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Ash, European 10	European beech (Fagus sylvatica)
Balau, Red (Heavier) 14	Selangan batu (Shorea spp.), Giam (Hopea spp.)
Balau/ Selangan batu (Heavier) 16	Red Balau (Shorea spp.), Giam (Hopea spp.), Indian Sal (Shorea robusta)
Ebony, African 34	Indian Ebony (Diospyros ebenum)
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A HANDBOOK OF LESSER KNOWN TIMBERS

K. M. Bhat[1]
P. K. Thulasidas[1]
K. H. Hussain[2]

[1]Division of Forest Utilisation
[2]Division of Library and Information

Kerala Forest Research Institute
An institution of Kerala State Council for Science Technology & Environment
Peechi - 680 653, Kerala, India

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The Kerala Forest Research Institute (KFRI) is one of the five institutions under the Kerala State Council for Science, Technology and Environment (KSCSTE) of the Government of Kerala, established in 1975. By conducting time-bound multidisciplinary applied research in thrust areas of tropical forestry, KFRI has created a niche among the leading forest research organizations in the tropics. The Institute undertakes multidisciplinary research on all aspects of tropical forestry including wood science and technology, wildlife biology and socio-economics under the Programme Divisions. KFRI has a sub-centre at Nilambur and a Field Station at Veluppadam for carrying out nursery and plantation trials, germplasm collection, etc. KFRI has the largest collection of bamboo and rattan species in India for research and conservation purpose. Also at Nilambur, there is a Teak Museum, the only one of its kind, devoted to a single tree species in the world; it is open to public, researchers, forest officials and others interested in teak.

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INTRODUCTION

In 1981, Kerala Forest Research Institute (KFRI) had brought out a *Handbook of Kerala Timbers*, for the benefit of various sectors involved in timber production, processing and marketing which provides information for 162 common timbers. Apart from the non-forest plantations (rubber wood, coconut, etc.) and forest plantations of eucalypts, teak, acacia and pines, it is recognised that the futuristic timber supply is from the trees outside forests (ToF) especially farm lands, estates/converted forests, small woodlots, etc. as well as from the import which include many commercially unfamiliar species in Kerala, India. India being one among the major log importers in Asia, the dependence on import is likely to increase for all industrial wood products by 2010, at least 16% of industrial roundwood, 18% of sawn wood, 28% of wood-based panels, 9.2% of paper and paper-board and 11.6% of fibre furnish in the country (FAO 1998). In Kerala, the State forests including plantations account for only 9% of industrial round wood supply, in contrast to 76% by households and estates while the rest being from imports (Krishnankutty 1990, 1998, 2005). Therefore, many lesser known timbers increasingly become significant in the market supply, causing difficulties in assessing the quality and price fixation.

This handbook will serve as a source of ready reference in the trade and user-sectors to get acquainted with the lesser known timbers of domestic market particularly in Kerala. Properties and uses of 77 timbers are provided in the handbook of which 52 timbers are imported species. The information presented on various properties of timbers and their standard trade and botanical names will facilitate selection of right timber for various applications. This will also be of use to organisations like State Forest Departments, Central Public Works Department, and various public-sector units/ Corporations, who commonly handle timbers.

This user-friendly handbook with illustrations of wood figure (colour, grain and texture) and appearance will point to right choice of timbers especially to substitute the well known commercial timbers which are increasingly becoming scarce in the market. The market price of timber in Indian Rupees (as on year 2006) wherever available, and the substitutes for some of the well-known timbers are also highlighted for the benefit of end-users.

The handbook was prepared by collating published technical information and newly investigated properties of 77 timbers obtained from wood farm/agroforestry sectors and imported sources of Kerala, including those supplied from other states in India. Besides the hardcopy, computer CD-ROM is also provided for the benefit of those who seek real images of surface appearance of different wood species along with technical properties. Content of the CD can be browsed using Adobe Acrobat Reader and can be navigated through the index.

Timber Classification/Explanatory Note

Name and Timber Identity

For each timber, before description of properties, standard trade name and vernacular names are given in accordance with Indian Standard or as mentioned in the international sources of publications for imported timbers. This is followed by botanical name and family

of the timber before indicating the distribution/origin of supply. Timber species are organised in the text as per the standard trade name in alphabetical order.

Timber Description

Each timber is described in the following manner:

Colour: Generally referred to heartwood only unless noted otherwise as heartwood and sapwood.

Weight (Specific gravity): Depending on weight, in air-dry condition, timber is classified as:

a. Very light and light (Specific gravity up to 0.55)
b. Moderately heavy (Specific gravity 0.55-0.75)
c. Heavy and very heavy (Specific gravity above 0.75)

Texture:

a. Fine (Smooth to feel)
b. Medium (Fairly smooth to feel)
c. Coarse (Rough to feel)

Strength group:

a. Weak (Compression parallel to grain up to 28 N/mm^2*)
b. Moderately strong (Compression parallel to grain: 28-41 N/mm^2)
c. Strong and very strong (Compression parallel to grain: above 41 N/mm^2)

Durability: Life span in years (as determined by graveyard tests)

a. Perishable (Less than 5 years)
b. Moderately durable (5-10 years)
c. Durable (10-25 years)
d. Very durable (above 25 years)

Treatability: Ability of the timber to preservative treatment

a. Easy (Timbers that can be penetrated with preservatives completely under pressure without difficulty)
b. Moderately resistant (Timbers that are fairly easy to treat)
c. Resistant (Timbers that are difficult to impregnate under pressure)
d. Extremely resistant (Timbers that are refractory to treatment)

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Krishnankutty, C. N. 1998. Timber price trends in Kerala. *KFRI Research Report 160*. Kerala Forest Research Institute, Peechi, India.

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*1N/mm^2 (1 newton per square millimeter) = 1 MPa (1 mega pascal) = 10.2 Kg/cm^2 (10.2 kilogram per square centimeter)

Standard Trade Name

ACACIA / EAR-POD WATTLE

Flat sawn

Quarter sawn

Cross cut

Vernacular names	Akasia (Indonesia), Australian babul, Australian wattle, Acacia, Kasia (India), Darwin black wattle, Tan wattle (Australia)
Botanical name	*Acacia auriculiformis* A. Cunn.ex Benth.
Family name	Fabaceae
Origin (Distribution)	Native to Papua New Guinea, Australia and Solomon Islands; introduced to many tropical countries as a fast growing plantation species for pulpwood.

THE WOOD

Colour	Heartwood light brown to dark red; clearly demarcated from the yellowish white sapwood.
Weight	Moderately heavy (Air-dry specific gravity 0.60-0.75 with average value of 0.72)

Grain Straight or wavy

Texture Fine

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	74	10531	45.0

Drying and shrinkage Dries easily; Shrinkage- radial (2.0%), tangential (4.0%), volumetric (6.0%)

Durability Moderately durable

Treatability Moderately resistant

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing- satisfactory; Finish- good

Typical uses Mainly used for pulpwood production. Suitable for door and window shutters, light construction, furniture, flooring, industrial and domestic woodware, tool handles, turnery articles, carom coins, agricultural implements, charcoal etc.

Price (Rs. per m^3) Log: 6000-11000

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Bolza, E., and Keating, W. G. 1982. Characteristics, Properties and Uses of Timbers of South-east Asia, Northern Australia and the Pacific. Vol. 1, CSIRO, INKATA Press, Melbourne, Australia. 362p.

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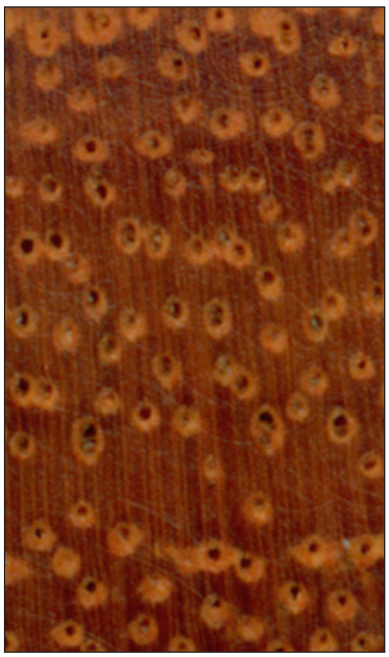
Wood News. 2005. Acacia (*Acacia auriculiformis*). Vol. 15 (1): 22-24.

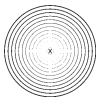
Standard Trade Name

AFZELIA

Flat sawn



Cross cut



Vernacular names	Aligna (Nigeria), Azza, Beyo (Uganda), Chamfuta (Mozambique), Doussié (Cameroon), Lingué (Ivory Coast), Papao (Ghana), Bolengu (Zaire), Afzelia (UK)
Botanical name	*Afzelia* spp.
Family name	Fabaceae
Origin (Distribution)	Tropical West, Central and East Africa

THE WOOD

Colour	Heartwood light brown when freshly cut, darkening to reddish brown upon exposure; moderately lustrous; clearly demarcated from the pale straw to whitish sapwood. Wood pores contain a yellow dyestuff, *afzelin* which under moist conditions may discolour textiles, paper or other cellulosic materials.
Weight	Heavy (Air-dry specific gravity 0.62-0.95 with average value of 0.82)

Grain Straight to interlocked

Texture Medium to coarse

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	125	13100	79.2

Drying and shrinkage Dries slowly; Shrinkage- radial (1.0%), tangential (1.5%), volumetric (2.5%)

Durability Very durable

Treatability Extremely resistant

Working properties Rather difficult to saw and machine because of rapid dulling of saw teeth and cutters, but works to a smooth finish.

Typical uses Highly valued timber for interior and exterior joinery, door and window frames, furniture, flooring, heavy construction including harbor and dock work, laboratory equipment and chemical containers. Sliced veneers used for decorative veneering, flush doors etc.

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Bolza, E., and Keating, W. G. 1972. African timbers- the properties, uses and characteristics of 700 species. Division of Building Research, CSIRO, Melbourne, Australia.

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

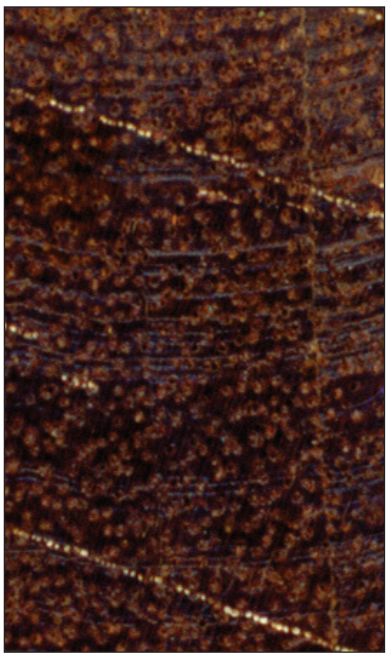
Lavers, G. M. 1967. The strength properties of timbers. *Forest Products Research Bulletin. No. 50,* Her Majesty's Stationery Office, London.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

ALAN BATU (Heavier form)

Quarter sawn



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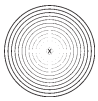


Vernacular names	Alan, Alan batu, Meraka (Malaysia)
Botanical name	*Shorea albida* Sym.
Family name	Dipterocarpaceae
Origin (Distribution)	Malaysia

THE WOOD

Colour	Heartwood deep reddish brown to purplish red; clearly distinct from the light greyish brown sapwood. White coloured streaks of gum canals on the flat-sawn and cross cut surfaces are conspicuous.
Weight	Heavy (Air-dry specific gravity 0.80- 0.93 with average value of 0.81)
Grain	Slightly interlocked
Texture	Medium to coarse

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	114	13600	57.0

Drying and shrinkage Dries fairly rapidly; Shrinkage- radial (2.1%), tangential (5.2%), volumetric (7.3%)

Durability Very durable

Treatability Resistant

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing- good but pre-boring necessary; Finish- good

Typical uses Used for industrial or heavy flooring, panelling, heavy and medium construction, boat building, furniture, exterior and interior joinery.

Special remarks / diagnostic features : Similar to Indian Sal (*Shorea robusta*). A substitute timber for Giam (*Hopea* spp.) and Red Balau (*Shorea* spp.)

Price (Rs. per m^3) Log: 19500-23000

Additional reading

Keating, W. G., and Bolza, E. 1982. Characteristics, Properties and Uses of Timbers of South-east Asia, Northern Australia and the Pacific. Vol. 1, CSIRO, INKATA Press, Melbourne, Australia. 362p.

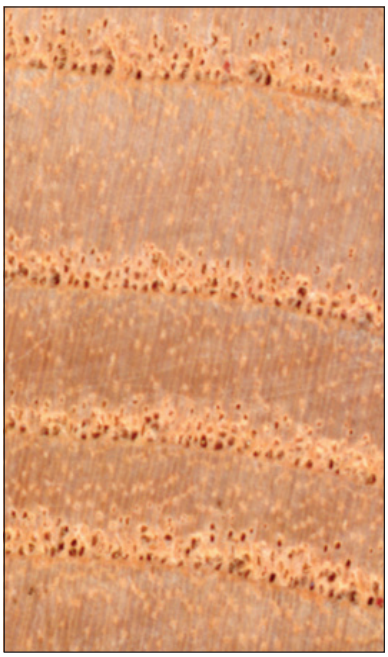
International Tropical Timber Organisation 1997. The Database of Tropical Industrial Lesser-used Wood Species. ITTO Project PD 58/97 Rev. 1 (1), Reference Guide to Tropical Timber Species. Nagoya University Museum, Nagoya, Japan.

Malaysian Timber Industry Board. 1986. 100 Malaysian Timbers. 50728 Kuala Lumpur, Malaysia. 226p.

Standard Trade Name

ASH, AMERICAN

Quarter sawn



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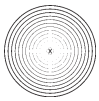


Vernacular names	White ash, Green ash (USA), Canadian ash (UK), Red ash (Canada)
Botanical name	*Fraxinus americana* L.
Family name	Oleaceae
Origin (Distribution)	USA and Canada

THE WOOD

Colour	Heartwood colour varies from greyish brown to light brown, to pale yellow streaked with brown; moderately lustrous. Sapwood creamy-white.
Weight	Heavy (Air-dry specific gravity approx. 0.67)
Grain	Straight
Texture	Coarse and even

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	103.7	11977	51.1

Drying and shrinkage Dries easily without degrade; Shrinkage- radial (5%), tangential (8%), volumetric (13%)

Durability Perishable

Treatability Moderately resistant

Working properties Planing- fairly easy; Boring- easy; Turning- rather poor; Nailing- easy; Finish- good

Typical uses Suitable for plywood and decorative veneer, interior joinery, panelling, kitchen cabinets, furniture, tool handles, agricultural implements, boat frames, vehicle bodies, tennis rackets, piano frames. White ash is famous for the manufacture of various kinds of sports goods.

Special remarks / diagnostic features : American ash is similar in appearance and colour to European ash (*Fraxinus excelsior*)

Price (Rs. per m^3) Log: 30000

Additional reading

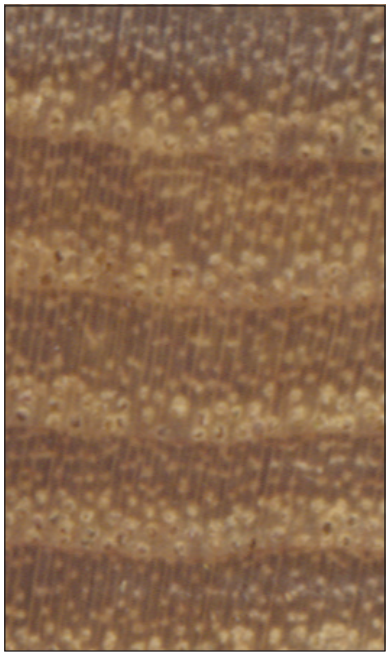
Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

ASH, EUROPEAN

Flat sawn



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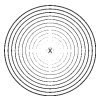


Vernacular names	Common ash, English ash, Belgian ash, French ash, Weeping ash
Botanical name	*Fraxinus excelsior* L.
Family name	Oleaceae
Origin (Distribution)	Throughout Europe, West Africa and Western Asia

THE WOOD

Colour	Heartwood is cream to light brown occasionally with irregular dark brown lines. Sapwood and heartwood not distinct.
Weight	Moderately heavy (Air-dry specific gravity approx. 0.51- 0.83 with average value of 0.69)
Grain	Straight, decorative in plain-sawn surface
Texture	Coarse and even

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	116	11900	53.3

Drying and shrinkage Dries fairly rapidly and care need to be taken to avoid surface checking and splitting; Shrinkage- radial (4.5%), tangential (7%), volumetric (11.5%)

Durability Perishable

Treatability Moderately resistant

Working properties Planing- easy; Boring- easy; Turning- satisfactory; Nailing- easy but pre-boring necessary; Finish- good

Typical uses Due to its renowned toughness and pliability, the wood is suitable for tool handles, sports goods such as hockey sticks, oars and hurdles. Extensively used for decorative veneer, plywood, interior joinery, panelling, kitchen cabinets, furniture, agricultural implements, boat building, vehicle bodies, bentwood furniture, fancy turnery and laminated articles.

Special remarks / diagnostic features : The wood is similar to European beech (*Fagus sylvatica*) in strength properties, but has outstanding toughness.

Additional reading

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

BABUL

Flat sawn

Quarter sawn

Cross cut

Vernacular names	Babul (India), Gabdi (Cameroon), Mgunga (East Africa)
Botanical name	*Acacia nilotica* (Linn.) Willd. ex Del. Syn. *Acacia arabica* Auct. non (Lamk.) Willd.
Family name	Fabaceae
Origin (Distribution)	India (Gujarat, Rajasthan, Maharashtra, Madhya Pradesh) and Africa

THE WOOD

Colour	Heartwood pinkish brown to reddish brown, lustrous; sapwood wide, whitish to pale yellow.
Weight	Heavy (Air-dry specific gravity 0.72- 0.85 with average value of 0.80)
Grain	Straight to interlocked

Texture Medium to coarse

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	87	11058	52.5

Drying and shrinkage Dries rather slowly without degrade; Shrinkage- radial (2.6%), tangential (6.0%), volumetric (8.6%)

Durability Very durable

Treatability Resistant

Working properties Planing- rather easy; Boring- easy; Turning- easy; Nailing- good but pre- boring necessary; Finish- good

Typical uses Used in constructional work for posts, beams, rafters, door and window shutters and frames. Also used for agricultural implements, tool handles, cart building, sports goods and charcoal.

Special remarks / diagnostic features :A heavy, somewhat twisted-grained and coarse textured reddish brown non-ornamental wood; one of the best of Indian *Acacia* species.

Price (Rs. per m^3) Log: 13000
Converted: 16000

Additional reading

Nazma, Ganapathy, P. M., Sasidharan, N., Bhat, K. M., and Gnanaharan, R. 1981. A Handbook of Kerala Timbers. *KFRI Research Report No. 9*, Kerala Forest Research Institute, Peechi, Kerala, India, 260p.

Pearson, R. S and Brown, H. P. 1981. Commercial timbers of India: their distribution, supplies, anatomical structure, physical and mechanical properties and uses. Vols. I- II. A. J. Reprints Agency, New Dehli, India. 1150p.

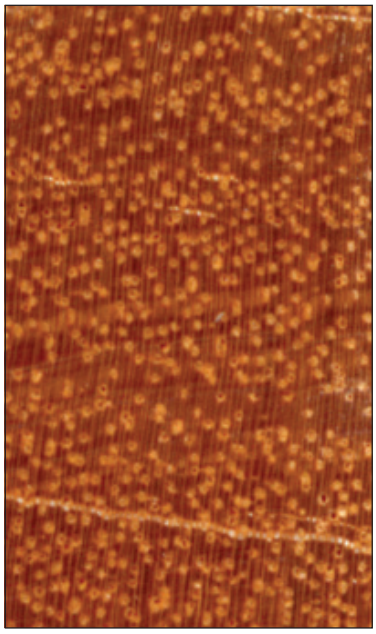
Ramesh Rao, K. and Purkayastha, S. K.1972. Indian woods: Their identification, properties and uses. Volume III, Leguminosae to Combretaceae. Manager of Publications, Govt. of India Press, Delhi, India. 262p.

Tewari, M. C., Rajput, S. S. 1987. *Acacia nilotica* - utilisation aspects. *Journal of the Timber Development Association of India*, 33 (2):28-32.

Standard Trade Name

BALAU, RED (Heavier form)

Quarter sawn



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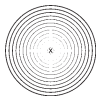


Vernacular names	Red selangan batu, Selangan batu merah (Malaysia), Balau merah (Indonesia), Guijo (Philippines)
Botanical name	*Shorea* spp.
Family name	Dipterocarpaceae
Origin (Distribution)	Malaysia, Indonesia and Philippines

THE WOOD

Colour	Heartwood light to deep red brown; clearly demarcated from the purple brown or grey brown sapwood. Gum canal visible as concentric lines on cross-cut surface.
Weight	Heavy (Air-dry specific gravity 0.80-0.88)
Grain	Interlocked
Texture	Medium to coarse

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	142	17000	69.2

Drying and shrinkage Dries rather slowly; liable to surface check and split, end coating recommended; Shrinkage- radial (2.2%), tangential (3.6%), volumetric (5.8%)

Durability Durable

Treatability Extremely resistant

Working properties Planing- easy; Boring- easy to slightly difficult; Turning- easy to difficult; Nailing- poor; Finish- good

Typical uses Used for heavy and medium construction, beams, transmission posts, lorry and truck bodywork, railway sleepers, flooring, furniture, door and window frames.

Special remarks/ diagnostic features : A substitute timber to Selangan batu (*Shorea* spp.) and to Giam (*Hopea* spp.) but more reddish.

Price (Rs. per m^3) Log: 19500-25000

Additional reading

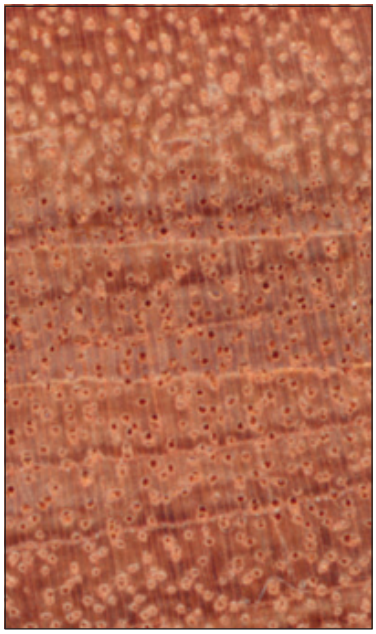
Keating, W. G., and Bolza, E. 1982. Characteristics, Properties and Uses of Timbers of South-east Asia, Northern Australia and the Pacific. Vol. 1, CSIRO, INKATA Press, Melbourne, Australia. 362p.

Malaysian Timber Industry Board. 1986. 100 Malaysian Timbers. 50728 Kuala Lumpur, Malaysia. 226p.

Standard Trade Name

BALAU/ SELANGAN BATU (Heavier form)

Flat sawn



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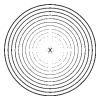


Vernacular names	Balau, Kumus, Selangan batu (Malaysia), Aek, Chan (Thailand), Sen (Vietnam), Thitya (Myanmar)
Botanical name	*Shorea* spp.
Family name	Dipterocarpaceae
Origin (Distribution)	South-east Asia, mainly in Malaysia

THE WOOD

Colour	Heartwood yellow brown, varying to brown and dark reddish-brown; clearly distinct from the paler coloured sapwood. Gum canal visible as white lines on the flat sawn surface and as concentric lines on cross-cut surface.
Weight	Heavy (Air-dry specific gravity 0.85-1.15 with average value of 0.90)

Grain Interlocked

Texture Fine and even

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	142	20100	76.0

Drying and shrinkage Dries very slowly with a tendency to warp; thick material may check and end split, end coating suggested; Shrinkage- radial (2.1%), tangential (3.9%), volumetric (6.0%)

Durability Very durable

Treatability Extremely resistant

Working properties The wood is moderately difficult to work with machines as the interlocked grain and toughness has a blunting effect on tools. Planing- fairly difficult; Boring- slightly difficult; Turning- easy; Nailing- poor; Finish- good

Typical uses Used for all forms of heavy construction, utility furniture, bridges, railway sleepers, industrial or heavy flooring, piling, transmission posts, beams, boat building, lorry and truck body work, door and window frames, boxes and crates.

