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Prepared by
Dr. Youcef Kamal

Wood

Summary

Overview and Classification

WOOD STRUCTURE

- Macrostructure of wood:
- Wood Microstructure:

Physical Properties:

Traditional Wood Products:

The different materials, elements, and constructions in wood are

Positive properties of wood:

Defects of wood

The defects of wood

Wood defects caused by plant pests

Wood protection against alterations caused by fungi and insects

Wood

Overview and Classification:

Wood is a natural and versatile material widely used in construction, furniture making, the production of various products, and many other fields. It is classified into two main categories: hardwood and softwood. This classification is based on the structure of the tree from which the wood comes.

Hardwood: These are deciduous trees such as oak, beech, cherry, walnut, etc. They are generally denser and harder than softwoods.

Softwood: They come from evergreen trees such as pine, spruce, cedar, etc. They are often less dense than hardwoods and generally contain more resin.

Wood

WOOD STRUCTURE

The structure of trees and wood is fundamental to understanding their properties and their use in various applications. Here is an explanation of wood structure, both at the macroscopic and microscopic levels:

Macrostructure of wood:

Tree trunk: The tree trunk is the main part that supports the crown and transports nutrients between the roots and the leaves.

Crown: The crown of the tree includes the branches and leaves that grow above the trunk.

Roots: Roots are responsible for anchoring the tree in the soil, absorbing water and minerals, and transferring these nutrients to the trunk.

Wood

Parts of the trunk:

Bark: The outer protective layer of the tree.
Phloem: The layer just beneath the bark that transports sap (nutrients) produced by the leaves to other parts of the tree.
Cambium (or sapwood): The layer of newly formed wood between the phloem and the heartwood. It is where the growth and development of the tree occur.
Heartwood (or core): The innermost and oldest part of the tree's wood.
Pith: The central part of the trunk, often present in young trees but disappearing with age.

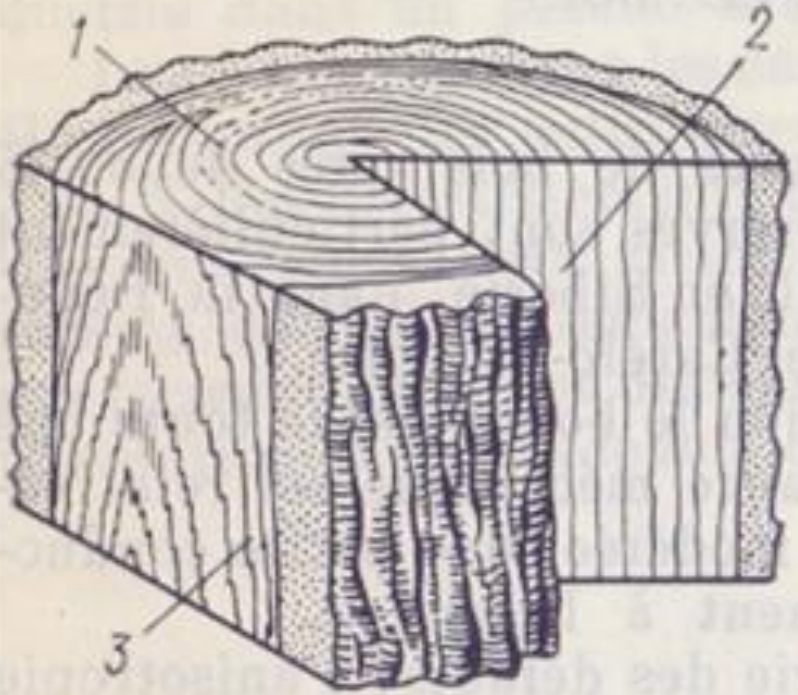
Wood

Wood Cuts:

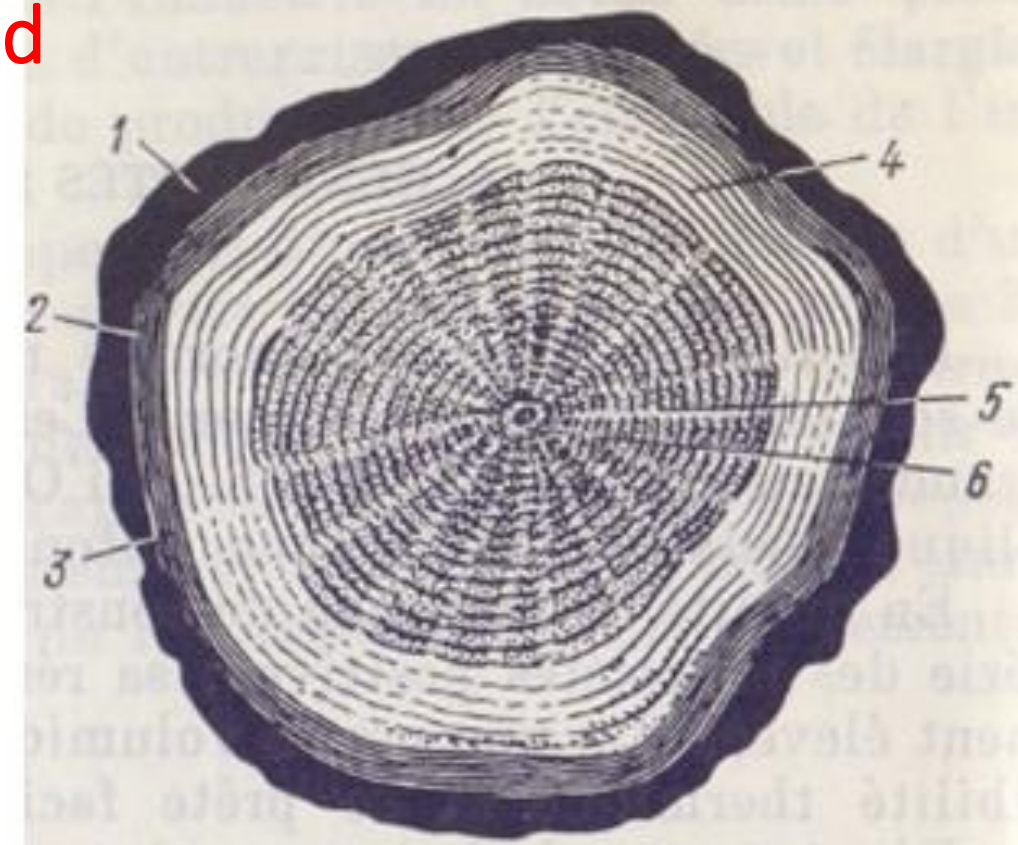
- **Transverse:** Cut across the tree trunk, revealing the circular structure of the wood.
- **Longitudinal Radial:** Cut along the diameter or radius of the tree, showing variations in the wood structure from the bark to the core.
- **Longitudinal Tangential:** Cut along the chord of the tree, showing variations in the wood structure on a surface tangent to the tree's growth.

Wood

Wood Cuts:



Coupes principales du tronc :
1 — transversale ; 2 — radiale ; 3 — tangentielle



Coupe transversale du tronc :
1 — écorce ; 2 — liber ; 3 — cambium ; 4 — aubier ; 5 — cœur 6 — moelle

Wood

Wood Microstructure:

The microstructure of wood, visible under a microscope, reveals the anatomical details of the cells and vessels that compose wood, including parenchyma cells, fibers, and conducting vessels. Understanding both the macrostructure and microstructure of wood is essential for its effective use in construction, woodworking, and other applications. The microstructure of wood, observed under a microscope, reveals a complex composition comprising various dead and living cells. Here is a detailed explanation of the components and types of cells present in wood:

Wood

Composition of Living Cells:

Cell Wall: The main cell wall, primarily composed of cellulose. As the cell grows, variations in structure and composition occur, which can lead to its transformation into wood, cork, or mucilage.

Protoplasm: A thick, granular, transparent mucus called plant albumen, composed of carbon, hydrogen, oxygen, nitrogen, and sulfur.

Nucleus: An oval structure distinguished from the protoplasm by the presence of phosphorus.

Wood

Transformations of the Cell Wall:

Formation of Lignin: When the cell transforms into wood, a substance called lignin forms in its cell wall, thereby increasing its strength and resistance.

