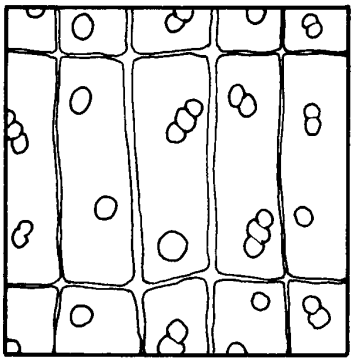
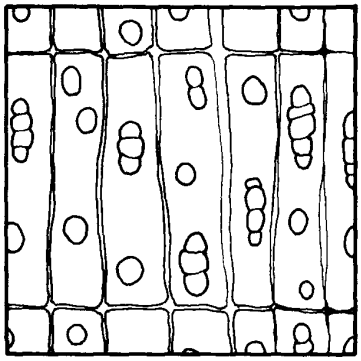
Glossary of terms used to describe wood

Distribution of vessels: This refers to the way in which vessels are seen in transversal section: solitary, oblique multiples, arranged radially or in groups.



vessels solitary and in
oblique multiples of 2 to 3

Figure 5

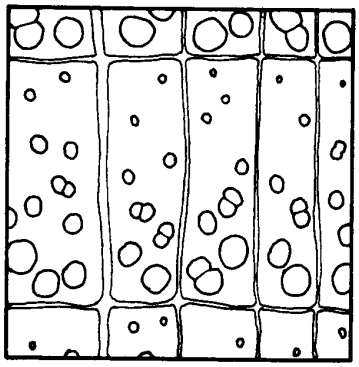


vessels solitary and in
radial multiples of 3 to 5

Figure 6

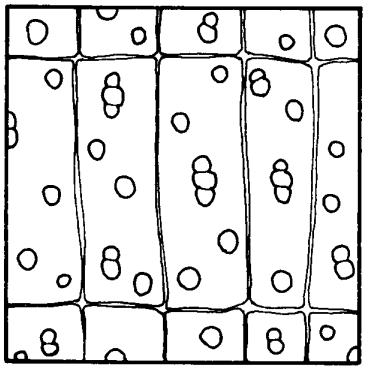
Ring porous wood: Hardwood in which the pores of the spring or early wood are noticeably larger than the fall or late wood, forming a well-defined area or ring (Fig. 7).

Diffuse porous wood: Hardwood in which the dimensions and distribution of the pores are similar throughout the growth ring (Fig. 8).



ring porous wood

Figure 7



diffuse porous wood

Figure 8

Fibres: A common term in the description of wood for any long and narrow cell of wood other than vessels and the parenchyma. In broad-leaved species, there are two basic types of fibres: libriform fibres and fibre-tracheid (Fig. 4).

Fibre-tracheid: Imperforate elements present in broad-leaved trees similar to a tracheid that usually have thick walls with small pitting (Fig. 4).

Libriform fibre: Imperforate elements usually with thick walls that have a simple pit in the longitudinal walls, (Fig. 4).

Growth rings: The concentric layers of wood produced during a single period (annual or seasonal) of growth of a tree.

Early wood: Wood formed inside a growth ring during spring and summer growth in temperate countries and during the rainy season in tropical countries. This is characterized by cellular elements of various diameters and large lumens with thin walls when viewed in transversal section.

Late wood: Wood formed within a growth ring during the end of the summer and autumn in temperate countries or during the dry season in the tropics. This wood is characterized by cellular elements of small diameters and lumens, as well as thickened walls when compared with early wood in a transversal section.

Heartwood: The central cylinder of a tree trunk, consisting of internal layers of wood. Heartwood contains no living cells. The dead cells are often used to store reserve materials which have been converted into heartwood substances. Heartwood is normally darker in colour than sapwood, although the difference is not always readily identifiable (see also sapwood).

Idioblast or **oil cell:** A special type of cell larger than the others found in the rays of broad-leaved trees and that contain oily substances. This type of cell is characteristic for some plant families.

