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Concrete pavements

Part 1: Materials

National foreword

This British Standard is the UK implementation of EN 13877-1:2023 and supersedes [BS EN 13877-1:2013](#), which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/510/3, Materials for concrete roads.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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European foreword

This document (EN 13877-1:2023) has been prepared by Technical Committee CEN/TC 227 “Road materials”, the secretariat of which is held by BSI.

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of an identical text or by endorsement, at the latest by May 2024, and conflicting national standards shall be withdrawn at the latest by May 2024.

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 13877-1:2013.

EN 13877-1:2023 includes the following significant technical changes with respect to EN 13877-1:2013:

- the normative references have been updated;
- the scope has been adapted;
- lean concrete has been removed;
- the requirements on the density of fresh concrete have been removed;
- fibres have been included in the definition of reinforcement;
- the notes in Table 1 have been updated;
- Table 3, Dimensions for tie bars, has been removed;
- EN 197-1, EN 13863-6 and EN 14889-1 have been added to the normative references;
- the Bibliography has been updated.

EN 13877, *Concrete pavements*, is currently composed with the following parts:

- *Part 1: Materials*
- *Part 2: Functional requirements for concrete pavements*
- *Part 3: Specifications for dowels to be used in concrete pavements*

This document refers to EN 206. In accordance with the scope of EN 206 some additional or different requirements are necessary for pavements, particularly to comply with safety of users, durability, environment and health.

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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1 Scope

This document specifies requirements for the constituents (concrete and other materials) of concrete pavements, cast *in situ*. Concrete compacted by rollers is not covered by this document.

This document covers concrete pavements for roads and other traffic-bearing structures.

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.

CEN/TS 14754-1, *Curing compounds — Test methods — Part 1: Determination of water retention efficiency of common curing compounds*

EN 197-1, *Cement — Part 1: Composition, specifications and conformity criteria for common cements*

EN 197-5, *Cement — Part 5: Portland-composite cement CEM II/C-M and composite cement CEM VI*

EN 206, *Concrete — Specification, performance, production and conformity*

EN 1008, *Mixing water for concrete — Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete*

EN 10025-2, *Hot rolled products of structural steels — Part 2: Technical delivery conditions for non-alloy structural steels*

EN 10060, *Hot rolled round steel bars for general purposes — Dimensions and tolerances on shape and dimensions*

EN 10080, *Steel for the reinforcement of concrete — Weldable reinforcing steel — General*

EN 12350-7, *Testing fresh concrete — Part 7: Air content — Pressure methods*

EN 12390-3, *Testing hardened concrete — Part 3: Compressive strength of test specimens*

EN 12390-5, *Testing hardened concrete — Part 5: Flexural strength of test specimens*

EN 12390-6, *Testing hardened concrete — Part 6: Tensile splitting strength of test specimens*

EN 12620, *Aggregates for concrete*

EN 13863-6, *Concrete pavements — Part 6: Test method for the determination of the tensile strength of concrete on cylindrical discs*

EN 13877-2:2023, *Concrete pavements — Part 2: Functional requirements for concrete pavements*

EN 13877-3, *Concrete pavements — Part 3: Specifications for dowels to be used in concrete pavements*

EN 14188-1, *Joint fillers and sealants — Part 1: Specifications for hot applied sealants*

EN 14188-2, *Joint fillers and sealants — Part 2: Specifications for cold applied sealants*

EN 14188-3, *Joint fillers and sealants — Part 3: Specifications for preformed joint sealants*

EN 14889-1, *Fibres for concrete — Part 1: Steel fibres — Definitions, specifications and conformity*

EN ISO 9227:2022, *Corrosion tests in artificial atmospheres — Salt spray tests (ISO 9227:2022)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

3.1 concrete pavement

concrete layer capable of withstanding direct passage of traffic and environmental effects

Note 1 to entry: Several types exist: jointed unreinforced, jointed reinforced, continuously reinforced.

3.2 exposed aggregate concrete surface

surface finish for concrete pavements achieved by removing the surface mortar, in order to expose the coarse aggregate

3.3 curing compound

product that can be applied on the surface of newly placed concrete to minimize the loss of moisture and in the case of pigmented compounds to reflect heat, minimizing heating up of the concrete

3.4 dowel

smooth bar which extends into adjoining slabs at a joint in a concrete pavement, to improve load transfer and to avoid faulting

3.5 tie bar

bar used to interconnect adjacent concrete slabs along joints, normally longitudinal joints, in order to prevent the slabs from horizontally drifting apart, or used for cross-stitching of cracks or joints

3.6 reinforcement

bars, meshes or fibres embedded in concrete to control cracking and/or to provide tensile capacity

4 Requirements for constituent materials of concrete

4.1 General

Only constituent materials permitted in EN 206 shall be used.

