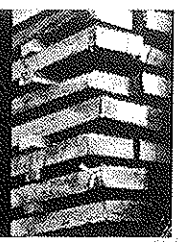
Timber Advisory Notes



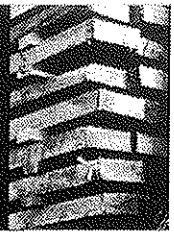
Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

SPECIES LIST

16 January 1997

Timber Advisory Notes



Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

Species: *Eucalyptus marginata* Donn ex Sm.

Standard Trade Name: Jarrah

Common Names: Jarrah

1. Size of tree / type of forest: Found only on lateritic soils in the South-west of Western Australia, in the 650 to 1250 mm rainfall zone. Under optimum conditions it is a tall tree attaining 30 to 40 m in height with diameters at breast height up to 2 m. On poor sites the species is reduced to a mallee form.

2. Wood description: Heartwood dark-red, although regrowth is pinkish-red. Sapwood pale yellow. Texture relatively coarse but even. Grain slightly interlocked, sometimes producing a fiddleback figure.

3. Wood density:

Green density (kg/m^3):	About 1170 kg/m^3.
Air-dry density (kg/m^3):	About 820 kg/m^3.
Basic density (kg/m^3):	About 670 kg/m^3.

4. Drying and shrinkage:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	7.5	5.0
After reconditioning:	6.7	4.6

5. Workability: Relatively easy to work with sharp tools. Planer angle may need to be reduced to 15°.

6. Durability Class: 3/2 Decay: 3/2 Decay + termites (CSIRO revised ratings 1996).

7. Strength Groups: S4 and SD4.

8. Strength Properties:

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	68	112
Modulus of Elasticity	**MPa**	10000	13000
Max Crushing Strength	**MPa**	36	61
Hardness	**kN**	5.7	8.5

9. Uses: General construction, sleepers, poles, piles, flooring, panelling, joinery and high quality furniture.

10. Availability: One of the major timber species of Western Australia, and readily available locally and interstate.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

Species: *Eucalyptus diversicolor* F. Muell.

Standard Trade Name: Karri

Common Names: Karri

1. Size of tree / type of forest: One of Australia's tallest hardwoods between 45 to 70 m, native to the extreme south-west of Western Australia around Manjimup. which is 300 km south of Perth. The mean annual rainfall is mainly from 900 mm to 1300 mm, with a distinct winter maximum. Outlying forests, away from the main karri belt, occur between Karridale and Forest Grove, and other smaller ones are at Mount Many Peaks, Torbay, Rocky Gully and the Porongorup Range.

2. Wood description: Heartwood pale pink to reddish brown, although regrowth is a lighter colour. Sapwood whitest and usually easy to distinguish.

3. Wood density:

Green density (kg/m^3):	About 1200 kg/m^3.
Air-dry density (kg/m^3):	About 900 kg/m^3.
Basic density (kg/m^3):	About 690 kg/m^3.

4. Drying and shrinkage:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	10.0	4.5
After reconditioning:	8.5	4.0

5. Workability: Not easy to work with sharp tools. Planer angle may need to be reduced to 15°.

6. Durability Class: 3/2 Decay: 4 Decay + termites (CSIRO revised ratings 1996).

7. Strength Groups: S3 and SD2.

8. Strength Properties:

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	73	132
Modulus of Elasticity	**MPa**	14000	19000
Max Crushing Strength	**MPa**	36	72
Hardness	**kN**	6.0	9.0

9. Uses: General construction, flooring, paneling, shipbuilding, sleepers, guides or side beams in mines, structural plywood, roofing timbers and pulp and paper. Larger lengths are available than from any other Western Australian hardwoods.

10. Availability: One of the major timber species of Western Australia and available both locally and interstate.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

Species: *Corymbia calophylla* (formerly *Eucalyptus calophylla)*

Standard Trade Name: Marri

Common Names: Red gum

1. **Size of tree / type of forest:** Marri is usually a medium sized to tall tree up to 40 m in height and is widely distributed in the south-west of Western Australia in the jarrah and karri forests. It can extend from north of Geraldton southwards to Cape Riche and eastwards to beyond Narrogin in the Wheatbelt.

2. **Wood description:** Heartwood pale yellow to light brown to reddish brown. Sapwood is up to 40 mm wide, usually sufficiently paler to be distinguishable.

3. **Wood density:**
   Green density (kg/m^3): Unavailable
   Air-dry density (kg/m^3): About 850 kg/m^3.
   Basic density (kg/m^3): About 650 kg/m^3.

4. **Drying and shrinkage:**

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	6.5	3.5
After reconditioning:	5.6	3.4

5. **Workability:** Relatively easy to work and nails satisfactorily.

6. **Durability Class:** 4/3 Decay: 4/3 Decay + termites (CSIRO revised ratings 1996).

7. **Strength Groups:** S3 and SD3.

8. **Strength Properties:**

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	78	125
Modulus of Elasticity	**MPa**	14000	17000
Max Crushing Strength	**MPa**	41	66
Hardness	**kN**	6.6	7.1

9. **Uses:** Sawmill recoveries are low because of the extensive occurrence of kino or gum veins. Used in general construction, case manufacture, tool handles, sporting goods and oars. Preservative treated material is useful for piles, poles and fence posts. Marri is also the principal Western Australian species used for woodchips to manufacture pulp and paper.

10. **Availability:** Small quantities only are available, and limited to Western Australia.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

Species: *Eucalyptus patens* Benth.

Standard Trade Name: Western Australian blackbutt

Common Names: Yarri

1. **Size of tree / type of forest:** Western Australian blackbutt is usually a tall tree up to 45 m in height and with diameter at breast height to 1.8 m and a relatively large straight bole. On less favourable, particularly swampy sites it is a smaller tree of poor form. It has a natural distribution which coincides closely with that of jarrah (*E. marginata*), that is from near Perth in the north to Albany on the south coast, about 500 km.

2. **Wood description:** Heartwood pale yellowish brown. Sapwood is sufficiently paler to be distinguishable.

3. **Wood density:**

Green density (kg/m^3):	About 1120 kg/m^3.
Air-dry density (kg/m^3):	About 850 kg/m^3.
Basic density (kg/m^3):	About 690 kg/m^3.

4. **Drying and shrinkage:**

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	10.0	5.0
After reconditioning:	7.0	3.5

5. **Workability:** Relatively easy to work, although interlocked grain can make it difficult.

6. **Durability Class:** 2 Decay: 4 Decay + termites (CSIRO revised ratings 1996).

7. **Strength Groups:** S4 and SD5.

8. **Strength Properties:**

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	66	99
Modulus of Elasticity	**MPa**	12000	13000
Max Crushing Strength	**MPa**	37	65
Hardness	**kN**	5.5	6.9

9. **Uses:** General construction, case manufacture, sleepers, flooring and panelling.

10. **Availability:** Generally limited to Western Australia, and in relatively short supply.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

Species: *Eucalyptus wandoo* Blakely.

Standard Trade Name: Wandoo

Common Names: White gum

1. **Size of tree / type of forest:** Wandoo is usually a medium to large tree up to 25 m in height and with diameter at breast height (dbh) to 0.8 m, but is occasionally found up to 30 m tall and 1m dbh. Wandoo grows in the 380 to 500 mm rainfall zone of south-west Western Australia, either in broad shallow valleys or on low ridges, with the best wandoo forests occurring from between Darkan and Quindanning and up to Toodyay.

2. **Wood description:** Heartwood yellow to light reddish brown. The sapwood band is very narrow.

3. **Wood density:**

Green density (kg/m^3):	About 1280 kg/m^3.
Air-dry density (kg/m^3):	About 1100 kg/m^3.
Basic density (kg/m^3):	About 920 kg/m^3.

4. **Drying and shrinkage:**

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	4.0	2.5
After reconditioning:	2.6	2.3

5. **Workability:** Hard to work because of its high density but machines to a smooth surface. The grain is interlocked or wavy and careful drying is required to avoid checks and end splits.

6. **Durability Class:** 1 Decay 1 Decay + termites (CSIRO revised ratings 1996).

7. **Strength Groups:** S2 and SD3.

8. **Strength Properties:**

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	101	142
Modulus of Elasticity	**MPa**	14000	17000
Max Crushing Strength	**MPa**	55	82
Hardness	**kN**	9.9	15.0

9. **Uses:** Heavy and light construction, poles, sleepers, and flooring. The bark and wood contain commercial quantities of tannins, the extraction of which was once a medium-sized industry in the wandoo area.

10. **Availability:** Limited to Western Australia, and in relatively short supply.

BACKGROUND INFORMATION

1. Size of tree and type of forest

Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. Wood description

For example, sapwood and heartwood colour, grain, figure

3. Wood density (kg/m^3)

Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. Drying and shrinkage

As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. Workability

Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. Durability

The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. Strength grouping

In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. Strength Properties

Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. Uses

Various past and potential uses are given, but the list is obviously not conclusive.

10. Availability

Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

Species: *Eucalyptus astringens* (Maiden) Maiden.

Standard Trade Name: Brown mallet

Common Names: Brown mallet

1. Size of tree / type of forest: Brown mallet is a small to medium-sized tree, 10-25 m in height and with diameter at breast height (dbh) to 0.7 m, but is occasionally found up to 30 m tall and 1m dbh. Brown mallet grows in the south-west of Western Australia on the drier, inland side of the jarrah (*E. marginata*) forest, in the 300 to 400 mm rainfall zone. It occurs from north-west of York to Narrogin and Wagin, southward to GMT Barker and eastwards to near Kondinin, Lake Grace and Ravensthorpe.

2. Wood description: Heartwood light red-brown to dark grey-brown, with reddish streaks. Sapwood is up to 30 mm wide and distinctly paler.

3. Wood density:

Green density (kg/m^3):	About 1120 kg/m^3.
Air-dry density (kg/m^3):	About 980 kg/m^3.
Basic density (kg/m^3):	About 770 kg/m^3.

4. Drying and shrinkage:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	7.0	5.5
After reconditioning:	4.4	3.6

5. Workability: Rather hard to work but dresses well. The grain is often interlocked and the timber is easy to dry.

6. Durability Class: 2/1 Decay 2 Decay + termites (CSIRO revised ratings 1996)

7. Strength Groups: S1 and SD2.

8. Strength Properties:

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	113	179
Modulus of Elasticity	**MPa**	15000	19000
Max Crushing Strength	**MPa**	53	94
Hardness	**kN**	9.9	15.0

9. Uses: General construction (particularly on farms), tool handles, mining timbers and fuel. The bark has a high tannin content (40 per cent or more), which can be used for tanning leather and adhesives manufacture.

10. Availability: Limited to Western Australia and available in small quantities around the Narrogin area.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

Species: *Eucalyptus gomphocephala* DC.

Standard Trade Name: Tuart

Common Names: -

1. **Size of tree / type of forest:** Tuart is a large hardwood 25 to 40 m tall, occurring in a narrow strip of limestone between the coast and the Darling Range in the south-west corner of Western Australia.