Special remarks / diagnostic features **:** A substitute timber for Red balau (*Shorea* spp.) Giam (*Hopea* spp.) and to Indian Sal (*Shorea robusta*).

Price (Rs. per m^3) Log: 21000-27000

Additional reading

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

Malaysian Timber Industry Board. 1986. 100 Malaysian Timbers. 50728 Kuala Lumpur, Malaysia. 226p.

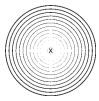
William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

BANYAN

Quarter sawn

Cross cut



Vernacular names	Peepal, Peraal, Banyan (India)
Botanical name	*Ficus bengalensis* L.
Family name	Moraceae
Origin (Distribution)	Asia

THE WOOD

Colour	Creamy white to greyish white when first exposed, turning grey or pale brownish grey with age, discolours rapidly; heartwood and sapwood not distinct.
Weight	Light to moderately heavy (Air-dry specific gravity approx. 0.61)
Grain	Shallowly interlocked
Texture	Coarse and uneven

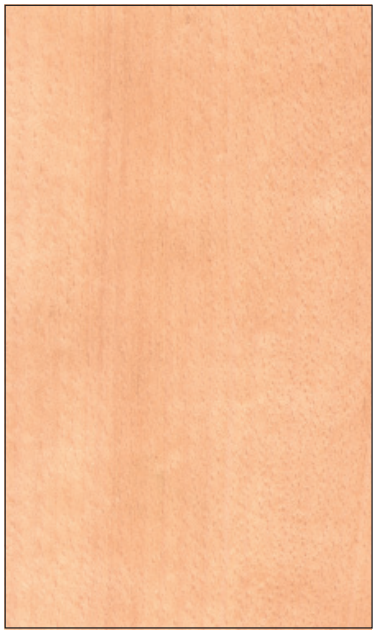
Strength	Weak
Drying and shrinkage	Dries easily; liable to warp. Shrinkage data not available.
Durability	Perishable
Treatability	Easy
Working properties	Sawing-easy; mottling figure may be obtained by flat-sawing.
Typical uses	Wood of the third class, used for making tea boxes, toys and for light packing cases.

Additional reading

Pearson, R. S and Brown, H. P. 1981. Commercial timbers of India: their distribution, supplies, anatomical structure, physical and mechanical properties and uses. Vols. I- II. A. J. Reprints Agency, New Dehli, India. 1150p.

Standard Trade Name

BEECH, EUROPEAN



Flat sawn

Quarter sawn

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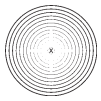


Vernacular names	Carpathian beech, Danish beech, Yugoslavian beech
Botanical name	*Fagus sylvatica* L.
Family name	Fagaceae
Origin (Distribution)	Europe (from southern Norway to northern Spain and from southern England to Black Sea) and western Asia.

THE WOOD

Colour	Heartwood pale brown when freshly cut, turning reddish brown on exposure; lustrous; not distinct from the sapwood. After steaming, the colour changes to pink or light red.
Weight	Heavy (Air-dry specific gravity approx. 0.72)
Grain	Straight

Texture Fine and even

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	118	12600	56.3

Drying and shrinkage Dries fairly rapidly; Shrinkage- radial (4.5%), tangential (9.5%), volumetric (14.0%)

Durability Perishable

Treatability Easy

Working properties Planing- moderately easy; Boring- easy; Turning- easy; Nailing- good but pre-boring necessary; Finish- good

Typical uses Beech wood is perishable and hence generally used indoors. Mainly used for cabinetmaking, high class joinery, panelling, solid and laminated furniture, plywood and face veneer. Good timber for turnery, steam bending, flooring, domestic woodware, tool handles and sports goods. The wood also makes good charcoal, especially for producing gunpowder. Sliced veneers have an excellent flecked figure on quarter-sawn surface.

Price (Rs. per m^3) Log: 28000-32000

Additional reading

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

Lavers, G.M. 1967. The Strength Properties of Timbers. *Forest Products Research Bulletin, No. 50*, Ministry of Technology, Her Majesty's Stationery Office, London.

Timber Research and Development Association. 1980. Timbers of the World. Volume 2. The Construction Press Ltd; Lancaster, England.

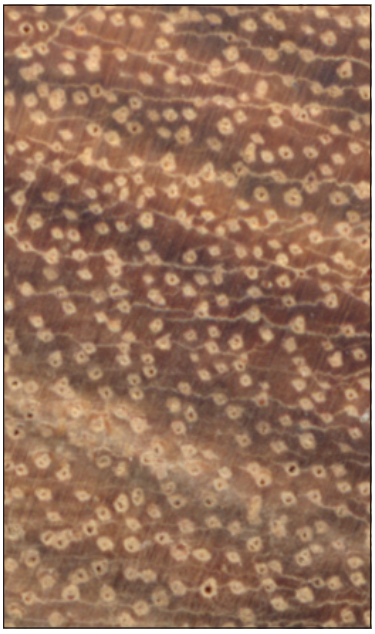
William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Wood News. 2004. Beech (*Fagus* spp.). Vol. 14 (2): 20-23.

Standard Trade Name

BELI

Flat sawn



Cross cut

Vernacular names	Awoura, Beli (Gabon), Ekop-Beli (Cameroon), Zebrali (France, Germany)
Botanical name	*Julbernardia pellegriniana* Troupin Syn. *Paraberlinia bifoliolata* Pellgr.
Family name	Fabaceae
Origin (Distribution)	Tropical West Africa

THE WOOD

Colour	Heartwood light brown with a darker, longitudinal stripped figure; clearly demarcated from the yellowish white sapwood. Wood highly veined with alternate dark and light coloured streaks.
Weight	Heavy (Air-dry specific gravity 0.75- 0.85 with average value of 0.80)

Grain Straight or interlocked, sometimes oblique

Texture Medium to coarse

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	128	17832	68.2

Drying and shrinkage Drying is moderately easy; Shrinkage- radial (4.3%), tangential (8.9%), volumetric (13.5%)

Durability Moderately durable. The wood is not suitable for conditions with risks of permanent or long-lasting humidification.

Treatability Moderately resistant

Working properties Planing- moderately easy; Boring- easy; Turning- easy; Nailing- good but pre- boring necessary; Finish- good

Typical uses Used for high class furniture and cabinet work, interior joinery, panelling, heavy carpentry, agricultural implements, boat building and sliced veneer.

Additional reading

CIRAD- Forestry Department. 2003. TROPIX 5.0, Technological characteristics of 215 tropical species. Montepellier, France.

International Tropical Timber Organisation 1997. The Database of Tropical Industrial Lesser-used Wood Species. *ITTO Project PD 58/97 Rev. 1 (1), Reference Guide to Tropical Timber Species*. Nagoya University Museum, Nagoya, Japan.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

BISHOPWOOD / CHOLAVENGA

Flat sawn

Quarter sawn

Cross cut

Vernacular names	Gadog (Indonesia), Nhoi (Vietnam), Neeli, Uriam, Cholavenga (India), Tuai (Philippines)
Botanical name	*Bischofia javanica* Bl.
Family name	Euphorbiaceae
Origin (Distribution)	Extending from India to South China, Pacific islands and Northern Australia

THE WOOD

Colour	Heartwood reddish brown to chocolate brown; clearly demarcated from the light creamy to reddish brown sapwood.
Weight	Moderately heavy (Air-dry specific gravity 0.50 - 0.90 with average value of 0.74)

Grain Straight to interlocked

Texture Coarse

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	86	11088	52.2

Drying and shrinkage Dries easily although liable to warping; Shrinkage- radial (3.9%), tangential (7.5%), volumetric (11.4%)

Durability Perishable

Treatability Moderately resistant

Working properties Saws easily when green; Planing- easy; Boring- easy; Turning- easy; Nailing- easy; Finish- good

Typical uses Used for construction as beams for building, panelling, packing cases and boxes, carom boards, carvings, music instruments, poles and posts.

Price (Rs. per m^3) Log: 11000

Additional reading

Bolza, E., and Keating, W. G. 1982. Characteristics, Properties and Uses of Timbers of South-east Asia, Northern Australia and the Pacific. Vol. 1, CSIRO, INKATA Press, Melbourne, Australia. 362p.

International Tropical Timber Organisation 1997. The Database of Tropical Industrial Lesser-used Wood Species. *ITTO Project PD 58/97 Rev. 1 (1), Reference Guide to Tropical Timber Species*. Nagoya University Museum, Nagoya, Japan.

Nazma, Ganapathy, P. M., Sasidharan, N., Bhat, K. M., and Gnanaharan, R. 1981. A Handbook of Kerala Timbers. *KFRI Research Report No. 9*, Kerala Forest Research Institute, Peechi, Kerala, India, 260p.

Pearson, R. S and Brown, H. P. 1981. Commercial timbers of India: their distribution, supplies, anatomical structure, physical and mechanical properties and uses. Vols. I- II. A. J. Reprints Agency, New Dehli, India. 1150p.

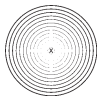
Standard Trade Name

BLUE PINE

Flat sawn

Quarter sawn

Cross cut



Vernacular names	Chil, Kail, Kairu, Raisalla (India)
Botanical name	*Pinus excelsa* Wall. Syn. *Pinus wallichiana* A. B. Jacks.ll.
Family name	Pinaceae
Origin (Distribution)	Himalayas from Afghanistan to Arunachal Pradesh in India, Nepal and Bhutan

THE WOOD

Colour	Heartwood pale red or pinkish red, with darker lines along the grain, fairly lustrous with resinous odour; clearly demarcated from the white or pale yellow sapwood.
Weight	Light (Air-dry specific gravity approx. 0.56)
Grain	Straight and even

Texture Medium

Strength Moderately strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	46.8	6800	36.3

Drying and shrinkage Dries easily, easy to kiln-season without degrade; Shrinkage data not available

Durability Perishable, but durable under cover

Treatability Easy to treat with preservatives

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing-easy; Finish- good

Typical uses Used for planking and ceiling in house construction, door and window frames, light furniture, general carpentry, packing cases and crates. It yields a good sleeper when treated.

Price (Rs. per m^3) Log: 9000-14000

Additional reading

Pearson, R. S and Brown, H. P. 1981. Commercial timbers of India: their distribution, supplies, anatomical structure, physical and mechanical properties and uses. Vols. I- II. A. J. Reprints Agency, New Dehli, India. 1150p.

Wood News. 1999. Pines.Vol. 9 (3): 41-43.

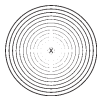
Standard Trade Name

CHARCOAL TREE

Flat sawn

Quarter sawn

Cross cut



Vernacular names	Indian nettle tree
Botanical name	*Trema orientalis* (Linn.) Blume
Family name	Ulmaceae
Origin (Distribution)	India, Nepal, Bangladesh, Myanmar and Sri Lanka

THE WOOD

Colour	Heartwood off white, light reddish-grey or tinged with pink colour; not distinct from the sapwood.
Weight	Light (Air-dry specific gravity approx. 0.39)
Grain	Straight to interlocked
Texture	Fine to medium

Strength Weak

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	54	8535	26.8

Drying and shrinkage Drying moderately difficult; Shrinkage- radial (6.9%), tangential (9.8%), volumetric (18.8%)

Durability Perishable

Treatability Easy

Working properties Planing-easy; Boring- easy; Turning- easy; Nailing- easy; Finish- good

Typical uses Suitable for manufacturing panel products, poles and drumsticks. Also used in making wooden shoes, fruit boxes, packing, handicrafts, particle board, charcoal, pulp and paper.

Price (Rs. per m^3) Log: 4500-7000

Additional reading

Gamble, J. S. 1972 (reprint). A Manual of Indian Timbes. Bishen Singh Mahendra Pal Singh, 23-A, Dehra Dun, India.

International Tropical Timber Organisation 1997. The Database of Tropical Industrial Lesser-used Wood Species. *ITTO Project PD 58/97 Rev. 1 (1), Reference Guide to Tropical Timber Species*. Nagoya University Museum, Nagoya, Japan.

Standard Trade Name

CHERRY, AMERICAN

Flat sawn

Quarter sawn

Cross cut

Vernacular names	Black cherry, Cabinet cherry, Wild black cherry, Wild cherry (USA)
Botanical name	*Prunus serotina* Ehrh.
Family name	Rosaceae
Origin (Distribution)	North America

THE WOOD

Colour	The heartwood varies in colour from reddish brown to deep red, or light reddish brown and will darken on exposure to light. Sapwood creamy-white.
Weight	Moderately heavy (Air-dry specific gravity 0.46-0.67 with average value of 0.58)
Grain	Straight

Texture Fine and even

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	85	10281	49.0

Drying and shrinkage Dries fairly easy; Shrinkage- radial (3.7%), tangential (7.1%), volumetric (10.8%)

Durability Moderately durable

Treatability Moderately resistant

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing- easy; Finish- satisfactory

Typical uses Suitable for furniture, cabinet work, boat interiors and high class joinery, panelling, plywood and decorative veneer, turnings and carvings, tobacco pipes, musical instruments, toys, professional and scientific instruments.

Price (Rs. per m^3) Log: 86000

Additional reading

Hough, A. F. 1965. Black cherry (*Prunus serotina* Ehrh.). *In*: Fowells, A. H. (ed.), *Silvics of forest trees of the United States. Agriculture Hanbook 271:* 539-545, USDA Forest Service, Washington, DC, USA.

Marquis, D. A. 1990. *Prunus serotina* Ehrh. Black Cherry. *In*: Burns, R. M., Honkala, B. H (eds.). *Silvics of North America. Volume 2. Hardwoods*. *Agriculture Handbook 654*: 238-249, USDA Forest Service, Washington, DC, USA. Also available at http://www.willow.ncfes.umn.edu/silvics_manual/volume_2/

Timber Research and Development Association. 1980. Timbers of the World. Volume 2. The Construction Press Ltd; Lancaster, England.

Standard Trade Name

CHIR PINE

Flat sawn

Quarter sawn

Vernacular names	Chil, Chir (India), Dhup (Nepal)
Botanical name	*Pinus roxburghii* Sarg. Syn. *Pinus longifolia* Roxb.
Family name	Pinaceae
Origin (Distribution)	Outer Himalayas from Punjab to Arunachal Pradesh in India, Pakistan, Afganistan, Bhutan and Nepal.

THE WOOD

Colour	Heartwood yellowish brown to reddish brown with age, with darker lines along the grain, somewhat lustrous with faint resinous odour and taste. Sapwood creamy-white.
Weight	Moderately heavy (Air-dry specific gravity approx. 0.68)
Grain	Straight to strongly twisted and uneven

Texture Medium

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	76	12600	52.6

Drying and shrinkage Dries easily; the timber kiln-seasons well, liable to excessive splitting, warping and cracking during seasoning, resin exudes on the surface during the process; Shrinkage- radial (5.9%), tangential (7.1%), volumetric (13.0%).

Durability Durable under cover

Treatability Easy

Working properties Planing- moderately easy; Boring- satisfactory; Turning- moderately easy; Nailing- good but pre-boring necessary; Finish- good

Typical uses A moderately heavy, straight to spiral grained, medium coarse-textured wood, more resinous than Blue Pine, but a good timber of the first class. Used for constructional purposes, cheap joinery and furniture, general carpentry, drawing boards, doors and window frames. Also used for making packing cases, matches, boxes and long fibred pulp.

special remarks / dignostic features : The wood is the best of the Indian Pines and stands next to Deodar (Devadaru), *Cedrus deodara* in value.

Price (Rs. per m^3) Log: 19500-25000

Additional reading

Pearson, R. S and Brown, H. P. 1981. Commercial timbers of India: their distribution, supplies, anatomical structure, physical and mechanical properties and uses. Vols. I- II. A. J. Reprints Agency, New Dehli, India. 1150p.

Purkayastha, S. K. 1996. A Manual of Indian timbers. Sribhumi Publishing Company. Calcutta, India.

Siddiqui, K. M. 1982. The wood and pulping properties of chir pine (*Pinus roxburghii* Sarg.) Part-I. Wood Properties. *Pakistan Journal of Forestry*, 33 (2):45-54.

Wood News. 1999. Pines. Vol. 9 (3): 41-43.

Standard Trade Name

EBONY, AFRICAN

Quarter sawn

Vernacular names	Cameroon ebony, Kukuo (Gambia), Mgiriti, Msindi (Tanzania), Nigerian ebony
Botanical name	*Diospyros* spp.
Family name	Ebenaceae
Origin (Distribution)	Equatorial West Africa, mainly in southern Nigeria, Ghana, Cameroon and Zaire.

THE WOOD

Colour	Heartwood uniform jet black or black brown sometimes with streaks; clearly demarcated from the pale red brown sapwood.
Weight	Very heavy (Air-dry specific gravity 0.96-1.12 with average value of 1.0)
Grain	Straight to slightly interlocked or somewhat curly

Texture Fine

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	189	17700	92.0

Drying and shrinkage Dries fairly rapidly; Shrinkage- radial (5.5%), tangential (6.5%), volumetric (12.0%).

Durability Very durable

Treatability Extremely resistant

Working properties Planing- slightly difficult; Boring- easy; Turning- easy; Nailing- good but pre-boring necessary; Finish- good

Typical uses A hard, heavy, strong and attractive timber with many decorative uses. Used for hardwood flooring and inlaid work, parts of musical instruments, handles for cutlery and tools, decorative carvings, turnery and antiques.

Special remarks / diagnostic features : Similar to Indian Ebony (Karimaram), *Diospyros ebenum* in its physical properties.

Additional reading

Bolza, E., and Keating, W. G. 1972. African timbers- the properties, uses and characteristics of 700 species. Division of Building Research, CSIRO, Melbourne, Australia.

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

International Tropical Timber Organisation 1997. The Database of Tropical Industrial Lesser-used Wood Species. *ITTO Project PD 58/97 Rev. 1 (1), Reference Guide to Tropical Timber Species*. Nagoya University Museum, Nagoya, Japan.

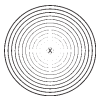
William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

GAMARI / KUMBIL

Flat sawn

Cross cut



Vernacular names	Gamar (Bangladesh), Gamari, Gumhar, Kumbil (India), Yemane (Myanmar, Malaysia, Philippines)
Botanical name	*Gmelina arborea* Roxb.
Family name	Verbenaceae
Origin (Distribution)	Native to India, Sri Lanka, Myanmar, southern China, Laos, Cambodia, Vietnam, Indonesia and introduced to many tropical countries as a fast growing tree species.

THE WOOD

Colour	Heartwood colour varying from creamy white to light brown; moderately lustrous; not distinct from the sapwood.
Weight	Light to moderately heavy (Air-dry specific gravity 0.40-0.60 with average value of 0.51)

Grain Straight to interlocked or slightly wavy

Texture Medium to coarse

Strength Moderately strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	64.6	8896	33.4

Drying and shrinkage Dries fairly rapidly; Shrinkage- radial (2.4%), tangential (4.9%), volumetric (8.8%)

Durability Durable

Treatability Resistant

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing- easy; Finish- good

Typical uses Highly valued timber for door and window panels, joinery and furniture especially for drawers and cupboards, Class I plywood for general purpose, picture and slate frames, turnery articles, musical instruments, tool handles, instrument boxes, boat building, tennis and badminton rackets, packing cases and crates. Also used in paper making and matchwood industry.

Price (Rs. per m^3) Log: 17000-20000

Additional reading

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

International Tropical Timber Organisation 1997. The Database of Tropical Industrial Lesser-used Wood Species. *ITTO Project PD 58/97 Rev. 1 (1), Reference Guide to Tropical Timber Species*. Nagoya University Museum, Nagoya, Japan.

Nazma, Ganapathy, P. M., Sasidharan, N., Bhat, K. M., and Gnanaharan, R. 1981. A Handbook of Kerala Timbers. *KFRI Research Report No. 9*, Kerala Forest Research Institute, Peechi, Kerala, India, 260p.

Pearson, R. S and Brown, H. P. 1981. Commercial timbers of India: their distribution, supplies, anatomical structure, physical and mechanical properties and uses. Vols. I- II. A. J. Reprints Agency, New Dehli, India. 1150p.

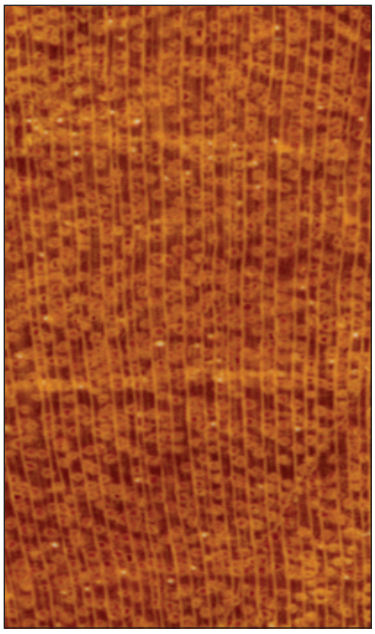
Tewari, D. N. 1995. A Monograph on Gamari (*Gmelina arborea* Roxb.). International Book Distributors, Dehra Dun, India. 125p.

Wood News. 2005. Gamari (*Gmelina arborea*). Vol. 15 (2): 34-36.

Standard Trade Name

GIAM (Heavier form)

Quarter sawn



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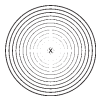


Vernacular names	Gagil (Sabah), Selangan (Sarawak)
Botanical name	*Hopea* spp.
Family name	Dipterocarpaceae
Origin (Distribution)	Malaysia, Myanmar, Thailand, Sabah and Philippines

THE WOOD

Colour	Heartwood light yellow brown; weathering to a dark red brown, not sharply demarcated from the pale yellow sapwood. Gum canals often visible as white lines on the flat sawn surface and as concentric lines on cross-cut surface.
Weight	Very heavy (Air-dry specific gravity 0.83-1.15)
Grain	Deeply interlocked

Texture Fine to medium and even

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	122	16500	58.9

Drying and shrinkage Dries very slowly, with slight end-checking, splitting and surface-checking as the main sources of degrade; Shrinkage- radial (2.0%), tangential (4.4%), volumetric (6.4%)

Durability Very durable

Treatability Extremely resistant

Working properties Planing- easy; Boring- easy to slightly difficult; Turning- difficult; Nailing- very poor; Finish- good

Typical uses Very durable timber suitable for high grade permanent construction, posts, beams, rafters and bridges. Also used for keels and frame work of boats, lorry and truck bodies, railway sleepers, joinery, door and window frames and sills, furniture and heavy-duty flooring.

Special remarks / diagnostic features : Similar to Indian Hopea (*Hopea parviflora*). A substitute timber for Selangan batu (*Shorea* spp.) and Red balau (*Shorea* spp.).

Price (Rs. per m^3) Log: 23000-25000

Additional reading

Lim, S. C. 1984. *Malaysian Timbers - Giam*. Timber Trade Leaflet No. 84. The Malaysian Timber Industry Board and Forest Research Institute Malaysia, Kuala Lumpur. 8 p.

Malaysian Timber Industry Board. 1986. 100 Malaysian Timbers. 50728 Kuala Lumpur, Malaysia. 226p.

Purkayastha, S. K. 1996. A Manual of Indian timbers. Sribhumi Publishing Company. Calcutta, India.

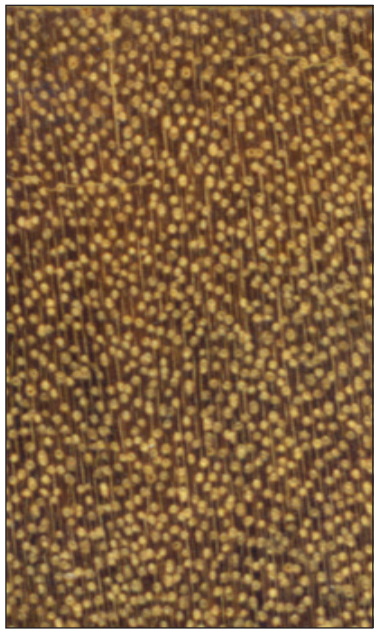
Timber Research and Development Association. 1980. Timbers of the World. Volume 2. The Construction Press Ltd; Lancaster, England.

