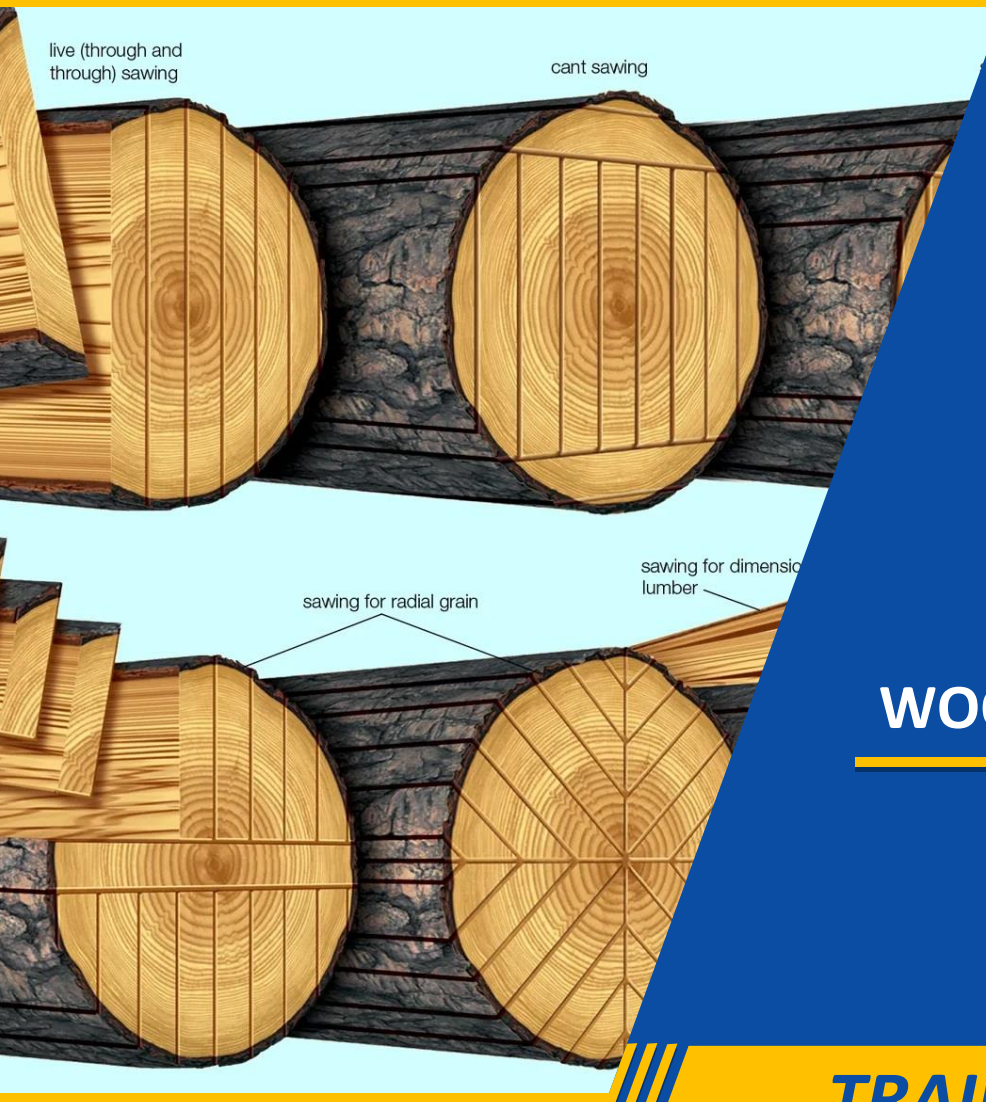
ROUND WOOD AND SAWN TIMBER GRADING



WOOD TECHNOLOGY

TRAINING MANUAL

November, 2022.

ROUND WOOD AND SAWN TIMBER GRADING

Implemented by

2022

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LEARNING UNIT 1: DESCRIBE ROUND WOOD AND SAWN TIMBER

1.1 Description of wood

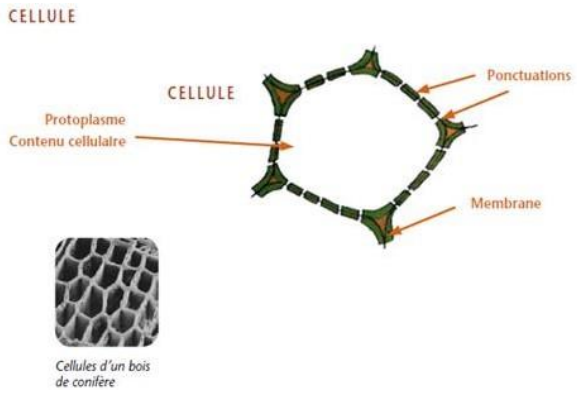
1.1.1 Wood material

➢ Cells

Wood is composed of several small cells produced by the tree itself, and visible only under a microscope. The cell consists of alveolus composed of cellulose (45-50%), lignin (25-30%) and water, protected by a more or less thick and rigid membrane. This composition is called protoplasm.

All cells are connected by small "gates" called punctuations; cells of the same type make up the"fabric" and all tissues make up the wood.

There are more than 22,000 trees species with commercial value, all of them producing tissues andtimber, each of them being different from each other; this means that there are more than 22,000 different timbers.



In conclusion, timber is not a material but there are 22,000 different materials as well from mechanical as well aesthetical point of view.

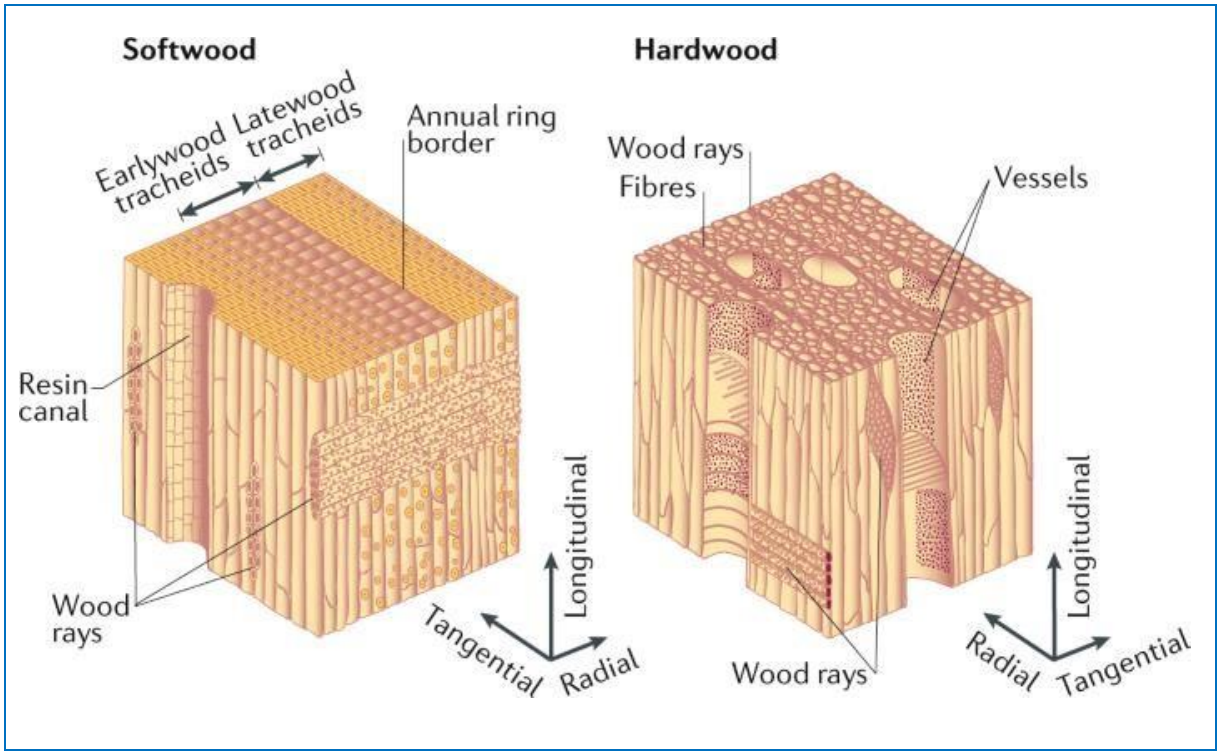
The cells types in the xylem are:

- Parenchyma cells (conductive and supportive)
- Vessels
- Tracheids
- Fibres
- Ray Tracheids

- Ray parenchyma cells
- Axial parenchyma cells

Wood is composed of cellular tissue that has different functions. Cells aligned either parallel (mainly

"grain direction" ~90%) or perpendicular ("rays") to the axis of the tree.



Softwood:

- Tracheids (support and conduction)
  - Aspect ratio ~100:1
- Parenchyma (storage – mainly in the rays)

Hardwood:

- Tracheids
- Parenchyma
- Fibres (thick walled cells) whose main function in mechanical support
- Vessels (or pores), specialised conductive tissue

Wood cells features:

- Tube like structure
- Wall thickness depends on function
- Void space in the center is called the ***lumen***

- Structures known as **pits** connect cells formed by cell division

1.1.2 Wood origin

Wood formation is a complex biological process, involving five major developmental steps, including

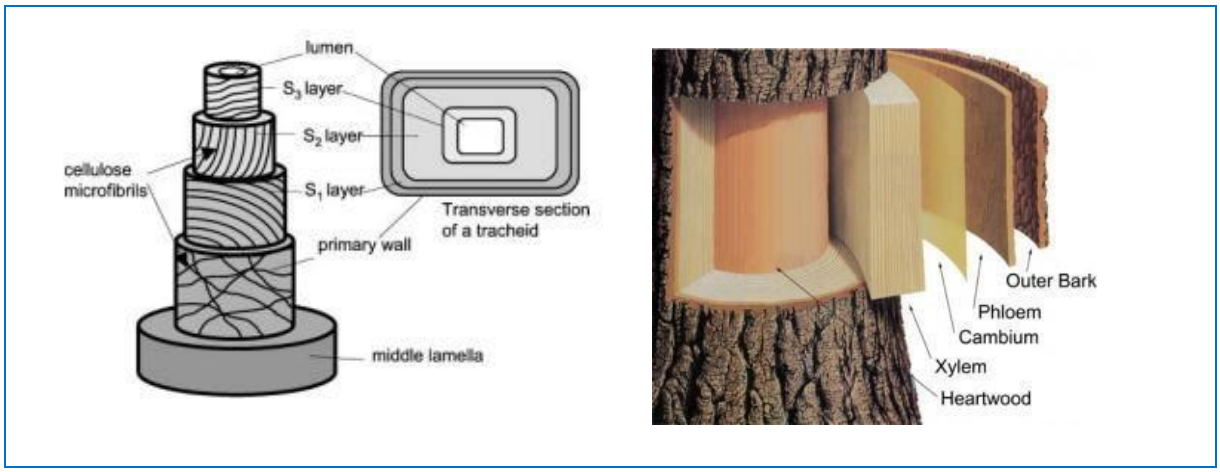
1. Cell division from a secondary meristem called the vascular cambium,
2. Cell expansion (cell elongation and radial enlargement), (
3. Secondary cell wall deposition,
4. Programmed cell death, and
5. Heartwood formation.

➢ Wood is produced by the vascular cambium

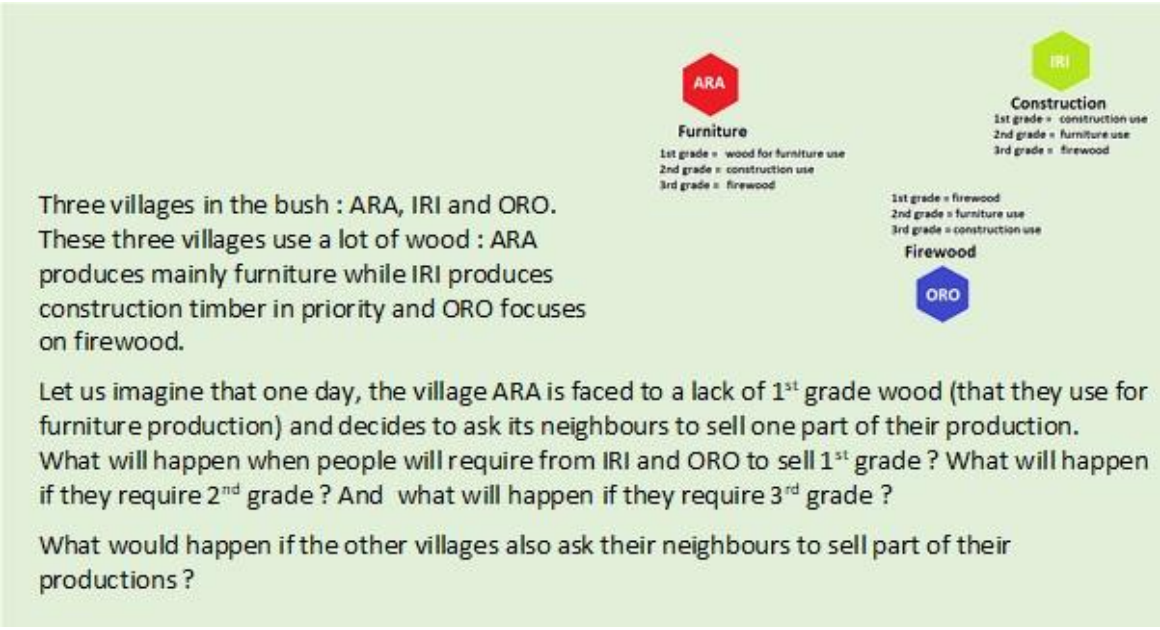
Wood, also called secondary xylem, is produced seasonally at the periphery of the trunk by the vascular cambium. Derived from the procambium, this meristem is responsible for shoot and root secondary growth. It is of major importance in the perennial life of trees as it regularly produces functional xylem and phloem cells, towards the inner and outer parts of the trunk, respectively. The cambium is made of initials, which divide to produce phloem and xylem mother cells. When it is reactivated in the spring, in many species, the cambium starts to produce first phloem cells, sometimes several weeks before any xylem cells are produced. However, at the end of the growing season, the number of xylem cells formed exceeds the number of phloem cells. Wood is therefore produced in a larger quantity than secondary phloem in the stem. In contrast to primary meristems, the cambium is made of two types of initials, different in size and shape. Elongated fusiform initials give rise, by periclinal divisions in the tangential plane, to the axial cell system in wood (water-conducting vessel elements, vessel-associated cells, fibres and axial parenchyma cells) while radial isodiametric initials produce the radial cell system, consisting of the parenchyma ray cells. The identity of the cambial cells seems to be linked to positional signals, more than to the identity of the cell lineage, as fusiform and radial initials can inter-convert. On a stem cross-section, the cambial zone is characterized by a few layers of narrow and thin-walled cells. Anticlinal divisions of fusiform initials ensure the harmonious increase in the cambium circumference.

Wood is mostly made of secondary cell walls of dead fibres

The secondary walls are made of several layers, called S1, S2, S3, each composed of a network of long bundles of cellulose microfibrils, oriented at a fixed angle, and cemented in an amorphous matrix of hemicelluloses – xylans mainly, and lignins. In smaller quantities, proteins and pectins are also present. The S1, S2 and S3 layers differ in their thickness, chemical composition and cellulose MicroFibril Angle (MFA, measured from the fibre longitudinal axis). In particular, the alternation of high and low angles in the different layers of the secondary cell wall increases its rigidity and mechanical strength. Models derived from the mechanics of composite materials show the importance of MFA and cellulose crystallinity in explaining the macroscopic mechanical properties of wood. MFA in the S2 layer, which is the thickest one is a parameter widely used in wood technology. As MFA increases – the cellulose microfibrils diverge more from the vertical – stiffness and tensile strength decrease. An inverse relationship between MFA in the S2 layer and fibre length is generally observed for a given wood sample between growth rings: the closer the MFA is to 0°, the longer the fibre. However, fibres of the same length from different species can have widely different MFA



1.1.3 Name and classification



Example 1: Grading

The names '1st grade', '2nd grade' and '3rd grade' must be in this case interpreted as tree names.

Commercial names could have been used but it was preferable to use terms referring as well to trees names as to timber quality.

People from ARA village require 1st grade from IRI village and receive IRI's 1st grade, at good price but to be used for construction and not for furniture: **they will be claiming**

People from ARA village require 1st grade from ORO village and receive ORO's 1st grade, at very good price but to be used for firewood and not for furniture: **they will be claiming**

People from IRI village require 1st grade from ARA village and will be quoted ARA's 1st grade, to be used for furniture and not for construction: **they will be have to pay higher price than expected, not sure that they will agree**

People from IRI village require 1st grade from ORO village and receive ORO's 1st grade, at verygood price but to be used for firewood and not for construction: **they will be claiming**

People from ORO village producing a lot of firewood, lack timber for furniture and require 2nd[t] grade timber from ARA village; they will receive ARA's 2nd grade, to be used for construction and not for furniture: **they will be claiming**

People from ORO village producing a lot of firewood, lack timber for construction and require 3rd grade timber from IRI village; they will receive IRI's 3rd grade, to be used for firewood and not for construction: **they will be claiming**

Communication between all villages is very poor and in all cases, it is clear that there was no intention to commit fraud and deliver lower quality firewood or other species.

Such an example shows clearly how important it is to be very precise when requiring timber species and grade.

Before beginning any operation, it is absolutely necessary to confirm the right timber name. In fact, while using local names, it is not rare that, depending on the growing areas, one same name could be applied to many different species or that one same specie would be differently named.

For a very long time, people have named trees growing around their villages with local names in regard to the use of each of them (fire, construction, furniture, medicine,).

In the tropical areas, a lot of people are living in or nearby the forests, each of them using their own terms and to those, must be added names applied by the colonists.

For centuries and still actually, local names have been and are still created.

In the 17th century, many local names were used and the maritime companies, trading precious timbers from tropical areas, wishing to protect their interests, still complicated the situation by lying about timber origins and creating false names.

Looking at such situation, at the beginning of the 18th century, one Swedish botanist – Carl von Linné – decided to tidy up the wood classification, sorting trees from the flower and by creating divisions to end in a very precise result with botanical names.

Using Latin and old-Greek languages, he created 2 great classes – Gymnosperms (conifers) and Angiosperms (broad-leaved trees), and continued to divide them into sub-classes to end in families,then in kind and species.

Eucalyptus and Cypress timber

	Eucalyptus timber	**Cypress timber**
Subphylum	Angiosperm	Gymnosperm
Family	Myrtaceae	Cupressaceae
Genus	Eucalyptus	Cupressus
Specie	grandis	Lusitanicum

➢ **The pair Genus + Specie defines very exactly one timber species.**

While the use of such classification is irrefutable, professionals of wood and timber often prefer using their own classification.

Noting that Linné's classification was not receiving approval from the professionals, some organizations decided to create pilot names by choosing local names that would be the most representative of each species. These pilot names have been defined in professional books.

Nevertheless, although many wood and timber professionals recognize the utility to use these pilot names to avoid any confusion prefer to use – mainly in regard to some particular species – local names because these ones give a guarantee of origin for example, Ayous from Cameroon, which does not prevent any other professional to use the 'best' local name for timber of other origins.

In addition, for marketing reasons, the professionals also created commercial names:

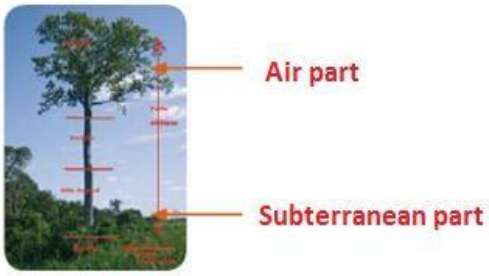
- to sell unknown species (as 'Tasmanian oak', covering in fact to 3 eucalyptus species)
- to group similar species in color and mechanical properties (north American Hemlock)
- to reduce the harvesting costs of some species for example, Meranti, a name defining a group of over 700 different species belonging to the same family. This allowed the foresters to harvest 150m3/ha instead of 15m3/ha and to become essential on the international markets).

