

Australian Standard[®]

Masonry structures

STANDARDS
Australia



This Australian Standard® was prepared by Committee BD-004, Masonry Structures. It was approved on behalf of the Council of Standards Australia on 12 October 2001. This Standard was published on 27 November 2001.

The following are represented on Committee BD-004:

- A2 |
- Australian Building Codes Board
 - Australian Chamber of Commerce and Industry
 - Building Designers Association of Australia
 - Calcium Silicate Brick Manufacturers
 - Cement and Concrete Association of Australia
 - Clay Brick and Paver Institute
 - Concrete Masonry Association of Australia Limited
 - CSIRO, Building, Construction and Engineering
 - Housing Industry Association
 - Masonry Contractors Association
 - Master Builders Australia
 - NSW Department of Public Works and Services
 - The Association of Consulting Engineers Australia
 - University of Newcastle
-

This Standard was issued in draft form for comment as DR 00381.

Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through the public comment period.

Keeping Standards up-to-date

Australian Standards® are living documents that reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued.

Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments that may have been published since the Standard was published.

Detailed information about Australian Standards, drafts, amendments and new projects can be found by visiting www.standards.org.au

Standards Australia welcomes suggestions for improvements, and encourages readers to notify us immediately of any apparent inaccuracies or ambiguities. Contact us via email at mail@standards.org.au, or write to Standards Australia, GPO Box 476, Sydney, NSW 2001.

Australian Standard[®]

Masonry structures

Originally in part as AS CA32—1963.
Previous edition AS 3700—1998.
Third edition 2001.

Reissued incorporating Amendment No. 1 (May 2002).

Reissued incorporating Amendment No. 2 (December 2003).

Reissued incorporating Amendment No. 3 (August 2007).

COPYRIGHT

© Standards Australia

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher.

Published by Standards Australia GPO Box 476, Sydney, NSW 2001, Australia

ISBN 0 7337 4173 8

PREFACE

This Standard was prepared by the Standards Australia Committee BD-004, Masonry Structures, to supersede AS 3700—1998, *Masonry structures*.

This Standard incorporates Amendment No. 1 (May 2002), Amendment No. 2 (December 2003) and Amendment No. 3 (August 2007). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

The objective of this Standard is to provide minimum requirements for the design and construction of unreinforced, reinforced and prestressed masonry, including built-in components, for use in masonry applications.

The Standard is the result of a consensus among representatives on the Joint Committee that it be produced as an Australian Standard.

In the preparation of this Standard valuable assistance was given by organizations and individuals experienced in various aspects of the design and construction of masonry, and the Committee acknowledges their help.

Acknowledgment is also made of the assistance gained from the following documents and publications:

- (a) *Australian Masonry Manual*, published by a joint committee of the Public Works Department, N.S.W. and the Association of Consulting Structural Engineers, N.S.W.
- (b) Publications of the Clay Brick and Paver Institute; the Concrete Masonry Association of Australia Co-op Limited; the CSIRO Division of Building, Construction and Engineering; and the Department of Civil, Surveying and Environmental Engineering of the University of Newcastle.

Statements expressed in mandatory terms in notes to tables and figures are deemed to be requirements of this Standard.

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.

CONTENTS

	<i>Page</i>
SECTION 1 SCOPE AND GENERAL	
1.1 SCOPE AND APPLICATION.....	6
1.2 REFERENCED DOCUMENTS	6
1.3 USE OF ALTERNATIVE MATERIALS OR METHODS	8
1.4 INFORMATION TO BE PROVIDED ON DOCUMENTS	8
1.5 DEFINITIONS	9
1.6 NOTATION	16
SECTION 2 PERFORMANCE REQUIREMENTS FOR DESIGN	
2.1 SCOPE OF SECTION	24
2.2 AIM	24
2.3 PERFORMANCE REQUIREMENTS	24
2.4 DESIGN REQUIREMENTS	24
2.5 SERVICEABILITY, STRENGTH AND STABILITY	25
2.6 LOADS AND LOAD COMBINATIONS	26
2.7 OTHER DESIGN REQUIREMENTS	27
2.8 THERMAL INSULATION	28
2.9 SOUND INSULATION	28
SECTION 3 DESIGN PROPERTIES	
3.1 SCOPE OF SECTION	29
3.2 MASONRY UNITS	29
3.3 MASONRY	29
3.4 TIES AND ACCESSORIES	32
3.5 GROUT	33
3.6 REINFORCEMENT	33
3.7 TENDONS	34
SECTION 4 GENERAL DESIGN ASPECTS	
4.1 SCOPE OF SECTION	35
4.2 MEMBERS OF MIXED CONSTRUCTION	35
4.3 CHASES, HOLES AND RECESSES	35
4.4 CAPACITY REDUCTION FACTORS	35
4.5 CROSS-SECTION PROPERTIES	36
4.6 DESIGN FOR ROBUSTNESS	37
4.7 PREVENTION OF MOISTURE PENETRATION	39
4.8 CONTROL JOINTS	41
4.9 MORTAR JOINTS	41
4.10 WALL TIES	41
4.11 BONDING, TYING AND SUPPORTING	42
4.12 ARCHES AND LINTELS	43
4.13 INTERACTION BETWEEN MASONRY MEMBERS AND SLABS, BEAMS OR COLUMNS	43
4.14 CORBELLING	43
4.15 ATTACHMENT TO FACE OF WALLS	44