Standard Trade Name

GREENHEART

Flat sawn

Quarter sawn



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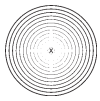


Vernacular names	Bibiri, Demerara, Greenheart (Guyana), Sipiroe (Surinam), Supiera (Brazil)
Botanical name	*Ocotea rodiaei* (Schomb.) Mez.
Family name	Lauraceae
Origin (Distribution)	South America (Guyana, Venezuela, Surinam and Brazil)

THE WOOD

Colour	Heartwood considerably varies in colour from light to dark olive green, yellow green, often marked with brown or black streaks; lustrous. Sapwood is pale yellow or green, not sharply well defined.
Weight	Very heavy (Air-dry specific gravity approx.1.03)
Grain	Straight or slightly interlocked. The wood is usually free of knots and other defects.
Texture	Fine and even

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	181	21000	89.9

Drying and shrinkage The timber is moderately difficult to air-season and kiln seasoning is extremely slow when compared to other timbers. Dries very slowly with a marked tendency to check and end splitting; Shrinkage- radial (3.0%), tangential (4.5%), volumetric (7.5%)

Durability Very durable. Excellent resistance to marine borers.

Treatability Extremely resistant

Working properties Moderately difficult to work with hand or machine tools because of its density, dulls cutting edges rather quickly but finishes to a fine smooth lustrous surface. Its low acid content provides corrosive effect on nails and spikes.

Typical uses With exceptional density and strength, an ideal timber for heavy work. Suitable for all marine construction work including ship construction. Also used for bridges, industrial flooring, chemical vats, filter press plates and turnery, cabinets and furniture. Unsuitable for plywood manufacture on account of high density.

Special remarks / diagnostic features : Exceptionally heavy density, very strong, hard and very durable timber suitable for heavy construction work.

Price (Rs. per m^3) Log: 16000-18000
Converted: 25000

Additional reading

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

International Tropical Timber Organisation 1997. The Database of Tropical Industrial Lesser-used Wood Species. *ITTO Project PD 58/97 Rev. 1 (1), Reference Guide to Tropical Timber Species*. Nagoya University Museum, Nagoya, Japan.

Longwood, F. R.1962. Present and potential commercial timbers of the Carribean. *Agriculture Handbook No. 207,* USDA Forest Service, Washington DC, USA.

Rendle, B. J. (ed.). 1969. World Timbers. Vol. 2, North and South America. Ernest Benn Limited. London. 150p.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

GULMOHUR

Flat sawn

Vernacular names	Flamboyant, Flame tree, Gulmohur, Royal poinciana, Poomaram (India)
Botanical name	*Delonix regia* (Bojer) Rafin. Syn. *Poinciana regia* Boj. ex Hook.
Family name	Fabaceae
Origin (Distribution)	Native to Madagascar and has been widely planted as a garden and avenue tree in tropical and subtropical regions of the world.

THE WOOD

Colour	Heartwood yellowish to reddish brown; not distinct from the light yellow sapwood.
Weight	Light (Air-dry specific gravity approx. 0.42)
Grain	Straight

Texture Medium

Strength Weak

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	27	2737	16.8

Drying and shrinkage Data not available

Durability Perishable

Treatability Easy

Working properties The wood is soft and weak, prone to insect and borer attack and fungal discolouration on its surface, limiting its use in carpentry.

Typical uses Used for light packing cases and internal fittings of furniture. Used as fuel wood.

Price (Rs. per m^3) Log: 2700-5000

Additional reading

Purkayastha, S. K. 1996. A Manual of Indian timbers. Sribhumi Publishing Company. Calcutta, India.

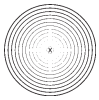
Ramesh Rao, K. and Purkayastha, S. K.1972. Indian woods: Their identification, properties and uses. Volume III, Leguminosae to Combretaceae. Manager of Publications, Govt. of India Press, Delhi, India. 262p.

Standard Trade Name

IDIGBO

Quarter sawn

Cross cut



Vernacular names	Black afara (Nigeria), Emeri (Ghana), Framiré (Ivory Coast), Bajee (Sierra Leone), Idigbo (UK)
Botanical name	*Terminalia ivorensis* A. Chév.
Family name	Combretaceae
Origin (Distribution)	West tropical Africa from Guinea to Cameroon

THE WOOD

Colour	Heartwood pale yellow brown or light pinkish brown, moderately lustrous; not clearly demarcated from paler sapwood. Timber may stain in contact with iron.
Weight	Light to moderately heavy (Air-dry specific gravity 0.48-0.62 with average value of 0.54)
Grain	Straight to slightly irregular or interlocked

Texture Medium to fairly coarse

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	83	9300	47.8

Drying and shrinkage Dries rapidly with little degrade; Shrinkage- radial (3.5%), tangential (5.2%), volumetric (9.0%)

Durability Durable

Treatability Extremely resistant

Working properties Planing- easy; Boring-easy, Turning-easy, Nailing- good but pre-boring necessary; Finish- good

Typical uses Used in furniture and high class joinery for both interior and exterior work, general carpentry, joinery, construction work, plywood and decorative veneer. It should not be used in damp conditions due to natural staining properties if in contact with iron compounds.

Additional reading

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, USA, 826p.

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

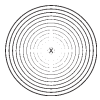
William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

IMBUYA

Flat sawn

Cross cut



Vernacular names	Embuia, Embuya, Imbuya (Brazil), Brazilian walnut
Botanical name	*Phoebe porosa* (Nees & C. Mart.) Mez
Family name	Lauraceae
Origin (Distribution)	Southern Brazil

THE WOOD

Colour	Heartwood colour varies from yellowish brown, olive to chocolate brown with variegated streaks and stripes,lustrous; clearly demarcated from the greyish sapwood.
Weight	Moderately heavy (Air-dry specific gravity approx. 0.66)
Grain	Straight, curly or wavy
Texture	Fine to medium

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	83	8968	46.1

Drying and shrinkage Dries easily and requires care to avoid warping; Shrinkage- radial (3.0%), tangential (6.1%), volumetric (9.1%).

Durability Durable

Treatability Moderately resistant

Working properties Planing- moderately easy; Boring-easy; Turning- easy; Nailing- good but pre-boring necessary; Finish- good

Typical uses Suitable for high grade flooring, panelling, cabinet work, high class furniture, interior joinery, naval uses, musical instruments and handicrafts, decorative veneer and gun stocks.

Special remarks / diagnostic features : Similar to Walnut (*Juglans* spp.) in colour, grain and texture.

Additional reading

Chudnoff, M. 1984. Tropical Timbers of the World. *Agriculture Handbook No. 607,* Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398.

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

Rendle, B. J. (ed.). 1969. World Timbers. Vol. 2, North and South America. Ernest Benn Limited. London. 150p.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

IROKO

Flat sawn

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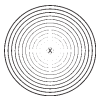


Vernacular names	Abang, Mandji (Cameroon, Gabon), Moreira (Angola), Mvule (East Africa), Oroko (Nigeria), Odum (Ghana), Kambala (Zaire), Semli (Sierra Leone).
Botanical name	*Chlorophora excelsa* (Welw.) Benth. and *Chlorophora regia* (A.Chév.) Corner
Family name	Moraceae
Origin (Distribution)	West and East Africa

THE WOOD

Colour	Heartwood yellow brown to dark chocolate brown with lighter markings on the flat-sawn surfaces; slightly greasy feel of teak; occasional large "stone" deposits of calcium carbonate liable to occur and the wood around them darker in colour. Sapwood yellowish white, clearly demarcated.

Weight Moderately heavy (Air-dry specific gravity 0.55-0.78 with average value of 0.64) similar to teak

Grain Typically interlocked and sometimes irregular

Texture Coarse and even

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	90	9400	54.5

Drying and shrinkage Dries easily without degrade; Shrinkage- radial (2.8%), tangential (3.8%), volumetric (8.8%)

Durability Very durable

Treatability Extremely resistant

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing- easy; Finish- good

Typical uses A very durable timber suitable for exterior and interior joinery, ship and boat building, piling and marine work, domestic flooring, wall panelling, furniture, railroad crossties, cabinet work, truck bodies, wagons, handicrafts, flush doors, plywood and decorative veneer.

Special remarks/ diagnostic features : A timber possessing many desirable features of Teak (*Tectona grandis*).

Price (Rs. per m^3) Log: 25000-32000

Additional reading

Bolza, E., and Keating, W. G. 1972. African timbers- the properties, uses and characteristics of 700 species. Division of Building Research, CSIRO, Melbourne, Australia.

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

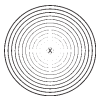
William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p

Standard Trade Name

KAPUR

Quarter sawn

Cross cut



Vernacular names	Keladan, Kapur (Malaysia), Petanang (Indonesia), Swamp kapur (Sarawak)
Botanical name	*Dryobalanops* spp.
Family name	Dipterocarpaceae
Origin (Distribution)	Malaysia and Indonesia

THE WOOD

Colour	Heartwood light reddish brown to deep reddish brown with a camphor-like odour and lustrous; clearly distinct from the whitish to yellowish brown sapwood. Gum canal often visible as white lines on flat-sawn and cross-cut surfaces, but resin does not exude from the surface of wood.
Weight	Moderately heavy (Air-dry specific gravity 0.58-0.80 with average value of 0.74)

Grain Straight to shallowly interlocked or spiral

Texture Medium and even

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	126	13000	69.6

Drying and shrinkage Dries rather slowly, with slight tendency to cup and twist; Shrinkage- radial (2.1%), tangential (5.1%), volumetric (7.2%)

Durability Moderately durable

Treatability Extremely resistant

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing- good but pre-boring necessary; Finish- moderately smooth

Typical uses A good constructional timber suitable for heavy and medium construction, rafters, beams, furniture, flooring, door and window frames. Also suitable for tool handles, boxes, boat framing, joinery, truck bodies, plywood and veneer.

Special remarks / diagnostic features : A strong and durable timber similar in some respects to Keruing (*Dipterocarpus* spp.) but more stable and non- resinous. Several species of *Dryobalanops* are marketed as Kapur.

Price (Rs. per m^3) Log: 18000-23000

Additional reading

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

Malaysian Timber Industry Board. 1986. 100 Malaysian Timbers. 50728 Kuala Lumpur, Malaysia. 226p.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

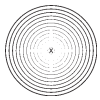
Wood News. 2005. Kapur (*Dryobalanops* spp.). Vol. 15 (3): 26-28.

Standard Trade Name

KASSI / MULLU-VENGA

Flat sawn

Cross cut



Vernacular names	Mullu-venga, Kassi (India), Seikchi, Seikchibo (Myanmar)
Botanical name	*Bridelia squamosa* (Lamk.) Gehrm. Syn. *Bridelia retusa* Spreng.
Family name	Euphorbiaceae
Origin (Distribution)	India and Myanmar, planted outside the forests mainly in home gardens.

THE WOOD

Colour	Heartwood dull olive brown, sometimes with lighter bands due to interlocked fibres; not sharply demarcated from the greyish white to grey sapwood.
Weight	Moderately heavy (Air-dry specific gravity approx. 0.75)
Grain	Deeply interlocked

Texture Medium to coarse

Strength Moderately strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	74.4	10617	41.3

Drying and shrinkage Dries fairly rapidly without any degrade; green conversion and stacking under cover recommended; Shrinkage data not available.

Durability Moderately durable

Treatability Data not available

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing- easy; Finish- good

Typical uses Good second class timber used for construction, door and window shutters, rafters, posts and floor boards and other domestic purposes. Also used for agricultural implements, tool handles, carts and carriages and handicrafts.

Price (Rs. per m^3) Log: 9000-11000
Converted: 16000

Additional reading

Nazma, Ganapathy, P. M., Sasidharan, N., Bhat, K. M., and Gnanaharan, R. 1981. A Handbook of Kerala Timbers. *KFRI Research Report No. 9*, Kerala Forest Research Institute, Peechi, Kerala, India, 260p.

Pearson, R. S and Brown, H. P. 1981. Commercial timbers of India: their distribution, supplies, anatomical structure, physical and mechanical properties and uses. Vols. I- II. A. J. Reprints Agency, New Dehli, India. 1150p.

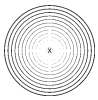
Throtter, H. 1960. The Common commercial timbers of India and their uses. The Manager of Publications, Govt. of India Press, Delhi. 296p.

Standard Trade Name

KEKATONG

Flat sawn

Cross cut



Vernacular names	Belangkan, Kekatong (Malaysia), Katong (Sabah), Myringa (Myanmar)
Botanical name	*Cynometra* spp.
Family name	Fabaceae
Origin (Distribution)	Philippines, Malaysia, Myanmar, Indonesia and India

THE WOOD

Colour	Heartwood red brown or pinkish brown or claret red with attractive streaks; not well-defined from the sapwood.
Weight	Heavy (Air-dry specific gravity 0.88-1.15)
Grain	Straight to slightly interlocked
Texture	Fine to medium and even

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	126	16068	66.0

Drying and shrinkage Dries rather slowly; Shrinkage- radial (1.6%), tangential (2.7%), volumetric (4.3%)

Durability Moderately durable

Treatability Extremely resistant

Working properties Difficult to saw; attractively streaked on quarter sawn face, mottled figure on flat sawn face. Planing- slightly difficult; Boring- slightly difficult; Turning- difficult; Nailing- poor; Finish- fair to difficult

Typical uses Suitable for interior construction work, posts, beams, door and window shutters and frames, tool handles, parquet flooring, panelling, railroad crossties and naval uses. Unsuitable for plywood.

Additional reading

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

Keating, W. G., and Bolza, E. 1982. Characteristics, Properties and Uses of Timbers of South-east Asia, Northern Australia and the Pacific. Vol. 1, CSIRO, INKATA Press, Melbourne, Australia. 362p.

Malaysian Timber Industry Board. 1986. 100 Malaysian Timbers. 50728 Kuala Lumpur, Malaysia. 226p.

Pearson, R. S and Brown, H. P. 1981. Commercial timbers of India: their distribution, supplies, anatomical structure, physical and mechanical properties and uses. Vols. I- II. A. J. Reprints Agency, New Dehli, India. 1150p.

Standard Trade Name

KEMPAS

Flat sawn

Cross cut

Vernacular names	Impas (Sabah), Mengris (Sarawak), Kempas (Malaysia)
Botanical name	*Koompassia malaccensis* Maing.
Family name	Fabaceae
Origin (Distribution)	Occur through Borneo, Malaysia, Philippines, Indonesia and Papua New Guinea.

THE WOOD

Colour	Heartwood pink to brick red when freshly cut, darkening to orange red or red brown with yellow brown streaks, moderately lustrous; sapwood pale yellow, clearly demarcated.
Weight	Heavy (Air-dry specific gravity 0.77-1.12 with average value of 0.88)
Grain	Interlocked, spiral or wavy

Texture Coarse and even

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	122	18600	65.6

Drying and shrinkage Dries well with little degrade; Due to the presence of occasional brittle-heart, splitting may occur while drying. Shrinkage- radial (2.0%), tangential (3.0%), volumetric (5.0%)

Durability Moderately durable

Treatability Easy

Working properties Planing- easy; Boring- slightly difficult; Turning- slightly difficult; Nailing- poor; Finish- smooth to rough

Typical uses Suitable for heavy construction, transmission posts, beams, bridges, parquet flooring, panelling and furniture, tool handles, sports tools, truck bodies, wagons, naval uses, plywood and veneer. Also used as railway sleepers after preservative treatment.

Special remarks / diagnostic features : An alternative timber for Tualang (*Koompassia excelsa*), which is dark brown in colour with striped figure on quarter sawn surface.

Additional reading

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

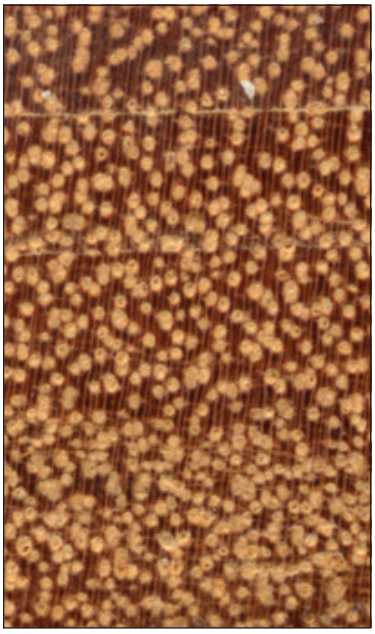
International Tropical Timber Organisation 1997. The Database of Tropical Industrial Lesser-used Wood Species. *ITTO Project PD 58/97 Rev. 1 (1), Reference Guide to Tropical Timber Species*. Nagoya University Museum, Nagoya, Japan.

Malaysian Timber Industry Board. 1986. 100 Malaysian Timbers. 50728 Kuala Lumpur, Malaysia. 226p.

Standard Trade Name

KERUING

Flat sawn



Cross cut

Vernacular names	Gurjan (India), Eng (Myanmar), Apitong (Philippines), Lagan (Indonesia), Yang (Thailand), Keruing (Malaysia)
Botanical name	*Dipterocarpus* spp.
Family name	Dipterocarpaceae
Origin (Distribution)	Indonesia, Malaysia, Philippines, Sabah, Sarawak, Brunei, Pakistan, India, Myanmar, Borneo, Thailand, Sri Lanka and Kampuchea.

THE WOOD

Colour	Heartwood varies in colour from pinkish brown to red brown or dark brown, sometimes with a purple tint, darkens with age, often with distinct resinous odour; sapwood grey-brown, well-defined.
Weight	Moderately heavy to heavy (Air-dry specific gravity 0.64-0.96 with average value of 0.75).

Grain Straight to interlocked

Texture Moderately coarse and even

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	133	22300	68.1

Drying and shrinkage Dries slowly, uniform seasoning difficult to achieve; Gum exudation is common during drying. Shrinkage- radial (3.1%), tangential (7.4%), volumetric (10.5%)

Durability Moderately durable

Treatability Moderately resistant

Working properties Planing- easy to slightly difficult; Boring- easy to slightly difficult; Turning- slightly difficult; Nailing- poor; Finish- fair to slightly difficult

Typical uses Suitable for plywood and veneer, container flooring, general construction work, railway sleepers, bridges, harbor work, wagons, truck bodies etc.

Special remarks / diagnostic features : Similar to Indian Gurjan (*Dipterocarpus indicus*). Keruing timber is produced by more than 70 species of the genus *Dipterocarpus*. The timber can be divided into three roughly distinguishable air-dry specific gravity classes: Light -up to 0.55, moderately heavy- less than 0.75 and heavy to very heavy- over 0.75. Most of the imported species available in the market are moderately heavy to heavy and moderately durable.

Price (Rs. per m^3) Log: 23000-25000

Additional reading

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

Keating, W. G., and Bolza, E. 1982. Characteristics, Properties and Uses of Timbers of South-east Asia, Northern Australia and the Pacific. Vol. 1, CSIRO, INKATA Press, Melbourne, Australia. 362p.

Malaysian Timber Industry Board. 1986. 100 Malaysian Timbers. 50728 Kuala Lumpur, Malaysia. 226p.

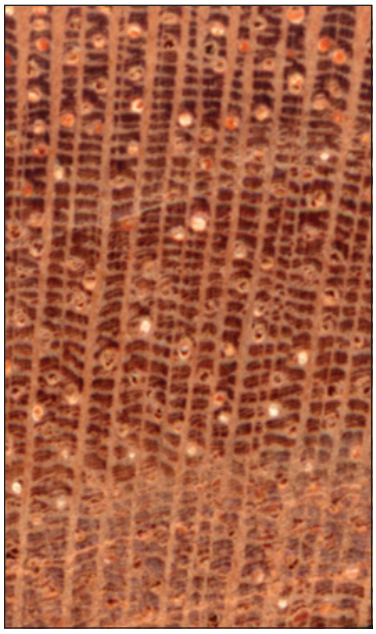
Pearson, R. S and Brown, H. P. 1981. Commercial timbers of India: their distribution, supplies, anatomical structure, physical and mechanical properties and uses. Vols. I- II. A. J. Reprints Agency, New Dehli, India. 1150p.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

KERUNTUM

Flat sawn



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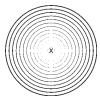


Vernacular names	Marapat (Indonesia), Perapat paya, Keruntum (Malaysia)
Botanical name	*Combretocarpus rotundatus* (Miq.) Danser
Family name	Rhizophoraceae
Origin (Distribution)	Sarawak, Sabah, Brunei, Indonesia and Malaysia

THE WOOD

Colour	Sapwood pale yellow merging into reddish brown heartwood; lustrous. Presence of whitish deposit in the pores is commonly visible on the planed wood surface.
Weight	Moderately heavy (Air-dry specific gravity 0.64-0.80)
Grain	Straight to interlocked
Texture	Coarse and uneven

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	103	14100	50.0

Drying and shrinkage Dries rather slowly; Shrinkage- radial (2.9%), tangential (4.8%), volumetric (7.7%)

Durability Moderately durable

Treatability Moderately resistant

Working properties Timber easy to saw and work but has tendency to spring during sawing. Planing- easy; Nailing- poor, pre- boring necessary. Flat-sawn and quarter-sawn surface exhibit attractive silver-grain figure.

Typical uses Highly favoured timber for sliced veneer, heavy interior construction. Also used for temporary construction, flooring, panelling, packing and fuelwood.

Additional reading

Boer, E., Lemmens, R. H. M. J. 1998. Combretocarpus Hook. f. *In*: Sosef, M.S..M., Hong, L.T. & Prawirohatmodjo, S. (Eds.): *Plant Resources of South-East Asia No 5 (3). Timber trees: Lesser-known timbers.* PROSEA Foundation, Bogor, Indonesia. pp 166-168.

International Tropical Timber Organisation 1997. The Database of Tropical Industrial Lesser-used Wood Species. *ITTO Project PD 58/97 Rev. 1 (1), Reference Guide to Tropical Timber Species*. Nagoya University Museum, Nagoya, Japan.

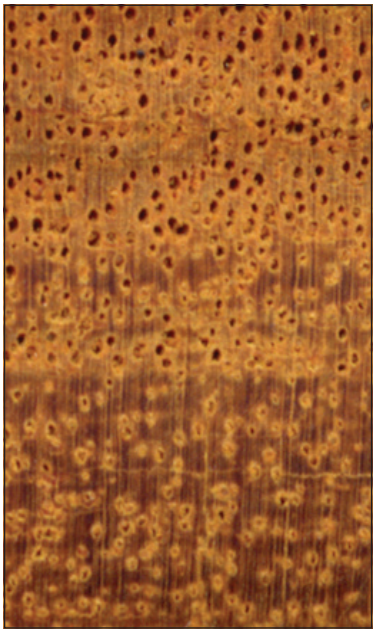
Keating, W. G., and Bolza, E. 1982. Characteristics, Properties and Uses of Timbers of South-east Asia, Northern Australia and the Pacific. Vol. 1, CSIRO, INKATA Press, Melbourne, Australia. 362p.

Malaysian Timber Industry Board. 1986. 100 Malaysian Timbers. 50728 Kuala Lumpur, Malaysia. 226p.

Standard Trade Name

KUSIA / OPEPE

Flat sawn



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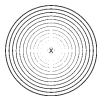


Vernacular names	Bilinga (Gabon, Camaroon), Opepe (Nigeria), Kusiaba, Kusia (Ghana), Badi (Ivory Coast), Kilingi (Uganda)
Botanical name	*Nauclea diderrichii* Merr. Syn. *Sarcocephalus diderrichii* De Wild.
Family name	Rubiaceae
Origin (Distribution)	West Africa

THE WOOD

Colour	Heartwood orange or golden yellow, darkening on exposure, lustrous; clearly demarcated from the whitish or pale yellow sapwood.
Weight	Moderately heavy (Air-dry specific gravity 0.63-0.78 with average value of 0.74)
Grain	Interlocked or irregular

Texture Moderately coarse

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	120	13400	71.7

Drying and shrinkage Quarter sawn material dries rather rapidly with little checking or warp; flat sawn lumber may develop considerable degrade; end-coating suggested; Shrinkage-radial (4.5%), tangential (8.4%), volumetric (12.6%)

Durability Very durable

Treatability Moderately resistant

Working properties Planing- moderately easy; Boring- rather easy; Turning- easy; Nailing- good but pre-boring necessary; Finish- satisfactory

Typical uses A strong, stable and durable timber, suitable for domestic flooring, exterior and interior joinery, decorative turnery, furniture and cabinet work. Also used for piling and decking in wharves and docks, boat building (except for bent parts), railway sleepers, general construction work and decorative veneer.

