
Trajnostna gradnja z betonom - 1. del: Praktična navodila

Sustainable construction with concrete - Part 1 - Practical guidance

Nachhaltig Bauen mit Beton - Teil 1 - Planungshilfe

Construction durable avec du béton - Partie 1 - Aide à la planification

Ta slovenski standard je istoveten z: CEN/TR 18290-1:2026**ICS:**

13.020.20	Okoljska ekonomija. Trajnostnost	Environmental economics. Sustainability
91.080.40	Betonske konstrukcije	Concrete structures

SIST-TP CEN/TR 18290-1:2026**en,fr,de**

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TECHNICAL REPORT

CEN/TR 18290-1

RAPPORT TECHNIQUE

TECHNISCHER REPORT

April 2026

ICS 13.020.20; 91.080.40

English Version

Sustainable construction with concrete - Part 1 - Practical guidance

Construction durable avec du béton - Partie 1 - Aide à la planification

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This Technical Report was approved by CEN on 6 April 2026. It has been drawn up by the Technical Committee CEN/TC 104.

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Ref. No. CEN/TR 18290-1:2026 E

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European foreword

This document (CEN/TR 18290-1:2026) has been prepared by Technical Committee CEN/TC 104 “Concrete and related products”, the secretariat of which is held by SN.

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Introduction

Increasing scarcity of raw materials, limited landfill space and the need to reduce GHG challenges facing society today. Sustainable buildings require a low consumption of raw materials and energy as well as the greatest possible flexibility of use and reusability or durability of the function in the building. Sustainable buildings have to meet environmental, economic and socio-cultural requirements, at the same time offer a high technical quality. Furthermore, ensuring the comfort of the user within the buildings while maintaining their health is essential. The specific requirement profile of the client therefore determines the priorities and the order of the numerous criteria of sustainability (e.g. in a certification). All measures in this practical guidance are based on the following key sustainability goals:

- An immediate and drastic reduction in CO₂ equivalent emissions as a measure for climate change mitigation,
- Take precautions for, and adapt to, the already existing consequences of climate change,
- Resource conservation and material optimization.

When considering whether to preserve a structure or to dismantle it, prioritizing the preservation approach aligns with sustainability goals. Extending the service life can be achieved through appropriate maintenance measures.

Since the value of a building in terms of sustainability does not only depend on its production costs, the planned service life and the pure property value, a large number of criteria are checked and incorporated into the design, construction or maintenance of the building. This results in holistic planning, rational architecture, optimized structural design, efficient building technology, a suitable choice of materials and a reasonable implementation process.

The following practical guidance for concrete construction serves investors, clients, designers, contractors and representatives of the building supervision for decision-making processes in sustainable construction with concrete. The guidance can be understood as a preparatory step for the conceptualisation and design of construction projects by the aforementioned target users, as well as for possible sustainability certification of a proposed or completed construction project, and show how sustainable design and construction is carried out with the existing technical specifications and authority regulations in concrete construction.

The basic documents for this guidance were [27].

This document is part 1 of two parts. Part 1 has the intention to give guidance, what measures can be taken in daily business already today to contribute to decarbonisation, resource efficiency and sustainability in the concrete sector. Part 2 shows further measures and potentials to contribute to decarbonisation, resource efficiency and sustainability in the concrete sector in the medium and long term.

1 Scope

This document gives guidance, what measures can be taken in daily business already today to contribute to decarbonisation, resource efficiency and sustainability in the concrete sector.

Although concrete structural elements can be supplemented by other materials either for new construction or the retrofit of a structure, this document addresses concrete elements, bearing in mind the possibilities to increase resource efficiency and reuse of structures.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp/>
- IEC Electropedia: available at <https://www.electropedia.org/>

4 Guidance for design

4.1 General planning principles

Sustainable construction requires all those involved in construction to work together as partners. Basics are:

- The duly definition of the essential goals
- Holistic planning over the foreseeable life cycle and future lifecycles of the structure and building elements as well as
- Efficient quality management with the definition of tasks, responsibilities and communication processes
- Durability of the structure and structural elements. The longest possible life cycle is to be taken into account when possible.

Architects, building physicists, structural engineers and company technicians collaborate with the client to develop a holistic building concept. This concept addresses current usage requirements, property-specific environmental effects, and considers realistic assessments of potential future usage changes. In principle, particular attention is paid to the interactions between the various criteria of sustainability considerations, because very often several criteria are influenced by one decision. This can also have opposite effects.



This symbol within the practical guidance indicates possible *interactions*.

The advantages of each building material can be optimally used if the relevant specialists (property planners, structural engineers, building physicists, etc.) are involved in the planning phase in required time. Concrete has considerable advantages for sustainable and durable constructions, especially in terms of affordability, the possibility of predominantly using locally available resources, technical quality (see also [6]), specially for long term use. This can be achieved through intensive collaboration along the

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value chain. There are hardly any limits to the freedom of design through the variety of shapes of buildings and components made of concrete.

