european wood

Selected European Wood Species and their Characteristics

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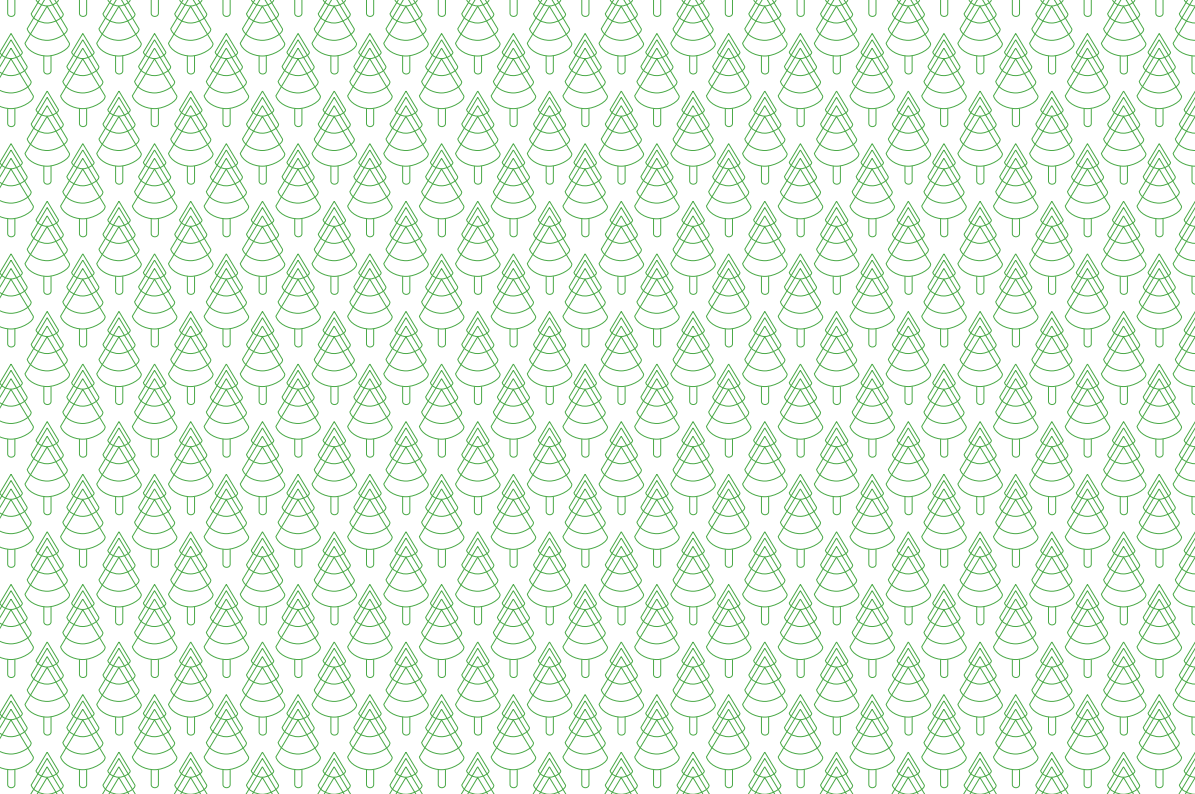
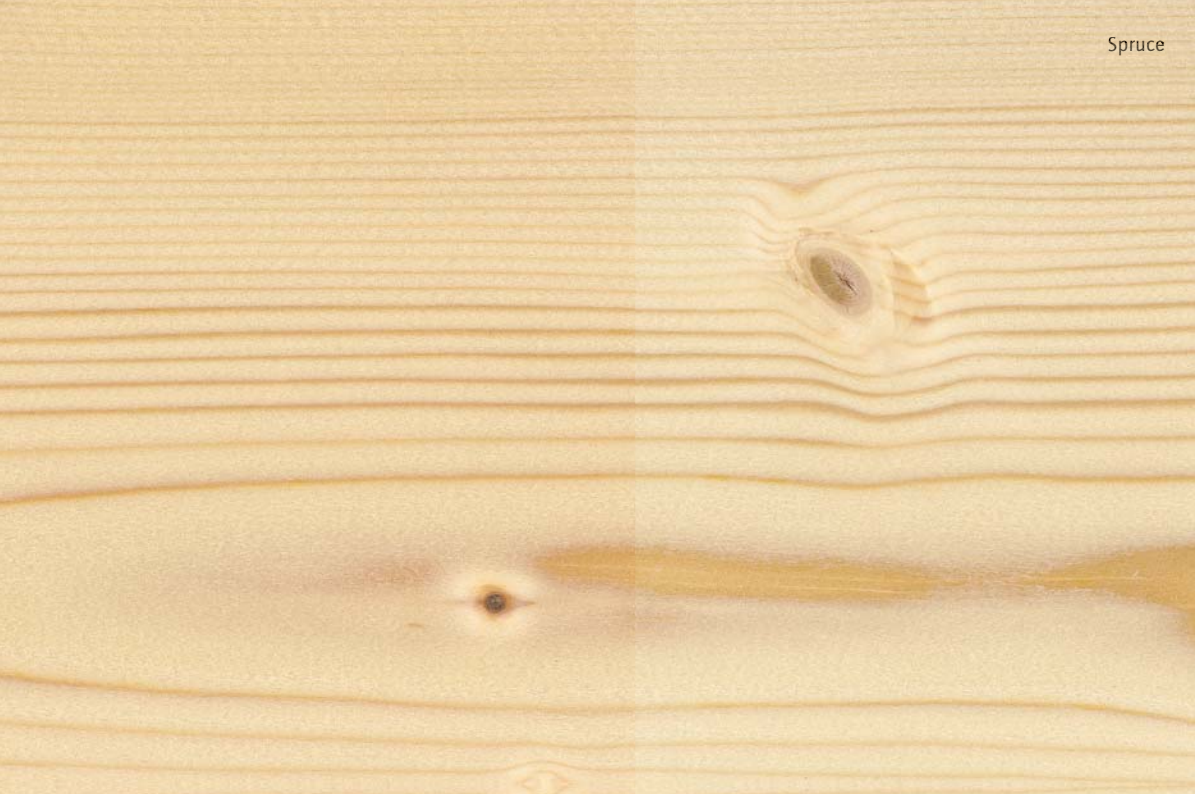
European Wood is a co-operation project by the national wood export promotion organisations French Timber, German Timber Promotion Fund, proHolz Austria, Swedish Forest Industries Federation, and Norwegian Sawmill Industries Association. European Wood has a close co-operation with CEI-Bois, the European organisation of wood producers and wood industries.