Price (Rs. per m^3) Log: 16000
Converted: 23000-25000

Additional reading

Bolza, E., and Keating, W. G. 1972. African timbers- the properties, uses and characteristics of 700 species. Division of Building Research, CSIRO, Melbourne, Australia.

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

International Tropical Timber Organisation 1997. The Database of Tropical Industrial Lesser-used Wood Species. *ITTO Project PD 58/97 Rev. 1 (1), Reference Guide to Tropical Timber Species*. Nagoya University Museum, Nagoya, Japan.

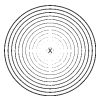
William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

MACHILUS / KOLAMAVU

Quarter sawn

Cross cut



Vernacular names	Kolamavu, Ooravu, Machilus (India)
Botanical name	*Persea macrantha* (Nees) Kosterm. Syn. *Machilus macrantha* Nees
Family name	Lauraceae
Origin (Distribution)	Western Ghats of southern India

THE WOOD

Colour	Heartwood light orange brown to light reddish brown; not distinct from the sapwood
Weight	Light to moderately heavy (Air-dry specific gravity 0.49-0.63 with average value of 0.52)
Grain	Straight
Texture	Medium to coarse and even

Strength Moderately strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	56	7745	29.1

Drying and shrinkage Dries easily, green conversion followed by immersion in water and stacking recommended; Shrinkage- radial (2.8%), tangential (6.0%), volumetric (10.2%)

Durability Perishable

Treatability Easy

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing- easy; Finish- good

Typical uses Largely used as Class I plywood for general purposes. Also used for flooring and ceiling boards, packing cases, boxes and match splints.

Price (Rs. per m^3) Log: 9000-12500

Additional reading

Nazma, Ganapathy, P. M., Sasidharan, N., Bhat, K. M., and Gnanaharan, R. 1981. A Handbook of Kerala Timbers. *KFRI Research Report No. 9*, Kerala Forest Research Institute, Peechi, Kerala, India, 260p.

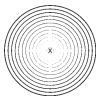
Purkayastha, S. K. 1996. A Manual of Indian timbers. Sribhumi Publishing Company. Calcutta, India.

Standard Trade Name

MAHOGANY, AMERICAN

Quarter sawn

Cross cut



Vernacular names	Honduras mahogany, Guatemala mahogany, Brazilian mahogany, Mogno (Brazil)
Botanical name	*Swietenia macrophylla* King
Family name	Meliaceae
Origin (Distribution)	Native to Central and South America, particularly Mexico and Honduras, and introduced to many tropical countries including India.

THE WOOD

Colour	Heartwood colour varies from light reddish or yellowish brown to dark reddish brown, lustrous. Sapwood yellowish white to pale brownish grey.
Weight	Moderately heavy (Air-dry specific gravity 0.54-0.76)
Grain	Straight to interlocked. Flat-sawn surface produce prominent growth ring figure.

Texture Medium to coarse

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	83	8800	44.2

Drying and shrinkage Dries fairly rapidly without degrade; Shrinkage- radial (2.0%), tangential (3.0%), volumetric (5.0%)

Durability Moderately durable

Treatability Extremely resistant

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing- satisfactory, but pre-boring necessary; Finish- good

Typical uses High class furniture and cabinet making, panelling and interior joinery, boat interiors, musical instruments, jewellery boxes, carvings, rotary cut logs for plywood and sliced veneers for decorative work.

Special remarks / diagnostic features : The wood is similar to its closely related species, Spanish mahogany (*Swietenia mahogani*) in its physical properties.

Price (Rs. per m^3) Log: 16000-18000
Converted: 17000

Additional reading

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

Rendle, B. J. (ed.). 1969. World Timbers. Vol. 2, North and South America. Ernest Benn Limited. London. 150p

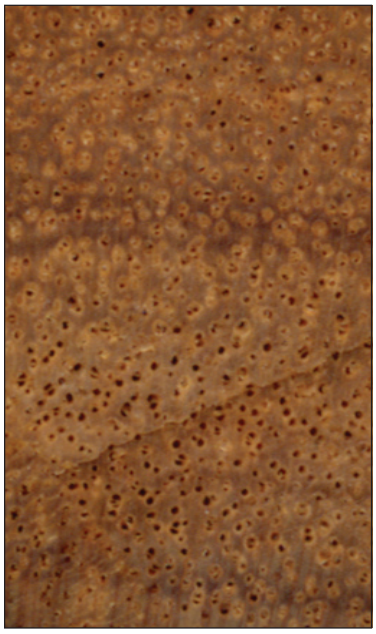
Richter, H.G., and Dallwitz, M.J. 2000. Commercial Timbers: descriptions, illustrations, identification, and information retrieval. In English, French, German, Portuguese, and Spanish. Version: 16th April 2006. http://delta-intkey.com

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

MANGIUM / BROWN SALWOOD

Flat sawn



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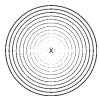

Vernacular names	Black wattle (Australia), Mangium (India), Hickory wattle (USA,UK), Brown salwood (UK)
Botanical name	*Acacia mangium* Willd.
Family name	Fabaceae
Origin (Distribution)	Native to Australia, Indonesia, Papua New Guinea; introduced to many tropical countries as a plantation species for pulpwood.

THE WOOD

Colour	Heartwood pale olive brown to pink, darkening to reddish brown or dark red with darker streaks; sharply demarcated from the pale yellowish sapwood.
Weight	Moderately heavy (Air-dry specific gravity 0.65-0.69)
Grain	Straight to interlocked

Texture Medium to fine

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	105	11588	59.9

Drying and shrinkage Dries slowly, kiln-dries fairly rapidly but marked collapse may occur during the early stages of seasoning; collapse may be remedied by reconditioning; Shrinkage- radial (2.2%), tangential (6.1%), volumetric (8.3%)

Durability Moderately durable, inner heartwood is subject to heart rot. The wood is liable to be attacked by termites on ground contact.

Treatability Moderately resistant.

Working properties A tough and hard timber easy to work with hand tools. Planing- easy; Boring-easy; Turning- easy; Nailing- easy; Finish- good

Typical uses Mainly used for pulpwood production. Suitable for door and window frames, furniture, cabinet making, light structural work, panelling and turnery, sports tools, agricultural implements and charcoal.

Price (Rs. per m^3) Log: 6000
Converted: 9000

Additional reading

Bolza, E., and Keating, W. G. 1982. Characteristics, Properties and Uses of Timbers of South-east Asia, Northern Australia and the Pacific. Vol. 1, CSIRO, INKATA Press, Melbourne, Australia. 362p.

Dhamodaran, T. K. and Chacko, K. C. 1999. Growth and wood characteristics of *Acacia mangium* grown in Kerala. *KFRI Research Report No. 174*. Kerala Forest Research Institute, Peechi, Kerala, India. 60p.

International Tropical Timber Organisation 1997. The Database of Tropical Industrial Lesser-used Wood Species. *ITTO Project PD 58/97 Rev. 1 (1), Reference Guide to Tropical Timber Species*. Nagoya University Museum, Nagoya, Japan.

Standard Trade Name

MAPLE, EUROPEAN

Quarter sawn

Vernacular names	Field maple, Hedge maple (UK), Érable (France), Norway maple (Norway)
Botanical name	*Acer* spp., principally *Acer campestre* L. and *Acer platanoides* L.
Family name	Aceraceae
Origin (Distribution)	Throughout Europe including UK and Russia

THE WOOD

Colour	Heartwood creamy white darkening into a light tan colour; lustrous.
Weight	Moderately heavy (Air-dry specific gravity approx. 0.66- 0.69)
Grain	Straight, often curly or wavy
Texture	Fine and even

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	99	9400	48.2

Drying and shrinkage Dries slowly without degrade; Shrinkage- radial (2.5%), tangential (5.5%), volumetric (8.0%)

Durability Perishable

Treatability Resistant

Working properties Planing- difficult; Boring- easy; Turning- easy; Nailing- easy but pre-boring necessary; Finish- good

Typical uses An excellent turnery wood, commonly used for plywood and decorative veneer, panelling, domestic woodware, furniture, musical instruments, flooring and joinery work.

Price (Rs. per m^3) Log : 11000 - 25000

Additional reading

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

MAPLE, ROCK

Flat sawn

Vernacular names	Bird's eye maple, Hard maple (UK, USA), Sugar maple (Canada)
Botanical name	*Acer saccharum* Marsh.
Family name	Aceraceae
Origin (Distribution)	Canada, Northern and Eastern states of USA

THE WOOD

Colour	Heartwood creamy white, generally with a reddish tinge; not sharply defined from the light coloured sapwood.
Weight	Heavy (Air-dry specific gravity approx.0.72)
Grain	Straight to curly or wavy. Fine brown lines give an attractive growth ring figure on flat-sawn surface.
Texture	Fine and even

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	94	11250	47.0

Drying and shrinkage Dries slowly but without difficulty; Shrinkage- radial (4.8%), tangential (9.3%), volumetric (14.1%)

Durability Perishable

Treatability Resistant

Working properties Planing- difficult; Boring- easy; Turning- easy; Nailing- easy but pre-boring necessary; Finish- good

Typical uses Commonly used for plywood and decorative veneer, furniture, panelling, heavy duty flooring, cabinets and interior joinery. It is excellent for turnery, tool handles, cutting blocks and musical instruments.

Price (Rs. per m^3) Log : 42000

Additional reading

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

Rendle, B. J. (ed.). 1969. World Timbers. Vol. 2, North and South America. Ernest Benn Limited. London. 150p.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Wood News. 2004. American hard maple (*Acer saccharum*, *A. nigrum*). Vol. 13 (4): 18-20.

Standard Trade Name

MERANTI BAKAU

Quarter sawn

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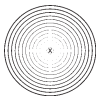


Vernacular names	Meranti buaya, Pengarawan buaya
Botanical name	*Shorea uliginosa* Foxw.
Family name	Dipterocarpaceae
Origin (Distribution)	Indonesia and Malaysia

THE WOOD

Colour	Heartwood light pink to light red brown; clearly demarcated from the white to pale brown sapwood. Vertical gum canals are often visible as white lines on the flat-sawn surface.
Weight	Moderately heavy (Air dry specific gravity 0.59-0.75)
Grain	Interlocked
Texture	Medium

Strength Moderately strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	68	14,700	35.9

Drying and shrinkage Dries rather easily with moderate cupping, bowing and twisting as the main sources of degrade; Shrinkage- radial (1.0%), tangential (2.7%), volumetric (3.7%)

Durability Moderately durable

Treatability Moderately resistant

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing- good; Finish- good

Typical uses Used for light construction, furniture, door and window frames, flooring, joinery and cabinet making, rafters, boat frames, plywoods.

Special remarks / diagnostic features : Meranti bakau is similar to Dark red meranti (*Shorea* spp.) but seasoning properties are different.

Additional reading

Engku Abdul Rahman Chik. 1998. Basic and Grade Stresses for Strength Groups of Malaysian Timbers. *Malayan Forest Service Trade Leaflet No. 38*. The Malaysian Timber Industry Board and Forest Research Institute Malaysia, Kuala Lumpur. 13p.

Keating, W. G., and Bolza, E. 1982. Characteristics, Properties and Uses of Timbers of South-east Asia, Northern Australia and the Pacific. Vol. 1, CSIRO, INKATA Press, Melbourne, Australia. 362p.

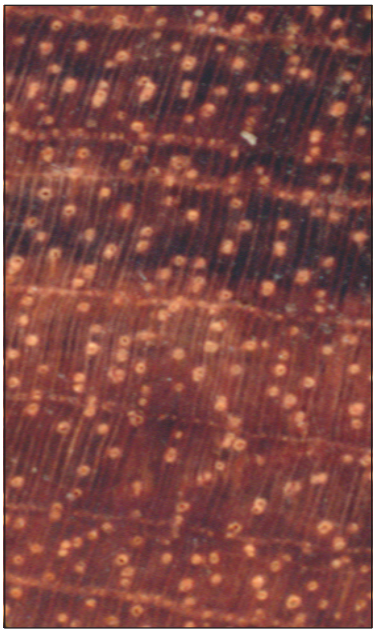
Choo, K.T., Lim, S.C., and Gan, K.S. 2002. Malaysian Timbers- Meranti bakau, *Timber Trade Leaflet No. 10/ 2002*. The Malaysian Timber Industry Board and Forest Research Institute Malaysia, Kuala Lumpur. 7p.

Malaysian Timber Industry Board. 1986. 100 Malaysian Timbers. 50728 Kuala Lumpur, Malaysia. 226p.

Standard Trade Name

MERANTI, DARK RED

Quarter sawn



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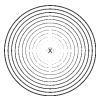


Vernacular names	Kawang (Sabah), Meranti merah (Indonesia), Red luan (Philippines)
Botanical name	*Shorea* spp.
Family name	Dipterocarpaceae
Origin (Distribution)	Malaysia, Indonesia, Philippines, Sabah and Sarawak

THE WOOD

Colour	Heartwood basically brown to dark red brown (from light to dark hues), with occasional gum canals seen as white lines on flat-sawn faces; sapwood not well defined.
Weight	Moderately heavy (Air-dry specific gravity 0.58-0.77 with average value of 0.67)
Grain	Interlocked

Texture Medium to coarse

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	92	13900	52.9

Drying and shrinkage Dries slowly with a tendency to surface checking and occasional cupping; Shrinkage- radial (2.1%), tangential (4.4%), volumetric (6.5%)

Durability Moderately durable. Prone to pinhole borer, termite and marine borer attack.

Treatability Extremely resistant

Working properties Planing- easy; Boring- moderately easy; Turning- easy; Nailing- good; Finish- good

Typical uses Used for the manufacture of plywood and veneer, exterior and interior joinery, light construction, furniture, panelling, flooring and moulding, boat building, door and window frames.

Special remarks/ diagnostic features : There are a number of species under Dark Red Meranti, which are attractive, heavier and more durable than Light Red Meranti (*Shorea* spp.) which are lighter.

Price (Rs. per m^3) Log: 19000-23000

Additional reading

Malaysian Timber Industry Board. 1986. 100 Malaysian Timbers. 50728 Kuala Lumpur, Malaysia. 226p.

Richter, H.G., and Dallwitz, M.J. 2000. Commercial Timbers: descriptions, illustrations, identification, and information retrieval. In English, French, German, Portuguese, and Spanish. Version: 16th April 2006. http://delta-intkey.com

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

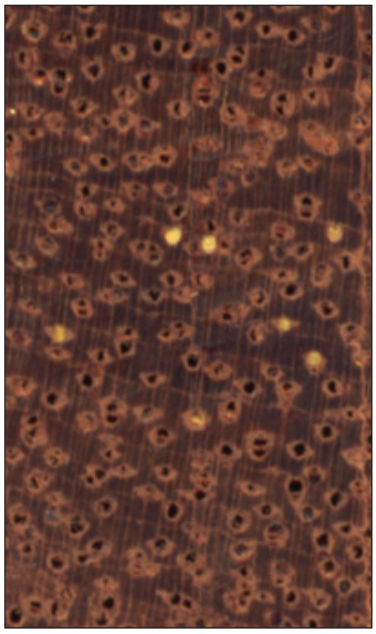
Wood News. 2005. Meranti (*Shorea* sp.). Vol. 14 (4): 24-26.

Standard Trade Name

MERBAU / KWILA

Flat sawn

Quarter sawn



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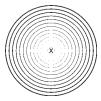

Vernacular names	Kwila (Australia), Gonuo (Vietnam), Ipil (Philippines), Mirabow (Sabah), Merbau (Indonesia)
Botanical name	*Intsia bijuga* (Colebr.) Kuntze. and *Intsia palembanica* Miq.
Family name	Fabaceae
Origin (Distribution)	Malaysia, Fiji, Vietnam, Philippines, Madagascar, Papua New Guinea, Thailand, Solomon Islands, Vanuatu, Samoa and Australia.

THE WOOD

Colour	Heartwood yellowish to orange- brown when freshly cut, turning brown or dark red brown on exposure, lustrous; clearly defined from the pale yellow sapwood. Dark coloured yellow sulphur deposits filling the pores, scattered on the planed wood surface clearly visible.
Weight	Heavy (Air-dry specific gravity 0.74-0.90 with average value of 0.80)

Grain Interlocked or wavy

Texture Medium to coarse

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	146	16436	76.9

Drying and shrinkage Dries rather slowly without degrade; Shrinkage- radial (2.7%), tangential (4.6%), volumetric (7.8%)

Durability Moderately durable. Extractives may leach out under wet conditions.

Treatability Extremely resistant

Working properties Planing- slightly difficult; Boring- difficult, pre-boring necessary; Turning- easy; Nailing- very poor; Finish moderately smooth.

Typical uses Used for heavy construction, boat building, posts, beams and railway sleepers. Also used in furniture, door and window frames, flooring, panelling, high class joinery, turnery, cabinet making, tool handles, musical instruments and decorative veneer.

Special remarks / diagnostic features : A substitute timber for Indian Bijasal (Venga), *Pterocarpus marsupium*. The wood extractives may leach out when used under wet conditions.

Price (Rs. per m^3) Log: 18000-19000
Converted: 26000-28000

Additional reading

Bootle, K. 2005. *Wood in Australia. Types, properties and uses,* (2nd edition). The McGraw-Hill Companies.

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

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Ilic, J. 1991. *CSIRO Atlas of Hardwoods.* Crawford House Press.

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Malaysian Timber Industry Board. 1986. 100 Malaysian Timbers. 50728 Kuala Lumpur, Malaysia. 226p.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

MERPAUH

Quarter sawn

Vernacular names	Boilam (India), Khan thong (Thailand), Selan (Sarawak), Merpauh (Malaysia)
Botanical name	*Swintonia* spp.
Family name	Anacardiaceae
Origin (Distribution)	Myanmar, Malaysia, Borneo, Cambodia and Philippines

THE WOOD

Colour	Heartwood light grey brown with a pinkish tinge; moderately lustrous; not distinct from sapwood.
Weight	Heavy (Air-dry specific gravity 0.64-0.88)
Grain	Interlocked
Texture	Medium to coarse

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	108	18100	56.6

Drying and shrinkage Dries fairly rapidly; Shrinkage- radial (1.4%), tangential (2.0%), volumetric (3.4%)

Durability Perishable

Treatability Easy

Working properties Planing- easy; Boring- difficult; Turning- difficult; Nailing- poor; Finish- good

Typical uses Used for light construction, matches, black board, packing cases, transmission posts, boat building, railway sleepers, high class joinery, furniture, interior panelling, plywood and rotary veneer.

Special remarks / diagnostic features : Similar to Indian Swintonia (*Swintonia floribunda*) but slightly heavier.

Price (Rs. per m^3) Log: 12000-16000

Additional reading

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

Keating, W. G., and Bolza, E. 1982. Characteristics, Properties and Uses of Timbers of South-east Asia, Northern Australia and the Pacific. Vol. 1, CSIRO, INKATA Press, Melbourne, Australia. 362p.

Malaysian Timber Industry Board. 1986. 100 Malaysian Timbers. 50728 Kuala Lumpur, Malaysia. 226p.

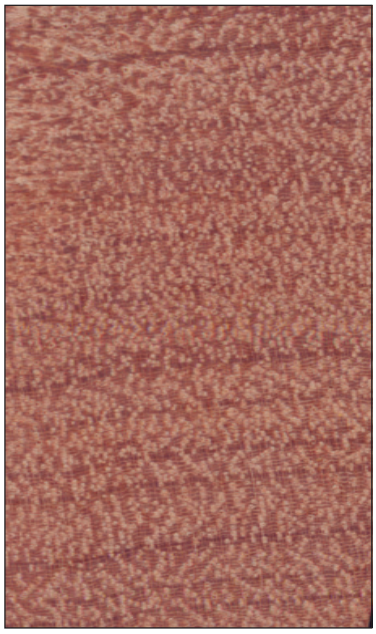
Pearson, R. S and Brown, H. P. 1981. Commercial timbers of India: their distribution, supplies, anatomical structure, physical and mechanical properties and uses. Vols. I- II. A. J. Reprints Agency, New Dehli, India. 1150p.

Standard Trade Name

MOABI

Flat sawn

Quarter sawn



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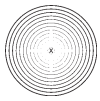

Vernacular names	Adza (Gabon), Dimpampi (Congo), Njabi (Nigeria), Ayab (Cameroon), Moabi (Congo, Angola)
Botanical name	*Baillonella toxisperma* Pierre Syn. *Mimusops djave* Engl.
Family name	Sapotaceae
Origin (Distribution)	Southern Nigeria and Gabon in West Africa

THE WOOD

Colour	Heartwood pinkish brown to red brown with a greyish tinge; clearly demarcated from the pinkish white or grey brown sapwood.
Weight	Heavy (Air-dry specific gravity 0.76-0.90 with average value of 0.87)
Grain	Straight or slightly interlocked

Texture Fine and even

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	142	21030	73.5

Drying and shrinkage Dries slowly; surface drying under cover and kiln seasoning must be handled with care to avoid checking. Shrinkage- radial (5.9%), tangential (7.5%), volumetric (13.4%)

Durability Very durable

Treatability Extremely resistant

Working properties Planing- moderately easy; Boring- moderately easy; Turning- easy; Nailing-good but pre-boring necessary; Finish- good

Typical uses Suitable for indoor and outdoor construction, cabinet making, turnery and carvings, musical instruments, knife grips, exterior and interior joinery, furniture, panelling and selected logs sliced for decorative veneers.

Price (Rs. per m^3) Log : 25000-29000

Additional reading

Bolza, E., and Keating, W. G. 1972. African timbers- the properties, uses and characteristics of 700 species. Division of Building Research, CSIRO, Melbourne, Australia.

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

CIRAD- Forestry Department. 2003. TROPIX 5.0, Technological characteristics of 215 tropical species. Montepellier, France.

International Tropical Timber Organisation 1997. The Database of Tropical Industrial Lesser-used Wood Species. *ITTO Project PD 58/97 Rev. 1 (1), Reference Guide to Tropical Timber Species*. Nagoya University Museum, Nagoya, Japan.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

MORA

Quarter sawn

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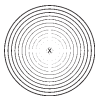


Vernacular names	Morabukea (Guyana), Muru (Trinidad and Tobago), Nato (Colombia), Praccuba (Brazil), Mora (Venezuela)
Botanical name	*Mora excelsa* Benth. and *Mora gonggrijpii* (Kleinh.) Sandw.
Family name	Fabaceae
Origin (Distribution)	South America (Guyana, Surinam, Trinidad and Venezuela)

THE WOOD

Colour	Heartwood pinkish brown to dull reddish brown streaked with white or brown lines; distinct from the yellowish to pale brown sapwood.
Weight	Very heavy (Air-dry specific gravity 0.90-1.10 with average value of 1.0)
Grain	Straight to commonly interlocked

Texture Medium to coarse

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	141	18940	80.0

Drying and shrinkage Dries very slowly, careful stacking is suggested to keep warp and other degrade to a minimum; Shrinkage- radial (6.9%), tangential (9.8%), volumetric (16.7%)

Durability Very durable

Treatability Extremely resistant

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing- difficult, pre-boring necessary; Finish- smooth

Typical uses Being hard, heavy and strong, the timber is highly suitable for heavy construction, heavy-duty industrial flooring, railway sleepers, boat-building and high quality charcoal production. Also used for door and window frames. The wood is not well fitted for furniture, interior flooring, turning and similar uses. Unsuitable for plywood manufacture because of its high density.

Price (Rs. per m^3) Log: 16000- 21000

Additional reading

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

CIRAD- Forestry Department. 2003. TROPIX 5.0, Technological characteristics of 215 tropical species. Montepellier, France.

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

Longwood, F. R.1962. Present and potential commercial timbers of the Carribean. *Agriculture Handbook No. 207,* USDA Forest Service, Washington DC, USA.

