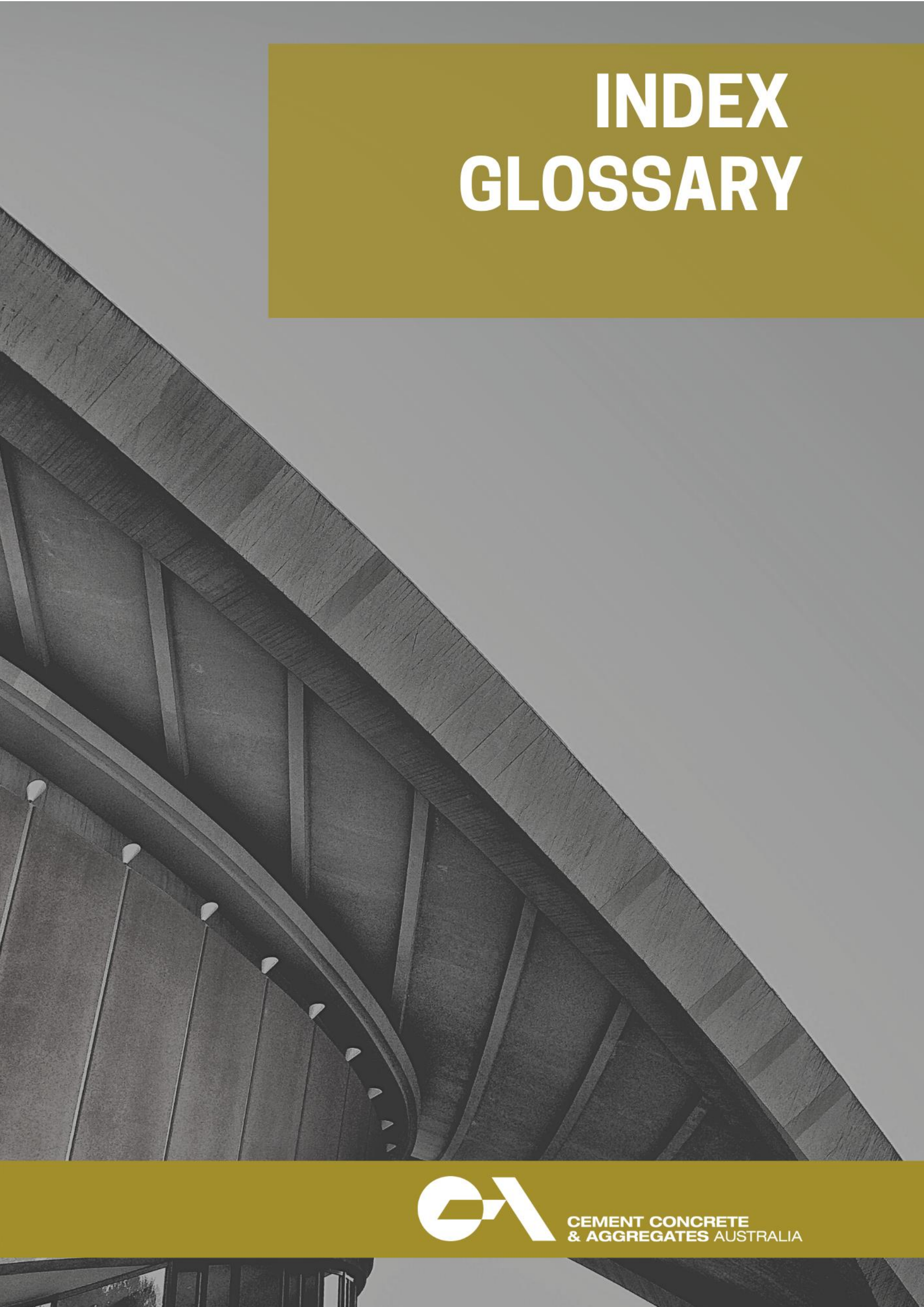
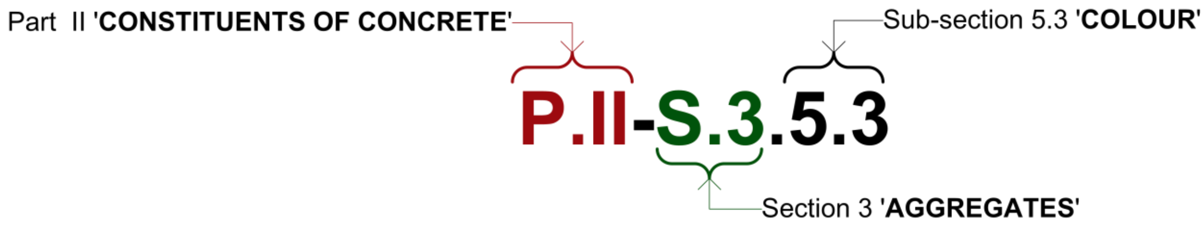


INDEX GLOSSARY

CEMENT CONCRETE & AGGREGATES AUSTRALIA

This document provides a list of technical terms popularly used in the field of cement, concrete and aggregate – accompanied by a brief definition for each of them. Interested readers may find it useful for a quick referencing in their everyday practice, as well as for self-learning purposes. Readers are also encouraged to follow the supplied indexes to locate the exact sections/sub-sections in the Guide where the terms are discussed in detail. To use the indexes:

- For composite parts of the Guide with lower individual sections (i.e. Part II, Parts IV to IX), indexes are composed using part, section and sub-section hierarchy. An illustration is given below for Part II-Section 3, Sub-section 5.3 of the Guide:



- For standalone parts with no lower individual sections (i.e. Introduction, Parts I, III, X and XI), indexes are simplified to the following form (example given for Part III, Sub-section 2.9 of the Guide):

A

Abrasion Resistance The abrasion resistance of concrete is important in many applications (e.g. driveways, industrial floors) and is a function primarily of compressive strength. To improve abrasion resistance, proprietary topping mixes or shakes may be used on the concrete surface or steel fibres may be included in the concrete mix.	**P.VIII-S.25.3.2**
Admixtures Admixtures are defined in AS 1478 as 'a material, other than water, aggregate and cementitious materials, used as an ingredient of concrete, and added to the batch in controlled amounts immediately before or during its mixing to produce some desired modification to the properties of the concrete'. There are a number of admixture types – the main ones are described below.	**P.II-S.5.2.1** **P.XI.7.4**

Air-entraining (Type AEA) These admixtures are used to purposefully entrain air in concrete. Entrained air assists in (a) preventing Freeze-Thaw damage in concrete exposed to repeated freezing and thawing and (b) increasing the cohesiveness of concrete (particularly lower concrete grades) which assists in improving workability and pumpability. *Retarder (Type Re)* Retarders slow the rate of cement hydration and are useful when concrete has to be transported and placed and finished in hot weather conditions. The retarder extends setting times and provides more time for handling and managing the concrete. *Accelerator (Type Ac)* Accelerators increase the rate of cement hydration and are useful in cold weather conditions to reduce the time taken for concrete to set and for finishing to be completed. *Water Reducer (Types WR, MWR, HRWR)* Water reducers (WR) are able to reduce the total water demand of a concrete mix while retaining required levels of workability. There are three grades of WR – namely 'normal', 'medium' and 'high range' (also known as super-plasticisers) water reducers – and these can reduce total water by up to 10%, 15% and 25% respectively. WR can also improve mix economy by allowing a lower W/C ratio to be used and still achieve required concrete workability. See also *Superplasticiser* and *Water Reducer*. *Other Admixtures* Other admixture types that are less commonly used include Shrinkage Reducing Admixtures; Corrosion Inhibitors; Hydration Control (Type HCA); Anti-Washout (Type AWA); Permeability Reducing; Internal Curing; Anti-Freeze; and Foaming. See also *'Water-proofing' Concrete Additive / Admixture*.	**P.II-S.5.2.2** **P.II-S.5.2.3** **P.II-S.5.2.3** **P.II-S.5.2.4** **P.II-S.5.2.5**
Admixture Overdose Admixtures are quite powerful chemicals and their misuse can cause significant concrete problems. An overdose of a retarding admixture can cause large delays to concrete setting time and hence to finishing time, while an overdose of accelerator can cause premature stiffening and serious issues in finishing the concrete. An overdose of air-entraining admixtures can cause significant issues with concrete strength.	**P.II-S.5.6**
Aggregates Aggregates are most broadly defined as 'Coarse' and 'Fine', with the cut-off size between the two groups being 4.75 mm. Aggregates make up about 75% of the volume of concrete and contribute substantially to all aspects of concrete performance. 'Coarse' aggregates may be either crushed rock, gravel or screenings. 'Fine' aggregates include both natural sands and crusher fines. Important aggregate properties include maximum size, individual and combined gradings, shape and texture, strength, durability and chemical resistance. Aggregate requirements for concrete are defined in AS 2758.1.	**P.II-S.3** **P.XI.7.5**

Aggregate Grading Grading refers to the determination of the particle-size distribution for aggregate. Grading limits and maximum aggregate size are specified because these properties affect the amount of aggregate used as well as cement and water requirements, workability, pumpability, and durability of concrete.	**P.II-S.3**
Agitator An 'agitator' is a concrete truck. In their earliest forms, these trucks were literally agitators into which plastic concrete mixed in a wet-batch plant was loaded. These trucks then agitated the concrete while it was delivered from the plant to job site – the agitation keeping the concrete 'live'. Colloquially, the term agitator is now used for 'transit mixers' in which concrete, having been batched into the bowl of the truck as dry materials, is mixed prior to delivery to the job site.	**P.IV-S.9.2.5** **P.IV-S.10.2**
Air Content (of concrete) All concrete contains some air trapped in its matrix. There are two forms of this air: *Entrapped air* Entrapped air is generally larger voids formed during mixing, these are largely removed during compaction processes (e.g. vibration of the concrete). *Entrained air* Entrained air is generally a finer matrix of air voids that are deliberately created by certain types of admixtures including air entraining agents (AEA) and some other surfactant admixtures, these are designed to be more resistant to compaction and should not be removed in well-designed concrete. See also *Admixtures*.	**P.XI.9.2** **P.V-S.13** **P.II-S.5.2.2**
Alkali Activated Materials (AAM's) Alkali activated binders have been the focus of research for decades, with Glukhovsky in the 1950's and Davidovits in the 1970's being two of the main proponents. Alkali activated slags were widely used in Eastern Europe when there were cement shortages, and more recently research into AAM's has been motivated by trying to find low-carbon alternatives to Portland cement. Australia is a leading force in both research and application of AAM's.	**P.VII-S.23.3**
Alkali-Aggregate Reaction (AAR) Chemical reaction in either mortar or concrete between alkalis (sodium and potassium) from Portland cement or other sources and certain constituents of some aggregates. The reaction products when combined with water can cause expansion and cracking in concrete containing the aggregates. Two major types of AAR are: *Alkali-Silica Reaction (ASR)* The reaction between the alkalis (sodium and potassium) in Portland cement and certain siliceous rocks or minerals, such as opaline chert, strained quartz, and acidic volcanic glass, present in some aggregates. *Alkali-Carbonate Reaction (ACR)* *ACR* is the reaction between certain dolomitic limestone and alkalis in the pore solution of the concrete. It is rare in Australia.	**P.II-S.3.4.6**

Alkalinity Hydrated cement paste is strongly alkaline, with a pH of about 12.5, due significantly to the presence of the hydration product calcium hydroxide or 'lime'. This alkalinity is important in passivating the surface of any embedded steel. Reduction in paste alkalinity and pH (e.g. by reaction with CO_2) may lead to steel corrosion.	**P.II-S.1.4.6** **P.II-S.4.3.3**
Anchorage (1) In post-tensioning, a device used to anchor the tendon to the concrete member; (2) In pretensioning, a device used to maintain the elongation of a tendon during the time interval between stressing and release; (3) In precast-concrete construction, the devices for attaching precast units to the building frame; (4) In slab or wall construction, the device used to anchor the slab or wall to the foundation, rock, or adjacent structure.	**P.V-S.11.5** **P.V-S.11.6** **P.V-S.11.7**
Agitator Truck 'Agitator' is the colloquial term for 'transit mixer' – the vehicles that are loaded with concrete raw materials at a dry-batch plant and in which the concrete mixing takes place. These vehicles then also transfer the plastic concrete to the job site and discharge it into the forms or into a concrete pump or some other receiving (and distribution) device. See also *Agitator*.	**P.IV-S.9.2.5** **P.IV-S.10.2**
Alternative Binder An 'alternative binder' is a binder used in the manufacture of concrete that does not contain Portland Cement. Examples of these materials are *Alkali Activated Materials* and *Geopolymers* that are defined in this Glossary. Research into alternative binders has been driven primarily by the need to reduce the levels of *Embodied* CO_2 and *Embodied Energy* (see below) in concrete.	**P.VII-S.23**
Amorphous Silica Amorphous silicas are a group of SCM's that are defined in AS 3582.3. The most common is silica fume, but other forms of amorphous silica are also used – the use depending largely on availability. In New Zealand a naturally occurring material known as Microsilica has been used to improve concrete performance and mitigate AAR/ASR. See also *Silica Fume*.	**P.II-S.2.8**
Architectural Precast Concrete Precast concrete has been instrumental in changing the view that concrete is a 'simple grey monotone structure'. Through a wide range of innovations, precast concrete has transformed the architectural use of concrete for building facades, monumental structures, cityscapes and public spaces and in many other areas. The use of special finishes (e.g. exposed aggregate, acid etching), a wide range of colours and textures (e.g. by using form liners) have shown that concrete does not have to be boring and is able to be produced with vibrant decorative finishes.	**P.VI-S.20.4**

