with protective and/or architectural function which are added after the main structure is complete

3.1.7
uniform temperature component
temperature, constant over the cross section, which governs the expansion or contraction of a member or structure

3.1.8
temperature difference component
part of a temperature profile in a structural member representing the temperature difference between the outer face of the member and any in-depth point

3.2 Symbols and abbreviations

(1) For the purposes of this Part of Eurocode 1, the following symbols, specific to this Part, apply, together with the general notations given in FprEN 1990:2022.

NOTE The notation used is based on ISO 3898:2013.

(2) A basic list of notations is provided in FprEN 1990:2022, and the additional notations below are specific to this Part.

3.2.1 Latin upper-case letters

R	thermal resistance of structural member
R_{in}	thermal resistance at the inner surface
R_{out}	thermal resistance at the outer surface
T_{max}	maximum shade air temperature with an annual probability of exceedance of 0,02 (equivalent to a mean return period of 50 years)
T_{min}	minimum shade air temperature with an annual probability of exceedance of 0,02 (equivalent to a mean return period of 50 years)
$T_{max,p}$	maximum shade air temperature with an annual probability of exceedance p (equivalent to a mean return period of $1/p$)
$T_{min,p}$	minimum shade air temperature with an annual probability of exceedance p (equivalent to a mean return period of $1/p$)
T_N	uniform temperature
$T_{N.max}$	maximum uniform temperature
$T_{N.min}$	minimum uniform temperature
$T_{N.night}$	uniform night cooling temperature
T_0	initial temperature when a structural member is restrained
$T_{0,inf}$	the minimum initial bridge temperature from which expansion is considered
$T_{0,sup}$	the maximum initial bridge temperature from which contraction is considered
T_{in}	air temperature of the inner environment
T_{out}	air temperature of the outer environment
ΔT_0	range of initial bridge temperature
ΔT_i	heating (cooling) temperature differences
ΔT_N	range of uniform temperature component
$\Delta T_{N, exp}$	maximum expansion range of uniform bridge temperature component
$\Delta T_{N, con}$	maximum contraction range of uniform bridge temperature component
ΔT_M	linear temperature difference component
$\Delta T_{M,heat}$	linear temperature difference component (heating)
$\Delta T_{M,cool}$	linear temperature difference component (cooling)
ΔT_E	nonlinear part of the temperature difference component
ΔT	sum of linear temperature difference component and nonlinear part of the temperature difference component
ΔT_p	difference in the coincident value of uniform temperature between different structural members within a structure