1.1.4 Tree and timber description

Just as people, trees are living things. Composed by cells, they have to eat, transform food and distribute it in their constituent parts, and besides resist to outer destructive agents (insects, fungi, wind and bad weather.)

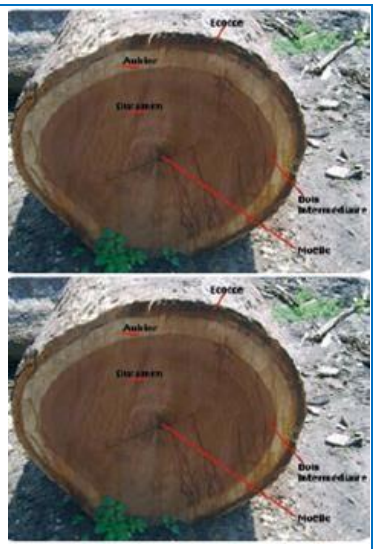
➢ External description

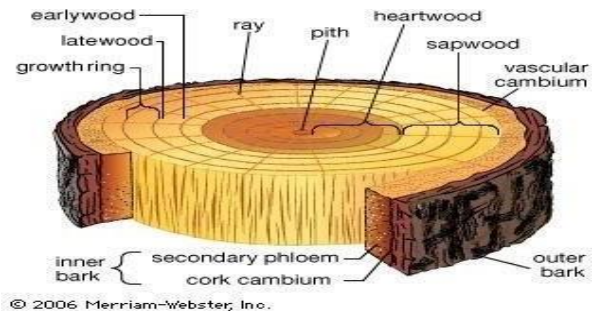
Trees consist in an aerial part and a subterranean part.

Visible part of the tree, the aerial part consists in the trunk and the top divided in branches, where appear the leaves whose role is important, insuring food and growth, its breath, its sweating, its reproduction and all rejections in the atmosphere (photosynthesis). Invisible part of the tree, the subterranean part is composed by roots ensuring tree's needs in water and mineral salts, while anchoring it solidly in the ground.	

➢ Internal description

When you a tree trunk and examine the section going from the center part towards the periphery of the trunk, there appears heterogeneity of tissues:

Outer bark	This is the dead, corky, material that protects the stem from damage and stops the tree from drying out. As the tree grows in circumference, the bark gradually splits and falls off, and is replaced by new bark.	
Phloem	The phloem forms the inner bark. It carries the food made in the leaves to all of the growing parts of the tree – that is, the branches, roots and stem.	
Cambium	Underneath the phloem is a thin slimy layer of cambium. Its cells are constantly multiplying and forming new phloem tissue on the outside and new wood tissue on the inside. The cambium layer gradually moves outwards as the tree grows in girth.	
Sapwood	The sapwood carries water and nutrients upwards from the roots. It is made up of living cells and is often lighter in color than the heartwood.	
Heartwood	As new sapwood is formed by the cambium, some of the inner sapwood becomes inactive and is converted to heartwood. The dead cells are used to store waste products from the growing tree, so the vessels become blocked and are no longer able to carry sap. This makes the heartwood turn a darker colour, and also makes it more durable in some species because the waste products are often toxic to attacking organisms.	
Pith	The small, soft core near the center is called the pith. It is the original tissue in the tree from its early growth as a sapling.	

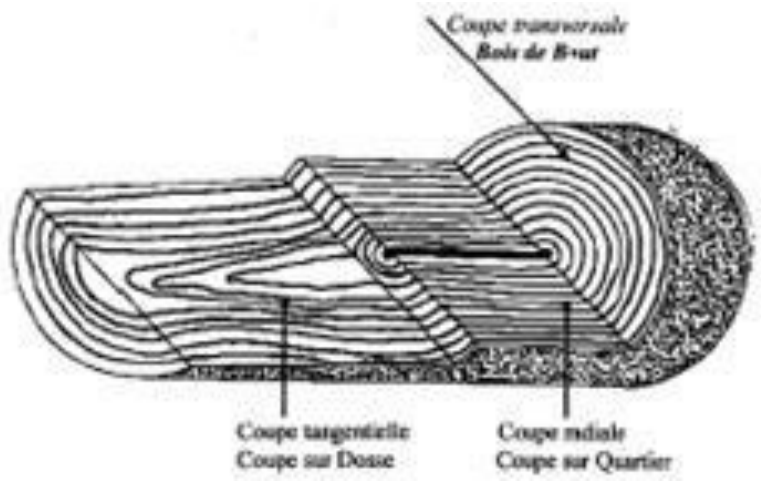


Even though all conifers are broad-leaved trees, they can be differentiated into two (2) kinds of trees as follows:

Species with indistinct sapwood, also called 'white woods' Easily damaged by insects and/or fungi attacks, they are not naturally resistant and they are limited to internal uses such as Frake/Limba (Terminalia superba)	
Species with **distinct sapwood**, also called '**red woods'** Except the sapwood part, these species are naturally resistant to insects and/or fungi attacks. So, they can be used for external purposes. The duramen of distinct sapwood species can be damaged by insects or fungi especially during the youthful stage of the tree, for example, Teak, Iroko)	

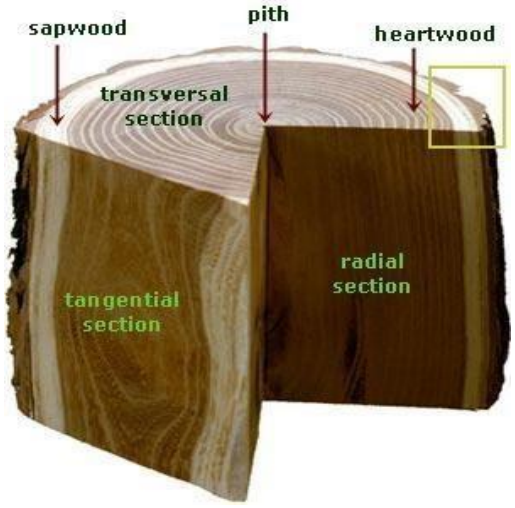
Nevertheless, all of them, red or white woods, have sapwood and heartwood (duramen).

1.1.5 Timber sections



There are three (3) different timber sections:

1. **Cross section**, showing circles as one standing tree, is the axial section used for timber species identification. It is very few affected by shrinkage on drying.
2. **Tangential section** shows one flame drawing; it appears on rotary veneers. This section is the most affected by shrinkage on drying.
3. **Radial section** shows parallel lines and appears while quarter sawing and on sliced veneers. This section is half as affected by shrinkage on drying as the tangential section.



1.1.6 Timber physical properties

➢ Humidity

Humidity rate is given in percentage by comparing the weight of one fresh piece of wood and its weight when it is absolutely dried.

The calculation formula is:

$$\textbf{Humidity rate} = \frac{(\text{Weight of fresh wood} - \text{Weight of dried wood})}{\text{Weight of dried wood}} \times 100$$

For example:

One piece of wood weighing 20kgs when fresh has a 16kg weight after drying. Calculation of the humidity rate when it was fresh is:

$$\frac{(20 - 16)}{16} \times 100 = 25\%$$

Activity 1.1

Question 1

One piece of wood that was weighing 34 kg when fresh, presents a 25 kgweight after drying. What was its humidity rate when it was fresh?

Question 2

How can you exactly define one timber species?

Possible solutions to Activity 1.1

Question 1

$\frac{(34-25)}{25} \times 100 = 36\%$

Question 2

The best way to identify one species is to use botanical names and more precisely the pair GENUS + SPECIES

➢ Weight

Timber weight varies in regard to the humidity level.

➢ Retractability

Immediately after sawing, water goes out the timber.

The humidity rate goes down to about 30% that is corresponding to the wood fibres saturation threshold (which may vary depending on the species).

This means that all water existing in liquid form is gone.

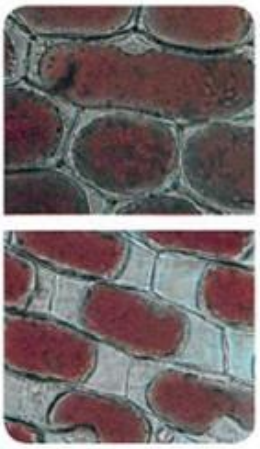
Below this, the water contained in the cells will disappear: this phenomenon is called 'Retractability of the timber'.

During several months, the timber will dry up to reach 16% humidity and will never naturally go lower than this level. At this step, it is called 'Air dried'.

The drying timber reaches more or less one (1) cm of each side per year: this means that one sawn piece of wood with thickness of 80mm will need at least four (4) years to be 'air dried'.

All its life, wood with lower normal moisture than its natural step of retractability, will go up and/or down its own moisture level following the close environment humidity level.

The moisture level changes due to the air humidity around; but the sizes changes are due to the species nervousness.



Cellules saturées d'eau (photo du haut) et cellules rétractées (photo du bas)

Learning Unit 1 Assessment

Question1

Describe a tree and how it lives

Question 2

What is the difference between 'white wood' and 'red wood'? Why are those terms used and what do they mean?

Question 3

Which timber sections are the most and the less affected by shrinkage?

Question 4

When can timber be called Air dried?

Possible responses to learning unit 1 assessment

Question 1

A tree is divided in 2 parts, the subterranean part where roots are present, ensuring the tree's needs for water and mineral salts while anchoring the tree in the ground. The second part is the visible one, standing out of the ground, and including the trunk and the crown with branches and leaves whose role is very important in terms of food and growth, breathing, sweating, the reproduction and all rejections in the atmosphere during the photosynthesis phenomenon.

Question 2

'White wood' means wood with indistinct sapwood that can be attacked in totality by insects and fungi.

'Red wood' means distinct sapwood specie that can be attacked by insects and fungi only in its sapwood, not in the heartwood.

Question 3

The tangential section is the most affected by shrinkage, and cross section is the less affected section.

Question 4

Timber is really air dried when it reaches 16% humidity; it can also be called Air dried once its humidity falls under 20%, but it will never fall under 16% humidity.

LEARNING UNIT 2: SORT LOGS

2.1 Logs and logs grading

2.1.1 Definition

The term 'log' is used to define one felled tree.

2.2 Measurement

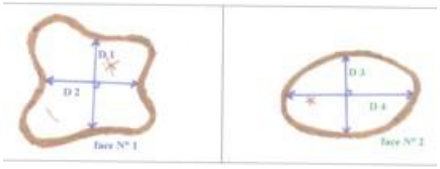
2.2.1 Diameter measurement

Small to medium diameters logs (temperate species)

- At mid length

Big diameters logs (as tropical logs):

- At each both ends of the logs
- Under bark
- In cross measurement considering one round circle
- Rounded at the inferior covered centimeter



Average diameter of each log is calculated :

- Diameter 1 at end 1
- + Diameter 2 at end 1
- + Diameter 1 at end 2
- + Diameter 2 at end 2

The total amount divided by 4 and rounded at the inferior covered centimeter.

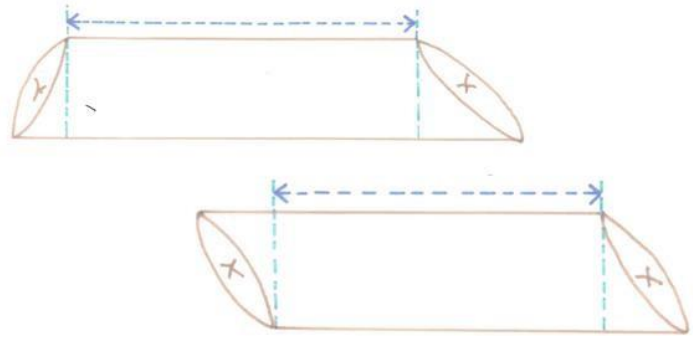
Example:

End 1: diameters 90 and 88
End 2: diameters 82 and 78

Calculation: 89 + 86 + 81 + 78 = 338/4 = 84.5 = 84

The average diameter of this log will be 84 cm.

2.2.2 Length measurement



The length is shortest distance between both ends of the logs.

It is measured in full covered decimeter.

One log measuring 12.47m will be noted in length as 12.40m and one log measuring 12.50m will be registered as measuring 12.40m.

2.2.3 Volume calculation

It is calculated with the following formula:

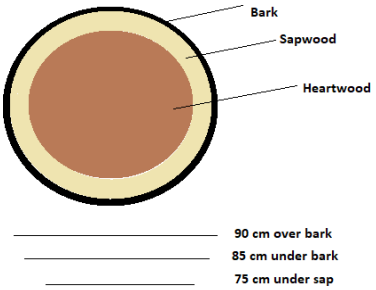
$V = L * D^2 * 0.7854$

Where D = average diameter (in meters)
L = length (in meters)
0.7854 = $\eta/4$

ATIBT volume calculation is made following the **metric system**.

Remark:

Some buyers mainly in India and the Middle East may require a Hoppus measurement which can be applied in cubic meters (m3) or in cubic feet (ft3).
Generally based on one mid girth (or diameter) measurement (instead of an average diameter) this volume calculation method considering squared log instead of round log, will take into account a reduced volume at 78.5 % only of the real volume.
The initial volume can be reached by multiplying the Hoppus volume by 1.2739.

A lot of buyers wish to buy 'under sap' with the aim to reduce the purchased volume and consequently, the purchasing price. If the bark must not be considered as timber (bark is the tree and timber protection), it is necessary to understand that sapwood must be considered as timber, even if it is not so resistant than heartwood. During the transportation operations, the sapwood volume will be handled by all operators in charge to finalize these operations. If this kind of measurement (under sap) is not mentioned, it is evident that a claim could rise because it would be considered as fraudulent requirement to reduce the volume significantly.	

Example

To understand very well the financial impact of this measurement, let us consider one log of average diameter 90 cm with bark and 85 cm under bark, measuring 14 m in length:

- Measured with bark, its volume (14*90) would be 8.906 m^3
- Measured under bark, its volume (14*85) is reduced to 7.944 m^3
- Measured under sap, its volume (14*75) is still reduced to 6.185 m^3. That means that the bark volume represents +/- 1 m3 (more than 10%)
- And the sap volume represents +/- 1.750 m3 (more than 22 % over the volume under bark)

Considering the log extracted from the forest with bark, when measuring under sap, the totalvolume difference is more than 30% in less.

2.3 Grading

2.3.1 Main terms definition

- **'Quality'** term applies to logs parcels.
- **'Grade'** term applies to logs.
- **'Fresh cut'** term means that logs are kept sound and free of any fungi or insect attack after falling, excepted weather degradations. 'Fresh cut' conditions are always established before shipment.
- **'Abnormally developed sapwood'**, can be considered as unusually developed when exceeding 8% of the log diameter, and can be deducted of the log diameter. Established in regard to the logs origin and diameter, it is currently neither penalized

nor rejected. But in such case, a double measurement must be controlled and separately listed:

- ✓ one commercial packing list with measurement under sap (concerning only the seller and the buyer)
- ✓ one packing list with measurement under bark (concerning administration and freight/transport)

2.3.2 Defects categories

There are three (3) main different categories of defects:

1. **Conformation defects** are due to trees growing (location, position, soil, weather exposition,…). Their presence must be first considered, their importance secondly.
   - ✓ Conicity (mainly due to workers preparing the logs)
   - ✓ Curvature
   - ✓ Flat
   - ✓ Buttress
   - ✓ Camel bumps
2. **Structural defects** are inherent to all trees. They cannot be all present on one same log, but their importance in numbers will be considered.
   - ✓ Knots or bumps
   - ✓ Bark pocket
   - ✓ Pin knots, wrinkly grain, channels
   - ✓ Burl
   - ✓ Ring shake
   - ✓ Splits and cracks
   - ✓ Abnormal heart
   - ✓ Interlocked, twist grain
3. **Adulterations** are due to sanitary problems (insect attacks, fungi attacks, senility,…)
   - ✓ Pin holes
   - ✓ Borer holes
   - ✓ Teredo
   - ✓ Discoloration (blue stain)
   - ✓ Decay
   - ✓ Spoiled heart
4. **Various defects** which cannot be considered while grading operations often oblige to reject the logs to local market because falling considerably their value.

- ✓ Internal cracks
- ✓ Burns
- ✓ Rot
- ✓ Abnormal color, heartwood discoloration
- ✓ Pitch presence
- ✓ Silica presence

2.3.4 Defects grading

Conformation defects grading: **(<> = appearing on the trunk)**

Conicity	<>	not to be considered = Best or Fair grade
Curvature	<>	1 curve only = Fair grade
Flat	<>	Fair grade
Buttress	<>	very small can be = Best grade ; more important = Fair grade
Camel bumps	<>	Fair grade (if small) or Reject grade

 **Buttress**	 **Flat & Buttress**	 **Light curve**

Structural defects grading: **(<> = appearing on the trunk; 0 = appearing on ends)**

Knots or bumps	<>	None, few, small = Best grade ; more important = Fair grade
Bark pocket	<>	Very small = Best grade ; important = Fair grade
Pin knots, wrinkly grain	<>	None, few = Best grade ; numerous = Fair grade
Burl	<>	Small = Best grade ; Very important = Fair grade
Ring shake	0	1 small = Fair grade ; important, numerous = Reject grade
Splits and cracks	0	Radial, not important = Best grade ; Tangential = Fair grade
Abnormal heart	0	Very light = Best grade ; other = Fair grade
Interlocked grain	<>	Light = Best grade ; other = Fair grade

		
Radial splits (normal) **Pitch presence** **Adulterated heart**	**Ring shake**	**Abnormal heart** **(double bole)** **Bark pocket**
		
Wrinkly grain	**Important wrinkly grain**	**Very big burl**

Adulterations grading: **(<> = appearing on the trunk ; 0 = appearing on ends)**

Pin holes	<>	Light, in sap only = Best grade
Borer holes	0	Fair grade ; numerous = Reject grade
Teredo	<>	Reject grade
Discoloration	0 <>	Fair grade
Decay	0 <>	Light = Fair grade
Spoiled heart	<>	Light = Fair grade

		
Spoiled heart (decay)	**Discoloration and Adulterated heart**	**Decay on trunk**

Various defects grading **(<> = appearing on the trunk; 0 = appearing on ends)**

Internal cracks	<>	Reject grade
Burns	0 <>	Fair grade or Reject grade
Rot	0	Fair grade or Reject grade
Abnormal color,…	0	Fair grade (allowance depending importance)
Pitch presence	0	Fair grade (allowance depending importance)
Silica presence	0	Fair grade (allowance depending importance)

2.4 Evaluating logs lots quality

Evaluating logs lots requires being able to grade individually a percentage of the logs and adapt the ratio to the whole parcel. That means that the inspector has visually ensured that such ratio is correct.

Logs parcels are adapted to clients' requests and needs. Some of them need very high quality to produce furniture while others producing carpentry products can be reasonably be comprehensive. Other clients using low cost raw materials will be more demanding, so rarely shipments will contain whole qualities in close same percentage.

