

AS 1379 Supplement 1—2008

Specification and supply of concrete— Commentary (Supplement 1 to AS 1379—2007)



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AS 1379 Supplement 1—2008

Specification and supply of concrete— Commentary (Supplement 1 to AS 1379—2007)

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PREFACE

This Commentary (AS 1379—Supplement 1) was prepared by Standards Australia Committee BD-049, Manufacture of Concrete, to supersede AS 1379 Supp 1—1997.

Objective

The objective of this Commentary is to—

- (a) provide background reference material to the Standard;
- (b) indicate the origin of particular requirements;
- (c) indicate departures from previous practice; and
- (d) explain the application of certain Clauses.

The clause numbers and titles used in the Commentary are the same as those in AS 1379 except that they are prefixed by the letter C. To avoid possible confusion between this Commentary and the Standard, clauses are cross-referenced within the text, while Commentary clauses are referred to as Paragraph C... in accordance with Standards Australia policy.

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STANDARDS AUSTRALIA

Australian Standard

Specification and supply of concrete—Commentary (Supplement 1 to AS 1379—2007)

SECTION C1 SCOPE AND GENERAL

C1.1 SCOPE

The Standard was prepared for use in the specification and supply of all concrete, whether or not it is addressed in the scope and application of AS 3600.

It is not intended to apply to mortars or grouts unless these contain coarse aggregates.

Requirements for mortars for masonry construction are specified in AS 3700 and the methods for sampling and testing mortars in AS 2701.

Requirements for grouts to be used for the grouting of prestressing tendons in ducts are specified in AS 3600.

The supply of concrete by the premix concrete industry has been expressly but not solely contemplated in the preparation of the Standard.

It is not intended that this Standard take precedence over existing Australian Standards for the manufacture of specific concrete products.

The Standard is intended to complete the independence of AS 1379 from AS 3600. Due to the lack of synchronization in publishing dates, for many years concrete as a material relied on both AS 1379 and AS 3600 to one degree or another. AS 1379 is now a ‘stand-alone’ document for the specification and supply of concrete.

C1.2 REFERENCED DOCUMENTS

The Standards listed in the Clause are subject to revision from time to time and the current edition should always be used. The currency of any Standard may be checked with Standards Australia.

C1.3 DEFINITIONS

No Commentary, except for the following clauses:

C1.3.6 Cement

The meaning of the term cement has been extended beyond its traditional meaning of portland cement to include supplementary cementitious materials. For the purpose of this Standard, cement can be portland or blended cements as defined in AS 3972.

Blended cements include any combination of portland cement with fly-ash, amorphous silica and ground granulated iron blast furnace slag.

C1.3.15 Project assessment

Section 6 requires suppliers to continuously monitor the strength of the concrete supplied by ‘production assessment.’

Project assessment is an additional assessment that may be specified, and attracts an additional cost.

Currently AS 3600 requires project assessment to be specified for all special-class concrete. Project assessment may also be specified for normal-class concrete.

The customer should not assume the supplier is aware of any liability to conduct project assessment. It is the responsibility of the customer to commission an appropriate testing body to carry out project assessment. The supplier may be an available choice for this purpose. The customer may commission the supplier to carry out the specified project testing, making appropriate arrangements for the recovery of the costs involved.

Project assessment is discussed further in Section C6.

C1.3.21 Total free water

The only water considered to be available for hydration of cementitious materials is the 'total free water', being 'added water' and the 'surface moisture' of the aggregates.

In this context, water separately added in the batching process, as distinct from water introduced as moisture content in the aggregates, is referred to as 'added water'. Added water 'includes water contained in admixtures and water added to adjust slump at any time prior to or during discharge.

The other component of total free water, the 'surface moisture' content of aggregates, is defined as the total moisture content less the 'absorbed moisture' content. 'Absorbed moisture' is that contained within capillary fissures in the aggregate particles. It is considered to remain within the aggregates and not to be available to enter into chemical combination with the cementitious materials. When aggregates are in a condition where the only water they contain is that which can fully occupy the capillary fissures within the aggregate particles, they are said to be in a 'saturated surface dry' condition. To bring aggregates to this condition, they are slowly dried from a higher moisture content until the surface water has evaporated. The 'saturated surface dry' moisture content can then be determined. Any moisture the aggregates contain in excess of the absorbed moisture is referred to as 'surface moisture'.