As Drawn Wire (mill coil) Wire drawing is a metalworking process used to reduce the cross-section of a wire by pulling the wire through a single, or series of, drawing die(s). This process is used to form wire strand, cables and prestress wire (refer to AS 4672.1).	**P.II-S.6.3**
AS 1379 The Australian Standard for 'Specification and supply of concrete'. AS 1379 covers concrete constituents, concrete plants/equipment, production and delivery, sampling and testing generally for concrete specified by compressive strength. Importantly, AS 1379 nominates coverage in terms of concrete grades (20-100 MPa) and classes – viz. 'Normal Class' and 'Special Class'.	**P.IV-S.8**
AS 3600 The Australian Standard for 'Concrete Structures'. AS 3600 provides unified rules for the design and detailing of concrete structures and members – with or without reinforcing steel or prestressing tendons. The Standard also provides performance criteria against which a structure can be assessed for compliance with design requirements.	**P.VIII-S.25**
Australian Standards Australian Standards are a set of nationally recognised documents which, if followed, provide producers, users and the community with some confidence that certain levels of technical and safety performance have been met for products used in industry and domestically. These Standards are internationally recognised and provide confidence to investors and others about required levels of manufacturing quality and product performance.	**P.XI.1.2**
Autoclaving Autoclaving is a method of curing concrete using high pressure steam at temperatures of 160-190°C (at 6-20 atmospheres steam pressure) to accelerate concrete strength gain. It is used particularly in the manufacture of Autoclaved Aerated Concrete (AAC).	**P.V-S.15.4.4**
Autogenous Shrinkage Autogenous shrinkage occurs in cement paste and comes about because water is being removed from the capillary pores over time to facilitate the ongoing hydration reaction, causing the paste to shrink. In low W/C ratio mixes the level of autogenous shrinkage might be expected to be higher but the more rigid skeleton tends to limit it. Similarly, the autogenous shrinkage of paste in a concrete mix is lower than with a cement plus water paste as the autogenous shrinkage is restrained by the aggregate. A typical level of autogenous shrinkage in concrete is about 50 microstrain.	**P.II-S.1.3.2**

B

Bar Chair The embedded items within reinforced concrete elements, which are used to maintain the position and cover of steel reinforcement during construction to ensure durability, strength and serviceability of the as-built elements (see also AS /NZS 2425:2014)	**P.V-S.11.3.3**

Barrier Walls Barrier walls (also known as jersey barriers) are slip-formed concrete structures used to separate lanes on major roads or to separate roads from tunnel walls etc. On modern roads, these are able to be produced as cast-in-place structures instead of being a series of discrete elements as was the case previously.	**P.VI-S.19.3.5**
Batch (Concrete) A quantity of concrete containing a fixed amount of ingredients and produced in a discrete operation.	**P.III.2** **P.IV-S.9.2** **P.IV-S.10.3**
Batching The process of combining the concrete ingredients in fixed proportions by weight or by volume.	**P.III.2** **P.IV-S.9.2** **P.IV-S.10.3**
Beams and Girders Precast concrete beams and girders come in a variety of shapes and sizes and are fundamental elements used in the construction of buildings and bridges etc. They may act as support structures only (e.g. L-beams and inverted tee-beams), or in some cases (e.g. single-tee and double-tee beams) they can form building floors or can provide the base for an in-situ concrete topping to act as the final floor. Super tee-girders and I-girders are common girder types typically used in bridge construction.	**P.VI-S.20.3.2**
Beam Form (and supports) Formwork and falsework used to support plastic concrete when beams are cast.	**P.IX-S.27.3.1**
Beam Shells Beam shells are long U-shaped beams that can contain the beam reinforcement and also be used to support floor planks. They can sit on a column and when the structure is finished they become integral with the planks and topping concrete.	**P.VI-S.20.3.2**
Binder In concrete technology the terms 'binder' and 'cement' are synonymous. However, while 'cement' is more definitive (see *Cement* below), 'binder' is more general in that it may refer to Portland cement alone, to Portland cement plus one or more SCM, or even to a non-Portland cement material (e.g. an *Alkali Activated Material* or a *Geopolymer* – see *Alternative Binder* above). When mixed with water, cements / binders form the 'glue' that binds the aggregate materials into the composite material called concrete. (Note: AS 1379 refers to complying 'cement' as a 'hydraulic binder' as is defined in *Hydraulic Cement* below.)	**P.II-S.1.1** **P.II-S.1.2.1** **P.XI.7.1**
Blue Metal A quarried, crushed aggregate rock that provides strength to concrete by binding with cement. Colour ranges from blue to black and size ranges from 5 mm to 20 mm. This term is not in common use currently.	

Bleed Water Bleed water appears on the surface of plastic concrete after it has been compacted and bull-floated, and (ideally) prior to final finishing. Bleeding is a consequence of the process of sedimentation – that is, the settling of heavy materials (e.g. cement and aggregate particles) in a mixture that contains a lighter component (e.g. water). While the concrete is still plastic the heavy particles are able to sink, leaving some water on the surface of the concrete. Sinking ceases once the concrete starts to stiffen. Bleed water may not always be obvious on the surface as the evaporation rate of water from the concrete surface may exceed the Bleed Rate. In this situation there is a heightened risk of Plastic Shrinkage Cracking.	**P.V-S.14.4** **P.VIII-S.25.2.3** **P.VIII-S.26.3.7**
Blended Cements (Type GB Cements) According to the requirements of AS 3972, blended cements are cements that (a) contain >7.5% fly ash or GGBFS or both, or (b) up to 10% silica fume, and (c) meet the performance requirements described in Table 2 of AS 3972. There is no upper limit for fly ash and GGBFS content in Type GB cements. The upper limit is determined by the performance of the Type GB cement – in particular the effect on setting time or mortar strength beyond the limits prescribed in the Standard. See also *General Purpose Blended Cement (Type GB)*.	**P.II-S.1.2.3**
Blinding Layer In construction, blinding is a base layer of weak concrete or cement stabilised sand that is laid on a paving sub-base to provide a clean, level and dry working surface.	**P.I.2**
Bony (Harsh) Mix A concrete mix made with a poorly ratioed composition such as too little water or too much cement and aggregate, leading to a less workable concrete mix.	**P.III.3.2**
Boxing A colloquial term for concrete formwork - see *Formwork.*	
Bracing and Props Bracing and props are important items used in precast concrete construction. Bracing is used to support vertical elements, while props are used to support horizontal elements. Precast panels are lifted into position and while the precast components are being assembled, and prior to them being fixed into position, the panels are stabilised using bracing. Props are used to support structures like cast-in-situ decks or beams while they gain strength. The proper use of bracing and props requires high quality engineering design input to ensure the safety of site personnel and the integrity of the structure.	**P.VI-S.20.7.7**
Brazil Test The 'Brazil Test' is a common name for the indirect tensile strength test for concrete. This measure of the tensile strength of concrete generally has a lower strength than the flexural strength test but higher than the direct tensile strength (refer to AS 1012.10). See also *Indirect Tensile Strength Test*.	**P.VIII-S.26.4.4**

Broom Finish A surface finish applied to create a non-slip surface. It is applied (a) using a stiff broom at the later stage of concrete finishing, and (b) usually at 90° to the direction of the path.	**P.V-S.14.7.4** **P.V-S.14.7.7**
Building Code of Australia (BCA) The BCA in the National Construction Code (NCC) provides the minimum necessary requirements for safety, health, amenity and sustainability in the design and construction of new buildings (and new work in existing buildings) throughout Australia. It contains technical provisions for the design and construction of buildings and other structures.	**P.XI.1.2**
Bulk Density The bulk density of a material is the density of the uncompacted material in a natural state (e.g. the density of aggregate in a stockpile or cement in a silo). The bulk density is not used in mix design but is used in designing concrete plants and storage vessels for cement and fly ash plants. For silica fume, bulk density is an important issue. As produced, silica fume has a low bulk density. To be able to handle it in concrete plants or elsewhere it is often densified to improve ease of handling or made into a slurry (at 50-60% solids content) to allow it to be added to mixes more conveniently.	**P.II-S.2.8** **P.II-S.3.4.4**

C

California Bearing Ratio The Californian Bearing Ratio (CBR) test is a penetration test used to evaluate the subgrade strength of roads and pavements. The results of these tests are used with the curves to determine the thickness of pavement and its component layers. This is the most widely used method for the design of flexible pavement (refer to AS 1289.6.1.1).	**P.I.2.2**
Cantilever Beam A cantilever beam is a structural beam that is fixed from being able to move freely at one end and is free at the other end. This design produces zero bending stress or shear stress at the free end and concentrates the greatest stresses at the fixed end.	**P.I.3.3**
Capillary Porosity (and Capillary Dis-continuity) Capillary porosity is a feature of Portland cement concrete. As water is taken up by the (relatively) slow hydration process the space left behind becomes capillary porosity. Concrete mixes with high W/C ratios have much higher levels of capillary porosity than do mixes with low W/C ratios. This porosity can allow fluids (gases and liquids) to penetrate into the concrete unless the porosity becomes dis-continuous. Capillary porosity can be made dis-continuous by (a) lowering the W/C ratio (= increasing the cement content); (b) curing; (c) using SCM's in the cementitious component.	**P.VIII-S.25.3.2**

Carbonation Reaction between carbon dioxide and a hydroxide or oxide to form a carbonate, especially in cement paste, mortar, or concrete. This is often called neutralisation where the pH in the concrete goes from a highly alkaline state to a more neutral state. This is important for durability as reinforcement in concrete has a higher risk of corrosion through carbonation. Also refers to the reaction with calcium compounds (e.g. lime) to produce calcium carbonate.	**P.VIII-S.25.3.2**
Casting Beds Casting beds are structures where concrete is cast, and the term is used particularly in the context of precast concrete manufacture. Casting beds may be in a factory where concrete elements are being made or may be set up adjacent to a building site where tilt-up panels are being cast. The design and operation of casting beds is an important element in determining the quality of the precast concrete products being produced.	**P.VI-S.20.7.5**
CemAssure The CemAssure scheme is owned and managed by the CemAssure Board of CemAssure Limited. CemAssure provides a process of third-party review of the conformity of despatched products including cement, fly ash, ground slag and amorphous silica with prevailing Australian, New Zealand or joint AS/NZS Standards and is accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ). Procedures include Annual or Bi-Annual Surveillance Auditing carried out by the Conformity Assessment Body. The Conformity Assessment Body auditors are independent of the cement and SCM suppliers being assessed and the CemAssure Board to ensure impartiality.	**P.XI.7.1** **P.XI.7.2**
Cement Cement in the 'normal' concrete context generally refers to Portland cement which is by far the most common 'cement' material in use. Cement is however, a general term, which can be applied to any material which is able to bind materials (e.g. aggregates) together. The resultant concretes are generally named to reflect the type of cement or binder used – e.g. Portland cement concrete, polymer concrete, asphaltic concrete, geopolymer concrete.	**P.II-S.1.1** **P.XI.7.1**
Characteristic Strength The Characteristic Strength of a concrete is the 28-day compressive strength level above which 95% of the concrete is expected to meet or to exceed. The characteristic strength is the value used by designers, in the ordering of concrete and for acceptance on delivery to the construction site. Projects covered by AS 3600 use concrete for which the characteristic strength is specified, and AS 3600 used characteristic strength as a basis for many of its design calculations.	**P.VIII-S.25.3.1**
Chemical Attack on Concrete Concrete is prone to attack by certain chemical species. Acids (low pH materials) readily attack concrete (a high pH material) and can cause significant damage. Acids may be found in industrial effluents and also in materials like fruit juices and dairy products. Sulfates also readily attack concrete. Sulfates are found in industrial effluents, in sewerage and in sea water. Sodium sulfate can react with lime to form an	**P.VIII-S.25.3.2**

expansive calcium sulfate reaction product which can cause cracking; while magnesium sulfate can attack CSH itself and cause concrete to disintegrate.	
Chlorides Chlorides are ubiquitous in the environment and can be problematic in concrete – most particularly in concrete containing embedded steel. In due course, chloride ions can penetrate through even low permeability concrete and ultimately reach steel reinforcing or other embedded steel. When that occurs, the passive layer protecting the steel from corrosion can be broken down and active corrosion can begin. Corroding steel expands and creates tensile stresses in concrete leading to cracking and potentially, to spalling. Concrete materials (cement, SCM's, admixtures) almost invariably have limits on maximum tolerable chloride concentration. AS 1379 also limits the total chloride content of concrete.	**P.II-S1.4.7** **P.II-S.2.7.4** **P.VIII-S.25.3.2**
Cohesiveness A measure of the ability of plastic concrete to resist segregation into its distinct components during handling, placing and compacting (a related measure being viscosity). Factors affecting plastic concrete cohesiveness include specific gravities of constituents, water content (higher 'consistency' results in lower cohesiveness) and aggregate grading (deficiency in fine aggregate increases likelihood of segregation, while too many fines cause difficulty in placing concrete). See also CCAA T41 (2002).	**P.VIII-S.25.2.3**
Cold Weather Concreting Concreting in cold weather (temperatures <5°C) brings with it an array of potential risks. The most obvious is that the cold weather will slow or stop the cement hydration reaction and prevent the concrete setting and/or gaining strength in a reasonable time. In extreme cold the mix water will freeze and damage the pore structure in the concrete. To deal with cold weather issues a number of actions can be taken including (a) use a Type HE cement, (b) use hot water for mixing, (c) use accelerating admixtures, (d) insulate forms and the finished surface or place concrete inside a heated enclosure. Low temperatures = low rates of strength gain but generally higher later-age strengths.	**P.V-S.18.3**
Column Forms Formwork that is used to support columns when they are cast.	**P.IX-S.27.3.1**
Compaction Compaction of concrete is one of the important site processes that is carried out to ensure the concrete reaches its design strength, density and permeability. Compaction must be carried out around all slab elements to be fully effective. The process of compaction removes air entrapped during the mixing and transport/transfer processes and consolidates the paste and aggregate components.	**P.V-S.13.3**
Compacting Factor Test The Compacting Factor Test provides a measure of the compaction achieved in a plastic concrete sample upon which a standard amount of work has been done. The standard amount of compactive effort is delivered through the design and operation of the test apparatus. The compaction achieved during testing is compared with that achieved for a fully compacted sample of the same concrete. Compacting Factor provides a better measure of workability than slump, and particularly for 'low slump' mixes.	**P.VIII-S.25.2.4**

