DOUGLAS

DOUGLAS FIR,
A NATURAL CHOICE FOR CONSTRUCTION

PRODUCT RANGE

FRANCE DOUGLAS

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DOUGLAS

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A word from the Chairman

This booklet represents the culmination of the work undertaken by the companies that form part of France Douglas, with a view to adapting their services to the changing nature of the construction industry.

Covering an area of 420,000 ha, the national resource of Douglas fir is a veritable mine of raw material that is of strategic importance to the construction industry.

It is a renewable resource with remarkable properties, in terms of natural durability as well as mechanical strength.

Although its usage did not really take off until the end of the 20th century, the reserve of Douglas fir in France is now the country's key emerging forest resource.

Its production, which has already seen a significant increase over the past ten years, will continue to grow in the decades to come, to reach around 6 million m^3 by 2030.

By this time, the sawmilling industry will be able to produce 2.5 million m^3 of lumber per year (compared to the current figure of 700,000 m^3).

It is with this in mind that the member companies of France Douglas took the decision to work together and deliver a product range that is:
- targeted,
- standardized,
- accredited, both technically and environmentally,
- in line with the body of relevant standards and regulations.

The various products that have been selected, for their ability to meet the requirements of both the construction market and their intended use (structural lumber, frames, cladding, decking, glued lumber), are described in detail in this booklet.

Naturally, these products are consistent with the standards currently in force, the main points of which are also covered in this document.

The product descriptions are also enhanced with information on how the products can be used and, more generally, on the design of the structures for which they are intended.

In addition to this, the products listed have **Environmental Product Declarations (EPDs)**, the redesigned European version of the Environmental and Health Declaration Forms (FDES in French), which assess the environmental impact of the product in question throughout the duration of its life cycle.

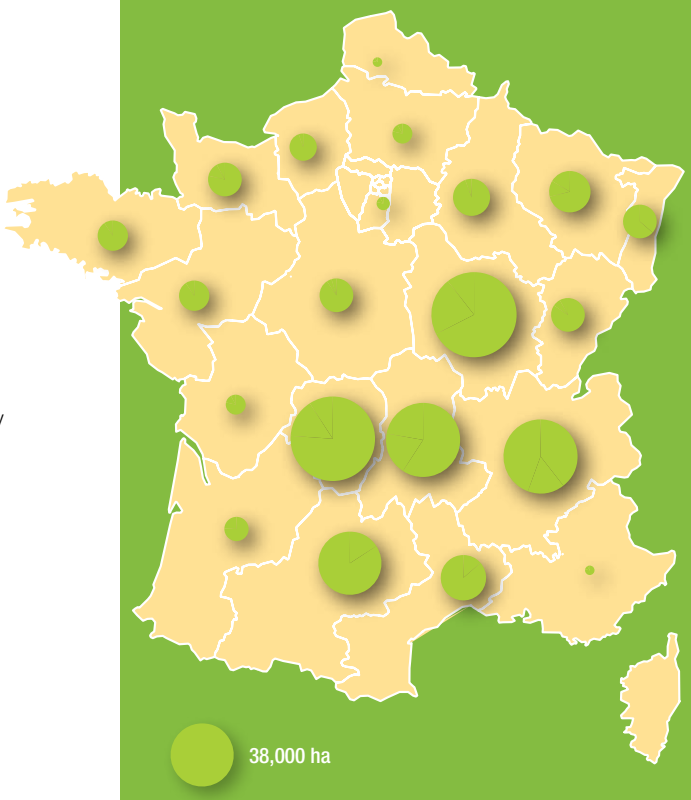
As a result, the industry now possesses a reference tool that can be safely used by advocates of our products and construction professionals to meet their needs.

Chairman of France Douglas
François Fockedey

DOUGLAS

DOUGLAS FIR - A FRENCH RESOURCE

The Douglas fir tree is predominantly found in central France.



DOUGLAS FIR:

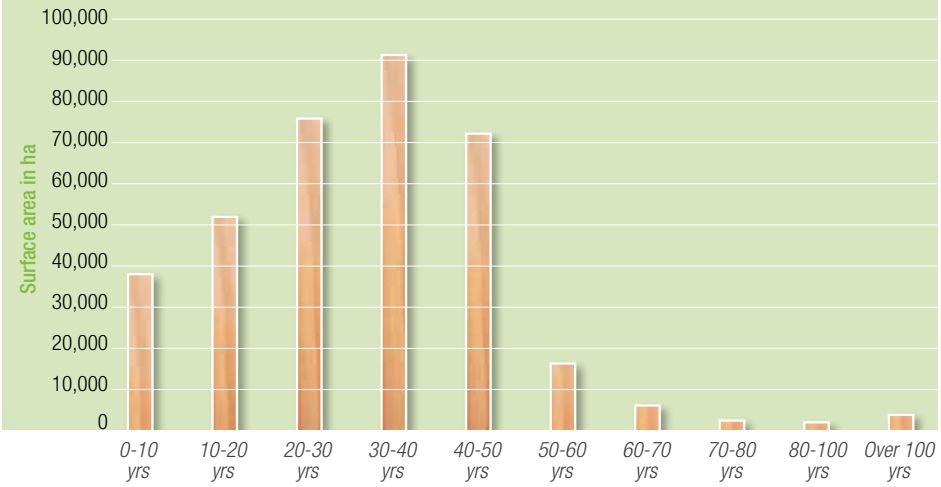
a key emerging forest resource for the next 20 years

Originating from the west coast of North America, where the attributes of its lumber had been widely documented, Douglas fir gradually saw its widespread use in reforestation programs implemented in the aftermath of World War II.

The success of these programs led to the trees covering an area of 420,000 ha (source- IFN, 2006-2010 campaign), thereby making France the biggest Douglas fir producer in Europe.

The tree's ability to adapt, in the low mountainous areas of central France in particular, has made Douglas fir the country's most promising species, with natural growth easily exceeding 5 million m^3 per year.

Distribution of Douglas fir populations by age category



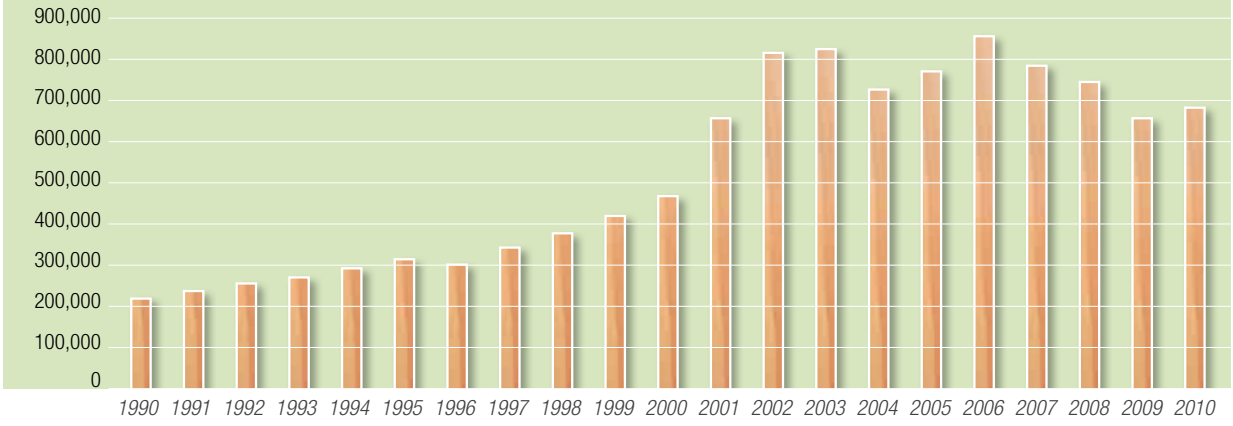
The median age of Douglas fir populations is between 30 and 40 years old.

The nationwide reserve of Douglas fir is still relatively young and will not reach full maturity for at least another 20 years.

Production of French Douglas fir has been constantly on the rise for a number of years. Roundwood yield has increased from 1 million m^3 to more than 2 million m^3 in the space of a decade.

Lumber production has seen a similar boom, demonstrating the industry's ability to adapt.

