AS 1170.4—1993

Australian Standard[®]

Minimum design loads on structures

Part 4: Earthquake loads

This Australian Standard was prepared by Committee BD/6, Loading on Structures. It was approved on behalf of the Council of Standards Australia on 21 April 1993 and published on 16 August 1993.

The following interests are represented on Committee BD/6: Association of Consulting Engineers, Australia Association of Consulting Structural Engineers, N.S.W. AUBRCC Australian Clay Brick Association Australian Construction Services-Department of Administrative Services Australian Federation of Construction Contractors Australian Institute of Steel Construction **AUSTROADS** Bureau of Meteorology Bureau of Steel Manufacturers of Australia CSIRO, Division of Building, Construction and Engineering Electricity Supply Association of Australia Engineering and Water Supply Department, S.A. James Cook University of North Queensland Master Builders Construction and Housing Association, Australia Monash University Public Works Department, N.S.W. University of Melbourne University of Newcastle

Additional interests participating in preparation of this Standard: Australian Geological Survey Organization Cement and Concrete Association of Australia

Department of Housing and Construction, S.A.

Department of Mines and Energy, S.A.

Department of Resource Industries, Qld.

Institution of Engineers, Australia

Insurance Council of Australia

Phillip Institute of Technology, Vic.

Steel Reinforcement Institute of Australia

University of Adelaide

University of Queensland

Review of Australian Standards. To keep abreast of progress in industry, Australian Standards are subject to periodic review and are kept up to date by the issue of amendments or new editions as necessary. It is important therefore that Standards users ensure that they are in possession of the latest edition, and any amendments thereto.

Suggestions for improvements to Australian Standards, addressed to the head office of Standards Australia, are welcomed. Notification of any inaccuracy or ambiguity found in an Australian Standard should be made without delay in order that the matter may be investigated and appropriate action taken.

This Standard was issued in draft form for comment as DR 91094..

Full details of all Australian Standards and related publications will be found in the Standards Australia Catalogue of Publications; this information is supplemented each month by the magazine 'The Australian Standard', which subscribing members receive, and which gives details of new publications, new editions and amendments, and of withdrawn Standards.

Australian Standard®

Minimum design loads on structures (known as the SAA Loading Code)

Part 4: Earthquake loads

First published as part of AS 2121—1979. Revised and redesignated in part as AS 1170.4—1993.

Incorporating: Amdt 1—1994.

PUBLISHED BY STANDARDS AUSTRALIA (STANDARDS ASSOCIATION OF AUSTRALIA) 1 THE CRESCENT, HOMEBUSH, NSW 2140

PREFACE

This Standard was prepared by the Standards Australia Committee for Loading on Structures to supersede AS 2121—1979, SAA Earthquake Code and AS 2121M—1979 Seismic Zone map of Australia.

This edition incorporates the following major changes to the previous edition:

- (a) The Standard is now in a *limit states format*.
- (b) New earthquake maps of Australia and of each State/Territory, defined in terms of an acceleration coefficient, are included.
- (c) Domestic structures are now included (Section 3).
- (d) AS 2121—1979 contains provisions for earthquake loads and in addition, design and detailing requirements for some of the major structural materials. This Standard contains only loading requirements.

In preparing this Standard, the Committee referred to the documents listed in the Commentary, AS 1170.4 Supplement 1.

Acknowledgment is made of the Australian Geological Survey Organization's copyright of the earthquake acceleration coefficient maps of Australia, States and Territory, and appreciation is recorded for permission to include the maps in this Standard.

© Copyright — STANDARDS AUSTRALIA

Users of Standards are reminded that copyright subsists in all Standards Australia publications and software. Except where the Copyright Act allows and except where provided for below no publications or software produced by Standards Australia may be reproduced, stored in a retrieval system in any form or transmitted by any means without prior permission in writing from Standards Australia. Permission may be conditional on an appropriate royalty payment. Requests for permission and information on commercial software royalties should be directed to the head office of Standards Australia.

Standards Australia will permit up to 10 percent of the technical content pages of a Standard to be copied for use exclusively in-house by purchasers of the Standard without payment of a royalty or advice to Standards Australia.

Standards Australia will also permit the inclusion of its copyright material in computer software programs for no royalty payment provided such programs are used exclusively in-house by the creators of the programs.

Care should be taken to ensure that material used is from the current edition of the Standard and that it is updated whenever the Standard is amended or revised. The number and date of the Standard should therefore be clearly identified.

The use of material in print form or in computer software programs to be used commercially, with or without payment, or in commercial contracts is subject to the payment of a royalty. This policy may be varied by Standards Australia at any time.

