

Timber structures

Part 3: Design criteria for timber-framed residential buildings



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- Building Research Association of New Zealand
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- Engineers Australia
- Forest and Wood Products Australia
- Forest Industries Federation, WA
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- Timber Queensland
- University of Technology, Sydney
- Wood Processors & Manufacturers Association of New Zealand

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Part 3: Design criteria for timber-framed residential buildings

Originated as AS 1684.1—1999. Revised and redesignated as AS 1720.3:2016.

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PREFACE

This Standard was prepared by the Australian members of the Joint Standards Australia/ Standards New Zealand Committee TM-010, Timber Structures and Framing, to supersede AS 1684.1—1999, *Residential timber-framed construction*, Part 1: *Design criteria*.

After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian Standard rather than an Australian/New Zealand Standard.

The objective of this Standard is to provide users with the design criteria considered suitable for the design of conventional timber-framed residential buildings, subject to the requirements and limitations described in the Scope. Design criteria for the most commonly used timber members are provided.

This revision continues to recognize the ongoing development of timber framing systems and the need to cater for a widening variety of materials and design conditions. Significant changes include—

- (a) closer alignment with the relevant requirements of AS 1720.1;
- (b) adoption of the nomenclature and relevant requirements of the AS/NZS 1170 series of loading standards and, in particular, the recently revised edition of AS 4055;
- (c) de-linking of this Standard from the timber member span tables components of AS 1684.2, AS 1684.3 and AS 1684.4;
- (d) inclusion of design criteria for additional members—wind beams;
- (e) limitation to Class 1 and 10 buildings as defined by the National Construction Code— Building Code of Australia;
- (f) adjustment of the structural models used for joist and bearer design;
- (g) removal of alternative characteristic beam shear strengths for F-grades; and
- (h) correcting errors and addressing anomalies and inconsistencies.

Mandatory statements in notes and footnotes to tables are deemed to be requirements of this Standard.

The term 'normative' 'has been used in this Standard to define the application of the appendix to which it applies. A 'normative' appendix is an integral part of a Standard.

Page

CONTENTS

SECTIO	N 1 SCOPE AND GENERAL	
1.1	SCOPE AND APPLICATION	4
1.2	REFERENCED DOCUMENTS	4
1.3	OTHER METHODS	5
1.4	BASIS FOR DESIGN	5
1.5	DEFINITIONS	8
1.6	NOTATION1	0
SECTIO	N 2 DESIGN OF ROOF MEMBERS	
2.1	ROOF BATTENS	1
2.2	RAFTERS 1	5
2.3	ROOF BEAMS—RIDGE OR INTERMEDIATE BEAMS	20
2.4	UNDERPURLINS	24
2.5	STRUTTING BEAMS	29
2.6	COUNTER STRUTTING BEAMS	\$2
2.7	COMBINED HANGING STRUTTING BEAMS	6
2.8	CEILING BATTENS4	0
2.9	CEILING JOISTS	13
2.10	HANGING BEAMS	17
2.11	COUNTER BEAMS	50
2.12	VERANDAH BEAMS	;4
SECTIO	N 3 DESIGN OF WALL MEMBERS	
3.1	POSTS	50
3.2	LOADBEARING WALL STUDS6	53
3.3	WALL PLATES FOR LOADBEARING WALLS	59
3.4	LINTELS	15
3.5	WIND BEAMS	;2
SECTIO	N 4 DESIGN OF FLOOR MEMBERS	
4.1	FLOOR JOISTS	36
4.2	BEARERS)1
SECTIO	N 5 DETERMINATION OF UPLIFT FORCES	
5.1	SCOPE AND GENERAL)8
5.2	DETERMINATION OF NET UPLIFT PRESSURES9)8
SECTIO	N 6 PRESSURES FOR DETERMINATION OF RACKING FORCES	
6.1	SCOPE AND GENERAL)4
6.2	EQUIVALENT PRESSURES ON PROJECTED AREAS)6
APPENI	DICES	
Α	WIND CLASSIFICATIONS AND DESIGN WIND PRESSURES	0
В	DESIGN OF OVERHANGS FOR BIRDSMOUTH NOTCHED RAFTERS11	1

STANDARDS AUSTRALIA

Australian Standard Timber structures

Part 3: Design criteria for timber-framed residential buildings

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE AND APPLICATION

1.1.1 Scope

This Standard sets out the design methods, assumptions and other criteria, including uplift forces and racking pressures, suitable for the design of timber-framed buildings constructed within the limitations and parameters of, and using the building practice described in, AS 1684.2, AS 1684.3 and AS 1684.4.

The design criteria apply for the preparation of design data for conventional timber-framed construction where the loading and performance requirements correspond to those for Class 1 and Class 10 buildings as defined by the National Construction Code—Building Code of Australia.

1.1.2 Application

This Standard is to be read in conjunction with AS 1684.2, AS 1684.3 and AS 1684.4, the AS/NZS 1170 series, AS 4055 and AS 1720.1.