2. **Wood description:** Heartwood pale yellow-brown. The grain is very interlocked and the timber is fine textured and even.

3. **Wood density:**

Green density (kg/m^3):	About 1250 kg/m^3.
Air-dry density (kg/m^3):	About 1030 kg/m^3.
Basic density (kg/m^3):	About 840 kg/m^3.

4. **Drying and shrinkage:**

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	7.0	3.0
After reconditioning:	5.8	2.6

5. **Workability:** The very interlocked grain makes it difficult to dress smoothly.

6. **Durability Class:** 1 Decay 3 Decay + termites (CSIRO revised ratings 1996).

7. **Strength Groups:** S3 and SD3.

8. **Strength Properties:**

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	81	125
Modulus of Elasticity	**MPa**	12000	16000
Max Crushing Strength	**MPa**	46	72
Hardness	**kN**	9.4	11.0

9. **Uses:** General building purposes and flooring. Tuart was once used for keels, stern posts, bridge supports, shafts and wheelwright work where great strength, solidity and durability were required, as well as railway carriage construction.

10. **Availability:** Not commercially available, although occasional logs may be supplied from private property.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

Species: *Allocasuarina fraseriana* (Miq.) L. Johnson

Standard Trade Name: Western Australian sheoak.

Common Names: Sheoak

1. Size of tree / type of forest: Western Australian sheoak is a medium-sized tree up to 15 m tall and 0.5 to 1 m in diameter at breast height. It occurs in the south-western corner of Western Australia in the coastal and hinterland region from Perth in the north to near Albany in the east, where it is an understorey species in the jarrah (*E.marginata*) forest. There is a small isolated population between Moora and Jurien Bay.

2. Wood description: Heartwood dark-red to brown. Sapwood pale yellow. The texture is moderately fine and even and the medullary rays are prominent.

3. Wood density:

Green density (kg/m^3):	Unavailable.
Air-dry density (kg/m^3):	About 730 kg/m^3.
Basic density (kg/m^3):	About 620 kg/m^3.

4. Drying and shrinkage:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	4.5	1.2
After reconditioning:	1.7	1.0

5. Workability: Relatively easy to work.

6. Durability Class: 2

7. Strength Groups: S6 and SD6.

8. Strength Properties:

Property	Units	Green	Dry
Modulus of Rupture	**MPa**		98
Modulus of Elasticity	**MPa**		9356
Max Crushing Strength	**MPa**		
Hardness	**kN**		

9. Uses: Furniture, decorative woodware and turnery, roofing shingles, flooring and panelling. Until the advent of the aluminium cask it was a favoured species for beer barrels.

10. Availability: Limited quantities are available in Western Australia.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

Species: *Pinus pinaster* Ait.

Standard Trade Name: Maritime pine.

Common Names: Pinaster pine.

1. Size of tree / type of forest: Maritime pine is a medium-sized softwood native to south-western Europe and north-western Africa, with major forestry developments on the Atlantic coast of southern France, Spain and Portugal. Extensive plantations have been established on the Swan coastal plain in Western Australia, particularly on the lower rainfall and lower nutrient soils, where radiata pine is not suitable.

2. Wood description: Heartwood pale reddish brown. Sapwood pale yellow. The texture is rather coarse and uneven, grain is generally straight and the timber resinous.

3. Wood density:

Green density (kg/m^3):	About 1000 kg/m^3.
Air-dry density (kg/m^3):	About 560 kg/m^3.
Basic density (kg/m^3):	About 450 kg/m^3.

4. Drying and shrinkage:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	5.0	3.0
After reconditioning:	5.0	3.1

5. Workability: Relatively easy to work, but knots and resin pockets are common.

6. Durability Class: 4

7. Strength Groups: Provisional (S6), and SD6.

8. Strength Properties:

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	36	83
Modulus of Elasticity	**MPa**	6600	11 680
Max Crushing Strength	**MPa**	17	45
Hardness	**kN**	1.7	2.7

9. Uses: General construction, house framing, moulding architraves, doors, shelves, joinery and turnery, decorative panelling, furniture, construction plywood, sliced veneer as a facing for particleboard, pulp and paper and reconstituted products e.g. particleboard and medium density fibreboard (mdf). If preservative-treated it can be used for posts, poles, sleepers, retaining wall, decking, cooling towers and mining timber.

10. Availability: Readily available in Western Australia, although not as widespread as radiata pine.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

Species: *Pinus radiata* D. Don

Standard Trade Name: Radiata pine.

Common Names: Radiata pine, Monterey pine.

1. Size of tree / type of forest: Radiata pine is a large-sized softwood native to a very limited area of the west coast of North America but planted widely in the world's south temperate zone, especially in South Africa, Chile, New Zealand and Australia. In Western Australia major plantations have been established in the south-west on fertile soil and in rainfall areas greater than 700 mm, but preferably south of Perth.

2. Wood description: Heartwood pale yellow-brown. Sapwood pale yellow-white and not always clearly visible. The texture is fine. Grain usually straight except for the central core which often has pronounced spiral grain.

3. Wood density:

Green density (kg/m^3):	About 1000 kg/m^3 .
Air-dry density (kg/m^3):	About 590 kg/m^3.(30-40 year old).
	About 480 kg/m^3.(10-20 year old).
Basic density (kg/m^3):	About 490 kg/m^3. (30-40 year old).
	About 405 kg/m^3.(10-20 year old).

4. Drying and shrinkage:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	5.1	3.4
After reconditioning:	5.0	3.5

5. Workability: Relatively easy to work but knots and resin pockets are common.

6. Durability Class: 4 Decay 4 Decay + termites (CSIRO revised ratings 1996).

7. Strength Groups: S6 and SD6.

8. Strength Properties:

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	42	81
Modulus of Elasticity	**MPa**	8100	10000
Max Crushing Strength	**MPa**	19	42
Hardness	**kN**	2.1	3.3

9. Uses: General construction, house framing, moulding architraves, doors, shelves, joinery and turnery, decorative panelling, furniture, construction plywood, sliced veneer as a facing for particleboard, pulp and paper and reconstituted products e.g. particleboard and medium density fibreboard (MDF). If preservative treated it can be used for posts, poles, sleepers, retaining walls, decking, cooling towers and mining timber.

10. Availability: Readily available in Western Australia and eastern states.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

Species: *Eucalyptus regnans* F. Muell.

Standard Trade Name: Mountain ash.

Common Names: Australian oak, stringy gum, swamp gum, Tasmanian oak, Victorian ash, white mountain ash.

1. **Size of tree / type of forest:** Mountain ash is the tallest hardwood species in the world, and is only exceeded in height by the redwoods of California. Under most conditions heights range from 55 m to 75 m, but measurements up to 100 m have been recorded. Mountain ash is native to Victoria and Tasmania. Best development is found on sheltered aspects in mountainous country with rainfall greater than 1100 mm, on deep friable clay loam soils.

2. **Wood description:** Heartwood pale pink-brown or pale straw. Sapwood not always clearly differentiated and up to 2.5 cm wide. The texture is open and coarse and the timber is straight grained with prominent growth rings.

3. **Wood density:**

Green density (kg/m^3):	About 1030 kg/m^3 .
Air-dry density (kg/m^3):	About 680 kg/m^3 (mature before reconditioning).
	About 630 kg/m^3 (mature after reconditioning).
Air-dry density (kg/m^3):	About 607 kg/m^3 (35 year-old -before reconditioning).
	About 548 kg/m^3 (35 year-old - after reconditioning).
Basic density (kg/m^3):	About 500 kg/m^3 (mature).
	About 425 kg/m^3 (35-year-old).

4. **Drying and shrinkage:**

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	13.0	6.5
After reconditioning:	7.0	4.0

5. **Workability:** Considerable collapse occurs during drying so reconditioning is standard practice for dressed products. Relatively easy to work, dresses and finishes well, has a light colour and readily accepts polishes and stains.

6. **Durability Class:** 4 Decay 4 Decay + termites (CSIRO revised ratings 1996).

7. **Strength Groups:** S4 and SD3.

8. **Strength Properties:**

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	63	110
Modulus of Elasticity	**MPa**	13000	16000
Max Crushing Strength	**MPa**	30	63
Hardness	**kN**	3.4	4.9

9. **Uses:** General construction, house framing, architraves, marine craft, flooring, furniture, plywood, panelling tool handles, It is considered the best eucalypt in Australia for pulp and paper manufacture.

10. **Availability:** Readily available Victoria / Tasmania, available in other states. Sold with alpine ash as Victorian ash; or with alpine ash and messmate as Tasmanian oak.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

IMPORTED TIMBER

12

Species: *Thuja plicata* D. Don.

Standard Trade Name: Western red cedar.

Common Names: British Columbia cedar and canoe cedar.

1. Size of tree / type of forest: A large softwood, the largest of the North American cedars, occurring in British Columbia, Washington, Oregon, Idaho and Montana.

2. Wood description: Heartwood variable from pale brown to dark brown. Sapwood yellowish white and up to 2 cm wide. The texture is fine but uneven due to the prominent growth rings. The timber is straight grained and not resinous.

3. Wood density:

Green density (kg/m^3):	Unavailable.
Air-dry density (kg/m^3):	About 380 kg/m^3 .
Basic density (kg/m^3):	Unavailable.

4. Drying and shrinkage:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	3.0	1.5
After reconditioning:	Unavailable	Unavailable

5. Workability: Easy to dry and work. It is brittle and care is needed when working the end grain. The wood is soft, therefore there is a risk when dressing that the cutters may compress the softer earlywood which will later recover to produce a ridged surface. Damp wood is corrosive to iron, resulting in a black discolouration of the surrounding wood, and galvanised nails are commonly used in areas likely to experience any dampness. A yellowish colouring readily leaches from the wood so white-painted woodwork at a lower level can stain if water penetrates an unprotected surface.

6. Durability Class: 3 Decay 3 Decay + termites (CSIRO revised ratings 1996).

7. Strength Groups: S7 and SD8.

8. Strength Properties:

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	37	54
Modulus of Elasticity	**MPa**	7200	8300
Max Crushing Strength	**MPa**	19	34
Hardness	**kN**	1.2	1.5

9. Uses: Not used as a structural timber. Widely used as weather boards, fascias, external joinery, garden furniture, window sashes and frames, greenhouses, roofing shingles and shakes and internal panelling. **Less durable than previously thought.** If the water run-off from a newly installed cedar roof is to be used for drinking it should be boiled. If damp conditions are common the shingles and shakes may be subjected to soft rot attack and some form of fungicidal treatment may be needed.

10. Availability: Large quantities are imported into the eastern states. Limited stocks are available in Western Australia.

BACKGROUND INFORMATION

1. Size of tree and type of forest

Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. Wood description

For example, sapwood and heartwood colour, grain, figure

3. Wood density (kg/m^3)

Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. Drying and shrinkage

As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. Workability

Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. Durability

The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. Strength grouping

In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. Strength Properties

Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. Uses

Various past and potential uses are given, but the list is obviously not conclusive.