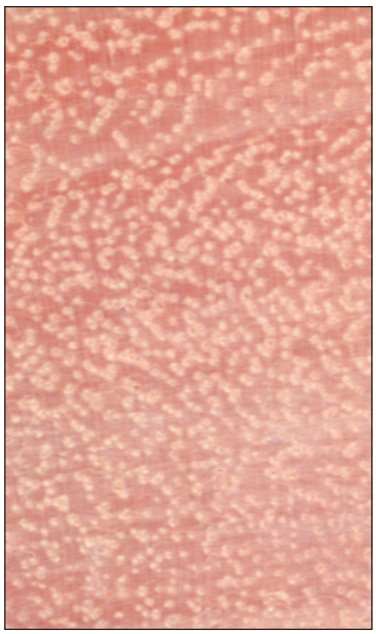
Rendle, B. J. (ed.). 1969. World Timbers. Vol. 2, North and South America. Ernest Benn Limited. London. 150p.

Standard Trade Name

MYSORE GUM

Flat sawn

Quarter sawn



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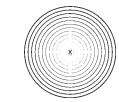


Vernacular names	Forest red gum, Mysore gum, Eucalypts (India), Queensland blue gum (Australia)
Botanical name	*Eucalyptus tereticornis* Sm.
Family name	Myrtaceae
Origin (Distribution)	Native of Australia, Papua New Guinea; extensively raised in plantations in many tropical and subtropical countries including India for pulpwood production.

THE WOOD

Colour	Heartwood reddish brown; fairly well demarcated from the light or pale red sapwood.
Weight	Very heavy (Air-dry specific gravity approx. 0.98)
Grain	Straight, sometimes interlocked

Texture Medium

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	85	9882	50.3

Drying and shrinkage Drying difficult; liable to warp and crack; Shrinkage- radial (6.3%), tangential (9.6%), volumetric (15.9%)

Durability Moderately durable

Treatability Resistant

Working properties Planing- easy; Boring-easy, Turning-easy, Nailing- good but pre-boring necessary; Finish- good

Typical uses Used mainly in the pulp and paper industry. Highly suitable for construction work, furniture, poles, stakes, boxwoods, packing cases and boxes, beams and columns.

Special remarks / diagnostic features : Mysore gum is denser and stronger than Rose gum (*Eucalyptus grandis*).

Price (Rs. per m^3) Log: 12000-14000

Additional reading

Bhat, K. M. and Thulasidas, P. K. 1997. Physical and mechanical properties of *Eucalyptus grandis* and *E. tereticornis* grown in Kerala. *Indian Forester* 123 (4): 297-302.

Keating, W. G., and Bolza, E. 1982. Characteristics, Properties and Uses of Timbers of South-east Asia, Northern Australia and the Pacific. Vol. 1, CSIRO, INKATA Press, Melbourne, Australia. 362p.

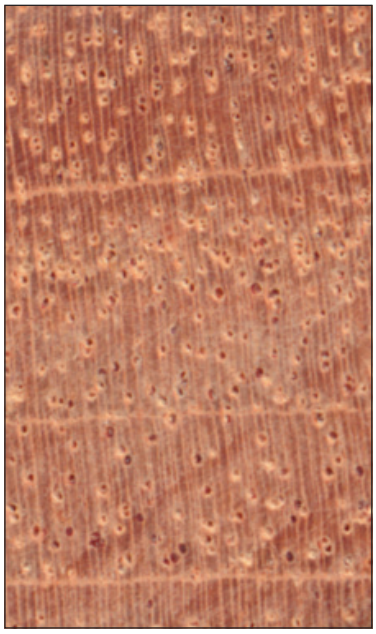
Nazma, Ganapathy, P. M., Sasidharan, N., Bhat, K. M., and Gnanaharan, R. 1981. A Handbook of Kerala Timbers. *KFRI Research Report No.* 9, Kerala Forest Research Institute, Peechi, Kerala, India, 260p.

Standard Trade Name

NEEM

Flat sawn

Quarter sawn



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Vernacular names	Aryaveppu, Vempu, Leemdo, Kadunimb, Neem (India), Nim (Pakistan), Baypay (Malaysia), Kwinin (Thailand), Mindi (Indonesia)
Botanical name	*Azadirachta indica* A. Juss.
Family name	Meliaceae
Origin (Distribution)	Native of Indian subcontinent; distributed throughout South-east Asia, East and Sub-Saherian Africa, Fiji and some parts of Central America.

THE WOOD

Colour	Heartwood reddish brown, aromatic, moderately lustrous; sapwood greyish yellow.
Weight	Heavy (Air-dry specific gravity approx. 0.83)
Grain	Interlocked

Texture Coarse

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	89	9666	47.1

Drying and shrinkage Dries well; Shrinkage- radial (4.5%), tangential (6.2%), volumetric (10.7%)

Durability Durable, resistant to termite damage

Treatability Resistant

Working properties Planing- easy; Boring-easy, Turning-easy, Nailing- good but pre-boring necessary; Finish- good

Typical uses Used in light construction, furniture, doors and window frames, boards and panels, cabinets, boxes and crates. Also used for agricultural implements, tool handles, musical instruments, cigar boxes, matches, plywood and veneer.

Special remarks / diagnostic features : The wood has insect repellant properties due to the presence of neem oil.

Price (Rs. per m^3) Log: 9000
Converted: 12500

Additional reading

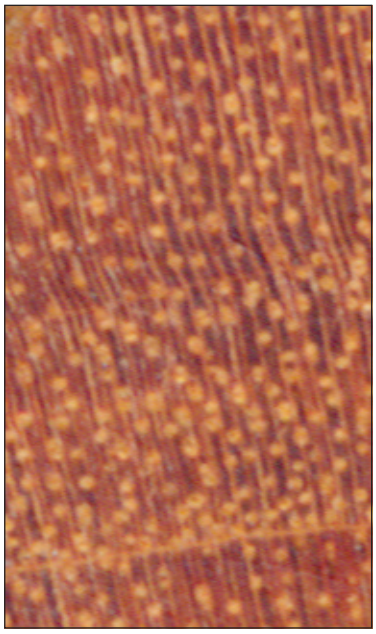
Nazma, Ganapathy, P. M., Sasidharan, N., Bhat, K. M., and Gnanaharan, R. 1981. A Handbook of Kerala Timbers. *KFRI Research Report No. 9*, Kerala Forest Research Institute, Peechi, Kerala, India, 260p.

Tewari, D. N. 1992. Monograph on Neem (*Azadirachta indica* A. Juss.). International Book Distributors, Dehra Dun, India. 279p.

Standard Trade Name

NIOVÉ

Quarter sawn



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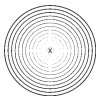


Vernacular names	Ekop (Cameroon), Kamashi (Zaire), Oropa (Nigeria), Niové (Gabon)
Botanical name	*Staudtia stipitata* Warb. Syn. *Staudtia gabonensis* Warb.
Family name	Myristicaceae
Origin (Distribution)	Tropical West Africa, Cameroon, Gabon and Zaire

THE WOOD

Colour	Heartwood orange yellow brown to reddish brown with darker streaks, slightly lustrous and occasionally oily with pepper like scent; sapwood wide, pale yellow to orange yellow, clearly defined.
Weight	Heavy (Air-dry specific gravity approx. 0.83)
Grain	Straight or wavy

Texture Fine

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	152	18437	90.0

Drying and shrinkage Dries slowly; initial surface drying prior to kiln seasoning recommended; Shrinkage- radial (5.1%), tangential (6.2%), volumetric (11.3%)

Durability Very durable

Treatability Extremely resistant

Working properties Planing- easy; Boring- rather easy; Turning- easy; Nailing- good but pre-boring necessary; Finish- good

Typical uses Used for external structural work, cabinet work (high class furniture), interior and exterior joinery, heavy duty flooring, turnery, interior and exterior panelling, truck bodies, wagons, ship building (ribs, planking and deck), handicrafts and sliced veneer.

Price (Rs. per m^3) Log: 14000-18000

Additional reading

Bolza, E., and Keating, W. G. 1972. African timbers- the properties, uses and characteristics of 700 species. Division of Building Research, CSIRO, Melbourne, Australia.

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

CIRAD- Forestry Department. 2003. TROPIX 5.0, Technological characteristics of 215 tropical species. Montepellier, France.

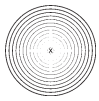
William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

OAK (RED), AMERICAN

Quarter sawn

Cross cut



Vernacular names	Eastern red oak, Gray oak (USA), Northern red oak (Canada)
Botanical name	*Quercus* spp., principally *Quercus rubra* L.
Family name	Fagaceae
Origin (Distribution)	Commercial red oak comprises ten or more species, mainly distributed in Eastern Canada and USA.

THE WOOD

Colour	Heartwood pinkish to light reddish brown or light brown; sapwood whitish to greyish or pale reddish brown, clearly defined.
Weight	Moderately heavy (Air-dry specific gravity approx. 0.63)
Grain	Straight. The quarter-sawn surface is less attractive than that of White oak.

Texture Coarse

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	96.8	12549	47.54

Drying and shrinkage Dries slowly with a tendency to split and warp; Shrinkage- radial (4.0%), tangential (8.0%), volumetric (12.0%)

Durability Perishable

Treatability Moderately resistant

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing- good but pre-boring necessary; Finish- good

Typical uses Attractive timber very commonly used for decorative veneer, flooring, wall panelling, furniture, interior joinery, turnery, cabinet work. Also suitable for vehicle construction, railroad crossties, agricultural implements and musical instruments. Unsuitable for exterior applications due to the lack of durability.

Special remarks / diagnostic features : The wood is similar in general appearance to White oak (*Quercus* spp., principally Q. *alba*) but with a slightly less pronounced figure and durability.

Price (Rs. per m^3) Log: 30000-32000

Additional reading

American Hardwood Export Council. 2002. 1111 Nineteenth Street, NW, 20036 Washington DC, USA.

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

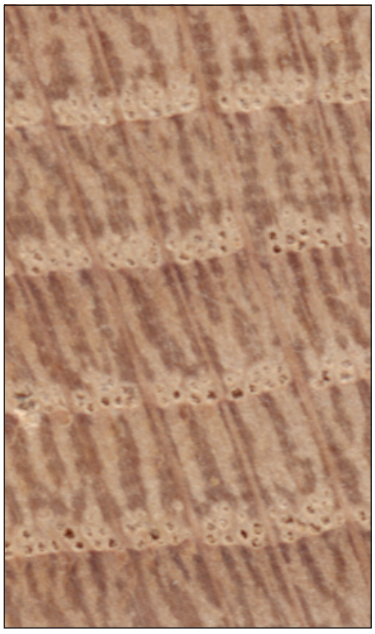
Timber Research and Development Association. 1980. Timbers of the World. Volume 2. The Construction Press Ltd; Lancaster, England.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

OAK (WHITE), AMERICAN

Quarter sawn



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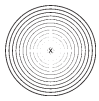


Vernacular names	Eastern white oak (France), Fork-leaf oak, Ridge white oak (USA)
Botanical name	*Quercus* spp., principally *Quercus alba* L.
Family name	Fagaceae
Origin (Distribution)	White oak comprises nine or more species, mainly distributed in the Eastern USA and South Eastern Canada.

THE WOOD

Colour	Heartwood colour varies from pale yellow brown to pale reddish brown, often with a pinkish tint; clearly demarcated from the white sapwood.
Weight	Heavy (Air-dry specific gravity approx. 0.76)
Grain	Straight. Quarter-sawn material has a characteristic ornamental 'silver grain' figure.

Texture Medium to coarse

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	110	11500	53.2

Drying and shrinkage Dries slowly with a tendency to check, split and honeycomb; Shrinkage- (radial (3.0%), tangential (5.5%), volumetric (8.5%)

Durability Durable

Treatability Resistant

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing- easy; Finish- good. An excellent timber for steam bending. The wood is liable to stain when contact with iron, steel or under damp conditions, due to the presence of tannin in wood. Use of non-corrosive metals for fastenings and fittings is recommended.

Typical uses Used for decorative veneer, panelling, heavy construction, ship building, railway sleepers, parquet and strip flooring, interior finish, furniture, cabinet making, joinery, doors, vehicle bodies, tool handles and agricultural implements.

Special remarks / diagnostic features : The wood resembles that of European oak (*Quercus robur*) but slightly heavier.

Price (Rs. per m^3) Log: 25000

Additional reading

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

Rendle, B. J. (ed.). 1969. World Timbers. Vol. 2, North and South America. Ernest Benn Limited. London. 150p.

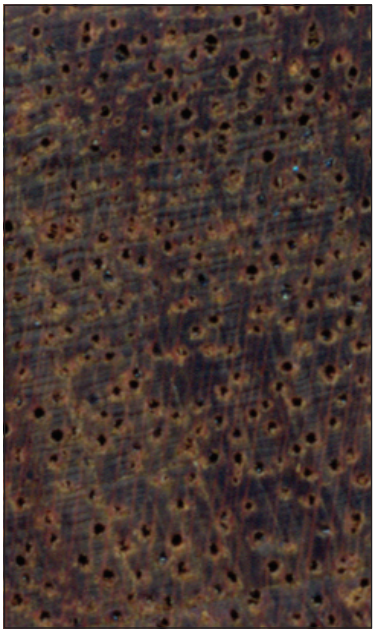
Timber Research and Development Association. 1980. Timbers of the World. Volume 2. The Construction Press Ltd; Lancaster, England.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

OVANGKOL

Flat sawn



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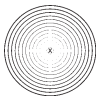


Vernacular names	Anokye, Ehie (Ghana), Amazoué (Ivory Coast), Kalukafuon (Nigeria), Ovangkol (Gabon)
Botanical name	*Guibourtia ehie* (A.Chev) J. Leon.
Family name	Fabaceae
Origin (Distribution)	Ivory Coast, Ghana, Southern Nigeria and Gabon.

THE WOOD

Colour	Heartwood yellow brown to chocolate brown with greyish black stripes and copper glints; sapwood yellow- white, fairly wide (about 4 inch).
Weight	Heavy (Air-dry specific gravity approx. 0.83)
Grain	Straight to interlocked
Texture	Medium to coarse

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	127	21457	69.0

Drying and shrinkage Dries slowly; Shrinkage- radial (3.9%), tangential (8.0%), volumetric (11.9%)

Durability Moderately durable

Treatability Resistant

Working properties There is moderate blunting effect on tools due to the silica content of the wood. The wood saws slowly but well. Planing-moderately easy; Boring- difficult; Turning- easy; Nailing- good but pre-boring necessary; Finish- good. Must be heated before slicing into veneer.

Typical uses A very attractive wood like Walnut (*Juglans* spp.), used for fine furniture and cabinet work, high class interior joinery, decorative veneer, interior panelling, turnery, domestic flooring and musical instruments.

Additional reading

Bolza, E., and Keating, W. G. 1972. African timbers- the properties, uses and characteristics of 700 species. Division of Building Research, CSIRO, Melbourne, Australia.

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

CIRAD- Forestry Department. 2003. TROPIX 5.0, Technological characteristics of 215 tropical species. Montepellier, France.

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

PADAUK, AFRICAN

Flat sawn

Quarter sawn

Cross cut

Vernacular names	Barwood, Camwood (UK), Bosulu, Ngula (Zaire), Mbé, Mbil (Cameroon)
Botanical name	*Pterocarpus soyauxii* Taub.
Family name	Fabaceae
Origin (Distribution)	Central and West Tropical Africa, extending from south-western Nigeria to Zaire.

THE WOOD

Colour	Heartwood vivid red when freshly cut, darkening to purple-brown with red streaks upon exposure, lustrous; sapwood 4-8 inch wide, whitish to brown yellow, clearly defined.
Weight	Heavy (Air-dry specific gravity 0.64-0.80 with average value of 0.72)
Grain	Straight to interlocked

Texture Medium to coarse

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	118	15293	62.6

Drying and shrinkage Dries rather easily; Shrinkage- radial (3.2%), tangential (5.0%), volumetric (8.2%)

Durability Very durable, very resistant to termite attack.

Treatability Resistant

Working properties Planing- moderately easy; Boring- moderately easy; Turning- easy; Nailing- good but pre-boring necessary; Finish- good

Typical uses Attractive timber ideal for high class joinery, furniture and cabinet making, decorative veneer, heavy duty flooring. Also used for fancy turnery and carvings, tool and knife handles, agricultural implements. Renowned as a dye wood.

Special remarks / diagnostic features : A substitute timber for Malaysian Padauk (Narra), *Pterocarpus indicus*

Price (Rs. per m^3) Log: 21000-22000
Converted: 32000-35000

Additional reading

Bolza, E., and Keating, W. G. 1972. African timbers- the properties, uses and characteristics of 700 species. Division of Building Research, CSIRO, Melbourne, Australia.

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

CIRAD- Forestry Department. 2003. TROPIX 5.0, Technological characteristics of 215 tropical species. Montepellier, France.

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

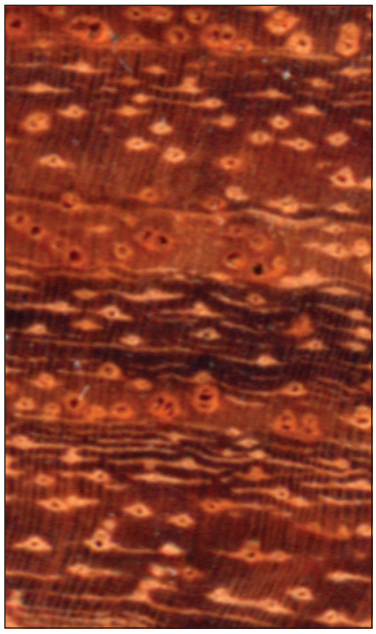
William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

PADAUK, BURMA

Flat sawn

Quarter sawn



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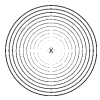


Vernacular names	Mai Pradoo, Pradoo (Thailand)
Botanical name	*Pterocarpus macrocarpus* Kurz.
Family name	Fabaceae
Origin (Distribution)	Myanmar and Thailand

THE WOOD

Colour	Heartwood bright yellowish red to brick red streaked with darker lines, but on exposure tones down to a golden reddish brown; sapwood greyish white, narrow.
Weight	Heavy (Air-dry specific gravity approx. 0.85)
Grain	Interlocked
Texture	Medium to coarse

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	142	14331	75.4

Drying and shrinkage Dries easily, but have a tendency to surface check; Shrinkage- radial (3.4%), tangential (5.8%), volumetric (9.2%)

Durability Very durable, resistant to termite attack.

Treatability Extremely resistant

Working properties Rather difficult to saw, especially when dry, and also difficult to work with hand tools; Planing- moderately easy; Boring- moderately easy; Turning- easy; Nailing- satisfactory; Finish- good

Typical uses Mainly used for decorative flooring, high grade furniture making, cabinetwork, decorative veneer, tool handles, billiard tables, high class joinery. Suitable for cart wheels, tool handles, bottoms of railway wagons, shafts, wheel hubs and oil presses.

Special remarks / diagnostic features : Timber similar to Andaman Padauk (*Pterocarpus dalbergioides*) but slightly harder and stronger.

Price (Rs. per m^3) Log: 17500
Converted: 26500

Additional reading

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

Keating, W. G., and Bolza, E. 1982. Characteristics, Properties and Uses of Timbers of South-east Asia, Northern Australia and the Pacific. Vol. 1, CSIRO, INKATA Press, Melbourne, Australia. 362p.

Pearson, R. S and Brown, H. P. 1981. Commercial timbers of India: their distribution, supplies, anatomical structure, physical and mechanical properties and uses. Vols. I- II. A. J. Reprints Agency, New Dehli, India. 1150p.

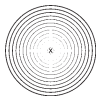
William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

PADAUK (MALAYSIA) / NARRA

Quarter sawn

Cross cut



Vernacular names	Amboyna (Indonesia), Malay Padauk, Sena (Malaysia), Liki (Solomon Islands), Burmese rosewood (Myanmar), Narra (Philippines, USA), New Guinea rosewood (Papua New Guinea)
Botanical name	*Pterocarpus indicus* Willd.
Family name	Fabaceae
Origin (Distribution)	Native to South-east and East Asia, including southern Myanmar, Malaysia, Indonesia, Philippines, Borneo, Papua New Guinea, Solomon Islands and Vanuatu.

THE WOOD

Colour	Heartwood variable in colour from blood red to golden brown to brick red, somewhat lustrous; clearly defined from the whitish or pale straw coloured sapwood.
Weight	Moderately heavy (Air-dry specific gravity 0.55-0.90 with average value of 0.66)

Grain Interlocked, sometimes wavy

Texture Medium to coarse

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	93	12068	53.0

Drying and shrinkage Dries rather slowly with little degrade; Shrinkage- radial (2.9%), tangential (5.0%), volumetric (7.9%)

Durability Very durable, resistant to termite damage.

Treatability Extremely resistant

Working properties Planing- easy, sawdust may cause irritation to skin; Boring- easy; Turning- easy; Nailing- satisfactory; Finish- good. Due to the occurrence of heart rot, wastage is reported during conversion.

Typical uses Highly favored for use in interior joinery, decorative veneer, panelling, decorative flooring, furniture and cabinets, cases for scientific instruments, interior trim for houses and boats, handicrafts, musical instruments. Some trees produce strongly figured wood known as 'amboyna', that is highly sought after for craftwood and face veneers for high value end uses.

Price (Rs. per m^3) Log: 19000
Converted: 21000

Additional reading

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

International Tropical Timber Organisation 1997. The Database of Tropical Industrial Lesser-used Wood Species. *ITTO Project PD 58/97 Rev. 1 (1), Reference Guide to Tropical Timber Species*. Nagoya University Museum, Nagoya, Japan.

Lex A. J. Thomson. 2006. *Pterocarpus indicus* (Narra) ver.2.1. *In*: Elvitch, C. R. (ed.), Species Profiles for Pacific Island Agroforestry. Permanent Agriculture Resources (PAR), Hawaii. 17p. http://www.traditionaltree.org

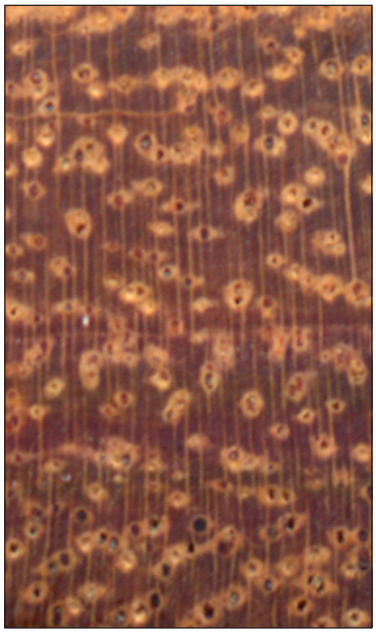
Timber Research and Development Association. 1980. Timbers of the World. Volume 2. The Construction Press Ltd; Lancaster, England.

Standard Trade Name

PARAMBAI / KARIVELAM

Flat sawn

Quarter sawn



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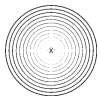


Vernacular names	Banni, Karivelam, Velvelam, Parambai (India), Khour (Nepal)
Botanical name	*Acacia ferruginea* DC.
Family name	Fabaceae
Origin (Distribution)	Native to India, Nepal and Sri Lanka

THE WOOD

Colour	Heartwood olive-brown, occasionally with darker lines, turning darker with age; clearly demarcated from the yellowish white sapwood. The wood pores are often plugged with reddish brown gum.
Weight	Very heavy (Air-dry specific gravity approx. 0.98)
Grain	Straight to interlocked
Texture	Medium to coarse

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	150	14215	84.5

Drying and shrinkage Drying difficult as it is liable to develop cracks and end splits unless proper care is taken. Kiln seasoning offers no difficulty. Shrinkage- radial (2.3%), tangential (4.0%), volumetric (6.3%)

Durability Durable

Treatability Resistant

Working properties Planing- easy; Boring- easy; Turning-moderately easy; Nailing- easy; Finish- good

Typical uses A very hard timber suitable for posts and beams in construction, cart wheels, knees of boats, brake blocks, wagon buffers, railway keys, agricultural implements and tool handles.

Special remarks /diagnostic features : A strong and very hard timber, similar to Khair (Karingali), *Acacia catechu*.

Price (Rs. per m^3) Log: 14000

Additional reading

Nazma, Ganapathy, P. M., Sasidharan, N., Bhat, K. M., and Gnanaharan, R. 1981. A Handbook of Kerala Timbers. *KFRI Research Report No. 9*, Kerala Forest Research Institute, Peechi, Kerala, India, 260p.

