Forest&Wood Products Australia

MARKET KNOWLEDGE & DEVELOPMENT

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Interim Industry Standard Recycled Timber – Visually Stress Graded Recycled Timber for Structural Purposes

This standard can also be viewed on the FWPA website

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Market Knowledge and Development

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Interim Industry Standard

Recycled Timber – Visually Stress Graded Recycled Timber for Structural Purposes

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Preface

This Interim Industry Standard was prepared under a project supported by Forest and Wood Products Australia and Department of Tourism, Regional Development & Infrastructure - Qld, with input and development from stakeholders, including industry associations, representatives of the recycled timber industry, government, researchers and specifiers.

The objective of this Interim Standard is to provide recycled timber manufacturers, suppliers and users with requirements for visually grading recycled hardwood timber intended for structural use. The Standard is an Interim Standard, as this is the first time visual grading rules have been developed specifically for recycled structural timber in Australia. It is intended that after a period of application and use, the Interim Standard will be reviewed and amended and then will be submitted to Standards Australia for consideration for development as a formal Australian Standard.

Specifiers and purchasers of recycled timber should be aware of the following key points and considerations prior to specifying or ordering recycled timber:–

a) Recycled timber is sourced from a disparate range of buildings, structures and products from a wide geographical area and from a wide range of environmental exposures. The resulting products obtainable from recycled timber will therefore reflect previous use, and availability of individual species/species mixes, grades and products may change with time.

b) Detailed discussions between purchasers and suppliers prior to specifying or ordering recycled timber is the key to a successful commercial transaction

c) Where practical, prior inspection should be undertaken of a realistic representative sample of recycled timber product and that the grade/quality is agreed upon in writing between purchaser and supplier. The use of actual samples, electronic images etc, where available, may assist in facilitating satisfactory placement and delivery of the order.

d) It should be noted that the grades available under this standard are specific to recycled timber and include recycled timber features.

In respect of the application of this Standard, statements expressed in mandatory terms in notes to tables or diagrams 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 this Standard, whereas an ‘informative’ appendix is only for information and guidance.

Contents

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SECTION 1

Scope and general

1.1 SCOPE

This industry standard (referred to hereafter as Standard) applies to recycled hardwood timber only and sets out the minimum requirements for structural visual grading. Recycled timber is timber that has been previously used and served its initial purpose. Recycled timber may be recovered from use for re-use either in its original cross-sectional size or re-manufactured to smaller dimensions. Whilst this document is specific to hardwood, some guidance on the use of recycled softwood is also provided in Appendix D.

This Standard covers:–

- small end-section timbers less than 0.012 m^2 (e.g. 200 mm x 50 mm) from
  - timber that has been sawn from larger members (e.g. girders, power poles)
  - structural timber recovered from previous use (e.g. floor joists, roof framing)
- large end-section members greater than 0.012 m^2 (e.g. 300 mm x 300 mm) in cross-section that have been recovered from previous use (e.g. girders) or have been sawn from larger members.

NOTE:

For lightly loaded (non-structural) large section recycled hardwood, refer to PN06.1039 – Recycled Timber – Visually Graded Recycled Decorative Products

1.2 APPLICATION

This Standard recognises that structural recycled hardwood will contain characteristics and be of dimensions that are included in AS 2082 and AS 3818, however recycled timber also contains characteristics that differ in nature from 'new' sawn timber covered by those two standards including age effects which need consideration. This Standard, while similar in many aspects to the 'new' sawn standards is to be used independently of them and is specifically for use with recycled timber only.

1.3 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

1604.1 Timber – Specifications for preservative treatment – Part 1: Sawn and round timber

1684 Residential timber framed construction

1720.1 Timber structures, Part 1: Design Methods

2082 Timber – Hardwood – Visually stress graded for structural purposes

3818.1 Timber – Heavy structural products – Visually graded – Part 1: General requirements

3818.7 Timber – Heavy structural products – Visually graded – Part 7: Large cross-section sawn hardwood engineering timbers

AS/NZS

1080.1 Timber – Methods of Test – Method 1: Moisture content

4491 Timber – Glossary of terms in timber related Standards

INDUSTRY STANDARDS

FWPA PN06.1039 – Recycled Timber – Visually Graded Recycled Decorative Products

1.4 DEFINITIONS

For the purpose of this Standard, the definitions given in AS/NZS 4491 and those in Appendix A apply. Where the definitions in Appendix A differ from those in AS/NZS 4491, for the purposes of this Standard those in Appendix A apply.

1.5 TIMBER SPECIES

1.5.1 General

A list of species covered by this Standard together with properties including species group, durability class and Lyctid susceptibility is given by standard trade name in Appendix B.

If timbers are supplied as a mixture of species then the species group applicable to the species group with the lesser properties shall apply to the whole parcel in respect of its properties.

1.5.2 Ordering

The order shall nominate one of the following:

(a) Grade and species.

(b) Grade together with species group or durability class, or both.

If no species is nominated, any species listed in Appendix B shall be accepted, provided any specified species group or durability class, or both, are met.

1.6 VISUAL GRADES AND DESIGN PROPERTIES

Two recycled visual grades, Recycled Grade 1 and Recycled Grade 2 are given for both small end-section and for large end-section recycled timber.

The strength properties, stiffness and effect of duration of load effects for recycled timber differ from 'new' timber therefore, the stress grade system ('F' ratings) that is applicable to 'new' timber is not appropriate to recycled timber.

Recommended characteristic strength & stiffness for recycled timber are given in Appendix D.

NOTES:

1. Specific span tables for domestic construction for recycled timber using the appropriate properties, stiffness and duration of load effects as outlined in Appendix D may be developed in the future to provide for more efficient design.

2. Test results indicate that the stiffness of recycled timbers is not affected from previous usage or reduced to the same extent as strength properties. Guidance on the application of values of MoE is presented in Appendix D.

1.7 CLAIM OF COMPLIANCE

In any statement or claim of compliance with this Standard or reference to one of the grades described in this Standard is a claim of compliance with the general requirements, product requirements and grading requirements set out in this Standard for that specific grade and that the product is recycled.

NOTE:

Manufacturers making a statement of compliance with this Standard on a product, packaging, or promotional material related to that product are advised to ensure that such compliance is capable of being verified.

SECTION 2

Product requirements

2.1 SIZES AND TOLERANCES

2.1.1 General

Except as permitted by Clause 2.1.2, and where permitted characteristics, want, wane or hit and miss occurs, measured at any point in the length of a piece, recycled structural timber must meet the minimum dimensional requirements specified in the order, in terms of length, depth and width.

2.1.2 Dimensions and Squareness

Where small end-section timber has been re-sawn from larger end-section material, deviation of the actual dimensions of the timber from the specified dimensions by more than the following are not permitted:

(a) The length shall be not less than the specified length.

(b) For width and thickness, except where permitted want, wane or hit and miss occurs, measured at any point in the length of a piece –

(i) for unseasoned timber: ±3 mm;

(ii) for seasoned timber: +5, –0 mm;

(iii) for sized timber: as for Items (i) and (ii) with an additional requirement of a maximum 2 mm difference between all pieces within a parcel for the sized dimension of the timber; and

(iv) for dressed timber: +2, –0 mm of the specified finished size.

(c) The tolerance on squareness shall be ±2 degrees, i.e. the angle at the arrises shall be 90 ±2 degrees.

NOTE:

When structural timber is supplied as dressed, the nominal size may be reduced due to the process of dressing to a 'finished dimension' or 'finished size'. Design calculations should be based on the finished dimension.

Where:–

a) small end-section timber has been recovered from previous use and is to be re-used in its original size and

b) for large end-section members,

The dimensional requirements specified in the order shall be a matter of agreement between the purchaser and supplier.

2.2 BOW, SPRING, TWIST AND CUP

For small end-section timbers the permitted limits for bow, spring and twist are provided in Table 3.1.3a and Table 3.1.3b and cup in Table 3.1.2 in Section 3 and the method of measurement is provided in Appendix C.

For large end-section members bow and spring shall be evenly distributed and shall not exceed 25 mm per 3.6 m length of the piece or equivalent curvature in other lengths and twist shall be a matter of agreement between the purchaser and supplier.

2.3 MOISTURE CONTENT

2.3.1 Small end-section timber

Where seasoned timber is specified for small end-section timber, at least 90 percent of the pieces being graded shall have a moisture content of not more than 15 percent and no piece shall have a moisture content greater than 18 percent. The moisture content of the timber shall be determined in accordance with AS/NZS 1080.1.

NOTE:

The requirements of State timber marketing acts (QLD and NSW) may be more stringent than those in this Standard.

2.3.2 Large end-section timber

The moisture content in large cross-section members may be variable due to past history and whether any re-sawing has taken place. This Standard does not impose any specific moisture content requirements on these members however moisture content may need to be considered in determination of serviceability performance. From a utility perspective, moisture content needs to be considered as in-service stability may be affected and more pronounced checking may occur depending on the member supplied.

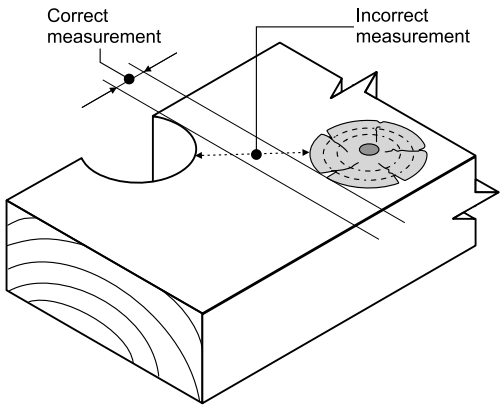
2.4 CHARACTERISTICS AND APPEARANCE

2.4.1 Measurement of characteristics

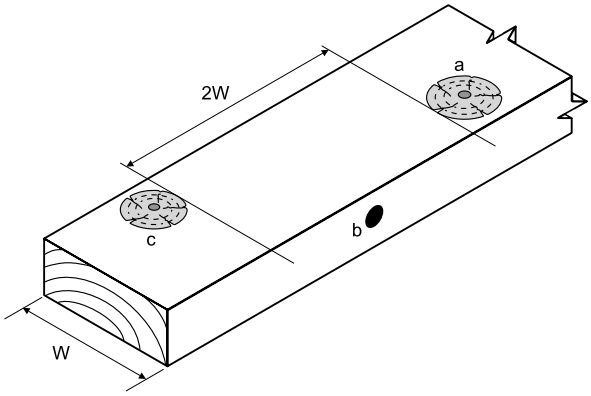
The measurement of characteristics shall be as given in Appendix C.

