ICS 91.080.10 PREDBEŽNÁ SLOVENSKÁ TECHNICKÁ NORMA November 2025

STN P	**Eurokód 4 Navrhovanie spriahnutých oceľobetónových konštrukcií Časť 1-101: Navrhovanie dvojplášťových a jednoplášťových oceľobetónových kompozitných (SC) konštrukcií**	**STN P CEN/TS 1994-1-101 73 2089**

Eurocode 4 - Design of composite steel and concrete structures - Part 1-101: Double and single skin steel concrete composite (SC) structures

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 10/25

Táto predbežná slovenská technická norma je určená na overenie. Prípadné pripomienky pošlite do marca 2027 Úradu pre normalizáciu, metrológiu a skúšobníctvo Slovenskej republiky.

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TECHNICAL SPECIFICATION

SPÉCIFICATION TECHNIQUE

TECHNISCHE SPEZIFIKATION

CEN/TS 1994-1-101

March 2025

ICS 91.080.13

English Version

Eurocode 4 - Design of composite steel and concrete structures - Part 1-101: Double and single skin steel concrete composite (SC) structures

Eurocode 4 - Calcul des structures mixtes acier-béton - Partie 1 101 : Structures mixtes acier-béton (SC) simple ou double peau

Eurocode 4 - Bemessung und Konstruktion von Verbundtragwerken aus Stahl und Beton - Teil 1 101: Bemessung von wandartigen Verbundkonstruktionen mit ein- oder beidseitig außenliegenden Stahlblechen

This Technical Specification (CEN/TS) was approved by CEN on 27 January 2025 for provisional application.

The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

CEN members are required to announce the existence of this CEN/TS in the same way as for an EN and to make the CEN/TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the CEN/TS) until the final decision about the possible conversion of the CEN/TS into an EN is reached.

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

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European foreword

This document (CEN/TS 1994-1-101:2025) 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.

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 has 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 this document.

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 announce this Technical Specification: 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

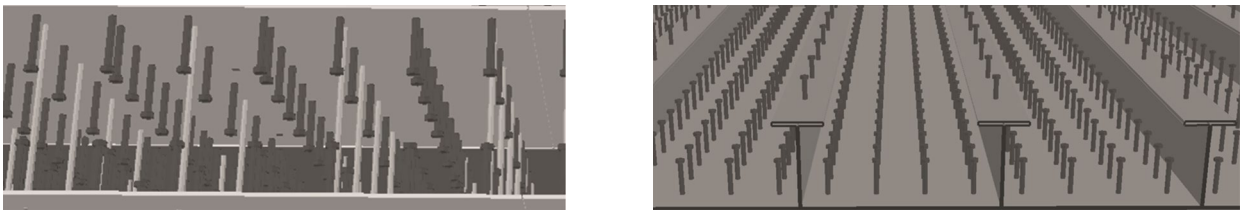
— New parts are under development, e.g. Eurocode for design of structural glass

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 CEN/TS 1994-1-101

Double skin steel concrete composite (DSC) structures comprise two steel plates connected by a grid of tie bars. The void between the plates is filled with concrete. The plates act as load bearing formwork during the placement of the concrete (core) eliminating the need for temporary formwork. In the permanent condition, the plates act as reinforcement to the concrete and therefore are fundamental to the structural performance of the panels. The tie bars in DSC (which may be welded or bolted to the steel plates) hold the two steel plates together at the construction stage allowing them to act as load bearing formwork and resist fresh concrete pressures during concreting. Once the concrete has set, they act as shear reinforcement, thus contributing to the transverse (out-of-plane) shear resistance of the structure. Alternatives to tie bars may be used (e.g. ribs or stiffeners). Composite action between the steel plates and the concrete is provided by shear connectors welded to the steel plates. DSC structures are commonly used in a vertical orientation as wall structural components but may also be used in a horizontal orientation as floor structural components.

Single skin steel concrete composite (SSC) structures comprise a single steel plate reinforced by steel sections (typically T-stiffeners) which provide stiffness during construction and shear resistance to the section against out of plane loading in the permanent condition. Shear stud connectors are welded to both the plate and the flange of the T-stiffeners to achieve composite action with the concrete which is placed on the plate. SSC structures are commonly used in a horizontal orientation as floor structural components.



a) DSC structure (typically used for walls) **b) SSC structure (used for floors)**

Figure 1 — SC structures

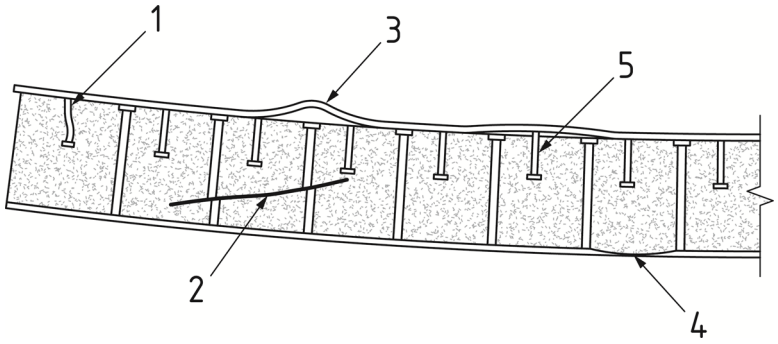
DSC and SSC structures are collectively referred to as SC structures, see Figure 1. SC structures are suitable for use in buildings and other structures whose structural system comprises shear walls or floor slabs (or decks) or a combination of shear walls and slabs/decks.