The mission of European Wood is to promote the benefits of using wood in construction & interiors as well as to share the experience and expertise along with the advanced technologies in the application of wood. European wood processing industries have adopted leading edge technologies in all the areas relevant to building systems and construction as well as the import/export of this clean and inexpensive material, including the development of new products and applications, logistics, transportation, and procurement.

With this folder we would like to give the Wood industry outside of Europe the possibility to get basic information about characteristics and application of the selected European wood species.




Spruce

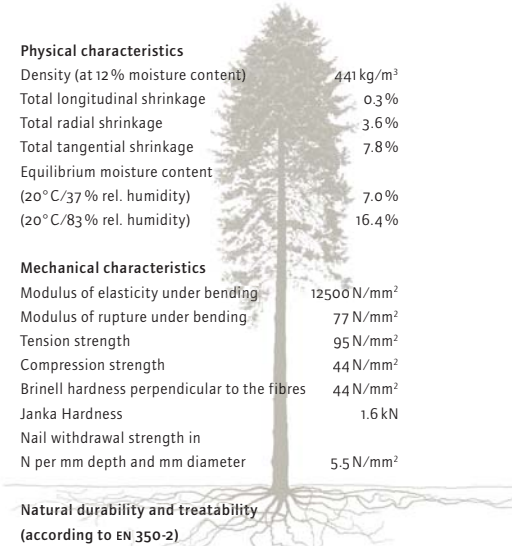
< Spruce Picea abies

Other names Whitewood, Norway spruce

General description The species is widely distributed throughout continental Europe and is a timber tree of major economic importance. The large tree usually has a straight, cylindrical trunk and grows to a height of about 30 m (up to 55 m), with a large diameter of about 60 cm (up to 1,5 m).

