

TECHNICAL NOTE



AEFAC - TN07

AEFAC FASTENER DICTIONARY

Ver. 1.1
December 2019

1. Scope

This Technical Note summarises the terminology adopted by the fastener industry, covering cast-in and post-installed fasteners for safety-critical applications. The advice provided in this document is general in nature and aligned with industry practice. While the descriptions provided below are generally accepted, they should not override descriptions provided in the manufacturer's installation instructions.

2. Terminology

Action: the cause of stress or deformations in a structure.

Allowable working load: See "Working Load Limit".

Anchor: See Fastener.

Anchorage: an assembly comprising base material (concrete or masonry), fastener or fastener group and a component fixed to the base material.

Anchor channel: a steel profile with rigidly connected fasteners that is installed prior to pouring the concrete base material concrete.

Attachment: Metal assembly that transmits loads to the fastener.

Assessment and Verification of Constancy of Performance (AVCP) is a high-level quality control system in the European Union that ensures the product continues to perform in accordance with its technical specification such as an ETA or harmonised European standard for the duration of its production. The procedure for conformity control was formerly conducted under the Attestation of Conformity.

Base material: Material in which the fastener is installed, e.g. concrete slab.

Base plate: a plate that is typically in contact with the base material that is secured by one or more fasteners and that may directly transfer loads from the structure to the fasteners.

Blow-out failure: a mode of failure whereby concrete spalling is experienced on the side-face of the concrete member at the level of the embedded head, with no major breakout at the top concrete surface. This typically occurs due to the combination of deep embedment and small edge distance.

Bonded fastener: Fastener placed into a hole in hardened concrete, which derives its resistance from a bonding compound placed between the wall of the hole in the concrete and the embedded portion of the fastening.

Bonded expansion fastener: a post-installed bonded fastener designed to generate expansion forces in response to tension loading.

Bond failure: a failure mode characterised by the loss of bond at the interface between the adhesive and the base material or at the interface between the adhesive and the fastener.

Capacity reduction factor: a factor used to multiply the nominal capacity to obtain the design capacity

Cast-in fastener: headed bolt, headed stud, hooked bolt or anchor channel installed before placing the concrete.

CE Marking: Conformité Européene (European Conformity) Marking which is a symbol denoting a manufacturer has conformed to the Essential Requirements of the Construction Products Regulation. The CE is only applicable to products that have an ETA and an AVCP system in place.

CEN: European Committee for Standardisation that is responsible for the planning, drafting and adoption of European Standards.

Characteristic strength: a value of the material or connection strength, as assessed by a standard test or by empirical calculation. The 5% fractile of the mean ultimate strength is based on a 90% probability (confidence level) that 95% of fasteners will have a strength exceeding the reported value.

Characteristic edge distance: the minimum edge distance required for a fastener to achieve its characteristic strength without causing concrete edge failure or splitting failure, measured from the edge of the concrete member to the centreline of the fastener.

Characteristic spacing: the spacing required to ensure a fastener is capable of achieving its characteristic strength.

Chemical fastener: See “bonded fastener”.

Combined action: combination of tensile and shear loads applied simultaneously

Combined pull-out and concrete cone failure: a failure mode for bonded fasteners whereby bond failure develops towards the lower end of the fastener and a concrete cone failure develops towards the top of the fastener.

Competent: possessing the necessary skills to undertake a task as instructed by the relevant authority, knowledge and experience and with an understanding of the implications of not performing the required task as specified.

Concrete Capacity (CC) Method: a theoretical method based on empirically derived equations that is used to predict the failure load of fasteners in concrete.

Concrete cone failure: the development of a wedge or cone shaped body forming around the fastener(s) and separating from the base material under tension loading.

Concrete edge failure: a mode of failure that may be experienced under shear loading whereby a crack develops from the top of the fastener and propagates towards the adjacent edge at an inclined angle resulting in a body separating from the base material.

Concrete pry-out failure: a failure mode whereby a spall develops on the opposite side to the loading direction under shear loading.

Concrete strength: the 5% fractile of the strength; the value having a 95% probability of being exceeded, with a confidence level equal to 90%.

Contractor: an organisation or employer whose employee(s) undertake construction work.

Cracked concrete: concrete that is likely to experience cracking during its lifetime; justification should be provided if uncracked properties are adopted.