Pearson, R. S and Brown, H. P. 1981. Commercial timbers of India: their distribution, supplies, anatomical structure, physical and mechanical properties and uses. Vols. I-II. A. J. Reprints Agency, New Dehli, India. 1150p.

Standard Trade Name

PAULOWNIA

Quarter sawn

Vernacular names	Kiri (Japan), Paulovia (Italy), Quiri (Brazil)
Botanical name	*Paulownia* spp.
Family name	Scrophulariaceae
Origin (Distribution)	Native to China and Japan; cultivated worldwide in temperate and subtropical climate regions.

THE WOOD

Colour	Heartwood varies in colour from silver-grey to a light brown or nut brown, sometimes with a reddish cast, lustrous. Sapwood and heartwood not distinct.
Weight	Light (Air-dry specific gravity 0.25-0.36 with average value of 0.32)
Grain	Straight

Texture Fine and even

Strength Weak

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	40.8	5500	21.6

Drying and shrinkage Dries easily; do not warp easily, crack or deform; Shrinkage- radial (2.7%), tangential (3.7%), volumetric (5.0%).

Durability Perishable

Treatability Easy

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing- good but pre-boring necessary; Finish- good

Typical uses Used for light construction, carpentry/joinery, flooring, wall panelling, fences, boxes and packaging. Not suitable for using as building components that usually require high strength. *Paulownia* wood is very good for making doors, windows, partition boards, ceilings and inner roofs, insulation material for cooling systems. Also used in the making of mouldings, cabinets, furniture, handicrafts, tool handles, musical instruments, sports equipment, pulp, plywood and veneer. Its charcoal is used for polishing. As it is light, rot-resistant, free of warping, cracks and knots, increasingly used in aircraft, vehicles and ships.

Additional reading

Cheng Jueng Ching et al. 1983. Research on the wood properties and utilization of the genus *Paulownia*. *Forestry Science in China* 19 (1–3).

IDRC 1986. Paulownia in China: Cultivation and Utilisation. Asian Network for Biological Sciences and International Development Research Centre, Ottawa, Canada.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

PINE, PITCH / LONGLEAF PINE

Flat sawn

Quarter sawn

Cross cut

Vernacular names	Broom pine, Brown pine, Southern yellow pine, Southern pine (USA), Longleaf pine (UK)
Botanical name	*Pinus palustris* Mill. and *Pinus ellottii* Engelm.
Family name	Pinaceae
Origin (Distribution)	Southern USA

THE WOOD

Colour	Heartwood yellowish brown to reddish brown and having resinous scent; clearly demarcated from the yellowish white sapwood.
Weight	Moderately heavy (Air-dry specific gravity 0.66-0.69 with average value of 0.67)
Grain	Straight

Texture Medium to coarse

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	100	13662	58.4

Drying and shrinkage Dries easily; Shrinkage- radial (5.1%), tangential (7.5%), volumetric (12.6%)

Durability Moderately durable

Treatability Resistant

Working properties Planing- moderately easy; Boring- moderately easy; Turning- easy; Nailing- easy; Finish- good. The resin may troublesome in clogging cutters and saw-teeth.

Typical uses Used for heavy construction work, bridges, beams, posts, lorry and railway wagons, ship building, decking, dock work etc. Also used for joinery, flooring, light construction, pulp, charcoal, boxes and crates.

Price (Rs. per m^3) Log: 25000-28000

Additional reading

Panshin, A. J. and De Zeeuw, Carl. 1980. Textbook of Wood Technology. Structure, identification, properties and uses of Commercial Woods of the Unites States and Canada (4th Edition). McGraw-Hill Series in Forest Resources, McGraw-Hill Book Co., NY, USA, 722p.

Rendle, B. J. (ed.). 1969. World Timbers. Vol. 2, North and South America. Ernest Benn Limited. London. 150p.

Timber Research and Development Association. 1980. Timbers of the World. Volume 2. The Construction Press Ltd; Lancaster, England.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

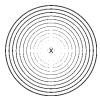
Standard Trade Name

PINE, PONDEROSA

Flat sawn

Quarter sawn

Cross cut



Vernacular names	Bird's eye pine, British Columbia soft pine, Knotty pine (Canada), Californian white pine (USA), Western yellow pine (USA and Australia)
Botanical name	*Pinus ponderosa* Dougl.ex Laws.
Family name	Pinaceae
Origin (Distribution)	Western Canada and Western USA

THE WOOD

Colour	Heartwood deep yellow to reddish brown and resinous; clearly defined from the wide, pale yellow sapwood. Resin ducts are fairly prominent on flat-sawn surfaces, appearing as fine, dark brown lines.
Weight	Light (Air-dry specific gravity approx. 0.51)
Grain	Straight

Texture Fine and even

Strength Moderately strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	65	8901	36.8

Drying and shrinkage Dries easily; the wide sapwood susceptible to fungal staining; Shrinkage- radial (3.5%), tangential (6.2%), volumetric (9.7%)

Durability Perishable

Treatability Moderately resistant

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing-easy; Finish- good

Typical uses Moderately strong, soft timber well suited for decorative veneer, window frames, doors, panelling, joinery, light and medium construction, turnery and carving. Also used for kitchen furniture, boxes, packing cases and general carpentry.

Special remarks / diagnostic features : Ponderosa Pine is occasionally found with bird's-eye figure, and extensively used as "knotty pine" for interior decoration.

Additional reading

Panshin, A. J. and De Zeeuw, Carl. 1980. Textbook of Wood Technology. Structure, identification, properties and uses of Commercial Woods of the Unites States and Canada (4th Edition). McGraw-Hill Series in Forest Resources, McGraw-Hill Book Co., NY, USA, 722p.

Timber Research and Development Association. 1980. Timbers of the World. Volume 2. The Construction Press Ltd; Lancaster, England.

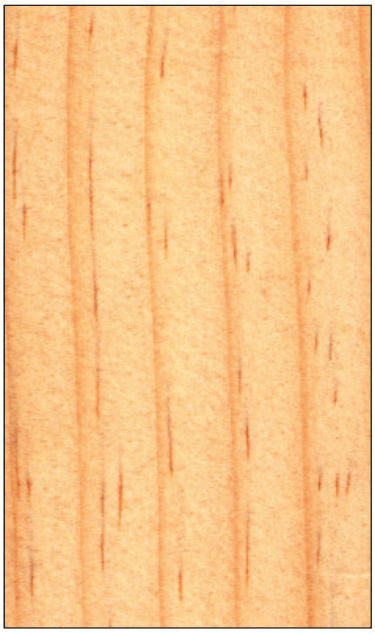
Wood News. 1999. Pines. Vol. 9(3): 41-43.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York 10022, 320p.

Standard Trade Name

PINE, RADIATA

Flat sawn



Quarter sawn

Vernacular names	Monterey pine (USA), Radiata pine (New Zealand), Insignis pine (Australia)
Botanical name	*Pinus radiata* D. Don.
Family name	Pinaceae
Origin (Distribution)	Native to Southern California and Mexico; introduced as a major plantation species throughout the world, especially in South America, Spain, Italy, South Africa, New Zealand and Australia.

THE WOOD

Colour	Heartwood reddish-brown varying to shades of yellow, slightly resinous; sapwood creamy-white.
Weight	Light, (Air-dry specific gravity approx. 0.48)
Grain	Straight

Texture Medium.

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	100	13700	58.4

Drying and shrinkage Dries easily; Shrinkage- radial (3.4%), tangential (6.7%), volumetric (10.1%)

Durability Perishable

Treatability Easy

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing- easy; Finish- good

Typical uses Used for veneers and plywood, pulp and paper, fibre and particle board, light construction work, shuttering, packing cases, furniture and joinery.

Price (Rs. per m^3) Log: 25000-28000

Additional reading

Kininmonth, J. A., Whitehouse, L. K. 1991. Properties and uses of Radiata pine grown in New Zealand, Vol. 1: Basic wood properties. Ministry of Forestry, Forest Research Institute, Rotorua, New Zealand.

Panshin, A. J. and De Zeeuw, Carl. 1980. Textbook of Wood Technology. Structure, identification, properties and uses of Commercial Woods of the Unites States and Canada (4th Edition). McGraw-Hill Series in Forest Resources, McGraw-Hill Book Co., NY, USA, 722p.

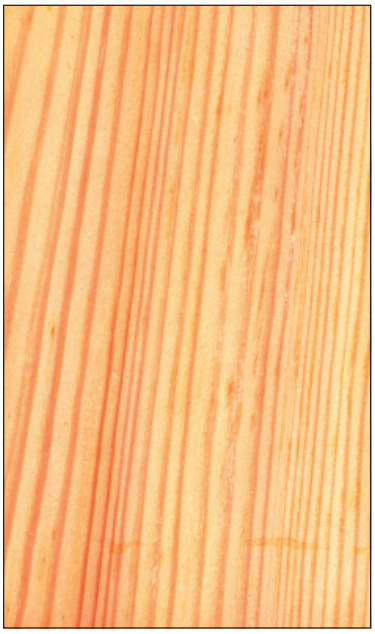
Rendle, B. J. (ed.). 1970. World Timbers. Vol. 3, Asia and Australia and New Zealand. Ernest Benn Limited. London.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

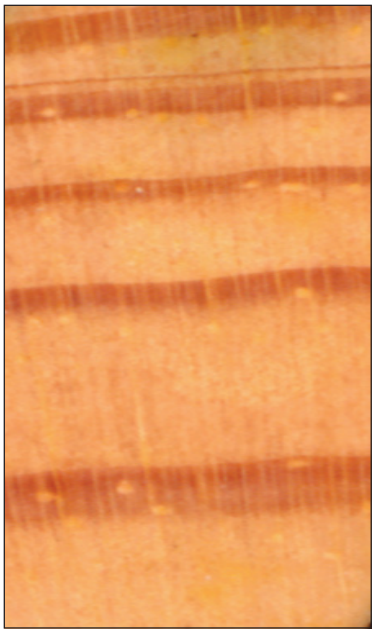
Wood News. 1999. Pines. Vol. 9 (3): 41-43.

Standard Trade Name

PINE, RED



Quarter sawn



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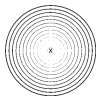


Vernacular names	Canadian pine, Hard pine, Norway pine (USA)
Botanical name	*Pinus resinosa* Ait.
Family name	Pinaceae
Origin (Distribution)	Native to North America and Canada

THE WOOD

Colour	Heartwood varies from red to reddish brown, oily feel with resinous odour, distinct from the pale yellow sapwood.
Weight	Light (Air-dry specific gravity approx. 0.51)
Grain	Straight
Texture	Medium

Strength Moderately strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	75	11247	41.8

Drying and shrinkage Dries easily; Shrinkage- radial (3.8%), tangential (7.2%), volumetric (11.0%)

Durability Moderately durable

Treatability Easy

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing- good but pre-boring necessary; Finish- good

Typical uses Used for light construction, carpentry, flooring, joinery, wall panelling, railway sleepers, piling, posts and poles, box boards, pulpwood and fuel.

Special remarks / diagnostic features : Similar in appearance to European red pine (*Pinus sylvestris*).

Price (Rs. per m^3) Log: 21000-25000

Additional reading

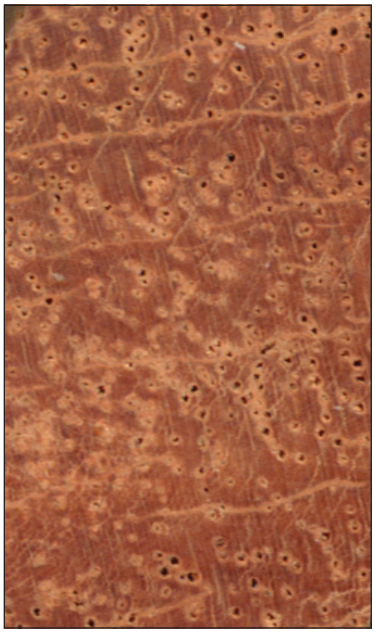
Alden, H. A. 1997. Softwoods of North America. *General Technical Report No. FPL-GTR-102*, Forest Products Laboratory, USDA Forest Service, Washington DC, USA,151p.

Timber Research and Development Association. 1980. Timbers of the World. Volume 2. The Construction Press Ltd; Lancaster, England.

Standard Trade Name

POON / PUNNA

Quarter sawn



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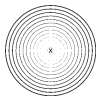


Vernacular names	Bintangur (Indonesia), Krathing (Thailand), Penaga (Malaysia); Ponnyet (Myanmar), Punna, Poon (India)
Botanical name	*Calophyllum inophyllum* Linn.
Family name	Clusiaceae
Origin (Distribution)	India, Myanmar, South-east Asia and Australia along the coastal regions.

THE WOOD

Colour	Heartwood reddish-brown with darker streaks, lustrous, without characteristic odour or taste; distinct from the pale yellow or pinkish-brown sapwood.
Weight	Moderately heavy (Air-dry specific gravity 0.55-0.80 with average value of 0.60)
Grain	Broadly interlocked

Texture Medium

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	75	6892	50.9

Drying and shrinkage Drying moderately difficult; liable for surface cracks; Shrinkage- radial (5.8%), tangential (7.7%), volumetric (13.5%)

Durability Moderately durable

Treatability Moderately resistant

Working properties Planing- moderately difficult; Boring- easy; Nailing- good but pre-boring necessary; Finish-good

Typical uses Hard and strong timber suitable for general construction and boat building, especially for keels and for pulley blocks. Also used for panelling, cabinet work, packing, handicrafts, musical instruments and decorative veneer.

Special remarks : A general constructional timber of the fisher folk along the coastal regions.

Price (Rs. per m^3) Log: 16000-21000

Additional reading

International Tropical Timber Organisation 1997. The Database of Tropical Industrial Lesser-used Wood Species. *ITTO Project PD 58/97 Rev. 1 (1), Reference Guide to Tropical Timber Species*. Nagoya University Museum, Nagoya, Japan.

Keating, W. G., and Bolza, E. 1982. Characteristics, Properties and Uses of Timbers of South-east Asia, Northern Australia and the Pacific. Vol. 1, CSIRO, INKATA Press, Melbourne, Australia. 362p.

Nazma, Ganapathy, P. M., Sasidharan, N., Bhat, K. M., and Gnanaharan, R. 1981. A Handbook of Kerala Timbers. *KFRI Research Report No. 9*, Kerala Forest Research Institute, Peechi, Kerala, India, 260p.

Pearson, R. S and Brown, H. P. 1981. Commercial timbers of India: their distribution, supplies, anatomical structure, physical and mechanical properties and uses. Vols. I- II. A. J. Reprints Agency, New Dehli, India. 1150p.

Standard Trade Name

PURPLEHEART / VIOLET WOOD

Flat sawn

Quarter sawn

Cross cut

Vernacular names	Violet wood (English trade), Guarabu, Purpleheart (Brazil), Morado (Panama, Venezuela), Palo morado (Mexico), Amaranth (USA)
Botanical name	*Peltogyne* spp.
Family name	Fabaceae
Origin (Distribution)	Central America and tropical South America from Mexico to southern Brazil.

THE WOOD

Colour	Heartwood colour varies, deep purple-violet when freshly cut, changes to well-known purple, which on prolonged exposure turns to purple-brown, lustrous; clearly demarcated from the whitish or cream coloured sapwood.
Weight	Heavy (Air-dry specific gravity 0.80-1.0 with average value of 0.86)

Grain Straight, sometimes wavy or interlocked

Texture Medium to fine

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	147	16700	78.5

Drying and shrinkage Dries fairly rapidly, but with thick material moisture removal is difficult from the centre of the planks; Shrinkage- radial (4.4%), tangential (6.5%), volumetric (10.9%)

Durability Very durable, resistant to dry-wood termites.

Treatability Extremely resistant

Working properties Planing- slightly difficult; Boring- difficult with a tendency to burn; Turning- easy; Nailing- satisfactory with care; Finish- good

Typical uses With high strength and very good durability, an excellent structural timber suitable for heavy outdoor constructional work such as bridges and harbour works, furniture, door and window frames, general carpentry. Suitable for chemical plant as filter-press plates and frames. Used for small turned articles and to a limited scale for decorative veneer inlays. Unsuitable for plywood because of its weight.

Price (Rs. per m^3) Log: 23000

Additional reading

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, USA, 826p.

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

Longwood, F. R.1962. Present and potential commercial timbers of the Carribean. *Agriculture Handbook No. 207,* USDA Forest Service, Washington DC, USA.

Rendle, B. J. (ed.). 1969. World Timbers. Vol. 2, North and South America. Ernest Benn Limited. London. 150p.

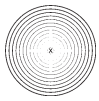
William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

PYINKADO

Quarter sawn

Cross cut



Vernacular names	Burmese irul (India), Pyin, Pyinkado (Myanmar)
Botanical name	*Xylia dolabriformis* Benth.
Family name	Fabaceae
Origin (Distribution)	Myanmar and North-eastern parts of India

THE WOOD

Colour	Heartwood dull red brown to dark brown with darker markings; clearly demarcated from the yellow brown to pale pink sapwood.
Weight	Very heavy (Air-dry specific gravity approx. 1.0)
Grain	Straight, wavy or broadly interlocked
Texture	Medium

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	142	17457	79.6

Drying and shrinkage Dries slowly; with thick material moisture removal is difficult from the centre of the planks; kiln- seasoning recommended; tendency to surface check and split and to distort. Shrinkage- radial (3.3%), tangential (6.7%), volumetric (10.0%)

Durability Very durable, highly resistant to termite attack.

Treatability Extremely resistant

Working properties Difficult to saw when green; wavy and interlocked grain affects machining properties; contains varying amounts of resin which may affect staining and polishing; Blunting- severe; Planing- moderately easy; Boring- moderately easy; Turning- easy; Nailing- poor, pre-boring necessary; Finish- good

Typical uses Suitable for heavy, structural work as in piling, bridges and harbour work. As a flooring timber it has high resistance to abrasion and makes a decorative floor suitable for public building. Also used for high quality furniture, posts, beams, railway sleepers, tool handles and boat building. Unsuitable for plywood because of its weight.

Special remarks / diagnostic features : Similar to Irul (*Xylia xylocarpa*) but heavier.

Price (Rs. per m^3) Log: 21000-25000

Additional reading

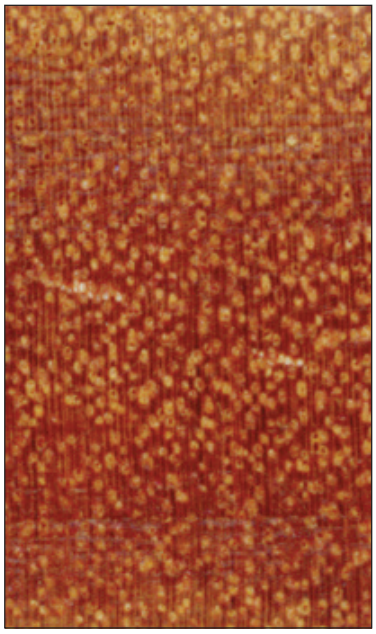
Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

Pearson, R. S and Brown, H. P. 1981. Commercial timbers of India: their distribution, supplies, anatomical structure, physical and mechanical properties and uses. Vols. I- II. A. J. Reprints Agency, New Dehli, India. 1150p.

Standard Trade Name

RESAK

Flat sawn



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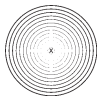


Vernacular names	Damarhiru (Indonesia), Lau-tau (Vietnam), Mascal wood (India), Narig (Philippines), Resak (Malaysia)
Botanical name	*Vatica* spp. and *Cotylelobium* spp.
Family name	Dipterocarpaceae
Origin (Distribution)	South-east Asia, mainly Malaysia and Borneo

THE WOOD

Colour	Heartwood yellowish when fresh, turning light to deep red brown on exposure; not sharply demarcated from the light coloured sapwood. Silica present in *Cotylelobium*.
Weight	Heavy (Air-dry specific gravity 0.65-1.1)
Grain	Straight or shallowly interlocked
Texture	Fine and even

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	105	18100	60.9

Drying and shrinkage Dries slowly; Shrinkage- radial (3.5%), tangential (5.0%), volumetric (8.5%)

Durability Very durable

Treatability Extremely resistant

Working properties Planing- easy to slightly difficult; Boring- easy; Turning- slightly difficult; Nailing- satisfactory with care; Finish- good

Typical uses A heavy, durable timber used for heavy construction, bridges, piling, posts, beams, door and window frames, railway sleepers, boat construction, heavy duty flooring, interior joinery, turnery, cabinet works, and sliced veneer. *Cotylelobium* often used for salt-water piling due to high silica content.

Special remarks / diagnostic features : A substitute timber for Balau (*Shorea* spp.) and Giam (*Hopea* spp.).

Additional reading

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

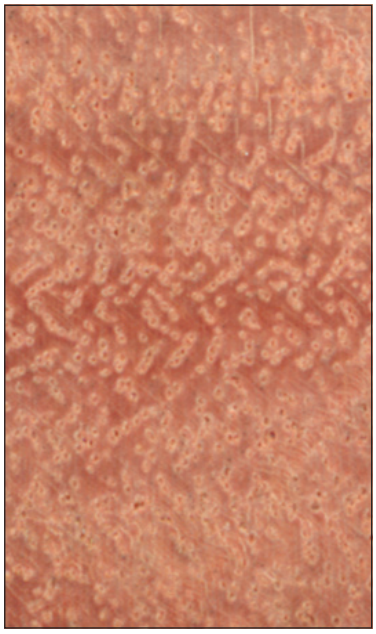
Keating, W. G., and Bolza, E. 1982. Characteristics, Properties and Uses of Timbers of South-east Asia, Northern Australia and the Pacific. Vol. 1, CSIRO, INKATA Press, Melbourne, Australia. 362p.

Malaysian Timber Industry Board. 1986. 100 Malaysian Timbers. 50728 Kuala Lumpur, Malaysia. 226p.

Standard Trade Name

RIVER RED GUM

Flat sawn



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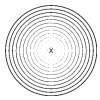

Vernacular names	Murray red gum, Queensland blue gum, Eucalypts, River red gum (Australia)
Botanical name	*Eucalyptus camaldulensis* Dehnh Syn. *Eucalyptus rostrata* Schlecht
Family name	Myrtaceae
Origin (Distribution)	Native to Australia; introduced to many parts of the world as a fast growing plantation species for pulpwood.

THE WOOD

Colour	Heartwood red, turning dark red brown on exposure.
Weight	Heavy (Air-dry specific gravity 0.82)
Grain	Interlocked, straight or wavy
Texture	Medium

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	100	11169	54.9

Drying and shrinkage Drying is not easy; Shrinkage- radial (8.2%), tangential (8.9%), volumetric (17.1%)

Durability Durable

Treatability Resistant

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing- good but pre- boring necessary; Finish- good

Typical uses Mainly used for pulp production. A popular timber for wood turners; suitable for flooring, cabinetry, interior finish, piling, ship building, constructional purposes, weather boards, bridges, furniture, packing cases, truck bodies, wagons, plywood and veneer, charcoal.

Price (Rs. per m^3) Log: 6000-7000

Additional reading

Bootle, K. 2005. *Wood in Australia; types, properties and uses*, (2nd edition). The McGraw-Hill Company, Sydney.

International Tropical Timber Organisation 1997. The Database of Tropical Industrial Lesser-used Wood Species. ITTO Project PD 58/97 Rev. 1 (1), Reference Guide to Tropical Timber Species. Nagoya University Museum, Nagoya, Japan.

Keating, W. G., and Bolza, E. 1982. Characteristics, Properties and Uses of Timbers of South-east Asia, Northern Australia and the Pacific. Vol. 1, CSIRO, INKATA Press, Melbourne, Australia. 362p.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

ROSE GUM

Flat sawn

Quarter sawn

Cross cut

Vernacular names	Flooded gum, Scrub gum, Eucalypts, Rose gum (Australia)
Botanical name	*Eucalyptus grandis* W. Hill ex Maiden
Family name	Myrtaceae
Origin (Distribution)	Native to Australia; introduced as a fast growing plantation species for pulpwood to many parts of the world, especially South and West Africa, India, South- east Asia, South America and USA.