Lumber production between 1990 and 2010 in m^3

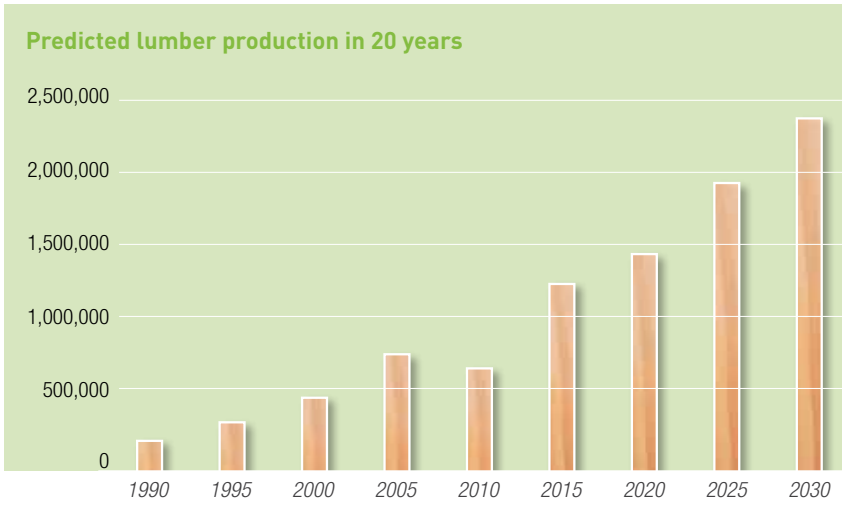


National production of Douglas fir lumber has doubled in ten years.
It now accounts for over 10% of the national production of softwood lumber.

Source: EAB

This trend is likely to continue for the next 20 years, after which it is predicted that national production will plateau at around 6 million m^3 (of roundwood), echoing the results of the most recent study conducted by the Institut Technologique FCBA (commissioned by France Douglas in 2012), giving a potential annual lumber yield of 2.5 million m^3 (compared to the current figure of 700,000 m^3).

Predicted lumber production in 20 years



It is expected that national production of Douglas fir lumber will reach 2.5 million m^3 by 2030.

Source: France Douglas (based on the 2012 FCBA study).

DOUGLAS FIR - A FRENCH RESOURCE

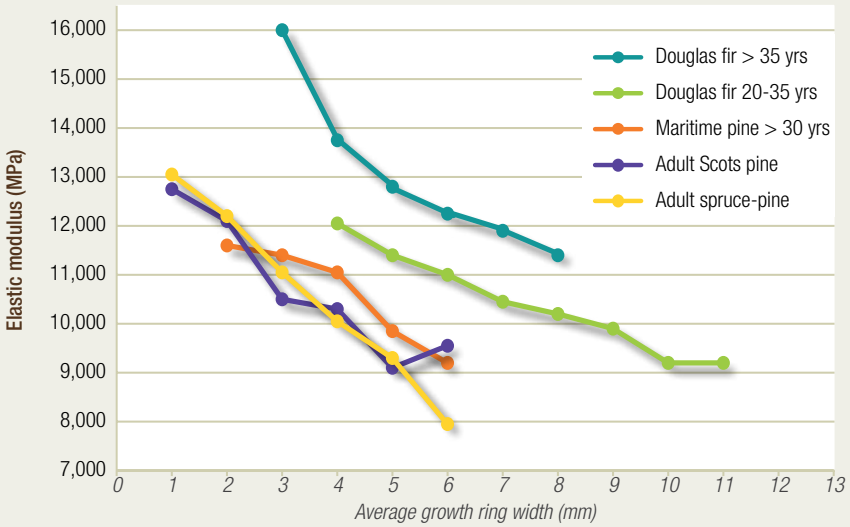
DOUGLAS FIR:
a material with recognized properties

A natural construction material, Douglas fir combines remarkable mechanical properties with a high level of natural durability.

The **mechanical performance** of French Douglas fir has now been widely demonstrated. For instance, from 1985 the INRA and FCBA (formerly the CTBA) have shown that the elastic modulus (E) of Douglas fir has remained greater than 12,000 MPa, including for growth rings with an average width of 5-6 mm.

Adult Douglas fir generally have a high proportion of heartwood.

Elastic modulus comparison for the main commercial softwood species in France



Source: 1985 Nepveu (INRA) - Blachon (FCBA, formerly CTBA) study

Breakdown of lumber (%) by mechanical strength grade

Strength grade (according to European standard EN 338)	Lumber taken from populations aged 40 yrs	Lumber taken from populations aged 50 yrs	Lumber taken from populations aged 70 yrs
C 40	14%	36%	77%
C 30	23%	34%	16%
C 24	9%	12%	3%
C 18	45%	12%	3%
Not permitted	9%	6%	1%

70% of the lumber tested from 50 year-old populations met the requirements of the C 30 grade as defined in the EN 338 European standard.

Source: FCBA (formerly CTBA), 2003 Mokuzai study.

Douglas fir's mechanical strength has been proven more recently by a new series of measurements (conducted by the FCBA - formerly CTBA - in 2003 and subsequently). In this, almost all of the lumber tested (over 1,200 pieces) achieved the level of performance required for the C24 grade in the EN 338 standard, provided it was taken from tree populations that had already reached a certain level of maturity.

This excellent level of mechanical performance is, however, poorly represented in the visual classification rules that are currently in force (the French NF B 52 001 standard), which rely mainly on analysis of the lumber's nodosity.

This is why France Douglas has spent the past few years contributing towards the development of a mechanical classification system, which is better able to validate a lumber's actual level of performance.

Douglas fir's **natural durability** is another major advantage.

Douglas fir heartwood (found in high proportions in adult trees) has greater resistance to insects and fungi than most other softwood species found in Europe.

Evidenced by over 30 years of use in the construction industry, this natural durability is documented in Booklet FD P 20-651, published in July 2011, which is considered to be the national reference for the durability of timber structures (see the page on Standards).

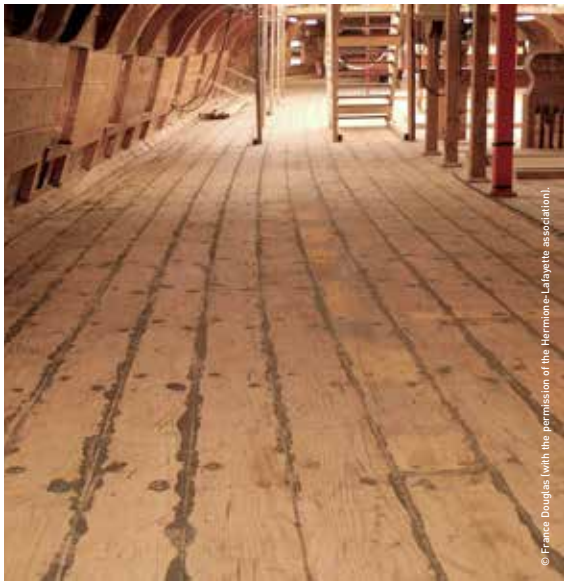
Equally admired for its **appearance** (namely its salmon pink coloration), Douglas fir is also able to meet specific requirements, for fittings in particular (paneling, renovations, etc.).

The Pôle international du Cheval (horse riding venue) in Deauville is one example of the possible uses of Douglas fir for exterior cladding.

Douglas fir's qualities are also sought for interior fittings.

Excellent **mechanical strength and natural durability** combine to make Douglas fir one of the top choices for complex architectural projects in which the wood has to be fit for demanding applications - open air structures, engineering works, high humidity enclosures, etc.

The Mézos fish farm in Landes showcases the potential uses of Douglas fir in exterior structures.



Douglas fir lumber from French forests was used in the reconstruction of the Hermione naval ship (a replica of the frigate used by Lafayette).

