AS 1720.1—1997
(Incorporating Amendment Nos 1, 2, 3 and 4)

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Australian Standard®

Timber structures

Part 1: Design methods

STANDARDS Australia

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- The Association of Consulting Engineers Australia
- Australian Building Codes Board
- Building Research Association of New Zealand
- CSIRO Division of Building, Construction and Engineering
- Curtin University of Technology
- Monash University
- National Association of Forest Industries
- New Zealand Forest Research Institute
- New Zealand Timber Industry Federation
- New Zealand Timber Suppliers Group
- Pine Australia
- Plywood Association of Australia
- University of Technology, Sydney

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Timber structures

Part 1: Design methods

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee TM/1, Timber Structures, to supersede AS 1720.1—1988.

This Standard incorporates Amendment Nos 1 (July 1998), 2 (May 2000), 3 (May 2001) and 4 (November 2002). The changes required by the Amendments are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure, or part thereof affected.

This Standard is the result of a consensus among representatives on the Joint Committee to produce it as an Australian Standard.

The objective of this Standard is to provide designers and manufacturers of timber structures with limit state design methods, design data and testing procedures for such structures.

This Standard is a ‘soft conversion’ of the working stress design (WSD) version to the limit state design (LSD) format. The term ‘soft conversion’ implies that average similar design solutions would be obtained from WSD and LSD codes. This approach was taken to ensure a smooth transition from WSD format to the LSD format. Hence only essential changes have been made to facilitate this conversion, and the contents of the LSD code remain substantially the same as the WSD code. New clauses and appendices have been added and the existing text has been thoroughly revised and updated to accommodate the conversion to LSD format.

Differences from the 1988 edition include the following:

(a) Conversion from WSD to LSD.

(b) Requirements for design data and details on drawings (Clauses 1.6.2, 1.6.3).

(c) The properties assigned to each strength group and F-grade multiplied by a factor to reflect the change to LSD.

(d) Joint types introduced for shear and withdrawal loadings.

(e) In-plane bending for plywood.

(f) Glulam grades, including characteristic strengths and elastic moduli.

(g) New Section on structural laminated veneer lumber.

(h) Section properties for plywood diaphragms.

(i) Guidance on appropriate deflection limits for various applications.

(j) Clauses on beam and column design and on curved and tapered members.

(k) Design properties for monitored, in-grade tested material.

(l) An appendix detailing the method for the assignment of capacity factors.

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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SECTION 1 SCOPE AND GENERAL

1.1 SCOPE AND APPLICATION

1.1.1 Scope

This Standard sets out limit state design methods for the structural use of timber which are based on the principles of structural mechanics and on data established by research. The Standard is intended for use in the design or appraisal of structural elements or systems comprised of timber or wood products and of structures comprised substantially of timber. To this end, the Standard provides design data for sawn timber, laminated timber, timber in pole form, plywood, laminated veneer lumber and various types of fastenings. In addition, it provides methods of test for components or assemblies of unconventional design which may not be readily amenable to detailed analysis.

For ease of use, the simpler design situations are covered in the main body of the text. Related appendices, which form an integral part of the Standard, give acceptable procedures for detailed design situations.

1.1.2 Application

This Standard will be referenced in the Building Code of Australia by way of BCA Amendment 3 to be published by 1 July 1998, thereby superseding the previous edition, AS 1720.1—1988, which will be withdrawn 12 months from the date of publication of this edition.

1.2 REFERENCED DOCUMENTS

A list of documents referred to in this Standard is given in Appendix A.

1.3 NEW MATERIALS AND METHODS

This Standard shall not be interpreted to prevent the use of material or of methods of design or construction not specifically referred to herein. Methods of design can be based on analytical and engineering principles, or reliable test data, or both, that demonstrate the safety and serviceability of the resulting structure for the purpose intended. The classification of timbers into strength groups (see Clause 1.4) or their grouping for joint design (see Clause 4.1) shall not be interpreted as precluding the use of design data derived on the basis of authoritative research information for a particular timber product or grade of timber. Such research shall include consideration of both short-term and long-term strength and stiffness properties, durability of adhesives and applicability to this Standard of the data or test methods used.

Reports containing complete information on the basis for the use of any new materials or methods of design shall be made available.

NOTE: It usually will be necessary to seek approval from the relevant building authority or other appropriate regulatory authority for the use of other materials or methods.

1.4 TIMBER

1.4.1 General

All timber used in accordance with this Standard shall comply with the requirements of the appropriate Australian Standards, as follows:

(a) *Visually graded sawn timber* Visually graded sawn timber shall conform to the requirements of AS 2082 and AS 2858.

(b) *Mechanically graded timber* Mechanically graded timber shall conform to the requirements of AS 1748.

(c) *Proof graded timber* Proof graded timber shall conform to the requirements of AS 3519.

(d) *Structural plywood* Structural plywood shall conform to the requirements of AS/NZS 2269.

(e) *Laminated veneer lumber* Laminated veneer lumber shall conform to the requirements of AS/NZS 4357.

(f) *Glued laminated timber* Glued laminated timber shall conform to the requirements of AS/NZS 1328.

(g) *Round timber* Round timber shall conform to the requirements of AS 2209.

1.4.2 Identification

Structural timber used in conjunction with this Standard shall have its stress grade identified in accordance with the relevant Australian timber product Standard given in Clause 1.4.1.

For many purposes it may also be necessary to specify a particular species. When a particular species is specified the specification shall require that all pieces of timber be suitably identified as to species.