Depending on the number of shear stud connectors used, full or partial shear connection between the plates and the concrete can be achieved. Partial shear connection results in greater relative movement (slip) between the plate(s) and the concrete such that force transfer will be limited by the capacity of the shear stud connectors. Where the number of shear stud connectors is such that full shear connection is provided, the structural resistance will be limited by the strength of either the concrete or the steel plates.

The strength of a steel plate in compression in a DSC structure can either be governed by outward buckling, before yield stress is reached, or by yielding and plastic deformation.

Concrete can fail in one of two modes in SC structures. The first is a compressive failure by crushing of the concrete. The second is shear failure, which is characterised by blocks of concrete sliding relative to each other.

Figure 2 illustrates the main failure modes of a DSC member.



Key

1 failure of connectors
2 shear failure
3 buckling of compression plate
4 yield of tension plate
5 stud pull-out due to locally applied tension (e.g. from attachments to the steel plate of the DSC member)

Figure 2 — Failure modes of a DSC member

Concrete shrinkage occurs with time and is evidenced by shortening of the concrete even when a member is not externally loaded. It occurs due to water/cement hydration and escape of water from the concrete mix. This effect is normally mitigated by suitable concrete mix design and controlled concreting operations. Creep occurs when concrete is subject to relatively high stress for a sustained period of time. The magnitude of the action, the time of application of the action and the age of the concrete influence the amount of creep. Creep can also occur when actions are not applied continuously over a long period

of time but in regular cycles. For SC construction the effects of creep can be accounted for by using in design an appropriate effective value of the concrete modulus. This results in the use of a higher effective modular ratio (ratio of steel to concrete modulus) for long term loads than for short term loads.

At present, there are no harmonized or national European standards covering the design of SC structures. This document fills this gap by providing rules for SC structures and has been developed as a first step towards defining requirements for a European Standard for SC structures (as a Part of EN 1994).

0.3 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.

0.4 National Annex for CEN/TS 1994-1-101

This document gives values within notes indicating where national choices can be made. Therefore, a national document implementing CEN/TS 1994-1-101 can have a National Annex containing all Nationally Determined Parameters to be used for the assessment of buildings and civil engineering works in the relevant country.

When not given in the National Annex, the national choice will be the default choice specified in the relevant Technical Specification.

The national choice can be specified by a relevant authority.

When no choice is given in the Technical Specification, in the National Annex, or by a relevant authority, the national choice can be agreed for a specific project by appropriate parties.

National choice is allowed in CEN/TS 1994-1-101 through notes to the following clauses:

8.1(3) – 2 choices	8.2.2(2)	8.2.3(1)	8.3.2(1)
8.4.2(2)	8.5.1(2)	8.5.1(7)	8.5.1(8)
8.5.1(9)	8.6(1)	8.6(3)	8.8(2)
10.2.3(2)	10.4(3)	11.2.1(2)	12.3.2.2(4)
12.3.4(2)	12.3.4(3)		

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 CEN/TS 1994-1-101

(1) This document deals with the design of steel-concrete composite (SC) structures comprising either:

— two steel plates with shear stud connectors connected by a grid of tie bars and having structural concrete between the plates (referred to as DSC), typically used for walls; or

— a steel plate with shear stud connectors and T-stiffeners welded to the plate (referred to as SSC), typically used for floors.

(2) This document gives basic rules for design, design for the construction stage and design for the accidental situation of fire exposure.

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 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, *Eurocode — Basis of structural and geotechnical design*

EN 1992-1-1:2023, *Eurocode 2 — Design of concrete structures — Part 1.1: General rules and rules for buildings, bridges and civil engineering structures*

EN 1992-4:2018, *Eurocode 2 — Design of concrete structures — Part 4: Design of fastenings for use in concrete*

EN 1993-1-1:2022, *Eurocode 3 — Design of steel structures — Part 1-1: General rules and rules for buildings*

EN 1994-1-1:—,[1] *Eurocode 4 — Design of composite steel and concrete structures — Part 1-1: General rules and rules for buildings*

[1] Under preparation. Stage at the time of publication: prEN 1994-1-1:2024.