2.4.2 Combination of characteristics

A combination of characteristics shall be permitted if the aggregate size of the combination is less than that of one characteristic of the maximum permissible size. A combination exists when two or more characteristics occur in a length of the piece such that there is less than twice the width of the piece between them (see Figure 2.1). Characteristics in combination may not necessarily appear on the same surface. If bow, spring, twist or cup is present in the piece each shall be measured separately and deemed not to be in combination with each other or with any other characteristic.



(a) Method of measurement of distance between



(b) Examples of combinations.

NOTES:

1. In diagram (b), c and b are in combination; a and b are in combination and a and c are not in combination

2. Given that knot 'a' is 90% of its allowance, bolt hole 'b' is 15% of its allowance and knot 'c' is 85% of its allowance, the combination of 'b' and 'c' complies but the combination 'a' and 'b' do not.

Figure 2.1 Measurement of distances between features.

2.4.3 Characteristics occurring entirely within the prescribed limits for want and wane excepting bolt holes and notches

Irrespective of the limits imposed by the grade descriptions, a characteristic or combination of characteristics occurring wholly within the limits prescribed for want and wane, and resulting in no greater reduction in effective dimension, shall be permitted.

2.4.4 Surface Finish

When graded recycled structural timber is used, the surface finish may be:—

1. as is, in its recovered state
2. a remanufactured surface (e.g. ground, wire brushed, sawn or planed)

In many instances the recycled structural timber will be in appearance applications. No specific constraints other than the grading rules apply to recycled structural timber used in appearance applications. However mechanical damage (refer clause 2.4.5) is not permitted in appearance products. The surface finish shall be a matter of agreement between purchaser and supplier.

2.4.5 Mechanical damage

Damage caused by hooks, ropes, forklifts and the like shall be permitted in non-appearance applications, provided that its effect is no more serious than that of a permissible characteristic. Particular attention should be given to any splitting or notch effects resulting from mechanical damage.

2.4.6 Residual Fixings

Unless otherwise agreed between the purchaser and supplier, recycled timber shall be supplied relatively free of nails, screws, bolts, brackets or similar fixings.

NOTE:

It may not be practical or possible to detect and remove 100% of all fixings that can occur in recycled timber and indeed, some purchasers may deem retention of some residual fixings as a desirable feature.

2.5 GRADE LIMITATION AND GRADING

2.5.1 Basis

Grading to the recycled grades in this Standard is based on assessing the characteristic or group of characteristics within a piece, which is considered to have the greatest limiting effect on the grade of that piece, when assessed in accordance with the grading rules. Each piece shall be inspected on all surfaces and the ends.

2.5.2 Limitations

The grade descriptions in Section 3 provide limitations on all characteristics known to have a significant effect on strength and describe material on the lower limit of that grade. Each parcel of small end-section timber used in structural applications shall contain a range of material such that not all of the material is near the lower limits of the grade.

2.5.3 Variations in assessment

Within any parcel a maximum variation of 5 percent between the grading of pieces by individual inspectors or graders shall be acceptable, provided that none of the pieces in the disputed 5 percent shall have characteristics that exceed the maximum allowed in the grade by more than 10 percent.

2.5.4 Re-sawing and dressing

If the cross-section of the piece of timber is reduced by longitudinal sawing or dressing after the initial assignment of a recycled grade, the original grading is nullified.

2.5.5 Docking of multiple lengths

When grading a piece of timber that is to be supplied as a multiple of a shorter ordered length it shall be graded as if it were in the shorter length.

2.5.6 Moisture content of preservative treated timber

Where timber is seasoned and subsequently preservative treated, the preservative treatment process may increase the moisture content of timber considerably. Unless such timber is re-dried (low temperature) to the moisture content range for seasoned timber it does not conform to the requirements of this Standard for seasoned timber.

2.5.7 Grading check

A check of the grading of the timber may be required some time after the grading undertaken by the producer or supplier. Where the purpose of the check is to estimate the accuracy of the previous grading, reasonable allowance shall be made for changes in characteristics of the timber that are the result of moisture change. These changes in characteristics may include but are not limited to:–

(a) reduction in dimensions (shrinkage);

(b) increase in distortion (bow, spring, twist and cup);

(c) increase in, or development of, seasoning checks, splits, end splits and shakes; and

(d) increase in, or development of, loose gum veins.

2.6 SAPWOOD SUSCEPTIBLE TO LYCTID BORERS

The method for detection of Lyctid-susceptible sapwood shall be as given in AS 1604.

NOTE:

Refer to Appendix A for the susceptibility of species and note that some states (Qld and NSW) limit the sale and use of Lyctid-susceptible timber.

2.7 PRESERVATIVE TREATMENT

When structural timber graded in accordance with this Standard is preservative treated, treatment shall be in accordance with AS 1604.1.

NOTE:

Generally, only the sapwood of hardwoods can be impregnated with preservative.

2.8 IDENTIFICATION

Where a parcel or member is graded as complying with this Standard, the following details shall be clearly stated on the invoice:–

(a) The name of this Standard

(b) The grade

(c) The species or that mixed species have been supplied

(d) The durability class if applicable

(e) If graded as seasoned, the word ‘SEASONED’ or the abbreviation ‘S’

(f) If preservative treated, additional branding in accordance with AS 1604.1.

Alternatively, if the timber is branded, labelled, stamped or marked to indicate that it complies with this Standard, the information in (a) to (f) shall be legibly marked on each piece.

SECTION 3

Grade descriptions

3.1 SMALL END-SECTION RECYCLED GRADE 1 AND 2

3.1.1 General

Timbers supplied to Recycled Grades 1 and 2 shall comply with the general requirements of Section 1 and the product requirements specified in Section 2 of this Standard, and shall be free from shakes, enclosed termite galleries and brashness.

3.1.2 Permissible characteristics

Type of characteristic	SMALL END-SECTION RECYCLED GRADE 1	SMALL END-SECTION RECYCLED GRADE 2
Knots, included branch stubs, knot holes and holes other than insect holes		
	Not exceeding 1/4 W on face or 1/4 W on edge	Not exceeding 3/8 W on face or 3/8 T on edge
Borer holes not associated with decay		
Diameter up to and including 3 mm	Not exceeding 20 holes per 100 x 100 mm	Unlimited, provided the distance between holes is at least 2x their diameter
Diameter over 3 mm or where separated by less than 2 x diameter	As for knots	As for knots
Nail, screw, spike and bolt holes		
Diameter up to and including 4 mm	Unlimited	Unlimited
Diameter exceeding 4 mm & not exceeding 10 mm	5 holes in any 1.0 m of the length	5 holes in any 1.0 m of the length
Diameter exceeding 10 mm & not exceeding 20 mm	4 holes in any 1.0 m of the length, only in the permitted zone shown in Figure 3.1 if separated by 3 x diameter	4 holes in any 1.0 m of the length, only in the permitted zone shown in Figure 3.1 if separated by 3 x diameter
Diameter greater than 20 mm	4 holes in any 1.0 m of the length not exceeding 1/4 W on face are permitted only in the permitted zone, as shown in Figure 3.1 if separated by 5 x diameter	4 holes in any 1.0 m of the length not exceeding 3/8 W on face are permitted only in the permitted zone, as shown in Figure 3.1 if separated by 5 x diameter
Notches		
On the face	As for bolt holes	As for bolt holes
On the edge	Not permitted unless they have been removed by planing or machining with a gradual slope not exceeding the slope of grain and want and wane requirements of this grade. (see Figure 3.2)	Not permitted unless they have been removed by planing or machining with a gradual slope not exceeding the slope of grain and want and wane requirements of this grade. (see Figure 3.2)
Termite galleries		
	Enclosed not permitted Not enclosed – as for want and wane	Enclosed not permitted Not enclosed – as for want and wane
Slope of grain		
	Jarrah not exceeding 1 in 8, All other species not exceeding 1 in 10	All species (including Jarrah) not exceeding 1 in 6
Sound heart and heart shakes		
For species marked with an * (asterisk) in Table B1	Permitted provided they do not exceed 1/9 of the cross-sectional area	Permitted provided they do not exceed 1/3 of the cross-sectional area
For all other species	Not permitted	Not permitted

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3.1.2 Permissible characteristics *continued*

Type of characteristic	SMALL END-SECTION RECYCLED GRADE 1	SMALL END-SECTION RECYCLED GRADE 2
Tight gum veins		
	Unlimited	Unlimited
Loose gum veins, ring shakes and included bark		
	Width not exceeding 3 mm Aggregate length not exceeding 1/6 L Extending from one surface to another – not permitted	Width not exceeding 3 mm Aggregate length not exceeding 1/3 L Extending from one surface to another – not permitted except where intersecting at ends, where the characteristics is considered as a split
Gum pockets, latex pockets ,and overgrowth of injury		
One surface to another and intersecting an end Otherwise:	As for end splits	As for end splits
Individual length and width (measured radially)	Not exceeding lesser of 3W and 300 mm	Not exceeding lesser of 3W and 300 mm
On one surface only	Not exceeding lesser of 20 mm and 33% of the surface on which it occurs	Not exceeding lesser of 30 mm and 50% of the surface on which it occurs
Extending from one surface to another	Not exceeding lesser of 12 mm and 25% of the surface on which it occurs	Not exceeding lesser of 25 mm and 33% of the surface on which it occurs
End splits, aggregate length		
	Not exceeding lesser of W and 100 mm	Not exceeding lesser of 1.5W and 150 mm
Checks other than internal		
	Width not exceeding 3 mm and individual length not exceeding 1/3L	Width not exceeding 3 mm and individual length not exceeding 1/2L
Internal check		
Loss of cross-section area	Not exceeding 10%	Not exceeding 10%
Primary rot		
Depth	not exceeding 3 mm	not exceeding 3 mm
Aggregate area in any 2m of length	not exceeding 150 x 100 mm	not exceeding 150 x 100 mm
Want, wane and Lyctid-susceptible sapwood		
	Not exceeding 1/5 of the cross-sectional area and not exceeding 1/2 W on face or 1/3 T on edge	Not exceeding 1/5 of the cross-sectional area and not exceeding W/2 on face or 1/3 T on edge
Hit and miss		
Exceeding the limits for want and wane	Depth not exceeding 3 mm and individual length not exceeding 600 mm	Depth not exceeding 3 mm and individual length not exceeding 600 mm
Hit and miss within the limits of want and wane is permitted		
Bow, spring and twist		
	As defined in Section 3.1.3	As defined in Section 3.1.3
Cup		
	1 mm per 50 mm of W	1 mm per 50 mm of W