Intercellular canal: Tubular intercellular space of indeterminate length that contain substances (gums, resins, etc.) produced by the epithelial cells that surround them. These canals can be a natural characteristic of the wood, but may also develop following damage caused by external factors (e.g. insects).

Lumen: The space enclosed by a cell wall.

Micron (µm): A unit of measurement in the metric system used for measuring cell components. It is one thousandth of a millimetre.

Parenchyma: Tissue formed by square or rectangular cells with simple pitting and whose main function is storage and distribution of food materials. The woody parenchyma can be divided into categories or types, which, in turn, can be further subdivided.

Apotracheal parenchyma: Tissue is arranged independently from the pores or vessels. (Figures 9 - 12).

a) **Banded apotracheal**: Axial parenchyma forming concentric lines or bands, as seen in cross section.

b) **Diffuse apotracheal**: One or a few cells distributed irregularly among the fibres (Fig. 9).

c) **Diffuse-in-aggregates**: The cells tend to grouped in short tangential groups (Fig. 10).

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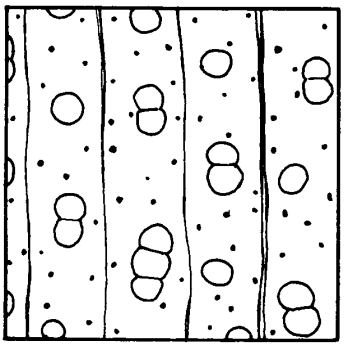


Figure 9

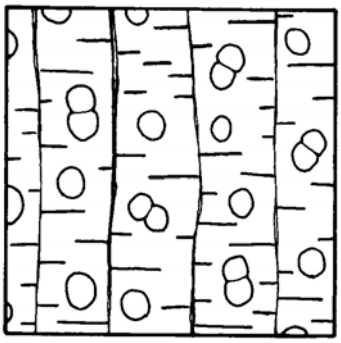
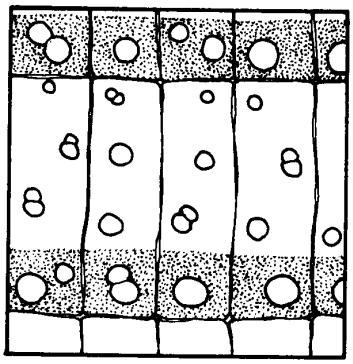


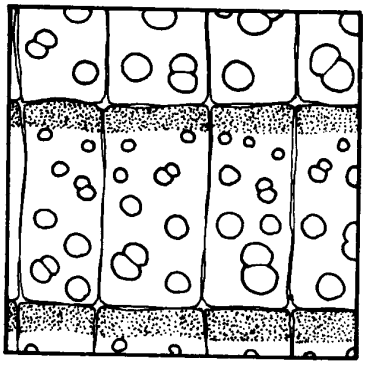
Figure 10

d) **Marginal**: Parenchyma cells occuring either singly or forming a more or less continuous layer of variable width at the beginning of a season's growth (Fig. 11; initial parenchyma) or at the close of a season's growth (Fig. 12; terminal parenchyma).



marginal (initial) parenchyma

Figure 11



marginal (terminal) parenchyma

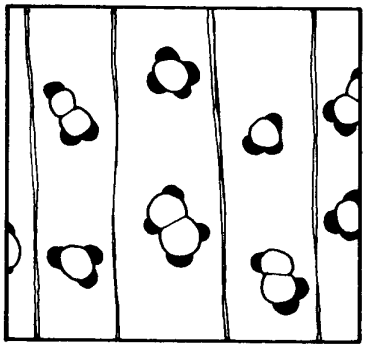
Figure 12

spring wood

Paratracheal parenchyma: When the tissue is associated with the vessels. This can be divided into the following main types: (Figures 13 - 17).