C1.3.22 Water-cement ratio (w/c)

Water for this purpose is defined as the total free water discussed in Clause C1.3.21 and cement as discussed in Clause 1.3.6.

C1.4 NOTATION

(No Commentary)

C1.5 SPECIFICATION OF CONCRETE

C1.5.1 General

'Normal-class concrete' is presented as the specification method likely to suit the majority of applications. Its properties are limited, albeit in reasonably wide ranges, in respect of a number of key parameters such as strength grade, density, aggregate size, slump and chemical composition.

The quality compliance provisions of Section 6 anticipate that the majority of specifications would call up normal-class concrete. The entire concept of production assessment is based on this assumption. In turn, the customer's level of protection also improves.

'Special-class concrete' provides the specifier with the opportunity to specify parameters or values, which are not permitted in normal-class concrete.

C1.5.2 Standard strength grades

With the increasing use of concrete with strength grades above 50 MPa, AS 3600 and, therefore, AS 1379 have introduced additional standard grades of 65, 80 and 100 MPa. This ensures that in specifying such grades, a standard approach is adopted for both design and production.

If special-class concrete is specified, it is preferable if the use of non-standard strength grades be avoided. If the strength grade is one of the standard grades, test data can sometimes be grouped with the data used for production assessment of normal-class concrete of the same strength grade even though concrete may be special-class. Strength grades above 50 MPa, whether standard or not, are treated as special-class.

The majority of structural concrete lies in the range of strength grades from 20 to 100 MPa. For such concrete, the committees responsible for AS 3600 and the Standard recommend the selection of one of the values 20, 25, 32, 40, 50, 65, 80 or 100 MPa.

The advantages of standardizing strength grades lies in the consequent increase in the volume of statistical information available for each mix and in avoiding a variety of unnecessary mix designs.

The use of standard strength grades, whenever possible, will result in more test results being available for statistical analysis and will generate more reliable statistical parameters with which to assess quality. This will enhance the effectiveness of suppliers' production assessment procedures, the principal tool for maintenance of the quality of concrete production.

A technical distinction is employed in the Clause with the use of the term 'design' characteristic strength. Characteristic strength is defined in Clause 1.3.7 as 'that value of the material strength, as assessed by the standard test, which is exceeded by 95% of the material.' The word 'design' is prefixed to it in the Clause to make clear that in this context the value referred to is the value upon which the designer relies. It is not to be confused with the value calculated from the test results for a particular grade, which will be expected to exceed the 'design' value.

C1.5.3 Normal-class concrete

C1.5.3.1 General

The Clause deals with various attributes and constituents of normal class concrete.

Any restrictions on the use of supplementary cementitious materials or chemical admixture, limitation of basic shrinkage strain after 56 days drying to less than 1000×10^{-6} or departure from the limits of other attributes in Clause 1.5.3, would change the classification to special-class as follows:

- (a) *Mass per unit volume* The range of from 2100 kg/m³ to 2800 kg/m³ was chosen to accommodate satisfactory dense aggregates commercially available. Lightweight concrete (<2100 kg/m³) would necessarily be special-class concrete.
- (b) *Chemical content* Normal class concrete in accordance with Clause 2.6 will have a chloride ion content limit of 0.8 kg/m³.

NOTE: For commentary to limits on chemical content, see Clause C2.6.

- (c) *Basic shrinkage strain* The maximum basic shrinkage strain, after 56 days drying, of 1000×10^{-6} is a value to which suppliers of normal-class concrete in any area of Australia are committed.

The following are relevant when considering the appropriateness of this limit:

- (i) *Practicality* In some areas, the locally available aggregates and cement for the production of concrete will result in concrete with a basic shrinkage strain approaching this value. A lower maximum value for normal-class concrete would, in such areas, preclude the use of economical and otherwise satisfactory materials for use in normal-class concrete.

