AS 5216:2018
(Incorporating Amendment No. 1)

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Australian STANDARD

Design of post-installed and cast-in fastenings in concrete

STANDARDS Australia

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- Association of Wall and Ceiling Industries of Australia
- Australian Building Codes Board
- Australian Chamber of Commerce and Industry
- Australian Engineered Fasteners and Anchors Council
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- New Zealand Heavy Engineering Research Association
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Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through the public comment period.

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PREFACE

This Australian Standard was prepared by the Standards Australia Committee ME-029, Fasteners, to supersede SA TS 101:2015, *Design of post-installed and cast-in fastenings for use in concrete*.

This Standard incorporates Amendment No. 1 (August 2019). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

The objective of this Australian Standard is to provide minimum design requirements for fastenings used to transmit loads to concrete for safety-critical applications.

Standards Australia acknowledges and thanks the European Committee for Standardization—CEN, Rue de la Science 23, B-1040 Brussels, Belgium for permission to reproduce its content in the development of this Standard.

The terms ‘normative’ and ‘informative’ are used in Standards to define the application of the appendices or annexes to which they apply. A ‘normative’ appendix or annex is an integral part of a Standard, whereas an ‘informative’ appendix or annex is only for information and guidance.

This Standard includes a commentary on some of the clauses. The commentary directly follows the relevant clause, is designated by ‘C’ preceding the clause number and is printed in italics in a box. The commentary is for information and guidance and does not form part of the Standard.

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SECTION 1 SCOPE AND GENERAL

1.1 SCOPE AND APPLICATION

1.1.1 Scope

This Standard specifies minimum requirements for the design of fastenings used to transmit loads to concrete for safety-critical applications.

The fasteners covered in this Standard are as follows:

(a) Post-installed fasteners:

  (i) Mechanical fasteners (e.g. expansion fasteners, undercut fasteners and concrete screws).

  (ii) Chemical fasteners (e.g. chemical fasteners, chemical expansion fasteners).

(b) Cast-in anchor channel with rigid connection (e.g. forged or welded) between the channel profile and anchor.

This Standard also includes requirements for the testing and assessment of post-installed and cast-in fasteners to establish the necessary design parameters for use with this Standard.

The design provisions in this Standard are relevant to static and quasi-static loading that may include tension, shear, bending or torsion moments, or a combination thereof.

The design provisions in this Standard do not apply to the following:

(a) Design of anchor channel for shear in the longitudinal direction of anchor channel.

(b) Design of fixtures.

(c) Design of fastenings for exposure to fire, durability and seismic actions.

(d) Fasteners for lifting, transport and erection (e.g. brace inserts, lifting inserts, etc.), headed fasteners, ferrules, reinforcement for development length considerations, headed reinforcement and anchorage for prestressing strands.

NOTES:

1 For design actions, fastener products, substrates and applications not covered by the scope of this Standard, the design engineer should seek technical advice from the fastener supplier in relation to the suitability of the selected fastener for the intended application.

2 This Standard does not include design provisions to address stress development in reinforcement. For design provisions for stress development refer to AS 3600. For post installed rebar connections, qualifications to be done to TR 023, refer to AEFAC *Technical Note: Post-installed rebar connection*.

C1.1.1 *The design theory for fastenings embodied in this Standard utilizes the tensile strength of concrete and is closely based on the design procedure published in EN 1992-4.*

The design and installation provisions of this Standard have been developed on the assumption that materials used and their maintenance ensure that the installed fasteners will fulfil their intended function for the intended life of the structure.

1.1.2 Application

This Standard relies upon design parameters and product specifications that define a fastener's suitability for a given application. The testing and assessment of a fastener shall be performed in accordance with the requirements of Appendix A. All necessary design parameters such as characteristic values and product specifications such as geometric and material properties required for Sections 2 to 9 of this Standard shall be obtained from an assessment report prepared in accordance with Appendix A.

NOTE: The design parameters and product specifications required for use with this Standard may also be obtained from a current European Technical Approval/Assessment for the relevant fastener.

Concrete members shall be composed of normal-weight concrete without fibres and shall conform to the requirements of Clause 2.4.

Supplementary reinforcement and reinforcing steel inserts in chemical fasteners shall have a ductility class type N in accordance with AS/NZS 4671.

Chemical fasteners intended for applications involving sustained tensile loads shall be qualified for sustained loading applications in accordance with Appendix A.

The design provisions for post-installed chemical fasteners with reinforcing bar as the metal component shall be limited to the design for shallow anchorage failure.

1.2 NORMATIVE REFERENCES

The following are the normative documents referenced in this Standard:

NOTE: Documents referenced for informative purposes are listed in the Bibliography.