Creep: a time-dependent deformation experienced in a system due to a sustained load that is in addition to the deformation experienced upon initial loading.

Critical edge distance: see “characteristic edge distance”.

Critical spacing: see “characteristic spacing”.

Curing time: minimum time from the end of mixing of chemical components until the time when the fastener may be torqued or loaded (whichever is longer). Also referred to as “setting time”.

Declaration of Performance (DOP) is a document published by the manufacturer that includes the essential characteristics of their product. The DoP is generated when a product is covered by a harmonised European standard or an ETA. The manufacturer therefore assumes the legal responsibility of the product conforming to the declared performance.

Deformation-controlled expansion fastener: a post-installed fastener that engages with the sidewall of a drilled hole via the actuation of an internal plug being driven into the sleeve, or by a sleeve being driven over an internal plug. Once set, no additional follow-up expansion is possible.

Design action or design load: the combination of the nominal actions or loads and the load factors specified in AS/NZS 1170.0, AS/NZS 1170.1, AS/NZS 1170.2, AS/NZS 1170.3, AS 1170.4 or other standards.

Design capacity: the product of the characteristic capacity and the capacity reduction factor.

Design life: the duration that a fastener is intended to remain in service. This information should be published in the technical literature accompanying the fastener product.

Diamond core bit: a non-percussion drill bit typically utilising a hollow tube that has a diamond impregnated tip that is used to drill the base material that generally results in smooth-walled holes.

Displacement: a measurement of the movement of the loaded end of the fastener relative to the base material into which it is installed, measured in the direction of loading. For cast-in anchor channel, this may be movement of the anchor bolt or anchor channel relative to the concrete element. Measurement is made parallel to the centreline of the fastener for tension tests and perpendicular to the centreline of the fastener for shear tests.

Drill: electric, hydraulic or air-powered tool for boring holes into the base material, using a rotary action that is often supplemented with percussion or hammering.

Drill bit: a solid shaft, typically containing a carbide-tip and spiral flutes, that is used to bore holes in base material.

Edge distance: the distance from the nearest edge of the concrete member to the centreline of the fastener.

Effective embedment depth: the overall depth through which the fastener transfers load to the surrounding base material, measured from the surface of the concrete member. This value is generally less than the embedment depth.

Embedment depth: distance measured from the surface of the base material to the farthest point of the fastener, measured prior to setting of the fastener.

European Assessment Document (EAD) is the replacement for an ETAG. An EAD provides the same framework for testing and assessment of fasteners, except design methods have been removed and placed in European Standard EN 1992-4 *Design of fastenings for use in concrete*.

Engineer: person with suitable training and experience in the field of post-installed fasteners, and who has the responsibility of providing the design and/or specification

of a fastener system and who may be called upon to ensure the fastener performs as intended throughout its service life.

European Organisation for Technical Assessments (EOTA) (formerly *European Organisation for Technical Approvals*) comprises Approval Bodies nominated to issue European Technical Assessments (ETAs) by EU Member States and European Free Trade Association States who have contracted to the European Economic Area Agreement. The EOTA monitors the drafting of ETAs and co-ordinates all activities relating to the issuance of ETAs.

European Technical Assessment (ETA) (formerly *European Technical Approval*) is prequalification for a construction product that represents a favourable technical assessment of its fitness for an intended use. European Technical Approvals issued prior to 1st July, 2013 will remain relevant for their period of validity. The period of validity of a European Technical Assessment is unlimited provided an AVCP system is in place.

European Technical Assessment Guideline (ETAG) is a document drafted by and for the EOTA Approval Bodies as a result of a mandate from the European Commission and EFTA. Its basic aim is to establish how Approval Bodies should evaluate the specific characteristics/requirements of a product or family of products. An ETAG is being replaced by a European Assessment Document.

European Technical Product Specification: a harmonised European Product Standard (hEN) or European Technical Approval or European Technical Assessment.

Expansion fastener: a type of fastener that engages with the base material via the expansion of its components and that derives its strength through frictional forces between the fastener and the sides of the hole.

Factor of safety: the ratio between nominal strength and nominated strength and represents all uncertainties in the Working Stress Design approach.

Failure mode: the mechanism leading to the failure of a fastener during load application.

Fastener: a manufactured device that connects a fixture to base material.