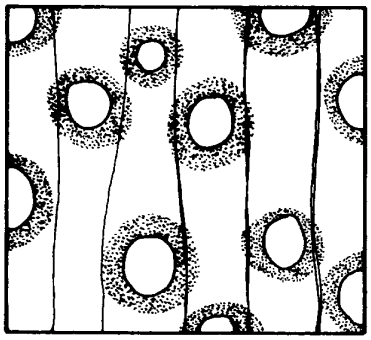
a) **Scanty paratracheal**: When the cells of the parenchyma are randomly arranged around the pores (Fig. 13).

b) **Vasicentric paratracheal**: Forming a complete sheath around the vessels of variable width, circular or slightly oval (Fig. 14).



scanty paratracheal parenchyma

Figure 13



vasicentric parenchyma

Figure 14

c) **Aliform/confluent paratracheal**: When the cells form extensions in the form of wings or when the wings become coalescent joining two or more pores without forming long, continuous bands (Fig. 15 and Fig. 16).

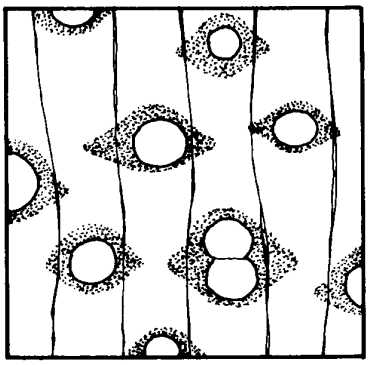


Figure 15

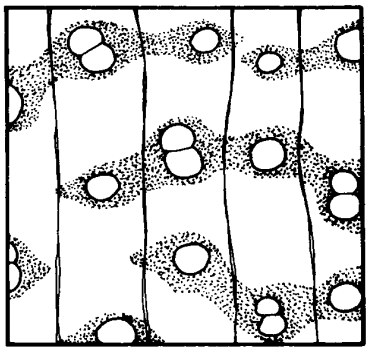


Figure 16

d) **Banded paratracheal**: Associated with the vessels, forming concentric bands. (Fig. 17).

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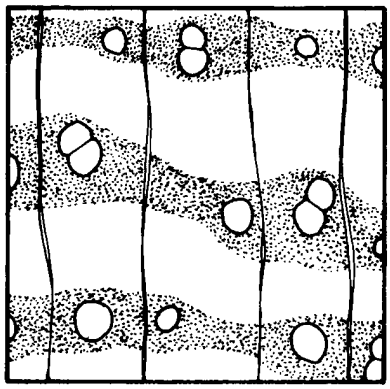
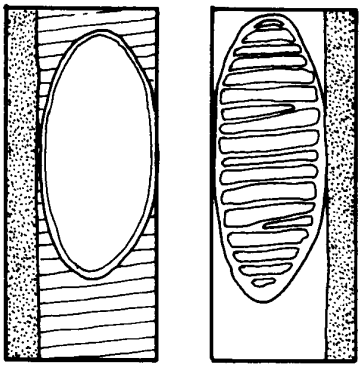


banded parenchyma

Figure 17

Perforation plate: An opening between two vascular elements. There are four types of perforation plates: simple, scalariform (a plate with multiple perforations elongated and parallel, the remnants of the plate between the openings are called “bars”), reticulate (a plate with multiple perforations having a net-like appearance) and foraminate (a plate having a small group of circular openings). The first two types are the most frequent.



simple perforation plate

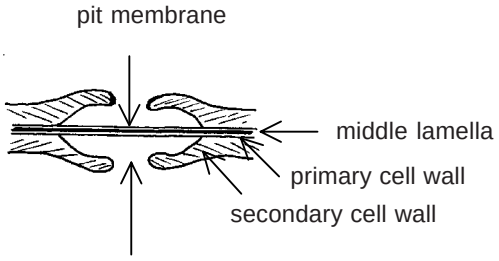
scalariform perforation plate

Figure 18

Phloem, included: A patch of phloem surrounded by secondary wood produced by abnormal secondary growth.