AS	
1012	Methods of testing concrete
1012.9	Method 9: Compressive strength tests—Concrete, mortar and grout specimens
1379	Specification and supply of concrete
3600	Concrete structures
4100	Steel structures
AS/NZS	
1170	Structural design actions
1170.0	Part 0: General principles
4671	Steel reinforcing materials
EN	
1992	Eurocode 2: Design of concrete structures
1992-4:2016	Part 4: Design of Fastenings for Use in Concrete
EOTA	European organisation for technical assessment
EAD	
330008	Anchor channels
330232	Mechanical fasteners for use in concrete
330499	Bonded fasteners for use in concrete

1.3 DEFINITIONS

For the purpose of this Standard, the definitions below apply.

1.3.1 Anchor

The headed component of anchor channel.

NOTE: In Australian practice, a fastener installed in concrete may be referred to as an ‘anchor’, such as ‘mechanical anchor’ and ‘chemical anchor’. For clarity in this Standard the term anchor is reserved for the headed component of the anchor channel.

1.3.2 Anchor channel

A fastener made of profiled steel element with two or more rigidly connected anchors that are installed into position prior to the casting of concrete.

1.3.3 Base material

The material in which the fastener is installed.

1.3.4 Bond failure

A mode of failure for chemical fasteners characterized by pull-out of the fastener caused by either separation at the interface of the bonding compound and the embedded steel element or between the bonding compound and the base material.

1.3.5 Capacity reduction factor

A factor used to multiply the nominal capacity to obtain the design capacity.

1.3.6 Cast-in fastener

A fastener that is installed into position prior to the casting of concrete [see Figure 1.3(B)].

1.3.7 Channel bolt

A screw or bolt positioned in the steel profile of the anchor channel that is used to connect an element to the anchor channel.

1.3.8 Characteristic edge distance

The distance required between the free edge of a concrete member and the centre-line axis of the fastener in order to develop the characteristic strength of the fastener.

1.3.9 Characteristic spacing

The specific distance required between two fasteners having the same characteristics in order for the characteristic strength of the fasteners to be achieved.

1.3.10 Characteristic strength

The 5% fractile strength (value with a 95% probability of being exceeded with a confidence of 90%).

1.3.11 Chemical fastener

A post-installed fastener that includes a steel element (threaded rod or reinforcing bar) and a bonding compound that transmits loads from the embedded steel element into the base material.

NOTE: Also known as bonded fastener.

1.3.12 Chemical expansion fastener

A chemical fastener with an embedded steel element with a profile specially designed such that the application of displacement on it results in follow-up expansion.

NOTE: Also known as bonded expansion fastener.

1.3.13 Combined pull-out and concrete cone failure

A possible mode of failure of chemical fasteners characterized by bond failure in the lower portion of the embedded fastener and concrete cone failure in the upper portion of the embedded fastener.

1.3.14 Concrete blow-out failure

A mode of failure characterized by spalling of the side face of the concrete member that is confined to a region adjacent to the head of the fastener.

NOTE: This failure mode does not involve concrete break-out at the top surface of the concrete member.

C1.3.14 *Concrete blow-out failure is usually experienced by fasteners that have a deep embedment and small side cover.*

1.3.15 Concrete cone failure

A mode of failure characterized by the formation of a cone or wedge of concrete surrounding a fastener or group of fasteners that become separated from the base material.

1.3.16 Concrete pry-out failure

A mode of failure characterized by the formation of a concrete spall on the opposing side of the fastener, relative to the direction of shear loading.

1.3.17 Concrete screw

A post-installed fastener installed into a pre-drilled hole that contains threads to engage with the concrete via mechanical interlock.

1.3.18 Concrete splitting failure

A mode of failure characterized by cracks in the concrete member which form in the plane of the axis of the fastener.

1.3.19 Deformation-controlled expansion fastener

A post-installed fastener installed into a pre-drilled hole that requires an internal plug in the sleeve to be driven via a hammer during the setting procedure of installation, resulting in lateral expansion of the fastener.

NOTES:

1 A follow-up expansion behaviour does not exist.

2 Also known as ‘drop-in’ fastener’ or ‘knock-in’ fastener’.

1.3.20 Edge distance

The distance between the free edge of the concrete member and the centre-line axis of the fastener.

1.3.21 Effective embedment depth

The length of the fastener that is considered to effectively engage the base material, which is generally smaller than the total length of the fastener that is embedded [see Figure 1.3(C)].

1.3.22 European Technical Assessment (ETA) (formerly European Technical Approval)

Prequalification for a fastener, which represents technical assessment of its fitness for an intended use.