10. Availability

Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

IMPORTED TIMBER 13

Species: *Pseudotsuga menziesii* (Mirb.) Franco

Standard Trade Name: Douglas fir.

Common Names: Oregon, oregon pine.

1. Size of tree / type of forest: The most important softwood of North America, growing on the western fringe from Mexico to British Columbia. It is used as a plantation species in other countries, but there are only small areas of it in Australian plantations.

2. Wood description: Heartwood yellow brown to pale reddish brown. Sapwood distinctly paler, varying in width from about 50 mm in mature trees to 75 mm in fast growing plantation trees. Growth rings are very prominent because of the considerable difference in density and colour between earlywood and latewood, which leads to a coarse and uneven texture. Grain generally straight. Resin content can be high, causing occasional bleed-through of paint films, and a distinctive odour to the freshly cut surface. Spiral grain is rare and compression wood is relatively uncommon. Good quality wood near the pith.

3. Wood density:

Green density (kg/m^3):	About 650 kg/m^3
Air-dry density (kg/m^3):	About 530 kg/m^3
Basic density (kg/m^3):	About 370 kg/m^3

4. Drying and shrinkage:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	4.0	1.9
After reconditioning:	3.5	1.7

5. Workability: As it is one of the hardest softwoods it is only moderately easy to work. Care is needed in dressing as the softer earlywood may be compressed and later, on recovery, produces a ridged surface. This characteristic makes it unsuitable for wood turning. The strong contrast in hardness between earlywood and latewood makes it liable to wear unevenly. Poor base for paint because of the uneven nature of the wood, and in external applications early failure on the latewood of backsawn material is sometimes experienced. Inclined to split when nailed near the ends.

6. Durability Class: 4 Decay 4 Decay + termites (CSIRO revised ratings 1996).

7. Strength Groups: S5 and SD5.

8. Strength Properties:

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	56	90
Modulus of Elasticity	**MPa**	12000	13000
Max Crushing Strength	**MPa**	26	55
Hardness	**kN**	2.1	3.1

9. Uses: Its availability in large sections and long lengths has made it suitable for structural framing, scantling, and laminated beams. It is also used in joinery, furniture, panelling, vats, boat building and for many years as window joinery timber. In North America the most important plywood species but seldom used for that purpose in Australia.

10. Availability: Readily available and in large sections.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

IMPORTED TIMBER

14

Species: *Tectona grandis* L.f.

Standard Trade Name: Teak.

Common Names: Djati (Java), kyun (Burma) and teck (Thailand).

1. Size of tree / type of forest: Teak is variable in size and form depending on local conditions. Clear boles may be up to 27 m, but more often are 9 to 10 m. In drier areas trees are smaller, and older trees may have fluted and buttressed boles. A native tree of India, Burma, Thailand, Vietnam and Indonesia. Plantations are established in its natural range and other tropical areas, e.g. Papua New Guinea, Solomons, Fiji and northern Australia.

2. Wood description: Heartwood golden brown, often with dark markings. Sapwood pale yellow, to 25 mm wide and easily distinguished. The wood contains many oleoresins which give it a greasy feel and a distinctive odour to freshly cut material. Texture is uneven, being alternately smooth and coarse because of the wood's porous nature. Grain usually straight. The freshly cut wood can be very variable in colour, with blotches and streaks, but prolonged exposure to light reduces the more extreme variations.

3. Wood density:

Green density (kg/m^3):	Unavailable
Air-dry density (kg/m^3):	About 670 kg/m^3 (mature trees)
	About 550 kg/m^3 (plantation trees)
Basic density (kg/m^3):	Unavailable

4. Drying and shrinkage:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	2.5	1.5
After reconditioning:	Unavailable	Unavailable

5. Workability: Generally easy to work but silica can be present and this will necessitate frequent sharpening of tools or the use of tungsten carbide-tipped tools and a 20° cutting angle when planing. Peels easily, nails satisfactorily but gluing may be difficult because of the oily nature of the wood, and a freshly dressed surface is needed. Teak seasons well but rather slowly, showing marked variation in drying rate between individual boards. Some collapse may occur if high kiln temperatures are used. Very stable in-service; good resistance to acids and non-corrosive to metal fixings.

6. Durability Class: 2 Decay (Burmese) 2 Decay and termites (CSIRO revised ratings 1996).

7. Strength Groups: S4 and SD5.

8. Strength Properties: (Burmese teak)

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	84	106
Modulus of Elasticity	**MPa**	8800	10000
Max Crushing Strength	**MPa**	43	60
Hardness	**kN**	4.1	4.5

9. Uses: Boat building (mainly tropics), ship's decking, garden furniture, decorative veneer, cabinet work/ furniture and in industrial chemical plants. Dust may cause dermatitis.

10. Availability: Available from a limited number of suppliers.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

IMPORTED TIMBER 15

Species: *Dryobalanops* spp. principally
D. aromatica Gaertn.

Standard Trade Name: Kapur.

Common Names: Camphorwood (Sabah), kapoer (Indonesia), kapor (Borneo) and keladan (Sarawak).

1. Size of tree / type of forest: Kapur species are large hardwoods of Malaysia and Indonesia.

2. Wood description: Heartwood is yellow, pink or reddish brown which darkening on exposure. Sapwood is distinctively paler and 50 mm to 150 mm wide. Texture is medium and even and the grain is sometimes slightly interlocked producing a small amount of figure on the radial surface. Freshly cut wood has a camphor-like odour.

3. Wood density:

Green density (kg/m^3):	Unavailable
Air-dry density (kg/m^3):	About 750 kg/m^3 .
Basic density (kg/m^3):	Unavailable

4. Drying and shrinkage:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	6.0	3.0
After reconditioning:	Unavailable	Unavailable

5. Workability: The presence of silica makes it somewhat difficult to work when seasoned. Wet wood is blackened by contact with iron. Glues satisfactorily but extra care is needed with urea-formaldehyde and phenol-formaldehyde. Pre-drilling may be needed when nailing near extremities.

6. Durability Class: 2

7. Strength Groups: S3 and SD3.

8. Strength Properties:

(Sabah timber)

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	82	119
Modulus of Elasticity	**MPa**	11000	14000
Max Crushing Strength	**MPa**	41	66
Hardness	**kN**	4.0	5.4

9. Uses: Plywood, furniture, joinery, general construction, barge boards and fascias.

10. Availability: Readily available in Western Australia.

BACKGROUND INFORMATION

1. Size of tree and type of forest

Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. Wood description

For example, sapwood and heartwood colour, grain, figure

3. Wood density (kg/m^3)

Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. Drying and shrinkage

As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. Workability

Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. Durability

The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. Strength grouping

In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. Strength Properties

Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. Uses

Various past and potential uses are given, but the list is obviously not conclusive.

10. Availability

Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

IMPORTED TIMBER 16

Species: *Dyera costulata* Hook. f. and *D. lowii*. Hook. f.

Standard Trade Name: Jelutong.

Common Names: Djelutong (Indonesia).

1. Size of tree / type of forest: Both species are large hardwoods of Malaysia and Indonesia.

2. Wood description: Both heartwood and the wide sapwood band are a creamy colour. Texture is fine and even and grain is straight. The timber has a slight but distinctive odour and its appearance is affected by the slits of latex canals which are about 10 mm to 20 mm long and often occur in clusters at 600 mm to 900 mm intervals.

3. Wood density:

Green density (kg/m^3):	Unavailable.
Air-dry density (kg/m^3):	About 465 kg/m^3 .
Basic density (kg/m^3):	About 385 kg/m^3 .

4. Drying and shrinkage:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	3.6	1.3
After reconditioning:	1.0	3.1

5. Workability: The timber is easy to dry but there is a risk of bluestain. Easy to work and the timber gives a very smooth finish. Glues satisfactorily, nails well and is good for carving.

6. Durability Class: 4 ?

7. Strength Groups: S7 and SD8.

8. Strength Properties:

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	39	50
Modulus of Elasticity	**MPa**	8000	8100
Max Crushing Strength	**MPa**	21	27
Hardness	**kN**	1.5	1.7

9. Uses: Pattern-making, carving, core stock, plywood, drawing boards, interior joinery, cabinet work and coffins.

10. Availability: Limited availability, occasionally imported.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

IMPORTED TIMBER

Species: *Dipterocarpus* spp.

Standard Trade Name: Keruing (combined group).

Common Names: Apitong, eng, gurjun, yang and bagac.

1. **Size of tree / type of forest:** Keruing species are large hardwoods of south-east Asia, the Philippines and the Indian sub-continent.

2. **Wood description:** Heartwood colour varies considerably because of the large number of species included in this combined group, but it is generally pale to dark reddish brown. The sapwood is 30 mm to 100 mm wide and is usually grey, yellowish or pale brown and not always clearly distinguishable from the heartwood. Texture is moderately coarse but even and the grain is usually straight but may be slightly interlocked, resulting in some striped figure on the radial surface. The resin content can be high and the wood has a strong resinous odour.

3. **Wood density:**
Green density (kg/m^3): About 950 kg/m^3
Air-dry density (kg/m^3): About 750 kg/m^3 .
Basic density (kg/m^3): Unavailable
(Because of diversity of species the density values can vary considerably).

4. **Drying and shrinkage**:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	7.0	3.5
After reconditioning:	Unavailable	Unavailable

5. **Workability:** Careful drying is needed to avoid checks and end splits. The timber can be difficult to work when dry because of the presence of both silica and resin. Nails satisfactorily but glues variably. Its high resin content makes it a poor base for coatings. Sanding dust can irritate the skin.

6. **Durability Class:** 3

7. **Strength Groups:** S3 and SD3.

8. **Strength Properties:** (Sabah timber)

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	82	137
Modulus of Elasticity	**MPa**	12000	14000
Max Crushing Strength	**MPa**	39	72
Hardness	**kN**	4.7	5.7

9. **Uses:** General construction, flooring (especially industrial flooring), preservative-treated poles, piles, sleepers and crossarms.

10. **Availability:** Limited availability, not normally stocked in Western Australia.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

IMPORTED TIMBER

Species: *Heritiera* spp, principally
H. javanica (Bl.) Kosterm.
H. simplicifolia (Mast.) Kosterm.

Standard Trade Name: Lumbayau.

Common Names: Mengakulang and chumprag.

1. Size of tree / type of forest: Lumbayau species are large hardwoods of Philippines, Indonesia, Malaysia and Thailand, belonging to the same genus as the Australian tulip oaks and having wood of similar appearance.

2. Wood description: Heartwood is reddish-brown to brown, sometimes with dark streaks. Sapwood pale yellowish red or greyish yellow, not always readily distinguishable from the heartwood, and up to 120 mm wide. Texture is moderately coarse and even. Grain is straight or shallowly interlocked, giving some striped figure to the radial surface. The rays are prominent and give a fine fleck figuring. The timber is greasy to touch.

3. Wood density:

Green density (kg/m^3):	Unavailable.
Air-dry density (kg/m^3):	About 730 kg/m^3 .
Basic density (kg/m^3):	Unavailable.