DOUGLAS

STANDARDS

Mechanical strength

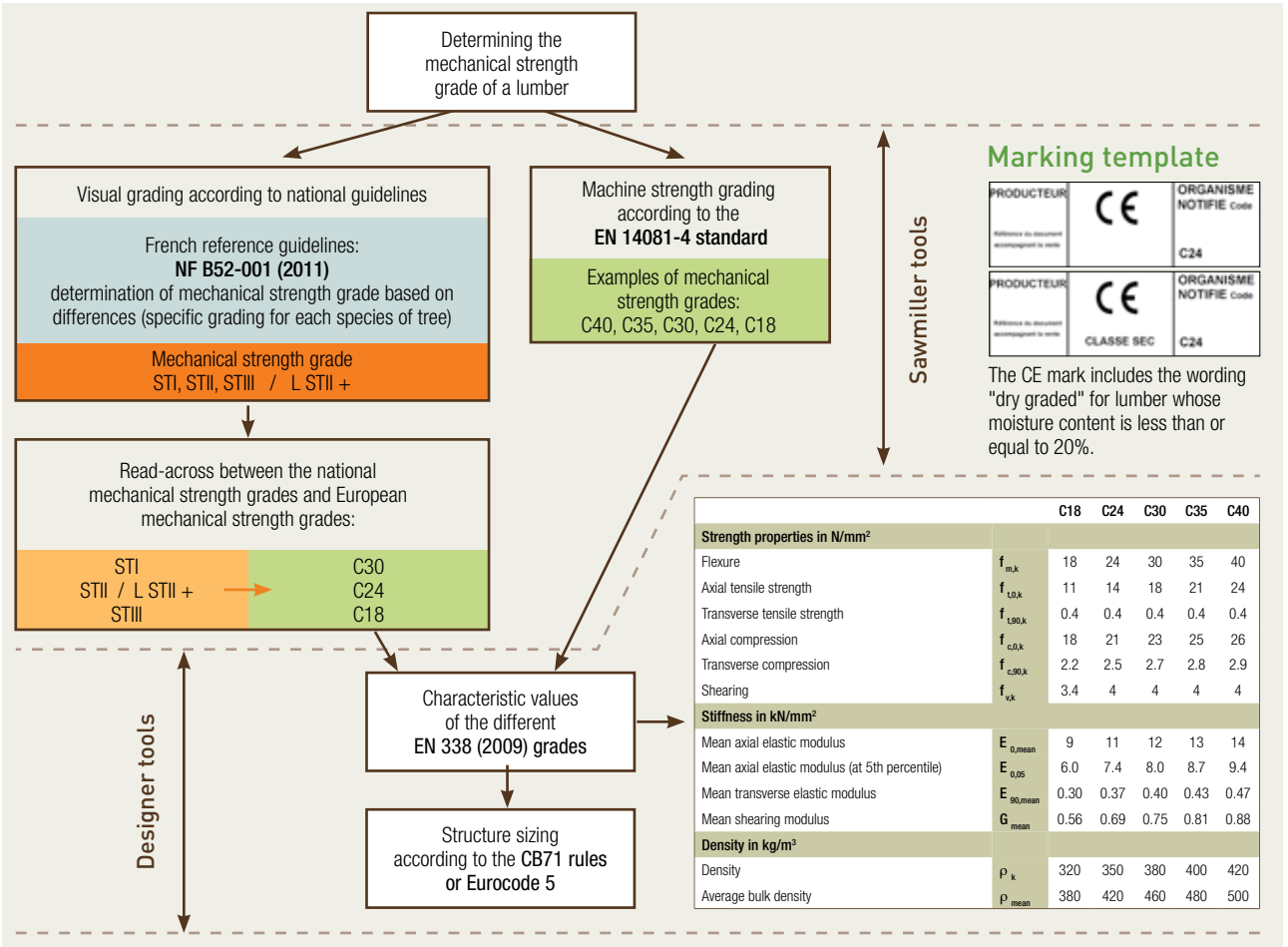
Wood, due to its intrinsic properties, combining lightness with mechanical strength, is a material that has always been used in construction. Thus, it represents the best technical/economic compromise for structures with low to medium spans. Wood accounts for over 90% of the structural frame market for individual houses. Thanks to products with higher added value (such as Glulam, SCL or LVL), wood has become equally competitive for large-span structures.

This positioning primarily involves complete control over the material's properties which, as in other areas of the construction industry, benefit from precise and detailed normative tools to help develop controlled and optimized structural designs.

General principles

The introduction of the Construction Products Directive has meant that, as of January 1, 2012, the CE mark must be present on all structural lumber in accordance with the EN 14081–1 to 4 harmonized standard on the display of certain information relating to lumber. The mechanical strength grade is one of the key pieces of information that must be provided. For example, it is of vital importance when designing structures made from solid wood (as per Eurocode 5 or the CB71 rules), as well as for determining the mechanical grade of glue-laminated timber, structural composite lumber, and finger-jointed lumber.

Process for determining the mechanical strength grade of softwood



Marking template

The CE mark includes the wording "dry graded" for lumber whose moisture content is less than or equal to 20%.

		C18	C24	C30	C35	C40
Strength properties in N/mm²						
Flexure	$f_{m,k}$	18	24	30	35	40
Axial tensile strength	$f_{t,0,k}$	11	14	18	21	24
Transverse tensile strength	$f_{t,90,k}$	0.4	0.4	0.4	0.4	0.4
Axial compression	$f_{c,0,k}$	18	21	23	25	26
Transverse compression	$f_{c,90,k}$	2.2	2.5	2.7	2.8	2.9
Shearing	$f_{v,k}$	3.4	4	4	4	4
Stiffness in kN/mm²						
Mean axial elastic modulus	$E_{0,mean}$	9	11	12	13	14
Mean axial elastic modulus (at 5th percentile)	$E_{0,05}$	6.0	7.4	8.0	8.7	9.4
Mean transverse elastic modulus	$E_{90,mean}$	0.30	0.37	0.40	0.43	0.47
Mean shearing modulus	G_{mean}	0.56	0.69	0.75	0.81	0.88
Density in kg/m³						
Density	ρ_k	320	350	380	400	420
Average bulk density	ρ_{mean}	380	420	460	480	500

Resource location and mechanical strength of the lumber

Two types of lumber with seemingly very similar features can have very different mechanical strengths. This is caused by the influence of numerous parameters, such as the climate or soil type. As a result, each country has been forced to adopt its own set of visual mechanical grading reference guidelines that best fit the species that grow within its own borders (NF B52-001 for France, INSTA 142 for Scandinavian countries, DIN 1074 for Germany, etc.). For the same reason, grading machines need to be calibrated for each species based on an identified source.

Visual grading of Douglas fir lumber in accordance with the NF B52-001 standard, part 1.

			Grades					
			ST-I[4]		ST-II		ST-III	
Criteria	Width of growth rings (mm)		≤ 6	≤ 8	≤ 6	≤ 10	≤ 8	≤ 12
	Section		≤ 18,000 mm²	> 18,000 mm²	≤ 18,000 mm²	> 18,000 mm²	≤ 18,000 mm²	> 18,000 mm²
	Knot diameter	- on the face [1]	Ø ≤ 30 mm and Ø ≤ 1/6 of w	Ø ≤ 40 mm and Ø ≤ 1/6 of w	Ø ≤ 50 mm and Ø ≤ 1/2 of w	Ø ≤ 70 mm and Ø ≤ 1/2 of w	Ø ≤ 100 mm and Ø ≤ 3/4 of w	Ø ≤ 130 mm and Ø ≤ 3/4 of w
		- on the side [2]	Ø ≤ 40 mm and Ø ≤ 2/3 of t	Ø ≤ 80 mm and Ø ≤ 2/3 of t	Ø ≤ 40 mm and Ø ≤ 2/3 of t	Ø ≤ 80 mm and Ø ≤ 2/3 of t	Ø ≤ 40 mm and Ø ≤ 2/3 of t	Ø ≤ 80 mm and Ø ≤ 2/3 of t
	Splits [3] [5]	- through-splits	length ≤ twice the width of the piece				length ≤ 600 mm	
		- non through-splits	length ≤ half the width of the piece				unlimited	
	Large resin pocket		not permitted		permitted if < 80 mm			
	Ingrown bark		not permitted					
	Slope of grain (ratio)	- local	1:10		1:4			
		- general	1:14		1:6			
	Wane	- length	not permitted		< 1/3 of the length of the piece and < 100 cm			
		- width			< 1/3 of the thickness of the side			
	Biological decay	- blue - traces of mistletoe	permitted					
		- black specks	permitted if only on one face					
		- dote	not permitted					
	Maximum deformation in mm for a length of 2 m	- face deflection (mm)	< 10				< 20	
		- side deflection (mm)	< 8				< 12	
		Warping	1 mm/25 mm wide				2 mm/25 mm wide	
	Cupping		no restrictions					

1) w: width of the piece

2) t: thickness of the side

3) The length of the splits is linked to the moisture content, and for this reason the limits shown are only applied at the time the piece is being graded.

4) For sections smaller than 50 x 150, pieces containing pith are excluded and graded down to ST-II. This measurement takes into account the fact that the populations of this particular species are relatively young, and could therefore be revised when new information allows it.

5) For pieces graded as wet and for strong sections, the "split" criterion is difficult to predict.

Information:

The NF B52-001 standard, introduced in August 2011, contains a part 2 that provides for an alternative L STII+ grading for solid wood used in the production of glue-laminated timber and structural composite lumber.

Mechanical strength test on Douglas fir lumber.

STANDARDS

Durability

Wood is a natural material whose properties vary from one species to another.
Natural durability* is one of the properties that characterizes a tree species, and it is this that determines whether or not the wood can be used without preservation treatment according to the various use categories (with which different levels of fungal growth are associated). In parallel to this, each species is also characterized* by its resistance or susceptibility to attack from insects with wood boring larvae, or from termites.

The properties of Douglas fir heartwood, in terms of durability, mean that its lumber is now one of the most sought-after for outdoor uses, as more and more professionals are looking for products that do not need preservation treatment.

* Durability grades with regards to wood-decay fungi, insects with wood boring larvae, and termites are explained in the EN 350-2 standard on the natural durability of solid wood.

Standards in France

Since July 2011, a document on the durability of timber parts and structures (FD P 20-651) has been available from AFNOR, specifying the rules that apply for the identification of use categories 3.1* and 3.2*. These rules are a key factor in guaranteeing the durability of timber-based structures when they are partially or fully exposed to adverse weather conditions.

The document also highlights three factors that can influence the moisture content in lumber, and therefore the use category it should be assigned:

- weather conditions;
- size;
- design.

* The subdivisions of use category 3 are expressed as 3a and 3b in the first version of FD P 20-651, published in July 2011. These will change to bring them in line with the revised EN 335 European standard, becoming 3.1 and 3.2. The terminology used in this document reflects this forthcoming change.