Compressive Strength Testing Test made on a test specimen of mortar or concrete to determine the compressive strength.	**P.VIII-S.26.4.3**
Compressive Strength Compressive Strength of a concrete mix is a measure of the ability of concrete to resist loads that would tend to crush it. It is measured using a standard test cylinder when prepared and tested in accordance with AS 1012.8.	**P.VIII-S.25.3.1**
Concrete A mixture of cement, aggregates, and water with or without the addition of chemical admixtures or other materials.	**Introduction**
Concrete Cover Concrete cover refers to the amount of concrete that lies between the surface of an element and any embedded steel – typically reinforcement. Having adequate concrete cover is critical in preventing corrosion of the steel and AS 3600 defines minimum concrete cover requirements for different exposure conditions and where different strength concretes are being used.	**P.VIII-S.25.3.2**
Concrete Pavement Concrete pavement is an efficient type of road structure – particularly for major roads and highways. Concrete roads are placed using a dedicated machine (see 'Paving Machines') and the concrete may be placed in single-lane or multi-lane formats. Concrete roads are used extensively in NSW (and overseas) but not so much in other Australian States. Concrete roads reduce maintenance costs and are long-life structures.	**P.I.2** **P.V-S.14** **P.V-S.17.4** **P.VI-S.19.3.2**
Concrete Plant A 'concrete plant' is a manufacturing site for concrete, which may be of several types. The most common concrete plant is the Dry-Batch Plants, while Wet-Batch Plants are also widely used. For some forms of concrete (e.g. Roller Compacted Concrete – RCC) a Pug Mill may be used. A Pug Mill is a batch plant that combines concrete materials on a volumetric basis (as opposed to the mass basis normally used). Concrete plants are found in most cities and towns as plastic concrete is a perishable product that can only be transported for relatively short times/distances. See also *Dry-Batch Plant*, *Pug Mill* and *Wet-Batch Plant*.	**P.IV-S.9.2**
Concrete Pump See *Pump / Concrete Pump*.	**P.IV-S.10.4.1** **P.V-S.12.4.6**
Concrete Test Cylinder A concrete test cylinder is the test specimen of compacted concrete that has undergone initial curing in the cylinder mould and is then placed into a standard curing environment for use in the compressive strength test and indirect tensile strength test (refer to AS 1012.8.1).	**P.VIII-S.25.3.1** **P.VIII-S.26.4.3**
Consistency A term used to describe the ease with which a concrete will flow and is often used to reflect the 'degree of wetness' of a concrete mix. It is different to workability – in	**P.VIII-S.25.2.2**

practice the two terms are often confused and merged into one descriptor – namely 'slump'.	
Construction Joint A construction joint is generally created where a concrete placement is ceased with the intention of joining on another placement of concrete in the same structure at a time when the earlier placement will have set and hardened. The joint is generally required to pass design stresses across the joint and will either allow limited movement or no movement at the joint.	**P.I.2.2** **P.V-S.17.4.2** **P.XI.15.18**
Contraction Joint A contraction joint is a line of weakening formed into a concrete slab on ground. This can be formed by forming the joint while the concrete is still in plastic state (using a jointing tool) or can be cut into the hardened concrete surface using a concrete saw. The cut is generally to a depth of between 25% and 30% of the slab depth.	**P.I.2.2** **P.V-S.17.4.3** **P.XI.15.18**
Controlled Low Strength Material (CLSM) Controlled low strength material (CLSM) is also known as Flowable Fill. It is a low strength backfill material that is used to embed pipes, to fill trenches and to fill cavities. Typical 28-day strengths are about 1-2 MPa. CLSM can be made with high levels of fly ash to promote flow or with a high dose of AEA. The cementitious content of a fly ash mix may be (say) 50 kg/m^3 of cement plus 300 kg/m^3 of fly ash with the balance as sand. The water content of this type of mix is high – in the range of 250-300 L/m^3.	**P.II-S.2.7.5**
Corrosion Corrosion is problematic in concrete containing embedded steel – as reinforcement or for some other reason. Anything that initiates corrosion of the embedded steel is an issue that needs to be controlled. Chloride ion penetration is problematic, as is carbonation (where the pH of the concrete may be reduced to a level where steel passivation is compromised). Steel corrosion leads to cracking which can then lead to spalling and the appearance of 'concrete cancer'. In part, corrosion can be managed through the use of high quality (low permeability) concrete and sufficient concrete cover.	**P.VIII-S.25.3.2**
Crack A complete or incomplete separation of concrete into two or more parts produced by breaking or fracturing (also referred to as 'fracture').	**P.V-S.17** **P.VIII-S.25**
Crack Mouth Opening Displacement (CMOD) A value determined from a three-point loaded beam using European standard EN 14651 method. The measured width of a crack formed in the bottom of a centrally loaded beam with a pre-formed joint is carried out with increasing loading of the beam. The CMOD values of 0.5 mm, 1.5 mm, 2.5 mm and 3.5 mm – defined by F_1, F_2, F_3 and F_4, respectively. This method is used to assess the impact of steel and structural synthetic fibres on concrete flexural toughness (refer to AS 3600).	**P.I.5.2** **P.II-S.7.2.2**
Crazing Cracks These are very fine (spider web-like) cracks which appear on the surface of concrete after it has been exposed to the atmosphere for some time. It can occur on both trowelled and formed surfaces but is more noticeable on trowelled surfaces, particularly when the surface has been wetted and allowed to dry off.	**P.V-S.17.3.1**

Creep Concrete creep is a form of concrete deformation that occurs over long periods of time (e.g. shortening of columns; deflection of floors or slabs; loss of strength in prestressed concrete). Creep begins when load is applied to the concrete and reduces (but not totally) when the load is removed. The extent of creep depends on a number of factors including the load applied, the modulus of elasticity, the strength at the time of loading and conditions such as temperature and RH.	**P.VIII-S.25.3.2**
CSH – Calcium Silicate Hydrate CSH is the primary cement hydration product – the gel (or glue) material that binds the aggregate materials to form concrete. Calcium silicate minerals in cement react with water to form the hydrate gel product. If heated to sufficiently high temperatures the hydrate loses water and the CSH gel breaks down.	**P.II-S.2.2**
Curing Curing is a process undertaken after concrete has hardened – the aim being to control moisture loss from the concrete to allow the hydration reaction to continue and the concrete to achieve its full potential. Curing can be achieved by (a) minimising moisture loss from the concrete surface using an impermeable membrane, (b) preventing moisture loss by continuously wetting the surface, and (c) keeping the surface moist while increasing concrete temperature to maximise strength gain.	**P.V-S.15.4**
Curing Compound A compound sprayed onto the surface of hardened concrete immediately after finishing to limit moisture loss and maximise concrete strength gain and durability.	**P.V-S.15.4.2** **P.XI.7.7**
Cusum Chart A quality control charting method used to assess variation in measured properties from a target average value. The method takes account of expected variability and provides early warning of a significant variance trend (refer to AS 3940).	**P.VIII-S.26.5.6**

D

Delayed Ettringite Formation 'DEF' Delayed ettringite formation (DEF) may result in the expansion and cracking of concrete associated with the delayed formation of the mineral ettringite which is a normal product of early cement hydration. DEF is generally a result of high early temperatures in concrete (typically an early curing temperature above 70ºC to 80ºC) which prevents the normal formation of ettringite. The likelihood of this occurring is increased where thicker sections of concrete are cast (mass concrete), where concrete contains low levels or no SCM and contains higher levels of Portland Cement. Poorly controlled Heat Accelerated Curing concrete temperature can also influence DEF. See also *Heat Accelerated Curing*	**P.XI.16.6**

Dematerialisation Dematerialisation is one element used to establish the sustainability of a product or process. Dematerialisation involves modifications to a building or building element that result in less material being used in that building or element than has been historically used – without reducing the effectiveness of the building or element (or perhaps improving it). A 'concrete' example is the use of post-tensioned concrete floors in high-rise construction. Post-tensioned floors are stronger than cast in-situ reinforced floors and can be made thinner – using less concrete – and this contributes to the 'sustainability performance' of the structure.	**P.VI-S.20.3.1**
Density The mass per unit volume of concrete. Can be measured dry and wet. Dry density is the mass per unit volume of a dry substance at a stated temperature. Wet density is defined in AS 1012. See also *Bulk Density*.	**P.II-S.3.4.4** **P.III.2.8** **P.VIII-S.25.3.1**
Design Strength Nominal strength of concrete usually taken as the characteristic compressive strength of concrete, multiplied by a strength reduction factor (*phi* factor).	
Distribution Methods Concrete can be distributed on a job site by a variety of methods including 'off the (truck) chute'; barrow; crane and bucket; conveyor; tremie; pumps and pipelines. Consideration needs to be given to volume to be distributed, location, cost, available labour and nature of the concrete to determine the most appropriate distribution method.	**P.V-S.12.4**
Dry-Batch Plant A dry-batch plant is a concrete producing operation in which the concrete raw materials are 'dry-batched' into an 'agitator' or transit mixer where the concrete mixing occurs. Once fully mixed and checked for slump, the concrete is despatched to the job site. This type of operation became the norm in Australia from about the late 1950's.	**P.IV-S.9.2.5**
Dry-Shake Toppings (and Driers) Dry-shake toppings may be used to impart special finishes to the surface of concrete but should not be used to mask quality or finishing deficiencies. Driers are sometimes used to 'mop up' excess bleed water to speed up finishing. They should not be used for this purpose and the drier/water mix should not be worked into the concrete surface. This type of use will invariably result in a dusty final concrete surface.	**P.V-S.14.7.2**
Drying Shrinkage Shrinkage of the hardened concrete resulting from water loss by evaporation through the surface of the concrete. The water loss is from the paste. Lower paste content (or higher aggregate content) means lower drying shrinkage. Drying shrinkage is expressed in terms of the unit 'microstrain'. It is measured using procedures described in AS 1012.13.	**P.II-S.4.5.5** **P.VIII-S.25.3.2** **P.VIII-S.26.4.6**
Ductile Mesh A higher ductility class reinforcing mesh for use in applications where higher ductility is a requirement.	**P.II-S.6.2.3**

Ductility Class of Reinforcement The relative ductility of steel reinforcement is identified by a 'ductility class' of 'L', 'N' or 'E' representing, in order, Low ductility, Normal ductility or Earthquake (high) ductility. Each is specified by a minimum ductility ratio (steel failure stress / yield stress).	**P.II-S.6.2.1** **P.V-S.11.2.1**
Durability Durability is the ability of a structure and its component members to perform the functions for which they have been designed, over a specified period of time, when exposed to their particular environment.	**P.II-S.2.9** **P.VIII-S.25.3.2**
Duty of Care Duty of Care is a legal responsibility that falls on all employers and employees in relation to matters of occupational health and safety and the environment. The duty of care responsibility requires that everyone exercises reasonable standards of care when performing acts that may harm other people or the environment. Such acts must be done with a level of care commensurate with the risks and includes the carrying out of acts and omitting to carry out acts that carry risks.	**P.IX-S.28.1**
Dynamometer A device for measuring the force applied (in this reference it applies to measuring the post tensioning force).	**P.V-S.11.6.4**

E

Edging Edging is carried out using a special tool to provide a quarter-round edge around the perimeter of a concrete slab. This type of edge improves the appearance of the slab and helps to prevent chipping of edges and corners during use. Warehouse floors and slabs which will have tile or carpet coverings should not be 'edged'.	**P.V-S.14.6**
Efflorescence A generally white deposit formed when water-soluble compounds emerge in solution from (generally new) concrete, masonry, or plaster substrates and precipitate by reaction (such as carbonation of lime) or crystallise (by evaporation).	**P.V-S.16.5**
Elastic Modulus An elastic modulus (also known as modulus of elasticity) is a quantity that measures an object or substance's resistance to being deformed elastically (i.e., non-permanently) when a stress is applied to it. Commonly expressed as stress/strain in units of kPa, MPa or GPa. This property applies to confined soils as well as concrete and reinforcement.	**P.I.2.2** **P.VIII-S.26.4.8**
Embodied CO_2 Embodied carbon dioxide is a measure of the amount of CO_2 produced in the extraction, processing, manufacturing and delivery of building materials to a building	**P.X.3.3**

site. In terms of the whole-of-life CO_2 use, embodied carbon represents about 20-50% of the total carbon intensity.	
Embodied Energy Embodied energy is the sum of all of the energy consumed in extraction, processing, manufacturing and delivery of building materials to a building site. In terms of the energy consumption of a building in its whole life, the embodied energy represents about 10-20% of the total energy.	**P.X**
Entrained Air See *Air Content*.	**P.II-S.5.2.2**
Entrapped Air See *Air Content*.	**P.V-S.13**
Environmental Product Declarations (EPD's) Environmental Product Declarations (EPD's) are independently produced and verified documents that provide information on the life cycle environmental impact of products. They are prepared in accordance with Product Category Rules and in accordance with ISO 14025.	**P.X.4.5**
Expansion Joints Joints placed along pathways prone to cracking in typically large concrete slabs (floors, bridges, footpaths etc.) to control and mitigate cracking. Expansion joints can take on forms such as bridge, masonry, railway and pipe expansion joints and can contain compressible filler material to allow expansion and contraction (see also ACI CT-18).	**P.V-S.17.4.4** **P.XI.15.18**
Exposed (Aggregate) Concrete Exposed aggregate concrete is a decorative concrete finish in which aggregate (usually specially chosen) is exposed at the surface of the concrete by washing off some of the cement mortar using a light water spray after initial setting has occurred. The aggregate to be exposed can be (a) incorporated in the concrete mix or (b) added after concrete placement by 'seeding' the aggregate into the surface and using a bull float to emplace it in the surface.	**P.V-S.14.7.7**
Exposure Class or Classification Exposure classification or classes are derived from AS 3600 for the case of concrete structures. The classes relate to the severity of the environment in which the concrete is placed or is located while the structure is in service. For concrete aggregates, AS 2758.1 (Appendix B) uses a similar exposure classification system to define aggregate durability requirements. In each case the exposure class is identified as A1, A2, B1, B2, C1, C2 or U from least severity to greatest severity of environment.	**P.XI.9.5**
External Vibration In certain cases, external vibration may be applied to concrete formwork to bring about compaction. Examples of where this may be used include in precast operations and for thin elements. Where external vibration is used, the formwork must be very rigid and leak-proof and the concrete should be placed in lifts to allow the air to be removed during vibration. Another example of external vibration is a vibrating table – where the	**P.V-S.13.6.4** **P.IX-S.27.8.3**

formwork is attached to a vibrator and not the reverse. These systems are used in the manufacture of concrete blocks. See also *Form Vibrators*.	