Very good quality	**Good quality**	**Poor quality**
1st grade minimum 60%	Mixed 1st and 2nd grades 75 – 80 %	Mixed 1st and 2nd grades 40 - 50 %
2nd grade minimum 30%	3rd grade 20 – 25 %	3rd grade 50 – 60 %
3rd grade maximum 10 %		

LEARNING UNIT 3: SAWING TIMBER

3.1 Wood processing

The timber industry consists of three main areas:

- Forestry (management, maintenance, production) and forestry ;
- Primary processing including sawmills, manufacture of veneers, panels, plywood, wood pulpand paper ;
- Secondary and tertiary processing, characterized by various activities:
  - ✓ Industrial production (furniture, carpentry, packaging,...)
  - ✓ Construction, building works and fittings (carpentry, frameworks) and civil engineering ;
  - ✓ Finished products (flooring, decking, cladding,)

3.1.1 Round wood products

	Coniferous woods mainly, can – after appropriate treatment – be used in the state or with little transformation (pointing, preservation treatment) for common uses such as: ○ Vineyard stakes, ○ Telephone or electrical line poles, ○ Fence stakes, ○ Outdoor games, and ○ Riding bars, instead of temperate and tropical hardwoods which naturally more resistant, that are primarily intended for hydraulic or maritime works.

3.1.2 Sawing and products

Sawing is the operation of cutting a log into boards of varying sizes according to their future use.

➢ Band saw

A quite slow sawing method permitting the sawyer to be in a position to control operations at any time according to the log conformation, hidden defects or products specifications.

Particularly suitable for sawing hard and tropical woods of large diameters and operations where quality prevails over yield.

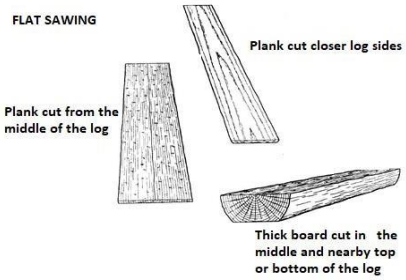
Band saws can be vertical or horizontal.

➢ Flat sawing

Flat sawing (also called plain sawing, tangent sawing) is the most common and least expensive method of sawing.

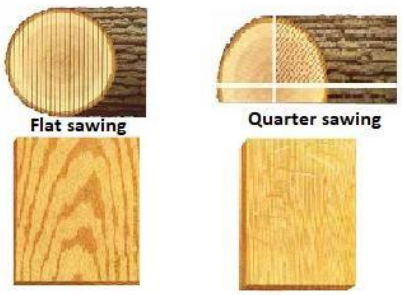
Lumber can be flat-cut produced over a single saw passing the log back and forth or more quickly with a side-by-side set of mechanical saws. Orientation of the log and direction of the blade do not change. Depending on the chosen sawing thickness, the cutting is made from top to bottom, with minimal waste of material.

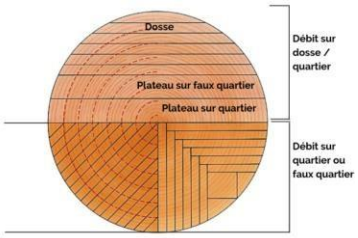
Flat sawn wood is vulnerable to deformation as it dries, or if later exposed to moisture; it is less stable than quarter sawn wood.

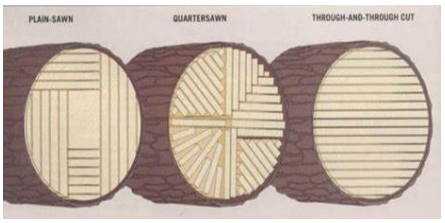


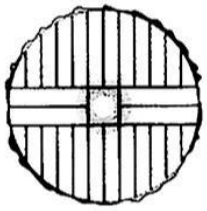
➢ Quarter sawing

The first cut to do is lengthwise. After that, both half of the cut wood are cut again in order to make two quarters. From these two quarters, the needed material on requested thickness is produced. Quarter sawn woods have two distinct advantages: the shrinkage is less noticeable and even when it is moist; it is not prone to warping. This method of sawing is more expensive compared with plain sawn wood though, but due to its cleaner cut, it has better design value overall.









In some countries and particularly in the United States, logs are cut in a concern of performance rather than aesthetics. The method used is often called tangential sawing because each of the cuts forms a tangent with one of the annual rings of the tree.

Pieces of wood shaped in this way often have a large volume of sapwood on one side.

➢ Industrial sawing by canter



Scierie Garmier, France

Especially adapted for softwoods sawing, this method of sawing is based on yield and low cost sawing. Electronic, electrical and mechanical equipment allow sawing performances from several hundred to several thousand cubic meters per day.

➢ Mobile saws

Mobile saws are adapted to work in many different conditions, as well in forest as on industrial yards, as well for private than industrial needs through vertical or horizontal band saws or circular saws.

Mobile horizontal band saw

Mobile double circular saw blades

3.1.3 Peeling

Peeling consists of unrolling a log into a continuous thin sheet of wood, intended for the panels manufacture or for packaging boxes.

For the panels industry, the unrolled veneers are cut into rectangular sections and then, after gluing, stacked in folds superimposed on top of each other and forming plywood.

A distinction is made between MR (Moisture Resistant) interior plywood bonded with non-moisture resistant glue (urea-phormol glue) and WBP (Water Boiled Proof) or CTBX bonded with moisture- resistant glue (phenolic glue).

Plywood panels can be covered on one or two sides by coatings such as impregnated paper, plastic. The slated panels are made of folds on both sides and slats inside.

The required humidity rate is 10% (+/- 2)

Current sizes of dried sheets are 257/127, 257/158, 257/175, 317/158, 317/188 cm (but they may vary depending on industrials and industrial production lines.

Allowance in thickness varies from 0.05 up to 0.1 mm.



Main defects:

- Difference in length between the diagonals of the sheet
- Scratches, furrows appearing on the surface of the sheets, caused by one or more breaches of the knife; the defect is allowed if after surfacing, the nominal thickness is not reduced
- soiling is allowed insofar as it can be recovered by sanding or scraping while maintaining the nominal thickness
- Thickness difference, due to improper settings of the pressure bar, is not allowed
- Holes due to improper treatment of preservation are not allowed

It is recommended to pack the veneers in one or more sheets of transparent or opaque plastic.

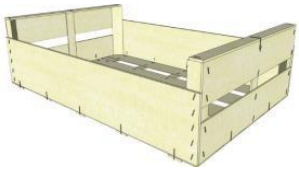
Veneers must be protected from strip by the use of angles.

Depending on the countries of export and import (or transit), the treatment of packaging in accordance with ISPM 15 is mandatory.

Whatever the regulatory obligation, it is advisable to treat pallets wood against fungal and zoological attacks, because they represent a real risk of contamination of veneers.

Rotary veneers billing unit is the cubic meter (m^3).

For the packaging industry, the sheets are used in their full dimensions to produce crates or lightweight packaging.



3.1.4 Slicing

During this operation, logs of high quality are squared and cut using an animated knife, to produce thin sheets of sliced veneers, thickener ranging from one tenth of a millimeter (1/10 mm) to some millimeters (usually 6 to 7 tenths of a millimeter – 6/10, 7/10 mm) commonly used in ornamental veneers after gluing on various supports (plywood panels, fiberboard panels.

Sliced veneers are intended for decoration, furniture, parquet flooring, boating, industrial carpentry and industrial or decorative paneling.

- General humidity rate: 10% (+/-2)
- Recommended over length (current use): 5 cm
- Current lengths are 2.10 m – 2.45 m 2,55 m – 2,80 m 3,10 m – 3,40 m
- Current width generally 10 cm/+ (depending on logs diameter)
- Allowance in thickness: +/- 5/100 mm

Main defects:

- Scratches, furrows appearing on the surface of the sheets, caused by one or more breaches of the knife; the defect is allowed if after surfacing, the nominal thickness is not reduced
- soiling is allowed insofar as it can be recovered by sanding or scraping while maintaining the nominal thickness
- Metal oxidation is not acceptable for decorative uses, except in the case where it disappears by sanding

Veneer sheets consist of bundles of 24, 32 or 40 sheets on a pallet handling. The assembly must be wrapped in an opaque sheet of plastic and all placed in a container or in a crate as for unrolled veneers.

In the case of packaging of veneers in crates, the latter must not exceed 10 cm of the length of the veneers and 10 cm of the width of the veneers.

Depending on the countries of export and import (or transit), the treatment of packaging in accordance with ISPM 15 is mandatory.

Whatever the regulatory obligation, it is advisable to treat pallets wood against fungal and zoological attacks, because they represent a real risk of contamination of veneers.

Sliced veneers billing unit is the square meter (m^2).

3.1.5 Industrial products - Panels

Small logs, crowns and branches of both deciduous and coniferous trees are recovered and marketed as crushing wood. Added to the waste of primary processing, these woods are oriented to five main sectors:

➢ Fibreboards:

Panels made with lignocellulosic fibres whose primary cohesion results from the felting of fibres and their own adhesive properties; binders and adhesives can be incorporated into them. These panels can be obtained wet or dry treatment.

By wet treatment, wood fibres are first separated from one another and then placed in a tank of water on the bottom of which they settle and felt. This fibre mattress is then pressed and dried to obtain either a hard panel, smooth on one side and meshed on the other for decorative use or in flat door veneer, a soft panel with two felted faces, because less pressed, and used as insulation.

By dry treatment, fibres are deliberated then dried and mixed with a binder and finally pressed to obtain the MDF panel (Medium Density Fibreboard) used in carpentry and furniture.

➢ Particleboards:

Material made under pressure, mainly from wood particles or other lignocellulosic fibrous materials, with or without the addition of binder, it is often called chipboard.

Woods are crushed into particles, sorted, dried then coated with glue and pressed to obtain a flat surface.

➢ Other panels:

- **Oriented Strand Board (OSB),** mechanically superior to the classic chipboards, they are used in construction, decoration, furnishing, packaging.
- **Laminate panels,** consisting of several layers of Kraft paper impregnated withresin and polymerized to high temperature, often used as a coating for other panels.

- **Wood-cement particleboard**s consist of a mixture of wood particles bondedwith cement. They are used in construction and as fire protection.
- **Fibragglo panels**, mixtures of wool, coniferous wood and cement, are used insound and thermal insulation or in fire insulation.
- **Glulam panels**, composed of wood slats glued to edges, are used in interiordesign, carpentry and furnishings.
- **Bakelite panels** are superposition wood veneers and impregnated withresin; resistant to wear and impact, they serve for chemical uses or in insulation electrical.
- **Laminated Veneer Lumber (LVL)** and Parallam panels consist of strips of veneers unrolled, joined and glued on wire. They are used in carpentry andconstruction

3.1.6 Industrial products - Pulp and paper

Paper is made from pulp in pulp mills. The pulp is composed of cellulose fibers extracted from wood. The paper manufacturer then buys it, refines it and threshes the fibers. Then the paper itself is machined and wound on huge reels.

3.1.7 Wood chemistry

Some species are distilled in order to extract alkaloids used in perfumery, cosmetology,... when others are processed into flours and used in the food industry or chemically transformed for manufacture of plastics, textiles,...

Assessment

Question1
What are the main kinds of timber processing?

Question2
What kind of timber processing can you find in Rwanda?

Question3
What kind of sawing is the most valuable?

Question4
What are its advantages and disadvantages?

Question5
What is the most current kind of sawing?

Question6
Are peeling and slicing a good alternative to rough sawn timber use? Why?

Question7
Are peeling and slicing interesting for the furniture production? Why?

Possible responses assessment

Question 1
Round wood, sawing, peeling, slicing

Question 2
Round wood, sawn timber, rotary veneers, sliced veneers, sawn veneers

Question 3
Quarter sawn is the most valuable and the one ensuring the best timber quality

Question 4
Valuable and ensuring the best sawn timber quality, its disadvantage consists in slow and expensive sawing

Question 5
The most current kind of sawing is flat sawing

Question 6
Of course, it allows using high grade in small quantities mixed with low quality timber, providing (visually) high grade products for multiple uses at one attractive price.

Question 7
Yes, even if the products resistance is not the same, they allow visual high grade and customized products which could not be produced with rough sawn timber or only at a very expensive price commercially inaccessible except in small number of privileged people

3.1.8 Drying

The principle of a drying system is to accelerate the evaporation of water by heating or mechanical aeration of wood. During the process, humidity and temperature are carefully controlled to avoid creating damage to the wood.

Artificial drying is a complex procedure because wood is naturally a thermal insulator and, depending on the timber species and size, heat is not transfer in the same way or at the same speed into the wood. Artificial drying thus presents risks if it is not correctly conducted: in case of too brutal drying, the external parts of the wood dry significantly faster than its central parts.

The shrinkage, which is then not identical everywhere, can create constraints manifested by twists, cups, splits or other damages).

Three basic directions of the wood must be considered:

- The axial or longitudinal direction, is the direction of fibers, therefore of the tree axis
- The tangential direction is the one that is tangential to the growth rings
- The radial direction is the one of the woody rays, perpendicular to the tangential direction.

3.1.9 Drying and shrinkage

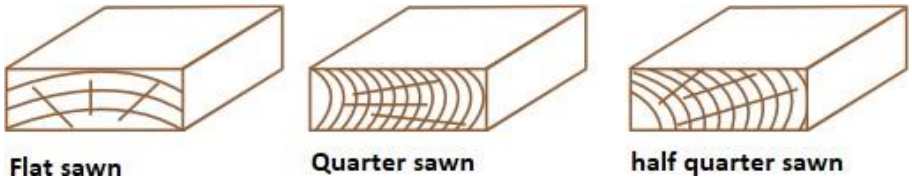
Axial shrinkage, very low, since 20 to 25 times lower than radial shrinkage, is negligible. Radial shrinkage is about half as low as tangential shrinkage

Tangential shrinkage is the largest and the most penalizing of the three kinds of shrinkage.

In practice, the total volume loss is considered the sum of tangential and radial shrinkage, axial shrinkage being considered negligible.

Overall, softwoods show a shrinkage that can be described as medium to moderate compared to common leafy species.

Due to the shrinkage differences between the Wood directions, its calculation in width or thickness depends on the mode of sawing. Flat sawn timber will shrink more in width than quarter sawn timber.

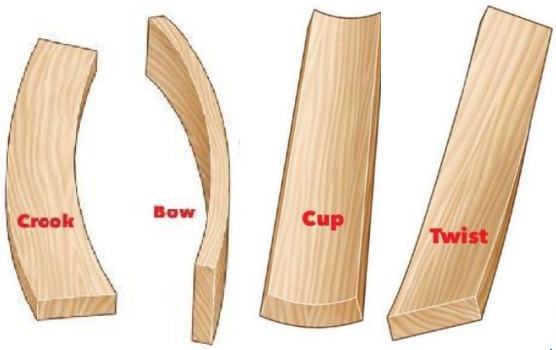


3.1.10 Deformations

Since the shrinkage is not the same in the different directions, the loss of wood volume can be accompanied of deformations, even if the drying was carried out with the utmost care.

Deformations are not caused but just revealed by the drying process

- The most penalizing deformation is Twist: the defect will never disappear.
- The most common deformation found on boards is the cup (or tile) : appearing on wide boards, it can be corrected by sawing the boards in two narrower boards.
- Face bending (bow) and side bending (crook) are rarely important; they can be corrected or reduced by sawing the board in shorter lengths.



LEARNING UNIT 4: SORT SAWN TIMBER

4.1 Sawn timber and sawn timber grading

There are several kinds of sawn timber:

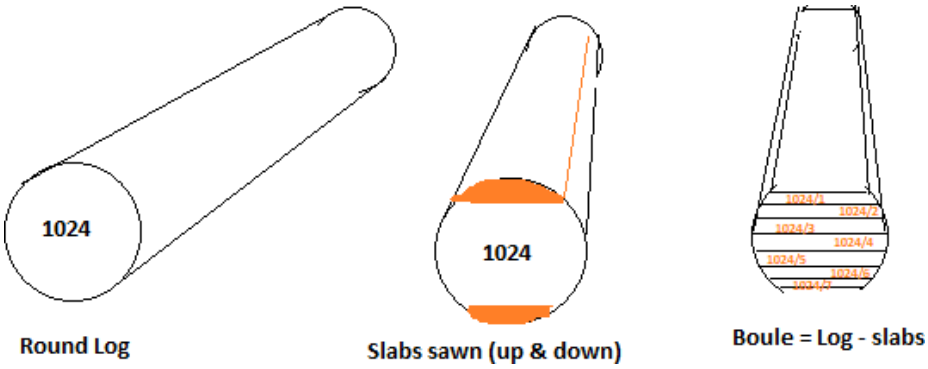
- Boules are composed of boards of a same thickness sawn in one log and where the log is reconstituted accepted both slabs.
- Unedged boards and mismatched boards are produced from boules sawing.
- Industrial square sawn timber produces parallel square sawn and non-parallel square sawn timber.
- Square edged sawn timber requires parallel sides and squared edges.

4.1.1 Boules and Unedged boards

4.1.1. Boules

Are composed of planks reconstituting the log except both superior and inferior slabs

- All defects are allowed ; they are deducted of each board volume
- Each board length is measured in full covered decimeter
- Each board width is measured at the thinner place, from mid wane to mid wane
- Each board thickness is measured at the thinner place
- The boule volume is the addition of each board volume
- Each board must notify the boule number and the board number (850/1, 850/2, ...



Round Log Slabs sawn (up & down) Boule = Log - slabs

➢ Unedged sawn timbers

Are boards sawn horizontally one by one out of a log without re-sawing their both sides to obtain squareedged sawn timber.

They are boards of variable width, with all defects present on the log, bark, wane, sap, knots, splits, curvature, …..

4.1.2 Square edged sawn timber

Square edged lumber can be of squared or rectangular section, both faces and sides parallel sawn

- They are packed in bundles of same thickness and of same length ; width can be fix or vary (all widths)
- Several grading rules exist but ATIBT recognizes the SATA rules as guide line in case of claim and no contractual quality specification.
- SATA rules specifies four (4) grades, but 1st and 2nd are exportable ; many contracts require FAS quality (what means mixed 1st and 2nd grades) but the percentage of each grade should be specified (normally mini 40% 1st & maxi 60% 2nd)

- The volume calculation formula for one piece of wood is

Length (m) x Width (m) x Thickness (m)

4.1.3 Measurement

Board volume is calculated as follows: **V = L x w x Th**

Where:

- **L** is the Length in meter, rounded at covered decimeter (3.40 up to 3.49 m = 3.40 m)
- **W** is the width in meter, rounded at covered centimeter (33.0 up to 33.9 = 33 cm = 0.33 m)
- **Th** is the thickness in meter, rounded at covered millimeter (27.0 up to 27.9 mm = 27 mm = 0.027 m)

One board measuring 3.47 m in length, 28 cm in width and 36 mm in thickness will have the following volume: **3.40 x 0.28 x 0.036 = 0.034m^3** (exactly 0.034272, but the volume is rounded after 3 decimals).

The length is the smaller distance between both ends of the plank.

The width is the smallest distance between both sides of the board; it must be controlled in several places and at least at 15 - 20 cm of each ends.

The thickness is the smallest distance between both faces of the board; it must be controlled in several places and at least at 15 - 20 cm of both ends.

➢ Thickness standards:

mm 19 – 22 – 25 – 32 – 38 – 44 – 50 – 57 – 63 – 75 – 100. In regard to exportations all over the world, they may vary following different destinations.

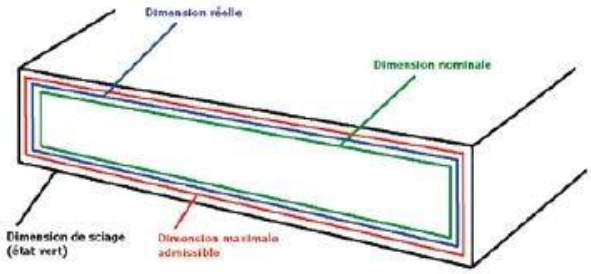
The contractual thickness is the only one to be respected. It can be determined for fresh sawing and in this case, the contract will require for example mm 63 (+5). That means that the logs being sawn fresh, the sawn timber should be measured at least 68 to allow thickness reduction during the drying operations or natural drying and ensuring the client to be in a position to reach the final thickness after drying and surfacing operations.