Formation of Corky Substances: When transformation into cork occurs, substances with lower oxygen content than lignin form in the cell wall. This gives cork resistance to rot and water impermeability.

Transformation into Mucilage: When transformation into mucilage occurs, the cell wall partially or completely dissolves in water, forming openings through which cells can come together to form vessels.

Wood

Types of Cells:

Conductive Cells: Responsible for transmitting nutrients from the roots to the branches and leaves of the tree.

Mechanical Cells: These cells have an elongated shape, thick walls, and narrow internal cavities, imparting high mechanical strength to the wood.

Reserve Cells (or Parenchyma): Mainly located in the medullary rays, they store and transmit nutrients to living cells in a horizontal direction.

Understanding the microstructure of wood is essential for comprehending its physical and mechanical properties, as well as for optimizing its use in various applications.

Wood

Types of Cells:

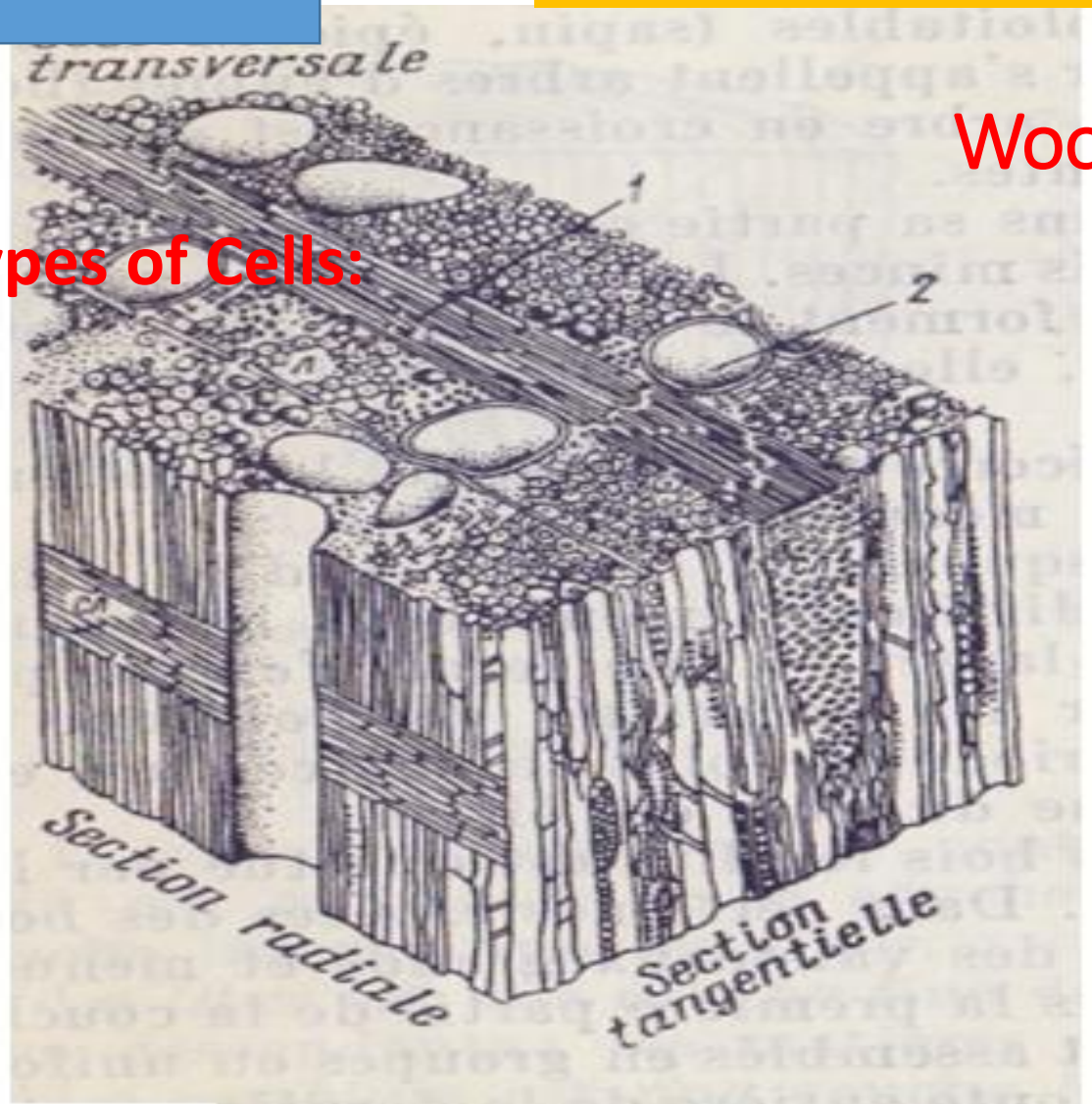


Schéma de structure anatomique du chêne (espèce à vaisseaux annulaire) :
1 — rayons médullaires ; 2 — vaisseaux