Wood description The colours range from creamy white to light yellow and to red-brown. Heartwood is not distinct from sapwood. Spruce is straight-grained with thin and regular texture. Resin canals are rather common. The wood is soft, low in weight and has medium density. The strength properties are good.
Sawing and machining is easy, also assembling. Spruce has a slight tendency to split when nailed.

Common uses The typical end-uses for spruce wood are for structural end uses, indoors and outdoors, thus it is the most important building and construction timber in Europe. It is also used for decorative plywood, decorative veneer, domestic flooring, factory flooring, general carpentry, interior construction, joinery (external). Spruce wood from Central and Eastern Europe shows exceptional resonance qualities and is used for musical instruments like sound boards of pianos and bellies of violins and guitars.



Physical characteristics	
Density (at 12 % moisture content)	441 kg/m³
Total longitudinal shrinkage	0.3 %
Total radial shrinkage	3.6 %
Total tangential shrinkage	7.8 %
Equilibrium moisture content	
(20° C/37 % rel. humidity)	7.0 %
(20° C/83 % rel. humidity)	16.4 %

Mechanical characteristics	
Modulus of elasticity under bending	12500 N/mm²
Modulus of rupture under bending	77 N/mm²
Tension strength	95 N/mm²
Compression strength	44 N/mm²
Brinell hardness perpendicular to the fibres	44 N/mm²
Janka Hardness	1.6 kN
Nail withdrawal strength in N per mm depth and mm diameter	5.5 N/mm²

Natural durability and treatability (according to EN 350-2)	
Fungi	Class 4 – poorly durable
Dry wood borers	susceptible
Termites	Class S susceptible
Treatability	3-4 poorly or not permeable

Natural durability is based on mature heartwood. Sapwood must always be considered as non durable against wood destroying agents.

Fir

< Fir Abies alba

Other names Silver fir, Sapin

General description Fir is a typical tree growing in the shadows of higher trees. It is distributed over the whole of Europe, has a straight trunk and grows to a height of about 40 m.

Wood description The colour is white with a little tendency to grey-violette. Heartwood is not distinct from sapwood. The texture is fine to medium according to growing speed. There is no resin in the wood.
The wood is similar to spruce: soft, low in weight and has medium density. Strength properties are good.
Sawing and machining is easy, also assembling. Fir also has a slight tendency to split when nailed.

Common uses Fir and Spruce wood are often mixed for structural end uses, indoors and outdoors: general carpentry, interior construction, windows and doors.

Physical characteristics

Density (at 12 % moisture content)	441 kg/m³
Total longitudinal shrinkage	0.1–02 %
Total radial shrinkage	3.8 %
Total tangential shrinkage	7.6 %
Equilibrium moisture content	
(20° C/37 % rel. humidity)	7.1 %
(20° C/83 % rel. humidity)	16.9 %

Mechanical characteristics

Modulus of elasticity under bending	11000 N/mm²
Modulus of rupture under bending	73 N/mm²
Tension strength	84 N/mm²
Compression strength	45 N/mm²
Brinell hardness perpendicular to the fibres	14 N/mm²
Janka Hardness	1.8 kN
Nail withdrawal strength in N per mm depth and mm diameter	5.0 N/mm²

Natural durability and treatability (according to EN 350-2)

Fungi	Class 4 – poorly durable
Dry wood borers	susceptible
Termites	Class S susceptible
Treatability	2 – 3 poorly to moderately permeable

Natural durability is based on mature heartwood. Sapwood must always be considered as non durable against wood destroying agents.


Pine

< Pine Pinus sp.