		Page
FO	DREWORD	5
SECTIO	ON 1 SCOPE AND GENERAL	
1.1	SCOPE	8
1.2	REFERENCED DOCUMENTS	8
1.3	DEFINITIONS	8
1.4	NOTATION	10
1.5	METHODS OF DETERMINATION OF EARTHQUAKE LOADS	12
1.6	EARTHQUAKE LOAD COMBINATIONS	12
SECTIO	ON 2 GENERAL REQUIREMENTS	
2.1	GENERAL	13
2.2	STRUCTURE CLASSIFICATION	13
2.3	ACCELERATION COEFFICIENT	13
2.4	SITE FACTOR	23
2.5	IMPORTANCE FACTOR	24
2.6	EARTHQUAKE DESIGN CATEGORY	24
2.7	REQUIREMENTS FOR GENERAL STRUCTURES	24
2.8	STRUCTURAL SYSTEMS OF BUILDINGS	26
2.9	CONFIGURATION	27
2.10	DEFLECTION AND DRIFT LIMITS	28
SECTION 3 DOMESTIC STRUCTURES		
3.1	GENERAL	29
3.2	REQUIREMENTS FOR EARTHQUAKE DESIGN CATEGORIES	29
3.3	STRUCTURAL DETAILING REQUIREMENTS FOR DOMESTIC STRUCTURES	29
3.4	STATIC ANALYSIS FOR NON–DUCTILE DOMESTIC STRUCTURES OF EARTHOUAKE DESIGN CATEGORY H3	29
3.5	NON-STRUCTURAL COMPONENTS	30
SECTION 4 STRUCTURAL DETAILING REQUIREMENTS FOR GENERAL STRUCTURES		
4.1	GENERAL	31
4.2	STRUCTURAL DETAILING REQUIREMENTS FOR STRUCTURES OF EARTHQUAKE DESIGN CATEGORY A	31
4.3	STRUCTURAL DETAILING REQUIREMENTS FOR STRUCTURES OF EARTHQUAKE DESIGN CATEGORY B	31
4.4	STRUCTURAL DETAILING REQUIREMENTS FOR STRUCTURES OF EARTHQUAKE DESIGN CATEGORIES C, D AND E	31
SECTIO	ON 5 REQUIREMENTS FOR NON–STRUCTURAL COMPONENTS	
5.1	GENERAL REQUIREMENTS	33
5.2	REQUIREMENTS FOR ARCHITECTURAL COMPONENTS	35
5.3	REQUIREMENTS FOR MECHANICAL AND ELECTRICAL	
	COMPONENTS	36
5.4	AMPLIFICATION FACTOR	37
	This is a preview. Click here to purchase the full publication.	

CONTENTS

Page

SECTION 6 STATIC ANALYSIS

6.1	GENERAL	38
6.2	HORIZONTAL FORCES	38
6.3	VERTICAL DISTRIBUTION OF HORIZONTAL EARTHQUAKE FORCES	39
6.4	HORIZONTAL SHEAR DISTRIBUTION	42
6.5	TORSIONAL EFFECTS	42
6.6	STABILITY EFFECTS	44
6.7	DRIFT DETERMINATION AND <i>P</i> –DELTA EFFECTS	44
6.8	VERTICAL COMPONENT OF GROUND MOTION	45
SECT	ION 7 DYNAMIC ANALYSIS	
7.1	GENERAL	46
7.2	EARTHQUAKE ACTIONS	46
7.3	MATHEMATICAL MODEL	47
7.4	ANALYSIS PROCEDURES	47
7.5	STABILITY EFFECTS	48
7.6	DRIFT DETERMINATION AND P-DELTA EFFECTS	48
S	SECTION 8 STRUCTURAL ALTERATIONS	49
APPE	NDICES	
А	STRUCTURE CLASSIFICATION	50
В	STRUCTURAL SYSTEM	55
С	DOMESTIC STRUCTURES	56
D	TYPES OF DYNAMIC ANALYSIS	58
Е	STRUCTURAL ALTERATIONS	60

FOREWORD

The purpose of designing structures for earthquake loads is to—

- (a) minimize the risk of loss of life from structure collapse or damage in the event of an earthquake;
- (b) improve the expected performance of structures; and
- (c) improve the capability of structures that are essential to post-earthquake recovery to function during and after an earthquake, and to minimize the risk of damage to hazardous facilities.

The design of structures to this Standard does not necessarily prevent structural and non-structural damage in the event of an earthquake. The provisions provide the minimum criteria considered to be prudent for the protection of life by minimizing the likelihood of collapse of the structures.

The ground motions specified in this Standard are for the 'design earthquake' based on an estimated 90% probability of these ground motions not being exceeded in a 50-year period.

The detailing requirements specified in this Standard are of a general nature related specifically to earthquake resistant design. Specific detailing appropriate for each material (concrete, steel, masonry, timber, etc.) will be found in the relevant material Standards.

A flow chart showing the procedure for determining whether a structure needs to be designed for earthquake loads and, if required, the determination of design earthquake loads is shown in Figures 1(a) and 1(b).

COPYRIGHT