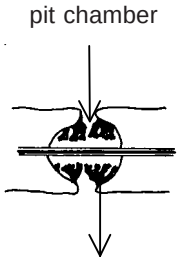
Pit: A perforation in the secondary wall of the cell, opening internally in the cell lumen, ending in the primary cell wall or pit membrane; a pit is usually connected to a similar pit in the wall of the adjacent cell. The two corresponding pits provide the possibility of transport of nutrients from one cell to another.

Bordered pit: A pit in which the membrane is overarched by the cell wall, forming a cavity, perforated at the tip leaving underneath a space or chamber. (Figure 20).



bordered pit

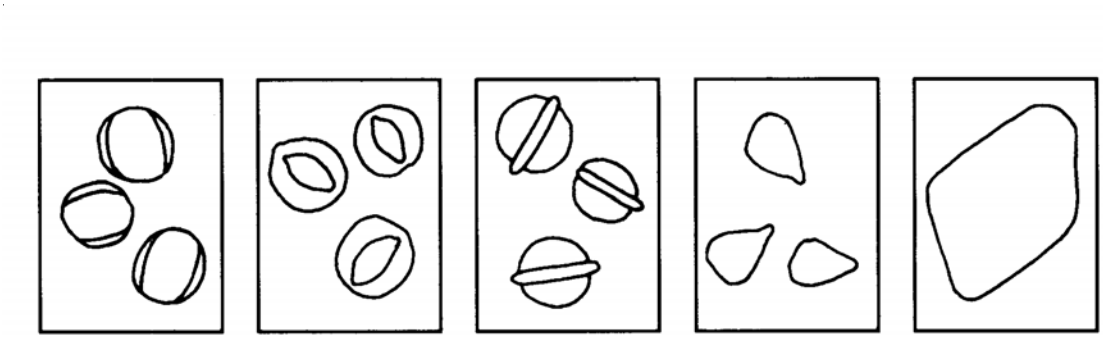
Figure 19



vestured pit

Figure 20

Cross-field pits: The area defined by the intersection of the walls of a longitudinal tracheid with a radial parenchyma cell. This is one of the most useful microscopic characteristics for the identification of non-porous wood. At the point of intersection, five types of pits can be identified that characterize the main groups of conifers: piceoid (*Picea, Larix* and *Pseudotsuga*); cupresoid (*Cupresaceae*); taxodioid (*Sequoia* and *Taxodiaceae*); pinoid (*Pinaceae*) and fenestrate (*Pinaceae*). (Figure 21).



piceoid cupressoid taxodioid pinoid fenestrate

Figure 21

Intervascular pit: Pits or small perforations in the walls between vessels. According to their arrangement in the walls of the vessels, the intervascular pits can be classified as scalariform, opposite and alternate.

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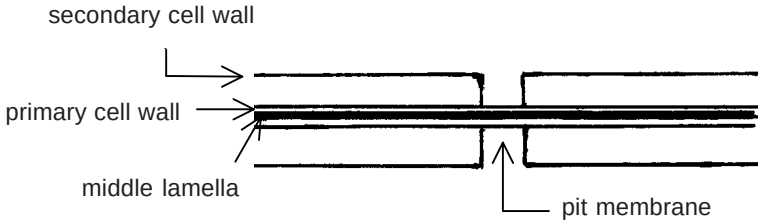
Simple pit: Simple interruption of the secondary wall that gives on to the cell lumen and does not form a cavity.



simple pit

Figure 22

Vestured pit: A bordered pit with the pit cavity wholly or partially lined with projections from the tertiary cell wall. (Figure 20).