4. Drying and shrinkage:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	4.0	2.0
After reconditioning:	Unavailable	Unavailable

5. Workability: Easy to work, but the presence of silica can soon dull saws and cutting blades. Logs are easily peeled, while the timber nails and glues satisfactorily and dresses to a smooth finish.

6. Durability Class: 4

7. Strength Groups: S5 and SD5.

8. Strength Properties:

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	82	132
Modulus of Elasticity	**MPa**	14650	14650
Max Crushing Strength	**MPa**	41	52
Hardness	**kN**	-	-

9. Uses: Plywood, internal joinery, furniture, flooring, boatbuilding, panelling and general utility timber.

10. Availability: Limited availability, not normally stocked in Western Australia.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

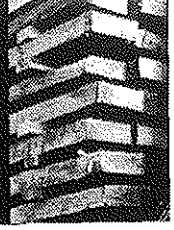
9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes



Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

IMPORTED TIMBER

Species: *Shorea* spp.

Standard Trade Name: Dark red meranti

Common Names: Seraya (Sabah) and lauan (Philippines).

1. Size of tree / type of forest: Dark red meranti applies to a large number of *Shorea* species, which is a dominant hardwood genus in Malaysia, Indonesia , Philippines and Thailand.

2. Wood description: The separation into light red meranti and dark red meranti is based more on wood density than on heartwood colour. Heartwood is reddish-brown. Sapwood is often wide (to 50 mm) and usually distinctively paler, and it may have a grey tinge. Texture is coarse and even and grain usually interlocked, producing a striped figure on the radial surface.

3. Wood density:

Green density (kg/m^3):	Unavailable
Air-dry density (kg/m^3):	640 - 720 kg/m^3 .
Basic density (kg/m^3):	Unavailable

4. Drying and shrinkage:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	4.0	2.0
After reconditioning:	Unavailable	Unavailable

5. Workability: Relatively easy to work though some species may contain a little silica, which can soon dull saws and cutting blades. Tools need to be kept sharp to avoid producing a 'woolly' surface. Logs are easily peeled, while the timber nails and glues satisfactorily and dresses to a smooth finish.

6. Durability Class: 3

7. Strength Groups: S5 and SD6.

8. Strength Properties:

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	68	92
Modulus of Elasticity	**MPa**	9700	11000
Max Crushing Strength	**MPa**	34	53
Hardness	**kN**	3.5	3.1

9. Uses: Plywood, internal joinery, furniture and panelling.

10. Availability: Readily available in Western Australia.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

IMPORTED TIMBER 20

Species: *Shorea* spp.

Standard Trade Name: Light red meranti.

Common Names: Seraya (Sabah) and lauan (Philippines).

1. **Size of tree / type of forest:** Light red meranti applies to a large number of *Shorea* species, which is a dominant hardwood genus in Malaysia, Indonesia , Philippines and Thailand.

2. **Wood description:** The separation into light red meranti and dark red meranti is based more on wood density than on heartwood colour. Heartwood is pale to mid red-brown. Sapwood is yellow, pink or grey and usually easily distinguishable. Texture is coarse and even and grain interlocked, usually giving a ribbon or striped figure to the radial surface. Brittleheart and pin-hole borer damage are common in the logs.

3. **Wood density:**

Green density (kg/m^3):	Unavailable.
Air-dry density (kg/m^3):	400 - 640 kg/m^3 .
Basic density (kg/m^3):	Unavailable.

4. **Drying and shrinkage:**

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	5.2	2.5
After reconditioning:	4.2	2.0

5. **Workability:** Relatively easy to work but may give a rather 'woolly' cut, so sharp tools are necessary. Glues satisfactorily.

6. **Durability Class:** 4

7. **Strength Groups:** S6 and SD7.

8. **Strength Properties:**

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	63	88
Modulus of Elasticity	**MPa**	9700	11000
Max Crushing Strength	**MPa**	32	50
Hardness	**kN**	2.5	2.8

9. **Uses:** Plywood, internal joinery, furniture and panelling.

10. **Availability:** Readily available in Western Australia.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

IMPORTED TIMBER

Species: Mainly *Palaquium* and *Payena* spp.
but other genera of the Sapotaceae family are sometimes included.

Standard Trade Name: Nyatoh.

Common Names: Balam (Sumatra), betis (Philippines), bitis (Indonesia), bubunga (Solomon Islands), ketiau (Borneo, Sabah, Sarawak), keya (Burma), nato (Philippines), njatoh (Sumatra).

1. Size of tree / type of forest: Nyatoh species are large hardwoods of south-east Asia and the Philippines.

2. Wood description: Heartwood is pink to red-brown and the sapwood is usually paler but not always readily distinguishable, and up to 100 mm wide. Texture is medium and even and grain may be shallowly interlocked. The freshly cut surface may have a sour taste.

3. Wood density:

Green density (kg/m^3):	Unavailable
Air-dry density (kg/m^3):	600 - 700 kg/m^3 .
Basic density (kg/m^3):	Unavailable.

4. Drying and shrinkage:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	4.0	2.5
After reconditioning:	Unavailable	Unavailable

5. Workability: Generally easy to work though gummy material can build up on the saw teeth. Susceptible to burn marks during sanding and turning. Some species contain silica. The timber nails well. Logs are easily peeled.

6. Durability Class: 4 ?

7. Strength Groups: S4 and SD4.

8. Strength Properties:

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	66	103
Modulus of Elasticity	**MPa**	11775	14650
Max Crushing Strength	**MPa**	33	59
Hardness	**kN**	-	-

9. Uses: Plywood, internal joinery, furniture and panelling.

10. Availability: Readily available in Western Australia.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

IMPORTED TIMBER

22

Species: Mainly *Gonystylus* spp. *Gonystylus bancanus* (Miq.) Baill. and *G. macrophyllus*

Standard Trade Name: Ramin.

Common Names: Ainunura (Solomon Islands), baygo (Philippines), gaharu buaja (Indonesia), lanutan (Philippines), mavota (Fiji), melaweis (Malaysia), ramin telur (Sarawak).

1. **Size of tree / type of forest:** Ramin species are medium-sized hardwoods of the coastal swamp forests from south-east Asia to Fiji.

2. **Wood description:** Heartwood and sapwood are a straw colour, with the latter up to 60 mm wide. Texture is medium and even and grain straight or shallowly interlocked. The timber has very little figure, while green timber has an unpleasant odour which disappears when it dries.

3. **Wood density:**

Green density (kg/m^3):	Unavailable
Air-dry density (kg/m^3):	About 650 kg/m^3 .
Basic density (kg/m^3):	Unavailable

4. **Drying and shrinkage:**

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	6.4	2.4
After reconditioning:	6.2	2.4

5. **Workability:** Easy to work to a smooth finish. Pre-boring may be needed when nailing near ends. Peels well although the veneer is inclined to be brittle. If inner bark is present on material being processed, any fine splinters can cause skin irritation.

6. **Durability Class:** 4

7. **Strength Groups:** S4 and SD4.

8. **Strength Properties:**

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	71	134
Modulus of Elasticity	**MPa**	10000	14000
Max Crushing Strength	**MPa**	39	72
Hardness	**kN**	2.9	5.8

9. **Uses:** Flooring, mouldings (very popular for picture frames), dowels, handles, turnery, carving, plywood, internal joinery, furniture, panelling and cabinet work.

10. **Availability:** Available in limited quantities.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

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CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

Species: *Eucalyptus globulus* Labill ssp. *globulus*

Standard Trade Name: Southern blue gum.

Common Names: Tasmanian blue gum, blue gum, Western blue gum (W.A. plantation grown).

1. **Size of tree / type of forest:** Tasmanian blue gum varies from a medium-sized woodland tree 15-20 m in height with branches retained to below one-third of total height, to an impressive forest tree of excellent form, to 70 m in height and 2 m diameter. On very harsh, exposed sites such as Flinders and King Islands it may be reduced to a mallee-like shrub. Occurs naturally in south-east Tasmania, the Bass Strait Islands and south-east Victoria. Its low level of frost tolerance restricts distribution to low altitudes and near coastal locations. Extensive plantations have been established in the south-west of Western Australia on ex-pastured land.

2. **Wood description:** Heartwood is a light yellowish brown, sometimes with a pinkish tinge. Sapwood is paler, not always distinguishable from heartwood, and up to 50 mm wide. Texture is medium and grain often interlocked. Growth rings distinct, particularly on end grain.

3. **Wood density:**

Green density (kg/m^3):	Between 1100 - 1200 kg/m^3 . About 1040 kg/m^3 (WA data for 13-year-old)
Air-dry density (kg/m^3):	About 900 kg/m^3 (mature). About 740 kg/m^3 (WA data for 13-year-old).
Basic density (kg/m^3):	About 680 kg/m^3 (mature). About 540 kg/m^3 (WA data for 13-year-old).

4. **Drying and shrinkage:**

		Tangential Shrinkage (%)	Radial Shrinkage (%)
(Mature)	Before reconditioning:	7.7	6.1
	After reconditioning:	7.2	5.3
(17-23-year-old)	Before reconditioning:	14.4	6.9
	After reconditioning:	9.4	4.6

5. **Workability:** Needs care in drying to minimise checking of the tangential surface. Quartersawing (at right angles to the growth rings) is recommended because of surface checking. Considerable collapse can occur, but this can be recovered by steam reconditioning.

6. **Durability Class:** 3 Decay 4 Decay + termites (CSIRO revised ratings 1996).

7. **Strength Groups:** S3 and SD2.

8. **Strength Properties:**

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	78	146
Modulus of Elasticity	**MPa**	11000	20000
Max Crushing Strength	**MPa**	40	83
Hardness	**kN**	7.3	12

9. **Uses:** General construction, pulp and paper, rayon, flooring and furniture timber. If preservative-treated it can be used for posts, poles, sleepers and fence posts.

10. **Availability:** Slowly increasing availability from plantations in Western Australia.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

Species: *Eucalyptus muelleriana* Howitt

Standard Trade Name: Yellow stringybark.

1. **Size of tree / type of forest:** Yellow stringybark is commonly a tall tree 25-40 m in height and up to 1 m diameter (dbh). On favourable sites, it may attain 50 m in height and exceed 3 m dbh. This species occurs on coastal plains and adjacent ranges in southeastern Australia from near Wollongong, New South Wales, in the north to Wilson's Promontory in Victoria. Yellow stringybark typically occurs in tall open-forest formation. Trial plantings have been established in south-west Western Australia for power poles.

2. **Wood description:** Heartwood is a light yellowish brown with a pinkest tinge. Sapwood is very pale brown, to 2.5 cm thick. Texture is medium and even and the grain interlocked.

3. **Wood density:**
   Green density (kg/m^3): About 1100 kg/m^3.
   Air-dry density (kg/m^3): About 870 kg/m^3.
   Basic density (kg/m^3): About 695 kg/m^3.