Other names Scots pine Pinus sylvestris; Nordic Scots pine Pinus sylvestris; Maritime pine Pinus pinaster

General description The growth range of the species is larger than that of any other softwood. It can be found from Scotland to the Pacific Coast of Siberia, from Norway to Spain, from Arctic Siberia to Mongolia and also in the Mediterranean region. The tree grows up to 10 – 30 m (max 40 m). Scots pine wood from the Nordic countries (Finland, Sweden, Norway) is a species for saw milling with a large volume of lumber produced in Scandinavia. Maritime pine is naturally growing in the west of the Mediterranean basin and is largely used in France as plantation tree.

Wood description Pines have distinct yellowish white sapwood and reddish heartwood. Heartwood is clearly demarcated from sapwood. Slow growing trees (esp. Nordic Scots pine) have a fine texture, faster growing ones show medium textures (Maritime pines can also have a coarse texture). Slow grown Nordic pine is very easy to machine to a smooth surface. Knots are tightly fixed in the timber and normally limited in size. The big red knots give a decorative character to the timber. All pines have a lot of resin canals. The wood is soft, medium in weight and has medium density. The strength properties are good. Sawing and machining is easy, gluing can be difficult depending on the percentage of resin in the wood.

Common uses Pine is a building and construction timber, also used for joinery and interiors (doors, parquets, windows) and furniture.

Physical characteristics	Scots pine	Nordic Scots pine	Maritime pine
Density (at 12 % moisture content)	520	550	550 kg/m³
Total longitudinal shrinkage	0.1 – 0.3 %	0.1 – 0.3 %	0.3 – 0.4 %
Total radial shrinkage	4.0 %	4.0 %	4.0 – 4.7 %
Total tangential shrinkage	7.0 %	7.0 %	7.7 – 9.0 %
Equilibrium moisture content			
(20° C/37 % rel. humidity)	7.0 %	7.0 %	7,0 %
(20° C/83 % rel. humidity)	15.3 %	15.3 %	15.3 %

Mechanical characteristics (Scots, Nordic Scots and Maritime pine)	
Modulus of elasticity under bending	12000 – 10200 N/mm²
Modulus of rupture under bending	100 – 80 N/mm²
Tension strength	104 N/mm²
Compression strength	55 N/mm²
Brinell hardness perpendicular to the fibres	20 N/mm²
Janka Hardness	2.5 kN
Nail withdrawal strength in N per mm depth and mm diameter	9.0 N/mm²

Natural durability and treatability (according to EN 350-2)	
Wood destroying fungi	Class 3 – 4 moderately to slightly durable
Dry wood borers	Heartwood: durable, Sapwood: susceptible
Termites	Class S susceptible
Treatability	Heartwood: 3 – 4 difficult to extremely difficult to treat Sapwood: 1 easy to treat 3 – 4 poorly or not permeable

Natural durability is based on mature heartwood. Sapwood must always be considered as non durable against wood destroying agents.


Larch

< Larch Larix decidua

Other names European Larch

General description Larch is a typical tree found in the Alp mountains in Central Europe with a straight trunk. It grows to a height of about 40 m with diameters ranging from 40 – 70 cm.

Wood description Sapwood is thin, from 1 to 3 cm and yellow. The clearly demarcated heartwood is light brown to dark red brown and can vary largely, depending on origin and growth conditions. The texture is fine to medium according to growing speed.
The resin canals are smaller than in Pine, but do occur as often.
Softwood shows medium to high density and very good strength properties. Gluing properties are good, if the wood is technically dried, but due to resins it can be more difficult, if the wood is not dried. Sawing properties are good, but due to resin clogging of saw blades may occur. Nailing and screwing properties are good, but pre-boring is necessary.

Common uses Larch is used for heavy carpentry, exterior paneling, exterior and interior joinery and also for flooring.