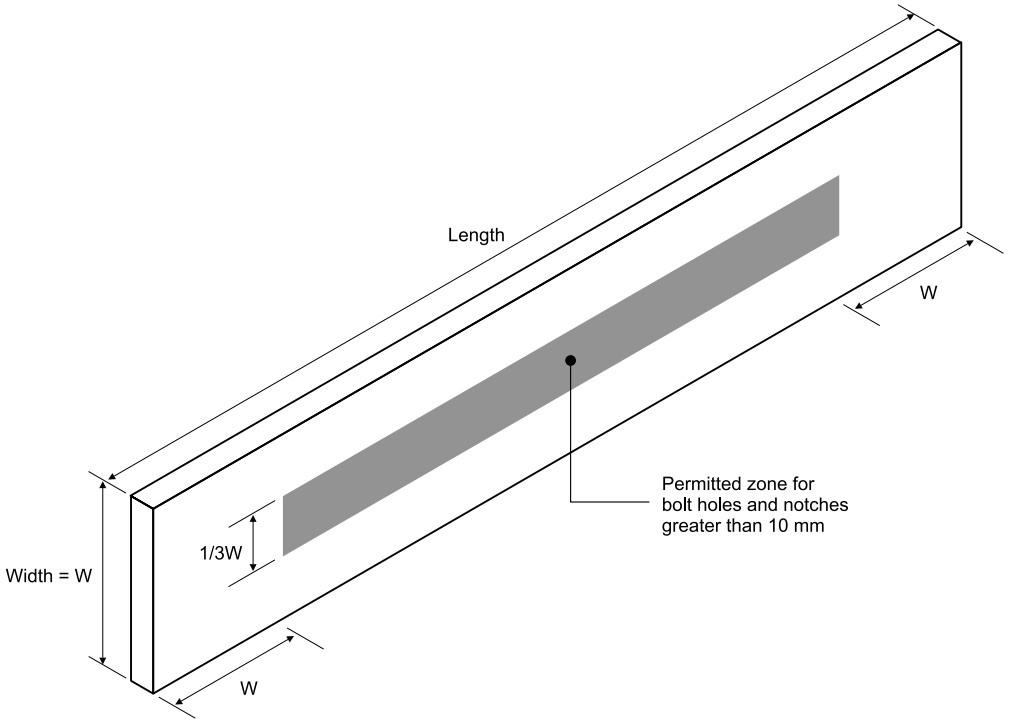
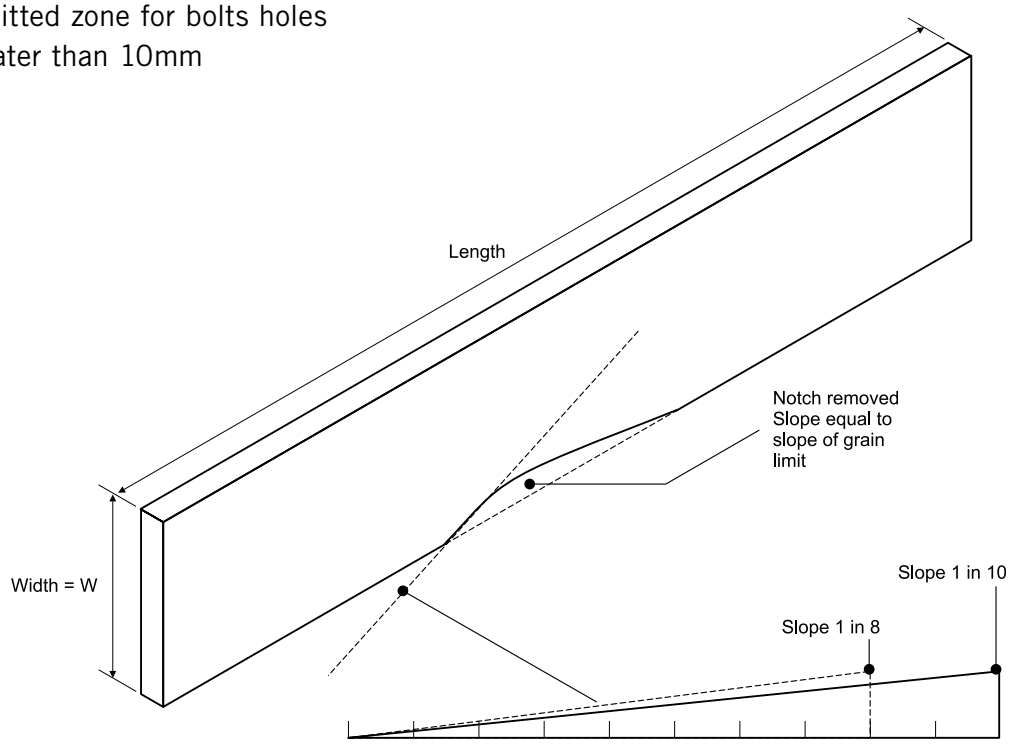


Figure 3.1 Permitted zone for bolts holes and notches greater than 10mm



NOTE:

Example shown is for small end section Recycled Grade 1 (1:8 for jarrah and 1:10 for other species)

Figure 3.2 Planing or machining to remove notches or holes on

3.1.3 Bow, Spring and Twist

Limits for Bow, Spring and Twist are given in Tables 3.1.3a and 3.1.3b, below.

TABLE 3.1.3a MAXIMUM PERMISSIBLE BOW AND SPRING

Length	Maximum permissible spring or bow, d mm									
(L)	Width W (for spring) or thickness T (for bow), mm									
M	38	50	75	100	125	150	175	200	225	250
1.8	10	10	7	5	4	3	3	3	2	2
2.4	20	15	12	9	7	6	5	4	4	4
3	35	25	19	14	11	9	8	7	6	6
3.6	50	35	25	20	16	13	12	10	9	8
4.2	60	45	28	25	22	18	16	14	12	11
4.8	70	50	30	30	29	24	21	18	16	14
5.4	75	55	40	40	36	30	26	23	20	18
6	80	60	45	45	45	37	30	28	25	22
6.6	85	65	50	45	45	45	39	34	30	27
7.2 and over	90	70	55	50	50	50	46	40	36	32

NOTE:

The permissible allowances for nominal lengths between those quoted in the table may be obtained by interpolation.

TABLE 3.1.3b TWIST

Nominal length (L) m	Nominal thickness (T) mm	Maximum Permissible Twist Nominal width (W), mm			
		Up to 100	101 to 150	151 to 200	201 to 250
up to 2.4	up to 50	5	7	10	15
	over 50 to 75	4	6	8	11
2.7 to 3.0	up to 50	7	10	14	20
	over 50 to 75	5	8	11	15
3.3 to 3.6	up to 50	8	13	18	25
	over 50 to 75	6	9	13	19
3.9 to 4.2	up to 50	9	15	51	29
	over 50 to 75	7	11	15	22
4.5 to 4.8	up to 50	10	16	23	33
	over 50 to 75	7	12	17	24
5.1 to 5.4	up to 50	11	18	26	37
	over 50 to 75	8	14	19	27
5.7 and over	up to 50	12	20	28	40
	over 50 to 75	9	15	21	30

NOTE:

The limitations on distortion have been governed by considerations of production and utilization within the constraints of the principles of structural adequacy.

3.2 LARGE END-SECTION RECYCLED GRADE 1 AND 2

3.2.1 General

Timbers supplied to Recycled Grades 1 & 2 shall comply with the general requirements of Section 1 and the product requirements specified in Section 2 of this Standard, and shall be free from shakes, cross fractures, enclosed termite galleries and brashness.

3.2.2 Permissible characteristics

Type of characteristic	LARGE END-SECTION RECYCLED GRADE 1	LARGE END-SECTION RECYCLED GRADE 2
Sound intergrown knots, individual and in aggregate		
	Not exceeding 1/6 W of the face and 1/4 T of the edge in any 2m of the length.	Not exceeding 1/4 of the width of surface on which they occur in any 2m of the length.
Holes (including nail, screw, spike and bolt holes)		
Diameter up to and including 4 mm	Unlimited	Unlimited
Diameter exceeding 4 mm & not exceeding 10 mm	5 holes in any 1.0 m of the length	5 holes in any 1.0 m of the length
Diameter exceeding 10 mm & not exceeding 20 mm	4 holes in any 1.0 m of the length, in permitted zone shown in Figure 3.1 if separated by 3 x diameter	4 holes in any 1.0 m of the length, in permitted zone shown in Figure 3.1 if separated by 3 x diameter
Diameter exceeding 20 mm	4 holes in any 1.0 m of the length not exceeding 1/4 W on face are permitted only in the permitted zone, as shown in Figure 3.1 if separated by 5 x diameter	4 holes in any 1.0 m of the length not exceeding 3/8 W on face are permitted only in the permitted zone, as shown in Figure 3.1 if separated by 5 x diameter
Termite galleries		
Enclosed galleries	not permitted	not permitted
Fully open to view	depth less than 25 mm and aggregate length not exceeding 1/4 L	depth less than 25 mm and aggregate length not exceeding 1/4 L
Slope of grain		
	Not exceeding 1 in 12	Not exceeding 1 in 10
Sound heart and heart shakes		
For species marked with an * (asterisk) in Table B1	Permitted provided they do not exceed 1/9 of the cross-sectional area	Permitted provided they do not exceed 1/3 of the cross-sectional area
For all other species:–		
BEAM APPLICATIONS Where the smallest cross-section dimension does not exceed 180 mm	permitted within the middle 1/3 of the intended in situ depth and within 30 mm of the intended in situ vertical surface (refer Figure 3.3)	permitted within the middle 1/3 of the intended in situ depth and within 30 mm of the intended in situ vertical surface (refer Figure 3.3)
BEAM APPLICATIONS Where the smallest cross-section dimension exceeds 180 mm	permitted within the middle 1/3 of the intended in situ depth	permitted within the middle 1/3 of the intended in situ depth
APPLICATIONS OTHER THAN BEAMS (e.g. columns) where either the smallest cross-section dimension does not exceed 180 mm	permitted within 30 mm of the intended in situ surfaces	permitted within 30 mm of the intended in situ surfaces

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3.2.2 Permissible characteristics *continued*

Type of characteristic	LARGE END-SECTION RECYCLED GRADE 1	LARGE END-SECTION RECYCLED GRADE 2
APPLICATIONS OTHER THAN BEAMS (e.g. columns) where either the smallest cross-section dimension exceeds 180 mm	unlimited	unlimited
Pipe and heart rot		
BEAM APPLICATIONS	not permitted	not within 75 mm of the intended in-situ upper or lower surface
APPLICATIONS OTHER THAN BEAMS	permitted within 30 mm of the intended in situ surfaces and not exceeding 40 mm dia.	permitted within 30 mm of the intended in situ surfaces and not exceeding 40 mm dia.