Nevertheless, during inspection operations, 63 up to 69 mm will be accepted (only a small percentage of thickness 63 or 64 mm).

In case of sawing an inferior thickness, the client can refuse the products or accept to receive them at the inferior thickness (that can represent an important loss for the seller) or at lower price.

In case of superior sawing (for example 70 mm instead of 63-66 mm), the client will generally claim (or even refuse the products) because to reach the final thickness after drying and surfacing, he could be obliged to surface twice the timber, what means additional costs for him.

The thickness at the moment of timber inspection must correspond to one timber moisture of 20%. If the timber is already dried, or has moisture inferior to 20%, the thickness could be a few lower than the contractual thickness, considering that the timber has already dried and will not retract more or too much.



This drawing here above shows the different sizes:

- Sawing size (in black)
- Maximal size allowed (in red)
- Real size (in blue grey)
- Nominal size (or contractual size (in green)

That shows that fresh timber is sawn at sizes superior at the maximal allowed size, knowing that between the time of sawing and the moment of inspection, the timber will dry and its sizes will reduce.

The maximal sizes are superior to the real size to cover sizes reduction during drying.

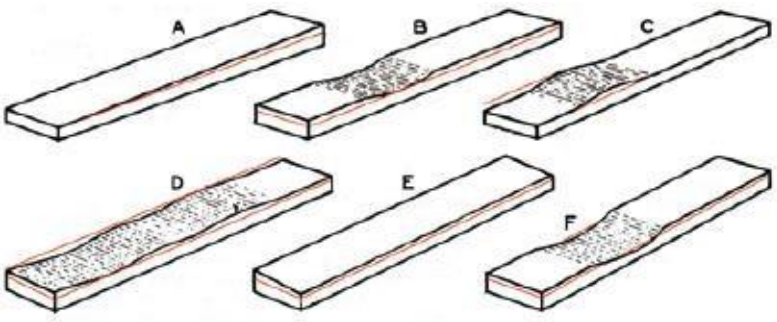
And the real size must be superior to the nominal or contractual size, to ensure the client to reach his final size after drying and surfacing.

4.1.4 Oversizes

Current requested oversizes are:

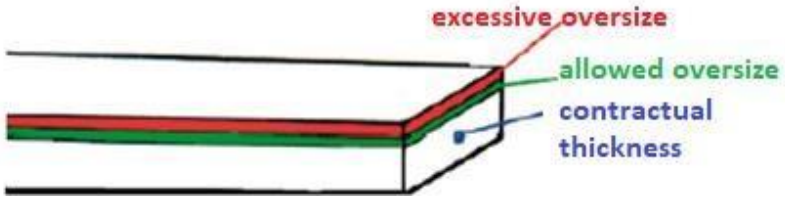
- In thickness,
  - ✓ From 16 mm to 25 mm + 3 mm
  - ✓ From 32 mm to 50 mm + 4 mm
  - ✓ From 57 to 63 mm (more really up to 75 and even 100 mm) + 5 mm
  - ✓ From 75 to 100 mm + 6/7 mm
- In width + 5 mm
- In length + 50 mm

➢ **Thickness oversizes**

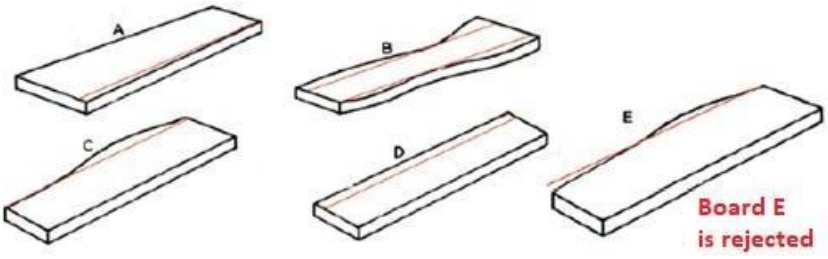


Planks A – B – C – D – E can be allowed if the oversize does not exceed the maximum oversize allowed.

Plank F, not reaching the nominal (contractual) thickness, cannot be allowed and will be rejected. Summarize of different oversizes in thickness:

• Excessive oversize considered as defect • Allowed oversize • Nominal or contractual size	

➢ Width oversizes

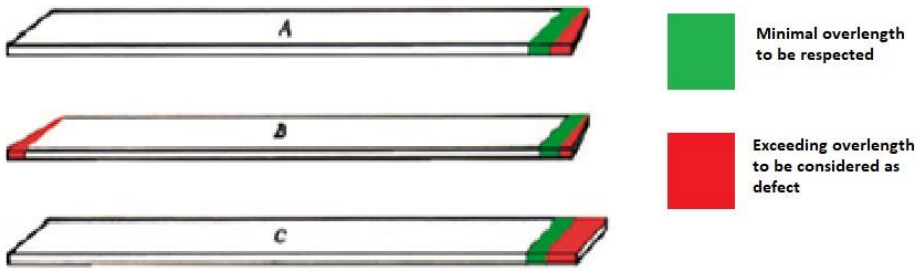


Planks A – B – C – D – E are acceptable but the plank E will be rejected. The standard allowed width oversize is 5 mm.

Calculation of an average width (over whole bundle) is :

$$\frac{\text{Total width (of all pieces)}}{\text{Total number of pieces of the bundle}}$$

➢ Length oversizes

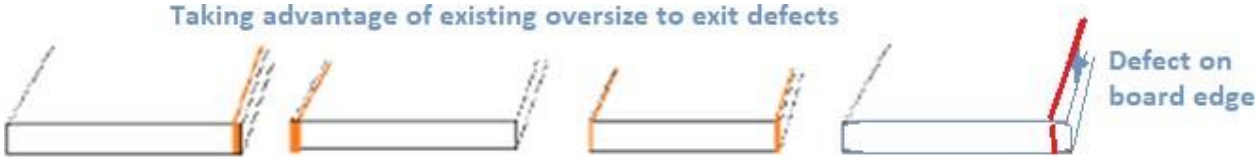


The standard allowed length oversize is 50 mm and the maximal allowed length oversize is 70 mm. Calculation of an average length (over whole bundle) will be:

$$\frac{\text{Total length (of all pieces)}}{\text{Total number of pieces of the bundle}}$$

Remark:

Any defect appearing entirely in the oversizes only, cannot be considered.



And in case of oversize, this one can be considered as well on the left or the right side or even partially on both sides, permitting to allow or reduce some defects.

Activity 4.1.4

Question 1
What is the difference between reconstituted log and boule?

Question 2
How is their volume calculated?

Question 3
What is the difference between mismatched boards and boules?

Question 4
What is the difference between square sawn timber and square edged sawn timber?

Question 5
How is their volume calculation?

Question 6
What are oversizes? Why are they requested?

Question 7
This board sizes are: mm 3875 in length, mm 179 in width and mm 67 in thickness. What are the contractual sizes?

Question 8
One dead knot of 22 mm diameter appears on one side: what will be the longest acceptable length of this board? May that board be accepted or not? Why?

Possible solutions to activity 4.1.4

Question 1
They are both sawn in boards but the slabs are included in the reconstituted log volume

Question 2
Boule: each board is individually measured and the total volume is the total board volume while the reconstituted log volume is the same as the log one.

Question 3
Boule includes all boards of the boule sawn in one log; mismatched boards are issued from one boule, but all of them are not present, some have already been used or sold

Question 4
Square sawn timber can be parallel sawn or not; squared sawn timber is parallel sawn only

Question 5
Volume calculation in both cases: Length (m) x width (m) x thickness
The width of non-parallel square sawn timber is measured at the narrowest place and the thickness at the thinnest place.
Square edged sawn timber must be sawn at precise width and thickness (generally defined by contract) which must be respected in all places of the board; if not, the narrowest width and/or thinnest thickness are used for the volume calculation or the wood pieces are rejected

Question 6

Oversizes consist in added some mm in length, width and thickness to prevent the timber shrinkage when drying and guarantee to the client the contracted sizes respect.

Question 7

a). Contractual sizes of the board should be mm 63*175*3200-3700 mm (3.20 - 3.70 m)

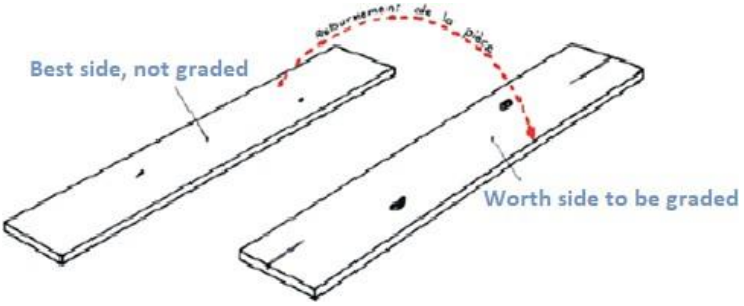
The acceptable length may vary from 3.20 m up to 3.70 m but the nominal length should be defined by contract.

b). The longest acceptable length of this board is 3.50 m (3.75 – 0.22 = 3.53 m)

If the dead knot is present inside the over length, the piece of wood will not be rejected, so from 3.20 m up to 3.50 m, this board is acceptable; if its length is 3.60m or 3.70m, it must be rejected.

4.1.5 Grading

Grading is done by inspecting the worth face of the sawn timber in a majority of cases. Nevertheless, in some rare cases, for some particular or high value species, it is possible to meet rules allowing grading on the best side.



Planks must be looked on both sides before choosing the grading side.

Different rules are managing grading and we will consider in this case a summarized grading considering 3 kinds of grades:

- High grade free of any defect or presenting small defects
- Standard grade presenting allowed defects
- Low grade to be rejected, presenting unacceptable defects.

➢ High grade (Best, including 1st and 1bis

Presenting no defect (1st) or small defects (1bis) as

- small splits in ends appearing one side only
- small sound knots (less 10 mm diameter) appearing only one side

- small pin holes appearing one side only

➢ Standard grade (Fair)

Presenting allowed defects as

- splits in ends, less than 5% of the length, appearing or not on both sides
- sound knots less than 50 mm diameter, appearing or not on both sides
- Small bark pocket in size less than 3% of length and less than 3 % of width, not appearing on both sides
- pin holes appearing on both sides or numerous (no important concentration) pin holes
- small surface of discoloration (blue stain)
- small touch of sap wood, appearing on 1 side only, less than 10% (1/10) of length, less than 20% (1/5) of width and less than 30% (1/3) of thickness.
- small touch of Unedged timber, appearing on 1 edge only, less than 10% (1/10) of length, less than 20% (1/5) of width and less than 30% (1/3) of thickness.
- Small sun cracks disappearing after surfacing

➢ Low grade (Reject)

- Decay and/or rot heart
- Bark pocket exceeding 3% of length and width in size and/or appearing on both sides
- Dead or unsound knots
- Sound knots exceeding 50 mm diameter
- Borer holes
- Important discoloration or blue stain
- End splits exceeding 5% of length and/or appearing on both sides
- Splits appearing elsewhere than in ends (faces or sides)
- Important sun cracks not disappearing after surfacing (3 mm/+)
- Important sap wood
- Important Unedged timber
- Heart timber
- Breaks, wind breaks

4.1.6 Sawing defects

If some of them can be caused by a poor timber quality, sawing defects can be easily avoided through conscientious and quality sawing. They are allowed under conditions.

The top four ones are due to poor machine settings, while the bottom four are due to little conscientious work.

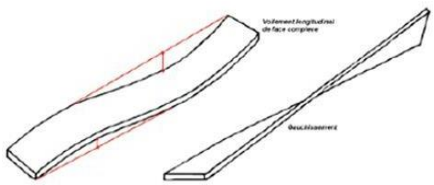
➢ Defects allowed under condition

How to correct those defects:

Wane	Reduce the board length
Irregular width	Correct tension of the saw blade
Tile	Exclude heart by sawing the board in 2 lower width boards
Face bending	Reduce the board length
Side bending	Reduce the board length
Irregular thickness	Correct tension of the saw blade
Corrugated sawing	Correct sharpening of the saw blade
Irregular sawing in end	Correct tension of the saw blade

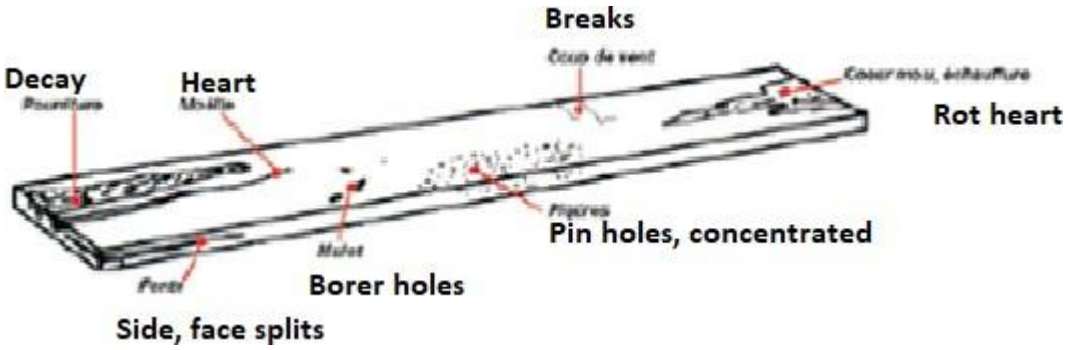
Those defects can be allowed if their incidence on final use is not too important.

➢ Sawn timber drying defects



Warp is due to combination between fast drying and low quality of nervous timber.

➢ Sawn timber prohibited defects



Remark:

Any defect appearing entirely in the oversizes only, cannot be considered.

And in case of oversize, this one can be considered as well on the left or the right side or even partially on both sides, to allow or reduce some defects.

4.1.7 Grading lots of sawn timber

Evaluating lots requires being able to grade individually a percentage of the sawn timber bundles and adapt the ratio to the whole parcel. That means that the inspector has visually ensured that such ratio is correct.

Sawn timber parcels are adapted to clients' requests and needs : while big industries request high grade because they cannot waste time to correct timber of medium or law quality and need timber 'ready to use', small or medium companies prefer obtaining a fair price and spend some time to rework timber.

In countries as China, where labour costs are cheap, buyers do not request high quality timber, preferring allowing low quality to obtain low costs.

In Europe and USA, FAS grade is the most requested grade. FAS means 'First and Second', where 1st grade should represent minimum 60% of the parcel volume, and the second grade should not exceed a maximum of 40% of the parcel volume.

Those percentages are not really respected, often by mutual agreement; anyway, buyers and sellers can allow any grading conditions by contract.

For China and other Asian countries (or other countries where the way of life is quite cheap), the random quality is saw falling, allowing almost all defects (except the more penalizing ones, generating volume loss) at the condition the price is low.

Grading FAS grade lots is made in regard of buyer's requirements:

- By total inspection, where 100% of the timber will be inspected
- Or partial inspection where a minimal percentage to inspect is defined (generally around 25% of the parcel) and the result is applied to the whole parcel quantity).

During 'free inspection', if the quality of the first inspection batch is really bad, the inspector can decide to inspect more volume.

Saw falling grade means accepting timber as it is just after sawing; but this intends that logs have been correctly prepared to avoid big splits, decay, rot heart and other penalizing big defects.

Port of Douala, sawn timber for export

During a partial inspection, the inspector chooses for himself the bundles he wishes to inspect and is not obliged to accept those presented by the seller. It is not rare that sellers may invoke a lot of reasons for not submitting to the inspector's request to present some bundles. The lowest quality if there any, is generally stored in bundles that are difficult to access.

4.1.8 Timber defects and their incidence

➢ Structure defects

Bark pocket is a piece of bark included in the timber. It can be allowed if very small and appearing one side only. In other cases, the piece is rejected.

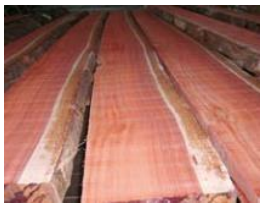
Dead knots are not allowed.

Pin knots (very small knots) and **wrinkly grain** (small oval cavity generating cracks at drying) are aesthetical defects few appreciated.

End splits are allowed under conditions; Face and side/edge splits are not allowed.

Ring shake are splits running on growth rings graded as face splits and hardlypenalized.

Sapwood – even when sound - is not allowed in 1st and 2nd grades.



Pith is the central part of the tree and should not be considered as defect, butits lack of consistency doesn't bring any advantage.

Breaks, wind breaks, are compression breaks appearing in old trees. Very difficult to spot, they appear perpendicular to the piece axle, making sawn timber easy to break. Their presence gets the timber rejected.

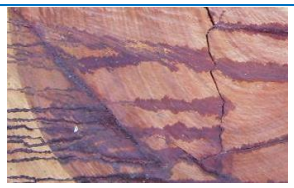
Torse grain and **twist grain** make the timber very difficult to work, dry and use. Not a sign of good quality, such defects are rarely penalized as they should be.

➢ Adulterations

This name is used as soon as the physical, mechanical or chemical composition of the wood is modified by the action of an external agent.

Worm holes, pin holes also called **shot holes** when they are grouped, are due to insects attacks; the black coloured galleries (1 – 2 mm) areinactive.	
Active worm, due to insect presence and activity, is found in sapwood and/or white wood. Thin galleries (0.5 – 1 mm) are not black coloured and it is advisable to get rid of the whole timber batch to avoid any risk of contamination.	
Borer holes are due to insect attacks for long time, in the sapwood (but they can be found later in heartwood after duramenization). Galleries size is important (5 – 10 mm).	
Fungi grow on timber altering neither its chemical composition nor mechanical properties. If they only attack redwoods sap, they affect whitewoods entirely. Blue stain is an aesthetical defect depreciating timber.	

➢ Other defects

Mold, due to an improper storage because Ineffective sticks, too small or absent, can generate rot.	
Discoloration cannot be graded but its presence must be the subject of a negotiation between seller and buyer.	
Resin and latex pockets are the trees wound healing products. Considered to be inherent in the wood specie, they are not graded.	

EXERCISES 4.1.8

Question 1
What is the difference between reconstituted log and boule?

Question 2
Generally which side of the boards is graded?

Question 3
Sawing defects are they allowed, allowed under conditions or prohibited? Q3: Drying defects are not very important, yes or no?

Question 4
Splits and knots are prohibited defects, yes or no? Q5: Can you find borer holes in red woods heartwood? Q6: What is the difference between splits and breaks?

Question 5
What are the most penalizing defects?

Possible solutions to exercises 4.1.8

Question 1
They are both sawn in boards but the slabs are included in the reconstituted log volume

Question 1
The north side of the planks is generally graded

Question 1
They are allowed under conditions.

Question 1
Drying defects can be very important and prohibited; Warp is immediately rejected

Question 1
Splits and knots are generally allowed or allowed under conditions in the superior grades

Question 1
Yes, because the timber had been attacked when the tree was young and the attacked part was still sapwood. Borer attack only sapwood, but when the tree grows, sap is duramenized year by year a borer holes are found in the coloured heartwood.

Question 1
Splits are defects appearing naturally after felling and after sawing, when the wood is drying; they are arranged longitudinally, following the direction of the timber grain. Breaks are not 'natural' defects; they are caused by the wind and storms shaking trees and getting them breaking perpendicular at the sense of the timber grain, as the rays.

Question 1
The most penalizing defects are ring shakes, breaks, warp.

LEARNING UNIT 5: TIMBER TRADE & WOOD IDENTIFICATION

5.1 Timber trade

5.1.1 When using local or imported timber

➢ Difference between tropical and temperate timber

If tropical woods can a priori be considered to be on the whole harder and more resistant than temperate woods, both must be considered in the same way, i.e. for their use in the best conditions according to their properties and the targeted market.