Physical characteristics

Density (at 12 % moisture content)	583 kg/m³
Total longitudinal shrinkage	0.3 %
Total radial shrinkage	3.3 %
Total tangential shrinkage	7.8 %
Equilibrium moisture content	
(20° C/37 % rel. humidity)	8.4 %
(20° C/83 % rel. humidity)	17.1 %

Mechanical characteristics

Modulus of elasticity under bending	13800 N/mm²
Modulus of rupture under bending	99 N/mm²
Tension strength	107 N/mm²
Compression strength	55 N/mm²
Brinell hardness perpendicular to the fibres	19 N/mm²
Janka Hardness	2,5 kN
Nail withdrawal strength in	
N per mm depth and mm diameter	12 N/mm²

Natural durability and treatability (according to EN 350-2)

Fungi	Class 3 – 4 moderately to poorly durable
Dry wood borers	durable
Termites	Class S susceptible
Treatability	4 – not permeable

Natural durability is based on mature heartwood. Sapwood must always be considered as non durable against wood destroying agents.


Douglas Fir

< Douglas Fir Pseudotsuga menziesii

Other names Oregon pine

General description The country of origin of the Douglas fir is the North West of America. It was introduced 200 years ago in Europe. Properties of the European Douglas Fir (most with a rapid growth) are different from those of its area of origin.

Wood description The heartwood with its pinkish to dark red colour is clearly demarcated from the yellow sapwood, which has a thickness between 5 and 10 cm. The texture is medium, the timber has a straight grain. Douglas Fir may show some resin pockets, sometimes of great dimensions. Softwoods have medium density and good strength properties.
Gluing and sawing properties are good, but due to resin pockets clogging of saw blades may occur. Nailing and screwing properties are good, but pre-boring is necessary and there is a strong tendency to split.

Common uses The uses of Douglas Fir are similar to those of Larch, mainly for building and construction.

Physical characteristics

Density (at 12 % moisture content)	540 kg/m³
Total longitudinal shrinkage	0.3 %
Total radial shrinkage	4.5 %
Total tangential shrinkage	7.5 %
Equilibrium moisture content	
(20° C/37 % rel. humidity)	8.3 %
(20° C/83 % rel. humidity)	16.1 %

Mechanical characteristics

Modulus of elasticity under bending	12500 N/mm²
Modulus of rupture under bending	95 N/mm²
Tension strength	100 N/mm²
Compression strength	50 N/mm²
Brinell hardness perpendicular to the fibres	20 N/mm²
Janka Hardness	2.5 kN
Nail withdrawal strength in N per mm depth and mm diameter	9.0 N/mm²

Natural durability and treatability (according to EN 350-2)

Fungi	Class 3 – 4 moderately to poorly durable
Dry wood borers	durable
Termites	Class S susceptible
Treatability	4 – not permeable

Natural durability is based on mature heartwood. Sapwood must always be considered as non durable against wood destroying agents.


European Oak

< European Oak Quercus petrea, Quercus robur

Other names European White Oak

General description Oak trees are one of the dominant broad-leaved species of temperate Europe. The trees grow 20–30 m in height with diameters ranging from 40–80 cm.

Wood description Sapwood is thin, between 1 to 4 cm, and white. The clearly demarcated heartwood is light brown to dark brown. Oak is mostly straight grained with a medium to coarse texture.
Annual rings and rays are clearly visible, oak is a ring porous wood.
European White Oak is a hard and heavy wood with medium strength properties.
Machining is well, nailing and screwing properties are good, but pre-boring is necessary. Gluing must be done with care, the wood is dense, slightly acid and rich in tannins.

Common uses European White Oak is one of the most important hardwoods and is mainly used for furniture and flooring. It is also used for stairs, windows and doors and also for external paneling.