4. **Drying and shrinkage:**

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	7.5	4.3
After reconditioning:	5.5	3.2

5. **Workability:** Needs care in drying to minimise checking and splitting. Hard and heavy timber to work.

6. **Durability Class:** 3 Decay 4 Decay + termites (CSIRO revised ratings 1996).

7. **Strength Groups:** S3 and SD3.

8. **Strength Properties:**

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	90	132
Modulus of Elasticity	**MPa**	14000	17000
Max Crushing Strength	**MPa**	44	72
Hardness	**kN**	6.3	8.5

9. **Uses:** General construction, wharves, flooring, posts, poles, bridge timber, sleepers and cross arms.

10. **Availability:** Common on the south coast of New South Wales. Not readily available in Western Australia.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

Species: *Corymbia maculata* (formerly *Eucalyptus maculata*)

Standard Trade Name: Spotted gum.

Common Name: Spotted gum

1. Size of tree / type of forest: Spotted gum grows well on favourable sites, usually attaining 35-45 m in height and 1-1.3 m diameter at breast height (dbh), with exceptionally large trees reaching 70 m and exceeding 3 m dbh. On poorer sites it may be 20-35 m in height and 0.7-1.2 m diameter. This species naturally occurs in open-forest to tall open-forest formation on the east coast of Australia from the Victoria-New South Wales border to the Maryborough District in Queensland. Trial plantings have been established in the south-west of Western Australia for pole timber.

2. Wood description: Heartwood is light brown to dark brown. Sapwood is pale and up to 8 cm wide. Texture is moderately coarse, with an interlocked grain. The frequent presence of wavy grain produces an attractive 'fiddleback' grain. The wood is slightly greasy and gum veins are common.

3. Wood density:

Green density (kg/m^3):	About 1150 kg/m^3 .
Air-dry density (kg/m^3):	About 970 kg/m^3.
Basic density (kg/m^3):	About 790 kg/m^3.

4. Drying and shrinkage:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	6.1	4.3
After reconditioning:	5.0	3.7

5. Workability: Not hard to work. Unseasoned wood is somewhat corrosive to aluminium nails and screws. The high extractives content can be a problem when gluing phenolic type adhesives. For good bonding a pressure of about 1000 kPa and temperatures above 20^0 C are usually needed. A low moisture content, preferably between 8 and 10 per cent, is also desirable.

6. Durability Class: 2 Decay 2 Decay + termites (CSIRO revised ratings 1996).

7. Strength Groups: S2 and SD2.

8. Strength Properties:

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	99	150
Modulus of Elasticity	**MPa**	18000	23000
Max Crushing Strength	**MPa**	50	75
Hardness	**kN**	8.0	11.0

9. Uses: Heavy engineering construction and mining timbers, where shock resistance is important, house framing, flooring, tool handles, piles and poles, shipbuilding, agricultural machinery and plywood.

10. Availability: Common in New South Wales and southern Queensland. Not readily available in Western Australia.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

Species: *Eucalyptus obliqua* L'Herit., *E. regnans* F.Muell. and *E. delegatensis* R.T. Bak..

Standard Trade Name: Tasmanian oak.

Common Names: Messmate stringybark, mountain ash and alpine ash respectively.

1. **Size of tree / type of forest:** These three 'ash type' species are tall to very tall trees of the hilly and mountainous locations of Tasmania, Victoria and NSW Mountain ash is the tallest tree in Australia, attaining heights between 55 and 75 m, with some trees to 100 m and 2.5 m diameter. Alpine ash attains heights of 20 to 40 m, occasionally 90 m, with stem diameters of 2 to 3 m, and messmate 45 to 90 m and 2 to 3 m diameter.

2. **Wood description:** Heartwood is light brown, yellow-brown or straw coloured to brown or pink brown. Sapwood is 2 to 3 cm wide, pale and not clearly distinguishable from heartwood in alpine and mountain ash, and pale yellow and usually distinguishable from heartwood in messmate stringybark. Texture is coarse and open, with straight grain and prominent growth rings.

3. **Wood density:**
   - Green density (kg/m^3): About 1050 alpine ash, 1030 mountain ash, 1080 messmate stringybark.
   - Air-dry density (kg/m^3): About 620 alpine ash, 680 mountain ash, 780 messmate stringybark.
   - Basic density (kg/m^3): About 490 alpine ash, 520 mountain ash, 630 messmate stringybark.

4. **Drying and shrinkage:**

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	8.0 - 13.0	4.5 - 6.5
After reconditioning:	6.5 - 7.0	3.5 - 4.0

5. **Workability:** Considerable collapse occurs during drying so reconditioning is standard practice for dressed products. To reduce surface checking, boards are usually quartersawn. Relatively easy to work, dresses and finishes well, and polishes and stains easily.

6. **Durability Class:** 4 Decay 4 Decay + termites (CSIRO revised ratings 1996). Sapwood of messmate stringybark is susceptible to *Lyctus* borer attack.

7. **Strength Groups:** S4 and SD4 alpine ash, S4 and SD3 mountain ash, S3 and SD3 messmate stringybark.

8. **Strength Properties:**

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	63	110
Modulus of Elasticity	**MPa**	11000	13000
Max Crushing Strength	**MPa**	30	60
Hardness	**kN**	3.4	4.9

* Figures in the above Table are the minimum values for the group of species.

9. **Uses:** General construction, house framing, architraves, marine craft, flooring, furniture, plywood, panelling and tool handles. Used for pulp, paper and hardboard.

10. **Availability:** Readily available in all states of Australia, although the proportions of species in the mix can vary considerably.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

Species: *Eucalyptus regnans, E. delegatensis*

Standard Trade Name: Victorian ash.

Common Names: Mountain ash, alpine ash respectively.

1. **Size of tree / type of forest:** These two 'ash type' eucalypts are tall to very tall trees of the hilly and mountainous locations of Tasmania, Victoria and NSW. Mountain ash is the tallest tree in Australia, attaining heights between 55 and 75 m, with trees up to 100 m and 2.5 m diameter. Alpine ash attains heights of 20 to 40 m, occasionally up to 90 m, with stem diameter 2 to 3 m.

2. **Wood description:** Heartwood is light brown, yellow-brown or straw coloured to brown or pink-brown. Sapwood is 2 to 3 cm, pale and not clearly distinguishable. Texture is coarse to medium and open, with straight grain and prominent growth rings.

3. **Wood density:** Green density (kg/m^3): About 1030 mountain ash, 1050 alpine ash.
Air-dry density (kg/m^3): About 680 mountain, 620 alpine ash.
Basic density (kg/m^3): About 520 mountain ash, 490 alpine ash.

4. **Drying and shrinkage:**

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	8.0 - 13.0	4.5 - 6.5
After reconditioning:	6.0 - 7.0	3.0 - 4.0

5. **Workability:** Considerable collapse occurs during drying so reconditioning is standard practice for dressed products. To reduce surface checking, boards are usually quartersawn. Relatively easy to work, dresses and finishes well, and with the light colour easy to polish and stain.

6. **Durability Class:** 4 Decay 4 Decay and termites (CSIRO revised ratings 1996).

7. **Strength Groups:** S4 and SD3 mountain ash, S4 and SD4 alpine ash.

8. **Strength Properties:**

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	62	99
Modulus of Elasticity	**MPa**	10000	13000
Max Crushing Strength	**MPa**	30	58
Hardness	**kN**	3.4	4.9

* Figures in the above Table are the minimum values for the group of species.

9. **Uses:** General construction, house framing, architraves, marine craft, flooring, furniture, plywood, panelling and tool handles. Used for pulp, paper and hardboard.

10. **Availability:** Readily available in all states of Australia, although the proportions of species in the mix can vary considerably.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

IMPORTED TIMBER 28

Species: *Khaya anthotheca* (Welw.) C. DC. *K. grandifoliola* C. DC. *K. ivorensis* A.Chev. *K. senegalensis.*

Standard Trade Name: African mahogany

Common Names: Khaya

1. **Size of tree / type of forest:** African mahogany timbers are from large hardwoods mainly in West Africa but found eastward as far as Uganda and Tanzania.

2. **Wood description:** Heartwood is pinkish brown to dark reddish brown. Sapwood is yellow-brown, not always distinct from the heartwood. Texture is course and even with large pores and the grain is frequently interlocked, producing a striped figure on the radial surface.

3. **Wood density:**

Green density (kg/m^3):	N/A
Air-dry density (kg/m^3):	About 570 kg/m^3
Basic density (kg/m^3):	N/A

4. **Drying and shrinkage:**

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	3.0	1.5
After reconditioning:	N/A	N/A

5. **Workability:** Relatively easy to work unless a lot of interlocking grain is present Nails and glues well. Unsuitable for steam bending. Damp wood develops black stains in contact with iron. The sanding dust can irritate the skin so good dust extraction is needed.

6. **Durability Class:** 3. Sapwood is susceptible to *Lyctus* borer attack.

7. **Strength Groups:** S6 and SD6.

8. **Strength Properties:**

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	52	76
Modulus of Elasticity	**MPa**	7700	9200
Max Crushing Strength	**MPa**	25	44
Hardness	**kN**	3.0	3.8

* Figures in the above Table are the minimum values for the group of species.

9. **Uses:** Furniture, decorative veneer, panelling, joinery and boatbuilding

10. **Availability:** Limited availability in Western Australia.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

IMPORTED TIMBER

Species: *Chlorophora excelsa* (Welw.) Benth. et Hook. f.

Standard Trade Name: Iroko

Common Names: West African teak.

1. Size of tree / type of forest: Iroko is a very large, slightly buttressed hardwood of tropical Africa.

2. Wood description: Heartwood is pale yellow to golden brown, darkening on exposure to the air. Sapwood is very pale yellow, easily distinguishable from the heartwood, and varying in width from 5 to 10 cm, depending on the maturity of the tree. Texture is coarse and even. Grain usually interlocked. The timber looks similar to teak.

3. Wood density:

Green density (kg/m^3):	N/A
Air-dry density (kg/m^3):	About 660 kg/m^3
Basic density (kg/m^3):	N/A

4. Drying and shrinkage:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	2.5	1.5
After reconditioning:	N/A	N/A

5. Workability: Heartwood may contain hard deposits of calcium carbonate as a result of earlier wounding and this material is very destructive to saw teeth and planer blades. Difficult to work if mineral deposits present, otherwise satisfactory although the interlocked grain will require care in dressing. Glues satisfactorily. Pre-drilling is required before nailing near board ends. Moderately satisfactory for steam bending. Sanding dust is likely to irritate the skin so efficient dust extraction equipment is needed.

6. Durability Class: 2. Good resistance to marine borers. Sapwood is susceptible to *Lyctus* borer attack.

7. Strength Groups: S5 and SD6.

8. Strength Properties:

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	74	90
Modulus of Elasticity	**MPa**	8300	9400
Max Crushing Strength	**MPa**	35	55
Hardness	**kN**	4.8	5.6

9. Uses: Furniture, decorative veneer, general joinery, and boatbuilding, particularly decking.

10. Availability: Limited availability in Western Australia.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

IMPORTED TIMBER 30

Species: *Tieghemella heckelii* Pierre

Standard Trade Name: Makore

Common Names: Makore

1. **Size of tree / type of forest:** A large hardwood of West Africa.