Identifying the use category
Details of influencing factors

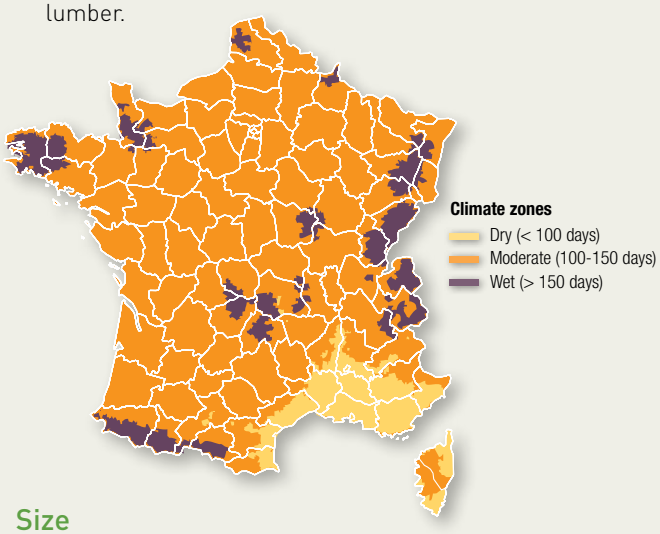
Weather conditions

Three climate zones are defined based on the average annual number of days during which there is over 1 mm of rainfall.

Impact:

→ The lumber is exposed to longer or shorter wet periods.

→ Periods with higher relative humidity mean that a greater moisture content can be maintained in the lumber.



Size

Three sizes (thickness of the piece) are defined according to the type of material used.

Impact:

→ When lumber is wet, its drying time will vary according to its desorption capacity.

Size	Solid wood, finger-jointed lumber	Glulam with lamellas > 35 mm and SCL	Glulam with lamellas up to 35 mm
Small	t ≤ 28 mm	t ≤ 28 mm	t ≤ 28 mm
Medium	28 mm < t ≤ 75 mm	28 mm < t ≤ 150 mm	28 mm < t ≤ 210 mm
Large	t > 75 mm	t > 150 mm	t > 210 mm

Design

Three classes of design performance are defined:

- draining;
- average;
- trapping.

When the structure is covered by a DTU, a document that defines the implementation rules for that structure, the DTU will provide the criteria needed to define the associated design class.

Impact:

→ good or poor rainwater run-off;

→ ventilation and consequent drying capacity of the lumber.

Assigning the use category based on influencing factors

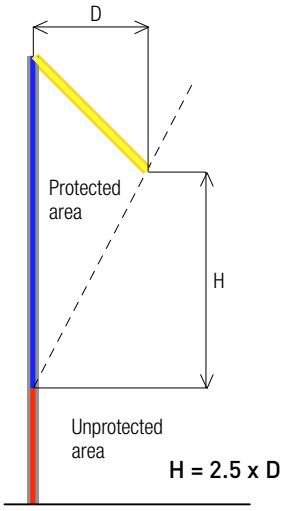
General examples: wood used in building facades (cladding, joinery, etc.)

Size	Design	Weather conditions		
		Dry	Moderate	Wet
		Use categories		
Small	Draining	3.1	3.1	3.1
	Average	3.1	3.1	3.2
	Trapping	3.1	3.2	3.2
Medium	Draining	3.1	3.1	3.2
	Average	3.1	3.1	3.2
	Trapping	3.1	3.2	4
Large	Draining	3.1	3.1	3.2
	Average	3.1	3.2	3.2
	Trapping	3.2	3.2	4

Specific examples: fully exposed wood (decking, pergolas, etc.)

Size	Design	Weather conditions		
		Dry	Moderate	Wet
		Use categories		
Small	Draining	3.1	3.1	3.1
	Average	3.1	3.2	3.2
	Trapping	3.2	4	4
Medium	Draining	3.1	3.1	3.2
	Average	3.1	3.2	3.2
	Trapping	3.2	4	4
Large	Draining	3.1	3.2	3.2
	Average	3.2	3.2	4
	Trapping	4	4	4

Area protected by an overhang assignable in use category 2



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These will change to bring them in line with the revised EN 335 European standard, becoming 3.1 and 3.2. The terminology used in this document reflects this forthcoming change.

Species durability against different biological degradation agents

The booklet lists a very large number of wood species, and gives each one a level of natural durability with regards to the following biological degradation agents:

> fungi

The risk level for fungi is associated with the use category to be assigned to the structure.
For each species, the lifespan is shown depending on its use category.

The lifespan categories described in the document are:

L3: over 100 years;

L2: between 50 and 100 years;

L1: between 10 and 50 years.

> insects

Susceptibility (or resistance) to both insects with wood boring larvae and termites is shown for each of the species listed.

The purpose of this new tool is to set out the rules (which are intended to be as unambiguous as possible) to apply during the design stage, to ensure that timber structures are optimally reliable and durable, based on their expected lifespans.

Douglas fir: recognized durability

The booklet (FD P 20-651) confirms the high quality of Douglas fir heartwood (the most durable softwood along with larch and red cedar), and underscores its particular resistance to moisture uptake, guaranteeing the superior durability of this lumber for structures in use categories 3.1 and 3.2 when compared to other species that are equally durable but more sensitive to moisture uptake.

	Fungal resistance of heartwood based on use category				Resistance to insects with wood boring larvae	Resistance to termites
	1	2	3.1	3.2		
Douglas fir	L3	L3	L2	L1	Yes	No
Larch	L3	L3	L2	L1	Yes	No
Red cedar	L3	L3	L2	L1	Yes	No

Special feature of Douglas fir sapwood

Douglas fir sapwood has the special characteristic of being relatively resistant to moisture uptake and, as a result, consistently keeps the lumber's moisture content below the level needed for fungi to grow. Following a literature review and surveys carried out on older structures, the IT FCBA noted that, with regards to fungal growth, Douglas fir sapwood has an L1 lifespan for the 3.1 use category. As for the risk of insects, this has to be determined in accordance with the conditions defined in decree 2 of the *law relating to termites and other insects with wood boring larvae,* and in the DTUs.

STANDARDS

Appearance grading

The appearance grades defined in the NF EN 1611 standard are currently used for lumber and siding products and, in some cases, they are used in addition to the structural grade, especially when the timber is intended to be visible.

NF EN 1611 - Appearance grading for softwood lumber

NODOSITY

The visual appearance grading procedures have:

- a grading on two faces: **G2** (the most frequently used – see table opposite);
- a grading on four faces: **G4** (to find out more about the criteria used for this grading procedure, refer to the NF EN 1611 standard).

Grading for two sides for knots - maximum accepted values for the following species: Douglas fir, pine, fir, spruce, and European larch.

Characteristics		Limits				
		Grade G2-0	Grade G2-1	Grade G2-2	Grade G2-3	Grade G2-4
Size of round/oval knots on graded face see NOTES A and B	sound and intergrown	10% of width +10 mm	10% of width + 20 mm	10% of width + 35 mm	10% of width + 50 mm	Unlimited but must not impact the strength of the board
	dead or partially intergrown	10% of width + 0 mm	10% of width + 10 mm	10% of width + 20 mm	10% of width + 50 mm	
	ingrown bark	not permitted	10% of width + 0 mm	10% of width + 15 mm	10% of width + 40 mm	
	rotten or loose	Not permitted	Not permitted	10% of width + 15 mm	10% of width + 40 mm	
Number of knots on the most afflicted meter of the graded face see NOTES A and C	total number	2	4	6	unlimited	Unlimited but must not impact the strength of the board
	including rotten/ loose or in ingrown bark	0	1*	2	5	
	including spike or splay knots	0	4	6	unlimited	

* Only applies to knots in ingrown bark.

NOTE A: knots measuring 10 mm or less are not taken into account unless they are rotten or loose.

NOTE B: for spruces, firs, Douglas firs and larches wider than 225 mm, the size of the knots must be increased by 10 mm.

For pines wider than 180 mm, the size of the knots must be increased by 10 mm.

NOTE C: for pieces wider than 225 mm, the total number of knots must be increased by 50%.

OTHER CHARACTERISTICS

Grading for two sides - maximum accepted values of other characteristics for the following species: Douglas fir, pine, fir, spruce, and European larch.

Characteristics		Limits				
		Grade G2-0	Grade G2-1	Grade G2-2	Grade G2-3	Grade G2-4
Ingrown bark on graded side	number on most afflicted meter	0	2	2	4	unlimited
	total length (mm)	0	100	200	300	unlimited
Resin pockets on graded face	number on most afflicted meter	2	4	4	4	unlimited
	total length (mm)	75	100	200	300	unlimited
Resinated wood on any side	(% of surface area)	0	0	30	50	unlimited
Compression wood on any side	(% of surface area)	0	10	30	50	unlimited
Abnormal slope of grain see NOTE E	on any side	not permitted	not permitted	permitted	permitted	permitted
Rot see NOTE F	on any side	not permitted				small traces of rot permitted
Discoloration or dote on any side see NOTE F	deep (% of total surface area)	0	0	10	50	unlimited
	surface discoloration (% of total surface area)	0	0	20	100	unlimited
Insect damage Wane Pith Splits Deformation		See NF EN 1611				

NOTE E: an abnormal slope of grain includes burls, cross grain, and other similar conditions.