It is more rational to use wood of lower quality and prices for common uses, which are intended for mass markets, while species of higher standing will be reserved for higher value targeted uses, making possible to the finished product price according to the raw material purchase price.

Thus, pines whose price is one of the most attractive on the markets, is highly sought after for common uses and markets where price is the main factor.

Conversely, Libuyu - as an example -, wood imported from the DRC whose price is much higher than local timbers, will be reserved for more noble uses targeting a clientele able of being interested in this type of product (solid wood or veneers for high-end furnishings, custom-made creations, etc. ...)

In the same vein, Tali– much harder and more difficult to saw – will be rather used for appropriate uses to its hardness and resistance (parquet, decking, cladding ...) and not instead of Libuyu to produce furniture.

Species	Prices	Uses
Eucalyptus	Medium to low	Furniture, flooring, decking, construction
Pine	Low	Construction, low cost furniture, boxes, pallets
Cypress	Medium to low	Carpentry, furniture
Grevillea	Low	Coffers, furniture elements, boxes, construction
Cedrella	Medium	Furniture, veneers, joinery, panels (high standing)
Acacia	Medium	Furniture, joinery, decking , flooring

Teak	Medium to high	Furniture, joinery, decking , flooring
Sapelli, Sipo, Mahogany	High	Furniture, veneers, joinery (high standing)
Kosipo, Bosse, Tiama	Medium to high	Furniture, joinery
Iroko	High	Furniture, flooring, joinery (high standing)
Tali	High	Flooring, decking, construction (high standing)
Afrormosia	High	Flooring, decking, veneers, joinery (high standing)

Looking at such table, it is clear that Pine, Cypress, Eucalyptus and Grevillea are much more requested than tropical timbers imported from DRC because the purchasing power of the majority of local people does not allow them to buy high prices products.

Cedrella which is a local species convenient for valuable uses is particularly appreciated.

Teak imported from Tanzania should be an excellent option at the condition that the import price is reasonable.

All this means that if the demand for Eucalyptus, Pine, Cypress, Grevillea and Cedrella is staying atthe same level (or increasing), the pressure on the local forests cannot be reduced, which may getcomplicated the reforestation programmes

➢ Why choosing local or imported timber?

For quality applications, creating real added value, it is obvious that tropical woods, with their multiple colours and responding to different resistance classes have advantages.

For outdoor uses (decking, flooring, cladding) requiring perfect resistance professionals will turn to Afrormosia, Tali, and Limbali.

For the furniture industry, if Iroko, Afrormosia are perfectly suited, it is necessary to open a parenthesis concerning the specie called ‘Libuyu’, widely present on the Rwandan market.

Tropical woods and temperate woods, must be considered complementary: it is really possible and mainly interesting to use woods of lower quality and low prices to make interiors (doors, panels) and cover them with a more noble, more resistant veneer, in order to produce aesthetically more refined achievements, whose selling price will be much more attractive than using only solid wood.

This approach offers many advantages:

- Diversification of production
- New opportunities
- Direct impact on the forest by reducing the volume of high-value wood used
- While offering the opportunity to market them more to a greater number of prospects invarious forms
- Placing on the market wood products of better structure at more advantageous prices
- This translates into the promotion of wood products and forest development
- Better use of local timbers (less sorting and less loss)
- Valorization of local timbers
- Overall reduction of pressure on some species to the benefit of all of them

A. Libuyu, a special case

The name 'Libuyu' concerns several different and mixed species of the Meliaceae family, imported from the DRC and where are present:

- Entandrophragma cylindricum (Sapelli)
- Entandrophragma utile (Sipo)
- Entandrophragma candollei (Kosipo)
- Entandrophragma angolense/congoense (Tiama)
- Entandrophragma excelsum
- Guarea cedrata (Bosse)
- Kahya ivorensis/spp (Mahogany)

Some of those species, very well-known and reputed on the international market, are negotiated at high prices (Sapelli, Sipo), while other ones as Kosipo, Tiama, Bosse, Mahogany are well known but don’t have the same appeal and whose prices are lower.

On the other hand, Entandrophragma excelsum whose quality is inferior to that of other species, is neither known nor reputable.

Such a mix of species is neither a sign of transparent trade and legality, nor a sign of quality for buyers.

Faced with such a case, Rwandan authorities and professionals must demand transparent relations and resort to species identification.

5.1.2 Legality

One very important subject is the timber legality.

Besides the fact that illegal timber is currently flooding markets, some species were over exploited, are endangered or even threatened with extinction.

Afrormosia (Pericopsis elata) is for a long time listed on CITES red list and subject to very strong harvesting and export requirements.

Logo de la CITES.

CITES, what means **Convention on International Trade of Endangered Species,** is also known as Washington Convention, an intergovernmental agreement signed on March 3, 1973 in Washington,D.C. The head Office is located in Geneva, Switzerland,

CITES must ensure that international trade in species listed in its Appendices, as well as parts and products thereof, does not undermine the conservation of biodiversity and is based on the sustainable use of wildlife.

To this end, CITES sets out a legal framework and procedures to ensure that wildlife in international trade is not overexploited. CITES periodically updates its international trade data on protected species and publishes them.

All species listed in CITES, as well as other species that the Community protects on its territory or whose flows it wishes to control, are listed in 4 EU Appendices A, B, C and D:

- Appendix A corresponds to Appendix I of CITES (endangered species), to which are added certain species to which the EU wishes to confer a higher protection status.
- Appendix B corresponds to CITES Appendix II species (species that could be listed in Appendix A, some CITES Appendix III species and some "non-CITES" species constituting ecological threats (so-called invasive species)
- Appendix C corresponds to the rest of CITES Appendix III (species that a country protects on its territory and for which it wishes the collaboration of other States to detect illegal exports)
- Appendix D consists of species that are not listed in CITES, but whose import volumes the EU considers to warrant surveillance.

DRC is listed in the countries using security stamps following notification 2020/037.

In 2017, DRC was subject to a mandatory verification of cutting permits : by decision SC66, the CITES committee required that importing countries not accept neither cutting permit nor CITES certificate issued by DRC for Pericopsis elata until they have been officially certified;

Taxon : Pericopsis elata (Plantae)

Id_WCMC : 18339
Classe : Sans classe (Plantae)
Ordre : Fabales
Famille : Leguminosae
Genre : Pericopsis

Nom FR : Afrormosia
Nom EN : Satinwood; African Teak; Yellow Satinwood
Nom ES : Afrormosia; Teca Africana

Aire de répartition :

Cameroun , Congo , Côte d'Ivoire , Ghana , Nigéria , République centrafricaine , République démocratique du Congo

Réglementation Cliquer ici pour consulter l'historique

ORIGINE	ANNEXE	DATE	NOTE
CITES	II	11/06/1992	Annotation #17 (remplace l'annotation #5) : les grumes, les bois sciés, les placages, les contreplaqués, le bois transformé. 26/11/2019
UE	B	01/06/1997	Annotation #17 (remplace l'annotation #5) : les grumes, les bois sciés, les placages, les contreplaqués, le bois transformé. Espèce parfois appelée à tord "teck d'Afrique"

01/12/2017	**RDC - Pericopsis elata - Vérification des permis obligatoire** La 69ème session du Comité permanent CITES (SC69, Genève, 27 novembre - 1er décembre 2017) a confirmé la décision du SC66 (janvier 2016) demandant que les pays importateurs n'acceptent aucun permis ou certificat CITES délivré par la RDC pour Pericopsis elata tant que l'authenticité de ce document n'a pas été confirmée par le Secrétariat CITES.	République démocratique du Congo

➢ Know more about CITES

At the time when the ideas for CITES were first formed, in the 1960s, international discussion of the regulation of wildlife trade for conservation purposes was something relatively new. With hindsight, the need for CITES is clear. Annually, international wildlife trade is estimated to be worth billions of dollars and to include hundreds of millions of plant and animal specimens. The trade is diverse, ranging from live animals and plants to a vast array of wildlife products derived from them, including food products, exotic leather goods, wooden musical instruments, timber, tourist curios and medicines. Levels of exploitation of some animal and plant species are high and the trade in them, together with other factors, such as habitat loss, is capable of heavily depleting their populations and even bringing some species close to extinction. Many wildlife species in trade are not endangered, but the existence of an agreement to ensure the sustainability of the trade is important in order to safeguard these resources for the future.

Because the trade in wild animals and plants crosses borders between countries, the effort to regulate it requires international cooperation to safeguard certain species from over-exploitation. CITES was conceived in the spirit of such cooperation. Today, it accords varying degrees of protection to more than 37,000 species of animals and plants, whether they are traded as live specimens, fur coats or dried herbs.

CITES is an international agreement to which States and regional economic integration organizations adhere voluntarily. States that have agreed to be bound by the Convention are known as Parties.

Although CITES is legally binding on the Parties – in other words they have to implement the Convention – it does not take the place of national laws. Rather it provides a framework to be respected by each Party, which has to adopt its own domestic legislation to ensure that CITES is implemented at the national level.

For many years CITES has been among the conservation agreements with the largest membership, with now 183 Parties.

➢ How does Cites work

CITES works by subjecting international trade in specimens of selected species to certain controls. All import, export, re-exports and introduction from the sea of species covered by the Convention has to be authorized through a licensing system. Each Party to the Convention must designate one or more Management Authorities in charge of administering that licensing system and one or more Scientific Authorities to advise them on the effects of trade on the status of the species.

The species covered by CITES are listed in three Appendices, according to the degree of protection they need.

Appendices I and II

Appendix I include species threatened with extinction. Trade in specimens of these species is permitted only in exceptional circumstances.

Appendix II includes species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival.

Appendix III

This Appendix contains species that are protected in at least one country, which has asked other CITES Parties for assistance in controlling the trade. Changes to Appendix III follow a distinct procedure from changes to Appendices I and II, as each Party's is entitled to make unilateral amendments to it.

A specimen of a CITES-listed species may be imported into or exported (or re-exported) from a State party to the Convention only if the appropriate document has been obtained and presented for clearance at the port of entry or exit. There is some variation of the requirements from one country to another and it is always necessary to check on the national laws that may be stricter, but the basic conditions that apply for Appendices I and II are described below.

Appendix-I specimens

An import permit issued by the Management Authority of the State of import is required. This may be issued only if the specimen is not to be used for primarily commercial purposes and if the import will be for purposes that are not detrimental to the survival of the species. In the case of a live animal or plant, the Scientific Authority must be satisfied that the proposed recipient is suitably equipped to house and care for it.

Exports permit or re-export certificate issued by the Management Authority of the State of export or re-export is also required.

An export permit may be issued only if the specimen was legally obtained; the trade will not be detrimental to the survival of the species; and an import permit has already been issued.

A re-export certificate may be issued only if the specimen was imported in accordance with the provisions of the Convention and, in the case of a live animal or plant, if an import permit has been issued.

In the case of a live animal or plant, it must be prepared and shipped to minimize any risk of injury, damage to health or cruel treatment.

Appendix-II specimens

Exports permit or re-export certificate issued by the Management Authority of the State of export or re-export is required.

An export permit may be issued only if the specimen was legally obtained and if the export will not be detrimental to the survival of the species.

A re-export certificate may be issued only if the specimen was imported in accordance with the Convention.

In the case of a live animal or plant, it must be prepared and shipped to minimize any risk of injury, damage to health or cruel treatment.

No import permit is needed unless required by national law.

Appendix-III specimens

In the case of trade from a State that included the species in Appendix III, an export permit issued by the Management Authority of that State is required. This may be issued only if the specimen was legally obtained and, in the case of a live animal or plant, if it will be prepared and shipped to minimize any risk of injury, damage to health or cruel treatment.

In the case of export from any other State, a certificate of origin issued by its Management Authority is required.

In the case of re-export, a re-export certificate issued by the State of re-export is required

Exemptions and special procedures

There are special rules in these cases and a permit or certificate will generally still be required. Anyone planning to import or export/re-export specimens of a CITES species should contact the national CITES Management Authorities of the countries of import and export/re-export for information on the rules that apply.

When a specimen of a CITES-listed species is transferred between a country that is a Party to CITES and a country that is not, the country that is a Party may accept documentation equivalent to the permits and certificates described above. (https://cites.org)

➢ Cites in Rwanda

Official name	Region	ISO 3166-2 code	Flag
Rwanda	Africa	RW	

Party status

Type	Party status	Date of joining	Entry into force
Party	Accession	20 October 1980	18 January 1981

MANAGEMENT AUTHORITIES

1. Rwanda Development Board / Tourism and Conservation

Telephone: +250 7 277 75 17, (local 1415)

Websites: http://www.rdb.rw

Email: info@rdb.rw

Mailing address
KG 220 St,
Gishushu,
PO BOX 6239 – Kigali

Last update: 17 October 2019

ENFORCEMENT FOCAL POINTS

1. Rwanda Development Board / Tourism and Conservation

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Websites: http://www.rwandatourism.com

Contact people: Dr Antoine Mudukikwa

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Corner Blvd de l'Umuganda (Airport road)
Nyarutarama Road
BP. 6239 - Gishushu
Kigali

Last update: 14 February 2014

SCIENTIFIC AUTHORITIES

1. Rwanda Development Board / Tourism and Conservation

Websites: (in English and French/en inglés y francés/en français et anglais)

Contact people: Dr Richard Muvunyi

Email: info@rdb.rw, richard.muvunyi@rdb.rw

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Kn 5 Rd, Kg 9 Ave,
Nyarutarama Road
PO.BOX 6239 - Gishushu
Kigali

Last update: 15 October 2019

(https://cites.org)

ACTIVITY 5.1.2

Question 1
What are the main Rwandan Wood species?

Question 3
Why purchasing Libuyu would be not recommended?

Question 4
What is CITES?

Question 5
Where appear the names of species under CITES trade control?

Question 5
How could you define 'a legal timber'?

Possible solutions to activity 5.1.2

Question 1
Eucalyptus, Pine, Cypress, Grevillea, Cedrella, Acacia

Question 2
Because Libuyu is not defining one species; that is a local name given to several species, many of which are similar.

Question 3
Cites means 'Convention on International Trade of Endangered Species. It is an intergovernmental agreement signed in 1973; its Head Office is located in Geneva, Switzerland. It controls endangered species trade and ensures that harvested and traded species are legally harvested under permits.

Question 4
In Appendix II

Question 5
Legal timber has been harvested with authorization of the country and the forests administration, certifying that it was cut legally, in legally harvested forests, by legal companies submitting to their legal obligations

5.1.3 Timber trade

➢ How to purchase?

Timber trading is a very specific profession that requires a lot of meticulousness and rigor, without forgetting to record the negotiations and strives to know and respect a minimum of rules for timber trading and grading.

Here below, the main tips to remember before opening the negotiations.

- Who is the seller?
- What is the required or offered species?
- What sizes are needed, for which use?
- What is the billing unit?
- What about the quality of offered timber? Does it match with intended use on the local market?
- What are the delays of delivery of the timber? Is it ready to be loaded or not?
- What about the price? Does it match with the local market?
- Who is in charge of transport? What will be the transport cost? With which incidence on the final price?
- What are the selling conditions?
- Is that timber legal or not?
- What about custom duties?
- What documents will be required? What documents can be really produced by the seller?
- What about inspection? Who will do it? When?
- What recourse in case of dispute?

In this way, drafting a contract containing all the details of the transaction and providing for a response to any possibility constitutes the trading basis.

Seller	complete name, adress, contacts, legal identification nr
Buyer	complete name, adress, contacts, legal identification nr
Specie	Pilot name + botanical name
Specifications	Kind of timber (logs, rough sawn timber, S4S timber, ...) Contractual sizes and allowed/requested oversizes
Quantity	Number of m3 or number of containers specifying approximative volume per ctr
Quality	Quality definition depending on reference grading rule or deal
Origin	Country of origin
Price	Per m3, per piece, per container..... specifying incoterms
Packing	break bulk (logs, boules), in bundles (sawn timber), ...
Shipment	Break bulk, containers,....
Delivery	Port and country of delivery
Delays of delivery	First shipment, total order
Port of shipment	In case of seafreight
Destination	Destination port, destination locality , ...
Markings	Requested markings if any
Insurance	Who will pay transport insurance ?
Inspection	If any requested, where, when, who ?
Payment	Payment terms
Documents	Requested documents
Claim	Clause in case of claim.....

Professionals never appreciate long and detailed contracts. Yet the realization of a contract is a very important thing - it is enough to refer to insurance contracts to be persuaded - never to neglect.

Never forget that the contract is the most important document studied in the event of a dispute.
It has priority over all grading rules and traditional uses that will be taken into account in the absence of a contractual specification.

➢ Example of contract

CONTRACT 201024/DAp/EWIC/Ca/01 **Date : October 24, 2020**

The present contract is subject to delivery by the Seller to the Buyer who accepts, of one parcel of Doussie sawn timber, delivered FOB Abidjan port (Ivory Coast).

Both parties signing this contract declare accepting all clauses without any reserve.

1	Seller	
2	Buyer	
3	Specie	Doussie (Afzelia bipendensis)
4	Specifications	Rough sawn timber Mm 63/75 (+5) * 150 (+5) Minimum 75% Mm 63 (+5) * 175/200 (+5) Maximum 25% Mm 63/75 (+5) 88/125 (+5) Maximum 10% (Recovery sizes) Lengths : 2.10m/up with minimum 40% of 4.00 m/up
5	Quantity	Three (3) containers load , about seventy-five cubic meters (+/- 75 m3) (*) (*) +/- 10%
6	Quality	FAS grade (ATIBT/SATA rules)
7	Origin	Ivory Coast
8	Price	In Euro per cubic meter delivered FOB Abidjan port Mm 63/75 (+5) * 150 (+5) €/m3 FOB Mm 63 (+5) * 175/200 (+5) €/m3 FOB Mm 63/75 (+5) * 88/125 (+5) €/m3 FOB
9	Packing	Export bundles, with 4 steel or plastic strips Each lay with sticks each 100 cm One (1) width, one(1) thickness per bundle One (1) length per bundle, except 1 or 2 bundles to complete the shipment.
10	Loading	In bulk or in containers
11	Delivery	FOB Abidjan port
12	Delay	Partial delivery allowed First shipment expected beginning of December 2020
13	Port of loading	Abidjan port (Ivory Coast)
14	Destination port	Anvers port, Belgium
15	Markings	Bundle nr - Contract nr – Specie – Dimensions – Number of pieces
16	Insurance	At charge of the Buyer
17	Inspection/Approval	Measurement and quality inspection by Richard Fays or SGS before shipment Measurement and quality approval by Richard Fays in case of claim (*) (*) voir 20 'Arbitrage de litige'
18	Payment	100% Cash At Documents in original, after shipment Seller's bank references: Buyer's bank references :
19	Documents	Signed commercial invoice in three (03) originals and three (03) copies Full set Bill of Lading 'clean on board' Packing list identifying : • specie(s), • bundles nr, sizes and volume • container(s) nr, seal(s) nr, weight of each filled container (*in case of shipment in container) • maritime company • vessel Certificate of origin Phytosanitary certificate Inspection report made before shipment EUTR documents
20	Claim Arbitration	Any dispute submitted at Richard Fays' arbitration, in one expertise, recognized as irrevocable by both parties. All costs moved forward by the claimer to the expert at the time of his application, but totally at charge of the failing party, recognized as irrevocable by both parties.

For acceptation of terms and conditions

THE SELLER THE BUYER

➢ Rules to know

The first rule to be aware of is that the qualitative risk is inversely proportional to the purchasing price, in other words, the less one wants to pay the timber, the more the risk of acquiring a lower quality.