F

False Setting False setting is a stiffening of a cement and water paste that can be reversed by rapid stirring of the mix. False setting is caused by too high a proportion of 'plaster' – a dehydrated form of gypsum. While partial dehydration of gypsum is required during the cement milling process, if it proceeds too far it can lead to false setting, which in most cases is a controllable issue.	**P.II-S.1.2.2**
Falsework Falsework consists of the propping, bracing and fixings that support formwork and transfer load to the supporting foundation (e.g. the ground). Falsework should be considered as an essential part of the formwork system.	**P.IX-S.27.7** **P.XI.15.9**
Fibres *Alkali Resistant Glass Fibres* Alkali Resistant (AR) Glass Fibres are designed specifically for use in concrete. They are manufactured from a specially formulated glass composition with an optimum level of Zirconia (ZrO_2) to be suitable for use in concrete. *Fibrillated Fibres* Fibrillated Fibres are the general term for fibres that have been processed (refined) to develop fibres with a higher surface area and a 'branched structure'. *Mineral Fibres* Mineral Fibres generally refer to fibres sourced from mined minerals. Examples are Asbestos Fibres and Basalt Fibres. *Monofilament Fibres* A monofilament fibre is generally referring to a synthetic fibre where each fibre is composed of a homogenous material. Typically, these are produced using an extrusion process. *Natural Fibres* Natural fibres generally refer to fibres sourced from plants or animal hair. *Structural Synthetic Fibres* 'Structural' synthetic fibres (sometimes referred to as 'macro synthetic fibres) are made from blends of polymers and were originally developed to provide an alternative to steel fibres in some applications.	**P.I.5.1** **P.II-S.7.2**

Fibre Reinforced Concrete Fibre reinforced concrete has been used for decades, with both steel and plastic fibres in common use. In some places, natural fibres (e.g. straw and hemp) are also used, as are glass fibres. As a general comment, fibre reinforcing is used to improve the structural integrity of concrete. Steel fibres are often used to increase tensile capacity as well as improve abrasion resistance and control crack widths. Plastic fibres (e.g. polypropylene or nylon) are used to improve cohesiveness, reduce crack widths, improve resistance to plastic shrinkage cracking and improve freeze-thaw resistance. Fibre dimensions and addition rates vary considerably and specific advice regarding their use should be sought from suppliers.	**P.I.5** **P.VII-S.24.3.2**
Finish Classes Off-form concrete finishes may be classified (or specified) as being in one of 5 classes defined in AS 3610. Class 1 – highest class; for monumental pieces, single pour; Class 2 – good quality architectural precast concrete; Class 3 – visual importance, but not necessarily architecturally; Classes 4 and 5 – visual quality not important, concrete may not be generally visible. Test panels should be done for Class 1 and Class 2 finishes. See also Table 16.1 in P.V-S.16.	**P.V-S.16.3.1**
Finishing Finishing concrete can be considered to be the combination of two processes – compaction and finishing. A good finish does not imply quality concrete and compaction is a critical activity. Finishing involves sequential processes which are typically screeding, bull floating, floating and final finishing. Timing of these operations is critical to achieving a high-quality surface finish.	**P.V-S14.1**
First Flush Systems In concrete batch plants, first flush water containment systems are used to collect to the (nominally) first 20 mm of rainfall (in a 24-hour period) – this rain being that most likely to be contaminated by dust, oil and other materials normally residing on the plant site. Rain after the nominal first 20 mm is considered to be clean and is able to be discharged off site. (see also D. B. Martinson, T. H. Thomas *Quantifying the First-Flush Phenomenon: Effects of First-Flush on Water Yield and Quality*, 2009).	**P.II-S.4.2**
Fixed End Beam A fixed end beam is a structural beam that is fixed from being able to move freely at both ends. These fixed ends generally reduce deflection of the beam.	**P.I.3.3**
Flash Setting Flash setting is the very rapid and irreversible stiffening of a cement plus water mixture that occurs if the cement does not contain a small proportion of a sulfate-containing material (e.g. gypsum). The sulfate-containing material partially dissolves in the water and prevents the rapid hydration of the tri-calcium aluminate mineral which is the primary cause of flash setting.	**P.II-S.1.2.2**
Flexural Strength The maximum load per unit cross-sectional area (stress) in the extreme tensile fibre that a beam can withstand when a loading is applied on a beam and perpendicularly to the beam's longitudinal axis.	**P.VIII-S.25.3.1** **P.VIII-S.26.4.5**

Flexural Tensile Strength Test or Modulus of Rupture Test A test designed to assess the flexural tensile strength of concrete carried out in accordance with AS 1012.11.	**P.VIII-S.25.3.1** **P.VIII-S.26.4.5**
Floating Floating the surface of a concrete slab can occur as two separate tasks. Immediately after screeding, the surface may be bull-floated to even out the surface and embed any larger pieces of aggregate. After bull-floating the surface should not be worked further until bleed water has left the surface and it is sufficiently strong to cope with additional finishing processes. After the bleed water has gone, the surface may be floated by hand or by machine to densify the surface and begin to work towards a final finish.	**P.V-S.14.4**
Fly Ash Fly ash is a fine, inorganic residue formed from the combustion of black coal in power stations. Fly ash derives from mineral matter mined with the coal. This mineral matter is typically sand and clay, and occasionally, other mineral species. The coal and the mineral matter are milled prior to combustion which separates the coal and mineral matter particles. In the flame, the coal burns off and the mineral matter (generally) melts in the high temperature (1,800°C) combustion zone. When the flue gas containing the fly ash passes into cooler areas of the furnace the particles solidify into (quite) spherical particles. They are ultimately removed from the flue gas by collection devices (electrostatic precipitators or fabric filters) before the clean flue gas is emitted to the atmosphere via the stack. The fly ash can be collected and processed to a standard that allows it to be used as a supplementary cementitious material.	**P.II-S.2.6**
Form Face The form face is the surface of the formwork that creates the finish on the exposed concrete face. Different surface finishes may be created by steel, plywood or timber formwork or by using a form liner.	**P.IX-S.27.2**
Form Liners Form liners are effectively a mould which is placed inside the form. The patterns or surface texture on the liner are effectively imposed on the surface of the concrete when the plastic concrete takes up the shapes on the liner surface. These (decorative) surface effects remain embossed in the hardened concrete. Form liners may be created from cardboard, wood, rubber etc. The type of material used is dictated to some extent by the amount of re-use required.	**P.IX-S.27.4.3**
Form Vibrators Form vibrators are used to compact concrete by attaching them to the outside of formwork – most often in precast factory situations. They require very securely constructed formwork. In another type, the formwork may be constructed on a vibrating table which imparts compaction forces. These systems are more often used in manufacturing concrete products (e.g. blocks) where stiff concrete mixes are used. See also *External Vibration*.	**P.V-S.13.6.4** **P.IX-S.27.8.3**
Formwork Total system of support for freshly placed concrete including the mould or sheathing that contacts the concrete as well as supporting members, hardware, and necessary bracing (also referred to as shuttering).	**P.IX-S.27** **P.XI.15.10**

Formwork Stripping Formwork stripping in cold conditions needs considerable care to (a) ensure that the concrete has gained sufficient strength to allow formwork to be safely removed, and (b) to ensure that a high temperature differential between the core and the surface of the element is not created – which, if it occurred, would increase the risk of thermal cracking. See also *Stripping Times*.	**P.V-S.18.3.6** **P.IX-S.27.8.4**
Freezing and Thawing The exposure of concrete to cycles of freezing and thawing can lead to serious damage to the surface of concrete. Unless this has been anticipated, the free water in the concrete will freeze and melt with each freezing cycle – the freezing part of this cycle causing the water to expand which increases tensile stresses within the concrete surface – leading ultimately to the surface breaking apart. To overcome this, air (at about 5% level) is entrained in the concrete. The fine, evenly distributed air bubbles provide space for the water to expand into, thus reducing stresses in the surface of the concrete.	**P.VIII-S.25.3.2**

G

Gang Forms Gang forms are typically modular formwork components that can be connected together, and when braced, moved (by crane) as a complete unit. Gang forms allow increased construction efficiency when the same formwork components are able to be re-used in various locations in a structure without having to break the formwork down into its individual components and to re-build it continually.	**P.IX-S.27.5.2**
General Purpose Blended Cement (Type GB) According to the requirements of AS 3972, blended cements are cements that (a) contain >7.5% fly ash or GGBFS or both, or (b) up to 10% silica fume, and (c) meet the performance requirements described in Table 2 of AS 3972. There is no upper limit for fly ash and GGBFS content in Type GB cements. The upper limit is determined by the performance of the Type GB cement – in particular the effect on setting time or mortar strength beyond the limits prescribed in the Standard. See also *Blended Cements (Type GB Cements)*.	**P.II-S.1.2.4**
General Purpose Cement (Type GP) Type GP cement is described in AS 3972 as a hydraulic cement which may contain, at the discretion of the manufacturer, Portland cement plus a combination of mineral additions up to a maximum of 7.5% by mass.	**P.II-S.1.2.4**
General Purpose Limestone Cement (Type GL) Type GL cement is defined in AS 3972 as a hydraulic cement that contains, at the discretion of the manufacturer, Portland cement plus limestone alone or in combination with minor additional constituents (maximum 5%) at levels of 8-20% by mass.	**P.II-S.1.2.2**

Geopolymers The term 'geopolymer' was coined by J. Davidovits in the 1970's as a name for a class of alternative binder materials that he patented. These materials are typically alkali activated materials, with alkali activation by strong alkalis, often in conjunction with sodium silicate. Davidovits proposes that these are polymeric materials that are different from the hydrated compounds formed when either cement hydrates (by reaction with water) or slag is activated by strong alkaline materials. The term 'geopolymer' is used by some, and particularly in Australia, for all alkali activated binders regardless of the nature of the reaction product. RILEM, a European expert group who are developing specifications, Standards and test methods for AAM's, are of the view that all of these binders are AAM's and that 'geopolymer' is a commercial name. See also *RILEM*.	**P.VII-S.23.3**
GGBFS GGBFS is Ground Granulated Blast Furnace Slag. When iron blast furnace slag is rapidly cooled (i.e. quenched by air or water spray) it forms a glassy product known as Granulated Blast Furnace Slag (GBFS). When the GBFS is milled in a 'cement' mill to a fineness level higher than Portland cement it becomes GGBFS. GGBFS is an excellent Supplementary Cementitious Material which is able to be substituted for Portland cement at levels of up to about 70%. See also *Slag*.	**P.II-S.2.2.7**
Girder Wrap A reinforcing mesh suitable for adding strength to major structural beams (e.g. bridge sections).	**P.II-S.6.2.3**
Grading (Individual Material) The distribution of particle sizes in an aggregate material (see also ACI CT-18).	**P.II-S.3.4.2**
Grading (Combined) The combination of fine and coarse aggregate materials of varying size, such that not more than 45% passing any sieve is retained on the following sieve grade during sieve analysis testing (see also ASTM C33/C33M – 18).	**P.II-S.3.4.2**
Granolithic Topping (Grano) A surface layer of concrete, suitable for use as a wearing surface finish to floors, with specially selected aggregate of suitable properties, that may be laid on a base of either fresh or hardened concrete. Can also be achieved by screeding (see also ACI CT-18).	**P.V-S.14.7**
Graphic Concrete Graphic concrete involves the creation of complex images on the surface of concrete walls and is used particularly with precast concrete. A couple of techniques are used including (a) selective use of retarders under form liners to create contrasts between coarser and finer finishes to form the images, or (b) thermochromatic compounds added to the concrete which are stimulated using wire-heating systems under microprocessor control to create coloured images.	**P.VII-S.24.3.9**

Glossary term and definition	Reference
Gravity Dam A gravity dam is a dam constructed from concrete or stone masonry and designed to hold back water by using the weight of the material alone to resist the horizontal pressure of water pushing against it. Gravity dams are designed so that each section of the dam is stable and independent of any other dam sections.	**P.I.2.4** **P.IV-S.10.4.1**
Green Star Green Star is a sustainability rating system developed by the Building Council of Australia to provide a 'sustainability score' for a building – currently for office buildings and apartment blocks – with the score being represented as a 'star rating'. 1-Star = minimum practice; 4-Stars = Best Practice; 5-Stars = Australian Excellence; 6-Stars = World Leadership.	**P.X.4.3**
Gypsum Gypsum is added to clinker during the milling process to make cement. The gypsum (in a partially dehydrated form) provides sulfate ions into the paste formed when water is added to the cement. The sulfate ions react with the tri-calcium aluminate mineral in cement clinker to slow the hydration reaction of this mineral. If sulfate was not added, the mineral would hydrate very quickly (called Flash Setting), forming a solid compound which would make the paste/mortar/concrete stiff and unworkable. Gypsum is added at about 5% of the mass of cement clinker.	**P.II-S.1.2.2**

H

Glossary term and definition	Reference
Heat Accelerated Curing The rate of strength growth of concrete can be increased by increasing the temperature of the concrete, and one way this is done in practice is by steam curing and another method, with similar resulting effect on concrete, is using hot water to raise the temperature of the forms surrounding the concrete. Heat accelerated curing is routinely used in the manufacture of precast concrete elements. Heat accelerated curing is a multi-stage process that has to be highly controlled to achieve optimum concrete strengths and economic efficiency. See also *Steam Curing*.	**P.XI.17.9.1**
Heat of Hydration Heat in the form of 'Heat of Hydration' is a product of the hydration reaction between cement and water. For concrete cast in large masses, the heat generated from the hydration reaction cannot escape and the core temperature of these elements can be quite high (up to 80°C). While the high temperature itself can be problematic, so too is the temperature differential between the core and the surface of the element. Temperature differentials of >20°C can lead to high tensile stresses and cracking. There are a variety of ways of reducing concrete temperatures and dealing with potentially high temperature differentials (e.g. using Type LH cements, cooling aggregates, using ice as part of the mixing water).	**P.II-S.1.4.2**

High Alumina Cement (HAC) HAC is a very different material to Portland cement in terms of its mineralogy and its manufacture. HAC is manufactured from bauxite and limestone and compared to Portland cement has a high alumina content and a low calcium content. HAC is characterised by rapid strength gain and high heat of hydration. It is a refractory cement and used in furnaces and other high temperature environments. One detriment with HAC is that HAC concrete exposed to warm humid environments can undergo a 'conversion' reaction with a resulting significant loss in strength.	**P.II-S.1.2.4**
High Early Strength Cement (Type HE) Type HE cements are typically finely ground general purpose cements. They are used in applications where higher early-age strengths are needed (e.g. precast concrete, post-tensioned slabs).	**P.II-S.1.2.4**
High Strength / Ultra High Strength Concrete In AS 1379 the highest compressive strength noted is 100 MPa. Today the use of strengths of this magnitude and higher is not uncommon, with strengths in columns for high-rise buildings now approaching 150 MPa. Ultra-high strength concretes with compressive strengths >200 MPa are also being produced. These are being used in high-impact structures and in bridges (for decks and girders) and for seismic retrofits. See also *Reactive Powder Concrete*.	**P.VII-S.24.3.3**
Hold Point A Hold Point is a specified, mandatory verification point beyond which work cannot progress without approval by the designated authority, typically the Engineer or Consultant or 3rd Party Inspector. These are commonly added to specifications to ensure that work cannot proceed before appropriate checks are made of documentation.	**P.XI.5.1**
Hollowcore Hollowcore is a factory-produced suite of concrete products that are becoming more widely used in commercial, industrial and domestic construction. Hollowcore comes in two main formats – panels and 'slabs' or 'planks'. Hollowcore panels can replace cast in-situ reinforced concrete panels or tilt-up panels. Hollowcore planks create wide-span flooring that has many advantages overcast in-situ flooring. The prestressed hollowcore products are strong, lightweight elements that have a wide range of applications.	**P.VI-S.20.5**
Hot Water Hot water is sometimes used in cold climates to raise the temperature of the concrete being produced. Even in cold climates, if an acceptable concrete working temperature can be obtained using hot water, and provided the concrete is kept insulated, the natural exotherm of the hydration reaction will allow the concrete to gain strength.	**P.V-S.18.3.3**
Hot Weather Concreting Placing concrete in hot weather can lead to issues with slump loss, plastic shrinkage cracking and potentially thermal cracking. Concrete temperature can be reduced by (a) using blended cements, (b) cooling aggregates, (c) using ice or liquid nitrogen to cool the concrete and (d) by using admixtures.	**P.V-S.18.2**