Physical characteristics

Density (at 12 % moisture content)	702 kg/m³
Total longitudinal shrinkage	0.4 %
Total radial shrinkage	4.3 %
Total tangential shrinkage	8.9 %
Equilibrium moisture content	
(20° C/37 % rel. humidity)	8.9 %
(20° C/83 % rel. humidity)	17.2 %

Mechanical characteristics

Modulus of elasticity under bending	13000 N/mm²
Modulus of rupture under bending	88 N/mm²
Tension strength	90 N/mm²
Compression strength	61 N/mm²
Brinell hardness perpendicular to the fibres	34 N/mm²
Janka Hardness	4.5 kN
Nail withdrawal strength in	
N per mm depth and mm diameter	17 N/mm²

Natural durability and treatability (according to EN 350-2)

Fungi	Class 2 durable
Dry wood borers	durable
Termites	Class M – moderately durable
Treatability	4 – not permeable

Natural durability is based on mature heartwood. Sapwood must always be considered as non durable against wood destroying agents.

Beech

< Beech Fagus sylvatica

General description Beech is a Western European species found up to an altitude of 1500 meters and up to 60 degrees northern parallel. The trees grow to 35 m in height with diameters ranging from 40 – 90 cm.

Wood description The colour is creamy white to pale pink and gets more red due to higher drying temperatures or when exposed to steam. The heartwood is not demarcated from the sapwood. Sometimes there are reddish areas near the heart. The wood has a fine texture.
Beech is a diffuse porous timber but annual rings and rays are clearly visible. The wood is very hard and heavy with very good strength properties. Machining is well, gluing is good, nailing and screwing is good, but pre-boring is necessary.
Beech has good properties for bending in processing of bent furniture.

Common uses Beech is one of the most important European hardwoods. Its common uses are furniture, flooring, stairs, and bent wood for furniture.

Physical characteristics

Density (at 12 % moisture content)	712 kg/m³
Total longitudinal shrinkage	0.3 %
Total radial shrinkage	5.8 %
Total tangential shrinkage	11.8 %
Equilibrium moisture content	
(20° C/37 % rel. humidity)	7.3 %
(20° C/83 % rel. humidity)	15.7 %

Mechanical characteristics

Modulus of elasticity under bending	16000 N/mm²
Modulus of rupture under bending	123 N/mm²
Tension strength	135 N/mm²
Compression strength	62 N/mm²
Brinell hardness perpendicular to the fibres	34 N/mm²
Janka Hardness	6.7 kN
Nail withdrawal strength in	
N per mm depth and mm diameter	18 N/mm²

Natural durability and treatability (according to EN 350-2)

Fungi	Class 5 not durable
Dry wood borers	susceptible
Termites	Class S susceptible
Treatability	1 – easily permeable

Natural durability is based on mature heartwood. Sapwood must always be considered as non durable against wood destroying agents.


European Ash

< European Ash Fraxinus excelsior

Other names White Esh

General description

Ash is found in temperate areas of Europe.
The trees grow to 30 m in height with diameters ranging from 40 – 100 cm.

Wood description

The colour is white and turns to yellow when exposed to light. Heartwood is not demarcated from sapwood. In the heart of logs there are often brown areas, so called Brown Ash. The wood has a medium to coarse texture.
Ash is a ring-porous timber, so the annual rings are clearly visible, in contrast to rays.
The wood is hard and heavy with very good strength properties.
Machining is well, gluing is good, also nailing and screwing.
Ash has good properties for bending in processing of bent furniture.

Common uses

European Ash is mainly used for furniture, veneers, flooring and stairs.

Physical characteristics

Density (at 12 % moisture content)	702 kg/m³
Total longitudinal shrinkage	0.2 %
Total radial shrinkage	5.0 %
Total tangential shrinkage	8.0 %
Equilibrium moisture content	
(20° C/37 % rel. humidity)	7.3 %
(20° C/83 % rel. humidity)	16.5 %