NOTE: While this Standard may be applied for Class 10 buildings less conservative levels of design may be permitted, for this Class, by building regulations and other Australian Standards.

The design criteria contained herein provide a basis for the design of timber members and timber-framed building systems and components, including the preparation of Span Tables and design data for structural wood products.

NOTE: The use of the design criteria contained in this Standard may provide evidence of satisfactory safety and serviceability performance.

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS	
1170	Structural design actions
1170.4	Part 4: Earthquake actions in Australia
1684	Residential timber-framed construction
1684.2	Part 2: Non-cyclonic areas
1684.3	Part 3: Cyclonic areas
1684.4	Part 4: Simplified—Non-cyclonic areas
1720	Timber structures
1720.1	Part 1: Design methods
4055	Wind loads for housing

AS/NZS

1170	Structural design actions	
1170.1	Part 1: Permanent, imposed and the other action	ns
1170.2	Part 2: Wind actions	

1170.3 Part 3: Snow and ice actions

CSIRO Low-rise domestic and similar framed structures

CSIRO BCE Report Notched composite beams, Dec. 97/169M, September 1997

1.3 OTHER METHODS

This Standard does not preclude the use of other methods of design, other assumptions or criteria for design or any other means of demonstrating satisfactory safety and serviceability performance in accordance with the requirements of the Building Code of Australia.

1.4 BASIS FOR DESIGN

1.4.1 General

The design criteria contained in this Standard are an interpretation of the AS/NZS 1170 series, AS 4055 and AS 1720.1. The criteria have been formulated for the preparation of generalized design data for residential buildings constructed using the conventional timber framing system described in AS 1684.2, AS 1684.3 and AS 1684.4. The design criteria are based upon the assumptions described in Clauses 1.4.2 to 1.4.11 below.

1.4.2 Geometric limitations

The following geometric limitations have been assumed:

- (a) The overall building width at any section, excluding eaves and lean-to verandahs but including verandahs under the main roof, does not exceed 16.0 m.
- (b) The roof pitch does not exceed 35° .
- (c) Roof shapes may be skillion or gable, hip or gable ended or any combination of these.
- (d) The number of trafficable floors supported by timber framing does not exceed two.
- (e) Wall height, measured from floor to ceiling, does not exceed 3.0 m. NOTE: For further details refer to AS 1684.2, AS 1684.3 and AS 1684.4.

1.4.3 Design methods

1.4.3.1 General

The design methods used shall be based upon analytical and engineering principles and comply with the requirements of AS 1720.1.

1.4.3.2 Capacity factor

Values of capacity factor (φ) shall generally be determined based on Category 1 applications in accordance with AS 1720.1 Table 2.1. Area affected shall typically be computed as area = span × load width × 2 and where this value exceeds 25 m², as may be the case for a primary roof support member, the application shall be considered Category 2.

NOTE: Where a member supports a significant point load, such as for a lintel supporting a girder roof truss, special consideration may be required in determining area affected.

1.4.4 System-based assumptions

The design criteria include many system-based assumptions, which recognize the interactions between structural elements and other elements of the overall construction system. These assumptions are based upon the methods of assembly and materials given in AS 1684.2, AS 1684.3 and AS 1684.4.

NOTE: The use of materials (both structural and non-structural) or installation methods other than those given in AS 1684.2, AS 1684.3 and AS 1684.4, may invalidate the system-based assumptions contained in this Standard.

1.4.5 Durability

The structural design criteria have been developed on the assumption that materials used and their installation and maintenance ensure that components will fulfil their intended structural function for the intended life of the structure.

NOTE: In the selection of materials, specific consideration should be given to the risk of and resistance to biological attack and corrosion, long-term durability of adhesives and the long-term strength and rigidity of materials taking into account the short-term and long-term conditions of exposure.

1.4.6 Structural timber

The design criteria are provided primarily for, but are not limited to, design using the generic stress grades and sizes of scantling timber as specified in AS 1684.2, AS 1684.3 and AS 1684.4.

NOTE: For other materials, where the application and performance are claimed to be consistent with AS 1684.2, AS 1684.3 and AS 1684.4, the design procedures and assumptions may require modification in accordance with the requirements of AS 1720.1.

1.4.7 Design properties

The design properties given in AS 1720.1, for generic stress grades and strength groups, have been used as the basis for the development of the design criteria given in this Standard.

1.4.8 Bearing and crushing

A check of bearing strength is indicated, where considered necessary, in the member design Sections of this Standard. Care should be taken to ensure that relevant checks are performed where large concentrated loads may cause crushing of members, such as may occur under the ends of girder trusses, or at the supports for members supporting such high point loads.

1.4.9 Structural design actions

1.4.9.1 Permanent (dead load)

Permanent actions are based upon standardized allowances for the mass of roof, wall and floor constructions.