Many areas have materials that will ensure the basic shrinkage strain of concrete in those areas is considerably less than 1000×10^{-6} . Designers should ascertain the shrinkage characteristics of commercially produced concrete in any area by inspecting the records of suppliers in that area.

It is preferable that such enquiries be made before the specification of lower shrinkage strain limit is contemplated.

- (ii) *Consistency* A median value of 850×10^{-6} is used in AS 3600 for the basic shrinkage strain as an alternative to values determined from tests on the concrete proposed to be used or similar local concrete.

The maximum to 1000×10^{-6} specified in the Standard includes allowance for the range of values each side of the median and for the testing precision in the determination of shrinkage.

For further discussion on basic shrinkage strain, see Clause C1.5.4.

- (iii) *Coarse aggregate influence* Where for any specific coarse aggregate, the maximum size or the proportion, or both, is decreased, as may occur to facilitate difficult placing conditions such as pumping through small diameter pipelines, the drying shrinkage of concrete increases. Conversely, if the proposed placement method and design of the member can tolerate increases in the volume or the maximum size of aggregate, or both, lower drying shrinkage will result.

- (d) *Strength gain characteristics* The needs for strength growth characteristics vary. Relatively high early strengths are needed in some circumstances, for example, when stripping time for suspended slabs is critical.

A minimum mean 7 day strength is included in the Standard to inform customers what they may anticipate if normal-class concrete is specified.

When higher early age strengths are needed, special-class concrete should be specified.

Early age strengths have not been specified for standard grades above 50 MPa, as suppliers employ wide variations in approaches to achieve these higher strengths. Because these grades are defined as special-class concrete, the specification of early age strength will not affect their classification.

It should be emphasized, especially in the absence of an additional early strength specification parameter, that it takes some time for concrete to achieve its potential strength. The importance of extended continuous curing to achieve the full potential properties also needs to be emphasized in this context.

C1.5.3.2 Basic parameters

The following basic parameters need to be specified when ordering normal-class concrete:

- (a) *Standard strength grades* The significance of standard strength grades is discussed in Clause C1.5.2.
- (b) *Slump* When a customer orders a specific value of slump, that slump becomes the supplier's target. The tolerances given in Table 6 of the Standard are to provide for the operator's inability to precisely assess slump in the production process.

The specification of slump of normal-class concrete is commonly established by the designer in contractual documents, often without discussion with those responsible for placing the concrete or certain knowledge of the details of the method of placement.

There is merit in the alternative of allowing the customer to specify the slump to the supplier, after considering the alternative methods of placement and finishing. The customer may need to strike a balance between the higher cost of purchasing concrete with a higher slump and the considerable cost associated with the difficulties of placing concrete at lower slump. For example, it is usually more expensive to pump concrete at an 80 mm slump than a 100 mm slump.

Due to local aggregate characteristics, suppliers in some areas may not be able to meet the shrinkage requirements of the Standard at a specified slump of greater than 80 mm. In this case, the supplier cannot offer normal-class concrete of greater than 80 mm slump, but only lower slump. It is the responsibility of the supplier to decide if a greater than 80 mm slump normal-class concrete can be supplied.

Note 2 has been introduced to give guidance to the supplier where the customer ordering concrete for residential slabs and footings provides no specified slump requirement. A default value of 100 mm has been chosen because this is the minimum slump with which concrete placers prefer to work.

- (c) *Maximum size of aggregate* This is the maximum nominal size of aggregates. Concrete mixes will contain a range of particular sizes from this size down to fine material.

In the absence of specific advice, a default value of 20 mm maximum aggregate size has been established (see Clause C2.3).

- (d) *Method of placement* The method of placement may affect the concrete mix design and the performance of the concrete. Common placement methods include chute discharge only, pumping and spray. Some project requirements will necessitate the need for a special mix design to achieve site placement needs outside the normal-class concrete's capabilities. Consult with the supplier if abnormal placement demands such as small diameter pumplines, extra long or high pumping distances, extrusion machines and the like are to be used.
- (e) *Any requirement for project testing* In the absence of specific advice, only production assessment is required.