The constituent materials for concrete shall be selected to satisfy the specified requirements of this document for fresh and hardened concrete including consistence, strength, durability, and protection of embedded steel against corrosion.

Where there is no European standard for a particular constituent material which refers specifically to the use of this constituent material in concrete conforming to EN 206, the establishment of suitability may result from:

- a European Technical Approval which refers specifically to the use of the constituent material in concrete conforming to EN 206; or
- the relevant national standards or provisions valid in the place of use of the concrete which refers specifically to the use of the component's material in concrete conforming to EN 206.

Characteristics of constituent materials and properties of concrete shall be measured in accordance with EN 206 except where otherwise given in the following clauses.

4.2 Type of cement

Cement shall comply with EN 197-1 or EN 197-5 and the type of cement shall be selected in accordance with EN 206 for the specified exposure class. Additional requirements may be specified by relevant national standards or provisions in the place of use.

4.3 Aggregates

4.3.1 General

Aggregates shall comply with EN 12620. The permitted types and classes of aggregates shall be specified by relevant national standard or provisions in the place of use.

4.3.2 Maximum size of aggregates

The maximum nominal size of aggregates shall not exceed one third ($1/3$) of the layer thickness.

For jointed reinforced concrete and continuously reinforced concrete pavements, the maximum aggregate size shall not exceed one fourth ($1/4$) of the spacing between the reinforcing bars.

4.4 Mixing water

Mixing water for concrete shall comply with EN 1008.

4.5 Other constituent materials

Admixtures, additions and other constituent materials, when used, shall comply with the requirements of EN 206.

5 Basic requirements for concrete

5.1 General

The specified properties of the concrete shall be measured as prescribed in EN 206 and in this document. In specifying the concrete, account shall be taken of the environmental, traffic and site conditions, and the effect these can have on the concrete.

5.2 Fresh concrete

5.2.1 Consistence

The consistence of concrete shall be in accordance with the requirements of EN 206.

The consistence of concrete may be specified by consistence class or by target value in accordance with EN 206, which should be suitable for the construction equipment.

5.2.2 Air content

When the air content of concrete is to be determined, it shall be measured *in situ* in accordance with EN 12350-7.

Air content may be specified by relevant national standards or provisions in the place of use.

5.2.3 Cement content

The minimum cement content shall be in accordance with the requirements of EN 206. A higher minimum cement content may be specified by relevant national standards or provisions in the place of use.

5.2.4 Content of particles smaller than 0,250 mm

The content of particles smaller than 0,250 mm shall conform to the national standards or the provisions in the place of use.

5.2.5 Chloride content

When concrete contains embedded steel not protected against chloride induced corrosion the total chloride ions content shall not exceed 0,40 % of the mass of cement in accordance with EN 206.

5.3 Hardened concrete

5.3.1 Resistance to the effects of freeze-thaw and de-icing agents

Where concrete is exposed to significant attack by freeze-thaw cycles with and without de-icing agents, the freeze-thaw resistance may be specified according to a test method described in CEN/TS 12390-9 or by relevant national standards or provisions in the place of use.

5.3.2 Mechanical strength

Specimens shall be evaluated for mechanical strength by one (or more) of the following methods:

- compressive strength in accordance with EN 12390-3;
- tensile splitting strength in accordance with EN 12390-6;
- tensile strength on cylindrical discs in accordance with EN 13863-6;
- flexural strength in accordance with EN 12390-5.

NOTE 1 The standards EN 12390-6 and EN 13863-6 make use of different types of specimens for the determination of the tensile (splitting) strength and can yield different results. EN 13863-6 contains precision data, while EN 12390-6 does not. The same table of classes (Table 1) is used for both types of tensile strength.

Where required

- a class of compressive strength shall be selected and specified in accordance with EN 206;
- a class of tensile splitting strength or tensile strength on cylindrical discs shall be selected and specified in accordance with Table 1;
- a class of flexural strength shall be selected and specified in accordance with Table 2.

NOTE 2 The required class is related to a specific type of specimen.