NOTES:

1 The design properties recommended in this Standard have been chosen on the assumption that structures of unseasoned timber that are allowed to dry will not receive their full design load until a period of air drying for at least 2 weeks has taken place. Freshly sawn timber which is unseasoned, or has recently been treated with waterborne chemicals, tends to have a reduced resistance and stiffness to sustained loads during the initial drying period. Under normal circumstances unseasoned timber will have had this drying period before being subjected to its full design load.

2 Usually, only a limited number of the timber species and stress grades listed in this Standard will be readily available at any particular place and time.

1.4.3 Change of grade

The strength properties of graded timber or timber products may alter as a consequence of subsequent processes such as longitudinal resawing, chemical treatments and redrying processes. Hence, it may be necessary to reassess strength properties to ensure that graded timber or timber products still satisfy design requirements after having been subjected to such processes.

1.4.4 Special provisions

Design loads for timber joints and design rules for notched beams given herein are based on the assumption that there are no loose knots, severe sloping grain, gum veins, gum or rot pockets, lyctus-susceptible sapwood, holes or splits in the vicinity of any fasteners or notch roots.

1.4.5 Treated timber

Timber, treated by impregnation with waterborne chemicals such as preservatives, is classified as unseasoned timber unless seasoning is specified.

NOTE: Where the material is reseasoned, regrading will normally be required.

1.5 GENERAL DESIGN CONSIDERATIONS

1.5.1 Loads

1.5.1.1 *General*

A structure and its structural elements shall be designed to resist the design action effect produced by—

(a) the design loads for strength, stability and serviceability limit states as specified in
A4 AS/NZS 1170.0; or

(b) such other design loads deemed to be acceptable for the limit state as appropriate to the intended end-use service conditions of a structure or its structural elements.

1.5.1.2 *Duration of load*

Duration of load effects needs to be considered in the determination of the critical combination of loads. For definition of duration of loading refer to Clause 1.8.2.12 and for further information Clause 2.4.1.

1.5.2 Design methods

1.5.2.1 *General*

A structure and its structural elements shall be designed to resist the design action effects produced by the design loads so as to satisfy the requirement for strength, stability and serviceability limit states.

1.5.2.2 *Strength limit state*

This limit state condition shall be deemed to be satisfied when the structural elements of a structure are proportioned so that their design capacities, (ϕR), equal or exceed the design load effects, S^*. For a given failure mode the strength limit state takes the general form—

$$(\phi R) \geq S^*$$

where

(ϕR) = design capacity of a structural element determined in accordance with the relevant Sections of this Standard. The general requirements are given in Section 2

S^* = design action effect, such as bending moments, axial loads and shear forces produced by the design loads for strength limit states.

NOTE: The design capacity, (ϕR), of a structural element is also referred to as the factored resistance of the structural element for a given failure mode.

1.5.2.3 *Stability limit state*

The structure as a whole (or any part of it) shall be designed to prevent instability due to overturning, uplift or sliding as follows:

(a) The design effect and the design resistance effect shall be determined in accordance
A4 with AS/NZS 1170.0.

(b) The whole or part of the structure shall be proportioned so that the design resistance effect is not less than the design action effect.

1.5.2.4 *Serviceability limit state*

The structure and its structural elements shall be designed to give satisfactory performance under the specified service conditions by controlling or limiting deflections, vibration and displacement of fasteners as follows:

(a) The load combinations for serviceability limit states shall, unless otherwise agreed,
A4 be in accordance with AS/NZS 1170.0.

(b) Deflections due to design loads appropriate to the serviceability limit state shall be determined by elastic analysis methods.

1 The deflection limits for the serviceability limit state should be appropriate to the structure and its intended use, the nature of loading, the relationship between adjacent members and the effect on other elements supported.

2 Guidance on selection of deflection limits is given in Appendix B.

3 The determination of acceptable deflection limits is part of the design process performed by the design engineer.

4 The characteristic modulus of elasticity values given in this Standard are mean values only and accordingly deflection of individual members subjected to the design loads may vary both above and below the calculated estimate. Where deflection must not exceed a specific allowance then it is suggested that lower fifth percentile estimates of modulus of elasticity should be obtained and used.

A procedure for estimating lower fifth percentile values of modulus of elasticity is given in Appendix B.

(c) Where required, structures shall be designed to ensure that the vibration induced by machinery, or vehicular or pedestrian traffic does not adversely affect the serviceability of the structure.

5 Where there is likelihood of a structure being subjected to vibration effects, measures should be taken to minimize any dynamic behaviour so as to prevent possible discomfort or alarm, damage to the structure, or interference with its proper function.

6 AS 2670 gives guidance to the evaluation of human exposure to whole-body vibrations of the type likely to be transmitted by structures.

(d) Where required, the displacement associated with various types of fasteners shall be assessed in accordance with the methods given in Appendix C.

1.5.2.5 *Experimentally based design*

Where a structure or a structural element is demonstrated by the full-scale tests specified in Appendix D to satisfy requirements for strength, deformation, stability and serviceability, the corresponding design requirements of this Standard shall also be deemed to have been satisfied. Other design considerations will still be required to be met.

1.5.3 Timber dimensions for engineering calculations

All engineering calculations shall be based on the actual cross-section. Such calculations shall not be based on the nominal cross-section.

NOTE: Nominal cross-section is sometimes referred to as 'called' cross-section.

1.5.4 Other design considerations

1.5.4.1 *Buckling restraints*

Where there may be some doubt as to the effectiveness of buckling restraints, appropriate computations, such as those indicated in Appendix E, shall be made to check the stiffness and strength of the restraints.