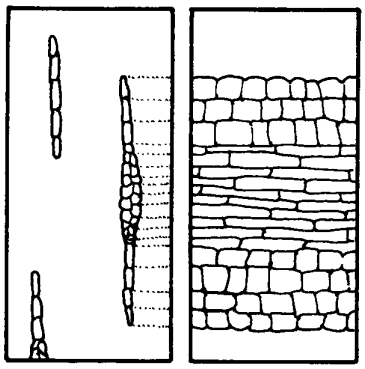
Pore: A common term for the transversal section of a vessel.

Rays: The series of parenchyma cells formed by the cambium that extend radially throughout the wood.

The descriptions below refer to individual ray types. There may be combinations or several types in most species of wood.

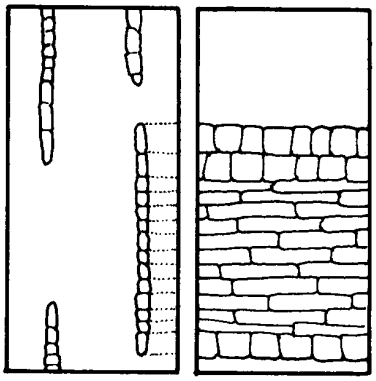
Aggregated ray: A group of woody rays that give the impression of being a very wide single ray.

Heterocelular ray: A ray formed by more than one type of cell. (Figures 23 and 24).



tangential radial

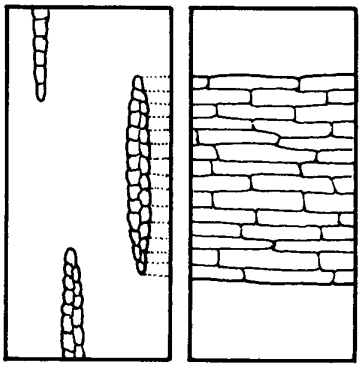
Figure 23



tangential radial

Figure 24

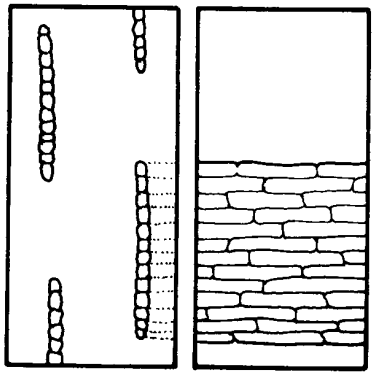
Homocelular ray: A ray formed by a single type of cell. (Figures 25 and 26).



tangential radial

multiseriate

Figure 25



tangential radial

uniseriate

Figure 26

Multiseriate ray: A ray more than one cell in width (seen in a tangential section) (Fig. 23 and 25).

Uniseriate ray: A ray only one cell in width (seen in the tangential section) (Fig. 24 and 26).

Sapwood (alburnum): The younger, softer living or physiologically active outer portion of wood that lies between the cambium and the heartwood. It is more permeable, less durable and usually lighter in colour than the heartwood.

Storied: A term used to describe the axial cells and rays when these are arranged in horizontal series as seen on tangential surfaces.

Tracheid: The imperforate conducting element of non-porous wood (conifers) that also fulfils the mechanical function of support; of relatively large dimensions characterized by the presence of ordered pits in its walls. The tracheids are the elements used to move water and nutrients from the soil to the green parts of the plant (Fig. 4).

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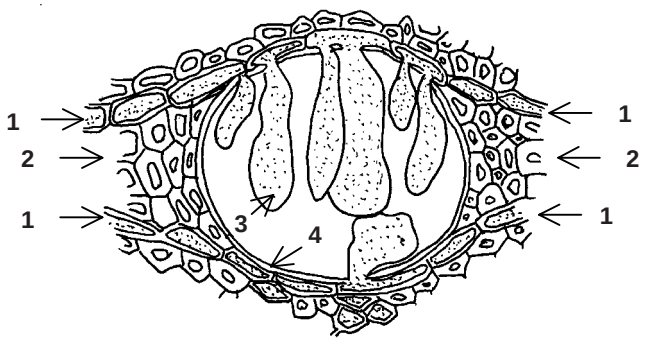
Tylosis: An outgrowth from an adjacent ray or axial parenchyma cell through a pit cavity in a vessel wall, partially or completely blocking the vessel lumen.