NOTE F: measured in accordance with EN 1311- if there are several infested or infected areas, add the areas in question together.

DOUGLAS

THE RANGE

Structural lumber

ENVIRONMENTAL ACCREDITATION:
The Structural Lumber product range has been awarded an Environmental Product Declaration (**EDP** = new version of the **FDES**)


© SPBL

Providing a natural structural material, Douglas fir has mechanical properties that need no further proof.

Commonly used for interior frames, its natural durability means it can also be used for structures that are exposed to adverse weather conditions, for building designs that do not trap water.

DTU 31-1 defines the rules applicable to the use of structural lumber. Structural lumber is subject to CE marking (EN 14081-1 to 4), and the production of cut frames intended for sale on the market is governed by the NF P21-365 standard.

Details of the Structural Lumber range

Standard sections:

The range consists of two complementary options, each of which responds to different needs:
- rough sawn lumber sections (greenwood);
- planed sections (20% dry).

Rough sawn lumber sections (greenwood) (in mm)

	75	100	150	175	200	225	250	300
32			●	●				
38			●	●	●	●		
41			●	●	●	●		
50			●	●		●		
63	●		●	●	●	●	●	
75	●	●			●	●		●
100		●			●		●	●
150			●					
175				●				
200					●			●
300								●

Planed sections (20% dry)* (in mm)

	68	70	90	95	120	140	145	165	190	215	220	240	285
35						●		●					
45				●	●		●	●	●		●		
56	●					●		●	●	●		●	
68			●						●	●			●
70		●											
90			●						●	●		●	●

* Some planed sections come from specific lumber sections that do not appear in the previous table.

The product range described in these two tables is not exhaustive. For particular applications, other sections may also be offered.

Information:
Drying causes sections to shrink.
The EN 336 standard gives the calculation that should be used to obtain the lumber size after drying.


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Mechanical properties:

The Douglas fir product range is divided into three grades of mechanical strength: **C18, C24, and C30.**

The minimum mechanical strength grade required by DTU 31-1 is C18.

Appearance grade:

For some uses, a particular appearance quality may be required. Where this is the case, this quality must be specifically mentioned in the Special Contract Documents (DPMs). The **NF EN 1611** standard can be used as a reference for the appearance grading of softwoods.

Durability

There are two types of Douglas fir product:

1 Products with natural durability ("red wood")

Some of the preferred lumber sections mentioned previously are offered (see tables below) for use without treatment ("red wood" or "sapwood-free").

Rough sawn lumber sections (greenwood) in "red wood"

	100	125	150	175	200	225
32			■	■		
38	■	■	■	■	■	■
41			■	■	■	■
50			■	■		■
63			■	■	■	■
75					■	■

Planed sections (20% dry) in "red wood"

	95	120	140	145	165	190	215
35			■		■		
45	■	■		■		■	
56			■		■	■	■
68						■	■

"Red wood" lumber can include a certain volume of sapwood. The acceptable volume is usually defined by the DTUs, depending on the applications in question.

With regards to structural lumber, the Douglas fir product range incorporates a tolerance of 5% sapwood (in a section at any point in the piece).

2 Products with conferred durability

As soon as the proportion of sapwood exceeds the 5% tolerance level, a preservation treatment suited to the intended use category must be applied*.

* Use category 2: surface treatment (dipping, spraying, brushing) / Use category 3.1: surface treatment with a suitable, maintained finish / Use categories 2, 3.1 and 3.2: treatment in an autoclave with the application of a suitable, maintained finish as necessary.

Douglas fir in the context of standards and regulations (in mainland France)

- For the most part, the structural lumber market involves the use of wood that is protected from adverse weather conditions (use category 2).
If the structures are exposed, they may equally be assigned to use category 3.1*, 3.2", or even 4.

→ **Compatibility of Douglas fir structural lumber with use categories:**

Use category	2	3.1*	3.2*
Durability of Douglas fir heartwood	Very durable	Very durable	Durable

* The subdivisions of use category 3 are expressed as 3a and 3b in the first version of FD P 20-651, published in July 2011. These will change to bring them in line with the revised EN 335 European standard, becoming 3.1 and 3.2. The terminology used in this document reflects this forthcoming change.

- Decree 2 of the *law on termites and other insects with wood boring larvae* concerns, for the areas in question, the resistance of the lumber (be it natural or conferred) contributing towards the stability of the structure.

→ **Douglas fir heartwood is well-known for its resistance against insects with wood boring larvae in accordance with the EN 350-2 standard***

* Douglas fir, like all other tree varieties grown in France and often used in construction, is susceptible to termites. In the majority of cases, for lumber that contributes towards structural stability, a suitable preservation treatment will be required.

Design and durability of exterior structural lumber

Ensuring the durability of a lumber structure depends on the reliability of the use category to which it has been assigned. The decision to use a draining design, which would lengthen the structure's lifespan, is encouraged.

Assigning use categories

General example - Timber built into facades

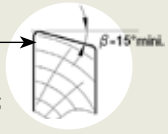
Size	Design	Weather conditions		
		Dry	Moderate	Wet
		Use categories		
Small	Draining	3.1	3.1	3.1
	Average	3.1	3.1	3.2
	Trapping	3.1	3.2	3.2
Medium	Draining	3.1	3.1	3.2
	Average	3.1	3.1	3.2
	Trapping	3.1	3.2	4
Large	Draining	3.1	3.1	3.2
	Average	3.1	3.2	3.2
	Trapping	3.2	3.2	4

The subdivisions of use category 3 are expressed as 3a and 3b in the first version of FD P 20-651 published in July 2011. These will change to bring them in line with the revised EN 335 European standard, becoming 3.1 and 3.2. The terminology used in this document reflects this forthcoming change.

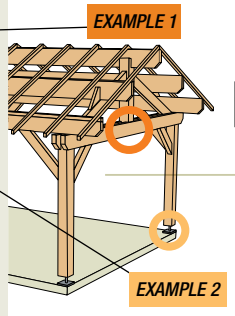
Best design practice for exposed structural parts:

- machining of parts to facilitate water run-off;
- protective element for timber ends or the upper surfaces of horizontal parts;
- column bases raised above the floor;
- assembly with separating parts to prevent water traps;
- and many more...

Example:



Specific example: building in a moderate climate



Case 1

Struts:
50 x 175 (medium size)
sloped upper surface: draining.

Assembly:
separated: draining.
Assigned to use category 3.1.

Case 2

Columns:
150 x 150 (large size)
Column base with support plate to elevate the timber end of the column 10 cm off the ground (draining)
Assigned to use category 3.1.

DOUGLAS

THE RANGE

Timber frames

ENVIRONMENTAL ACCREDITATION:
The Timber Frame product range has been awarded an Environmental Product Declaration
(**EDP** = new version of the **FDES**)


© Provedi Industrie

Thanks to its mechanical properties and durability, Douglas fir has been used in the construction of timber frame buildings for several years. Manufacturers offer standard sections for use in vertical walls and floor joists.

DTU 31-2 defines the rules applicable to the construction of walls with timber frames. Structural lumber is subject to CE marking (EN 14081-1 to 4). Prefabricated walls sold on the market are also subject to CE marking in accordance with the NF EN 14732 standard.

Details of the Timber Frame range

Sections (moisture: 18%)

List of standard sections (planed with rounded or chamfered edges):

	Thickness (mm)	Widths (mm)
Timber frame	45	95 - 120 - 145 - 165 - 190 - 220*
Counter-batten	45	27 - 45 - 60

* section can also be used for joists (floors, flat roofs, etc.)

Mechanical properties

The Douglas fir product range is divided into two grades of mechanical strength: **C18 and C24.**

The minimum mechanical strength grade required by DTU 31-2 is C18.

Durability

There are two types of Douglas fir product:

1 Product with natural durability ("red wood")

DTU 31-2 permits 10% sapwood content for all "padded" sections in walls with timber frames. The Douglas fir "red wood" product range meets this requirement.

2 Products with conferred durability

As soon as the proportion of sapwood exceeds the 10% tolerance level, use category 2 can usually be achieved by applying a surface treatment (dipping, spraying, brushing).

Douglas fir in the context of standards and regulations (in mainland France)

- Lumber used for primary structures must have a level of durability (natural or conferred) that is compatible with use category 2.