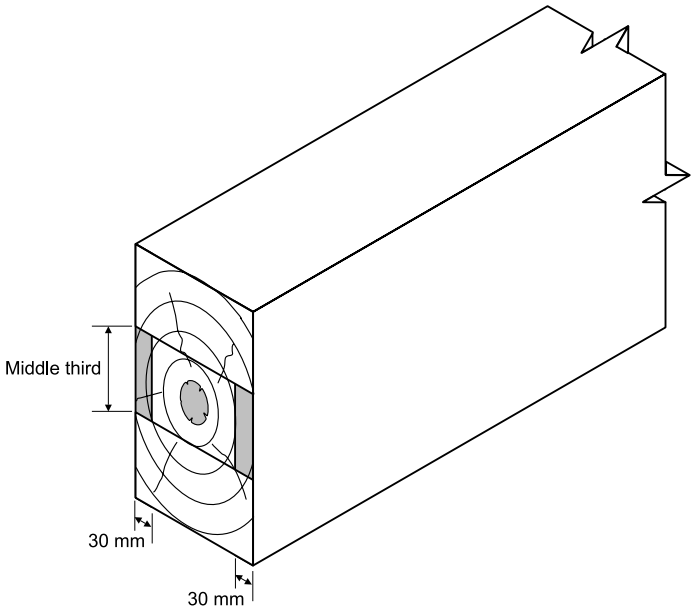

Figure 3.3 Areas where sound heart and heart shakes are permitted

Tight gum veins		
Length	Individually not exceeding 1/3 L and in aggregate, not exceeding L on any surface	Unlimited
Width	Not exceeding 4 mm, measured radially	Unlimited
Loose gum veins, gum pockets & overgrowth of injury		
Length	Individually not exceeding 300 mm and not exceeding 2 in any 2m of the length of the piece	Individually not exceeding 300 mm and not exceeding 2 in any 2m of the length of the piece
Confined to one surface	Not exceeding 20 mm in width	Not exceeding 20 mm in width
From one surface to another	Not exceeding 12 mm in width	Not exceeding 12 mm in width
Shelling-off		
	Permitted within the central third of the width and the central third of the length of the piece on the heart side (refer Fig. 3.4) Depth not exceeding 6 mm	Permitted within the central half of the width and the central half of the length of the piece on the heart side (refer Fig. 3.4) Depth not exceeding 12 mm

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3.2.2 Permissible characteristics *continued*

Type of characteristic	LARGE END-SECTION RECYCLED GRADE 1	LARGE END-SECTION RECYCLED GRADE 2
End splits		
	Not exceeding 6 mm in width and not exceeding the lesser of 200 mm and 3% of the length	Not exceeding 6 mm in width and not exceeding the lesser of 225 mm and 5% of the length
Checks		
	Not exceeding 6 mm in width and not exceeding 20 mm in depth	Not exceeding 6 mm in width and not exceeding 20 mm in depth
Want, wane and untreated sapwood, and notches and holes on edges that have been removed by planing or machining with a gradual slope not exceeding the slope of grain requirements for each grade. (see Figure 3.2) Separately or in combination		
	• not exceeding 1/10 of the cross-sectional area • not exceeding 1/3 T on the edge or 1/2 W on the face • not exceeding 25 mm deep and on one surface only	• not exceeding 1/5 of the cross-sectional area • not exceeding 1/3 T on the edge or 1/2 W on the face • not exceeding 25 mm deep and on one surface only
Bow, spring and twist		
	To be agreed between purchaser and seller	To be agreed between purchaser and seller
Notches		
BEAM APPLICATIONS	Notches are only permitted in the permitted zones indicated in Fig 3.5. The aggregate size of all notches in either the centre section and / or the beam ends shall be: Max depth: d_{notch} = 12 mm for a maximum length of: l_{notch} = 1/2 W	Notches are only permitted in the permitted zones indicated in Fig 3.5. The aggregate size of all notches in either the centre section and / or the beam ends shall be: Max depth: d_{notch} = 8 mm for a maximum length of: l_{notch} = 1/2 W
APPLICATIONS OTHER THAN BEAMS	Edge notches are permitted provided the depth of the notch does not exceed 10 mm in depth. The loss of timber due to notches at any cross-section shall not exceed 10% of the gross cross section of the member and shall not occur in combination with any other listed characteristic.	Edge notches are permitted provided the depth of the notch does not exceed 10 mm in depth. The loss of timber due to notches at any cross-section shall not exceed 10% of the gross cross section of the member and shall not occur in combination with any other listed characteristic

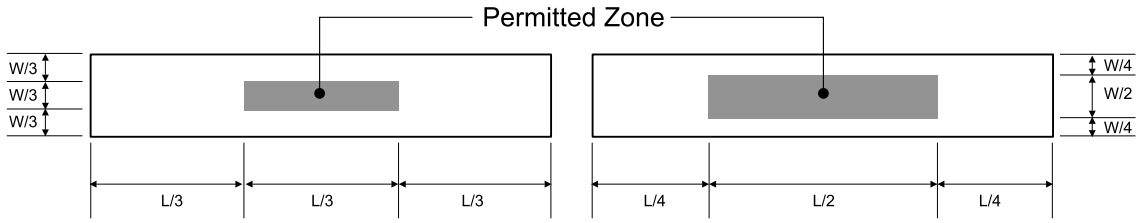


Figure 3.4 Permitted zones for "shelling off" RG1 (left) and RG2 (right)

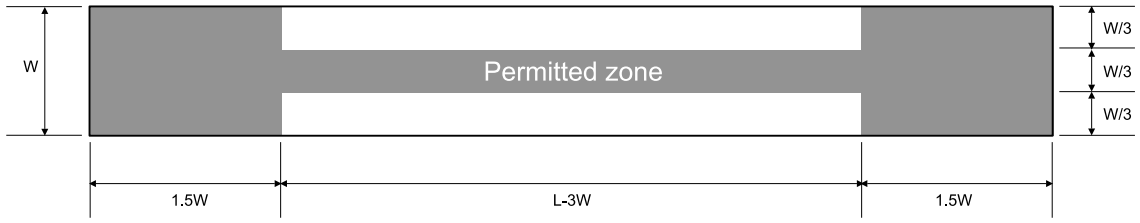


Figure 3.5 Permitted zones for notches in beams

Definitions (Normative)

Arris

The sharp intersection of two surfaces, e.g., the face and edge of a piece of timber (refer Figure A.1)

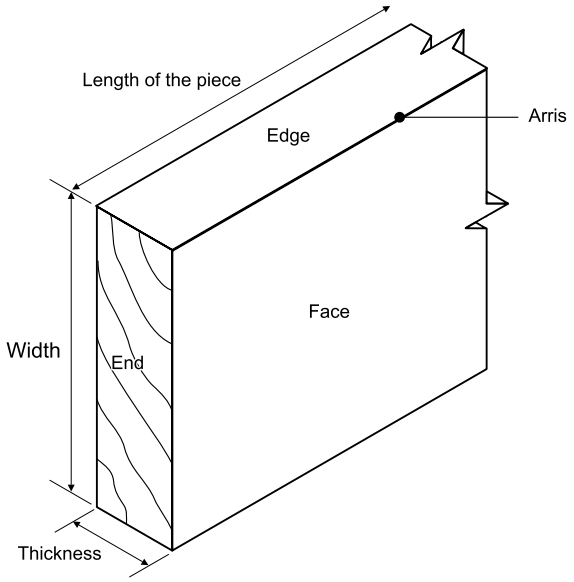


Figure A.1 Surfaces and Arris.

Bow

A deviation in the longitudinal direction of the piece causing the face to curve away from its intended flat plane (see Figure A.2).

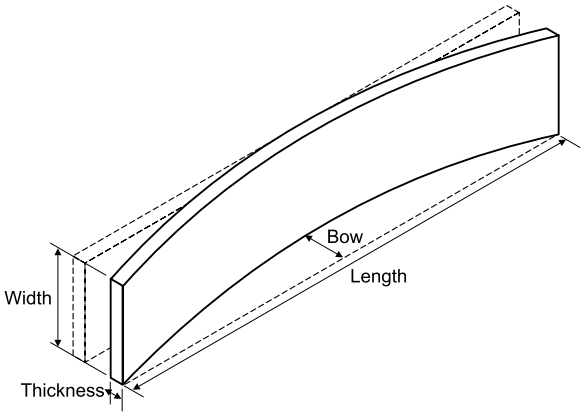


Figure A.2 Bow

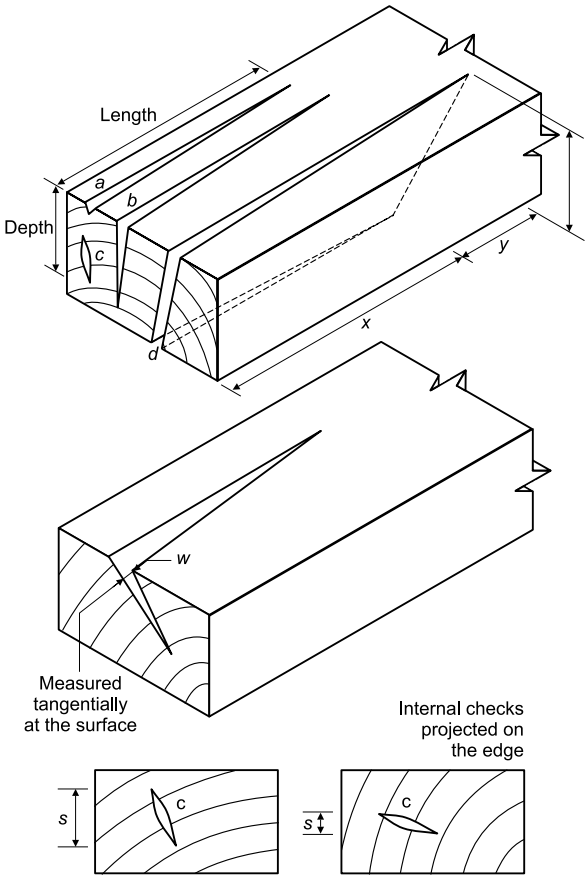
Check – longitudinal

Separation of fibres radially across growth rings and along the grain forming a fissure but not extending from one surface to another. Types include the following (see Figure A.3):

(a) **End check** – A check occurring at the end of a piece.