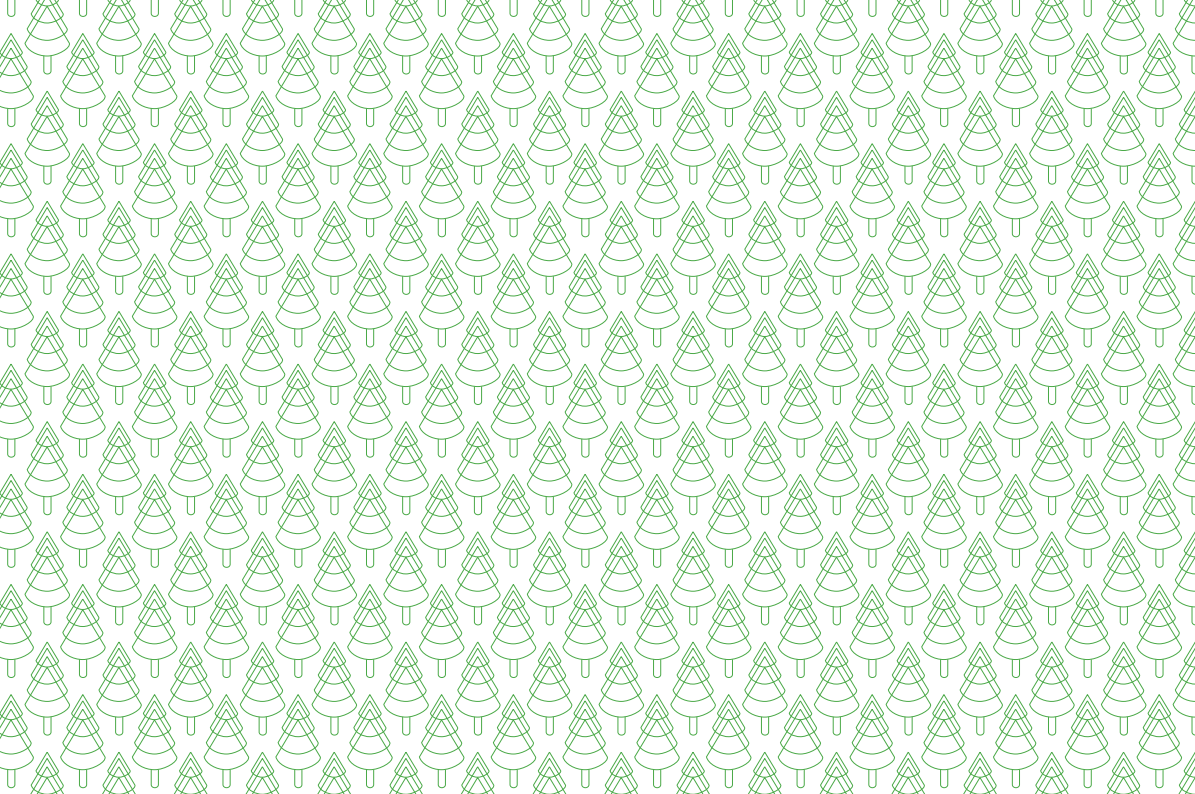
Mechanical characteristics

Modulus of elasticity under bending	13400 N/mm²
Modulus of rupture under bending	120 N/mm²
Tension strength	165 N/mm²
Compression strength	52 N/mm²
Brinell hardness perpendicular to the fibres	38 N/mm²
Janka Hardness	4.4 kN
Nail withdrawal strength in	
N per mm depth and mm diameter	16 N/mm²

Natural durability and treatability (according to EN 350-2)

Fungi	Class 5 not durable
Dry wood borers	susceptible
Termites	Class S susceptible
Treatability	2 – moderately permeable

Natural durability is based on mature heartwood. Sapwood must always be considered as non durable against wood destroying agents.