C1.5.4 Special-class concrete

Detailed guidance on the specification of special-class concrete is described in Appendix CB and Appendix B of the Standard.

Shrinkage strain

Special-class concrete may be specified as having maximum values of basic shrinkage strain below or, indeed, above 1000×10^{-6} .

The specification of maximum basic shrinkage strains less than 1000×10^{-6} may carry with it some disadvantages. Depending on the material resources available in the region, it may—

- (a) be necessary to import distant materials, thus increasing the cost of concrete; or
- (b) unnecessarily deplete scarce resources, or both.

Consultation with experienced suppliers in the region is advisable to determine what shrinkage may be expected with normally used materials, and the cost, if any, associated with specifying a limit less than 1000×10^{-6} .

In the event that more restrictive values for basic shrinkage strain are specified, the specification of a median value is recommended. A limit on the median is more capable of rational assessment than a limit on the maximum. In view of the inherent variability of the sampling and testing procedures, unusually high values may randomly occur. Where maximum value is specified, irrational assessment may occur.

Identifying prefixes for special-class concrete should follow the following conventions:

- (i) Mix codes such as S25 may be used to identify a 25 MPa strength grade special-class concrete, distinguishing it from N25, being a 25MPa strength grade normal-class concrete.

- (ii) Codes SF 'x' and ST 'y' may be used to identify special-class concrete with a design characteristic strength in flexure of 'x' MPa and indirect tension 'y' MPa, respectively.
- (iii) Additional identifying prefixes have been introduced to ensure that durability requirements are recognized. AS 3600 intends to provide that all concrete with exposure classifications B2, C1 and C2 be classified as special-class.
- (iv) Appropriate alphanumerical codes agreed between the supplier and the user may be used to identify concrete specified by properties other than strength; for example, KC280 may be used to identify a kerb and channel mix with 280 kg cement/m³.

High performance concrete

Where high performance concrete is specified, it is recommended that the specification require the supplier to submit for approval to the customer or his agent a quality plan specific to the project. The plan should confirm the supplier's ability to supply and deliver concrete conforming to the requirements of the specification. The plan should also be implemented for the duration of the project.

Specification of slump as a maximum value in lieu of the default mean value

The practice of specifying slump in accordance with the normal-class provisions is encouraged. The specification of maximum slump or any non-standard method of slump specification is discouraged to avoid confusion.

C1.6 METHODS OF ORDERING

The purpose of the Clause is to establish standard guidelines for ordering concrete produced in accordance with the Standard, so that, when placing and accepting an order, there is a clear understanding between the purchaser and the supplier with regard to the expectations of the former and the responsibilities of the latter.

The Standard covers the specification, manufacture and delivery (where applicable) of plastic concrete containing certain basic ingredients and having specified plastic state properties. Further, the purchaser should have confidence that the concrete supplied will achieve specified hardened state properties at the nominated time when handled, cured and tested in accordance with the relevant procedures.

Whether or not the concrete placed into the structure achieves the same hardened state properties as the test specimens is dependent on the handling, placing and compacting techniques employed, the methods and duration of curing used and the method, sequence and timing of any formwork stripping. As these factors are outside the control of the supplier, assessment of compliance of concrete on the basis of testing of the concrete in the structure is outside the scope of the Standard. In fact, assessment for compliance based on testing the concrete in a structure is not covered by any Standard; however, AS 3600 does give a method of estimating the strength of concrete in a structure. In the absence of test results on samples made from the fresh concrete, testing of concrete in the structure can be undertaken, but only to provide guidance as to whether the concrete produced by the supplier would have achieved the required hardened state properties.

It is intended that normal-class concrete provide a 'standardized' range of concretes that are suitable for the majority of applications in domestic, commercial, industrial and institutional buildings. There will of course be other areas, such as particular civil engineering structures, where normal-class concrete would also be suitable.