1. Parenchyma cells
2. Libriform fibres
3. Tylosis
4. Vessel wall



tylosis

Figure 27

Vessel frequency (porosity)**:** The number of vessels per square millimeter in a transversal section (see also: Distribution of vessels).

Vessel member: The special cell elements that have coagulated to form an articulate tube-like structure of indeterminate length (see also Fig. 4).

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Annex

Given the fact that wood is an object with a certain hardness (some more than others), wood offers resistance to being cut and thus most woods must be specifically treated to be soft enough to make very thin slices of it. Normally small samples of wood, usually 1 cubic centimetre, are used. This means pieces with faces of approximately 1 centimetre square, although slightly larger samples may be used.

There are several chemical treatments used to soften wood including a mixture of acetic acid and hydrogen peroxide as well as nitric acid. Most specialists prefer to boil samples in water over a period of two to four weeks for wood of medium hardness. Although empirical, the method used to determine whether a wood sample is ready to be sliced in thin sections is to firmly pass a thumbnail across a transversal section of the wood. If the wood registers a mark, the sample is ready for slicing. If there is no mark, then the wood should be boiled longer.

Once the sample has reached the correct softness for sectioning or cutting, it should be stored in a covered container in a mixture of distilled water and glycerine in equal proportions, especially if the sample is not going to be cut immediately.

In order to make precise cuts, it is necessary to have a sliding microtome, because the samples, although softened, always offer some resistance that can cause the knife's carriage to raise and lead to an accident (a too thick slice).

Before beginning an explanation of each of the characteristics that make possible the identification of wood, it is necessary to point out that there are three sections or basic planes used for the identification of the structures (see also figure 1).

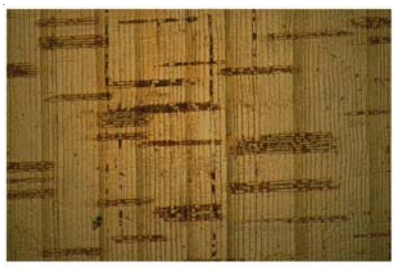
◊ **Transversal section:** With the help of a magnifying glass, identify the cross section in which the vessels or pores of broad-leaved trees or the tracheids, in the case of conifers, are cut in cross section and appear as small holes and the woody rays as lines that cross them. Once identification has been made, the sample is positioned in order that the knife is perpendicular to the axial parts and parallel to the woody rays.

◊ **Tangential longitudinal section:** Using a magnifying glass, look for the surfaces of the sample that have axial elements running parallel to the surface and wood rays arranged in bunches or short lines.

◊ **Radial longitudinal section:** With the help of a magnifying glass, inspect the faces of the block with the axial elements in the same direction and the wood rays forming light and dark bands.

transversal or cross section

tangential section



radial section

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Timber identification: Technical properties 25

Technical properties

A. Toughness

The combination of the various types of cells that compose the total structure of wood, also offers a means to identify species or groups of species. The combination of cell types make a particular wood very suitable for flooring, but not for construction, for making wooden shoes but not for exterior wall decoration (bridges, walls of ditches) or for use inside only, etc. This section is rather technical but certainly relevant in wood identification.
Toughness is the quality of resistance of a particular wood to penetration by another specific body. A more technical definition is that hardness is the resistance of a surface to aggression at a very localized point.

In wood, hardness is especially important in relation to the ease or difficulty that a surface offers to being worked with tools (adze, axe, saw or chisel).

Toughness, like other properties of wood, varies depending on the direction of the fibre in the surface in question.

Axial toughness is usually 1.5 to 2.5 times the hardness of the surface perpendicular to the fibre. There is little appreciable difference between tangential and radial toughness. In addition, toughness quickly decreases with an increase in humidity.