During the sawing, the logs volume decreases considerably: roughly 20% just for sawdust and few percent more for the defects penalties, depending on the log quality.

The sawing yield varies according to:

- the requested type of product
- the required on the quality

Boules sawn from logs of very good quality give about a 75% yield; from logs of medium quality, 60 to 65%, and from logs of poor quality, about 50%.

In the case of squared sawn timber, the maximum yield will not even reach 50%; if the required quality is good to very good (e.g. FAS), the yield will not exceed 30 to 35% from nice grade logs and could drop to 10% and even less when sawing poor quality logs

In his offer, the producer will therefore include logs value, losses value, his labour costs and certainly an additional margin.

We thus understand the difficulty for one supplier who would own only poor quality logs, to provide first-grade sawn timber and the reason that pushes some manufacturers to decline some orders.

➢ Buying logs

Buying logs whose price will always be cheaper than that of sawn timber requires a very good knowledge of logs grading. Getting them inspected is very important because some defects are not easy to detect while the incidence of visible defects can be much more important than expected.

Producers have always exported high-quality logs while keeping bad ones for sawing.

Provided you agree to pay the price to obtain good quality logs will guarantee good yield and quality production, this kind of business can be profitable.

ATIBT (Association Technique Internationale des Bois Tropicaux) assigns to log lots a value in points, which is very realistic and represents well the logs yield (It would be more precise to write 'represented' because forests having been largely exploited since the introduction of this rule, the actual logs quality is lower than that of decades ago)

Logs quality	Continental value in points	Logs quality	Imperial value in points
A	100	A	100
A/B	87.5	A/B	87.5
B	75	B	75
B/C	62.5	B/C	62.5
C	50	C	50
D	25	D	40

Reading these tables, it is clear that the more the quality of the logs decreases, the possible sawing yield also decreases, both in terms of sawn yield (sawn wood volume compared to the log volume) and quality yield (volume of best commercial grades compared to the log volume)

➢ Buying sawn timber

a) Boules and boards

Boules trade became scarce since the advent of industrialization.

Boules were – and remain – used and appreciated by cabinetmakers, joiners and other craftsmen knowing timber very well. This less elaborate product is cheaper, and users' experience and talent allow them to take advantage of it.

b) Square edged sawn timber

That kind of product eliminating sapwood and wane, defects that strongly devalue timber, gets sawmill equipment more profitable.

For the buyer, it is an opportunity to acquire better calibrated wood, with better yield that he can quickly use for industrial or semi-industrial work.

There are some different qualities and grades of sawn timber; each buyer adapts his requests to his needs and although price remains an important selection criterion, the right timber quality adapted to the buyer's production, is a prime necessity. In fact, it's all about finding the right value for money.

If the price is subject to negotiations, timber quality, once clearly defined at the moment of purchase in order to enforce it, can never be discussed.

One thing is clear: the higher the choice, the better the yield.

To be convinced, we can refer to the SATA grading rule (ATIBT, grading of African square edged sawn timber) and the minimum yield percentage required for each grade:

Grades	Minimal yield required for each piece of wood
1st grade	90 %
2nd grade	80 %
3rd grade	60 %
4th grade	60 %

FAS grade (1st and 2nd mixed grades) is the most commonly contracted grade. Theoretically, it must be composed of:

- Minimum 60% of 1st grade
- Maximum 40% of 2nd grade

If receiving very good quality - or in any case a quality corresponding well to the needs of raw material - is a necessity for buyers, producers cannot contract only superior choices, because sawing a log generates all the different grades, in different proportions relative to the quality of the log, and producers must be able to commercialize their whole production.

A lot of sawmills are in trouble because they are congested with medium to low quality products or low demand products.

Requiring high grade increases the price of sawn timber and increases the timber yield. But requiring high grade from poor quality logs is heresy.

➢ Profitability of sawing logs into boules

Log m3	Log grade	Log price/m3	Total costs	Sawing	Sawing yield %	Sawn m3	Price/m3	Sawn timber price	Resawing yield %	Sawn m3	Price/m3	Sawn timber price	Average price	Rentability/m3	Quality yield	
1,000	AB	200	200	Boule	78	0,780	325	253,50	1st grade 50%	0,385	625	240,63			50,00%	1st grade
				Defects penalty	-1	-0,010	325	-3,25	2nd grade 30%	0,231	600	138,60			30,00%	2nd grade
									3rd grade 10%	0,077	540	41,58			10,00%	3rd grade
Sawing cost			30						4th grade 5%	0,039	400	15,40			5,00%	4th grade
			230			0,770		250,25		0,732		436,21	596	185,96		
1,000	AB	200	200	Boule	78	0,780	325	253,50	1st grade 35%	0,266	625	166,25			35,00%	1st grade
				Defects penalty	-2	-0,020	325	-6,50	2nd grade 35%	0,266	600	159,60			35,00%	2nd grade
									3rd grade 15%	0,114	540	61,56			15,00%	3rd grade
Sawing cost			30						4th grade 10%	0,076	400	30,40			10,00%	4th grade
			230			0,760		247,00		0,722		417,81	579	170,81		
1,000	AB	200	200	Boule	78	0,780	325	253,50	1st grade 20%	0,150	625	93,75			20,00%	1st grade
				Defects penalty	-3	-0,030	325	-9,75	2nd grade 30%	0,225	600	135,00			30,00%	2nd grade
									3rd grade 30%	0,225	540	121,50			30,00%	3rd grade
Sawing cost			30						4th grade 15%	0,113	400	45,00			15,00%	4th grade
			230			0,750		243,75		0,713		395,25	555	151,50		

The table here above shows a projection of log sawing into boules: one log of 1 m^3 is sawn for 30$. The table studies 3 logs of different grades, A/B, B and C, purchased at 200 $, 170 $ and 140 $ per m^3.

These boules will be re-sawn in such a way as to produce the most of superior grades and obtain the best possible yield; the upper grades are used for the visible parts while the lower ones are for the non-visible parts of the product. In this way, the material yield is widely optimized and losses reduced.

From the best log (A/B), it is possible to produce an important volume of 1st and 2nd grades

From the B log, both mixed 1st and 2nd grade represent a good yield, but it must be noted that the quantity of 3rd grade is already increasing.

From C log, the total production is balanced between superior and inferior grades.

Although all grades will be used for the realization of the final product, the importance played by the quality of the log in the calculation of profitability of the company is clearly demonstrated.

➢ Profitability of sawing logs into square edged sawn timber

Log m3	Log grade	Log price/m3	Total costs	Sawing	Sawing yield %	Sawn m3	Price/m3	Sawn timber price	Average price	Rentability/m3	Quality yield	
1,000	AB	200	200	FAS fix	28	0,280	570	159,6			59,57%	Fax fix
				Fas all widths	12	0,120	520	62,4			25,53%	Fas all widths
				Shorts	5	0,050	400	20			10,64%	Shorts
Sawing cost			30	3rd	2	0,020	300	6			4,26%	3rd
			230			**0,470**		**248**	**528**	**18**		
1,000	B	170	170	FAS fix	15	0,150	570	85,5			34,88%	Fax fix
				Fas all widths	17	0,170	520	88,4			39,53%	Fas all widths
				Shorts	7	0,070	400	28			16,28%	Shorts
Sawing cost			30	3rd	4	0,040	300	12			9,30%	3rd
			200			**0,430**		**213,9**	**497**	**13,9**		
1,000	C	140	140	FAS fix	5	0,050	570	28,5			12,50%	Fax fix
				Fas all widths	15	0,150	520	78			37,50%	Fas all widths
				Shorts	8	0,080	400	32			20,00%	Shorts
Sawing cost			30	3rd	12	0,120	300	36			30,00%	3rd
			170			**0,400**		**174,5**	**436**	**4,5**		

The table here above shows a projection of log sawing into square edged timber: one log of 1 m^3 is sawn for 30$.

The table studies 3 logs of different grades, A/B, B and C, purchased at 200 $, 170 $ and 140 $ per m^3.

From these logs, sawing will produce different grades: FAS grade fix sizes, FAS grade all widths, shorts and 3rd grade.

From the best log (A/B), it is possible to produce an important volume of FAS fix size, sold at the best price ; FAS all width sawing makes possible to increase the sawing yield, while shorts and 3rd grade are recovery productions.

From the B log, it is not possible to produce so much FAS fix sizes, but FAS all widths makes possible to realize an honest production.

From C log, FAS fix production is poor while 3rd grade and shorts represent 50% of the total sawing yield.

When the logs quality decreases, both quality yield and sawmill profitability decrease too.

This projection is just an example intended to show the impact of the log quality according to the finished product to be obtained. Yields that vary from one log to another should not be considered representative of each log, but must be analysed as part of the sawing of a complete batch.

In all cases, the quality of the logs plays an essential role in the timber trade and the relations between sellers and buyers.

To summarize the purchasing process, we can keep in mind:

- Always defining precisely by contract the requested specie, quality and sizes
- Always purchasing per m3 and not accepting to buy per piece of wood what doesn't give any guarantee about specie, sizes nor quality
- Mastering the manufacturing process and costs of the products you want to market
- Mastering the volume needs by product quality you need for your manufacturing and order the right products at right price and grade in right percentage

Activity 5.1.3
Question 1 What is the interest to sign a contract before purchasing or selling timber? **Question 2** The main rule is buying at the best price, do you agree? **Question 3** What is the most currently traded sawn timber grade? What does it require? **Question 4** You receive an offer: 150 m3 Libuyu logs, AB grade at 380 $/m3 Franco, 80 m3 Iroko sawn timber Fair grade at 640 $/m3 Franco, or Cedrella boules at 500 $/m3 Franco. What do you choose, why? **Question 5** Establish contracts for 150 m3 Sapelli sawn timber bought from DRC and 250 m3 Rwandan species Eucalyptus 30%, Pine 45%, Cypress 10%, Cedrella 10%, and Grevillea 5%.
Possible solutions to activity 5.1.3 **Question 1** Signing a contract is recording and getting accepted all clauses negotiated by the seller and the buyer; the contract is the reference document in case of claim or dispute **Question 2** Price makes not all: low price means low grade. **Question 3** FAS grade (1st + 2nd) is the most traded grade: it requires a good selection that should respect minimum 60% of 1st grade and maximum 40% of 2nd grade **Question 4** To be noted on explanations **Question 5** To be noted on contract terms

5.1.4 Prices evolution on international markets

The evolution of market prices is linked to a large number of parameters, but which always boil down to two major factors: supply and demand.

However, these do not only vary according to producers and buyers, themselves influenced by various conditions: climatic, political, sanitary, financial, social, both within the producing countries and in those of buyers abroad and even in other places not concerned by the transaction.

Following the global health crisis, international logistics has significantly tightened transport conditions while containerization does not help to solve the problem. Various organizations monitor and analyse monthly prices fluctuations of the main commercial species (particularly ITTO, which has been very discreet since the health crisis). These market studies where the species are rated FOB, cover all continents and main importing/exporting countries.

Monthly fluctuations are generally not very important (2 to 3%) and may very quickly return to normal; they can last for a few months as was the case in 2020 when importers have voluntarily reduced import volumes to bring back to normal prices that were rising sharply. This was followed by a surplus of stock in sawmills that destabilized small and medium-made producers whose cash flow is tighter, and a quick drop in tariffs

Few species suffer sharp price increases or falls. However, it is possible that some of them, whose price is high, are abandoned by buyers (case of the Wenge some years ago).

FOB quotations, October 2021, origin Central Africa

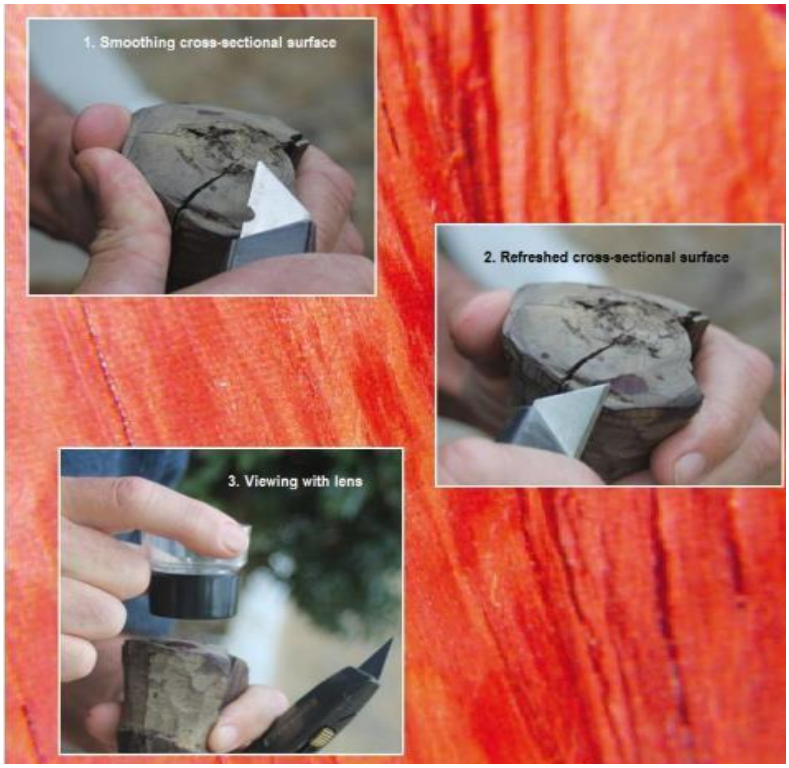
Species	Logs €/m³		FAS sawn €/m³
Sapelli	285 - 325		580 – 630
Sipo	310 - 340		600 – 640
Kosipo	260 – 280		500 – 530
Tiama	240 - 250		440 – 470
Bosse	250		500 - 540
Mahogany	280		500 – 580
Iroko	300-340		610 – 650
Tali	320 – 340		570 - 640
Afrormosia			1000 - 1250
Teak	450 - 900		

LEARNING UNIT 6: WOOD IDENTIFICATION

6.1 Timber identification

Any confusion or ignorance in the recognition of a wood species can be perceived as a fraud rather than as an involuntary error, is generally a source of dispute. It is thus necessary to be extremely precise on this matter. Wood identification must not be perceived as a science, but as a simple action to identify sometimes an unknown wood, sometimes to confirm or to counter the identity of a commercial species. This technical skill must be acquired by experience and rightly considered as an art. To do so, we can use natural tools, our senses of view · of smell · of touch – but they are limited and cannot however supply all answers. To identify standing trees, we have no other choice than use our senses, mainly the view, and additionally, our smell. In case of logs identification, view and smell are also used but we have the possibility to confirm our impressions by using microscopical identification. But when we are faced to sawn timber, view, smell and touch are not sufficient to clearly identify all wood species and the microscopical identification becomes really necessary because some species share between them pronounced similarities which can seem not different at first sight. In such case, it is necessary to increase artificially the efficiency of our senses by using a small lens and study in details the wood anatomical characteristics.

6.1.1 Identification process



First, looking at the cross-section makes possible to observe arrangement, size and number of vessels, the presence and arrangement of the axial parenchyma, the thickness of cell walls.

Secondly, observing the tangential section makes possible to study the woody rays, their size, their arrangement, the possible presence of crystals, ...

Finally, the observation of the radial section provides information on the links between woody rays and vertical cells.

Accurate wood identification depends mainly on characteristics of the wood cells revealed under a microscope

➢ Techniques for removal small samples

First, a cross-sectional surface of the sample is smoothed with a sharp knife and examined with a hand lens.

Then small, thin sections are cut freehand along the grain from the radial and tangential surfaces and prepared for viewing under the microscope.

Because the species can be present in different areas, countries and even on different continents, identifications under wood anatomy are generally limited to a genus or in some case to a sub-genetic grouping, rarely to the exact specie.

The wood's common name, the country or the geographic area of origin are especially useful to determine the precise specie. The age determination is only possible in laboratory.

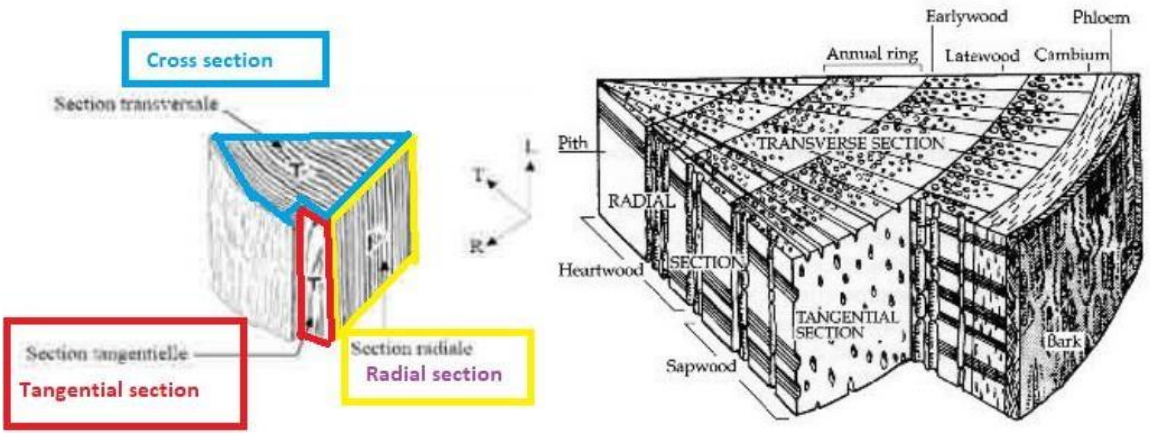
6.1.2 Tools used for identification

Tools	Kind of timber	Use
Gouge, chisel, sharp knife, cutter	Logs identification	Rough cut for specie identification
Cutter, chisel, gouge, sharp knife	Rough sawn timber	Light and discrete cut
Chisel, razor blade, cutter	Surfaced timber	Cutting very small and discrete wood sample
Chisel, razor blade, cutter	Valuable topics	Cutting very small, thin and discrete wood sample
Jeweler's magnifying glass	All cases	Searching for clues allowing identification

Duration

The duration of such process can require minutes or hours, even some days, depending on the type of wood, the size and the quality of the sample and all information provided with.

6.1.3 Timber structure



➢ Hardwood structure

- Outer bark consisting of corky cells with a specialized 'cork cambium' which forms new cells and enables the bark to increase circumferentially with the growth in thickness of the stem. Its function consists in protecting living tissues of the stem from drying out and from other exterior influences (insect attack, mechanical damage, etc.)
- Phloem or inner bark consisting of sieve tubes and their companion cells and often fibres, it carries elaborated food-stuffs (mainly sugars in solution) made in the leaves, down the stem.

Both the above types of tissue are popularly known as bark.

- Cambium (vascular cambium) is a growing layer of cells (one layer only) : its function consists in forming new phloem and xylem cells and produce growth in thickness of the stem.
- Xylem (wood, including sap and heart wood) consisting mainly of fibres, vessels, parenchyma and rays, shows the relative position of these tissues and the three planes of sectioning used in examination. It has three (3) functions :
    - ✓ Fibres are the principal mechanical tissue of wood
    - ✓ Vessels in the outer sapwood conduct water from the soil to the leaves while vessels in the inner sapwood and heartwood are no longer active in this way

- ✓ Parenchyma and rays in sapwood store and transport foodstuffs made by the leaves

➢ Arrangement of cells and tissues

Cube of hardwood showing planes of sectioning and principaltissues of the xylem.