NOTES:

- 1 Where actions arise as a result of non-standardized imposed dead loads (including permanent proportion of live loads) which may include, but not be limited to, cupboards suspended from walls and or ceilings, roof mounted hot water systems, heavy stone bench tops, safes, tiled waterproof decking systems etc., then specific allowance in design is made for these actions.
- 2 Where mass or load allowances are different from those referred in this Standard are used, then such variation should be noted in any published data.

1.4.9.2 Imposed (live load)

Generally, the imposed actions used for design correspond to those given in AS/NZS 1170.1. The following departures and interpretations have been used:

(a) The partial live load for the serviceability design of continuous span joists and bearers is taken as 0.75 kPa.

- (b) The permanent component of floor live load is taken as 0.5 kPa.
- (c) Balconies and decks 1 m or more above the ground, are designed for a 1.5 kPa floor live load for the serviceability limit state, as for balconies and decks less than 1 m above the ground.
- (d) For generic design, the concentrated load on primary ceiling support members, including ceiling joists, hanging beams and counter beams is taken as 1.4 kN regardless of cladding installation status and available headroom.

NOTES:

- 1 Live loads specific to construction, e.g. loads resulting from the use of fall protection devices or scaffolding attached to the structure, are not considered.
- 2 AS/NZS 1170.1 allows this load to be reduced to 0.9 kN for some defined design applications.

1.4.9.3 Wind

Wind actions for member design are derived from AS 4055 using wind classifications N1 to N4 and C1 to C3 and associated design wind pressures as specified in Appendix A. Pressure coefficients are determined from AS 4055 unless noted otherwise in the member design information. It is assumed that all of the cladding elements including windows, doors and garage doors are capable of resisting the design winds and comply with the relevant Australian standards. Wind actions for tie-down design are determined from AS 4055 and AS/NZS 1170.2.

1.4.9.4 Snow

Snow actions, determined in accordance with AS/NZS 1170.3, up to 0.2 kPa have been considered and determined as not critical. For this reason, snow actions are not included in the action combinations given for member design in this Standard.

1.4.9.5 Earthquake

AS 1170.4—2007 introduces a performance parameter K_pZ which is calculated using return period factor determined from the annual probability of exceedance and the hazard factor for the site. Domestic structures designed and detailed for lateral wind forces in conjunction with AS 1684 or AS 1720.1 with a $K_pZ \le 0.11$ do not require specific earthquake design. For this reason, earthquake actions are not included in the action combinations given for member design or considered necessary for the calculation of racking loads to be resisted by bracing.

1.4.9.6 Combinations of actions

Combinations of actions included for the determination of the strength limit states and the serviceability limit states for each member are those considered appropriate in accordance with AS/NZS 1170.1.

1.4.10 Strength limit states

For each member, all strength limit states have been considered; however, only those strength limit states deemed as potentially critical are included in the design criteria and are required to be assessed for the purposes of this Standard.

NOTE: For non-generic timber-based products, design may require consideration of strength limit states other than those included in this Standard.

1.4.11 Serviceability limit states

The serviceability limit states used for the design have been determined on the basis of experience with the known serviceability performance of individual member types in typical applications. Serviceability limits used are intended to provide satisfactory rigidity for average situations.

NOTES:

- 1 For installations where greater than usual rigidity may be required it is anticipated that larger sizes and or materials with higher or more uniform modulus of elasticity should be used (see AS 1720.1), e.g. granite kitchen benchtops, large ceramic floor tiles, island benches.
- 2 Consider the relative deformation of joists parallel and close to relatively rigid walls (either above or below the floor). Resultant localized differential deflection can cause cracking of rigid surface finishes and can cause high/narrow furniture to lean noticeably.
- 3 The serviceability limit states given are for individual elements. Where one element is supported by another, the cumulative deflection of the system of elements should be considered to prevent cracking of linings, cladding or glazing and to prevent result in load transfer to joinery items and consequent damage.
- 4 The limits on deflection used as part of the definition of the serviceability limit states are limits intended for comparison with calculated deflections only. Actual or measured deflections may differ from calculated deflections due to any or all of the following factors:
 - (a) Differences between actual loads and design loads used for serviceability calculations.
 - (b) Differences between the actual modulus of elasticity of components and the average value used for design.
 - (c) Differences between the structural behaviour of the system and the structural models used for design.

1.5 DEFINITIONS

For the purpose of this Standard, the following definitions apply.

1.5.1 Balcony

An external trafficable floor area of a house.

1.5.2 Birdsmouth

A triangular notch cut into the underside of a sloping beam (e.g. rafter) to permit seating on the supporting member.

1.5.3 Bracing

An assembly intended to resist racking forces including diagonal members, shear panels, diaphragms, cantilevered columns or portal (rigid) frames.

1.5.4 Cladding

Material used for the external surface of walls or roofs.

1.5.5 Deck

An external attached or detached trafficable floor area.

1.5.6 Flooring or decking

Boards or sheets overlying floor joists intended to support floor loads. Flooring is usually tongue and groove jointed along the edges whereas decking comprises individual non-connected boards.

1.5.7 Generic stress grades

Stress grades for which properties are included in AS 1720.1.