In summary, the toughness of wood is directly proportional to specific weight and is a reliable key to identification, taking into account seasonal variation.

B. Density (or specific weight)

In spite of variation such as the influence of humidity within a species, this characteristic is a very useful complement for the identification of species of wood. In cases where density is extreme (<0,35 or > 0,9 g/cm^3), this physical property is very important.

The property of specific weight, namely the physical relationship between weight and volume, has special characteristics that, for wood, are used in a practical interpretation.

It should be kept in mind that specific weight (in the metric system) is the weight of a cubic centimetre of material compared to the weight of one cubic centimetre water but relative specific weight, for wood used as “its density” is the relation between weight and volume. In the timber industry, this is a very important characteristic of wood.

By definition, Density is: $\rho = \frac{weight}{volume}$ (in kg / in m^3)

For wood, volume and weight are influenced by ambient humidity. In order to obtain comparable results, it is necessary to specify the conditions of ambient humidity under which the measurements determining the density are made. As reference points, rates of 0 per cent and 12 per cent humidity are used as a standard, but other humidity values are used as well.

The value found at 0 % humidity is called anhydrous weight and that found at 12 per cent humidity is called normal specific weight. They are represented in this text by ρ_0 and ρ_{12}, respectively.

With regard to volume, wood being the porous body that it is, will have an apparent volume and a real volume. What is left after discounting the interior spaces (eliminating the volume of intercellular spaces and that of the space in individual cells, but also the ultramicroscopic ones; in fact, any space that can be infiltrated by a liquid like water) is called real volume. The one including the interior spaces is called apparent volume.

Any increase in volume caused by increased humidity is slight. It increases until the wood reaches a percentage of humidity that corresponds to the point of saturation of the cell wall; (water or preserving liquids) approximately 30 per cent for all the species for which technical calculations are made. After this point, volume remains constant because the water that penetrates the lumen of the cells does not produce a swelling of the cell wall. The value of 30 per cent is a value to be used in practice, although each species has a specific saturation point for its cell walls. This makes wood, once it has been treated properly, such an excellent material for utilization under many different conditions related to the different properties of the species used.

These standards are not constantly applicable, since for some woods volume continues to increase until reaching a maximum of water content for the species.

Commercial specific weight

Commonly known as the commercial density, commercial specific weight is an approximate value used for calculations in commercial transactions. This usually refers to dry wood at ambient humidity.

The following values are used as standards (expressed in kg/m3):

Resinous	520
Tropical broad-leaved trees for growth	850
Tropical broad-leaved trees for sawing	900

Various studies have shown that the specific weight of summer wood in conifers is equal to approximately 2.5 times that of spring wood. As a result, the apparent specific weight of conifers depends on growth conditions.

Magnitudes

Weight is measured using sufficiently sensitive scales and applying pertinent standards. Weight is measured with accuracy to within 0.01g.

Humid weight is determined directly in the first instance, and then is corrected to the value for a humidity of 12 per cent.

Anhydrous weight is obtained by drying a sample in an oven at 103° ($\pm$ 2°C), until a constant weight is reached, indicating that the wood has no more water to lose.

Volume may be measured using two different methods: the stereometric method - the direct measurement of the dimensions of a sample - or the method using the displacement of a liquid or gas of known specific weight. The first method requires the careful preparation of the sample in order to avoid cracks or bulges. The measurement of precise dimensions is difficult and complicated. In light of this, this method is not usually used; the method of displacement is preferred.

Measurement by displacement is basically the use of a wood sample to displace a volume of liquid that is measured as accurately as possible. Interaction between the displaced fluid and the sample whose volume is being measured has an important influence on the result. The hygroscopic characteristics of wood make the use of water inadvisable. The use of substances as grease, oil and paint to prevent the wood from absorbing water does not really overcome the inconveniences of this method.

Mercury is usually used to determine apparent volume of wood by displacement as well as helium which has small molecules that are neither absorbed nor retained by wood to determine real volume.

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