F= fibres, P= parenchyma, R= ray, V= vessel,

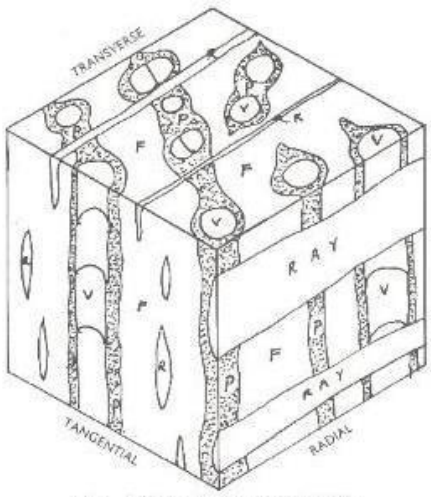


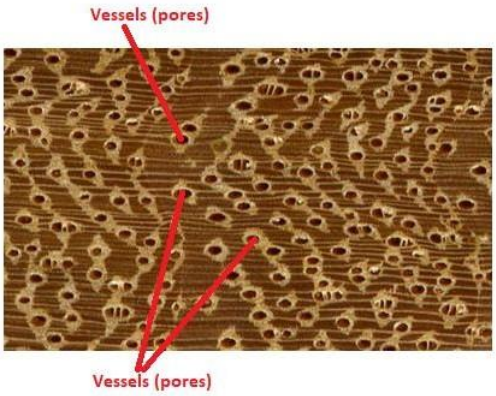
Fig. 1 Arrangement of tissues in the stem
(b) cube of hardwood showing planes of sectioning and principal tissues of the xylem
F: fibres, P: parenchyma, R: ray, V: vessel

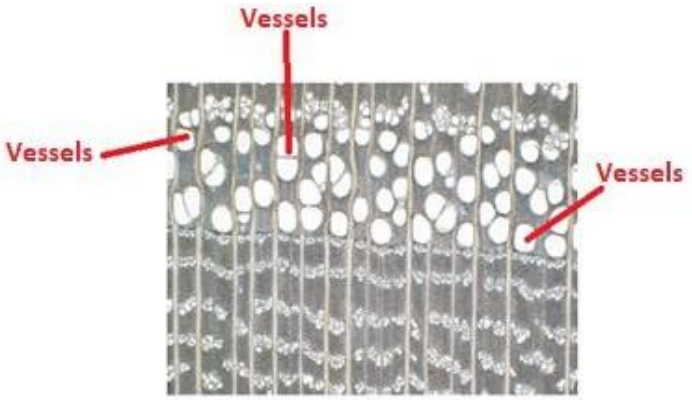
a) Fibres

'Fibre' is defined as a general term of convenience in wood anatomy for any long, narrow cell of wood or bast other than vessels sieve tubes and parenchyma. The name is also used loosely for wood elements in general.

b) Vessels

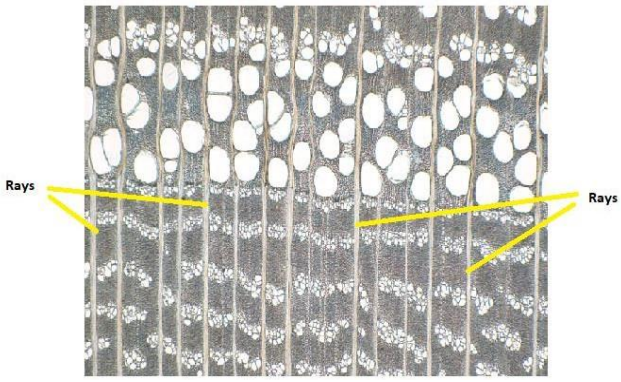
Vessel term is defined as 'an axial series of cells that have coalesced to form an articulated tube-like structure of indeterminate length'. Pore is a term of convenience to describe the cross section of a vessel (or of a vascular tracheid)

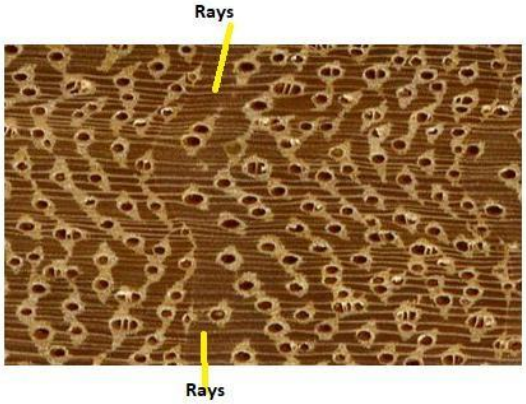




c) Rays

'Ray' term is defined as a ribbon-like aggregate of cells formed by the cambium and extending radially in the xylem and phloem. In hardwoods, rays are composed entirely of parenchyma cells.





Types of rays

- Uniseriate and multiseriate rays
    - ✓ Uniseriate rays (only one cell wide as seen in tangential section)
    - ✓ Biseriate (two cells wide)
    - ✓ Triseriate (three cells wide)
    - ✓ Multiseriate (more than three cells wide). The term multiseriate is also used for any rays more than one cell wide
    - ✓ Homocellular (one cell type) or heterocellular (two or more cells type)

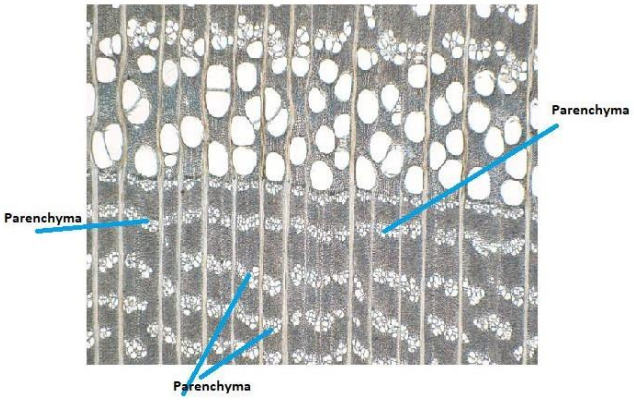
In identification keys, rays, which are mostly uniseriate but have occasional biseriate, are regarded as uniseriate

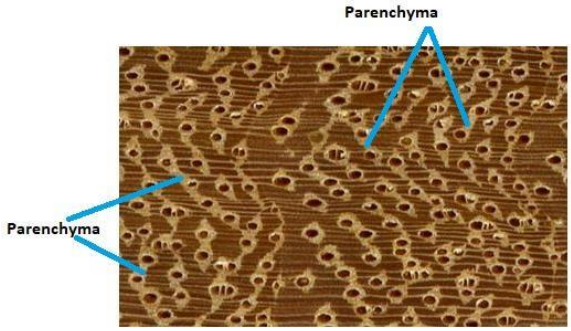
- ✓ Aggregate rays are a group of closely associated rays appearing to the unaided eye or at low magnification as a single large ray.
- ✓ Fused rays: in some woods a ray may be joined or 'fused' to another ray immediately above or below it as seen on tangential section. Such rays are known as 'fused rays'. This feature is not normally regarded as of diagnostic importance; it is found commonly in Khaya spp and the Rubiaceae.

d) Parenchyma

Parenchyma is a term used for tissue composed of cells that are typically brick-shaped or square (there is also fusiform parenchyma) and have simple pits. Synonyms for parenchyma are "soft tissue" and "storage tissue".

Strictly parenchyma occurring in the xylem should be called wood or xylem parenchyma, to distinguish it from phloem parenchyma, which occurs in the phloem.

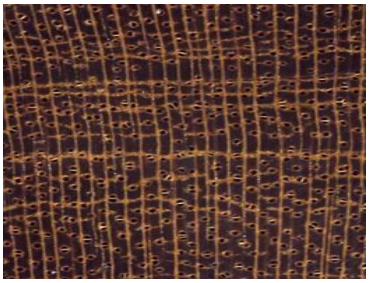
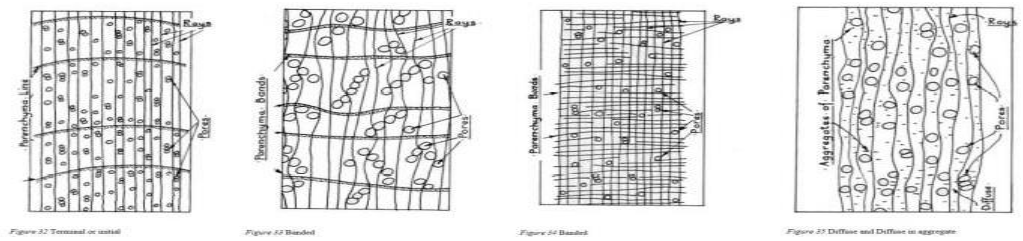




Types of wood parenchyma

- Ray parenchyma (radial parenchyma) formed from ray initials and composing the rays wholly or in part.
- Axial parenchyma (longitudinal parenchyma) derived from fusiform initials, may occur in the following forms :
  - ✓ Parenchyma strand, an axial series of two or more parenchyma cells derived from a single cambial initial, occurring in Iroko, Bosse, Makore, and many others.
  - ✓ Fusiform parenchyma, an axial parenchyma cell formed from a fusiform cambial initial without sub-division, found in a limited number of species including Ayous androsewoods

Arrangement of axial parenchyma

• APOTRACHEAL: in which the tissue is typically independent of the pores. • Terminal or Initial : cells occurring either singly or forming More or less continuous layer of variable width at the close or beginning of a season's growth, the latter sometimes called 'initial' parenchyma (Doussie, Sapelli, Sipo, Tiama, Tola)	 ***Sapelli***
• Banded: concentric lines or bands of frequent occurrence within the growth ring, and less than four cells wide. (Azobe, Koto, Kosipo, Wenge)	 ***Kosipo***
• Diffuse: single parenchyma strands or cells irregularly distributed among fibres, sometimes very difficult to determine.(Bilinga, Kotibe)	 ***Bilinga***
• Diffuse-in-Aggregate: parenchyma cells that tend to be grouped in short tangential lineswhich may extend from ray to ray. 	

- PARATRACHEAL : where the tissue is associated with the pores
- Scanty paratracheal : incomplete sheaths or occasional parenchyma cells around pores (Dibetou, Framire, Tiama)

- Vasicentric: parenchyma forming a complete sheath around a vessel of variable width and circular or slightly oval in cross section. (Most Lauraceae's, Mahogany).

- Aliform: parenchyma with wing-like lateral extensions. (Albizia spp. and Afzelia spp)
- Confluent: coalesced aliform parenchyma joining two or more pores, but not forming long, continuous bands. (Iroko)

- Banded: concentric lines or bands of frequent occurrence within the growth ring, and less than four cells wide. (Padouk).
- Bands broad and conspicuous: as for paratracheal banded except that the width of the bands are more than four cells wide. (Bosse)

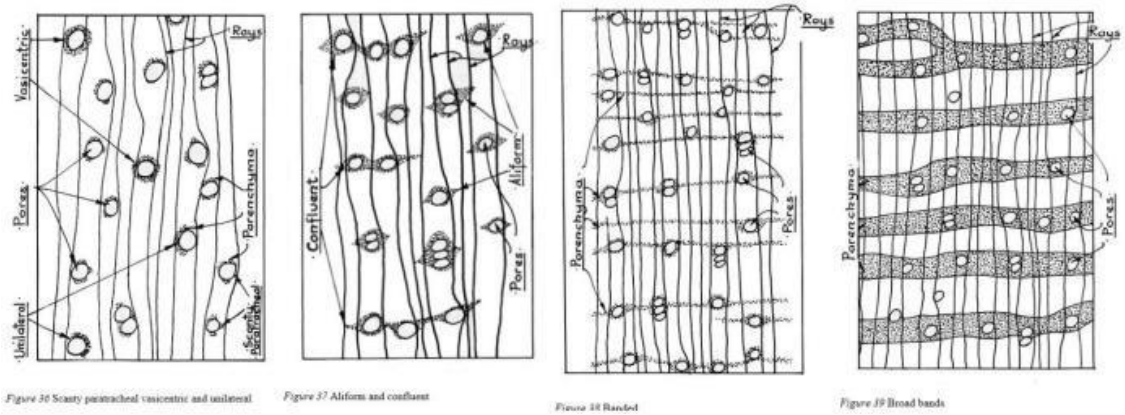


Figure 36 Scanty paratracheal vasicentric and unilateral

Figure 37 Aliform and confluent

Figure 38 Banded

Figure 39 Broad bands

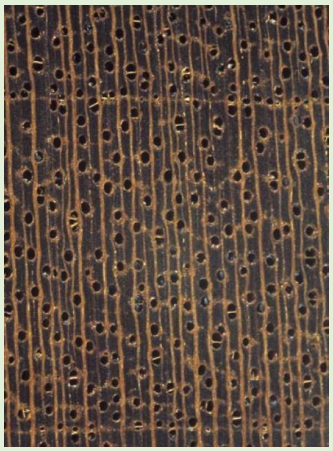
ACTIVITY 6.1.3

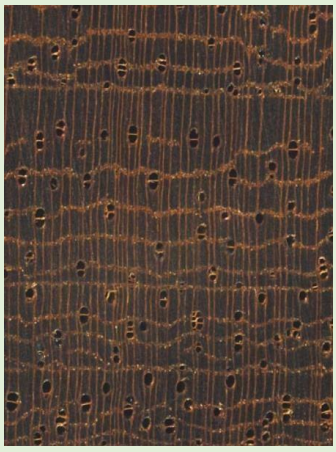
Question 1

Can you identify those 6 species of the Meliaceae family?

For information, there are 4 Entandrophragma, 1 Guarea, and 1 Kahya








EXCERCISE: 3 – 4 hours then 1 hour/day

With help of the identification tools and technical sheets, search on different wood samples to identify pores, rays and parenchyma, after what it will be necessary to try to identify all wood samples by their commercial name and their botanical name.

6.1.4 Main species in Rwanda

➢ Local species:

Eucalyptus grandis (red eucalyptus, fast growth) **Eucalyptus saligna** (red eucalyptus, similar to E. Grandis) **Eucalyptus citriodora** (pinky, pale, valuable specie) **Eucalyptus camaldulensis** (red eucalyptus, fast growth, only for construction uses) **Eucalyptus sideroxylon** (red eucalyptus, suitable forpoles, stakes, scaffolding) **Eucalyptus maidenii** (white eucalyptus, suitable forconstruction, joinery, tools handles) **Eucalyptus microcorys** (red eucalyptus, suitable for furniture, joinery, flooring, decking, construction, railway sleepers)	Eucalyptus is the most represented genus in Rwanda (over 200 species) where professionals sort it by color : red, pink and white, what is certainly not the best solution because each specie of the same genus owns particular properties (density, durability, resistance, shrinkage, ...) and does not share them necessarily with all others. Consequently, mixing timbers of different properties is a risk to produce low quality, because their drying will not behomogeneous. **Red Eucalyptus** are convenient for furniture, joinery, flooring, carpentry, construction and outdoor uses. **Pinky Eucalyptus** is generally timber issued from juvenile tree, not so resistant and drying faster than red species. **White Eucalyptus** corresponds with a nonresistant timber to be used indoor and in all cases, in dry environment ; drying fast, it can be adapted to low grade furniture, elements, panels, ...
Pine genus is mainly represented by Pinus patula.	With its attractive price, it is widely used locally.
Cypress present are Cupressus lusitanica and Cupressus tortulosa	Appreciated for their timber, it is necessary to relieve the pressure on this specie.
Grevillea (Grevillea superba) is often disseminated	frequently harvested and uses for coffers, construction,boxes
Markhamia (Markhamia lutea) is native to eastern Africa and related to the African tulip tree.	It is an evergreen small tree that can reach more than 10 m in its zones of origin. Its white wood is locally commercialized for low cost furniture, elements, and boxes.
Cedrella serrata is present in Rwanda and has beenplanted a lot. Cedrella serrata is not listed in Cites appendix.	The specie was faced to insect attacks but seems to be ableto grow. That is a good opportunity for the country because that specie is valuable.
Acacia melanoxylon, endemic to Australia, has been introduced worldwide and is present in Rwanda.	Its timber is excellent for valuable uses as furniture, cabinetmaking, musical instruments and veneers.

➢ Imported species:

Sapelli, Sipo, Kosipo, Tiama (Entandrophragma), mixed with **Bosse** (Guarea cedrata, thompsonii) and from time to time with **Mahogany** (Kahya ivorensis, spp)	Mixed red woods imported from DRC under local 'Libuyu' name, they are targeted to be used for furniture, veneers, and other valuable uses.
Iroko (Milicia/Heritiera excelsa)	Imported from DRC but can grow in Rwanda, it is appreciated for valuable uses.
Tali (Erythrophleum ivorense) and **Afrormosia** (Pericopsis elata)	Imported from DRC, these species appear in small quantities on local Rwandan markets
TEAK (Tectona grandis)	Imported from Tanzanian plantations, it can be an excellent solution for several uses.

LEARNING UNIT 7: TECHNICAL SHEETS

7.1 Rwandan species technical sheets

➢ Local species

Eucalyptus, Eucalyptus grandis, E. saligna	 
Family	○ Myrtaceae
Other Common Names	○ Rose gum, Flooded gum, Red Grandis
Distribution	○ Native to eastern Australia, worldwide plantations
Tree	○ Height growth 30 up to 60 m ○ Bole diameter of 70 to 200/+ cm.
Logs	○ Well shaped, straight, cylindrical
Wood characteristics	○ Heartwood pink orange to reddish brown ○ Sapwood distinct, paler pinkish. ○ Generally straight grain ○ Medium to coarse-grained ○ End grain : diffuse-porous, exclusively solitary, small tovery large pores with no specific arrangement ○ Parenchyma : Vasicentric, confluent ○ Rays: narrow, spacing fairly close.
Weight	○ Green : 0.980 - 1.230 ○ Air-dried : 0.820 - 0.880 ○ Kiln dried 12%: 0.780 - 0.830.
Drying	○ Slow air- and kiln drying ○ Important shrinkage at drying
Working properties	○ Fairly easy to work (hand and machine tools) ○ Easy nailing, medium gluing, stains and finishes well ○ Very nervous.
Durability	○ Durable to very durable but poor insect resistance
Preservation	○ Not treatable
Uses	○ Poles, flooring, decking, furniture, boatbuilding, general construction
Sources : Wood Data Base, Richard.Fays (Des forêts, des bois, technical sheets)	

Eucalyptus, Eucalyptus maidenii	
Family	○ Myrtaceae
Other Common Names	○ Eucalyptus globulus maidenii, Maiden's gum, Southern blue gum ○ Subspecies of Eucalyptus globulus, named E. globulus ssp maidenii
Distribution	○ Native to Australia, New South Wales, eastern Victoria, in mountainvalleys, on slopes and ridges in near-coastal ranges ○ Planted in eastern Africa (Kenya, Tanzania, Rwanda), both species E.globulus and E. maidenii seem to be very distinct. ○ Widely cultivated worldwide (South America, China, south east Asia, ○ Mediterranean countries)
Tree	○ Height growth from 30 up to 40 - 50 m ○ Bole diameter of 60 to 100 cm
Logs	○ Tall and straight, cylindrical
Wood characteristics	○ Heartwood creamy yellow ○ Sapwood few distinct, yellowish to light grey ○ Straight grain ○ Coarse grained ○ End-grain : Diffuse porous ○ Parenchyma Vasicentric
Weight	○ Green : 1.070 - 1.200 ○ Air-dried : 0.880 - 0.930 ○ Kiln dried 12% : 0.690 - 0.740
Drying	○ Slow drying recommended
Working properties	○ Moderately easy to work (hand and machine tools) ○ Nailing, gluing, staining and finishing correct
Durability	○ Moderately durable
Preservation	○ Treatable
Uses	○ Light and heavy construction, joinery (interior, exterior), flooring, ○ tools handles, pulp
Sources : Australian plants, Australian Biodiversity Research	