THE WOOD

Colour	The heartwood colour ranges from pale pink to red brown; sapwood is usually paler in colour, not clearly differentiated.
Weight	Moderately heavy (Air-dry specific gravity approx.0.74)
Grain	Predominantly straight grained with no pronounced figure.
Texture	Moderately coarse and even

Strength Moderately strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	82	10954	34.9

Drying and shrinkage Dries satisfactorily using conventional air and kiln seasoning methods; care needs to be taken in the early stages of drying to avoid collapse and surface checking due to brittle heart. Shrinkage- radial (4.0%), tangential (7.2%), volumetric (11.2%).

Durability Perishable

Treatability Resistant

Working properties Sawing easy. Due to the presence of kino veins in pockets, careful sawing is necessary to obtain defect-free sawn timber. Planing- easy; Boring- easy; Turning- easy; Nailing- good but pre-boring necessary; Finish- good.

Typical uses Used mainly for pulping; suitable for internal quality furniture, outdoor furniture, joinery, carving, turnery, packing cases and boxes. Also used in general construction, plywood, panelling, boat building (framing components, planking, decking), flooring, beams, columns, poles and posts.

Price (Rs. per m^3) Log: 10000-12500

Additional reading

Bhat, K.M., and Thulasidas, P. K. 1997. Physical and mechanical properties of *Eucalyptus grandis* and *E. tereticornis* grown in Kerala. *Indian Forester* 123 (4):297-302.

Bootle, K. 2005. *Wood in Australia; types, properties and uses,* (2nd edition). The McGraw-Hill Company, Sydney.

International Tropical Timber Organisation 1997. The Database of Tropical Industrial Lesser-used Wood Species. *ITTO Project PD 58/97 Rev. 1 (1), Reference Guide to Tropical Timber Species*. Nagoya University Museum, Nagoya, Japan.

Keating, W. G., and Bolza, E. 1982. Characteristics, Properties and Uses of Timbers of South-east Asia, Northern Australia and the Pacific. Vol. 1, CSIRO, INKATA Press, Melbourne, Australia. 362p.

Nazma, Ganapathy, P. M., Sasidharan, N., Bhat, K. M., and Gnanaharan, R. 1981. A Handbook of Kerala Timbers. *KFRI Research Report No. 9*, Kerala Forest Research Institute, Peechi, Kerala, India, 260p.

Standard Trade Name

RUBBER WOOD

Flat sawn

Vernacular names	Rubber tree
Botanical name	*Hevea brasiliensis* (HBK.) Muell.Arg.
Family name	Euphorbiaceae
Origin (Distribution)	Native of Brazil; raised extensively in plantations in Malaysia, Indonesia, Thailand, Sri Lanka and India for latex production.

THE WOOD

Colour	Wood is white to creamy in colour when freshly cut, sometimes with a pinkish tinge, turns to light brown or creamy white on exposure; sapwood and heartwood not distinct.
Weight	Light to moderately heavy (Air-dry specific gravity 0.46-0.65)
Grain	Straight
Texture	Medium

Strength Moderately strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	66	9240	32.3

Drying and shrinkage Dries easily; but care is needed to avoid seasoning defects such as cupping, twisting, bowing, checking and splitting; a conventional kiln seasoning (steam-heated, forced-air drying system) is preferred in drying, Shrinkage- radial (1.2%), tangential (1.8%), volumetric (3.0%)

Durability Perishable. The wood has to be treated with preservatives soon after felling (preferably within 48 hrs) to avoid discolouration caused by sap stain fungi and attack by pinhole and powder post beetles.

Treatability Easy. Simple dip treatment or Vacuum- pressure impregnation process with preservatives such as borax-boric acid and copper- chrome arsenate (CCA) with adequate retention will protect the wood from fungal and insect attack.

Working properties Planing- easy; Boring-easy, Turning-easy, Nailing- good but pre-boring necessary; Finish- good. Tension wood can lead to fuzzy grain when machined. Finger jointing is often applied to achieve larger dimensions. Rubber wood can be steam-bent with good results. It can easily be stained to resemble walnut, cherry, oak or other woods, depending on consumer demand.

Typical uses Rubber wood's favourable woodworking and timber properties make it suitable for a wide scope of applications. Once traditionally used for fuelwood and industrial brick burning, the versatile timber after preservative treatment is now being used for the manufacture of furniture (dining sets, bedroom sets, lounge sets, rocking chairs) and furniture parts, bentwood furniture, parquet and strip flooring, panelling, wood-based panels (particle board, cement- and gypsum-bonded panels, medium-density fibreboard), packing cases, match splints and boxes etc.

Price (Rs. per m^3) Log: 8500-9000

Additional reading

Dhamodaran, T. K., and Gnanaharan, R. 1994. Upgradation of Rubber Wood. *KFRI Research Report No.93*. Kerala Forest Research Institute, Peechi, India, 22p.

Gnanaharan, R., and Dhamodaran, T. K. 1993. Mechanical properties of rubber wood from a 35-year old plantation in Central Kerala, India. *Journal of Tropical Forest Science* 6: 136-140.

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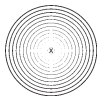
Standard Trade Name

SAPELE

Flat sawn

Quarter sawn

Cross cut



Vernacular names	Sapelli (Cameroon), Aboudikro (Ivory Coast), Libuya (Zaire), Muyovu (Uganda), Penkwa (Ghana), Sapele (Nigeria)
Botanical name	*Entandrophragma cylindricum* Sprague.
Family name	Meliaceae
Origin (Distribution)	West and East Africa

THE WOOD

Colour	Heartwood medium to fairly dark reddish- brown to purplish-brown, lustrous, without taste but with a cedar- like scent; clearly demarcated from the whitish or pale yellow sapwood.
Weight	Moderately heavy (Air-dry specific gravity 0.56-0.69 with average value of 0.62)
Grain	Interlocked, sometimes wavy

Texture Fine to medium

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	111	11700	58.6

Drying and shrinkage Drying is moderately easy; Shrinkage- radial (4.6%), tangential (7.4%), volumetric (12.0%)

Durability Moderately durable

Treatability Moderately resistant

Working properties Planing- moderately easy; Boring- easy; Turning- easy; Nailing- good but pre-boring necessary; Finish- good

Typical uses Mainly used for plywood and decorative veneer, flooring, panelling, furniture, cabinet work, musical instruments, sports goods, joinery and boat building. The log with wavy grain yield veneers with a highly decorative fiddle-back or striped figure.

Special remarks / diagnostic features : A timber of the mahogany type.

Price (Rs. per m^3) Log: 25000-28000

Additional reading

Bolza, E., and Keating, W. G. 1972. African Timbers- the properties, uses and characteristics of 700 species. Division of Building Research, CSIRO, Melbourne, Australia.

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

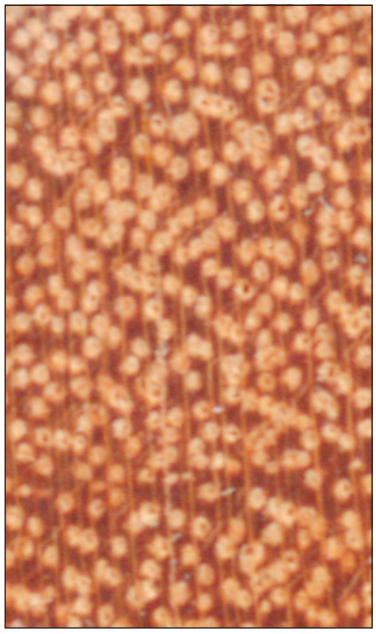
Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

SHIBIDAN / PEROBA ROSA

Flat sawn



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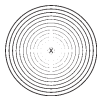


Vernacular names	Red Peroba, Peroba Rosa (Brazil)
Botanical name	*Aspidosperma peroba* Fr.All. Syn. *Aspidosperma polyneuron* Muell.Arg.
Family name	Apocynaceae
Origin (Distribution)	Southern Brazil and parts of Argentina

THE WOOD

Colour	Heartwood is characteristically roseate or yellowish- brown, often variegated or streaked with purple or brown, and becomes brownish- yellow to dark brown upon exposure. Sapwood is yellowish and not very distinct from heartwood.
Weight	Moderately heavy to heavy (Air-dry specific gravity 0.70-0.85)
Grain	Straight or irregular

Texture Fine and even

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	88	9900	56.9

Drying and shrinkage Dries easily; Shrinkage- radial (5.2%), tangential (8.7%), volumetric (13.9%)

Durability Durable

Treatability Extremely resistant

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing- pre-boring necessary; Finish- good

Typical uses Used for furniture and cabinet making, millwork, exterior joinery, interior decoration, panelling, turnery, ship building and decorative veneer.

Price (Rs. per m^3) Log: 14000-18000

Additional reading

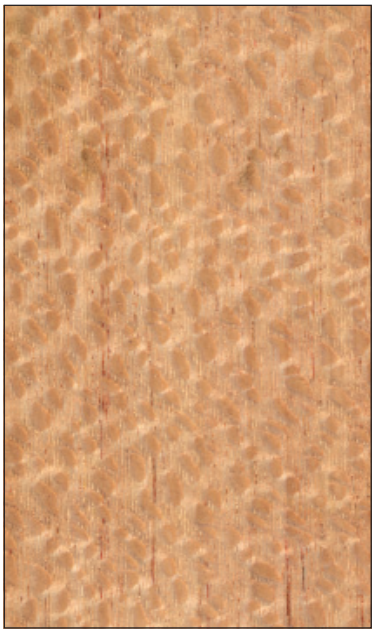
Richter, H.G., and Dallwitz, M.J. 2000. Commercial Timbers: descriptions, illustrations, identification, and information retrieval. In English, French, German, Portuguese, and Spanish. Version: 16th April 2006. http://delta-intkey.com.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

SILVER OAK

Flat sawn



Quarter sawn

Cross cut

Vernacular names	Southern silky-oak (Australia), Lacewood (USA), Silky-oak (Indonesia)
Botanical name	*Grevillea robusta* A. Cunn.ex R. Br.
Family name	Proteaceae
Origin (Distribution)	Native to Australia, extensively planted as a shade tree for coffee and tea plantations in Africa, India, Sri Lanka and other parts of the world.

THE WOOD

Colour	Heartwood distinctly pinkish brown becoming yellow brown on exposure, lustrous; well demarcated from the cream-coloured sapwood.
Weight	Moderately heavy (Air-dry specific gravity 0.56-0.66 with average value of 0.61)

Grain Straight to wavy

Texture Medium to coarse

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	77	10490	45.0

Drying and shrinkage Dries slowly; Shrinkage- radial (3.2%), tangential (9.6%), volumetric (12.8%)

Durability Moderately durable

Treatability Moderately resistant

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing- easy; Finish- good

Typical uses Used for carpentry, cabinet work, joinery, furniture, parquet flooring, interior finishes, panelling, turnery and light construction wok. Also suitable for bent wood furniture, packing, boxes, truck bodies, naval uses, handicrafts and decorative veneer.

Price (Rs. per m^3) Log: 7000-12500

Additional reading

Bolza, E., and Keating, W. G. 1982. Characteristics, Properties and Uses of Timbers of South-east Asia, Northern Australia and the Pacific. Vol. 1, CSIRO, INKATA Press, Melbourne, Australia. 362p.

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

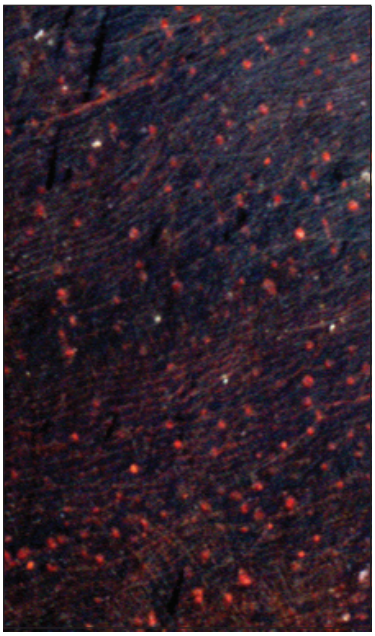
Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

Wood News. 2002. Silver Oak (*Grevillea robusta*). Vol. 12 (3): 24-25.

Standard Trade Name

SISSOO

Quarter sawn



Cross cut

Vernacular names	Shisham, Sissoo (India), Sissou (Nepal)
Botanical name	*Dalbergia sissoo* Roxb.
Family name	Fabaceae
Origin (Distribution)	Punjab to Assam in the sub-Himalyan tract in India and Nepal

THE WOOD

Colour	Heartwood golden brown to dark brown with deep dark streaks, soon becoming dull; clearly demarcated from the pale brownish to white sapwood.
Weight	Heavy (Air-dry specific gravity approx. 0.82)
Grain	Narrowly interlocked
Texture	Medium to coarse

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	95	10526	53.2

Drying and shrinkage Seasons slowly with little degrade; Kiln-seasoning enhances the value of the timber by darkening the colour. Shrinkage- radial (3.0%), tangential (5.4%), volumetric (8.4%)

Durability Very durable, highly resistant to termites.

Treatability Extremely resistant

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing- good but pre-boring necessary; Finish- good

Typical uses First class timber for cabinetry and furniture, panelling and flooring. It yields a very strong ply-board cut on a rotary machine, which is also highly decorative. Also used for boards, rafters, posts, boat building, truck and lorry bodies, door, window shutters and frames, carvings, agricultural and musical instruments and tool handles.

Special remarks / diagnostic features : Similar to Rosewood (*Dalbergia latifolia*) but with deeper colour.

Additional reading

International Tropical Timber Organisation 1997. The Database of Tropical Industrial Lesser-used Wood Species. *ITTO Project PD 58/97 Rev. 1 (1), Reference Guide to Tropical Timber Species*. Nagoya University Museum, Nagoya, Japan.

Pearson, R. S and Brown, H. P. 1981. Commercial timbers of India: their distribution, supplies, anatomical structure, physical and mechanical properties and uses. Vols. I- II. A. J. Reprints Agency, New Dehli, India. 1150p.

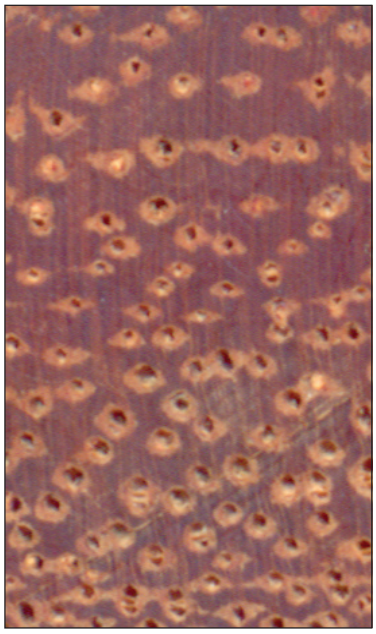
Tewari, D. N. 1994. A Monograph on *Dalbergia sissoo* Roxb. International Book Distributors, Dehra Dun, India. 316p.

Standard Trade Name

TALI

Flat sawn

Quarter sawn



Cross cut

Vernacular names	Erun, Sasswood (Nigeria), Kassa (Zaire), Missanda (UK), Muave (Zambia), Potrodom (Ghana), Tali (Ivory Coast)
Botanical name	*Erythrophleum ivorense*.A.Chev. and *Erythrophleum guineense* G. Don
Family name	Fabaceae
Origin (Distribution)	West, Central and East Africa

THE WOOD

Colour	Heartwood reddish-brown, yellow or orange brown, darkening on exposure, sometimes streaked, lustrous; sapwood creamy- white, well differentiated.
Weight	Heavy (Air-dry specific gravity 0.82-1.04 with average value of 0.94)
Grain	Interlocked

Texture Coarse

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	132	20180	78.8

Drying and shrinkage Dries slowly with a tendency to warp; Shrinkage- radial (5.8%), tangential (8.6%), volumetric (14.4%)

Durability Very durable, highly resistant to termite attack.

Treatability Extremely resistant

Working properties Dry wood is very difficult to saw and machine; Planing- rather difficult; Boring- moderately easy; Turning- easy; Nailing- good but pre-boring necessary; Finish- good

Typical uses A very durable timber suitable for heavy duty flooring, heavy construction work, bridges, railway sleepers, hydraulic works, door and window frames, posts and beams.

Price (Rs. per m^3) Log: 21000

Additional reading

Bolza, E., and Keating, W. G. 1972. African Timbers- the properties, uses and characteristics of 700 species. Division of Building Research, CSIRO, Melbourne, Australia.

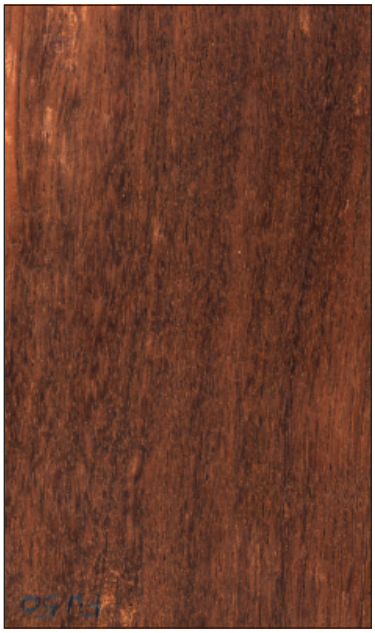
Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

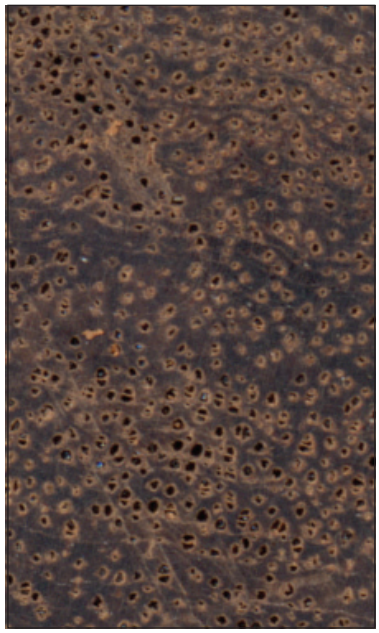
Standard Trade Name

TAUKKYAN

Flat sawn



Quarter sawn



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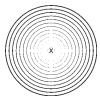


Vernacular names	Laurel, Asna, Mutti, Sain, Karimaruthu (India), Cay (Sri Lanka), Taukkyan (Myanmar)
Botanical name	*Terminalia crenulata* Heyne ex Roth Syn. *Terminalia tomentosa* (Roxb. ex DC.)Wt. & Arn.
Family name	Combretaceae
Origin (Distribution)	India, Pakistan, Bangladesh, Myanmar and Sri Lanka

THE WOOD

Colour	Heartwood varies from light brown with few markings or finely streaked with darker lines, to dark brown or brownish black producing an attractive figure. Sapwood reddish-white.
Weight	Heavy (Air-dry specific gravity 0.74- 0.95 with average value of 0.86)
Grain	Fairly straight or irregular

Texture Coarse

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	98	12300	55.1

Drying and shrinkage Drying rather difficult; should be dried slowly and evenly to avoid surface checking and splitting; Shrinkage- radial (4.7%), tangential (7.7%), volumetric (12.4%).

Durability Moderately durable

Treatability Resistant

Working properties Planing- rather difficult; Boring- moderately easy; Turning- good; Nailing- difficult, pre-boring necessary; Finish- good

Typical uses A heavy, compact and elastic timber used for marine construction and piling, boat-building, posts etc. Also suitable for furniture, turnery, cabinet work, joinery, panelling, door and window frames, railway sleepers, tool handles, building purposes and decorative veneer. Unsuitable for plywood because of splitting of the veneer during peeling.

Special remarks / diagnostic features : The timber is same as Indian Laurel (Karimaruthu), *Terminalia crenulata.*

Price (Rs. per m^3) Log: 16000
Converted: 25000

Additional reading

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

Nazma, Ganapathy, P. M., Sasidharan, N., Bhat, K. M., and Gnanaharan, R. 1981. A Handbook of Kerala Timbers. *KFRI Research Report No. 9*, Kerala Forest Research Institute, Peechi, Kerala, India, 260p.

Pearson, R. S and Brown, H. P. 1981. Commercial Timbers of India: their distribution, supplies, anatomical structure, physical and mechanical properties and uses. Vols. I- II. A. J. Reprints Agency, New Dehli, India. 1150p.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

TEAK

Flat sawn

Quarter sawn

Cross cut

Vernacular names	Jati (Indonesia), Java teak (Germany), Kyun (Myanmar), Teca (Brazil), Tek (Indonesia)
Botanical name	*Tectona grandis* L.f.
Family name	Verbenaceae
Origin (Distribution)	Native to India, Myanmar, Laos, Thailand and Indonesia. Extensively raised in plantations within and outside its natural range as well as in tropical areas of Central and South America, East and West Africa and the Carribean.
THE WOOD	
Colour	Heartwood golden brown or dark brown occasionally with black streaks with a waxy feel, lustrous, sometimes with white glistening deposit, distinct aromatic odour with the smell of leather; sapwood pale yellow or grey, well defined.
Weight	Moderately heavy (Air-dry specific gravity 0.55-0.70 with average value of 0.65)
Grain	Straight, sometimes wavy

Texture Coarse

Strength Strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	106	10000	60.4

Drying and shrinkage Dries well but rather slowly with little or no degrade; Shrinkage- radial (2.3%), tangential (4.8%), volumetric (7.1%). High resistance to water absorption.

Durability Very durable; highly resistant to termite damage.

Treatability Extremely resistant

Working properties Easily worked with both hand and machine tools. Planing- easy; Boring- easy; Turning- rather easy; Nailing- good but pre-boring necessary; Finish-good

Typical uses Used extensively for ship and boat building, Class 1general purpose plywood, cabinet making, interior and exterior joinery, flooring and fine furniture, carving, panelling, turnery, sliced for decorative and face veneers. Teak laboratory fittings and laboratory accessories are a logical choice due to the acid resistant (antioxidant) properties of this timber.

Price (Rs. per m^3) Plantation teak: Log: 42000-60000; Home garden teak- Log: 26000-39000; Burma teak- Log: 44000-51000; Columbian teak- Log: 21000-25000; Ghana teak- Log: 21000-28000; Costa Rican teak (class II/III pole size): 16000-26000; Teak, Ivory Coast: Log: 33000; Converted: 37000.

Special remarks/ diagnostic features of different types of teak wood:

Adilabad teak

- Grows in Rajulmaddugu locality of Andhra Pradesh, India.
- Rose coloured heartwood, attractive surface, fetches high price.

Central province teak (CPT)

- Slow grown wood with close grain from drier areas of central India.
- Deeper colour with twisted or wavy grain gives better appearance and fetches higher price.

Dandeli (North Kanara) teak

- Slow grown, close grained
- Darker in colour

Godavari teak

- Grows in Godavari region of Andhra Pradesh, India.
- Wood is ornamental because of unique appearance.

Home garden/farm grown teak

- Home garden teak has more defects like bends and knots lowering timber value.
- Wood from dry sites has darker golden brown colour with black streaks, making it more attractive in appearance.
- Wood from wet sites has paler colour affecting adversely the price of the timber.
- Wood from homesteads of wet sites is more susceptible to brown-rot fungi although no significant differences exists with respect to white-rot fungi among the home garden and plantation grown timbers.
- High natural durability of teak wood from drier locality is reflected in higher extractive contents with darker colour and is comparable to forest plantation teak.

Konni teak (Kerala)

- Slow grown wood with close grain and darker colour.
- Stronger than Nilambur teak.

Myanmar (Burma) teak

- Slow grown wood mostly from natural growth.
- Close and straight grain with uniform golden brown colour without markings.
- Fetches high price in international trade due to the availability of larger defect-free logs.

Nilambur (Malabar) teak

- Grows fast, yields large diameter logs.
- Straight grain with golden yellowish brown colour, often with darker chocolate-brown steaks.
- Reputed in the trade for ship building and furniture/cabinets.

West African teak

- Wood with black streaks and wavy or twisted grain.
- Wood figure is mostly inferior to that of Asian teak.
- Ghana teak is close and straight grained with uniform golden brown colour.

South and Central American teak

- Generally fast- grown and short rotation plantation teak with high amount of juvenile wood.
- Wood lighter in colour. High amount of sapwood.
  Fetches lower price due to small dimensional log and less heartwood.