Hydration Reaction The hydration of cement forms the basis of conventional concrete technology. Portland cement hydrates (relatively) slowly with the formation of a calcium silicate hydrate gel (that binds the concrete components together) plus lime plus heat (of hydration). The initial dormant phase of this reaction allows time for concrete to be transported to job sites and placed and finished, before the hardening phase causes strength to develop over the following weeks and months.	**P.II-S.1.3.2**
Hydration Staining Hydration staining is a mottled finish that can appear on the surface of concrete, and particularly concrete cured under plastic sheeting. In areas where the plastic sheeting touches the concrete surface a different colouration is seen compared to areas where the plastic sheeting remains off the concrete surface. The end result is a mottled finish reflecting different W/C ratios in the different areas of the concrete surface.	**P.V-S.15.4.2**
Hydraulic Cement A hydraulic cement is one that hardens when it reacts with water to form a solid, stable product. The cement combines with the water to form a hydrated compound (e.g. calcium silicate hydrate). The hydration reaction may also occur under water provided the bulk of the concrete mass is protected from exposure to excess water.	**P.II-S.1.2.1**
Hydrostatic Pressure in Formwork Hydrostatic pressure in formwork results from the force exerted from the plastic concrete which is only partly able to support itself. The hydrostatic pressure increases with the depth of the concrete and can be an issue with deep walls and columns. Where flowing concrete is being used (e.g. Super-Workable Concrete – SWC / Self-Compacting Concrete – SCC), significant lateral pressures are exerted against the formwork, requiring the formwork to be stiffened considerably when SWC/SCC is used.	**P.IX-S.27.6.2**

I

Immersion Vibrators An immersion (or ‘spud’ or ‘poker’) vibrator is used to compact concrete in a local area – with a radius of action in the range 100-500 mm. They may be used in combination with surface vibrators on slabs and pavements.	**P.V-S.13.6.2**
In-Situ Concrete Concrete that is cast in a structure or a structural or non-structural element at site.	**P.V-S.12**
Indirect Tensile Strength Test The Indirect Tensile Strength or Splitting or Brazil test is used to measure the tensile strength of concrete. A test cylinder like that used for compressive strength testing is placed in a rig and a load is applied to the length of the cylinder through two bearing strips. The cylinder splits along its length at failure. See also *Brazil Test*.	**P.VIII-S.25.3.1**

Isolation Joints Isolation joints are formed between newly placed concrete slabs (usually slab on ground) and existing structures. The joint is formed with a flexible filler to allow the concrete some movement without damaging the existing structure.	**P.V-S.17.4.5** **P.XI.15.18**

J

J-Ring Test (and L-Box and U-Box Tests) These tests are used to measure the flow of flowing concrete, under its own mass, through various impediments that might be encountered as flowing concrete moves through congested reinforcement or around other structural components.	**P.VIII-S.25.2.4**
Joints (1) A physical separation in a concrete system, whether precast or cast in-situ, including cracks if intentionally made to occur at specified locations. (2) The region where structural members intersect.	**P.I.2.2** **P.V-S.17.4** **P.VI-S.20.2.3**
Joint Sealants Joint sealants are used to fill the gap between (typically) precast concrete wall panels. These joint sealants must fulfil several functions, including (a) preventing water ingress and (b) maintaining the required fire rating of the structure.	**P.V-S.17.4.3** **P.VI-S.20.2.3**
Joint Widths Joint widths are an important aspect of construction using precast (factory-produced or tilt-up) concrete panels in particular. Appropriate joint widths allow for proper sealing between panels and also cater for erection tolerances. The typical joint width between panels is about 15-25 mm, while between panels and cast in-situ elements it is about 150 mm.	**P.VI-S.20.2.3**
Jump / Climb Forms These are a type of 'gang form' used for casting vertical elements like walls or shafts. Without the use of cranes these forms can be stripped and reassembled in a new position and then aligned in that new position using an in-built jacking system.	**P.IX-S.27.5.4**

K

Kerb (and Channel) Modifications above and below the surface of a slab such as a road along the outline to separate the concrete structure from soil or other structures such as a pavement.	**P.VI-S.19.3.3**

Kibble	P.V-S.12.4.4
A 'kibble' is a large (1-2 m^3 capacity) 'bucket' used on construction sites to move concrete from the transit mixer to the placing area. The kibble is suspended from a crane and moves back and forward between the transit mixer and placing area. This method of delivery is being replaced by pumps, but in some cases is still useful, provided there is sufficient crane time available for this demanding activity.	

L

Laitance The transportation of fine cement and aggregate particulates toward the surface due to water movement. This occurs due to the presence of too much water in the mixture and is not due to dissolution of salts in the water.	P.V-S.16.4
Lean Concrete Concrete of low cementitious material content.	
LEED Rating System The LEED Rating system is an American sustainability rating system which is sometimes used in Australia. Modern versions of this system use more holistic approaches based on LCA's and product disclosure and optimisation rather than a more simple focus on materials.	P.X.4.4
Life Cycle Assessment (LCA) Life cycle assessment is used to assess the total amount of energy consumed and greenhouse gases emitted in the whole life of a structure – its construction, operation and ultimate demolition. LCA is used to compare the environmental impact of different building materials and designs over the whole of the life of the structure to provide a more realistic comparison of relative environmental performance.	P.X.4.2
Lightweight Aggregate Aggregate of low density such as: (1) Expanded or sintered clay, shale, slate, diatomaceous shale, perlite, vermiculite, or slag; (2) Natural pumice, scoria, volcanic cinders, tuff, and diatomite; (3) Sintered fly ash or industrial cinders. Lightweight aggregates are defined by AS 2758.1 as those having a particle density less than 2,100 kg/m^3 but not less than 500 kg/m^3.	P.II-S.3.2
Lightweight Concrete Concrete of substantially lower density than that made using aggregates of normal density. It consists of either entirely lightweight aggregate or a combination of lightweight aggregate and normal-density aggregate. Its equilibrium densities are generally between 1,100 kg/m^3 and 2,000 kg/m^3.	P.II-S.3.2

Lime Lime, also known as hydrated lime or calcium hydroxide [$Ca(OH)_2$], is a by-product of the hydration reaction between (Portland) cement and water. Depending on the cement content, concrete may contain 70 kg of lime per cubic metre. Lime gives concrete its high pH and is primarily responsible for the existence of efflorescence where it occurs. Lime as a separate chemical is also used in cement-based mortar mixes to improve the workability of masonry mortars.	**P.II-S.1.3.2**
Load Cell A device for measuring force. Generally, the readout is electronic and can be recorded in digital format.	**P.V-S.11.6.4**
Loss on Ignition (LOI) Loss on Ignition (LOI) tests are used when testing both cements and Supplementary Cementitious Materials (SCM's). This simple test measures weight loss when the sample is heated to levels of 750-950°C. For cement – it provides a measure of chemically absorbed water and CO_2 which can reflect product (cement or clinker) that has been exposed to moisture and/or weather. For SCM's – (a) for fly ash and silica fume it reflects the presence of unburned carbon remaining from their production processes, and (b) for GGBFS it can reflect exposure to weather. (Note: For GGBFS, the LOI value can be negative as certain reduced species react with oxygen during the test and the sample may gain weight as a result.)	**P.II-S.1.6.5**
Low Heat Cement (Type LH) Type LH cements are typically blended cements and may contain either 40% fly ash or 65% GGBFS. Low heat cements hydrate more slowly and produce lower peak temperatures in concrete structures. They are used in mass concrete structures like concrete dams and mass footings to limit temperature rise and the risk of thermal cracking.	**P.II-S.1.2.4**

M

Masonry Cement Masonry cements are used in mortar for brick, block and stone construction. They usually contain finely milled blends of cement clinker, limestone, hydrated lime and pozzolans. They may also contain air entraining agents, plasticisers and water repellent materials. Masonry cements are intended to meet the requirements of AS 1316.	**P.II-S.1.2.4**
Mass Concrete Any volume of structural concrete in which a combination of dimensions of the member being cast, the boundary conditions, the characteristics of the concrete mixture, and the ambient conditions can lead to undesirable thermal stresses, cracking, deleterious chemical reactions, or reduction in the long-term strength as a result of elevated concrete temperature due to heat from cement hydration.	**P.V-S.17.4.3** **P.V-S.18.2.2** **P.V-S.18.2.4**

Maturity 'Maturity' in concrete terms is a measure used particularly in precast concrete manufacture, to assess likely concrete strength based on the temperatures achieved during the (steam) curing cycle multiplied by the duration of the curing cycle. A maturity value is calculated as [°C × time (hours)] and correlates well with expected concrete strength for a given mix and curing process.	**P.VI-S.20.2.2**
Megapascals (MPa) Measure of strength of concrete usually in compression, tension or flexure. It is a force per unit area.	
Membrane A compound formed during curing which solidifies to form a protective sheet material, acting as a barrier to restrict evaporation and to keep excess water from entering the concrete mixture.	**P.V-S.15.4.2**
Mesh Usually refers to intersecting reinforcing wires within a concrete member. A series of longitudinal and transverse wires arranged approximately at right angles to each other and welded together at all points of intersection.	**P.II-S.6.2.3** **P.V-S.11.2.1**
Metakaolin Metakaolin is an activated kaolin clay that is a highly efficient pozzolan and a suitable material for alkali activation to form a specific type of AAM. The clay mineral kaolin can be heated to about 600-800°C in a kiln to produce an anhydrous, calcined form of the mineral. The fine material is highly reactive and, because of its low temperature calcination, has a low level of embodied carbon dioxide.	**P.VII-S.23.5.4**
Microstrain Microstrain is most commonly used as the unit that indicates the degree of drying shrinkage in concrete. Microstrain is essentially 'parts per million'. Concrete with a drying shrinkage test result of 850 microstrain has shrinkage of 0.085% or 0.85 mm/m. Concrete drying shrinkage as measured in a laboratory is often at a quite different (and higher) level than that found in the field.	**P.VIII-S.25.3.2** **P.VIII-S.26.4.6**
Milestone Milestones are tools used in project management to mark specific points along a project timeline. These are generally time-based and relate to the critical path of the construction plan.	**P.XI.5.1**
Mineral Additions Mineral additions are materials that can be added to a cement mill in addition to clinker and gypsum when milling cement. According to AS 3972, allowable mineral additions are either fly ash, GGBFS, limestone or 'minor additional constituents' or a combination of these materials – in most cases up to a maximum of 7.5% by mass. However, no more than 5% 'minor additional constituents' (e.g. cement kiln dust) can be used in any circumstance. The mineral additions are used solely for the purpose of reducing the clinker content of cement with a view to reducing its 'carbon intensity' – but without creating any detrimental effect on cement performance.	**P.II-S.1.2.2**

Mix Design The optimal design by proportion of ingredients that makes up the most economical use of available materials for concrete of specified properties.	**P.III**
Mixing Time The time of mixing a concrete batch in a mixer.	**P.IV-S.9.2.5** **P.IV-S.9.3.1**
Mixing Water The water present in freshly-mixed mixtures, excluding water that was absorbed by the aggregate.	**P.II-S.4.1** **P.III.2.6**

N

Non-Chloride Accelerator To limit the amount of chloride in each cubic metre of concrete, all raw material suppliers ensure that the chloride content of their product(s) do not add substantially to the combined chloride content. A common and effective accelerating admixture used for many years was calcium chloride – a material with a very high chloride content. Admixture producers ensure that they limit the chloride content in their products and now do not use calcium chloride in accelerating admixtures. See also *Admixtures*.	**P.II-S.5.2.3**
No Fines Concrete A mixture of concrete which does not contain fine aggregate. This results in an agglomerated structure of coarse aggregate and cement which induces high porosity. Such a high porosity, as a result, allows water to flow through the concrete body. See also *Pervious Concrete*.	**P.VII-S.24.3.5**
Normal Class Concrete Concrete that is specified primarily by a standard compressive strength grade up to 50 MPa, has a density of 2,100-2,800 kg/m^3 and adheres to the requirements set out in AS 1379.	**P.IV-S.8.2.2** **P.XI.6.1**

O

Oil Well Cements Oil Well cements are used in the petroleum industry to grout oil and gas wells. In these applications the grout must remain fluid under high temperatures and pressures for up to several hours and then harden quite rapidly. They are also required to be highly resistant to aggressive agents (e.g. sulfur-containing compounds). These cements are modified general purpose cements which are specifically manufactured for this purpose. The testing and specification of these products falls under the jurisdiction of the American Petroleum Institute (API).	**P.II-S.1.2.4**
Orimet Test Method The Orimet test is an indirect method that measures the ability of a fluid concrete to flow into a defined space under its own mass.	**P.VIII-S.25.2.4**
Over-Vibration For well designed, normal weight concretes, over-vibration is rarely a problem. If it was to occur, it would be indicated by segregation and the formation of thick paste layers on the surface of the concrete. Under-vibration is much more likely to be a problem in concrete construction.	**P.V-S.13.7**

P

Packaged Concrete Mixes Packaged concrete mixes can be bought at hardware stores – typically in 20 kg bags of dry, pre-packaged concrete materials – a 'just add water' product. These bags typically make about 10 litres of plastic concrete. These mixes are designed to achieve strengths of around 15 MPa at 7 days when slump is in the range of 75-100 mm but can be quite variable.	**P.IV-S.9.3.2**
Pattern Paving Pattern paving is a texturing method which can be used to provide a geometric pattern to the surface of concrete for use in driveways and decorative concrete applications. After bull floating the surface is coated with a coloured dry-shake topping and a release agent is applied before the surface is 'stamped' with a patterning mould. When this is complete, the surface is cleaned and a light broom finish applied before curing. A sealer can be applied at a later time – but only after the release agent has been washed off.	**P.V-S.14.7**