→ **Douglas fir heartwood has a lifespan of L3 according to FD P 20-651 (> 100 years) for use category 2.**

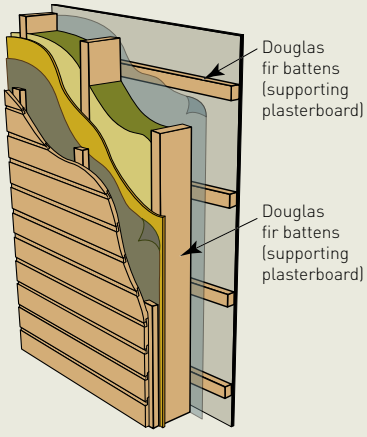
- Decree 2 of the *law on termites and other insects with wood boring larvae* concerns, for the areas in question, the resistance of the lumber (be it natural or conferred) contributing towards the stability of the structure.

→ **Douglas fir heartwood is well-known for its resistance against insects with wood boring larvae in accordance with the EN 350-2 standard***

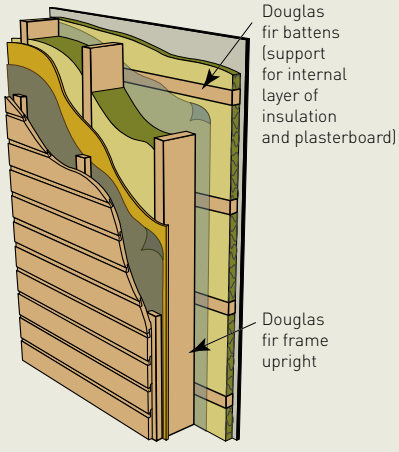
* Douglas fir, like all other tree varieties grown in France and often used in construction, is susceptible to termites. In the majority of cases, for lumber that contributes towards structural stability, a suitable preservation treatment will be required.

Standards for timber frame walls

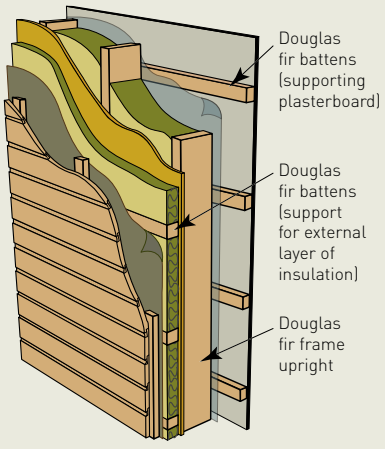
Solution 1: Primary structure with insulation in core



Solution 2: Primary structure with internal layer of insulation



Solution 3: Primary structure with external layer of insulation



Changes in thermal regulations:

The introduction of the 2012 Thermal Regulation (and the forthcoming 2020 Thermal Regulation) brings with it a tightening of the requirements for the insulation of building envelopes. Timber frame wall structures are therefore changing, which means:

- either the width of the primary structures for walls will need to increase (solution 1);
- or reinforced insulation will need to be used on the interior or the exterior (solutions 2 and 3).

DOUGLAS

THE RANGE

Glue-laminated timber (Glulam) and structural composite lumber (SCL)


© FARGEOT LAMELLE COLLE (ARBONIS) - Cabinet R2k Architectes

The demand for engineered products in the construction industry is constantly increasing. Glued lumbers (such as Glulam and SCL) offer solutions to this for medium- and large-span projects. The mechanical strength and durability of Douglas fir, a species that copes well with gluing, gives it a bright future in this field.

DTU 31-1 defines the rules applicable to the construction of glue-laminated timber or structural composite timber frames. Glulam is subject to CE marking (EN 14080), and SCL is covered by the NF B52-010 standard (until they are incorporated into the revised EN 14080 standard).

Details of the Glued Lumber range

Standard dimensions (moisture: 12 to 15%)


© Cosylva.

Glulam

Glue-laminated timbers (or Glulam) are composed of a large number of glued solid wood lamellas, each of which is no thicker than 45 mm. Whether straight or curved, their spans can reach up to 40 m for heights over 2 m.


© Piveteau Bois.

SCL

SCL is used for straight structural components, normally made up of two or three lamellas, although there may be as many as five.
The maximum thickness of each lamella is 80 mm.
SCL components are often between 12 and 16 m in length.

Lamella thickness:

< 45 mm*

* The thickness of the lamella can be less depending on the use category

Height:

Various heights (multiples of the thickness of the lamella)

Standard widths in mm (non-exhaustive list)

72, 75, 90, 115, 120, 135, 140, 160, 180, 200…

A selection of common cuts (in mm):

	100	120	140	160	180	200	220	240
80	●	●				●	●	●
100						●	●	●
120		●			●	●	●	●
140			●					
160				●				
180					●			
200						●		●
240								●

Mechanical properties

The Douglas fir product range is divided into three grades of mechanical strength for Glulam and two grades for SCL:

- **Glulam: GL20 , GL24, GL28***

* As only limited quantities are available in the GL28 range, lead times for delivery may be longer. The GL24 grade is sufficient in the majority of cases for designing structures with Glulam.

- **SCL: GT18, GT24**

Information:

A study carried out by the FCBA shows that the mechanical strength of SCL is 10% greater than the mechanical strength of the woods that they comprise, when used edgewise.

These characteristics may be incorporated into the EN 14080 standard that is currently being revised, which would allow SCL to be given CE marking.

Durability

There are two types of Douglas fir product:

1 Products with natural durability ("red wood")

"Red wood" lumber products can contain a certain amount of sapwood, which is generally defined by the DTUs.

With regards to structural lumber, the Douglas fir product range incorporates a tolerance of 5% sapwood (in a section at any point in the piece).

2 Products with conferred durability

As soon as the proportion of sapwood exceeds the 5% tolerance level, a preservation treatment suited to the intended use category must be applied*.

* Use category 2: surface treatment (dipping, spraying, brushing) / Use category 3.1: surface treatment with a suitable, maintained finish / Use categories 2, 3.1 and 3.2: treatment in an autoclave with the application of a suitable, maintained finish as necessary.

Douglas fir in the context of standards and regulations (in mainland France)

- For the most part, the Glulam and SCL structural frame market involves the use of wood that is protected from adverse weather conditions (use category 2).
If the structures are exposed, they may equally be assigned to use category 3.1*, 3.2", or even 4.

→ **Compatibility of Douglas fir Glulam and SCL structural frames with use categories:**

Use category	2	3.1*	3.2*
Durability of Douglas fir heartwood	Very durable	Very durable	Durable

* The subdivisions of use category 3 are expressed as 3a and 3b in the first version of FD P 20-651, published in July 2011. These will change to bring them in line with the revised EN 335 European standard, becoming 3.1 and 3.2. The terminology used in this document reflects this forthcoming change.

- Decree 2 of the *law on termites and other insects with wood boring larvae* concerns, for the areas in question, the resistance of the lumber (be it natural or conferred) contributing towards the stability of the structure.

→ **Douglas fir heartwood is well-known for its resistance against insects with wood boring larvae in accordance with the EN 350-1 standard***

* Douglas fir, like all other tree varieties grown in France and often used in construction, is susceptible to termites. In the majority of cases, for lumber that contributes towards structural stability, a suitable preservation treatment will be required.

DOUGLAS

THE RANGE

ENVIRONMENTAL ACCREDITATION:
The Cladding product range has been awarded an Environmental Product Declaration
(**EDP** = new version of the **FDES**)

Cladding


© Pinaton Bois - Architect BAL'AMI et BADER

The natural durability, aesthetic nature, and availability of Douglas fir make it a popular choice for exterior sidings, especially at a time when sustainable development tends to encourage external wall insulation systems to improve the energy efficiency of buildings.

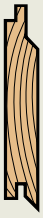
DTU 41-2 defines the rules for installing cladding. Cladding lamellas are subject to CE marking in accordance with the NF EN 14915 harmonized standard, and their manufacture must comply with theNF EN 14519 and NF EN 15146 standards.

Details of the Cladding range

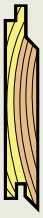
Durability

Douglas fir heartwood is compatible with **use category 3.2** (or 3b) for the entire expected lifespan of cladding products.

Three types of Douglas fir product are available*:



1
No sapwood:
- natural durability: compatible with **use category 3.2.**



2
Sapwood not visible once product in use:
- natural durability: compatible with **use category 3.1.**

3
No restrictions on sapwood content:
- natural durability: compatible with **use category 2.**
- conferred durability: compatible up to **use category 3.2** (dependent on preservation treatment used).

* Natural durability options can be used in mainland France.

Design and durability of lumber cladding

The durability of lumber cladding is predominantly determined by the accurate identification of the use category of the structure in question (as per FD P 20-651).

This is consolidated by using the table below.

Size	Design	Weather conditions		
		Dry	Moderate	Wet
		Use categories		
Small	Draining	3.1	3.1	3.1
	Average	3.1	3.1	3.2
	Trapping	3.1	3.2	3.2
Medium	Draining	3.1	3.1	3.2
	Average	3.1	3.1	3.2
	Trapping	3.1	3.2	4

The subdivisions of use category 3 are expressed as 3a and 3b in the first version of FD P 20-651 published in July 2011. These will change to bring them in line with the revised EN 335 European standard, becoming 3.1 and 3.2. The terminology used in this document reflects this forthcoming change.