The principal criterion for deciding whether normal-class concrete is appropriate for a particular application is to determine whether the limited number of parameters permitted to be specified for that class (see Clause 1.5.3) is sufficient to ensure that concrete with the desired properties can be provided. If it is considered to be insufficient, then special-class concrete is required and the different or additional parameters needed to ensure the desired results are to be specified (Clause 1.5.4) and noted in the order (Clause 1.6).

Apart from being an essential requirement for ordering, it is in the customer's interest to determine beforehand which class of concrete is the most appropriate for the project, as there will usually be a cost difference between the two classes. If there is a 'structural specification' for supply of the concrete, the decision as to which class is appropriate will usually have been made by the specifier well before an order is placed. If there is no specification, or the specification is not clear on which class is appropriate, it will be essential for the customer and the supplier to reach an agreement on the appropriate class, before any order is placed.

Having established which class of concrete is required, the following ordering procedures of Items (a) or (b) should be followed as appropriate:

- (a) *Ordering normal-class concrete* Where normal-class concrete has been specified, or it has been agreed between the customer and the supplier that normal-class concrete is appropriate for the intended use, the order should contain only the following information, as appropriate:
 - (i) The quantity of concrete required and sufficient information to ensure that the user receives the concrete ordered.
 - (ii) The standard compressive strength grade, designated in accordance with Item (a) of Clause 1.5.3.2.
 - (iii) A standard slump selected in accordance with Item (b) of Clause 1.5.3.2, at the point of acceptance.
 - (iv) The maximum nominal size of aggregate selected in accordance with Item (c) of Clause 1.5.3.2.
 - (v) The level of air-entrainment, if any in accordance with Item (f) of Clause 1.5.3.2.
 - (vi) The intended method of placement (see Item (d) of Clause 1.5.3.2).
 - (vii) Whether project assessment is to be carried out by the supplier.

Clearly Items (ii) to (v) are performance requirements. Furthermore, apart from the limitations imposed by Section 2, there is no restriction on the supplier regarding the selection or proportioning of the mix ingredients. An order for normal-class concrete is therefore a performance order.

It follows that in accepting an order for normal-class concrete, the supplier also accepts responsibility for supplying concrete that will have both the specified plastic-state properties, and the potential to attain the specified hardened-state properties, and for ensuring that due account has been taken of the other information contained in the order.

- (b) *Ordering special-class concrete* Clause 1.5.4 indicates that any concrete that is not normal-class is classified as special-class. Clause 1.6 requires that if the concrete is special-class, the class is to be further qualified as 'performance' or 'prescription'.

Where any property other than strength grade is specified as the principal criterion or the proportions of the mix constituents, or the materials to be used are specified, the concrete should be specified as a special-class prescription concrete. It is recognized that specifiers frequently specify both performance and prescriptive properties for the one concrete. If the specified principal criterion is not clear and cannot be agreed between the customer and supplier, then the principles set below should be applied.

It is important to remember that, like any other wholesaler or retailer, it is the supplier's prerogative to accept or decline an order for a product. Hence, whether an order for special-class concrete is accepted as a 'performance' order or a 'prescription' order will depend entirely on agreement between the supplier and the customer.

An order for special-class concrete may be accepted as either a performance order, or a prescription order. If the order is in the form given in Item (b)(i) of Clause 1.7, and it is agreed between the parties to the order that the supplier accepts responsibility for proportioning the concrete ingredients so that the specified, or otherwise agreed, properties or characteristics of the plastic and hardened concrete can be achieved, then the order will be accepted as a 'performance order'. If this does not apply, it is understood that the supplier does not agree to accept responsibility for achieving some or all of the specified, or otherwise agreed, properties or characteristics of the plastic and hardened concrete. The order is then classed as a 'prescription order' and the information listed in Item (b)(ii) of Clause 7 should be followed; however, the supplier is still responsible for carrying out all other applicable requirements of the Standard. Appendix B may be used as a guide to the ordering of special-class concrete, subject to the limitations given in the Clause.