Paving Machines Paving machines are large slip-forming operations that are used to place large areas of high quality paving concrete – most typically for concrete roads and for airport pavements. In concrete road construction, paving machines can pave in single-lane or multi-lane formats. These machines take low-slump concrete and compact and finish it in a single pass and can create concrete pavement in several formats including Plain Jointed (PCP), Jointed Reinforced (JRCP) and Continuously Reinforced Concrete Pavement (CRCP).	**P.VI-S.19.3.2**
Permanent Formwork Permanent formwork is formwork that is left in place to become part of the finished structure. Precast concrete can be used for permanent formwork in situations where some load-bearing capacity is required. Where only decorative capability is required glass reinforced concrete is typically used.	**P.IX-S.27.5.6**
Permeable Formwork Permeable formwork allows bleed water and air to escape through the formed face of a concrete element. This has several effects, including (a) lowering W/C ratio (to a depth of about 20 mm), (b) improving strength and lowering sorptivity at the formed surface, and (c) improving the surface finish.	**P.IX-S.27.3.6**
Permeability Permeability of a concrete reflects the ability of fluids (water or gases) to move through the concrete pore structure. While a concrete may have considerable porosity, if the pores are discontinuous it will not be permeable. Permeability is reduced by (a) lowering the W/C ratio (or increasing the cement content), (b) curing and (c) using SCM's. Lower levels of permeability generally mean better durability performance.	**P.II-S.1.4.5** **P.VIII-S.25.3.2**
Permissible Tolerances When batching concrete to meet the requirements of AS 1379, the Standard nominates tolerances of mass above and below the mix design requirements which must be met for all raw materials used in the batch. These tolerances are noted in Table 4.1 in AS 1379.	**P.IV-S.9.2.6**
Pervious Concrete Pervious or absorbent concrete is effectively a No-Fines concrete. The concrete mix contains only single-sized coarse aggregate and cement paste and as expected, the concrete contains a high proportion of voids. The advantage of this concrete is that water will flow through it. It is used to remove water from large paved areas (e.g. supermarket and airport car parks) where, in a significant rain event, water would pool and cause safety and traffic hazards. See also *No Fines Concrete*.	**P.VII-S.24.3.5**

Plastic Concrete Concrete exists in a plastic state for several hours – depending on temperature, cement content and type, presence of admixtures and other factors. This plastic state exists from the time the water is first mixed into the concrete components until it starts to stiffen at about the time it achieves Initial Set. Plastic concrete can be moulded into a vast array of shapes and it is this property particularly that makes it a popular building material. While the concrete has high tensile capacity when 'plastic', it has no strength and is prone to certain failure modes including plastic shrinkage cracking and segregation if the mix has not been designed properly or concrete placing does not take account of local environmental conditions. Plastic concrete is also a corrosive material with a high pH and care should be taken in relation to contact of plastic concrete with mucous membranes or bare skin.	**P.V-S.13.4** **P.IX-S.28.6**
Plastic Shrinkage Cracking Plastic shrinkage cracking occurs in plastic concrete when it dries out in the period between bull floating and initial set – a time when the concrete has minimal tensile capacity. Hot weather alone is not the primary cause – rather it is high drying (evaporative) conditions that include high wind speeds, low humidity and high concrete and ambient temperatures. These conditions cause bleed water to evaporate leaving the plastic concrete to dry out and crack like a dry creek bed.	**P.V-S.18.2.6**
Plastic Settlement Cracking Plastic settlement cracking occurs when plastic concrete settles over obstructions (e.g. reinforcing steel, deeper concrete sections) and effectively bends and breaks across the obstruction. Highly workable or poorly cohesive mixes that demonstrate high levels of settling are prone to this issue. The cracking that occurs is often geometric in pattern reflecting the obstruction below (e.g. the pattern of the reinforcing steel).	**P.V-S.17.2.1**
Poisson's Ratio Poisson's Ratio is a measure of the Poisson effect, that describes the expansion or contraction of a material in directions perpendicular to the direction of loading. For small values of these changes, Poisson's Ratio is the amount of transversal expansion divided by the amount of axial compression (refer to AS 1012.17).	**P.VIII-S.26.4.8**
Polymer Concrete Polymeric materials, both thermoplastic and thermo-setting types, can be used as complete or partial replacements for Portland cement in the manufacture of concrete. Polymer concrete generally provides high durability performance and is used in specialty applications where specific durability requirements exist (e.g. sewerage systems, concrete repair). The significant advantages of polymer concrete like excellent compressive and tensile strengths, low permeability, lighter weight, good freeze-thaw resistance and good adhesion to a wide range of materials are offset by higher cost.	**P.VII-S.24.3.4**

Polythene Sheet Polythene sheet is thin plastic sheeting usually used to cover the surface of recently finished concrete to retain moisture while the concrete cures over several days. After finishing, the concrete is moistened and the sheeting is then placed over the concrete surface, ensuring that it does not come loose during the curing period which would allow the concrete surface to dry out. If the sheet is allowed to contact the concrete surface in some places and not in others then a mottling effect (due to different levels of W/C ratio) known as 'hydration staining' may be seen when the plastic sheet is removed. Polythene sheet is also used to protect finished work against splashes from other concrete or staining from grout used in subsequent lifts.	**P.V-S.15.4.2** **P.V-S.16.2.6**
Portland Cement Portland cement was patented in 1824 in England but the product as we know it was not produced properly until the 1840's when higher kiln temperatures were able to be achieved. The product was named 'Portland' cement because the colour of the product resembled that of stone found in the Portland region in England. Although the modern product is much more efficient, the fundamental mineralogy remains very similar to the original product.	**P.II-S.1.2.2**
Pozzolanic Material / Pozzolan Pozzolans are fine, amorphous materials that, in the presence of water, react with lime produced by cement hydration to form cementitious products. Pozzolans can be substituted for part of the cement component in concrete mixes and are therefore considered to be Supplementary Cementitious Materials (SCM's). Examples include fly ash, GGBFS and silica fume. See also *Supplementary Cementitious Material (SCM)*.	**P.II-S.2.1**
Precast Concrete Concrete that is moulded and cured in a controlled factory environment using advanced manufacturing techniques, and is then transported to site and put into place by a crane or other lifting equipment (refer to 'Precast Concrete Handbook' – NPCAA/CIA).	**P.VI-S.20**
Prestressed Concrete Concrete that has induced internal compressive stresses supplied via incorporated reinforcement tendons (wires, bars), which is used to allow the concrete structure to withstand higher tensile loads (refer to AS 3600–18).	**P.I.4**
Premixed Concrete In the earliest days of concrete construction, concrete was mixed (often by hand) at the job site. Most often now, pre-mixed concrete is supplied by truck from a dedicated concrete batch plant located (typically) within reasonable proximity of the job site. Typically, this concrete is produced in a 'dry-batch' plant – these plants becoming the 'norm' in Australia from the late 1950's.	**P.IV-S.9.2**

Properties of Concrete Properties of consideration include: • **Strength** – the ability of concrete to resist strain or rupture induced by external forces. Sub-categories of strength include: – Compressive strength – see *Compressive Strength*; – Fatigue strength – cyclic-stress resistance to strain at stresses lower than the yield strength of concrete; – Flexural strength – see *Flexural Strength*; – Shear strength – resistance to shear strain under stresses parallel to the concrete surface; – Tensile strength – see *Tensile Strength of Concrete*; – Ultimate strength – the highest stress achieved for a concrete compression test; – Yield strength – the stress at which concrete begins to plastically deform. This is found in concrete using the 0.2% proof stress technique. • **Porosity** – the ratio of the volume of voids in a material to the total material volume (including voids). See also *Capillary Porosity (and Capillary Dis-continuity)*; • **Elasticity** – the ease of concrete to deform elastically, referring to the slope of the elastic region of the stress-strain curve. See also *Static Chord Modulus of Elasticity*; • **Durability** – see *Durability*; • **Workability** – see *Workability*; • **Consistency** – see *Consistency*.	**P.VIII-S.25**
Pug Mill A pug mill is a continuous concrete-producing plant in which batching is done by volume rather than by mass. Pug mills are typically used for the production of high volume, lower grade concretes that may be used, for example, for Roller Compacted Concrete construction.	**P.IV-S.9.2.5**
Pump / Concrete Pump Concrete pumps provide a highly effective way of delivering concrete to job sites of all types. They are useful in domestic construction to deliver from the road to the house slab, and equally effective when used in high-rise construction. A pump should be chosen on the basis of required delivery rate and suitability for the site. Multiple pumps may be required on some job sites. While they are highly effective, pumps also bring some safety issues in terms of their operation and maintenance and potential congestion of sites with delivery vehicles queuing for access to the pump(s). There are two basic pump types – piston pumps and peristaltic (or squeeze) pumps.	**P.IV-S.10.4.1** **P.V-S.12.4.6**

Q

Quenched and Tempered Wire Quenching and tempering are processes that strengthen and harden steel. The process of quenching or quench hardening involves heating the steel wire and then rapidly cooling it. This process is used in certain higher strength prestress wires.	**P.II-S.6.2.2**

R

Reactive Powder Concrete Reactive powder concrete is an ultra-high strength concrete product produced using very high cement and silica fume contents and at very low W/C ratios through the use of High Range Super-plasticisers. The mixes take a long time and considerable effort to produce. The principal use of this type of concrete is in very high strength applications – with strengths of >200 MPa being able to be achieved. See also *High Strength / Ultra High Strength Concrete*.	**P.VII-S.24.3.3**
Recycled Water (as Mixing Water) Water recycled within a concrete plant is able to be used as mixing water provided that it is stored in a manner that prevents it becoming contaminated with deleterious substances and the water meets the quality requirements described in AS 1379. See also *Water Quality (Mixing Water)*.	**P.II-S.4.3.4**
Reinforced Concrete Structural concrete reinforced with no less than the minimum amount of prestressing steel or non-prestressed reinforcement as specified from design using the applicable building code (see also ACI CT-18).	**P.I.3**
Reinforcement Bars, wires, strands, fibres or other slender elements that are embedded in concrete in such a manner that the two materials act together in resisting forces (see also ACI CT-18).	**P.II-S.6** **P.V-S.11**
Release Agent Release agents are used to ensure good separation of formwork away from the formed face of concrete when removing formwork so that the surface finish is both even and undamaged. Where high quality surface finishes are required, the type of release agent and its rate of application are key control areas. In these cases (a) the same release agent should be used throughout the project, and (b) the release agent should be applied uniformly at the minimum rate consistent with full coverage and any excess should be removed prior to concreting.	**P.V-S.16.2.3** **P.IX-S.27.8.2**
Relative Water Requirement Relative Water Requirement (RWR) is a test used to assess the effect of an SCM on workability. It is a mortar test in which the flow of a mortar containing an SCM as a partial cement replacement is compared with the flow of a cement-only mortar. The result is expressed as a %. This result cannot be transposed to concrete mixes to provide an estimate of potential water reduction, nor can results from tests involving different SCM sources or different SCM types be compared.	**P.II-S.2.6.4**
Reshoring Reshoring is the process of removing a section of the formwork and supporting structure and then replacing the supporting structure after the formwork has been removed.	**P.IX-S.27.7.3**

Respirable Dust Respirable dust is very fine particulate material that can be breathed in and penetrate deep into the lungs which can cause complaints with variable severity. Respirable dust is generally considered to be those with a diameter of <10 µm. For dusts that have high potential to affect human health, exposure limits have been set by regulatory authorities and testing to assess workplace levels should be carried out from time to time. From a concrete perspective, dusts of concern include those from cement, fly ash, GGBFS, silica fume, siliceous aggregates and concrete (e.g. when cutting concrete with a saw or breaking concrete during demolition). Dusts containing crystalline silica are of particular concern if there is repeated or ongoing exposure.	**P.IX-S.28.3.2**
Rheology of Concrete A term used to describe the combined consistency and workability in concrete. Measured using the Yield Stress and Plastic Viscosity properties of concrete. While a useful tool for describing all concrete mixtures, this is particularly useful in describing Super-Workable Concrete.	**P.VI-S.22.3.2**
RILEM RILEM is the International Union of Laboratories and Experts in Construction Materials, Systems and Structures. This European committee is currently working (amongst other things) on developing Standards and specifications for AAM's and concrete produced using AAM binders, as well as developing appropriate test methods for the materials. See also *Geopolymers* and *Alkali Activated Materials (AAM's)*.	**P.VII-S23.6**
Roller Compacted Concrete (RCC) Roller compacted concrete (RCC) is most commonly used in the construction of dams where high volumes of lower grade (e.g. 10 MPa at 28, 56 or 90-days) are placed virtually continuously and in lifts of about 300 mm thickness. The concrete is produced in a pug mill and the low slump mix is often delivered to the placing site by tipper or conveyor before being compacted by a variety of mobile 'roller-type' machines. RCC mix designs may vary from low cementitious (60 $kg.m^{-3}$) to high cementitious (200 $kg.m^{-3}$) contents, with strengths and permeability varying accordingly. In another form, RCC may be used for road pavements or hardstand construction where the wearing layer has typical 28-day compressive strengths of about 40 MPa. The advantage of all types of RCC is their rapid production and placing rates.	**P.IV-S.10.4.1**

S

Safety Data Sheets (SDS) All hazardous materials used in any workplace must have a Safety Data Sheet (SDS) and these SDS must be collated and made available to workers who might use the hazardous material(s). SDS must be supplied to users by the supplier of the product of the manufacturer and they must contain contact details for (a) the manufacturer and (b) a Poisons Information centre or similar. SDS must have current information, be dated and be reviewed each 5 years as a minimum. SDS must contain information about chemical constituents of a product and relevant information relating to first aid, health risks, physical and chemical properties and environmental risks.	**P.IX-S.28.3.1**