Fastener component: metal item of the fastener assembly that is attached to the base material.

Fastener group: a number of fasteners having identical characteristics acting together to support a common attachment, where the spacing of fasteners does not exceed the characteristic spacing.

Fixture: the component to be fixed to the base material via a fastener.

Follow-up expansion: the movement that may be experienced in an expansion fastener (excluding deformation-controlled expansion fasteners) resulting in the sleeve(s) experiencing additional expansion caused by the cone(s) being drawn further up due to the application of tension load.

Gel time: the timeframe after mixing of the chemical components when the anchor rod must be inserted. Also referred to as “working time”.

Global safety factor: the margin for safety including environmental conditions, uncertainties in loads, and uncertainties associated with the strength of the fixture.

Gross error: errors associated with incorrect installation that includes but is not limited to, the use of an incorrect drill diameter, the use of an incorrect drilling system, the use of incorrect setting tools, no attempt to clean hole if cleaning is required, the need for significant manipulation of fastener after installation, and hammering a fastener that should be installed by rotation.

Headed fastener: a steel cast-in fastener that is placed prior to pouring concrete and transfers load via mechanical interlock (bearing) between the head and base material.

Hold-down fastener: similar to ‘headed fastener’ but typically having a much greater depth of embedment and a smooth shank for high load applications.

Installer: an individual or company with suitable training for the installation of bonded fasteners, including the ability to follow manufacturer’s installation instructions.

Installation safety factor: partial safety factor that accounts for the sensitivity of a fastener due to reasonable errors associated with installation on site, and the impact these have on performance. Gross errors are not considered.

Installation torque: the torque specified on the installation instructions that accompany the fastener product that have been provided by the supplier.

Limit State: any limiting condition beyond which the structure ceases to fulfil its intended function.

Load: an externally applied force.

Manufacturer: an individual or organisation that designs and produces a fastener product. The manufacturer may also be the supplier of the fastener product.

Manufacturer’s installation instructions: instructions provided by the manufacturer in the form of text and illustrations specific to a product, to facilitate correct installation practice.

Masonry: a building system comprising a series of units embedded in a matrix of mortar.

Mechanical interlock: the mechanism of load transfer between two bodies via interlocking surfaces.

Minimum edge distance: For cast-in fasteners this is to ensure adequate placing and compaction of concrete, for post-installed fasteners this is to avoid damage to the edge of the concrete during installation. Value is published in European Technical Product Specification.

Minimum member thickness: the minimum thickness of the concrete member in which a fastener is fixed that ensures a given performance of the fastener is achieved under a unique set of conditions including, but not limited to, edge distance and fastener spacing.

Minimum spacing: the minimum spacing between two adjacent fasteners, measured centreline to centreline and published in the European Technical Product Specification. For cast-in fasteners this is to ensure adequate placing and compaction of concrete, for post-installed fasteners this is to avoid damage to the edge of the concrete during installation.

Multiple use: an application category including redundancy in the design such that the failure of a single fastener will not result in the collapse of the supported structure. Classification under the multiple use category requires consideration of the number of fixing points, the number of fasteners and the value of the design load.

Nominal capacity: the capacity of a member or connection typically computed using a design model not including capacity reduction factors.

Non-cracked concrete: concrete that has been demonstrated via stress analysis to remain crack-free in the vicinity of the fastener throughout the design life under all design load considerations.

Non-static action: actions that may include seismic, shock, cyclic or fatigue loading.

Open time: the maximum time from the end of mixing of the chemical components to when the insertion of the fastener into the bonding material shall be completed.

Option number: a number from 1 to 12 denoting the particular test regime a fastener is tested and assessed against that is also published in the ETA.

Partial safety factor: a (European) safety factor accounting for unknown variability in either the loads or strength.

Partial factor for action: a (European) safety factor accounting for uncertainties associated with the actions applied to the system.

Partial factor for resistance: a safety factor accounting for uncertainties associated with the resistance provided by the system.

Partial safety factor for installation: a safety factor that accounts for sensitivity of a fastener to installation inaccuracies on its performance.

Post-installed fastener: A fastener installed in hardened concrete.

Prequalification: the certification for a product attesting to it being fit for its intended use based on an independent testing and assessment program such as a European Technical Assessment.

Proof tests: tests performed on a sample population of fasteners to verify correct installation.