SECTION 5 DESIGN FOR DURABILITY

5.1	SCOPE OF SECTION	45
5.2	EXPOSURE ENVIRONMENTS	45
5.3	MASONRY UNITS	45
5.4	MORTAR	45
5.5	BUILT-IN COMPONENTS	45
5.6	GROUT	46
5.7	REINFORCEMENT AND TENDONS	46

SECTION 6 DESIGN FOR FIRE RESISTANCE

6.1	SCOPE OF SECTION	49
6.2	FIRE-RESISTANCE LEVELS	49
6.3	STRUCTURAL ADEQUACY	49
6.4	INTEGRITY	53
6.5	INSULATION	54
6.6	RECESSES FOR SERVICES	55
6.7	CHASES	56
6.8	PROTECTION OF STRUCTURAL STEELWORK	56

SECTION 7 STRUCTURAL DESIGN OF UNREINFORCED MASONRY

7.1	SCOPE OF SECTION	57
7.2	GENERAL BASIS OF DESIGN	57
7.3	DESIGN FOR MEMBERS IN COMPRESSION	57
7.4	DESIGN FOR MEMBERS IN BENDING	72
7.5	DESIGN FOR MEMBERS IN SHEAR	79
7.6	DESIGN OF SHEAR WALLS	81
7.7	DESIGN OF MASONRY VENEER WALLS	81
7.8	DESIGN OF CAVITY WALLS	83
7.9	DESIGN OF DIAPHRAGM WALLS	84

SECTION 8 STRUCTURAL DESIGN OF REINFORCED MASONRY

8.1	SCOPE OF SECTION	85
8.2	GENERAL BASIS OF DESIGN	85
8.3	GENERAL REINFORCEMENT REQUIREMENT	85
8.4	DESIGN FOR MEMBERS IN COMPRESSION	86
8.5	DESIGN FOR MEMBERS IN BENDING	87
8.6	DESIGN FOR MEMBERS IN SHEAR	88
8.7	DESIGN FOR MEMBERS IN TENSION	90
8.8	DESIGN FOR MEMBERS IN COMBINED BENDING AND COMPRESSION	91
8.9	DESIGN FOR MEMBERS IN COMBINED BENDING AND TENSION	91

SECTION 9 STRUCTURAL DESIGN OF PRESTRESSED MASONRY

9.1	SCOPE OF SECTION	92
9.2	GENERAL BASIS OF DESIGN	92
9.3	DESIGN CRITERIA FOR PRESTRESSING TENDONS	93
9.4	DESIGN FOR MEMBERS IN COMPRESSION	94
9.5	DESIGN FOR MEMBERS IN BENDING	94
9.6	DESIGN FOR MEMBERS IN SHEAR	97
9.7	DESIGN FOR MEMBERS IN TENSION	97
9.8	DESIGN FOR MEMBERS IN COMBINED BENDING AND COMPRESSION	97
9.9	DESIGN FOR MEMBERS IN COMBINED BENDING AND TENSION	98
9.10	DESIGN OF ANCHORAGE ZONES	98