2. **Wood description:** Heartwood is pink to blood red or reddish brown, sometimes even with a slight purplish tinge. Sapwood usually distinctively paler. Texture is fine to medium and even and similar to Nyotah. Grain variable, sometimes giving a mottled figure to the radial surface. The pattern is similar to Nyotah, quite often straight with some wavy grain. Many logs are heavily figured.

3. **Wood density:**
   Green density (kg/m^3): N/A
   Air-dry density (kg/m^3): About 610 kg/m^3
   Basic density (kg/m^3): N/A

4. **Drying and shrinkage:**

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	3.0	2.5
After reconditioning:	N/A	N/A

5. **Workability:** Machining can be hard because of the presence of silica, with cutters and saws needing frequent resharpening. Pre-drilling may be needed when nailing near the ends. Sanding dust likely to be irritating to nose and throat. Glues satisfactorily. Not very suitable for steam bending. Wet timber in contact with iron will develop a blackish stain.

6. **Durability Class:** 2. Sapwood is susceptible to *Lyctus* borer attack.

7. **Strength Groups:** S5 and SD6.

8. **Strength Properties:**

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	75	101
Modulus of Elasticity	**MPa**	8200	10000
Max Crushing Strength	**MPa**	37	53
Hardness	**kN**	4.1	4.9

9. **Uses:** Furniture, cabinets, turning, joinery, decorative veneer, and boatbuilding.

10. **Availability:** Limited availability in Western Australia.

BACKGROUND INFORMATION

1. Size of tree and type of forest

Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. Wood description

For example, sapwood and heartwood colour, grain, figure

3. Wood density (kg/m^3)

Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. Drying and shrinkage

As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. Workability

Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. Durability

The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. Strength grouping

In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. Strength Properties

Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. Uses

Various past and potential uses are given, but the list is obviously not conclusive.

10. Availability

Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

IMPORTED TIMBER 31

Species: *Acer saccharum* Marsh.

Standard Trade Name: American rock maple

Common Names: Sugar maple, hard maple

1. Size of tree / type of forest: A tall to medium sized deciduous hardwood that is found in an area ranging from the Appalachian mountain range of North-east America to Canada.

2. Wood description: Heartwood is pale brown to pale red-brown. Sapwood creamy, but not always clearly differentiated from the heartwood, and up to 13 cm wide. Texture is fine and even. Grain usually straight but wavy grain is sometimes present. Fine brown lines of tissue marking the extremities of the growth rings give a distinctive figure to the tangential surface. Other grain patterns include curly, birdseye, quilted and fiddleback.

3. Wood density:

Green density (kg/m^3):	N/A
Air-dry density (kg/m^3):	About 730 kg/m^3
Basic density (kg/m^3):	N/A

4. Drying and shrinkage:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	6.0	3.0
After reconditioning:	N/A	N/A

5. Workability: Not easy to work, with tools requiring frequent sharpening, but finishes to a smooth surface. Glues satisfactorily. The timber has a good resistance to splitting though pre-drilling is advisable. Stains and polishes well, which complements its natural lustre. Good for turning and steam bending. Has outstanding resistance to abrasion.

6. Durability Class: 4. Sapwood is susceptible to *Lyctus* borer attack.

7. Strength Groups: S4 and SD4.

8. Strength Properties:

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	69	109
Modulus of Elasticity	**MPa**	11000	13000
Max Crushing Strength	**MPa**	28	54
Hardness	**kN**	4.3	6.4

9. Uses: Flooring (especially for bowling alleys, squash courts and ballrooms), shoe lasts, textile bobbins, musical instruments (e.g. piano actions), handles, laminated golf club heads, decorative veneer, furniture kitchen utensils and butchers blocks.

10. Availability: Limited availability in Western Australia.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

IMPORTED TIMBER 32

Species: *Quercus alba.*

Standard Trade Name: American white oak

Common Names: White oak

1. **Size of tree / type of forest:** A common medium sized hardwood that grows extensively over the Eastern half of the USA up to the South Eastern corridor of Canada. The white oak family comprises of a number of different species that vary according to their place of origin.

2. **Wood description:** Heartwood varies in colour from pale yellow-brown to biscuit with a pinkish tint, similar to European oak. Sapwood almost white, but not always clearly differentiated from the heartwood. Texture is medium to coarse. Grain usually straight, with a characteristic silver grain on quartersawn timber. Large rays can be seen on the face of quartersawn boards.

3. **Wood density:**

Green density (kg/m^3):	N/A
Air-dry density (kg/m^3):	About 760 kg/m^3
Basic density (kg/m^3):	N/A

4. **Drying and shrinkage:**

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	5.0	3.0
After reconditioning:	N/A	N/A

5. **Workability:** Varies according to tree growth rate. Slow-grown oak is much easier to work with hand and machine tools than fast-grown. The timber takes nails and screws well, although pre-drilling is advised. Gluing properties are variable, and the timber stains and polishes to a good finish.

6. **Durability Class:** 3. Sapwood is susceptible to *Lyctus* borer attack.

7. **Strength Groups:** S6 and SD6.

8. **Strength Properties:**

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	57	105
Modulus of Elasticity	**MPa**	8600	12000
Max Crushing Strength	**MPa**	25	51
Hardness	**kN**	4.7	6.0

9. **Uses:** Furniture and cabinet making, joinery, heavy construction, parquet and strip flooring, vats and casks for maturing wine and spirits, boatbuilding and decorative veneer.

10. **Availability:** Limited availability in Western Australia.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

IMPORTED TIMBER

Species: *Prunus serotina* Ehrh.

Standard Trade Name: American cherry

Common Names: Cherry, black cherry

1. **Size of tree / type of forest:** A medium sized hardwood that is found in the Eastern USA in an area ranging from the Appalachian states of Pennsylvania to West Virginia up to Southern Canada.

2. **Wood description:** Heartwood varies from rich red to reddish-brown. Sapwood is a creamy colour and easily distinguishable from the heartwood. Texture is smooth and even. Grain is fine, straight and the timber has close grain with narrow brown pith flecks, small gum pockets and minute pin-knot clusters. Backsawn boards give a distinctive flame pattern.

3. **Wood density:**

Green density (kg/m^3):	N/A
Air-dry density (kg/m^3):	About 625 kg/m^3
Basic density (kg/m^3):	N/A

4. **Drying and shrinkage:**

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	N/A	N/A
After reconditioning:	N/A	N/A

5. **Workability:** The wood machines to a smooth finish owing to its fine grain, and the timber also turns well. The timber glues very well and has a fair resistance to splitting when nailed or screwed, but pre-drilling is advisable when nailing. It takes an excellent polish.

6. **Durability Class:** 3.

7. **Strength Groups:** S6 and SD5.

8. **Strength Properties:**

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	55	85
Modulus of Elasticity	**MPa**	9050	10300
Max Crushing Strength	**MPa**	25	49
Hardness	**kN**	2.9	4.2

9. **Uses:** Furniture and cabinetmaking, pattern making, tobacco pipes, musical instruments, high-class joinery, boat interiors, backing blocks for mounting printing plates, coffins, turnery and carving, and decorative veneer.

10. **Availability:** Limited availability in Western Australia.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

IMPORTED TIMBER

Species: *Fraxinus americana* L.

Standard Trade Name: American ash

Common Names: White ash

1. **Size of tree / type of forest:** A medium sized North American hardwood that is found between New England and Central North America.

2. **Wood description:** Heartwood is greyish-brown or light brown to creamy white, sometimes tinged with red. Sapwood is a light colour and generally wide. Texture is coarse and even, and grain is straight and open. The pronounced difference in early and latewood gives the backsawn timber a flame pattern.

3. **Wood density:**

Green density (kg/m^3):	N/A
Air-dry density (kg/m^3):	About 600 kg/m^3
Basic density (kg/m^3):	N/A

4. **Drying and shrinkage**:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	N/A	N/A
After reconditioning:	N/A	N/A

5. **Workability:** The timber has excellent machining properties making it suitable for mouldings. It has a better than average resistance to splitting when nailing and screwing, and holds glue well. Pre-drilling is sometimes required before nailing. Owing to its lustrous nature the timber takes all finishes well, and can be matched to most colours.

6. **Durability Class:** 4. Sapwood is susceptible to *Lyctus* borer attack.

7. **Strength Groups:** S5 and SD5.

8. **Strength Properties:**

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	65	103
Modulus of Elasticity	**MPa**	9930	12000
Max Crushing Strength	**MPa**	28	51
Hardness	**kN**	4.3	5.9

9. **Uses:** Furniture, joinery, plywood, decorative veneer, tool handles and sporting equipment.

10. **Availability:** Limited availability in Western Australia.

BACKGROUND INFORMATION

1. Size of tree and type of forest

Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. Wood description

For example, sapwood and heartwood colour, grain, figure

3. Wood density (kg/m^3)

Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. Drying and shrinkage

As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. Workability

Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. Durability

The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. Strength grouping

In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. Strength Properties

Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. Uses

Various past and potential uses are given, but the list is obviously not conclusive.

10. Availability

Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

IMPORTED TIMBER

Species: *Fagus sylvatica* L.

Standard Trade Name: European beech

Common Name: European beech

1. Size of tree / type of forest: This hardwood is common throughout Europe. A number of other *Fagus* species grow in Canada and eastern Asia and have similar properties.

2. Wood description: Heartwood is pale brown and the heat in kiln drying can change the colour of the heartwood to reddish-brown. Sapwood is creamy and not clearly distinguishable. Texture is fine and even, and the grain is usually straight. The ends of the large rays give a characteristic fleck to the tangential surface.

3. Wood density:

Green density (kg/m^3):	N/A
Air-dry density (kg/m^3):	About 680 kg/m^3.
Basic density (kg/m^3):	N/A

4. Drying and shrinkage:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	> 6.0	> 4.0
After reconditioning:	N/A	N/A

5. Workability: Relatively easy to work. The timber turns well, is easy to glue and suitable for steam bending. Pre-drilling may be needed when nailing. When dressed a very smooth finish is achieved.

6. Durability Class: 4. Sapwood resistant to *Lyctus* borer attack, but can be attacked by the *Anobium* borer.

7. Strength Groups: S5 and SD4, but varies considerably in strength.

8. Strength Properties:

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	65	118
Modulus of Elasticity	**MPa**	9800	13000
Max Crushing Strength	**MPa**	28	56
Hardness	**kN**	4.3	6.4

9. Uses: Furniture (especially bentwood chairs) veneer, flooring, joinery, tool handles, brush backs, handles, wrest planks for pianos, shoe heels and decorative turnery.

10. Availability: Very limited quantities are imported.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

IMPORTED TIMBER

36

Species: *Koompassia malaccensis* Maing.
K. excelsa Taub.
K. grandiflora Kosterm.