(b) **Heart check** – A check extending from the pith outwards in any direction but not reaching the surface of the piece.

(c) **Surface check** – A check confined mainly to the surface of the piece but of no appreciable depth, that is, depth not exceeding 10 percent of the thickness of the piece.



Legend: a=surface check, b=check, c=internal check, d=split, w=width of check measured tangentially, x=length of split, y=length of check, s=projected length.

Figure A.3 Longitudinal Checks

Decay
Decomposition of wood by fungi. Sometimes referred to as doze.

Fracture, cross
A fracture not in the direction of the fibres and resembling a breakage of the fibre.

Gum pocket
A cavity that contains or has contained gum or kino (see Figure A.4).

Gum vein
A ribbon of gum or kino between growth rings that may be bridged radially at short intervals by wood tissue (see Figure A.4).

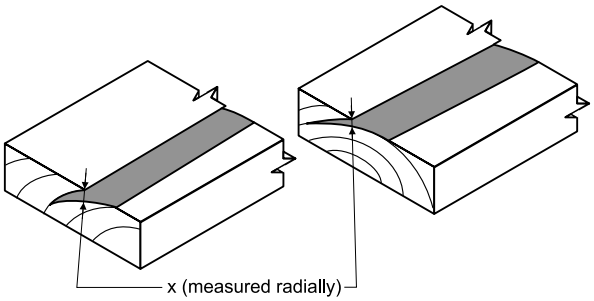


Figure A.4 Gum Pockets, Gum Veins, Bark Pockets, Overgrowths of Injury

Gum vein, loose
A gum vein associated with extensive discontinuity of wood tissue.

Gum vein, tight
A gum vein that is bridged radially at close intervals with woody tissue and not associated with extensive discontinuity of wood tissue.

Heart
The portion of a log that is near the growth centre (pith or log centre) and which is of reduced strength.(see figure A.5)

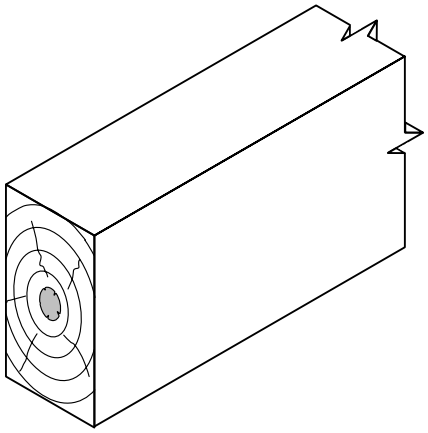


Figure A.5 Heart

Heartwood
Wood which in the living tree had ceased to contain living cells and in which the reserve materials (e.g., starch) had been removed or changed into more durable substances.

Hole
A hole extending partially or entirely through the piece and attributable to any cause as follows:

(a) **Borer hole** – A small hole in timber caused by the larval or adult stage of a wood boring insect, e.g., Lyctid, Anobiid, Bostrychid, Platypodid or Lymexylid.

(b) **Grub hole** – A hole or excavation usually larger than a borer hole made by the larval or adult stage of an insect, e.g., Cerambycid, Buprestid or Lepidoptera.

(c) **Pinhole** – Usually stained, made by a pinhole borer, i.e. Platypodid or Lymexylid.

(d) **Plugged hole** – A hole filled by inserting a matching piece of wood.

(e) **Termite hole** – See termite gallery.

(f) **Bolt Holes** – Mechanical damage in the form of a cylindrical hole, caused by removal of bolts that were inserted during a previous use of a piece of wood

Knot

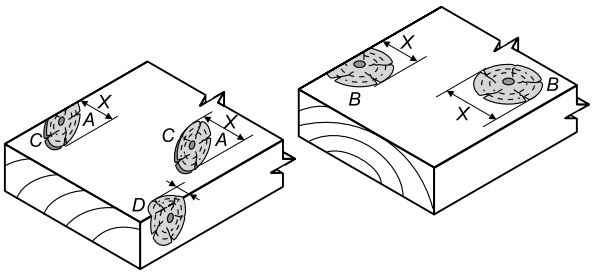
A section of a branch that is embedded in the wood of a tree trunk or of a larger branch (see Figure A.6. Knots are defined with respect to their position on a cross-section of a piece or by their appearance on a surface:

(a) **Defective knot** – A loose or unsound knot.

(b) **Loose knot** – A knot that is not held firmly in place by growth and which cannot be relied upon to remain in place in the piece.

(c) **Sound knot** – A knot solid across its face, as hard as the surrounding tissue and free from decay.

(d) **Unsound knot** – A knot more or less decayed and softer than the surrounding tissue; not solid across the face; checked or split.



A=oval knot, B=round knot, C=encasement, D=arris knot, X=size

Figure A.6 Knots in sawn timber.

Lyctid

The commonly used term in the timber and building industries for the lyctine beetles.

Notch

A loss of solid wood through the cross-section of a member usually in the shape of rectangular prism. Generally a notch represents a section of timber cut to form a connection, resulting from fabrication that occurred during previous history of a piece of wood.

Permitted Zone

The cross-sectional area in a piece of recycled timber, in which holes or notches are permitted, within the limits defined by this Standard

Pipe

A longitudinal cavity along the growth centre of round timber.

Rot, primary

Heart rot or a pocket of rot occurring in the living tree before felling.

Sapwood

The outer layers of the wood of a tree, which, when the tree was living, contained tissue in which water and food materials were conveyed and stored; generally lighter in colour than the heartwood (see Figure A.7).

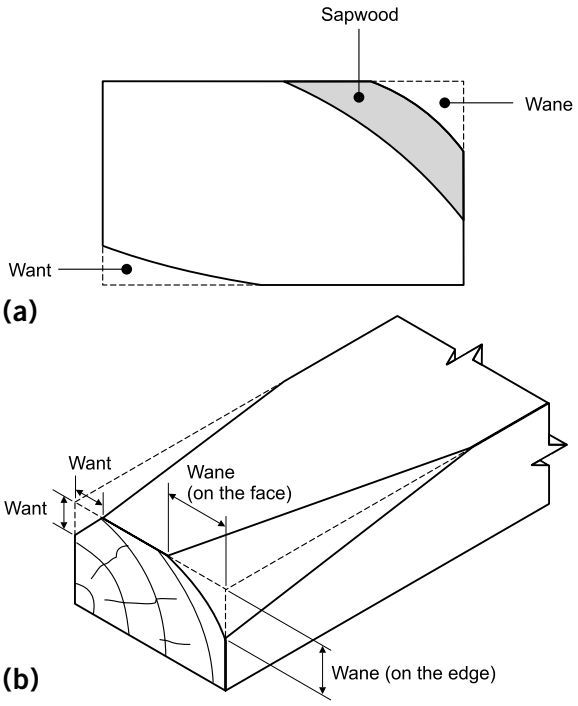


Figure A.7 Wane, want and sapwood

Shake
A partial or complete dislocation, breakage or longitudinal separation of wood fibres due to causes other than drying and usually originating either in the standing tree or in the log during felling or conversion as in the following:

(a) Heart shake – A shake extending from the pith of a tree (see Appendix C).

(b) Ring shake – A shake following a growth ring. Also referred to as a shell shake or cup shake and the timber may be described as shelly (see Appendix C).

(c) Star shake – A number of adjoining heart shakes in the form of a star.

Shell-off
Missing material resulting from a ring shake.

Species Group
A group assigned to species of timber as an indicator of it's basic strength classification.

Split
A longitudinal separation of wood fibres, which extends through a piece from one surface to another in sawn timber or through round timber.

Split, end
A split at the end of a log or piece.

Spring
A deviation in the longitudinal direction of the piece causing the edge to curve away from its intended flat plane (see Figure A.8).

Termite gallery
An irregularly shaped passage or burrow excavated by termites in the bark or wood. An enclosed termite gallery is one that is not completely open to visual inspection throughout its entire length.

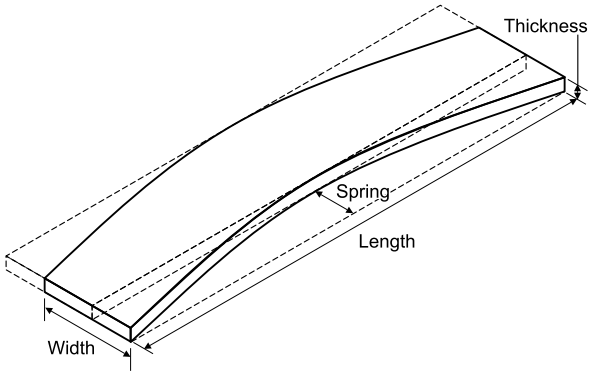


Figure A.8 Spring

Thickness (T)
The smaller dimension of the cross-section of a piece of timber (see Figure A.1).

Twist
A spiral distortion along the length of a piece of timber (see Figure A.9).

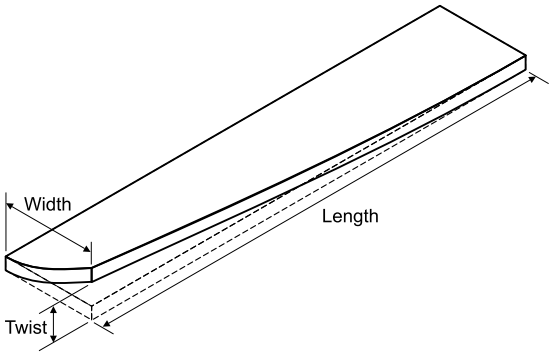


Figure A.9 Twist

Wane
The presence of the original underbark surface with or without bark, on any face or edge of a piece of timber (see Figure A.7).

Want
The absence of wood, other than wane, from the corner or surface of a piece of timber (see Figure A.7).

Width (W)
The larger dimension in the cross-section of a piece (see Figure A.1).

APPENDIX B

Species Properties (Normative)

Table B1 contains species that are appropriate for the visual grades given in the various Parts of this Standard. Suppliers and purchasers shall agree upon which species or species mixes are appropriate for their particular use. Properties are also given.

The standard common names used in the Table to refer to the timber species are as given in AS/NZS 1148.

The abbreviations used under Source in Table B1 are as follows:

N	New South Wales
NZ	New Zealand
Q	Queensland
S	South Australia
T	Tasmania
Ter	Northern Territory
V	Victoria
W	Western Australia

The species groups given are applicable to both seasoned and unseasoned timber and are specific to recycled timber only.

The joint groups are given with a 'J' prefix for unseasoned and a 'JD' prefix for seasoned and are as given in AS 1720.2. Refer to AS 1720.1 and Appendix D.

The codes for marking species are as given in AS 1720.2.