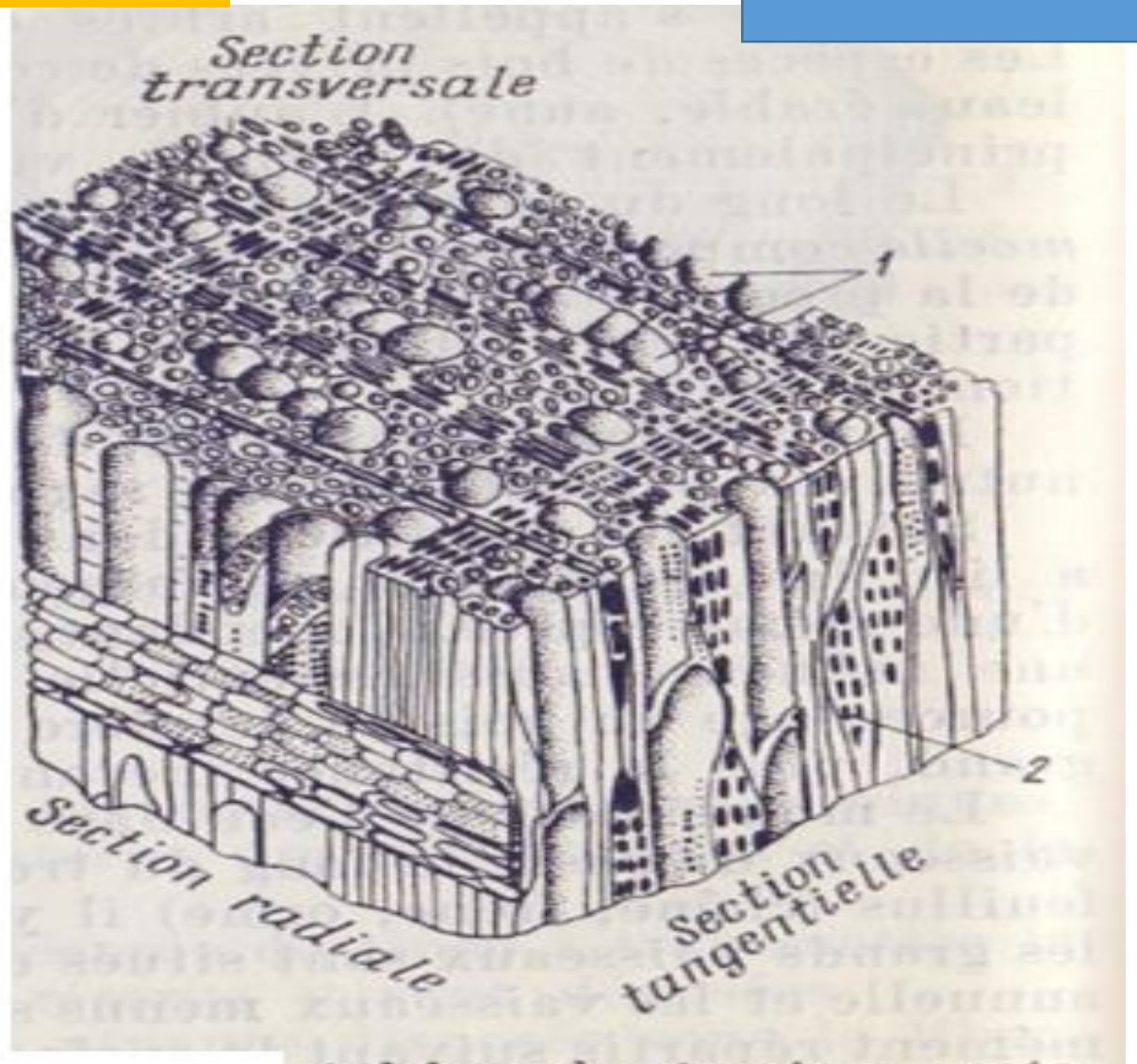


Schéma de structure anatomique du bouleau (espèce à vaisseaux disséminés) :
1 — vaisseaux ; 2 — rayons médullaires

Wood

Physical Properties:

The physical properties of wood vary depending on the species and tree structure, but generally, wood possesses the following characteristics:

- **Density:** Hardwood is typically denser than softwood.
- **Hardness:** Hardwood is harder than softwood.
- **Strength:** Hardwoods often have better tensile and compressive strength than softwoods.
- **Moisture Resistance:** Some softwoods like cedar have natural resistance to moisture, while other woods can be treated to enhance their resistance to rot and insects.

Wood

Physical Properties:

1- **Density:** Wood density is a measure of its mass per unit volume. This density can vary depending on various factors, including tree species, tree growth, growing conditions, and even the specific part of the tree used. Here are some additional explanations regarding the difference in density between hardwood and softwood:

- **Cellular Structure:** Hardwoods and softwoods have different cellular structures. Hardwoods are characterized by denser, more closed, and often more compact cells, contributing to a higher density. In contrast, softwoods tend to have more open and less dense cells, resulting in a lower density.

Wood

Physical Properties:

- **Moisture Content:** Hardwoods generally have lower moisture content than softwoods. This may be due to a different cellular structure and distinct water absorption properties between the two types of wood. A lower moisture content contributes to a higher density.
- **Chemical Composition:** Hardwoods and softwoods have slightly different chemical compositions. For example, softwoods often contain more resin, which can slightly affect their density.
- **Growth and Age:** Growing conditions and the age of the tree can also influence wood density. For example, hardwood from an older tree may be denser than hardwood from a younger tree due to slower growth and accumulation of woody material.

The density of hardwood is generally higher than that of softwood due to differences in structural, compositional, and growth conditions.

Wood

Physical Properties:

2. Hardness: Generally, hardwood is recognized to be harder than softwood. This difference in hardness is due to several factors:

Cellular Composition: Cells in hardwood tend to be denser and have thicker cell walls compared to softwood. This increased density and thickness of cell walls contribute to greater strength and therefore greater hardness of hardwood.

Resin Content: Softwoods often contain a higher amount of resin, which can make the wood softer. Conversely, hardwoods generally have less resin, contributing to their increased hardness.

Wood

Physical Properties:

Types of Fibers: Fibers in hardwood tend to be longer and stiffer than those in softwood, making them more resistant to deformation and thus harder.

Specific Species: It's worth noting that hardness can vary significantly from one wood species to another, even within the categories of hardwood or softwood. Some hardwoods, such as oak and beech, are particularly known for their high hardness, while some softwoods, such as pine, can be relatively soft.

The increased hardness of hardwood compared to softwood stems from its denser cellular structure, lower resin content, and the nature of the fibers present. However, it's important to note that this generalization may vary depending on the specific characteristics of each wood species.

Wood

Physical Properties:

3. Resistance: Hardwoods tend to exhibit better tensile and compressive strength compared to softwoods. This difference in strength stems from the intrinsic characteristics of these two types of wood.

Hardwoods, such as oak, beech, and ash, are generally denser and have a more complex cellular structure, which gives them increased tensile and compressive strength. Their fibers are often longer and tighter, making them stronger and capable of bearing heavier loads in different directions.

Wood

Physical Properties:

On the other hand, softwoods, like pine and spruce, tend to be less dense and have shorter, less tight fibers. Although they are often used in construction due to their availability and ease of processing, their tensile and compressive strength is generally lower than that of hardwoods.
The difference in strength between hardwoods and softwoods is mainly attributable to their cellular properties and density, with hardwoods typically having better tensile and compressive strength.