Standard Trade Name: Kempas

Common Name: Kempas

1. Size of tree / type of forest: Kempas are large hardwoods native to Malaysia, Indonesia, the Philippines and Papua New Guinea, and usually growing in swampy ground.

2. Wood description: Heartwood is reddish-brown, and often with yellow streaks. Sapwood is pale yellow or pinkish brown to about 5 cm wide, and distinct from the heartwood. Texture is coarse but even, and the grain is interlocked, giving some figure to the radial surface.

3. Wood density:

Green density (kg/m^3):	About 1000 kg/m^3.
Air-dry density (kg/m^3):	About 850 kg/m^3.
Basic density (kg/m^3):	N/A

4. Drying and shrinkage:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	3.0	2.0
After reconditioning:	N/A	N/A

5. Workability: Interlocked grain can cause difficulty in working the timber. The timber is unsuitable for turnery, but the logs peel satisfactorily into veneer. Pre-drilling may be need for nailing. The timber dries quickly but care is needed to prevent splitting.

6. Durability Class: 3. Sapwood susceptible to *Lyctus* borer attack.

7. Strength Groups: S2 and SD2.

8. Strength Properties:

Property	Units	Green*	Dry*
Modulus of Rupture	**MPa**	86	130
Modulus of Elasticity	**MPa**	14200	18500
Max Crushing Strength	**MPa**	43	70
Hardness	**kN**	N/A	N/A

* Figures in the above Table are the minimum values for strength group.

9. Uses: Plywood, flooring and when treated with preservative it is used for sleepers, bridges, and wharfing timbers.

10. Availability: Small quantities occasionally imported.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

IMPORTED TIMBER

Species: *Intsia bijuga* (Colebr.) O.Ktze.
I. palembanica Miq.

Standard Trade Name: Kwila

Common Name: Kwila, ipil, merbau, vesi

1. Size of tree / type of forest: Kempas are large hardwoods of wide distribution in south-east Asia and eastwards to Papua New Guinea, Philippines, Solomon Islands and Fiji. Occurs occasionally in north Queensland.

2. Wood description: Heartwood may be bright yellow when first cut but becomes pale to dark reddish brown. Sapwood is pale yellow to about 8 cm wide, and distinct from the heartwood. Texture is moderately coarse but even and the grain is slightly interlocked, producing a ribbon figure to the radial surface. The timber has a characteristic oily odour when freshly cut, and is rather greasy to touch.

3. Wood density:

Green density (kg/m^3):	About 1200 kg/m^3.
Air-dry density (kg/m^3):	About 825 kg/m^3 (Before reconditioning).
Basic density (kg/m^3):	About 700 kg/m^3

4. Drying and shrinkage:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	2.5	1.5
After reconditioning:	2.1	1.1

5. Workability: The timber cuts cleanly but saw teeth tend to become clogged with a gummy substance. The cutting angle of the planer needs to be reduced, especially on the radial surface. Pre-drilling may be needed for nailing. Glues and turns reasonably satisfactorily, and sanding dust can irritate both skin and mucous membranes. The vessels contain a yellow substance that will stain textiles and concrete. Contact with iron under moist conditions will cause formation of a black stain.

6. Durability Class: 3/2 Decay 3/2 Decay and termites (CSIRO revised ratings 1996).
Sapwood susceptible to *Lyctus* borer attack.

7. Strength Groups: S2 and SD3.

8. Strength Properties:

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	103	147
Modulus of Elasticity	**MPa**	15000	18000
Max Crushing Strength	**MPa**	55	81
Hardness	**kN**	7.6	8.6

9. Uses: Furniture, flooring, panelling, turnery, sills, boatbuilding, crossarms, carving, vats, window joinery and veneer.

10. Availability: Occasionally imported.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

IMPORTED TIMBER

Species: *Abies lasiocarpa* (Hook.) Nutt. and *A. balsamea* (L.) Mill.
Pinus banksiana Lamb and *P. contorta* Dougl.
Picea mariana (Mill.) Britt., Stern et Pogg., *P. engelmannii* (Parry) Engelm.,
P. rubens Sarg. and *P. glauca* (Moench.) Voss

Standard Trade Name: Spruce-Pine-Fir (SPF)

Common Name: In same order of species above : alpine fir, balsam fir,
jack pine, lodgepole pine,
black spruce, Engelmann spruce, red spruce and white spruce

1. Size of tree and type of forest: This group of species grow in the cold areas of Canada, where growth rates are slow and the mature tree seldom exceeds 30 m in height and 350 mm in diameter. Their occurrence extents into USA.

2. Description of wood: Heartwood can be almost white, but it may have a pale reddish-brown colour. Sapwood is whitish and is often wide and hard to distinguish visually from the heartwood. Texture is medium and the grain usually straight. Any knots are usually small. The timber has a slight odour and claimed to be non-tainting.

3. Wood density:
Green density (kg/m^3): N/A
Air-dry density (kg/m^3): About 360 kg/m^3 - alpine fir, 400 kg/m^3 - balsam fir, 430 kg/m^3 - white spruce, 460 kg/m^3 - red spruce, Engelmann spruce, black spruce and lodgepole pine and 500 kg/m^3 - jack pine.
Basic density (kg/m^3): N/A

4. Drying and shrinkage:

	Tangential Shrinkage (%)	Radial Shrinkage (%)
Before reconditioning:	3.5 - 4.5	2.0 - 3.0
After reconditioning:	N/A	N/A

5. Workability: The timber is easy to dry, work, glue and coat with finishes. May need protection from blue stain.

6. Durability Class: 4.

7. Strength Groups: SD7 - Canadian material and SD8 - other sources.
Sold seasoned in Australia, therefore only the SD rating is relevant.

8. Strength Properties:

Property	Units	Green*	Dry*
Modulus of Rupture	**MPa**	34	52
Modulus of Elasticity	**MPa**	6600	8500
Max Crushing Strength	**MPa**	16	31
Hardness	**kN**	1.2	1.6

* Figures in the above Table are the minimum values for the group of species

9. Uses: Building framework, panelling and internal joinery.

10. Availability: Increasing quantities are being imported into Australia.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

Department of Conservation and Land Management

CALM Timber Technology Weir Road Harvey WA 6220 (097) 29 1913 50 Hayman Road Como 6152 (09) 334 0333

Species: *Callitris columellaris* F. Muell. sens. lat.
Sm. *C. glauca* R. Br. ex R. Bak. *et* H.G. Sm.

Standard Trade Name: White cypress pine

Common Name: White cypress pine, cypress pine

1. Size of tree / type of forest: This softwood is widely distributed in inland areas of Australia with moderate rainfall. Today it forms extensive forests only in the Tambo-Dalby-Inglewood region of southern Queensland and the Baradine-Narrabri and Cobar districts of northern New South Wales. White cypress pine is a small to medium-sized tree, usually growing to about 18 m tall and 0.45 m in diameter at breast height, but occasionally reaching 30 m by 0.9 m.

2. Wood description: Heartwood is light-yellow to dark-brown and has frequent dark-brown knots, and sapwood pale yellow and wide. Texture is very fine and even and grain is straight. The wood has a characteristic resinous odour and has a slightly greasy feel.

3. Wood density:

Green density (kg/m^3):	About 770 kg/m^3.
Air-dry density (kg/m^3):	About 680 kg/m^3.
Basic density (kg/m^3):	580 kg/m^3.

4. Drying and shrinkage:

		Tangential Shrinkage (%)	Radial Shrinkage (%)
(Mature)	Before reconditioning:	2.8	2.1
	After reconditioning:	2.1	2.1
(Immature)	Before reconditioning:	3.6	2.9
	After reconditioning:	3.2	2.9

5. Workability: It is brittle and care is needed when working. Knots and resin are common, which can affect workability. Inadvisable to dress timber at low moisture contents because of its brittleness. Tends to split when nailed and pre-drilling is recommended. Owing to its susceptibility to fine surface checking, white cypress pine is one timber which gives a better painting performance when coated in the unseasoned condition, and by slowing the initial drying rate the coating inhibits the formation of checks. The sapwood is unusual in that it, as well as the heartwood, is very difficult to impregnate with preservatives, even when high pressures are applied.

6. Durability Class: 2 Decay 2 Decay + termites (CSIRO revised ratings 1996).
Sapwood resistant to *Lyctus* borer attack.

7. Strength Groups: S5 and SD6.

8. Strength Properties:

Property	Units	Green	Dry
Modulus of Rupture	**MPa**	71	79
Modulus of Elasticity	**MPa**	7700	9000
Max Crushing Strength	**MPa**	40	53
Hardness	**kN**	5.6	6.5

9. Uses: Flooring and lining boards, building framework, posts and small poles. Not favoured for paper manufacture owing to frequent knots and high extractives content.

10. Availability: Reasonable availability in Western Australia
Readily available in other States.

BACKGROUND INFORMATION

1. **Size of tree and type of forest**

   Small trees have average heights up to 15 m, medium 15 to 30 m, and large over 30 m. Types of forest are sclerophyll (with closed canopy), woodland (with scattered trees), or rain forest. Diameter breast height is stem diameter at 1.3 m above ground.

2. **Wood description**

   For example, sapwood and heartwood colour, grain, figure

3. **Wood density (kg/m^3)**

   Green density is the density of wood in the living tree, defined as green mass divided by green volume, and useful for estimating transport costs. It varies with season and growing conditions.
   Air-dry density is the average mass divided by volume at 12 per cent moisture content (this is the average environmental condition in the coastal capital cities around Australia).
   Basic density is oven-dry mass divided by green volume. This measure has the advantage that moisture content variations are avoided.

4. **Drying and shrinkage**

   As wood dries, it shrinks more in the tangential direction (i.e. parallel to the growth rings) than it does in the radial direction (i.e. at right angles to the growth rings). The figures given are shrinkage from green to 12 per cent moisture content, before and after steam reconditioning treatment. Reconditioning recovers any cells that may have collapsed during drying, and is essential for species such as the ash-type eucalypts.

5. **Workability**

   Comments are made on the comparative ease or difficulty of turning, nailing and bending, on susceptibility to splitting and other working properties.

6. **Durability**

   The CSIRO Durability Classes are based on the performance in ground of outer heartwood when exposed to fungal and termite attack. Class 1 gives more than 25 years life, Class 2 gives 15 to 25 years, Class 3 gives 8 to 15 years, and Class 4 less than eight years. The ratings are not relevant to above-ground use. In late 1996, CSIRO published revised ratings, which include termite susceptibility.

7. **Strength grouping**

   In grading of structural timber, each species is allocated a ranking for green timber of S1 (strongest) to S7, and for seasoned timber SD1 (strongest) to SD8.