Natural durability and lyctid susceptibility (S = susceptible, NS = not susceptible) information is as given in AS 5604.

The density (kg/m^3)at 12%MC is as given in AS 1720.2.

Legend to Table B1

– no information available at publication

* species referred to in Clauses 3.1.2 and 3.2.2 as being marked with an * (asterisk) in Table B1

TABLE B1 Species Properties

Standard common name and Botanical Name(s)	Source	Species group	Joint group	Code for species mark	Durability Class		Lyctid Suscept-ibility	Density at 12%MC
					In-Ground	Above Ground		
ash, alpine Eucalyptus delegatensis	N, T, V	D	J3 JD3	AA	4	3	S	660
ash, Crow's Flindersia. australis	N, Q	B	–		1	1	S	940
ash, hickory F ifflaiana	Q	A	–	HA	2	1	S	980
ash, mountain Eucalyptus regnans	T, V	D	J2 JD2	MA	4	3	NS	670
ash, silvertop E. sieberi	N, T, V	C	J2 JD2	ST	3	2	NS	850
beefwood Grevillea striata	N, Q	C	–		2	–	S	–
*blackbutt Eucalyptus pilularis	N, Q	B	J2 JD2	BB	2	1	NS	880
blackbutt, New England E. andrewsii E. campanulata	N, Q	C	J2 JD2	NA	2	2	S	880
blackbutt, Western Australian E. patens	W	D	J2 JD2	BA	2	1	S	850
bloodwood, brown Corymbia trachyphloia	N, Q	C	–	BD	1	1	S	1020
bloodwood, red C. intermedia C. polycarpa C. gummifera	N, Q, V	C	–	RW	1	1	S	880
box, black Eucalyptus largiflorens	N, Q, S, V	C	–	BX	1	1	S	1100
*box, grey E. microcarpa E. moluccana E. woolsiana	N, Q, V	B	–	GB	1	1	S	1120
box, grey, coast E. bosistoana	N, V	B	J1 JD1	CB	1	1	S	1100
box, red E. polyanthemos	N, V	C	–	RX	1	1	S	1060
box, white E. albens	N, Q, V	B)	–	WX	2	1	NS	1100
box, white topped E. quadrangulata	N, Q	B	–	WT	2	2	NS	1020
box, yellow E. melliodora	N, Q, V	C	J1 JD1	YB	1	1	NS	1070
brush box Lophostemon confertus	N, Q	C	J2 JD2	BH	3	3	NS	900
Cadaga Eucalyptus. torelliana	Q	B	–	CG	2	–	S	910
Carbeen E. tesselaris	N, Q	A	–	CN	1	1	S	1090
Gidgee Acacia cambagei	N, Q, S, Ter	A	–	G	1	1	NS	1100

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TABLE B1 Species Properties *continued*

Standard common name and Botanical Name(s)	Source	Species group	Joint group	Code for species mark	Durability Class		Lyctid Suscept-ibility	Density at 12%MC
					In-Ground	Above Ground		
gum, blue, southern E. globulus	V, T	C	J2 JD2	BG	3	2	S	980
gum, blue, Sydney Eucalyptus. saligna	N, Q	C	J2 JD2	SY	3	2	S	850
gum, grey E. canaliculata E. punctata E. propinqua	N, Q	A	J1 JD1	GG	1	1	NS	1060
gum, grey, mountain E. cypellocarpa	N, V	C	J2 JD2	MT	3	2	S	860
gum, Maiden's E. maidenii	N, V	C	–	MG	3	2	S	860
gum, manna E. viminalis	N, S, T, V	C	J3 JD2	MN	4	3	S	770
gum, mountain E. dalrympleana	N, T, V	D	J3 JD3	MO	4	3	S	690
gum, poplar E. alba	Q, W, Y	B	–	PG	3	3	–	–
*gum, red, forest E. blakelyi E. tereticornis	N, Q, V	C	J1 JD1	FR	1	1	NS	960
gum, red, river E. camaldulensis	N, Q, V, S	D	J2 JD2	RR	2	1	S	910
gum, rose E. grandis	N, Q	C	J2 JD2	RO	3	2	NS	750
gum, salmon E. salmonophloia	W	C	–	SA	2	1	NS	1070
*gum, spotted Corymbia maculata C. citriodora C. henryi	N, Q, V	B	J1 JD1	SG	2	1	S	990
gum, yellow Eucalyptus. leucoxylon	S, V	D	–		2	2	S	1010
Ironbark, Caley's E. caleyi	N, Q	B	–		–	1	S	1100
*Ironbark, grey E. drepanophylla E. siderophloia E. paniculata	N, Q	A	J1 JD1	GI	1	1	NS	1090
Ironbark, gum-topped E. decorticans	Q	B	–		1	1	NS	1100
*Ironbark, red E. sideroxylon	N, Q, V	B	J1 JD1	RI	1	1	S	1090
*Ironbark, red, broad-leaved E. fibrosa	N, Q	A	J1 JD1	BI	1	1	NS	1070
*Ironbark, red, narrow-leaved E. crebra	N, Q	B	J1 JD1	NI	1	1	NS	1070
Ironbark, silver-leaved E. melanophloia	N, Q	B	–		1	1	NS	1080

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TABLE B1 Species Properties *continued*

Standard common name and Botanical Name(s)	Source	Species group	Joint group	Code for species mark	Durability Class		Lyctid Suscept-ibility	Density at 12%MC
					In-Ground	Above Ground		
ironwood, Cooktown Erythrophloeum chlorostachys	Q	A	–	IW	1	1	S	1100
jarrah Eucalyptus marginata	W	D	J2 JD2	J	2	2	S	820
karri E. diversicolor	W	C	J2 JD2	K	3	2	NS	900
mahogany, red E. pellita E. resinifera	N, Q	B	J1 JD1	RM	2	1	S	960
mahogany, southern E. botryoides	N, V	B	J2 JD2	SM	3	2	NS	910
mahogany, white E. acmenioides E. tenuipes E. umbra	N, Q	B	J1 JD1	WM	1	1	NS	960
marri E. calophylla	W	C	J2 JD2	ME	3	3	S	850
messmate E. obliqua	N, V, T	C	J3 JD3	MS	3	3	S	770
messmate, Gympie E. cleoziana	Q	B	–	GM	1	1	NS	990
penda, brown Xanthostemon chrysanthus	Q	B	–	PN	2	1	NS	1120
penda, red X. whitei	Q	B	J1 JD1	PD	2	1	NS	1060
peppermint, narrow-leaved Eucalyptus. australiana E. radiata E. robertsonii	N N, V N, V, T	D	J3 JD2	NL	3	3	S	780
peppermint, Queensland E. exserta †	Q	B	–		1	1	S	780
peppermint, white E. pulchella	V, T	D	–		3	–	S	780
rustyjacket E. peltata	Q	B	–		2	2	S	–
satinay Syncarpia hillii	Q	C	J2 JD2	S	2	1	NS	900
stringybark, blue-leaved Eucalyptus. agglomerata	N	B	–		3	3	NS	–
stringybark, brown E. capitellata	N, V, T	C	J2 JD2	BS	3	2	NS	850
stringybark, Darwin E. tetrodonta	Q, W, Ter	A	–		1	1	S	–
stringybark, red E. macrorhyncha	N, V, T	C	J2 JD2	RS	3	2	S	900
stringybark, silvertop E. laevopinea	N, Q	B	J3 JD2	SS	3	3	NS	–

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TABLE B1 Species Properties *continued*

Standard common name and Botanical Name(s)	Source	Species group	Joint group	Code for species mark	Durability Class		Lyctid Suscept-ibility	Density at 12%MC
					In-Ground	Above Ground		
stringybark, white E. eugenioides E. globoidea E. phaeotricha	N, Q, V	C	J2 JD2	WS	3	2	NS	850
stringybark, yellow E. muelleriana	N, Q, V	C	J2 JD2	YS	3	2	NS	880
tallowwood E. microcorys	N, Q	B	J1 JD2	TW	1	1	S	990
turpentine Syncarpia glomulifera	N, Q	C	J2 JD2	TP	2	1	NS	940
wandoo Eucalyptus. wandoo	W	B	J1 JD1	WG	1	1	NS	1100
wandoo, powderbark E. accedens	W	C	–	PW	1	1	NS	1100
woollybutt E. longifolia	N	C	–		1	1	S	1060
woollybutt, northern E. miniata	Q, W, Ter	B	–		2	–	S	–
yapunyah E. ochrophloia	N, Q	B	–		1	1	S	–

Measurement of Characteristics (Normative)

C.1 KNOTS IN SAWN TIMBER

These include the following:

(a) Sound knots and knot holes – The size shall be the width as measured between lines enclosing the knot or hole and parallel to the arrises of the piece (see Figure C.1).

(b) Arris knots – The size shall be the dimension of the knot that forms the lesser proportion of the surfaces on which it occurs, as measured between lines touching the boundaries of the knot on both surfaces and parallel to the arris that intersects the knot (see Figure C.1).

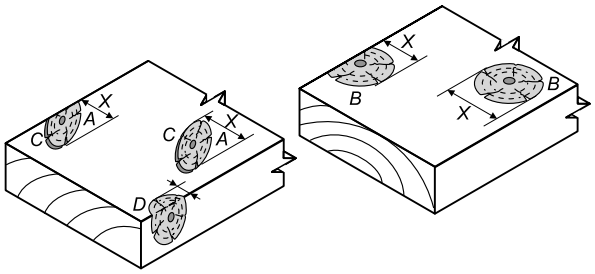
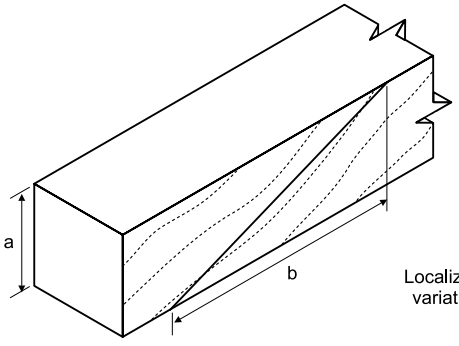


Figure C.1 Measurement of Knots in sawn timber

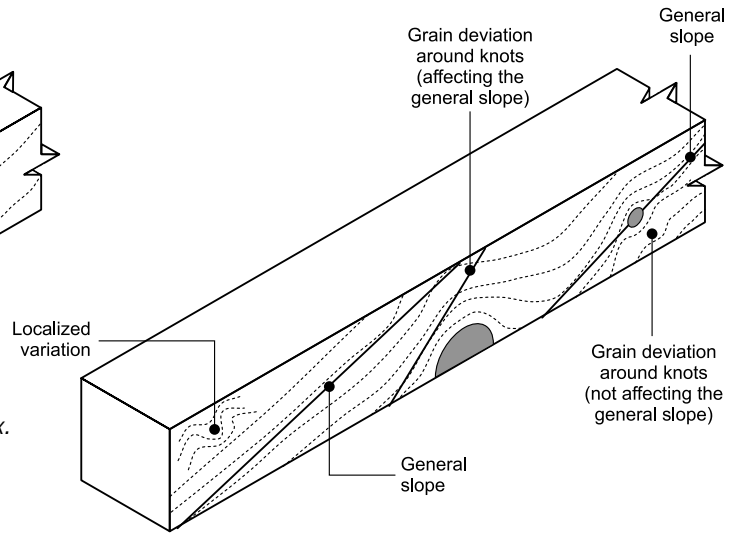
A=oval knot, B=round knot, C=encasement, D=arris knot, X=size.