Eucalyptus, Eucalyptus microcorys	 
Family	○ Myrtaceae
Other Common Names	○ Tallow wood
Distribution	○ Native to Australia, New South Wales, Queensland, in hilly andmountainous areas. ○ Planted in Africa (DR Congo, Rwanda, Ethiopia, Kenya, Uganda,Tanzania, Malawi, Zambia, Angola, Zimbabwe, Madagascar andSouth Africa) for timber.
Tree	○ Height growth from 35 up to 55 - 60 m ○ Bole diameter of 60 to 200 cm, can reach 65% of the total height
Logs	○ Tall and straight, cylindrical
Wood characteristics	○ Heartwood yellowish brown with a tinge of olive green to distinctively paler shades ○ Sapwood distinct, paler ○ Often interlocked grain ○ Coarse grained ○ End-grain : Diffuse porous ○ Parenchyma Vasicentric, confluent ○ Greasy nature
Weight	○ Green : 1.070 - 1.120 ○ Air-dried : 0.890 - 0.940 ○ Kiln dried 12% : 0.700 - 0.750
Drying	○ Slow drying recommended
Working properties	○ Easy to work (hand and machine tools) ○ Nailing, staining and finishing correct ; gluing difficult
Durability	○ Very durable
Preservation	○ Treatable
Uses	○ Heavy construction, furniture, joinery (interior, exterior), flooring, ○ decking, railway sleepers, poles
Sources : Flora of Australia, Australian plants, Australian Biodiversity Research	

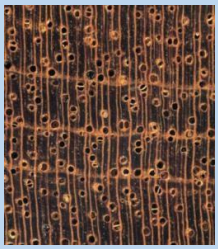
Pine, Pinus patula	 
Family	○ Pinac ○ eae
Other Common Names	○ Mexican weeping pine, Silver pine
Distribution	○ Native to eastern Mexico ○ Important pine specie planted in southern and eastern Africa ;Also introduced in Madagascar, New Zealand, Hawaii
Tree	○ Height growth up to 25 m ○ Bole diameter of 40 to 80 cm.
Logs	○ Usually well shaped, straight, cylindrical
Wood characteristics	○ Heartwood yellowish to light pinkish ○ Sapwood quite indistinct, paler yellowish. ○ Generally straight grain ○ Medium grained ○ Faint resinous smell ○ Resin channels are present
Weight	○ Green : 0.950 - 1.000 ○ Air-dried : 0.580 ○ Kiln dried 12% : 0.450 - 0.500
Drying	○ Fast air-drying
Working properties	○ Easy to work (hand and machine tools) ○ Easy nailing, glues and finishes well.
Durability	○ Non-durable to perishable
Preservation	○ Treatable
Uses	○ Furniture components, general construction, boxes and pallets
Sources : Wood Data Base, Richard.Fays (Des forêts, des bois, technical sheets)	

Cypress, **Cupressus lusitanica**	 
Family	○ Cupressaceae

Other Common Names	○ Mexican Cypress, Portuguese cypress
Distribution	○ Native to Mexico ○ Widely planted at high elevations throughout the tropical world
Tree	○ Height growth up to 30 m ○ Bole diameter of 60 to 90 cm, sometimes up to 120 cm
Logs	○ Usually well shaped, straight, cylindrical
Wood characteristics	○ Heartwood yellowish, pale brown, orange to pinkish,sometimes streaked or variegated ○ Sapwood distinct, paler, usually sharply demarcated. ○ Scented, spicy ○ Irregular straight grain ○ Texture fine and uniform ○ Coarse grained ○ Resin channels : rare
Weight	○ Green : 0.580 ○ Air-dried : 0.430-0.460 ○ Kiln dried 12% : 0.310-0.340
Drying	○ Fast air-drying ○ Small or no end split nor surface crack and only slight warp.
Working properties	○ Easy to work (hand and machine tools) ○ Nailing, gluing, staining and finishing well
Durability	○ Moderately durable
Preservation	○ Non- treatable by the open-tank process ○ Irregular response to pressure-vacuum systems
Uses	○ Posts and poles, furniture components, general construction, musical instruments, turnery.
Sources : Wood Data Base, R.Fays (Des forêts, des bois, technical sheets)	

Grevillea, Grevillea Robusta	
Family	○ Proteaceae
Other Common Names	○ Silky oak, silver Oak (Hawaii)
Distribution	○ Native to eastern Australia ○ Naturally grows in subtropical and dry tropical forests
Tree	○ Height growth from 15 up to 20 m ○ Bole diameter of 30 to 70 cm

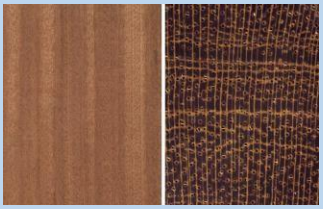
Logs	○ Medium shaped and straight, cylindrical to sometimes oval
Wood characteristics	○ Heartwood pink brown, ○ Sapwood distinct, beige to pale pink ○ Irregular to interlocked grain ○ Coarse grained ○ End-grain : Diffuse porous ○ Parenchyma obvious scalariform ○ Rays generally wide
Weight	○ Green : 0.730 - 0.780 ○ Air-dried : 0.630 - 0.650 ○ Kiln dried 12% : 0.540 - 0.560
Drying	○ Slow drying recommended ○ Honeycomb risk
Working properties	○ Easy to work (hand and machine tools) ○ Nailing, gluing, staining and finishing well
Durability	○ Durable
Preservation	○ Moderately treatable
Uses	○ components, coffers, general construction, boxes, pallets, crafts
Sources : World Agroforestry Centre, Richard Fays (E&F Data, technical sheets)	

Cedrella, Cedrella serrata	 
Family	○ Meliaceae
Other Common Names	○ Cedrella
Distribution	○ Native to Myanmar, India, Himalaya area Naturally grows in subtropical and mountain areas ○ Introduced in mountains areas of Africa (Kenya, Uganda, Malawi,South Africa) and Sri Lanka
Tree	○ Height growth from 25 up to 40 m ○ Bole diameter of 30 to 70 cm
Logs	○ Medium shaped and straight, cylindrical
Wood characteristics	○ Heartwood pink brown, ○ Sapwood distinct, beige to pale pink ○ Aromatic ○ Generally straight grain

	○ End-grain : Diffuse porous, no specific pattern, multiples ○ Parenchyma diffuse, banded ○ Rays generally wide
Weight	○ Green : 0.880 - 0.920 ○ Air-dried : 0.600 - 0.625 ○ Kiln dried 12% : 0.440 - 0.470
Drying	○ Slow drying recommended
Working properties	○ Easy to work (hand and machine tools) ○ Nailing, gluing, staining and finishing well
Durability	○ Moderately durable
Preservation	○ Treatable
Uses	○ Furniture, joinery (interior, exterior), moldings, cladding, veneers
Sources : World Agroforestry Centre, Richard Fays (E&F Data, technical sheets)	

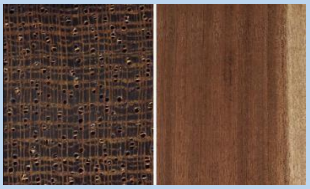
Acacia, **Acacia melanoxylon**	
Family	○ Fabaceae
Other Common Names	○ Australian blackwood, Tasmanian blackwood
Distribution	○ Native to coastal southeast to South Australia and southern Tasmania ○ Naturally grows in subtropical to cool humid temperate forests Grows well in different environments due to its high tolerance ofsaturated soils conditions ○ Introduced worldwide it is now considered as a pest in some ○ countries
Tree	○ Height growth from 8-15 up to 20 m ○ Bole diameter of 30 to 90 cm
Logs	○ Medium shaped and straight, cylindrical to sometimes oval
Wood characteristics	○ Heartwood dark to violet brown with streaks ○ Sapwood distinct, creamy to grey ○ Irregular, wavy to interlocked grain ○ Coarse grained ○ End-grain : Diffuse porous, rare and large pores ○ Parenchyma paratracheal Vasicentric
Weight	○ Green : 0.900 - 0.940 ○ Air-dried : 0.640 - 0.700 ○ Kiln dried 12% : 0.630 - 0.680
Drying	○ Normal, slow drying recommended
Working properties	○ Easy to work (hand and machine tools) ○ Nailing, staining and finishing well, gluing correct
Durability	○ Durable
Preservation	○ Non treatable
Uses	○ Furniture, cabinetmaking, boat building, musical instruments, ○ gunstocks
Sources : World Agroforestry Centre, Richard Fays (E&F Data, technical sheets)	

7.1.2 Imported species technical sheets

Sapelli, Entandrophragma cylindricum	
Family	○ Meliaceae
Other Common Names	○ Sapele, Muyovu, M'boyo, Assie, Penkwa, Aboudikro
Distribution	○ Native to central Africa ○ Naturally grows in subtropical and tropical forests
Tree	○ Height growth from 30 up to 45 m ○ Bole diameter of 60 to 100 cm
Logs	○ Well shaped, straight, cylindrical
Wood characteristics	○ Heartwood yellow red brown darkening tocopper brown ○ Sapwood distinct, pinkish white to palebrown ○ Irregular straight to interlocked grain ○ Medium grained ○ End-grain : Diffuse porous, medium sizedpores ○ Parenchyma : scanty paratracheal,Vasicentric, banded
Weight	○ Green : 0.900 – 0.930 ○ Air-dried : 0.660-0.690 ○ Kiln dried 12% : 0.680 – 0.710
Drying	○ Normal
Working properties	○ Fairly easy to work (hand and machine tools) ○ Nailing, gluing, finishing correct
Durability	○ Moderately durable
Preservation	○ Few to moderately treatable
Uses	○ Furniture, joinery, cabinetmaking, veneers, flooring
Sources : Tropical plants database , Richard Fays (E&F Data, technical sheets)	

Sipo, Entandrophragma utile	
Family	○ Meliaceae
Other Common Names	○ Utile, Mulumbi
Distribution	○ Native to central Africa ○ Naturally grows in subtropical and tropical forests

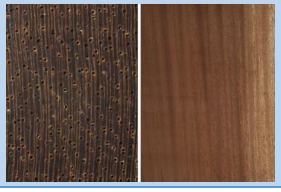
Tree	○ Height growth from 30 up to 45 m ○ Bole diameter of 60 to 120 cm
Logs	○ Well shaped, straight, cylindrical
Wood characteristics	○ Heartwood red brown to violet brown ○ Sapwood distinct, pinkish white ○ Irregular straight to interlocked grain ○ Medium grained ○ End-grain : Diffuse porous, medium sized pores ○ Parenchyma : scanty paratracheal, Vasicentric, confluent
Weight	○ Green : 0.910 – 0.940 ○ Air-dried : 0.680-0.700 ○ Kiln dried 12% : 0.620 – 0.640
Drying	○ Normal
Working properties	○ Fairly easy to work (hand and machine tools) ○ Nailing, gluing, finishing correct
Durability	○ Moderately durable
Preservation	○ Few treatable
Uses	○ Joinery (interior, exterior), cabinetmaking, veneers
Sources : Tropical plants database , Richard Fays (E&F Data, technical sheets)	

Kosipo, Entandrophragma candollei	
Family	○ Meliaceae
Other Common Names	○ Atom-assie, Impompo, Lifuco, Omu
Distribution	○ Native to central Africa ○ Naturally grows in subtropical and tropical forests
Tree	○ Height growth from 30 up to 45 m ○ Bole diameter of 60 to 120 cm
Logs	○ Well shaped, straight, cylindrical
Wood characteristics	○ Heartwood brown to violet brown ○ Sapwood distinct, pinkish white to pale brown ○ Irregular straight to interlocked grain ○ Medium grained ○ End-grain : Diffuse porous, medium sized pores ○ Parenchyma : paratracheal, Vasicentric, confluent

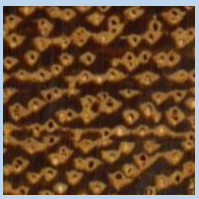
Weight	○ Green : 0.900 – 0.940 ○ Air-dried : 0.690-0.730 ○ Kiln dried 12% : 0.680 – 0.720
Drying	○ Normal to low
Working properties	○ Fairly easy to work (hand and machine tools) ○ Nailing, gluing, finishing correct
Durability	○ Moderately durable
Preservation	○ Few treatable
Uses	○ Furniture, joinery, cabinetmaking, veneers
Sources : Tropical plants database , Richard Fays (E&F Data, technical sheets)	

Bosse, Guarea cedrata, thompsonii	
Family	○ Meliaceae
Other Common Names	○ Guarea, Ossung
Distribution	○ Native to central Africa ○ Naturally grows in subtropical and tropical forests
Tree	○ Height growth from 30 up to 45 m ○ Bole diameter of 60 to 90 cm
Logs	○ Well shaped, straight, cylindrical
Wood characteristics	○ Heartwood pinkish brown to orange brown ○ Sapwood distinct, pinkish white to pale grey ○ Aromatic (spicy) ○ Straight to lightly interlocked grain ○ Medium grained ○ End-grain : Diffuse porous, multiples, small to big sized pores ○ Parenchyma : paratracheal aliform, confluent
Weight	○ Green : 0.890 – 0.910 ○ Air-dried : 0.680-0.710 ○ Kiln dried 12% : 0.580 – 0.610
Drying	○ Normal to fast
Working properties	○ Fairly easy to work (hand and machine tools) ○ Nailing, gluing, finishing correct
Durability	○ Few to moderately durable
Preservation	○ Moderately treatable
Uses	○ Joinery (interior, exterior), cabinetmaking, veneers, boat

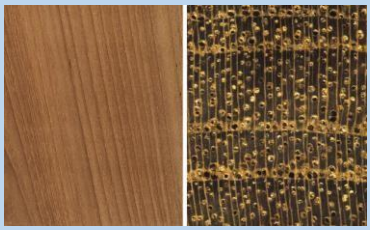
	building
Sources : Tropical plants database , Richard Fays (E&F Data, technical sheets)	

Mahogany, **Kahya ivorensis, anthotheca, grandifoliola**	
Family	○ Meliaceae
Other Common Names	○ Mahogany, Acajou
Distribution	○ Native to central Africa ○ Naturally grows in subtropical and tropical forests
Tree	○ Height growth from 30 up to 45 m ○ Bole diameter of 60 to 100 cm
Logs	○ Well shaped, straight, cylindrical
Wood characteristics	○ Heartwood pinkish to red brown with violet streaks ○ Sapwood distinct, creamy ○ Irregular straight to interlocked grain ○ Medium grained ○ End-grain : Diffuse porous, medium to big sized pores ○ Parenchyma : scanty paratracheal, Vasicentric, in strands
Weight	○ Green : 0.720 – 0.850 ○ Air-dried : 0.620-0.700 ○ Kiln dried 12% : 0.530 – 0.630
Drying	○ Fast drying
Working properties	○ Fairly easy to work (hand and machine tools) ○ Nailing, gluing, finishing correct
Durability	○ Moderately durable
Preservation	○ Non treatable
Uses	○ Furniture, joinery, cabinetmaking, veneers, boat building
Sources : Tropical plants database , Richard Fays (E&F Data, technical sheets)	

Iroko, **Chlorophora / Milicia excelsa**	
Family	○ Moraceae
Other Common Names	○ Kambala, Odoum, Mvule
Distribution	○ Naturally grows in dry tropical and gallery forests from western and ○ central Africa to eastern Africa.
Tree	○ **Height g**rowth from 30 up to 50 m ○ Bole diameter of 70 to 140 cm
Logs	○ Well shaped and straight, cylindrical
Wood characteristics	○ Heartwood yellow to yellow brownwith golden streaks. ○ Sapwood distinct, white to yellowishand thick ○ Irregular straight to interlocked grain ○ Coarse grained ○ End-grain : Diffuse porous with big pores ○ confluent parenchyma ○ Rays few numerous
Weight	○ Green : 1.040 ○ Air-dried : 0.680 - 0.720 ○ Kiln dried 12% : 0.640 - 0.670
Drying	○ Normal
Working properties	○ Not easy to work, important abrasiveness ○ Correct gluing and nailing, finishing sometime difficult.
Durability	○ Durable to very durable.
Preservation	○ Non-treatable
Uses	○ Flooring, decking, shipbuilding, joinery (interior/exterior), cooperage
Sources : Richard Fays (E&F Data, technical sheets)	

Tali, **Erythrophleum ivorense**	 
Family	○ Caesalpiniaceae
Other Common Names	○ Potrodom
Distribution	○ Naturally grows from western and central Africa to eastern Africa
Tree	○ Height growth from 15 up to 20 m ○ Bole diameter of 60 to 150 cm
Logs	○ Medium shaped and straight ○ Cylindrical to sometimes oval
Wood characteristics	○ Heartwood orange yellowish brown, darkening to exposure ○ Sapwood clearly distinct, creamy yellowish grey, 5 – 6 cm ○ Interlocked grain ○ Coarse grained ○ End-grain : Diffuse porous, in multiples ○ Parenchyma : paratracheal Vasicentric, aliform and confluent
Weight	○ Green : 1.150 - 1.200 ○ Air-dried : 0.950 - 1.050 ○ Kiln dried 12% : 0.870 - 0.900
Drying	○ Slow drying recommended ○ Distortion risks, but stable after drying
Working properties	○ Not easy to work, due to important abrasiveness and interlockedgrain ○ Nailing, gluing and finishing well
Durability	○ Very durable
Preservation	○ Non-treatable
Uses	○ Flooring, decking, bridges, docks and harbor works, railway ○ sleepers, joinery, construction
Sources : World Agroforestry Centre, Richard Fays (Des forêts, des bois, technical sheets)	

Afrormosia, Pericopsis elata	
Family	○ Fabaceae
Other Common Names	○ Assamela, African teak
Distribution	○ Naturally grows from central to eastern Africa
Tree	○ Height growth from 30 up to 50 m ○ Bole diameter of 80 to 110 cm
Logs	○ Medium shaped, straight and cylindrical
Wood characteristics	○ Heartwood yellow brown to red brown ○ Sapwood distinct, white beige to yellowish ○ Irregular to interlocked grain ○ Medium grained ○ End-grain : Diffuse numerous small to medium pores,in multiples ○ Parenchyma : paratracheal Vasicentric aliform confluent or not
Weight	○ Green : 1.080 – 1.120 ○ Air-dried : 0.780 – 0.810 ○ Kiln dried 12% : 0.740 - 0.760
Drying	○ Slow drying recommended
Working properties	○ Not easy to work, strong abrasiveness ○ Correct nailing, gluing, finishing
Durability	○ Very durable
Preservation	○ Non-treatable
Uses	○ Furniture, sliced veneers, joinery (interior/exterior), flooring, ○ decking, shipbuilding
Sources : Wood Data base, Richard Fays (Des forêts, des bois, technical sheets	

Teak, **Tectona grandis**	
Family	○ Verbenaceae
Other Common Names	○ Teak
Distribution	○ Native to India, Myanmar, south east Asia ○ Widely planted worldwide in subtropical and tropical areas
Tree	○ Height growth from 25 up to 30 m ○ Bole diameter of 20 to 100 cm
Logs	○ Medium shaped and straight, cylindrical
Wood characteristics	○ Heartwood yellow brown to dark brown with streaks ○ Sapwood distinct, yellowish to light grey ○ Straight grain ○ Coarse grained ○ End-grain : Diffuse porous, generally big sized ○ Parenchyma Vasicentric, banded ○ Rays few numerous
Weight	○ Green : 0.950 - 1.000 ○ Air-dried : 0.780 - 0.800 ○ Kiln dried 12% : 0.670 - 0.710
Drying	○ Slow drying recommended
Working properties	○ Moderately easy to work (hand and machine tools) ○ Nailing, gluing, staining and finishing correct
Durability	○ Durable
Preservation	○ Treatable
Uses	○ components, coffers, general construction, boxes, pallets, crafts
Sources : World Agroforestry Centre, Richard Fays (E&F Data, technical sheets)	

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