Sand Moisture Test A test used to assess the moisture content of sand. There are many methods, but the most common method is by oven drying of a sand sample to AS 1141.5. There are other tests using different drying methods and some chemical methods to determine the free water in sand.	**P.II-S.3.4.4**
Saturated Surface Dry (SSD) State of an aggregate particle when the interior, permeable pores are filled with water and no water is on the exposed surface of the particle (see also ACI CT-18).	**P.II-S.3.4.4** **P.III.2.8**
Screed A screed is a thin concrete topping that may be placed over a defective concrete surface. Screeds can be 'bonded' or 'unbonded'. 'Bonded' screeds are thin toppings that are bonded to the underlying surface with an adhesive. 'Unbonded' screeds tend to be thicker layers of concrete, and typically are jointed. Joints need to match any joints in the underlying surface or reflective cracking will be seen in the new screed. See also *Screeding*.	**P.V-S.14**
Screeding Screeding or levelling is the first operation carried out when finishing concrete. Screeding establishes the level of the concrete surface against the forms after the plastic concrete has been roughly levelled by shovel or similar. Screeding may be done using a screed board worked in a sawing motion across the forms, or by a mechanised vibrating screed. In large area projects (e.g. factory floors) a 'laser screed' may also be used to establish highly accurate slab heights and levels.	**P.V-S.14.3**
Segmental Construction Segmental construction is defined as a method of construction for bridges, buildings, tanks, tunnels, and other structures in which primary load carrying members are composed of individual segments post-tensioned together.	**P.I.4.4**
Segregation Segregation is separation of the coarse aggregate from the mortar in concrete. A segregated concrete mix will not achieve its performance requirements and will generally result in a non-uniform concrete containing porous and honey-combed areas. Segregation can be avoided by having a well-mixed, cohesive mix.	**P.V-S.12.2.2** **P.VIII-S.25.2.3**
Self-Compacting Concrete (SCC) or Super-Workable Concrete (SWC) Self-Compacting Concrete (SCC) or Super-Workable Concrete (SWC) has been in use for a number of years and its use is continually growing. SCC/SWC allows the placement of high strength/ low W/C ratio concrete mixes in a range of demanding situations. Its benefits accrue through properties that include its resistance to segregation, the ability to place SCC/SWC in areas of congested reinforcement and the ability to create high quality off-form finishes.	**P.VI-S.22** **P.VII-S.24.3.1**
Self-Curing Concrete Self-curing concrete contains either (a) polymeric materials that combine with the water in concrete and prevent it from evaporating from any exposed concrete surface, or (b) saturated porous aggregates that provide water for ongoing hydration after the concrete has hardened. In both cases the materials need to be added to the concrete at the time of manufacture.	**P.VII-S.24.3.7**

Self-Healing Concrete Self-healing concrete contains materials that react with any water ingress through cracks in the concrete to effectively seal the cracks. The concrete can contain polymeric materials or 'hydro-gels' (or in a more recent version a bacterium) that are activated by water and produce an expansive product that seals the cracks. These materials need to be added to the concrete at the time of manufacture.	**P.VII-S.24.3.6**
Setting Time The setting time for paste, mortar and concrete is one of the most important parameters from a practical perspective. Laboratory-based setting time tests are used to determine 'initial' and 'final' setting times and limit values for these times feature in most relevant Standards. In the field, setting time is of critical importance. While setting time can be manipulated to a degree by using accelerating and retarding admixtures, other factors also determine the working time available to concrete placers, bricklayers etc. Setting that is too fast or too slow has serious ramifications for those trades using cement-based products.	**P.II-S.1.4.1**
Shear Stress Shear stress is a force per unit area that causes layers or parts to slide upon each other in opposite directions. These stresses are more significant in concrete structure near the points of loading (e.g. beam or slab intersections with columns).	**P.I.3.2**
Shewhart Chart A quality control charting method used to assess variation in measured properties from a target average value. The method includes statistically based limits above and below the target average for individual test results or running averages of test results (refer to AS/NZS 3944).	**P.VIII-S.26.5.6**
Shoring Shoring is the process of temporarily supporting a building or structure with shores (also known as props) to prevent it from collapsing during construction or renovation.	**P.IX-S.27.7.1**
Shotcrete Concrete placed via high velocity projection from a nozzle (see also ACI CT-18).	**P.II-S.5.2.3** **P.II-S.5.2.5**
Shrinkage 'Shrinkage' is an issue for all cement-based products. To achieve workability, the amount of water required is in excess of that required just for hydration of the cement, and once the cement-based product hardens, some of that excess water will evaporate from the paste part of the mortar or concrete. This evaporation leads to drying shrinkage. See also *Autogenous Shrinkage*.	**P.II-S.1.4.4** **P.VIII-S.25.3.2**
Shrinkage Limited Cement (Type SL) Shrinkage Limited cement may be either a GP or a GB cement. If it is a GP cement it will often be a more coarsely ground cement than typical GP cement. If it is a GB cement then it might typically contain 25% fly ash or 65% GGBFS. The test for a Type SL cement is a laboratory-based mortar bar test that is conducted for a period of 28 days.	**P.II-S.1.2.4**

Silica Fume Silica fume is an ultra-fine material emitted from arc furnaces processing silicon metal or ferro-silicon alloys. Typically, this material has a particle size of 0.1-0.2 µm and a surface area of about 20,000 m^2/kg and an SG of about 2.1. As produced, it has a low bulk density and is difficult to handle, and densified products or slurries are more commonly used. Silica fume is a pozzolanic material that imparts excellent strength and durability performance to concrete. See also *Amorphous Silica*.	**P.II-S.2.8**
Skim Coat A skim coat is a fine finishing coat applied to a concrete or plasterboard wall and provides a finely finished surface. The skim coat may be a cement-based render or a plaster-based material. Skim coats are often applied to new structures (e.g. walls etc.). Skim coats are sometimes applied to slip-formed structures if a fine finish is required.	**P.VI-S.19.2.4**
Slag 'Slags' are produced as waste streams from all mineral processing systems where molten metal products are produced. Slags contain any non-metallic geological material contained in the ore as well as any additives added to improve the efficiency of the process. In iron blast furnaces, the slag contains non-metallic geological material plus limestone which is added to reduce the melting point of the materials charged into the blast furnace. Slags are 'tapped off' and separated from the molten metal product. They may then be either (a) air-cooled or (b) 'quenched' to form a glassy 'granulated slag' product. See also *GGBFS*.	**P.II-S.2.7.1**
Slag Aggregate Slag aggregate is formed from the air-cooled slag 'tapped off' from an iron blast furnace. The massive material is crushed and screened like a conventional aggregate to produce a range of aggregate products.	**P.II-S.2.7.3** **P.II-S.3**
Slip Forms Slip forms are forms which are continuously moving – either in the vertical or horizontal direction and are used to cast a variety of structures. Vertical slip-forming is used to create structures like chimneys and deep-sea oil platforms; while horizontal slip-forming is used to create structures like kerb and road barriers.	**P.VI-S.19** **P.IX-S.27.5.5**
Slump See *Slump Test (Slump Cone)*.	**P.VIII-S.25.2.4** **P.VIII-S.26.3.2** **P.XI.9.1**

Slump Flow The Slump Flow Test is applied to flowing (or Self-Compacting or Super-Workable) concretes. The concrete is placed in a standard slump cone and the cone is lifted, allowing the concrete to 'spread'. The diameter of the slumped or spread concrete is a measure of the workability of the mix. A typical spread diameter might be between 500 mm and 800 mm. The cohesiveness of the mix can also be determined from this test. Ideally the concrete remains consistent in composition across the whole spread sample – i.e. the mortar and the aggregate are evenly distributed across the whole sample and not separated or segregated. See also *Spread Test*.	**P.VI-S.22.5.2** **P.VIII-S.25.2.4**
Slump Test (Slump Cone) A test used to measure the consistency of freshly mixed concrete performed using a slump cone. This is done as follows: • The cone is filled in three layers. For each layer, a tamping rod is used to compact the concrete by poking the concrete 25 times (for each layer); • The cone is removed, and the concrete is allowed to slump. The height difference between the cone and the slump is measured as the 'concrete slump'.	**P.VIII-S.25.2.4** **P.VIII-S.26.3.2**
Slurry Mix A mixture of water and any finely divided insoluble material, such as Portland Cement, slag or clay in suspension (see also ACI CT-18).	**P.V-S.12.4.6** **P.V-S.16.2.2** **P.VI-S.19.3.4**
Soffit Forms (and Falsework) Formwork and falsework used to support plastic concrete when suspended slabs are cast.	**P.IX-S.27.3.1**
Sorptivity (or Absorptivity) of Concrete The sorptivity of concrete is a measure of the amount of water (or other liquid) that a concrete will absorb when immersed in it. This property is affected by the porosity of the concrete and also depends on the degree of inter-connectedness of the pores.	**P.VIII-S.25.3.2**
Soundness It is important that once a cement paste hardens it does not undergo any large changes in volume – particularly any expansions which will increase internal tensile stresses and lead to cracking. There are a couple of minerals which, if present in cement paste, can slowly hydrate and expand, causing the mortar/concrete to crack – or to become 'unsound'. These minerals are (a) Free Lime (CaO) which may be present in cement if it is not fully reacted to form calcium silicate minerals, or (b) periclase (MgO) – a mineral that is found in nature and may be present in either cement clinker or in some SCM's. Free lime levels are monitored by cement producers. MgO levels in clinker (and in some SCM's) are also tested and limits are set.	**P.II-S.1.6.2**
Special Class Concrete Concrete made with properties and materials that deviate from the attributes of normal-class concrete. It is used for special applications (refer to AS 1379-2007 and AS 3600-18). Examples of special class concretes can be found in Part VI, Sections 19-22 of this Guide.	**P.IV-S.8.2.3** **P.VIII-S.26.6.1** **P.XI.6.1**

Special Purpose Cements (Types HE, SL, SR, LH) Special purpose cements as defined in AS 3972 may be either general purpose cement or a blended cement – provided they meet the performance requirements for each as detailed in Table 2 of AS 3972. See also *High Early Strength Cement (Type HE)*, *Shrinkage Limited Cement (Type SL)*, *Sulfate Resisting Cement (Type SR)* and *Low Heat Cement (Type LH)*.	**P.II.S.1.2.1**
Spread Test The Spread Test is the simplest test used to measure the flow characteristics of Super-Workable Concrete mixes. The test uses the normal Slump Cone. After the cone is filled with the concrete mix it is raised to allow the flowable concrete to 'spread' out on a mat on which circles of specific diameters have been drawn. The average maximum spread of the concrete is measured and recorded. The test can also be used to measure the time taken for the concrete to flow to a specific diameter (e.g. 500 mm) and the final concrete can also be examined to determine whether any segregation has occurred during the testing process. A typical 'spread diameter' would be 600 mm. See also *Slump Flow*.	**P.II-S.5.2.4**
Stage Stressing Stage stressing is stressing of post-tension tendons at different times instead of stressing at one time. The value of this planned/designed technique is to ensure that the level of post-tension stress in concrete members is only that required to adjust the structure for changes in loading or stresses from other parts of the structure.	**P.I.4.4**
Standards Australia A national Australian organisation which publishes standards for concrete specifications (and other matters). These Standards set the minimum requirement for performance properties for concrete and concrete materials, and also describe concrete plant performance requirements. Separate Standards also describe rules for the design and detailing of concrete structures. See also *Australian Standards*.	
Static Chord Modulus of Elasticity The chord modulus is a specific method of test where a defined straight line is used to assess a value of elastic modulus. In the case of AS 1012.17, the line (or chord) starts at a low load that produces a strain of 50 microstrain in the concrete test specimen and the final point on the stress/strain curve is the strain at a load equivalent to 40% of the ultimate compressive strength of the concrete being assessed. The slope of the line between these points is calculated as the static chord modulus of elasticity. It will generally be a lower value than some other methods of assessing elastic modulus (sonic pulse velocity or tangent modulus) but is more reflecting the stress-strain relationship in structural concrete designed in accordance with AS 3600 (refer to AS 1012.17). See also *Elastic Modulus*.	**P.VIII-S.26.4.8**

Steam Curing The rate of strength growth of concrete can be increased by increasing the temperature of the concrete, and one way this is done in practice is by steam curing. Steam curing of concrete involves the application of saturated steam to concrete, in a chamber or under covers. Steam curing is routinely used in the manufacture of precast concrete elements. Steam curing is a multi-stage process that has to be highly controlled to achieve optimum concrete strengths and economic efficiency. See also *Curing and Heat Accelerated Curing*.	**P.V-S.15.4.4** **P.VI-S.20.2.2**
Strength Development (Rate of) The rate of development of compressive strength when a cement hydrates is dependent on several factors. For a Type GP cement, it depends on the mineral composition and the fineness of the cement. For a Type GB cement, in depends in part on the proportion of SCM in the blended cement. In both cases it also depends on the W/C ratio and temperature.	**P.II-S.1.4.3**
Strength Index Strength Index is a test applied to assess the strength performance of SCM's. A mortar containing a proportion of SCM as a cement replacement is prepared and tested for compressive strength. A control mortar containing cement-only is prepared and similarly tested. The ratio of the strength of the SCM-containing mortar to the Control mortar, expressed as a %, is the Strength Index. The Strength Index cannot be used to quantitatively express the cement-replacing capacity of the SCM.	**P.II-S.2.6.4**
Stripping Times Minimum stripping times for formwork are important with respect to ensuring (a) safety, and (b) concrete quality. Minimum stripping times for in-situ concrete are given in both AS 3600 and AS 3610.1. In a worst-case scenario, if forms are stripped too soon the concrete element may not be properly self-supporting and may collapse. In general, early stripping of formwork from the formed surface of the concrete may cause the concrete surface to be damaged. See also *Formwork Stripping*.	**P.IX-S.27.8.4**
Standard Deviation (SD) A statistical measurement of the amount of variation or dispersion of a set of data values from the Mean value in a Normal Distribution.	**P.III.2.4** **P.VIII-S.25.3.1** **P.VIII-S.26.5.3**
Storing Cement and SCM's Cement and SCM's are supplied as fine, dry powders. In this dry state, these powders flow easily and can be transported and transferred between storage vessels quickly and easily. If these powders come into contact with water/moisture, their flow characteristics quickly change. Moisture contents as low as 0.5% can cause this change. Cement and SCM's with higher moisture contents quickly form lumps and these lumps (in addition to the reduced inherent flow characteristics) will cause major issues when transferring the products – especially between silos and weigh hoppers in concrete batch plants.	**P.II-S.1.5.1**
Strength Grade Numerical value of the characteristic compressive strength of concrete at 28-days used in design (see also AS 3600-18).	**P.IV-S.8.2** **P.VIII-S.25.3.1** **P.VIII-S.26.5**