- All concrete will be assessed for conformity by the producer using the requirements in EN 206. Where flexural strength is specified, conformity assessment shall be made in the same way as for tensile splitting strength.
- When mechanical strength is to be evaluated on cores, the procedure given in EN 13877-1:2023, 4.2, shall be followed.

Table 1 — Tensile splitting strength, f_{sk} or tensile strength on cylindrical discs, $f_{ct,cd}$ classes

Strength class ^a	f_{sk} or $f_{ct,cd}$ ^b [MPa]
S1,3	1,3
S1,7	1,7
S2,0	2,0
S2,4	2,4
S2,7	2,7
S3,0	3,0
S3,3	3,3
S3,7	3,7
S4,0	4,0
S4,3	4,3
S4,6	4,6
S4,8	4,8
S5,0	5,0
S5,5	5,5
S6,0	6,0

^a In special cases intermediate strength levels between those given may be used if this is permitted by the relevant design standard.

^b f_{sk} is the characteristic tensile splitting strength and $f_{ct,cd}$ is the tensile strength on cylindrical discs. Unless specified otherwise in national regulations this strength is determined at 28 days. The diameter of the specimen shall be at least three times the nominal size of the aggregate in the concrete.

Table 2 — Flexural strength, f_{fk} classes

Strength class ^a	f_{fk} ^b [MPa]
F2,0	2,0
F3,0	3,0
F3,5	3,5
F4,0	4,0
F4,5	4,5
F5,5	5,5
F6,5	6,5
F8,5	8,5
F9,0	9,0
F10,0	10,0

^a In special cases intermediate strength levels between those given may be used if this is permitted by the relevant design standard.

^b f_{fk} is the characteristic flexural strength. Unless specified otherwise in national regulations this strength is determined at 28 days. The cross-section dimension of the prism shall be at least three and a half times the nominal size of the aggregate in the concrete, but with a minimum dimension 100 mm × 100 mm. The length of the prism shall not be less than three and a half times the cross-section dimension.

6 Basic requirements for other materials for concrete pavements

6.1 General

Where there is no European standard for a particular material used for the construction of concrete pavements which refers specifically to the use of this material, suitability shall be established from:

- a European Technical Approval which refers specifically to the use of this material;
- the relevant standards or provisions valid in the place of use of the concrete which refers specifically to the use of this material.

6.2 Curing materials

Curing compounds shall be specified according to CEN/TS 14754-1 or to the provisions in the place of use. Other materials used for curing concrete shall comply with national standards or provisions in the place of use.

6.3 Surface retarders

Surface retarders are used for exposed aggregate concrete surface finishes.

If a combined product for surface retarder and curing compound is used it shall be specified according to CEN/TS 14754-1 or to the provisions in the place of use.

6.4 Joint sealants

Joint materials shall comply with EN 14188-1, EN 14188-2 or EN 14188-3.

6.5 Tie bars

Tie bars are deformed or ribbed bars. Steel tie bars shall comply with the properties specified in EN 10080.

Diameter and tolerances on diameters of the tie bars shall be in accordance with EN 10060.

Tie bars have a minimum diameter of 10 mm and a minimum length of 500 mm. The tolerances in length shall be ± 15 mm.

Steel tie bars shall have a steel quality according to EN 10025-2 of B500 or higher.

If the material of the tie bar is susceptible to corrosion, protective measures against corrosion shall be applied over a length of 200 mm \pm 20 mm. The place to put these protective measures shall comply with national standards or the provisions in the place of use.

The durability of the tie bar shall be tested according to EN ISO 9227:2022, using the NSS-test (5.2.2). The test specimen can be cut from the tie bar and shall have a length of minimum 150 mm. The ends can be protected. The length of the tested surface is at least 100 mm, situated in the middle of the test specimen. Three test specimens shall be tested. The duration of immersion is set to 240 h. The evaluation shall be done visually. No crazing of the coating or corrosion of the bar over the tested surface is allowed.

6.6 Dowels

Dowels shall comply with EN 13877-3.

6.7 Reinforcing bars

Steel reinforcing bars shall be at least of grade B500 and shall comply with the properties specified in EN 10080.

Other types of reinforcing bars shall comply with the provisions in the place of use.

6.8 Reinforcing fibres

Steel fibres shall comply with EN 14889-1.

Other types of reinforcing fibres shall comply with the provisions in the place of use.

Bibliography

- [1] CEN/TS 12390-9, *Testing hardened concrete — Part 9: Freeze-thaw resistance with de-icing salts — Scaling*

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