- (i) *Special-class performance concrete* A special-class performance order should contain only the following information as appropriate:
- (A) The quantity of concrete required, and sufficient information to ensure that the user receives the concrete ordered.
 - (B) The relevant 'special-class' designation, in accordance with Clause 1.5.4, followed by the 'performance'. The reference to exposure classifications and the requirement for additional specification for classes SB, SC and SU should be noted (see Items (A) and (B) of Clause 1.5.4).
 - (C) The strength grade, if applicable.
 - (D) The slump, quoted in multiples of 10 mm, and the point of acceptance.
 - (E) The maximum nominal size of aggregate, selected from the standard sizes specified in AS 2758.1.
 - (F) The level of air entrainment, if any.
 - (G) The intended method of placement.
 - (H) Whether project assessment is to be carried out by the supplier.
 - (I) Any other construction, performance or quality criteria that may influence the selection of materials or proportioning of the ingredients. These criteria may include a minimum cement content or a maximum water-cement ratio, or both, but if other material proportions are specified, the order will be classed as a prescription order and the information given in Item (b)(ii) of Clause C1.6 should be followed.

It can be seen that this is almost identical with an order for normal-class concrete, except that the properties specified in Items (C), (D) and (E) do not have to be the standardized normal-class values. The other important exception is the information to be provided in Item (I). In the long run, this will determine whether the supplier accepts the order on a 'performance' basis.

Information that would need to be included in Item (I) would include the following:

- (1) Any early-age strength limitation.
- (2) Any shrinkage strain limitation (see Clause 5.6.2).
- (3) The inclusion of additives and other materials such as fibres or colouring pigments, waterproofing admixtures, corrosion-inhibiting additives.
- (4) A requirement for colour control of the hardened concrete.

As indicated in Item (I), a requirement for specific material proportions will generally preclude acceptance on a performance basis.

- (ii) *Special-class prescription concrete* A special-class prescription order should contain at least the following information:
 - (A) The quantity of concrete required and sufficient information to ensure that the user receives the concrete so ordered.
 - (B) The relevant 'Special-Class' designation, in accordance with Clause 1.5.4, followed by the word 'Prescription'.
 - (C) The particle density, maximum nominal size and grading of the coarse aggregate, within the ranges provided for in AS 2758.1 or, alternatively, the source of aggregate supply.
 - (D) The particle density and grading of the fine aggregates, within the ranges provided for in AS 2758.1 or, alternatively, the source of aggregate supply.
 - (E) The type of portland or blended cement, selected from AS 3972.
 - (F) The limitations, if any, on the use of other cement constituents.
 - (G) The limitations, if any, on the type and proportions of admixtures that may be used.
 - (H) The proportions of aggregates and cement, by mass, except as otherwise permitted by Clause 4.1.2.
 - (I) Either the maximum water-cement ratio, based on saturated surface-dry aggregates and total water content; or the required slump at the point of acceptance.

Persons requiring special-class prescription concrete are reminded that concrete properties are very sensitive to variations in the properties of the ingredients contained in the mix. Because concrete properties can be achieved with particular proportions in one area, there is no guarantee that these properties can be achieved in an area with different sources of materials.

It is therefore incumbent on the specifier to ascertain whether all prescribed requirements can be satisfied with the materials available to suppliers in the region in which the concrete is to be supplied.

C1.7 BASIS OF SUPPLY

C1.7.1 General

Item (c) of the Clause has been added to ensure that the responsibilities for performance are addressed in cases where the customer or a third party acting under the customer's instruction adds ingredients to the concrete, with or without the supplier's knowledge.

C1.7.2 Volume of plastic concrete

The Clause addresses what the industry commonly refers to as 'yield', that is the actual volume of concrete supplied, as against the volume ordered and charged. There is an unavoidable variation in the volume of concrete produced from any set of batch weights arising from batching deviations within the allowed tolerances, variations in the moisture content of aggregates, density of aggregates and, to a lesser degree, other factors such as slump variations and temperature.