Strongbacks Strongbacks are external reinforcing structures that are used to support odd-shaped precast elements when they are being lifted into position in a building. They are used with long, thin precast elements or where the shape of an element is such that some part of it may bend or flex significantly while it is being lifted. The strongbacks are attached to the building element during lifting and then removed once the element is in place.	**P.VI-S.20.7.4**
Studs or Joists Studs or joists are lengths of sawn timber or metal sections that support concrete formwork and prevent it from bowing in one direction.	**P.IX-S.27.2**
Sub-base The subbase is the layer of aggregate material ('road-base') laid on the subgrade (or local soil rock) to assist with distribution of pavement loads to the subgrade and provide a stronger foundation for the surface material (i.e. the Base-coarse, Concrete, Asphalt or Pavers).	**P.I.2**
Surface Defects – Precast Concrete Surface defects in concrete, and particularly precast concrete, are outlined in Tables 16.2 and 16.3 of Part V-Section 16 of this Guide.	**P.V-S.16.4**
Surface Vibrators Surface vibrators are used to compact concrete – particularly slabs and pavement. They are applied at the surface and act downwards. Typical devices are vibrating beam screeds (single or double beam) – from 3 m to 20 m in width – that may be either manually moved along the slab or motorised. The compaction forces act from the top and have a depth limitation of about 200 mm. They are used in conjunction with immersion vibrators at the edges of slabs where the surface vibration forces are less effective. See also *Screed* and *Screeding*.	**P.V-S.13.6.3**
Sulfates Sulfates are important components in concrete raw materials and important to concrete technology generally. The sulfate content of cement and SCM's is limited in the relevant Standards as sulfates have a tendency to form expansive reaction products within concrete (e.g. by reaction with lime) and cause concrete cracking. Sulfates in the environment (e.g. in sea water, soils and groundwaters) may attack solid concrete and cause it to crack or disintegrate. Sulfate is added to clinker when milling cement to prevent Flash Setting. See also *Flash Setting*.	**P.II-S.2.6.4** **P.VIII-S.25.3.2**
Sulfate Resisting Cement (Type SR) Sulfate Resisting (Type SR) cements as defined in AS 3972 may be either general purpose cement or blended cement. Typically, a blended Type SR cement will contain either 25% fly ash or 65% GGBFS. There is some contention about using general purpose cements in sulfate-resisting applications, and generally only blended cements would be used if they are available.	**P.II-S.1.2.4**

Super-Sulfated Slag Cement Super-sulfated slag cements are a binder type in which the main ingredient is ground granulated slag which is activated by a sulfate compound or blend of sulfates – commonly gypsum and sodium or potassium sulfate. These cements also typically contain about 10% of Portland cement to provide early-age strength. Concrete produced using super-sulfated slag generally shows good strength and durability performance and is reported to show low levels of drying shrinkage. A concrete type using this binder system has been commercialised in Australia. The product is known as *Envisia*™.	**P.VII-S.23.4**
Superplasticiser Superplasticisers or High Range Water Reducers are now commonly used concrete admixtures. They are able to effect water reduction of up to 25% which allows concrete mixes with very low W/C ratios (about 0.3) to be produced with high levels of workability. The levels of workability possible extend to the creation of flowing, super-workable concrete (SWC) mixes with Spread Test values of up to 700 mm. The latest version of these admixtures is the PCE's (poly-carboxylate ethers) which can be formulated to provide tailored performance characteristics.	**P.II-S.5.2.4**
Supplementary Cementitious Material (SCM) SCM's are materials that can substitute for cement in a concrete mix and produce reasonably equivalent strength performance and often much improved durability performance. In some cases, they are 'waste' materials (e.g. fly ash, GGBFS and silica fume), and in others they are intentionally produced (e.g. meta-kaolin). Most are pozzolans – that is, they react with the lime produced by cement hydration to form cementitious products similar to those produced by cement hydration. See also *Pozzolanic Material / Pozzolan*.	**P.II-S.2.1** **P.XI.7.2**

T

Table Forms Table forms are a type of 'gang form' used to form soffits. Large sections of soffit form (including required props and bracing) can be assembled and then used, moved to another area (by crane or transporter), and used again. The use of table forms helps to improve construction efficiency.	**P.IX-S.27.5.3**
Target Strength When carrying out a concrete mix design, the mix designer uses a strength that is referred to as the 'Target Strength' of the mix being designed or supplied. It is different from both the characteristic strength and the average strength of the test sample population. In general, its value is more an 'intended' average strength for the mix design and in general it will be either equal to or greater than the average compressive strength.	**P.III.2.4** **P.III.2.5** **P.VIII-S.26.5**

Tensile Strength of Concrete The tensile strength of concrete is considerably lower than the compressive strength – usually by a factor of about 10. Testing a concrete sample involves the application of direct or indirect tensile stress on a sample. The most common test methods are (1) the Indirect or Splitting or Brazil test, or (2) testing a beam in flexure (Flexural Strength Test). See also *Indirect Tensile Strength Test*, *Brazil Test* and *Flexural Tensile Strength Test or Modulus of Rupture Test*.	**P.VIII-S.25.3.1**
Tensile Stress Tensile stress is stress applied to a structural element in a direction that is parallel to the applied force and the forces at either end of the element are trying to pull the element apart.	**P.I.3.2**
Thermal Movement of Concrete Concrete moves with changes in temperature – expanding when heated and contracting when cooled. The movement is not great – in the range of about 5-12 microstrain/°C – depending in part on the type of aggregate used.	**P.V-S.17.3.3** **P.VIII-S.25.3.2**
Three-Dimensional (3-D) Concrete Printing Three-dimensional or 3-D Concrete Printing is a development involving the integration of robotics and concrete technology. Arguably, any design that can be converted into a computer file and loaded into a robot can be converted into a structure – provided the concrete technology issues can be overcome. There have been huge advances in this area of research and some quite complex structures have been created – simple housing, small bridges and pieces of art – all created using concrete with no (or little) manual input into the construction. Interest from the military and from agencies like NASA indicates that there will be huge advances in this technology over the very near future.	**P.VII-S.24.3.10**
Tilt-up Tilt-up construction involves the casting of concrete elements – typically wall panels – in a location adjacent to where they will be used in a structure. Once the panels have sufficient strength they are lifted by crane into position in the structure. Tilt-up panels are cast onto a base slab, singly or in layers – with bond breakers used to ensure that the panels can be separated when required.	**P.VI-S.20.2.3**
Topping A layer of concrete, mortar or mixture placed to form a floor or roofing surface on top of a concrete base. See also *Abrasion Resistance*, *Dry-Shake Toppings (and Driers)*, *Granolithic Topping (Grano)*, *Pattern Paving* and *Screed*.	**P.V-S.14.7**

Transit Mixer Transit mixers are concrete trucks – colloquially known as ‘agitators’ – which are used to mix concrete prior to delivery of the plastic concrete to the job site. At a dry-batch plant, the dry concrete raw materials (plus water and admixtures) are accurately batched into the mixing bowl on the transit mixer and the bowl is rotated to mix the concrete components. When mixing is complete the concrete is tested before delivery to the job site. At the job site the direction of rotation of the bowl is reversed, and the concrete is discharged into the chute or pump or other receiving system. See also *Agitator*, *Agitator Truck* and *Dry-Batch Plant*.	**P.IV-S.9.2.5**
Translucent Concrete Translucent concrete is concrete that allows some degree of light penetration, which can be formed in two ways. In one, optical fibres are included in the concrete mix and these align to a degree to allow some light to pass through the concrete. In another process, layers of thin translucent fabric are cast within the concrete. This process delivers little or no detriment to strength performance but provides visibility of both form and colour through concrete panels.	**P.VII-S.24.3.8**
Tremie Concrete Tremie concrete refers to the delivery of concrete to a location using a hopper to hold the mass of concrete and a long pipe to deliver the concrete to the final position. The pipe is lowered to the bottom of the hole or area to be filled and as concrete is passed down the pipe, the pipe is slowly withdrawn, ensuring that the end of the pipe remains (about 1 metre deep) within the body of the concrete. Concrete can be placed under-water using this technique.	**P.V-S.12.4.5** **P.VI-S.21**
Trench Mesh Trench Mesh is a Class L and N reinforcing mesh typically used in residential and industrial buildings to reinforce smaller concrete footings and beams.	**P.II-S.6.2.3**
Trowelling Trowelling is a multi-step task in which a concrete surface is further densified and a final finish created. (This assumes a textured finish like a broom finish is not required.) Trowelling may be by hand or by machine and as the process progresses, increasing effort is applied to achieve the final finish through increasing the surface densification with resulting increased smoothness and wear resistance.	**P.V-S.14.5**

U

Ultrasonic Pulse Velocity (UPV) UPV is a field test used to assess the quality of concrete and other solid/mass materials (e.g. rocks) in a non-destructive manner. The test measures the velocity of an ultrasonic pulse passing through the solid body, by which the quality of the object (e.g. strength, homogeneity etc.) can be evaluated. Higher velocity generally means better quality.	

V

Vebe Test A test for measuring workability of very low-slump to 'no-slump' concrete that determines the time required for the concrete sample to be consolidated into a mould. The Vebe Test measures the consistency of concrete by a method that is not dis-similar to the processes used when placing concrete. It is most useful for laboratory determinations with dry mixes (refer also to ACI CT-18).	**P.VIII-S.25.2.4** **P.VIII-S.26.3.4**
Vibration Agitation of freshly mixed concrete during placement by mechanical devices, either pneumatic or electric, that creates impulses of moderately high frequency to assist in concrete consolidation in the mould. This can be done externally, internally or on the surface depending on the thickness of the concrete form and the desired outcome. See also *Compaction*, *External Vibration*, *Form Vibrators*, *Immersion Vibrators* and *Surface Vibrators*.	**P.V-S.13.6**
Visual Stability Index (VSI) The VSI is established by observing the final concrete sample after the Slump Flow Test. The range is from '0' for highly stable to '3' for unacceptable. Ideally the spread mix shows no signs of bleed water around the outer edges or uneven distribution of aggregate – i.e. no signs of segregation.	**P.VIII-S.25.2.4**

W

Walers or Bearers These brace the studs or support the joists which hold formwork in place and prevent it from bulging in the opposite direction to that which is constrained by the studs or joists.	**P.IX-S.27.2**
Wall Forms Formwork that is used to support concrete walls when they are cast.	**P.IX-S.27.3.1**
Water/Cement Ratio (W/C Ratio) The W/C ratio of concrete is calculated by dividing the mass of (free) water by the mass of cementitious material. The W/C ratio is a fundamental determinant of many concrete performance attributes including strength and durability. The typical range of W/C ratios in conventional concretes is about 0.3-0.75, though this range can be extended through the use of admixtures and for some special purpose concrete materials [e.g. Roller Compacted Concrete (RCC)] (see also ACI CT-18).	**P.II-S.4.5** **P.III.2.5** **P.VIII-S.25.3.1** **P.VIII-S.25.3.2**

Water Density and Mix Design The W/C ratio is fundamental in concrete technology. It is calculated by dividing the mass of water by the mass of cementitious material. The typical range of W/C ratio in conventional concretes is about 0.3-0.75. These figures suggest that the quantity of water is much less than that of cement, and by mass it is. In volume terms though, the situation is very different – and relative volume more accurately reflects cement reaction potential. For a mix with a W/C ratio of 0.6 – say 180 L water and 300 kg of cement – in volume terms there is 180 L/m^3 of water, but only 95 L/m^3 of cement. The water is in significant excess in volume terms. This is due to the difference in SG of the two materials. Water SG = 1.00 and cement SG = 3.15.	**P.II-S.4.5.1**
Water Reducer A water reducing admixture is the most commonly used admixture in modern concrete mixes. There are several types of water reducer of varying effectiveness – Normal Range, Medium Range and High Range. The extent of water reduction possible varies from about 10% to about 25% depending on which WR is used. See also *Admixtures* and *Superplasticiser*.	**P.II-S.5.2.4**
'Water-proofing' Concrete Additive / Admixture A 'water-proofing' concrete admixture is an incorrect description. Permeability reducing admixtures are used to reduce the risk of water (or fluid) flow through concrete. These admixtures are usually composite materials including very fine materials which can act as pore blockers as well as hydrophobic chemicals which alter the surface tension within pores in the concrete and prevent water moving through them. While concrete permeability can be reduced, water proofing a structure requires consideration of structural detailing as well.	**P.II-S.5.2.5**
Water Quality (Mixing Water) The quality of mixing water is an important element in concrete manufacture, particularly where potable water is not available. AS 1379 gives some guidance as to basic water quality requirements. The most practical assessment of water quality is carried out by making a concrete mix with a new water source and comparing the performance of that concrete with concrete made using a known water source. AS 1379 gives guidance as to acceptable concrete performance in terms of comparative (a) setting time and (b) compressive strength. See also *Recycled Water (as Mixing Water)*.	**P.II-S.4.2**
Wet-Batch Plant A 'wet-batch' concrete plant usually involves concrete components being mixed in a 'split drum' mixer at a concrete plant. Once mixing is complete the plastic concrete is unloaded from the mixer into either an 'agitator' or a tipper for delivery to the job site. 'Wet-batch' plants are generally now used where high production rates are required and where high levels of consistency of quality are required. For many concrete road pavement projects 'wet-batch' plants are chosen for both of the reasons noted. (Note: Tippers are used to transfer concrete where the mix is being produced at a low slump (20-40 mm) and where the distance to the job site is short).	**P.IV-S.9.2.5**
Witness Point Witness Points are identified points in the process where the designated authority, typically the Engineer or Consultant or 3rd Party Inspector may review, witness, inspect method or process of work.	**P.XI.5.1**

Workability Concrete workability is an important concrete characteristic which may be quite variable, depending on the nature of the element being built. The workability should be appropriate to the type of construction and the method of delivery of the concrete to the job. (e.g. concrete to be placed in thin or narrow forms will need to be very workable, while concrete to be placed in a mass construction (e.g. dam or footing) or through a paving machine will need to be less workable.) Workability may also be considered to reflect the ease with which a concrete mix can be compacted without the risk of segregation. Loss of workability due to hot, windy weather or to water being adsorbed by concrete components (e.g. fine oxides used for colouring) also needs to be considered in any project. Modification of workability by uncontrolled water addition at site is problematic.	**P.V-S.12.2.1** **P.VIII-S.25.2.1**

X

Y

Yield For a theoretical mix proportioning, it is expected that the actual wet density of a concrete mixture will be the same as designed. However, in some cases, the measured density is higher or lower than the designed value. For example, a total mass of batched materials for 1.000m^3 according to a mix design is 2,350 kg/m^3. When tested, the plastic density is found to be 2,320 kg/m^3. This means that the concrete mix yield is equal to 2,350/2,320 = 1.013, which is 'over-yielding' by 1.3%. In the opposite case, if the batch mass is less than the measured plastic concrete density, it is 'under-yielding'.	**P.III.3.2** **P.IV-S.10.3.1**

Z

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