Minimum values for strength groups for green timber (units are MPa)

Strength property	S1	S2	S3	S4	S5	S6	S7
Modulus of rupture	103	86	73	62	52	43	36
Modulus of elasticity	16300	14200	12400	10700	9100	7900	6900
Maximum crushing strength	52	43	36	31	26	22	18

Minimum values for strength groups for seasoned timber (units are MPa)

Strength property	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Modulus of rupture	150	130	110	94	78	65	55	45
Modulus of elasticity	21500	18500	16000	14000	12500	10500	9100	7900
Maximum crushing strength	80	70	61	54	47	41	36	30

8. **Strength Properties**

   Values are from Bootle, K.R. (1983). 'Wood in Australia. Types, properties and uses'. (McGraw-Hill)

9. **Uses**

   Various past and potential uses are given, but the list is obviously not conclusive.

10. **Availability**

    Timber from many species is available only near the areas that the trees grow naturally or in plantations. Imported timbers and their current availability are identified.

Timber Advisory Notes

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UTILISATION OF *Pinus pinaster*

Introduction

The maritime pine (*Pinus pinaster*) occurs naturally in a range of geographic areas or provenances around the Mediterranean Sea. For this reason it was recognised as early as 1916 that the species had potential in Western Australia, with its Mediterranean climate. A paper by Hopkins and Butcher in the first edition of the CALMScience Journal in December 1993 gives a detailed description of the geographic races. However, for the purposes of this Information Sheet it is sufficient to discuss the major areas which provided the seed sources for the *P. pinaster* grown in Western Australia i.e. the Landes provenance from South-west France and the Leirian material from Portugal.

The Forests Department had carried out an extensive tree-breeding program with the species, and had achieved considerable improvements in the quality of the trees being planted. This program was supplemented by intensive silvicultural treatments which have further improved wood quality. Most of the *P. pinaster* forests have been grown at wide spacing to reduce the amount of water used by the trees on one of Perth's main water supplies, the Gnangara Mound. Consequently, with the additional space available to each tree, branches can grow unacceptably large unless the trees are pruned. An extensive pruning program was therefore carried out since the 1960s to improve the wood quality because large branches produce large knots in the sawn timber. Clear wood is produced by the trees after pruning, and therefore wood quality is improved.

The Department of CALM continued this research from its formation in 1985. The pedigreed *P. pinaster* is now available for planting of private areas as well as in Departmental plantations, and is particularly suitable for the areas north of Perth with their low rainfall and comparatively poor soils. The area planted to *P. pinaster* is approximately 27 500 ha, and in 1994 about 800 ha were established.

This Information Sheet is intended to provide information on the wood properties of the species, and on past, current and potential future uses.

Physical and Mechanical Properties

Early CSIRO research on the shrinkage and density of Western Australian-grown *P pinaster* estimated air-dry density of about 595 kg/m^3, compared with 485 to 590 kg/m^3 for *P. radiata*. A 1982 assessment of density and mechanical properties of the species in Western Australia reported mean air-dry density of 560 kg/m^3 (range 475 to 650 kg/m^3) over a range of provenances, with trees ranging from 15 to 44-years-old.

The strength properties of seasoned timber of Western Australian-grown *P. pinaster* in the above study (including the 15-year-old trees) are given in the Table below, with the comparable figures for *P. radiata* (minimum age 25 years), and jarrah (*E. marginata*). With timber from similarly aged trees, *P. pinaster* should have an advantage. The mean figures are used as the basis for stress-grading.

Species	Modulus of Rupture (MPa)	Modulus of Elasticity (MPa)	Maximum Crushing Strength (MPa)
P. pinaster (25 yrs+)	95.5	14 800	54.0
P. pinaster (15 yrs)	73.0	9 300	38.2
P. pinaster(Mean)	82.6	11 680	45.1
P. radiata	87.0	11 480	48.3
E. marginata	112	12 970	61.0

CSIRO reported mean tangential shrinkage of 5.0 per cent, and mean radial shrinkage of 3.0 per cent for *P. pinaster.*

Sawmilling

Previous sawmilling was based on the older resource from unselected seed sources, and consequently it was of lower quality than the pedigreed resource, improved by tree-breeding, which is now available. Sawmillers working with logs from the older *P. pinaster* trees commented that lower feed speeds through the saw were necessary than used for *P radiata*, because *P. pinaster* had higher density timber which was more abrasive on saws. Dead knots in *P. pinaster* had caused problems, and recoveries were slightly lower because more docking of defects was required. In addition, the slightly more yellow timber of *P. pinaster* was considered less desirable than the whiter timber of *P. radiata*, and because of the above reasons costs were therefore slightly higher for milling *P. pinaster.*

The major problem with the old growth logs was the high proportion of bark-encased knots because of inadequate pruning, and regular occurrences of resin veins and pockets. With structural grades, the higher resin content of *P. pinaster* compared with *P. radiata* has not been a problem, and it was appearance grades that were affected.

The timber resource that is currently available is of considerably higher quality. For example, only pedigreed *P pinaster* has been planted since 1974, and as discussed previously, the extensive pruning program and other silvicultural treatments since the early 1960s have resulted in improved wood quality. The limited sawmilling to date of this pedigreed resource has confirmed the improved quality.

In 1995/6, 37 000 m^3 of *P. pinaster* sawlogs were harvested from State plantations, as well as 2600 m^3 of pine rounds for preservative treatment and 89 000 m^3 of industrial wood logs.

Timber Drying

The Department has assessed high temperature drying of *P. pinaster*, and found that the species behaves similarly to *P. radiata* when using standard pine drying schedules in high temperature kilns. High temperature drying means that the kiln is operating at more than 100^{0}C.

Any sawn timber that was to be air-dried would need to be dipped in anti-sapstain chemicals such as 'Hylite' or Koppers' 'NP1' to prevent sapstaining. However, air-drying is not generally recommended because heart-in timber i.e. within 50 mm of the pith, is susceptible to twist when dried slowly

Grading of Structural Timber

Strength testing of W.A.-grown *P. pinaster* resulted in a strength group of SD6 being allocated for seasoned timber of the species. This strength group is the same as that for *P. radiata*, because the average values for *P. pinaster* were reduced by including a high proportion of young trees. The data indicated that P. pinaster would be stronger than P. radiata of the same age. However, there are definite practical advantages in visually stress grading the two species together. This would be done using AS 2858-1986 'Timber - Softwood - Visually stress-graded for structural purposes'.

Until the last few years, milling structural timber was the major use of *P. pinaster*. Visual stress grading would not give *P. pinaster* any advantage over *P. radiata*, because both species have the same strength group, and the same size limits for defects apply for a particular stress grade. Proof grading or mechanical stress grading should result in a larger proportion of higher stress grade timber from *P. pinaster* when similar aged material is graded. In recent years there has been a trend to in-grade testing, as described in AS/NZ 4063-1992, published by Standards Australia. Briefly, the strength properties of a particular population within the species are assessed, and used to develop suitable grading criteria. However, an extensive testing program would be required to establish rules for *P. pinaster*.

Other Sawn Timber

The species has been used for mining timber in Europe and North Africa, but has little potential for this purpose in Australia.

In South Australia, top or crown logs of *P. pinaster* have been sawn for lining boards. While tight intergrown knots were the general rule, there is the possibility of them checking slightly. The heavy branches at the base of the green crown were considered a problem by South Australian sawmillers. Mouldings would be a limited market, because of the lower hardness of pines compared with hardwood species, and the need to finger-joint. Flooring timbers could be produced which would be suitable with floor coverings provided that the knots were tight, and *P. pinaster* would be harder than *P. radiata*.

Manufacture of pallets is an alternative use, and as the packaging market is growing, *P. pinaster* has considerable potential.

In furniture manufacture, although there had been some comment about reduced screwholding ability in pieces with high resin content, there would be no problems with the clear wood produced after trees were pruned. This defect-free material should have an advantage in strength over *P. radiata* of the same age and ring width.

Preservation

The South African experience has been that *P. pinaster* is easier to treat with waterborne preservatives such as copper-chrome-arsenic (CCA), or with oilborne preservatives such as creosote, than is *P. radiata*.

Panel Products

The major use of residue material is now as medium density fibreboard (MDF), which is manufactured by Wesfi at its Kewdale plant.

Pruned logs are definitely suitable for appearance grades of plywood or similar products. Structural plywood usage is increasing, and the occasional bark-encased knots such as occurred in the Landes resource of *P. pinaster* becomes less important than in appearance grades of plywood.

Particleboard from *P. pinaster* logs is a higher strength, higher density product than that produced from *P. radiata*. The Wesfi plant at Dardanup has made specific requests for *P. pinaster* at times, generally to provide for the export market. The two pine species are kept separate in the manufacturing process.

Poles

The major testing of strength properties of *P. pinaster* poles was in South Africa. The SEC has tested a small sample locally, but extensive testing would be required to provide data for design stress calculation. The species can be easily preservative-treated, usually with copper-chrome-arsenic (CCA), and would be less susceptible to attack by soft rot or higher fungi than hardwoods are. The taper of the stem tends to be small, which could be a disadvantage from the aesthetic viewpoint.

Sleepers

The South African experience was that treated pine sleepers performed better than treated hardwood, including jarrah. *P. pinaster* was considered to give better results than *P. radiata*, because of more effective treatment with more sapwood and better penetration by preservatives.

Two piece dowelled sleepers of *P. pinaster, P. radiata* and jarrah regrowth, treated with furnace oil/creosote, were tested in the early 1980s in a joint Westrail/Forests Department trial, and gave good results. Dowelling has been used successfully in North America.

Although sleepers of *P. radiata* pressure-treated with creosote/furnace oil have performed well in South Australia and Victoria, it is presumed that there is limited scope for treated pine sleepers with the increasing use of concrete sleepers.

Pulp and Paper

P. pinaster has been shown to have satisfactory pulping characteristics. For example, the species has been used extensively as pulpwood for manufacturing kraft paper in the Landes area of France. In Australia, pulping trials of South Australian grown *P. pinaster* and *P. radiata* showed that both species produced satisfactory pulps, with *P. pinaster* producing inferior pulp except in the neutral sulphite semi-chemical process. Future shortages of long-fibred pulp have been forecast in the overall world supply, but it is unlikely that Western Australia could produce the quantities required as well as the volume required for MDF and glue-laminated products.

Residues

The species has been widely used for energy production, including charcoal. Production of naval stores, including resin and turpentine, have been traditional uses in the natural distribution in Europe, but this type of use is unlikely in Western Australia. The bark has been used for horticultural purposes.

Summary

In general, *P. pinaster* is a very satisfactory species for general utilisation, particularly for MDF and structural use. It is essential that the local industry is aware of the significant differences between old growth *P. pinaster* (Landes and Leirian provenances) and the pedigreed material which is given superior silvicultural treatment and will provide the future resource. Mechanical grading of *P. pinaster* should give it an advantage over *P. radiata.*

Softwood poles are an option for the future, because of the problems of fungal attack in hardwoods. New preservatives may be developed which will reduce the incidence of fungal attack in hardwoods, but the hardwood pole resource is dwindling. Softwood poles are easy to treat with preservative.

The use of *P. pinaster* for panel products has continued to increase, and MDF presumably being the major product.

General reading

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