

Australian Standard[®]

Concrete structures

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PREFACE

This Standard was prepared by Standards Australia Committee on Concrete Structures, and first published in 1988 as an amalgamation of and to supersede, SAA 1480—1982, *SAA Concrete Structures Code* and AS 1481—1978, *SAA Prestressed Concrete Code*.

Objective of the Standard: The principal objective of the Standard is to provide users with nationally acceptable unified rules for the design and detailing of concrete structures and elements, with or without steel reinforcement or prestressing tendons, based on the principles of structural engineering mechanics. A secondary objective is to provide performance criteria against which the finished structure can be assessed for compliance with the relevant design requirements.

Background to Second Edition: Amendment No. 1 to the Standard was issued in June 1990 to take account of the new limit-state versions of Part 1 and Part 2 of AS 1170—*SAA Loading code*, both published in 1989 and the new Part 3—*Snow loads*, published in 1990. It also incorporated improvements based on user experience in implementing AS 3600.

Following a regular five-yearly review, further amendments to the Standard were approved by the Concrete Structures Committee in March 1994. These amendments take account of more recent revisions of key materials' Standards, the 1993 publication of AS 1170.4—*Earthquake loads*, and incorporate additional improvements to the clarity and intent of particular requirements, based on user comments.

As a consequence of the Active Cooperation Agreement between Standards Australia (SAA) and Standards New Zealand (SNZ) regarding the preparation of joint SAA/SNZ Standards, and in view of the number and extent of the amendments to AS 3600 now involved, the SAA Concrete Structures Committee recommended that, rather than issuing further 'green slip' amendments, a Second Edition of AS 3600 be published which incorporated all published and approved amendments.

Objective of the Second Edition: The objective of the Second Edition is to provide users with a clean, updated version of the Standard.

Differences between AS 3600 and the Standards which it supersedes, and the principal areas affected by subsequent amendments, are briefly outlined below.

1. Differences between AS 3600 and previous Standards

Although AS 1480—1982 and AS 1481—1978 form the basis of AS 3600, it differs markedly from them in both format and content, as indicated below.

1.1 Limit state format In keeping with current ISO and SAA policy on structural design Standards, the appropriate functional states, such as strength and serviceability, and the corresponding performance limits are presented generally in the format of design action effects (bending moments, shear forces) and corresponding design resistances. Loads and load combinations are referred to AS 1170 from Section 3, and design action effects determined from analysis in accordance with Section 7. Design resistances are then determined for the various elements from Sections 8, 9 and 10 as appropriate. This represents the culmination of the advance from permissible stress design to full limit state design, which began with the introduction of the ultimate-strength method in the 1974 edition of AS 1480.

1.2 General application Requirements of the Standard have been broadened and modified where necessary, to ensure that generally they apply to reinforced members with, or without, some degree of prestressing. Requirements are given separately for unreinforced (plain) concrete, while requirements which apply only to prestressing are now included as separate clauses in the appropriate Sections.

The relevant provisions of the Standard have also been widened so that it is now suitable for design in conjunction with the *Austrroads Bridge Design Code* or the *ANZRC Railway bridge design manual*, either of which will take precedence over AS 3600 for bridges under the jurisdiction of the local representative authority.

1.3 New inclusions A tiered approach to member design rules has been introduced to allow the designer more flexibility in choice of design methods to suit a particular project. Simplified rules, for common applications within prescribed limits, are generally presented first, with more complex rules having wider applications following.

Durability and fire-resistance provisions have been included as independent considerations within the body of the Standard. Previously they have been either implied in various design rules, or given only as recommendations in appendices.

Provision has also been made for the use of the ‘truss analogy’ where non-flexural behaviour of members occurs.

Additional detailing rules and requirements for concrete structures required to be designed for earthquake loads, previously given in various appendices throughout AS 2121, *SAA Earthquake Code*, (now superseded), are given in Appendix A.

1.4 Technical changes The major technical differences between AS 3600 and the previous Standards lie in the areas of shear in beams and slabs, the design of columns and walls, and the development of stress in reinforcement. The changes that have been made reflect recent advances in materials technology, continuing research into structural behaviour and the ready availability of computer-aided methods of analysis and design. The background to the changes is covered in the Commentary (AS 3600 Supplement 1) on the corresponding clauses together with selected references from the published technical literature.