© Jordy Construction.

Example:
Criteria according to FD P 20-651
Location: Aveyron
→ **moderate climate**
Design: **draining***
Thickness: 22 mm
→ **small size**

* The revision of DTU 41-2 that is currently in progress will link the type of design (draining, average, trapping) to construction industry practices (horizontal, vertical, perforated cladding, etc.), for standard parts as well as particular features.

Appearance

The Douglas fir product range offers a single option that complies with the requirements of the NF EN 14519 and NF EN 15146 standards (see table below).

		Standard quality (grade A)
Size of round/oval knots on graded side	sound intergrown	10% of width + 35 mm
	dead or partially intergrown	10% of width + 30 mm
	in ingrown bark	no requirements specified in standard
	black	up to 5 mm if not grouped together
	rotten or loose	**not permitted**
Other criteria		See NF EN 14519 or NF EN 15146

Information:
The requirement level cited in the table is the minimum level needed.

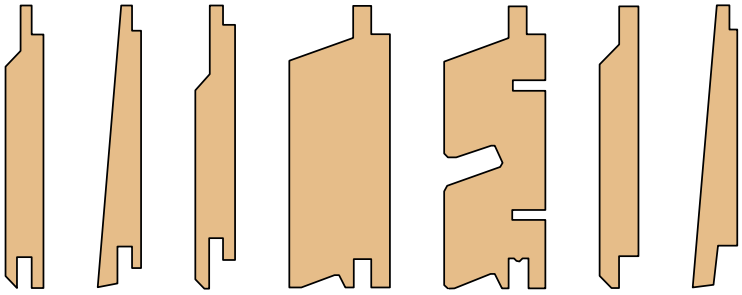
In practice, since there is only one option, batches in the Douglas range will consist of products that possess all the standard properties, provided they meet the requirements for grade A at least.

For particular uses, specific options (which will be detailed in the specifications relating to the contract) can be offered.

Information on storage requirements:
In order to prevent the lamellas from bending before use, it is advisable to store them in their packaging in an area protected from adverse weather conditions.

Profiles and machining

Examples of profiles normally used



The most common form of machining is planing. Douglas fir cladding can also be offered with a rough or brushed surface.

Standard sections*
(moisture: 18% +/- 1%)

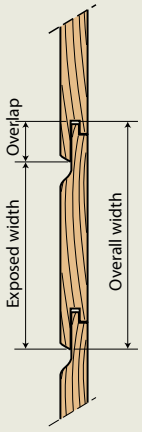
* Other sections may be supplied depending on the specificities of the manufacturer and/or the structure.

Interlocked or overlapped cladding

Cladding	Thickness (mm)	Examples of exposed widths (mm)
Solid cladding	22	100 – 110 – 125 – **130** – 135
	28	170 – 175
	44	110 – 130 – 135 – 170
Glulam cladding	20	200
	25	200

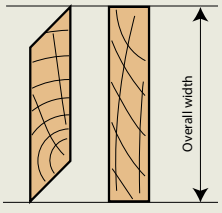
Minimum amount of overlapping or interlocking:

- Lamellas less than 100 mm overall: **10 mm**
- Lamellas between 100 and 150 mm: **10% of the overall lamella width**
- Lamella greater than 150 mm: **15 mm**



Open joint cladding

Thickness (mm)	Examples of overall widths (mm)
27/28	90 – 120 – 145
36	80 – 90
44	120 – 160



DOUGLAS

DOUGLAS

THE RANGE

The working life of Douglas fir cladding

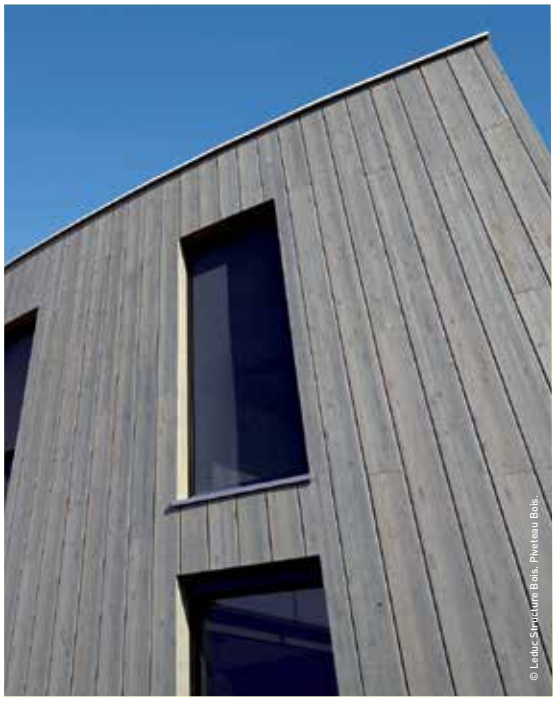
Controlling changes in appearance

Natural aging

With natural aging, in locations where the material does not require the application of a finish, Douglas fir lumber will turn a silver-gray color.

In certain damp conditions (e.g. if the structure is near a forest, lake, river, slopes shaded from the sun, etc.), it is preferable to apply a preservation treatment, with or without a finish (depending on the type of treatment used), in order to prevent the growth of mold on the wood's surface.

Care must also be taken when designing the building to ensure the aesthetics are not affected (the appearance of different colors on the same facade).



Cladding with finish (semi-transparent glaze).

Douglas fir cladding without finish after construction.

Finishes

The finish cannot be regarded as an element that affects the use category.
However, it can help extend the structure's service life, especially for small-sized parts. Its key role is to ensure that the appearance remains the same even if exposed to adverse weather conditions.

Finishes and painting systems for exterior timber surfaces must be graded in accordance with the NF EN 927-1 standard (examples of finishes that can be graded according to NF 927: glazes, opaque glazes, microporous paints).

Finishes that are applied on worksites must be used in accordance with the rules set out in:

- the technical sheets for the graded system;
- DTU 59-1.

Other types of finish, such as oil-heat treatment or saturators, are also available on the market.

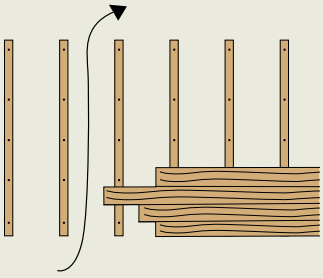
DOUGLAS

Advice for using wooden cladding

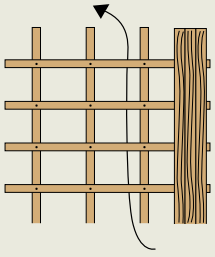
Number of fastenings and their placement determined by width

Exposed width of lamella W (in mm)	Number and location of fastenings
W ≤ 100	One fastening at upper end of chamfer or at lower end through lamella, 10 mm from bottom of groove.
100 < W ≤ 125	**With finish**: One fastening at upper end of chamfer or at lower end through lamella. **Without finish**: One fastening at lower end, 10 mm from bottom of groove.
125 < W ≤ 200	Two fastenings: - Lower fastening at least 10 mm away from bottom of groove. - Upper fastening in top third of lamella.

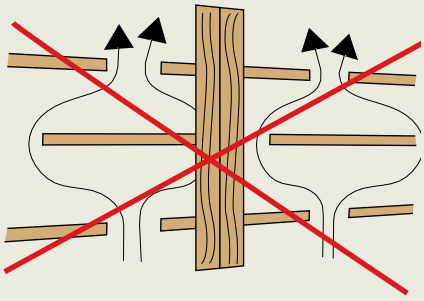
Cladding ventilation



Placed horizontally
on batten



Placed vertically
on double batten



Interrupted horizontal battens
("chicanes"): **do not use**

Sizing rules

Cladding lamellas:

- minimum thickness of 15 mm if the center distances between the supports ≤ 40 cm;
- minimum thickness of 18 mm if the center distances between the supports ≤ 65 cm;
- ratio between exposed width/thickness ≤ 7.5.

Battens:

Vertical battens in line with uprights:

- fastenings every 30 cm;
- width equal to at least 35 mm;
- minimum thickness of 22 mm.

Horizontal battens:

- minimum thickness of 22 mm for center distance and fastening up to 40 cm;
- minimum thickness of 27 mm for center distance and fastening up to 65 cm.

DOUGLAS

THE RANGE

Decking

ENVIRONMENTAL ACCREDITATION:
The Decking product range has been awarded an Environmental Product Declaration
(**EDP** = new version of the **FDES**)

Douglas fir, with its natural durability (heartwood), has some real advantages that help it meet the market requirements of the wooden terrace industry, which is currently booming.

DTU 51-4 defines the rules for constructing timber decking. The manufacture of decking boards is governed by the NF B54-040 standard. Exterior timber decking is generally allocated to use category 4 or 3.2*. In certain, specific locations (covered walkways, covered patios, balconies, etc.), it can be assigned to use category 3.1*.