Natural durability of heartwood against fungi
In EN 350-2 there are 5 groups in natural resistance against fungal attack and decay

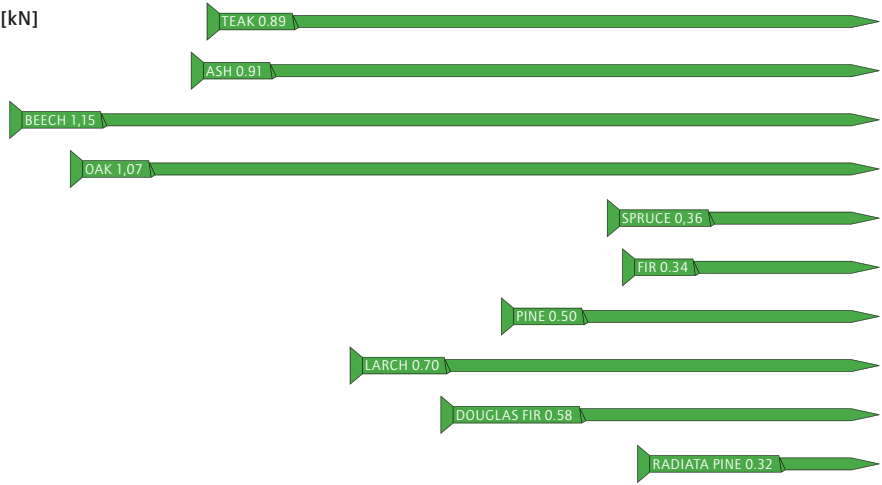
The durability of European timber in comparison with Teak (Tectona grandis) and Radiata Pine (Pinus radiata) is shown below:

Class 1	Very durable	Teak	Teak grown on plantations
Class 2	Durable	European Oak, Pine (Scots, Maritime), Larch, Douglas Fir	Teak grown on plantations
Class 3	Moderately durable	Pine (Scots, Maritime), Larch, Douglas Fir	Teak grown on plantations
Class 4	Slightly durable	Spruce Fir	Radiata pine
Class 5	Not durable	Beech Ash	Radiata pine

Natural durability of heartwood against termites
In EN 350-2 there are 3 groups in natural resistance against termites

Class D	Durable	Teak	Teak grown on plantations
Class M	Moderately durable	White Oak	Teak grown on plantations
Class S	susceptible	Spruce; Fir; Pine (Scots, Maritime); Larch; Douglas Fir; Beech; Ash; Radiata pine	

Nail Holding Power [kN]



Nail Withdrawal Resistance

Nail hold power or resistance of a nail to direct withdrawal from a piece of wood is closely related to the density or specific gravity of the wood, the diameter of the nail and the depth it has penetrated. The surface condition of the nail and the type of shank and point will also influence the withdrawal resistance. There are different methods determining the nail hold power, thus the methods and data are not easy to compare. The data of the best comparison found in the FPR data and also in investigations done in India, Turkey and Germany are shown in the diagram above.

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European Wood is a co-operation effort between national wood promotion organisations in Austria, France, Germany, Norway, and Sweden.

FrenchTimber
6, rue François 1er
F-75008 Paris
T +33 (0)1/566 952 00
F +33 (0)1/566 952 09
jf.guilbert@frenchtimber.com
www.frenchtimber.com

German Timber Promotion Fund
Godesberger Allee 142 –148
D-53175 Bonn
T +49 (0)228/308 38 - 25
F +49 (0)228/308 38 - 30
info@germantimber.com
www.germantimber.com

proHolz Austria
Uraniastrasse 4, A-1011 Wien
T + 43 (0)1/ 712 04 74 - 32
F + 43 (0)1/ 713 10 18
info@proholz.at
www.proholz.at

Swedish Forest Industries Federation
Box 55525
SE-10204 Stockholm
T +46 (0)8/ 762 72 60
F +46 (0)8/ 611 71 22
info@forestindustries.se

Author DI Dr. Josef Fellner, Federal Secondary College of Wood Engineering Moedling, Austria

Lectorate
Mag. Michaela Leithner, Langenzersdorf, Austria

Design
Atelier Reinhard Gassner
Marcel Bachmann, Schlins, Austria

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Project coordination
proHolz Austria, Vienna
Judith Wildling

Print Höfle GmbH, Dornbirn, Austria

European Wood Initiative
c/o CEI-Bois
Rue Montoyer 24,4°
BE-1000 Brussels
T +32 2 556 25 85
F +32 2 287 08 75
info@europeanwood.org