1.5 Construction and workmanship A considerable number of provisions relating to good construction practices and workmanship, contained in the previous Standards, have been omitted from AS 3600. The omitted material was considered to be either inappropriate because it had contractual implications, or inadequate because it was too specific to cover the likely variety of project situations that may occur and the variety of acceptable alternative practices that could be adopted. The Committee felt that the former should be placed in project specifications where they could be dealt with more effectively and the latter were more appropriate to handbooks and guides on good practice rather than in a structural design standard. The retained provisions have been expressed in terms of required end results rather than prescribing particular methods for achieving those results. Their retention is intended to ensure that the finished concrete structure satisfies the design requirements.

1.6 Editorial changes Advantage was taken of the 1988 revision to rearrange the material contained in the Standard so that it is more readily useable by the practising design engineer. In this regard, the usual sequence in the design process (namely load assessment, analysis, member design and detailing) rather than the checking process, was the guiding criterion.

In line with Standards Australia editorial policy, the words ‘shall’ and ‘may’ are used consistently throughout the Standard to indicate respectively, a mandatory provision and an acceptable or permissible alternative.

2 Amendments

As noted in the opening paragraphs of the Preface, this Edition incorporates Amendment No. 1 of June 1990 and amendments approved in March 1994. Throughout the Standard the amended portions are indicated by vertical bars in the left hand margin. The 1994 Amendments are further distinguished by double bars.

It was also noted that the primary purpose of the amendments was to take account of new, or revised, key reference Standards that had been issued after publication of the first Edition. The principal Standards concerned and the consequent changes to relevant AS 3600 requirements are briefly outlined below.

2.1 AS 1170—Minimum design loads on structures The 1989 revision of AS 1170.1—*Dead and live loads and load combinations*; AS 1170.2—*Wind loads*; and AS 1170.3—1990, *Snow loads*, were covered by the Amendment No.1 changes to Section 3. AS 4055—*Wind loads for housing*, published in 1992, has now been included in Section 3 under the 1994 Amendments.

The publication of AS 1170.4—*Earthquake loads* in 1993, which now supersedes AS 2121, is addressed by the 1994 Amendment. Apart from consequent minor changes in Section 3, the major impact of the new part is on Appendix A of AS 3600. This Appendix has been completely redrafted to take account of major differences between AS 1170.4 and AS 2121 in their approach to the zoning and classification of structures for which design for earthquake load is required. Although earthquake forces determined from AS 1170.4 are generally slightly higher than previously required for many areas, the detailing requirements of the new Appendix are generally somewhat less stringent than corresponding previous requirements. The net result is that there is little change to the 'status quo' except for taller buildings in regions of the highest seismic risk.

2.2 AS 1379—The specification and manufacture of concrete The 1991 revision of AS 1379 now covers all aspects of the manufacture of concrete, from the specification of ingredient materials, through batching and mixing, to discharge of plastic concrete at the site. It also includes production and project assessment of plastic-state properties and potential hardened-state properties. This obviates the need for detailed requirements for plastic concrete to be specified in AS 3600 and the consequent changes are reflected in the 1994 amendment. These involve the complete redrafting of Clause 19.1 and its dependent subclauses, and Section 20 in its entirety.

It should be noted that construction requirements for handling, placing, protection, curing and stripping have been retained in Section 19, as these all relate to activities which occur after site discharge of the plastic concrete and hence are outside the scope of AS 1379.

In the related area of concrete materials, AS 3582—1991, *Supplementary cementitious materials for use with portland cement*; AS 3799—1990, *Liquid membrane-forming curing compounds for concrete*; and AS 3972—1991, *Portland and blended cements* (supersedes AS 1315 and AS 1317) are also covered by the 1994 amendment.

2.3 AS 3735 Concrete structures for retaining liquids AS 3735—1991 and its companion Standard AS 2783—*Use of reinforced concrete for small swimming pools* (1992) now provide detailed requirements for this specialized group of concrete structures. The consequent change to Section 17 of AS 3600 is covered by the 1994 amendment.

2.4 Other changes Other technical changes covered by the 1994 Amendment are principally those initiated by comments from users of the Standard and relate to particular clauses in Sections 8, 9 and 10.

Publication of a second edition has provided the opportunity to incorporate recent changes to Standards Australia 'style' principles; notably the change from double to single column format. Some changes in Section 1, as noted in the 1994 Amendment, are also related to this. The remaining changes are of a minor editorial or typographical nature.

Appropriate amendments are also being made to the relevant clauses in the Commentary on the Standard (AS 3600 Supplement 1) which will be issued concurrently with this Second Edition of AS 3600.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

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