4.2 Influences on individual sustainability aspects

4.2.1 Reduced resource use for environment protection and climate change mitigation

During the project conception stage, designers and developers often evaluate building and user needs across multiple lifecycles of the structure. This evaluation typically identifies opportunities to minimize primary resource use and environmental impacts. In concrete construction, reducing resource use is commonly achieved through various approaches, such as optimizing material use and minimizing the environmental footprint of materials.

- Static optimization of structures or components made of reinforced concrete with simple, straight load paths has been observed to lead to material and weight savings (less concrete, less reinforcement). Designing in accordance with the characteristics of the material is generally practiced. Concrete structures working in compression within the in-service conditions have shown to be more durable due to less generation of microcracking.
- In the case of concrete structures, the optimization of the technical manufacturing process can be used to reduce waste and ensure a shorter production time (e.g. production of as many identical component cross-sections as possible or optimization of individual components of the structure).
- Optimization of the technical manufacturing process in concrete structures is used to reduce waste and ensure shorter production times. This includes producing as many identical component cross-sections as possible or optimizing individual components of the structure.
- Optimizing concrete composition is crucial for reducing CO₂ emissions while maintaining resistance and durability. Durable concrete requires less maintenance and has a lower impact on the life cycle of the structure in the long term.

In multi-storey buildings, the overall environmental impact of the entire supporting structure can essentially be improved by clever planning of the storey-ceilings. The amount of concrete used could have a greater influence on the environmental impact than the strength class of the concrete. In order to ensure an optimal transfer of the loads, arranging all load-bearing elements directly above one another is best practice. This measure can reduce the amount of concrete and reinforcing steel.



Interactions: It is observed that optimizing component cross-sections to use less material can influence the flexibility and convertibility of the load-bearing structure by potentially reducing load reserves. The focus for optimization is typically determined based on the specific requirements and specifications of those involved in the construction process.



4.2.2 Area and volume efficiency

In the field of housing and non-residential buildings the available floor space is best utilized not only for economic efficiency, but also from the perspective of sustainability in order to cover existing space requirements with the least possible consumption of space [27].

Column-free floor plans or as few vertical support members as possible over several floors increase the **space efficiency** and also serve the **flexibility and convertibility** of the building.

The compactness of a building plays a crucial role in its energy efficiency and minimizing energy loss. Measured as the Surface Area to Volume Ratio, a compact building design, reduces this ratio, which minimizes heat loss in winter and heat gain in summer.

The **volume-efficiency** of floor slabs can be optimized by choosing appropriate cross-sections, spans and way of reinforcement (pre-stressed vs. conventional).

EXAMPLE 1 Prestressed components and high-strength concretes even enable the realization of wide-span ceiling systems with a reasonable slab thickness. Optimizations are to be carried out here in accordance with the foreseeable possible uses.

EXAMPLE 2 Storey-frames can also be used as a static system in an efficient and balanced manner with regard to the stress, which generally requires less reinforcement.

EXAMPLE 3 With slender column cross-sections, e.g. optimized through the use of high-strength concrete or butt-joints, the floor area can be used just as efficiently.

Interactions:



It is observed that using slender, highly-utilized component cross-sections optimizes resource use and can improve the flexibility and convertibility of the building. In cases of generous, free floor plans, the effects on the assessment of fire compartments are typically considered.



4.2.3 Flexibility and convertibility

For the sustainable use of real estate, the flexibility and convertibility of the structure are of great importance. For this purpose, adapting to changed usage requirements with minimal cost and resource consumption can be considered.

Column-free floor plans offer maximum flexibility for interior design. Floor ceilings can be constructed with a span of up to 20 m [8], industrial halls with girder spans of up to 60 m. In the case of main and secondary girder ceilings, a flexible arrangement of the supports along the main girder increases the flexibility of the usable areas on the ground floor [7].

Load bearing reserves for later changes of use can be planned in advance in an appropriate framework. For example, buildings in mixed areas on the lower floors could be designed for increased working loads e.g. of 3,5 kN/m² to 5 kN/m² in order to enable variable usage options. In addition, it is important to consider reserves for changed expansion loads, e.g. for lightweight partition walls. In the case of industrial/commercial use, dynamic traffic loads and, if necessary, additional load cases such as “lift truck impact” or the subsequent installation of a crane runway can be taken into account for later functional changes or expansions. These principles are established with the building developers or owners first.

With an appropriate design of the bagle frames and eaves supports, subsequent hall expansions are possible without any problems. In this context, modular concepts can be important because they contain reproducible interfaces and (re)combination options. When separating the facade from the supporting structure and using detachable connections, facade panels can be dismantled in the event of expansion and reassembled at another location. In multi-storey buildings, the possibility of adding a later floor can be planned in advance through structural details and taking the corresponding loads into account.



Interactions: It is observed that planning for subsequent working load changes or extensions often involves larger, initially unused cross-sections and corresponding connection details, which can lead to greater material expenditure in the manufacturing phase. This typically affects the life cycle assessment (LCA) of the manufacturing phase.



4.2.4 Thermal comfort

The concrete core activation makes use of the thermal storage capacity of the concrete and stabilizes the interior temperatures in summer (avoid overheating) and winter. but also reduces the energy required for heating and cooling the building. The thermal properties of the concrete have a positive effect on the