C.2 SLOPE OF GRAIN

Slope of grain shall be determined by one of the methods described in AS/NZS 1080.2.1, AS/NZS 1080.2.2 or AS/NZS 1080.2.3, and shall be measured over a distance sufficient to determine the general slope. Localized variations, where the grain deviates over less than half the surface, may be disregarded. Grain deviation around knots shall be disregarded providing such deviation does not significantly affect the general slope within the piece (see Figure C.2).



(a) General slope of grain = a:b expressed 1 in x.



(b) Deviations around the knots and localized

Figure C.2 Measurement of slope of grain

C.3 GUM POCKETS, GUM VEINS, OVERGROWTHS OF INJURY AND PRIMARY ROT

The widths of gum pockets, gum veins, resin pockets, overgrowths of injury and primary rot shall be measured radially (see Figure C.3).

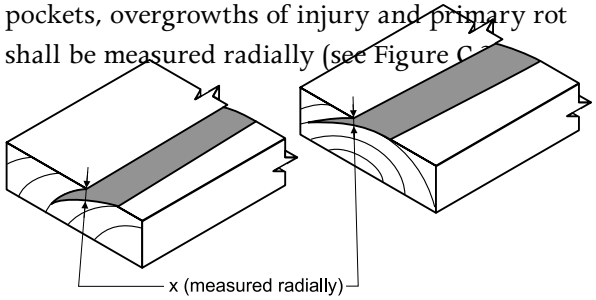


Figure C.3 Gum pockets, gum veins, bark

pockets, overgrowths of injury

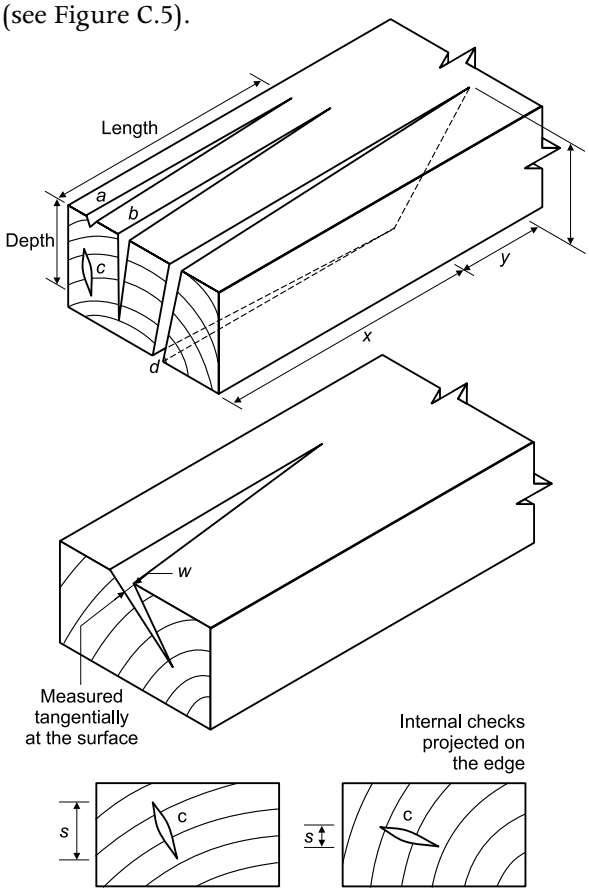
C.4 CHECKS

The measurement of checks shall be as follows (see Figure C.4):

(a) For checks other than internal checks, the width shall be measured tangentially at the surface at 90 degrees to the longitudinal direction of the check. The length shall be measured parallel to the arrises.

(b) For internal checks, the size shall be measured at their projected length s, on the thickness of the piece.

Checks are not to be confused with shakes (see Figure C.5).



Legend: a=surface check, b=check, c=internal check, d=split, w=width of check measured tangentially, x=length of split, y=length of check, s=projected length.

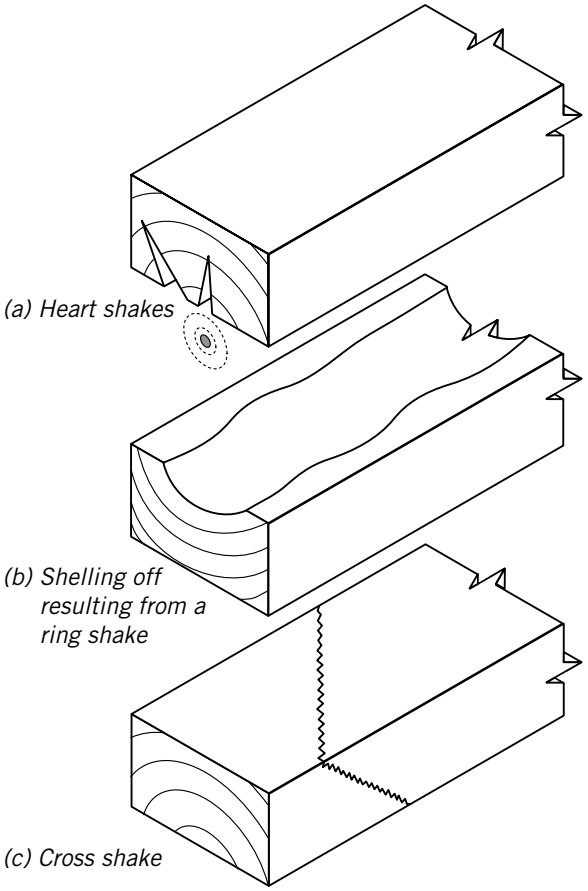


Figure C.4 Checks and splits

Figure C.5 Shakes

C.5 WANE, WANT AND LYCTID-SUSCEPTIBLE SAPWOOD

Wane, want and Lyctid-susceptible sapwood shall be measured as the amount by which the cross-section of the piece is deficient or is Lyctid-susceptible sapwood (see Figure 6).

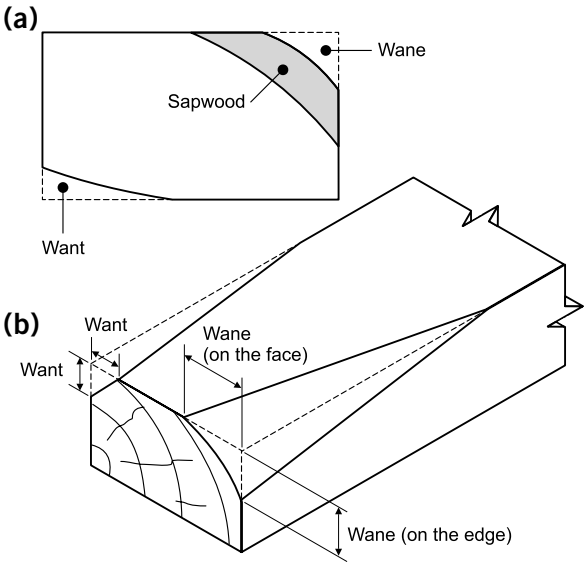


Figure C.6 Want, Wane and Sapwood

C.6 BOW AND SPRING

Bow and spring shall be measured as the maximum distance perpendicular to the surface of any point on the face (bow) or edge (spring) from a straight line joining the arris at one end to the same arris at the other end (see Figures C.7 and C.8). When a piece has a combination of at least two of bow, spring, twist and cup, care needs to be exercised to measure each separately.

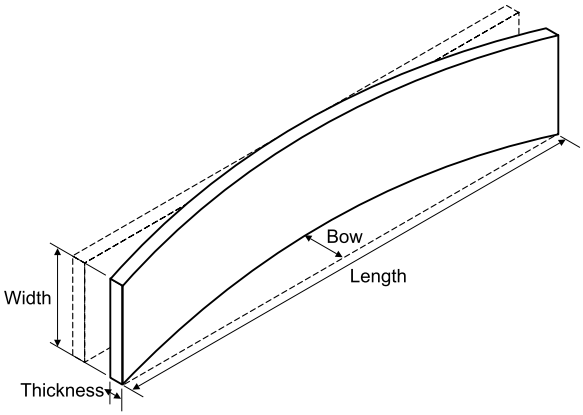


Figure C.7 Bow

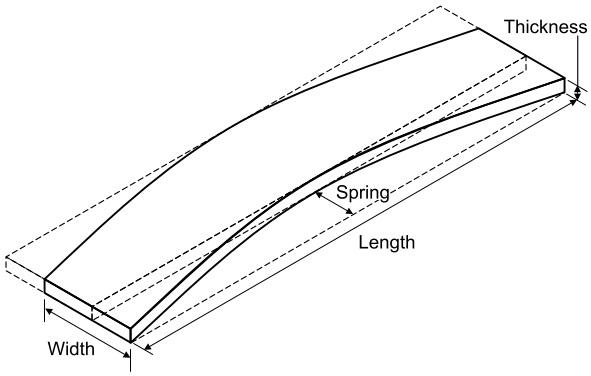


Figure C.8 Spring

C.7 TWIST

Twist shall be measured by placing the piece so that three of the corners of one face are in contact with a flat surface and measuring the perpendicular distance from the fourth corner to the flat surface (see Figure C.9).

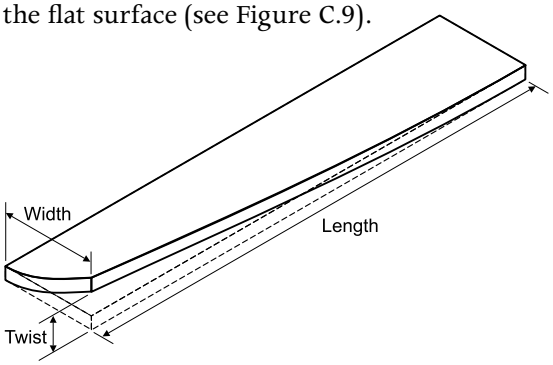


Figure C.9 Twist

C.8 CUP

Cup shall be measured on the concave surface as the maximum perpendicular distance of any point on the surface of the piece from a straight line joining the arrises of that surface (see Figure C.10).