Ghana Teak

Quarter sawn

Teak - Ivory Coast

Quarter sawn

Teak - Togo

Flat sawn

Benin Teak

Quarter sawn

Burma Teak

Quarter sawn

Malaysian Teak

Flat sawn

Columbian Teak

Flat sawn

Teak - Costa Rica

Flat sawn

Teak - Ecuador

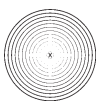
Flat sawn

Home garden Teak - Dry site

Quarter sawn

Thailand Teak

Cross cut



Home garden Teak - Wet site

Flat sawn

Additional reading

Bedell, P. E. 1989. Preliminary observations on variability of teak in India. *Indian Forester* 115 (2):72-81.

Bhat, K. M. 1998. Properties of fast-grown teak: impact on end-user's requirements. *Journal of Tropical Forest Products*, 4:1-10.

Bhat, K. M., Indira, E. P. 1997. Effects of faster growth on timber quality of teak. *KFRI Research Report No. 132*. Kerala Forest Research Institute, Peechi, Kerala, India.60p.

Bhat, K. M., Thulasidas, P. K. and Maria Florence, E. J. 2004. Timber quality of Teak grown in home garden forestry. *KFRI Research Report No. 262*. Kerala Forest Research Institute, Peechi, Kerala, India.19p.

Bhat, K. M., Thulasidas, P. K. and Maria Florence, E. J., Jayaraman, K. 2005. Wood durability of home-garden teak against brown-rot and white-rot fungi. *Trees* 19: 654-660.

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Nazma, Ganapathy, P. M., Sasidharan, N., Bhat, K. M., and Gnanaharan, R. 1981. A Handbook of Kerala Timbers. *KFRI Research Report No. 9*, Kerala Forest Research Institute, Peechi, Kerala, India, 260p.

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Sekhar, A. C. 1962. A note on some recent trends in Teak utilisation in India. *Indian Forester* 2 (2):29.

Tewari, D. N. 1992. A Monograph on Teak (Tectona grandis Linn.f). International Book Distributors, Dehra Dun, India. 479p.

Thulasidas, P. K., Bhat, K. M., and Okuyama, T. 2006. Heartwood colour variation in home garden teak (*Tectona grandis* L. f.) from wet and dry localities of Kerala, India. *Journal of Tropical Forest Science* 18 (1): 51-54.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

TOON

Quarter sawn

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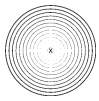

Vernacular names	Calantas (Philippines), Chomcha (Cambodia), Danupra (Philippines), Ranggoh (Sabah), Madagiri-vempu, Toon (India)
Botanical name	*Toona ciliata* Roemer Syn. *Cedrela toona* Roxb.ex. Rottler
Family name	Meliaceae
Origin (Distribution)	Indigenous to Thailand, Myanmar, Pakistan and India

THE WOOD

Colour	Heartwood reddish- brown with a spicy odour, rather lustrous; sapwood pinkish or greyish white.
Weight	Light (Air-dry specific gravity approx. 0.57)
Grain	Straight
Texture	Coarse to medium

Strength Moderately strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	83	9445	38.3

Drying and shrinkage Dries easily; Shrinkage- radial (3.8%), tangential (6.3%), volumetric (10.1%)

Durability Perishable

Treatability Easy

Working properties Planing- easy; Boring- easy to difficult; Turning- easy; Nailing- good; Finish- good

Typical uses Used for furniture, cabinets, agricultural implements, panelling, cigar boxes, packing cases, textile mill accessories, tennis, badminton and squash racket frames, musical instruments and decorative veneer.

Additional reading

Bhat, K. M. 1985. Properties of selected less-known tropical hardwood. *Journal of the Indian Academy of Wood Science*, 16 (1):26-35.

International Tropical Timber Organisation 1997. The Database of Tropical Industrial Lesser-used Wood Species. *ITTO Project PD 58/97 Rev. 1 (1), Reference Guide to Tropical Timber Species*. Nagoya University Museum, Nagoya, Japan.

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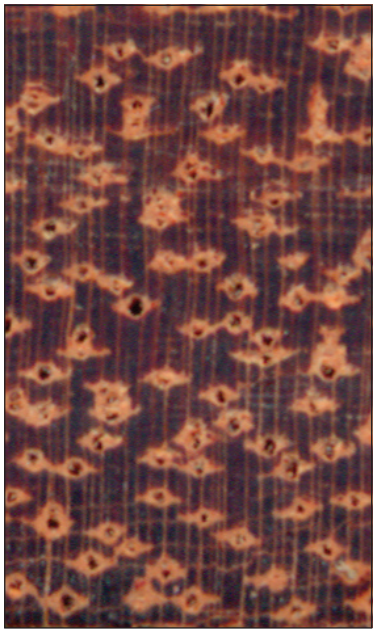
Pearson, R. S and Brown, H. P. 1981. Commercial timbers of India: their distribution, supplies, anatomical structure, physical and mechanical properties and uses. Vols. I- II. A. J. Reprints Agency, New Dehli, India. 1150p.

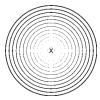
Standard Trade Name

TUALANG

Flat sawn



Cross cut



Vernacular names	Ginoo, Manggis, (Philippines), Menggeris, Tualang (Malaysia), Sialang (Sumatra), Tapang (Sarawak), Yuan (Thailand)
Botanical name	*Koompassia excelsa* (Becc.) Taub.
Family name	Fabaceae
Origin (Distribution)	South-east Asia, mainly Malaysia

THE WOOD

Colour	Heartwood dark red when freshly cut and weathering to a deep chocolate brown; clearly demarcated from the greyish white or yellow brown sapwood.
Weight	Heavy (Air-dry specific gravity 0.80-0.86)
Grain	Deeply interlocked
Texture	Coarse and even

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	121	17800	62.0

Drying and shrinkage Dries rather slowly; Shrinkage- radial (1.5%), tangential (1.7%), volumetric (3.2%)

Durability Moderately durable

Treatability Moderately resistant

Working properties Timber is very hard and tough, difficult to plane by hand and machine tools. Boring- slightly difficult; Turning- easy; Nailing- good; Finish- good

Typical uses Used for heavy construction, flooring, posts, beams, transmission poles, panelling, furniture and railway sleepers.

Special remarks / diagnostic features : Similar to Kempas (*Koompassia malaccensis*). However, Tualang is prone to severe pin-hole borer attack and moderately resistant, where as Kempas is easy to treat with preservatives.

Additional reading

Keating, W. G., and Bolza, E. 1982. Characteristics, Properties and Uses of Timbers of South-east Asia, Northern Australia and the Pacific. Vol. 1, CSIRO, INKATA Press, Melbourne, Australia. 362p.

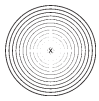
Malaysian Timber Industry Board. 1986. 100 Malaysian Timbers. 50728 Kuala Lumpur, Malaysia. 226p.

Standard Trade Name

VELLA-VEETTI

Quarter sawn

Cross cut



Vernacular names	Velleetti (India)
Botanical name	*Dalbergia lanceolaria* Linn. f.
Family name	Fabaceae
Origin (Distribution)	Moist mixed deciduous forests of southern India

THE WOOD

Colour	Yellowish or greyish white to brown; sapwood and heartwood not distinct.
Weight	Moderately heavy (Air-dry specific gravity 0.65-0.76)
Grain	Straight or slightly interlocked
Texture	Medium to coarse

Strength Moderately strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	65	7324	38.3

Drying and shrinkage Dries easily; liable to develop heart shake; green conversion recommended. Not difficult to season. Shrinkage data not available.

Durability Perishable

Treatability Easy

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing- easy; Finish- good

Typical uses Suitable for general construction, carving, light packing cases, rafters, carts and carriages.

Additional reading

Nazma, Ganapathy, P. M., Sasidharan, N., Bhat, K. M., and Gnanaharan, R. 1981. A Handbook of Kerala Timbers. *KFRI Research Report No. 9*, Kerala Forest Research Institute, Peechi, Kerala, India, 260p.

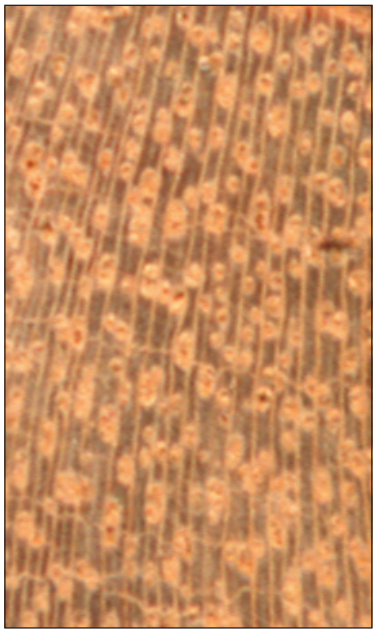
Pearson, R. S and Brown, H. P. 1981. Commercial timbers of India: their distribution, supplies, anatomical structure, physical and mechanical properties and uses. Vols. I- II. A. J. Reprints Agency, New Dehli, India. 1150p.

Standard Trade Name

VITEX

Flat sawn

Quarter sawn



Cross cut

Vernacular names	Cuajado (Panama)
Botanical name	*Vitex* spp.
Family name	Verbenaceae
Origin (Distribution)	Throughout tropical America, South- east and East Asia, mainly Papua New Guinea, Solomon Islands and Australia.

THE WOOD

Colour	Heartwood variable in colour with species, generally yellowish- brown or walnut brown with a greasy touch, lustrous; sapwood not sharply demarcated.
Weight	Heavy (Air-dry specific gravity 0.72-0.88)
Grain	Straight, rarely spiral
Texture	Fine and even

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	122	16551	75.2

Drying and shrinkage Dries easily; Shrinkage- radial (3.0%), tangential (5.0%), volumetric (8.0%)

Durability Durable

Treatability Moderately resistant

Working properties The shape of the bole often irregular, grooved and buttressed may cause conversion difficult. Planing- easy; Boring- easy; Turning- easy; Nailing- satisfactory; Finish- good

Typical uses Suitable for furniture, shelving, boat building, joinery, light framing and cabinet work.

Special remarks / diagnostic features : A substitute timber for Indian Milla (Mylellu), *Vitex altissima.*

Price (Rs. per m^3) Log: 18000
Converted: 25000

Additional reading

Keating, W. G., and Bolza, E. 1982. Characteristics, Properties and Uses of Timbers of South-east Asia, Northern Australia and the Pacific. Vol. 1, CSIRO, INKATA Press, Melbourne, Australia. 362p.

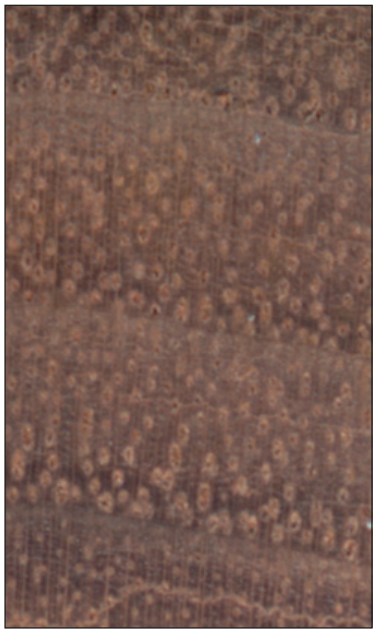
Timber Research and Development Association. 1980. Timbers of the World. Volume 2. The Construction Press Ltd; Lancaster, England.

Standard Trade Name

WALNUT, EUROPEAN

Flat sawn

Quarter sawn



Cross cut

Vernacular names	English walnut, French walnut, Italian walnut, Persian walnut
Botanical name	*Juglans regia* L.
Family name	Juglandaceae
Origin (Distribution)	South-eastern Europe, Western and Central Asia

THE WOOD

Colour	Heartwood variable in colour, greyish or greyish brown with irregular dark streaks; clearly demarcated from the pale straw coloured sapwood.
Weight	Moderately heavy (Air-dry specific gravity 0.45-0.74 with average value of 0.64)
Grain	Straight to somewhat wavy
Texture	Coarse

Strength Moderately strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	102	10500	38.8

Drying and shrinkage Dries well though rather slowly; Shrinkage- radial (3.0%), tangential (5.5%), volumetric (8.5%)

Durability Moderately durable

Treatability Resistant

Working properties Planing- easy; Boring- easy; Turning- easy; Nailing- easy; Finish- good

Typical uses Mainly used for the manufacture of plywood and decorative veneer. Also used for high class furniture, interior joinery, turnery and carving, cabinetmaking, panelling, door and window shutters and frames, musical instruments and sports goods.

Special remarks / diagnostic features : The timber is similar to Black American walnut (*Juglans nigra*) in appearance.

Additional reading

Farmer, R. H. (ed.).1972. Handbook of Hardwoods. Her Majesty's Stationery Office, London. 243p.

Knaggs, G. and Xenopoulou, S. 2004. Guide to Irish Hardwoods. COFORD, National Council for Forest Research and Development, Dublin, Ireland.

Timber Research and Development Association. 1980. Timbers of the World. Volume 2. The Construction Press Ltd; Lancaster, England.

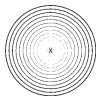
William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Standard Trade Name

YELLOW POUI / IPÊ

Quarter sawn

Cross cut



Vernacular names	Ipê (Brazil), Amapa (Mexico), Acapro (Venezuela), Lapacho (Argentina), Yellow poui (Trinidad)
Botanical name	*Tabebuia* spp.
Family name	Bignoniaceae
Origin (Distribution)	Central and South America from Mexico and West Indies to Ecuador, and the Caribbean

THE WOOD

Colour	Heartwood olive brown with lighter or darker streaks, often covered with a yellow powder, looks rather oily; sapwood yellowish white, well differentiated.
Weight	Very heavy (Air-dry specific gravity 0.96-1.20 with average value of 1.08)
Grain	Straight to interlocked

Texture Fine to medium

Strength Very strong

Moisture Content	Static Bending		Compression parallel to grain
	Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
Air-dry (12%)	194	21137	91.4

Drying and shrinkage Dries easily; Shrinkage- radial (6.6%), tangential (7.4%), volumetric (14.0%).

Durability Very durable

Treatability Extremely resistant

Working properties Planing- fairly difficult; Boring- rather easy; Turning- difficult; Nailing- good but pre- boring necessary; Finish- good

Typical uses A strong , tough and resilient wood used for building construction, furniture, interior joinery, cabinet work, window and door frames, plywood and veneer, tool handles, turnery, industrial flooring, textile mill items, naval uses, musical instruments, truck bodies and wagons.

Price (Rs. per m^3) Log: 14000-18000

Additional reading

Chudnoff, M. 1980. Tropical Timbers of the World. Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin 53726-2398, 826p.

CIRAD- Forestry Department. 2003. TROPIX 5.0, Technological characteristics of 215 tropical species. Montepellier, France.

International Tropical Timber Organisation 1997. The Database of Tropical Industrial Lesser-used Wood Species. *ITTO Project PD 58/97 Rev. 1 (1), Reference Guide to Tropical Timber Species*. Nagoya University Museum, Nagoya, Japan.

William A. Lincoln. 1986. World Woods in Color. Macmillan Publishing Company, New York. 320p.

Glossary

air-dry moisture content

The equilibrium moisture content of wood for conditions outdoors but under cover; see also **seasoning**.

air-seasoning

see **seasoning**.

annual ring

Layer of wood laid down during a single growing season. In the temperate wood, the growth rings are readily distinguishable because of differences in the cells formed during the early and late part of the season. In some of the temperate and most of the tropical wood, the annual growth rings are not easily distinguished, same as **growth ring**.

bird's-eye figure

Figure on the flat-sawn and rotary-cut surface of wood exhibiting numerous rounded areas resembling a bird's eye; common in *Pinus ponderosa*

bole

The main stem of a tree.

brittle heart

A defective core in hardwoods due to growth stresses resulting from the presence of fibres with localized wrinkles (abnormal tissue zones) that cause reduction in strength of the wood as well as serious splitting due to different rates of drying.

brown-rot fungi

A type of wood-destroying fungus that decomposes cellulose and the associated carbohydrates, leaving the lignin in a more or less unaltered state and appears as a brown crumbly powdery matrix.

coarse-textured wood

Wood with wide conspicuous growth rings with larger pores.

compression parallel to grain (maximum compression strength-MCS)

This property measures the ability of the timber to withstand loads when applied on the end grain. Values are given in N/mm^2

cross- grain

Wood in which the fibres deviate from a line parallel to the sides of the piece. Cross-grain may be either diagonal or spiral or a combination of the two.

cross-cut

To cut across the grain of wood.

curly grain

Grain that result from more or less abrupt and repeated right and left deviations from the vertical, in fibre alignment.

durability

A general term for permanence or resistance to deterioration. Frequently used to refer to the degree of resistance of a species of wood to attack by wood- destroying organisms like fungi, insects (beetles, termites) and marine borers under conditions that favour such attack. In this book, durability refers to the natural durability of the heartwood of the timber. Durability ratings are based on laboratory tests, field stake tests of performance under actual condition of use.

fibre

A loose term for wood 'elements' in general.

figure

The surface pattern on a piece of timber, known as figure, results from the interactions of several natural features. They include pattern produced in a wood surface by annual growth rings, rays, knots, deviations from regular grain, such as interlocked and wavy, and irregular colouration, stunted growth of burrs or burls. Wavy and curly grain produce "**fiddle back**" figure; wavy grain combined with spiral grain causes "**mottled**" figure; interlocked grain will provide "**ribbon striped**" figure. Such decorative pattern/ designs in wood are prized in the furniture and cabinet making industries.

fine textured wood

Wood with narrow, inconspicuous growth rings. The term is often used to designate wood having small and closely spaced pores, same as **close-grained** wood.

finish (finishing of wood products)

Coatings of paint, varnish, laquer, wax etc. applied to surfaces of wood products to protect and enhance their appearance or durability.

flat-sawn

Wood is sawn in such a way that the tangential face of wood is exposed on the surface of boards; same as **plain-sawn.**

fuzzy grain

The release of fibre, generally during and due to sawing, giving the surface a more or less wooly appearance, notably in Rubber wood.

grain of wood

Arrangement and direction of alignment of wood elements.

green wood

Freshly felled sawn wood in which cell walls are completely saturated with water.

growth ring

Ring of wood on a transverse surface or in a transverse section, resulting from periodic growth; if but one growth ring is formed during a year it is called an **annual ring.**

gum duct/ gum canal

The presence of vertical resin ducts in tangential series as seen on the cross sectional face of hardwoods, often filled with white deposits, notably members of the family Dipterocarpaceae; see also **resin canal.**

hardness

A property of wood that enables it to resist indentation.

hardwood

Wood produced by broad-leaved trees or angiosperms, same as **porous wood**, in contrast to the conifers or **softwood**. The term has no reference to the actual hardness of wood.

heart rot

Any rot characteristically confined to the heartwood. It generally originates in the living tree. Heart rot reduces wood quality but the tree is not killed and is, in most cases, externally asymptomatic.

heartwood

Dead inner core of a woody stem (or a log), generally distinguishable from the outer portion (sapwood) by its darker colour; see **sapwood.**

honeycombing

Checks, often not visible at the surface, that occurs in the interior of a piece of wood.

intercellular canal

See **resin canal**

interlocked grain

A condition produced in wood by the alternate orientation of fibres in successive layers of growth increments; the quarter-sawn face of such wood produces ribbon figure.

juvenile wood

Immature wood formed around the centre of the pith during the initial few years of growth, characterized by the progressive change in cell dimension, different microstructure than mature wood, and greater shrinkage parallel to grain.

kino

A red to red black exudate rich in tannins occurring in various, mainly tropical trees, notably Eucalyptus.

knot

Natural growth characteristic of wood caused by a branch base embedded in the tree trunk.

lustrous

The ability of the sawn wood surface to reflect light.

modulus of elasticity (MOE)

The modulus of elasticity calculated from bending tests. MOE is used for determining the deflection of beams under load, the greater the stiffness- the less the deflection. Values are given in N/mm^2.

modulus of rupture (MOR)

The maximum bending load to failure. The load is applied to the heart-side tangential face of the specimen at a constant rate descent of 2-3 mm per minute. Values are given in N/mm^2

moisture content (m.c)

Weight of water in wood, usually expressed as a percentage of the weight of oven-dry wood.

mottled figure

See **figure**

oven-dry

Wood dried to a relatively constant weight in a ventilated oven at 101° to 105° C.

particleboard

Panels manufactured from lingo-cellulosic materials-commonly wood- essentially in the form of particles (as distinct from fibres). The materials are boned together with synthetic resin or other suitable binder, under heat and pressure, by a process wherein the interparticle bonds are created wholly by the added binder.

plywood

A composite panel made up of cross-banded layers of veneer bonded with an adhesive. Generally the grain of one or more plies is roughly at right angles to the other plies, and almost always an odd number of plies are used.

pores

Openings as it appear on a transverse surface or transverse section of wood.

preservative

Any substance that, for a reasonable length of time, is effective in preventing the development and action of fungi, insects (beetles, termites) and marine borers that deteriorate wood.

quarter-sawn

Quarter-sawing means cutting a log radially (90-degree angle) to the growth rings to produce a "vertical" and uniform pattern grain; same as **edge grain, vertical grain.**

resin

Natural polymer secreted by plant tissues in special cavities or passages, collected by tapping. Insoluble in water, soluble in alocohol, ether or carbon disulphide.

resin canal/resin duct

Tubular, intercellular space sheathed by secreting cells (epithelium), bearing resin in the sapwood of softwoods, notably in Pines, see **intercellular canal.**

rotary-cut veneer

Veneer obtained by rotating a log against a cutting knife in such a way that a continuous sheet of veneer is unrolled spirally from a log, see **veneer.**

sapwood

Outer (younger) portion of a woody stem (or a log) by its lighter colour; see **heartwood.**

sap-stain fungi

A discolouration of the sapwood caused by the growth of certain group of fungi on the surface and in the interior of the wood.

seasoning

Removal of moisture from green wood either by (a) exposure to air under cover without artificial heat **(air-seasoning)** or (b) drying in kiln with artificial heat **(kiln-seasoning)**; see also **air-dry moisture content**.

shrinkage

The contraction of wood fibers caused by drying below the fiber saturation point (usually around 25-27% m.c). Values are expressed as a percentage of the dimension of the wood when green. In this book data have been shown to represent average radial, tangential and volumetric shrinkage. It is calculated based on green to oven-dry weight basis.

silver grain

Figure produced on quarter-sawn timber by conspicuous rays, as in Oak.

softwood

Wood produced by conifers, in contrast to the wood produced by angiosperms or **hardwood**. The term has no reference to the actual hardness of wood.

specific gravity

The decimal ratio of the oven-dry weight of a piece of wood to the weight of the water displaced by the wood at a given moisture content, abbreviated as sp. gr.

spiral grain

Wood in which the fibres are aligned in helical orientation around the axis of the bole, see **cross-grain**.

static bending

Bending under a constant or slowly applied load; flexure.

straight grain

Wood in which the fibres run parallel to the axis of the bole.

strength of wood

The ability of the timber to resist applied or external forces. It is this resistance or strength of the timber that determine the suitability of different species of timber for the various end uses.

tension wood

Abnormal wood found on the upper side of hardwood branches and leaning/crooked stems; characterized by abnormally high longitudinal shrinking, causing warping and splitting.

texture

Refers to the size and proportion of wood elements, a term often used interchangeably with grain. In this book, texture refers to the finer structure of the wood (see **grain**) rather than growth ring. Described as coarse (large elements), fine (small elements) or even (uniform size of elements).

treatability

The ease with which a timber can be impregnated with a preservative treatment to enhance durability. The term used in this book is to describe the extent to which a timber can be impregnated under pressure with preservatives. The treatability of the timber varies with species concerned.

veneer

A thin sheet of wood produced by slicing, rotary-cutting or sawing.

warping

Any distortion in a piece of wood from its true plane that may occur during seasoning. Warp includes cup, bow, crook and twist.

wavy grain

Wood in which the fibres collectively take the form of waves or indulations.

weight/density

Mass per unit volume of wood. Values are given in kilogram per cubic meter (kg/m^3) at specified moisture content.

workability

The degree of ease and smoothness of cutting wood with hand tools or machine.