Pull-out failure: failure mode where the fastener pulls out of the concrete without the full concrete resistance being developed.

Pull-through failure: a mode whereby the fastener body pulls through the expansion mechanism without developing the full concrete cone strength. It is not presently possible to predict this theoretically.

Pure epoxy: made from an epoxy resin and hardener and exhibit very high strength and chemical resistance.

Quasi-static action: a load that is applied sufficiently slowly that it may be treated as a static load.

Relaxation: the reduction in fastener prestress and thus associated clamping force, over time.

Resin: a natural organic substance that is soluble in organic solvents but not in water and is an electric non-conductor.

Resin capsule: a capsule: typically glass or foil: that is inserted into a drilled hole and mixed by either the anchor rod being spun during installation, or by the reinforcing bar being hammered in during installation, depending on the type of system.

Robustness: the ability of a fastening system to sustain a degree of damage without experiencing excessive failure or damage.

Safe working load: see "Working load limit".

Safety-critical application: an application in which a failure would result in risk to human life and/or cause significant economic consequences.

Screw anchor: a threaded fastener that is screwed into a drilled hole where the threads create a mechanical interlock with the base material.

Selection: the process followed in order to identify the chosen fastener(s) for a fixture.

Sleeve fastener: a torque-controlled expansion fastener that contains a sleeve containing deformations to prevent spinning during installation, a cone and an expansion element. During installation the bolt of the fastener is rotated via the application of torque, resulting in the cone being drawn up into the expansion element to cause dilation.

Spacing: the distance measured between the centrelines of adjacent fasteners.

Specifier: person or organisation that selects, designs and provides specification for fasteners.

Specification: the complete reference information that is required to identify a unique fastener for procurement or installation.

Splitting failure: a mode of failure whereby a crack passes through the axis of the fastener or fasteners.

Static mixer nozzle: product-specific, length chosen, matrix of baffles, the length of which is critical to ensure the appropriate mix ratio of the resin to hardener is achieved.

Statically determinate: a system whereby there is no redundancy in a fixture such that the failure of a single fastener will result in the failure of that fixture.

Statically indeterminate: a system including redundancy such that the failure of a single fastener will not result in the failure of that fixture and the additional load will be supported by neighbouring fasteners.

Steel failure of fastener: steel failure mode characterised by fracture of the steel component(s) of a fastener.

Strength reduction factor: see “capacity reduction factor”.

Structural integrity: soundness of a system to perform as originally intended for the duration of its service life.

Stud fastener: a bolt-type torque-controlled expansion fastener containing a small expansion segment that is dilated during installation with the application of torque causing the cone on the end of the bolt to be drawn up into the expansion segment. Also commonly referred to as “through-bolts”.

Substrate: base material used to restrain a fixture via a fastener.

Supervisor: a person with appropriate training and experience to supervise the installer.

Supplementary reinforcement: reinforcement positioned to tie a concrete breakout body with the concrete member

Supplier: an individual or organisation that supplies fasteners.

Tester: the individual or organisation that is responsible for undertaking proof tests on fasteners.

Through bolt: see “stud fastener”.

Torque-controlled expansion fastener: a post-installed fastener that derives its tensile resistance from sleeves expanding against the sidewall of the drilled hole via the application of torque that draws the cone(s) up into the sleeve(s) during installation. The application of tension load may cause follow-up expansion to enhance the engagement of the sleeve with the sidewall of the drilled hole.

Undercut fastener: a post-installed fastener that is engaged with the base material via mechanical interlock provided by undercutting the concrete at the embedment end of the fastener. A special drill bit may be required to provide the undercut or this may be achieved by the fastener during installation.

Unsaturated polyester: a type of bonded fastener providing medium strength, rapid curing times in low temperatures, with limited chemical resistance.

Vinylester (epoxy acrylate): a bonded fastener having the benefits of a polyester albeit with greater strength and chemical resistance.

Working load limit: the maximum load that can be applied without the strength and stability requirements being exceeded. Also known as safe working load, allowable working load, maximum rated load, and permissible working load.

Working Stress Design: a method of proportioning structural members and connections, such that elastically computed stresses produced in the members by nominal loads do not exceed specified allowable stresses. Also known as allowable stress design or permissible stress design.

Working time: see “gel time”.



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