	<i>Page</i>
SECTION 10 MATERIALS	
10.1 SCOPE OF SECTION	99
10.2 MASONRY	99
10.3 MASONRY UNITS.....	99
10.4 MORTAR.....	99
10.5 WALL TIES, CONNECTORS, ACCESSORIES AND LINTELS	101
10.6 DAMP-PROOF COURSES, FLASHINGS AND WEATHERINGS	101
10.7 GROUT	101
10.8 REINFORCEMENT AND TENDONS.....	102
SECTION 11 CONSTRUCTION	
11.1 SCOPE OF SECTION	104
11.2 GENERAL	104
11.3 MATERIALS	104
11.4 WORKMANSHIP	105
11.5 TOLERANCES IN MASONRY	107
11.6 SITE CONTROL.....	109
11.7 ADDITIONAL SITE CONTROL OF SPECIAL MASONRY	109
11.8 GROUTED MASONRY.....	110
11.9 MASONRY UNDER CONSTRUCTION.....	110
11.10 CLEANING.....	111
11.11 TESTING OF IN SITU MASONRY	111
SECTION 12 SIMPLIFIED DESIGN OF MASONRY FOR SMALL BUILDINGS	
12.1 SCOPE OF SECTION	112
12.2 MATERIALS	115
12.3 WALL SELECTION	119
12.4 LINTELS.....	131
12.5 BRACING	135
12.6 DETAILING.....	141
12.7 CONSTRUCTION.....	148
12.8 FLASHINGS IN CHIMNEYS.....	149
APPENDICES	
A ADDITIONAL CRITERIA FOR STRUCTURES SUBJECT TO EARTHQUAKE ACTIONS DETERMINED IN ACCORDANCE WITH AS 1170.4—1993	151
AA ADDITIONAL CRITERIA FOR STRUCTURES SUBJECT TO EARTHQUAKE ACTIONS DETERMINED IN ACCORDANCE WITH AS 1170.4—2007	157
B DETERMINATION OF CHARACTERISTIC VALUE	168
C METHOD OF TEST FOR COMPRESSIVE STRENGTH	170
D METHOD OF TEST FOR FLEXURAL STRENGTH.....	174
E ATMOSPHERIC ENVIRONMENTS.....	181
F GUIDANCE ON THE USE OF MASONRY IN RESTORATION WORK AND MASONRY CONSTRUCTED USING SQUARE-DRESSED NATURAL STONE.....	184
FA DURABILITY TESTING.....	185
G METHOD OF MEASUREMENT OF BOW.....	188
H ASSESSMENT OF STRENGTH VALUES FROM TEST RESULTS	189
I TESTING OF IN SITU MASONRY	191
J BASIS OF DESIGN FOR SECTION 12.....	192
K RACKING FORCES	197

STANDARDS AUSTRALIA

Australian Standard
Masonry structures

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE AND APPLICATION**1.1.1 Scope**

This Standard sets out minimum requirements for the design and construction of masonry, including unreinforced, reinforced and prestressed, using manufactured units of clay, calcium silicate and concrete laid in mortar, autoclaved aerated concrete (AAC) laid in thin-bed mortar, and square-dressed natural stone laid in mortar.

The Standard does not give values or material properties for the design and construction of square-dressed natural stone.

NOTES:

- 1 This Standard assumes that the structural design of masonry is entrusted to experienced structural engineers or similar appropriately qualified persons, and that the execution of such work is carried out under the direction of appropriately qualified persons who are experienced in masonry construction and who understand the structural requirements.
- 2 The Standard does not give specific requirements for prefabricated masonry panels or masonry in composite action with steel or concrete structural members. The principles of this Standard should be followed, as far as they are applicable, for such types of construction.
- 3 The provisions of this Standard do not include specification for design and construction of AAC laid in other than thin-bed mortar. However, for masonry so constructed the general principles of this Standard may be used.

1.1.2 Application

This Standard will be referenced in the Building Code of Australia by way of BCA Amendment 10 to be published by 1 January 2002, thereby superseding the previous edition, AS 3700—1988, which will be withdrawn 12 months from the date of the publication of this edition.

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS	
1141	Methods of sampling and testing aggregates
1170	Minimum design loads on structures
1170.1	Part 1: Dead and live loads and load combinations
1170.2	Part 2: Wind loads
1170.3	Part 3: Snow loads
1170.4	Part 4: Earthquake loads
A2	Not applicable
1310	Steel wire for tendons in prestressed concrete
1311	Steel tendons for prestressed concrete—7-wire stress-relieved steel strand for tendons in prestressed concrete