Wood

Physical Properties:

4. Moisture Resistance: Moisture resistance varies depending on the wood species. Some softwoods, such as cedar and cypress, exhibit high natural resistance to moisture and decay due to their content of natural oils and protective chemical compounds. These properties make them particularly suitable for outdoor use, such as in deck construction, fencing, and exterior siding.

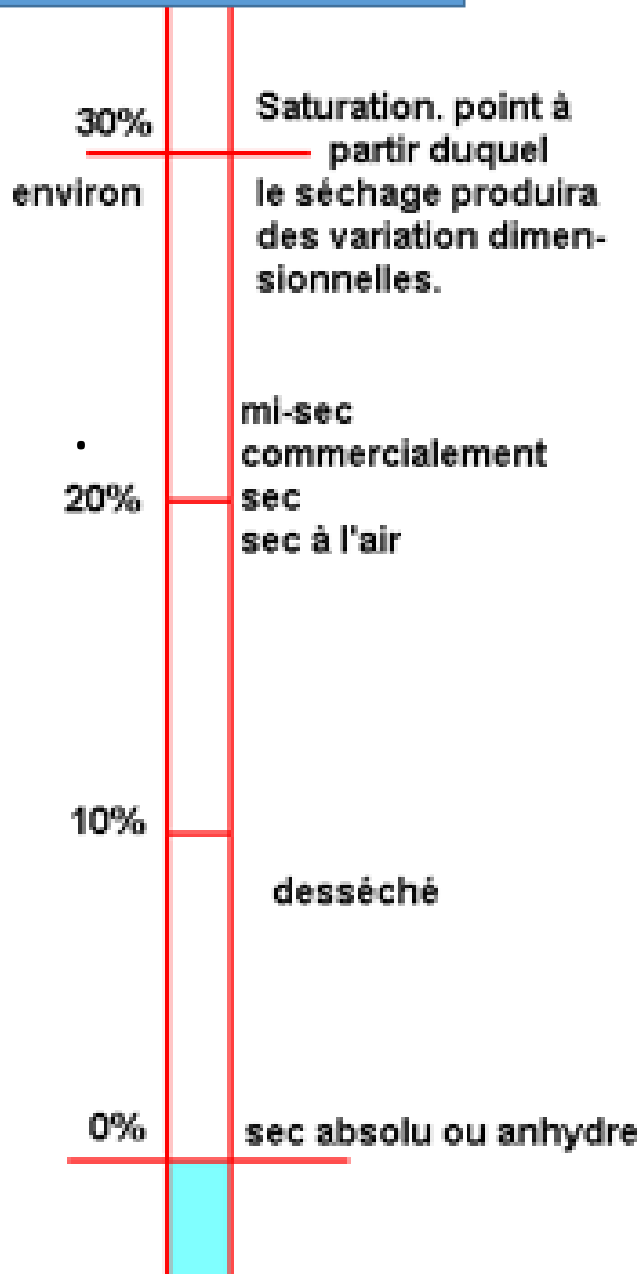
However, most woods, including hardwoods, can be prone to rot and degradation when exposed to humid conditions for extended periods. To enhance their moisture and decay resistance, it's common to treat them with antifungal and insecticidal chemicals.

Wood

Physical Properties:

This process, known as pressure treatment, involves injecting these products into the wood under high pressure, allowing them to penetrate deeply into the wood fibers.
Pressure treatment can significantly extend the wood's durability, making it more suitable for outdoor or humid environments. However, it's important to note that even with proper treatment, no wood is entirely immune to moisture and decay, and regular maintenance is often necessary to maintain its durability over time.

Wood



H > 30% Constructions en contact avec l'eau: pilotis, ponts, portes d'écluses.

25% < H < 30% Constructions en milieu très humide ou fréquemment exposées à la pluie.

20% < H < 25% Constructions non couvertes, non abritées : échafaudages, pylônes

17 % < H < 20% Constructions couvertes en locaux largement ouverts (hangar par exemple)

H < 17% Constructions en local couvert, clos, éventuellement chauffé. Dans ce cas il faut utiliser des bois amenés à. un taux d'humidité de 10 à 13%.

Physical Properties :

Moisture levels in accordance with usage conditions."