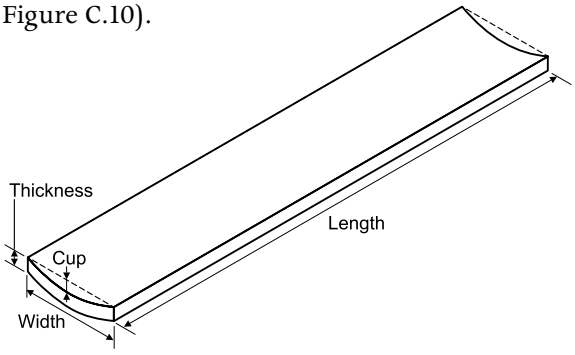


Figure C.10 Cup

APPENDIX D

Design Properties – Guidelines for Designers (Informative)

D.1 General Considerations

The general provisions for visual grading of hardwoods using this Standard have been developed to be reasonably consistent with the relevant Australian Standards for new sawn Hardwood timbers as described in AS 2082 and AS 3818 Part 1 and Part 7.

However, the fact that all recycled hardwoods have been subjected to previous use results in members that have a history of loading, have at times been subjected to weathering or degradation agents and often contain evidence of prior fabrication from notches, nail and bolt holes. All of these effects tend to create mechanical damage, which must be taken into account when using recycled timbers in structural applications.

In order to quantify these effects, particularly in regard to their influence on strength and stiffness properties, a comprehensive testing program was undertaken as a part of the research and development program that supports this Standard. Whilst details of this testing are reported elsewhere, a number of salient features are discussed below.

D.2 Strength and Stiffness

One of the important outcomes of the testing program was recognition that the traditional relationship between strength and stiffness inherent in the F-grade system, does not apply in the same way as for new timber.

Essentially, the strength reduction effect observed in testing means that if a piece of recycled timber is visually graded using AS 2082 or AS 3818, then the F grade for that piece is nominally two F-grades lower, than would apply for a 'new' piece of the same species and structural grade.

However, it is important to note, that the same reduction was not observed to apply for stiffness. This means that if a piece of timber is graded in accordance with the provisions of this Standard the stiffness, *E*, can be assumed to be that equivalent to 'new' timber.

Therefore, the characteristic strength, stiffness and other design considerations noted below for recycled structural timber do not align with the traditional 'F' grade properties given in AS 1720.1.

Table D1 provides recommended characteristic strength and stiffness for recycled hardwood timber graded in accordance with this Standard. Where recycled structural timber is proposed to be used in critical structural applications, designers and specifiers should consider specific structural or proof testing to satisfy themselves of the required characteristic strengths.

TABLE D.1 Recommended Characteristic Strengths and Stiffness for Recycled Hardwood Graded in accordance with this Standard

Species Group (Table B1)	Recycled Grade (Sect. 3)	Characteristic Strength, MPa				Short duration* modulus of elasticity parallel to the grain, MPa (E)	Short duration modulus of rigidity parallel to the grain, MPa (G)
		Bending *(f'b)*	Tension parallel to grain *(f't)*	Shear in beams *(f's)*	Compression Parallel to Grain *(f'c)*		
A	RG1	50	30	4.3	40	18 500	930
	RG2	40	25	3.7	30	16 000	800
B	RG1	40	25	3.7	30	16 000	800
	RG2	35	20	3.1	25	14 000	700
C	RG1	35	15	3.1	25	14 000	700
	RG2	25	12	2.5	20	12 000	610
D	RG1	25	12	2.5	20	12 000	610
	RG2	20	9.7	2.1	15	10 500	530

* Includes an allowance for shear deformation.

D.3 Duration of Load Effects

Designers using AS1720.1 are required to apply a duration of load factor (k_1) to account for the fibre damage and consequent loss of strength that occurs from accumulated periods of loading.

The question then arises, do the same factors have to be applied when designing a new structure using recycled timber?

In the case of recycled timbers, the 5th percentile strength observed from testing varied between approximately 55% and 65% of that for new timbers of the same visual grading, depending on the previous loading history. In most cases, this previous loading history will be unknown and as such it is appropriate to adopt a slightly conservative approach in recommending design properties. The general observation is that most recycled timbers have been subjected to an accumulated duration of loading somewhere between 5 months and 50 years.

A review of Madsen's work[1] that details testing and derivation of models used to account for the duration of load effect indicates the phenomenon is not linear but progressive, slowing gradually with time. The k_1 terms presented in AS1720.1 have been derived by utilising this same method of gradual loss of strength with increasing accumulated times of loading. This can be clearly seen in Figure D.1.

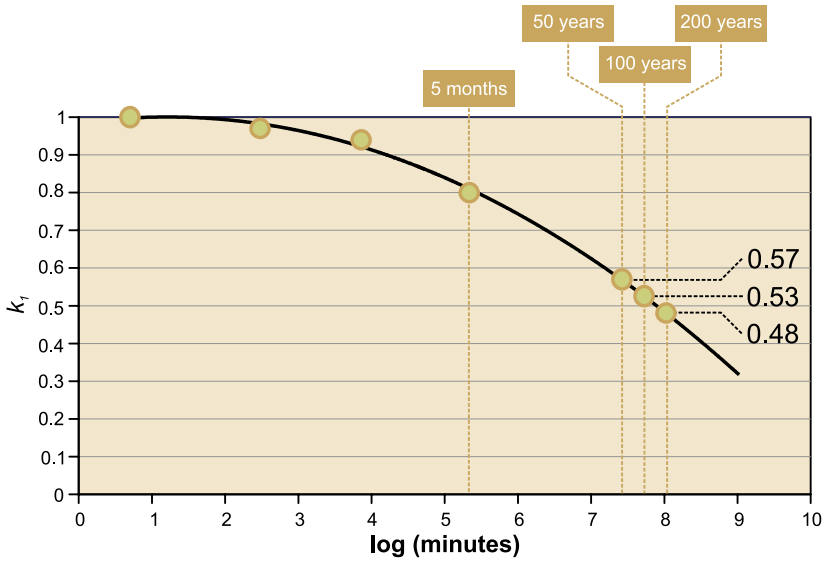


Figure D.1 Duration of Load and modification factor k_1

1 Madsen, Borg – *Structural Behaviour of Timber*, 1992; ISBN 0-9696162-0-1.

From AS1720.1 and the summary of this presented in Figure D1, it can be seen that at 50 years, the assumed value of k_1 is 0.57. However, if the member was to remain in service and continues to carry permanent loads for say another 50 years, the value of k_1 for the extended period of load accumulation using the same model, only changes from 0.57 to approximately 0.53 (0.526). A further 100 years of loading (total 200 years) would result in a further reduction to 0.48. However, adding a further 5 months of accumulated loading, which is typical for normal occupancy load events, would change the value of k_1 by less than 0.5% – in other words, it is negligible. A conservative approach for applying k_1 to recycled structural timber that will be put back into service would be to reduce the characteristic properties for occupancy loads by 2%, and for permanent loads by 10%.

The important thing to note is that application of a duration of load factor for recycled timber is very different than that for new timber. Based on this review, the following values of k_1 are recommended for designs utilising recycled timbers which are graded to this Standard with the characteristic properties given in Table D.1 for recycled hardwood.

TABLE D.2 Recommended Values of Duration of Load Factor k_1 when using AS1720.1 for recycled hardwood

Type of Load	Assumed accumulated duration	Value of k_1
All short term loads	Less than 5 days	1.0
Occupancy loads	Up to 5 months	0.98
Permanent loads	Over 5 months	0.90

D.4 Recycled Structural Softwood

Whilst specific recommendations regarding the characteristic strength, stiffness and duration of load effects for recycled structural softwood are not provided in this Standard, similar overseas research Falk et al[2] has demonstrated similar trends to that obtained for recycled structural hardwoods and therefore designers should make appropriate judgments and adjustments to design properties and procedures.

D.5 Bolt Holes and Notches

The testing program also involved consideration of notch effects. The effect of edge notches of any size in a "zone" subject to bending moment is quite severe and results in a significant loss of strength when compared to the bending capacity of an un-notched section. However, notches and holes in the vicinity of the neutral axis have a negligible effect on strength and stiffness.

For these reasons the "safe zones" for bolt holes and notches have been carefully defined in Section 3, and even where edge notches or holes may be permitted near the supports, designers are advised to check the member capacity using the relevant provisions of AS 1720.1 for beams.

D.6 Design of Connections

Table B1 notes the joint classifications for specific timber species referenced in this Standard. These joint classifications are based upon density of the timber, which for re-cycled timber does not change significantly from the "as new" state.

However, there is evidence that some reduction in connector strength due to previous load history occurs and as such, the characteristic capacities for each of the joint groups as defined in the relevant Tables of AS1720.1, should be reduced by multiplying the specified value by 0.8 (a reduction allowance of 20%). The appropriate values for k_1 (duration of load) for the connections in structural members designed using re-cycled timber, are given in Table D.2.

[2] Falk, Robert et al – *Engineering Properties of Douglas-fir Lumber Reclaimed from Deconstructed Buildings*, 2008, USDA Forest Products Laboratory

APPENDIX E

Guidelines for Specifiers and Purchasers of Recycled Timber (Informative)

When enquiring about or ordering recycled timber products in accordance with this standard, the following particulars should be supplied, where appropriate, preferably in this sequence:–

a) The product required e.g. Structural recycled hardwood

b) The Species Group and Recycled Grade in accordance with this Standard e.g. SG2, RG1

c) If a milled product, the finished dimensions

d) Any special requirements such as particular species, moisture content or required level of durability for specific applications.

e) Any special requirements in respect of colour or colour matching. (Inspection and agreement of a representative sample is strongly recommended).

NOTE:

Generally, only the sapwood of hardwoods can be impregnated with preservative

f) Hole plugging required/not required

g) Surface finish (sawn, dressed, brushed, wired etc)

h) Lengths (set, multiple, lineal etc)

i) Pre-delivery finishing (coatings, sealers, end grain anti split plates etc)

j) Packaging requirements (wrapping, blocks, corner strap protection, pack size/weight)

k) Place and time of delivery and

l) Delivery and on-site storage requirements (e.g. protection from the weather)

APPENDIX F

Images of recycled structural timber applications (Informative)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WINE


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