* The subdivisions of use category 3 are expressed as 3a and 3b in the first version of FD P 20-651, published in July 2011. These will change to bring them in line with the revised EN 335 European standard, becoming 3.1 and 3.2. The terminology used in this document reflects this forthcoming change.

Details of the Decking range

Durability

Douglas fir heartwood is compatible with use categories 3.1 and 3.2 for the entire expected lifespan for type 1 decking products.

*see DTU 51-4.

Two types of Douglas fir product are available:

1 **Product with natural durability ("red wood")**
Boards completely stripped of sapwood are compatible with **use category 3.2**.

2 **Products with conferred durability**
Boards with sapwood after treatment are compatible with **use category 3.2**.

Target moisture

18% (after production as per NF B54-040).

Mechanical properties

Boards have a minimum mechanical strength grade of **C18** for type 1 decking.

Information on storage requirements:
In order to prevent the boards from bending before use, it is advisable to store them in their packaging in an area protected from adverse weather conditions.

Sections and machining

There must be no sharp edges on any of the boards.

Standard thicknesses[1] (mm)	Standard widths[2] (mm)
21/22	90 - 110 - 120
27/28	110 - 120 - 140 - 145
32	120 - 140 - 145
36	140 - 145 - 165
45	145 - 165

For some sections, supply timescales can vary depending on the quantities requested.

[1] For increased stability of the product, it is advisable to opt for thicknesses greater than or equal to 27 mm.

[2] All the widths shown for a given thickness fall within the scope of the NF B54-040 standard (maximum slenderness of 6). In some situations, construction may entail a reduction in slenderness.

Optimizing design

Compatibility of Douglas fir decking boards and use categories as per FD P 20-651

Size	Design	Weather conditions		
		Dry	Moderate	Wet
		Use category		
Small or medium (< 75 mm)	Average	3.1*	3.2*	3.2*
	Trapping	3.2*		

* The subdivisions of use category 3 are expressed as 3a and 3b in the first version of FD P 20-651, published in July 2011. These will change to bring them in line with the revised EN 335 European standard, becoming 3.1 and 3.2. The terminology used in this document reflects this forthcoming change.

The general design rules defined in DTU 51-4 correspond to **"Trapping Designs"**.

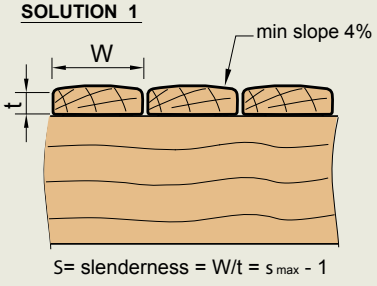
In addition to this, DTU 51-4 also introduces specific rules for obtaining **"Average Designs"**.

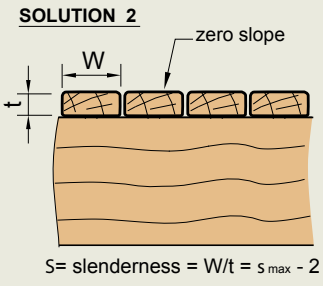
Average design* decking that can be assigned to use category 3.2 for moderate and wet climates (according to FD 20-651)

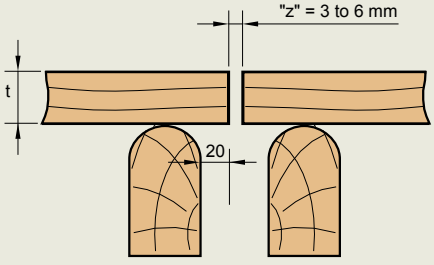
* The rules shown below are taken from DTU 51-4 and apply to type 1 decking.

Rules for boards

- Rule for slenderness of boards







- Confinement on the underside of the decking is limited to ensuring a minimum air flow. Air intake must be perpendicular to the boards, at the top of the joists, and over a surface area representing at least 1/100th of the total decking surface.

- The lamella ends do not need to be supported due to the use of a double joist (set back 20 mm from the end of the lamella) with a space of 3-6 mm between the two lamella ends.

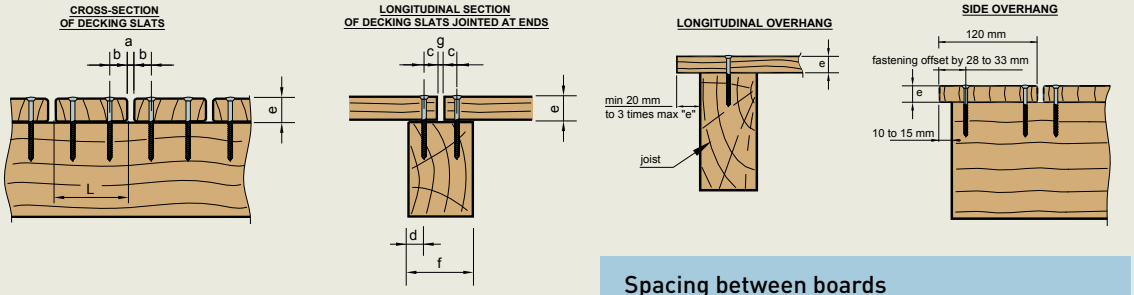
Rules for joists

- The "average" design also involves additional rules for joists (refer to DTU 51-4 P1-1).

DOUGLAS

THE RANGE

Recommendations for using Douglas fir lumber for exterior decking (taken from DTU 51-4)



- a: board spacing in standard conditions **from 3 to 12 mm.**
- b: position of the screw in relation to the board edge.
- c: position of the screw in relation to the board end.
- d: position of the screw in relation to the joist edge.
- e: board thickness.
- f: joist width.
- g: clearance between the board ends ranging from **0 mm to 5 mm** (type 1 decking).

Spacing between boards

DTU 51-4 sets the rules for defining the spacing between boards during construction, to ensure this remains between 3 and 12 mm at all times during the decking's lifespan. This spacing is determined based on the moisture content of the boards when they are laid and the lumber's minimum or maximum equilibrium moisture content for the site in question (maps are provided in DTU 51-4).

Values b, c, d and f depend on the diameter of the screw used.

Screw Ø	≤ 5 mm	≤ 6 mm	= 8 mm
b	15 mm < b < L/5		18 mm < b < L/5
c	≥ 15 mm	≥ 17 mm	≥ 20 mm
d	≥ 12 mm	≥ 14 mm	≥ 18 mm
f	≥ 57 mm	≥ 65 mm	≥ 79 mm

The lifespan of Douglas fir decking

Controlling changes in appearance

Douglas fir decking will, over time, turn an all-over silver-gray color when its surface is evenly exposed to adverse weather conditions.

A finish can be chosen for aesthetic reasons to minimize the natural aging appearance of the wood, but this cannot modify the use category. It is therefore necessary to use a suitable finishing system (such as a non filmogenic deck stain, an impregnation glaze or an oil) that has been designed for this purpose.

However, without repeated applications, this finish cannot prevent the natural aging of the wood.

Cleaning

It is advisable to clean the decking thoroughly twice a year to eradicate all mold growth or contaminated areas that are the main cause of slipping.

France Douglas:
uniting the industry for 20 years

France Douglas was founded in November 1993, initiated by forestry and sawmill professionals in France's main producing regions. Their aim was to ensure, with as much cohesion as possible, the promotion of Douglas fir, a new nationwide resource born from the reforestation programs in the second half of the 20th century, particularly centered on the mountainous regions of central France.

To meet this goal, France Douglas has focused on developing its operations in the following four areas:

- monitoring standardization work that contributes to defining technical guidelines for the qualification of materials and their usage conditions,
- engaging in the research work necessary for a better understanding of the material, as well as ways to obtain the most value from it. To complement the various studies conducted from the year 2000 to define the characteristics of Douglas fir, France Douglas has been heavily involved in certification projects for mechanical grading machines, which are better equipped to determine the resource's value than visual grading.
- supporting industry professionals, which translates into constant exchanges of information and, where needed, collective action to improve the organization and competitiveness of the sector.
  It is within this framework that France Douglas has supported its 50 or so members to develop the **product range** outlined in this document.

  With this new tool, the industry now has an added advantage to help establish Douglas fir in the construction market for the long term, and thereby capitalize on a national renewable resource with remarkable technological properties.
- implementing a consistent communications program that relies on - besides the usual tools such as newsletters, attendance at major trade shows, and organizing special events - a redesigned website (www.france-douglas.com) that lists **the association's members** and the **products within the range** that these companies decide to offer.

France Douglas is therefore contributing to the structuring of an industry that is increasingly asserting its economic potential, year after year.

© Jean-Christophe Duppy

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www.france-douglas.com

France Douglas
SAFRAN - 2 avenue Georges Guingouin
CS 80 912 Panazol - 87017 Limoges Cedex 1

Design by: Obea Communication.