

Introduction to Wood Science and Overview of wood based Industries in Sri Lanka

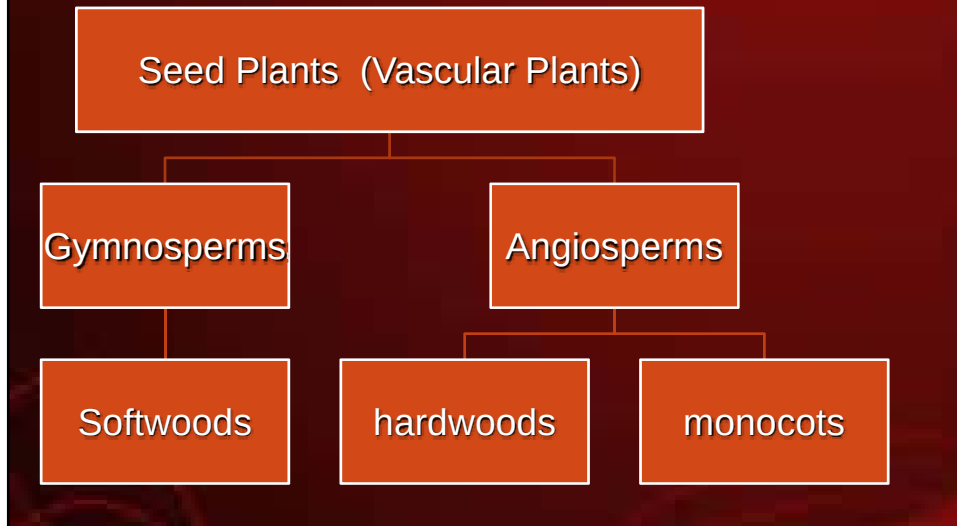
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Environment Science
University of Sri Jayewardenepura

Capacity Building Workshop on Modern
Technologies for Wood Based Industries
25th to 27th September 2013

at Department of Forestry and Environmental
Science, University of Sri Jayewardenepura

Organized by
Center for Sustainability

Types of **timber** producing trees



Softwoods

Conifers (Pine, Cypress)



Softwoods – Needle like leaves



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hardwoods

Broad leaved trees (Jak, Mahogany, Teak, Lunumidella, Rubber, Milla)



Hardwoods – Broad leaves

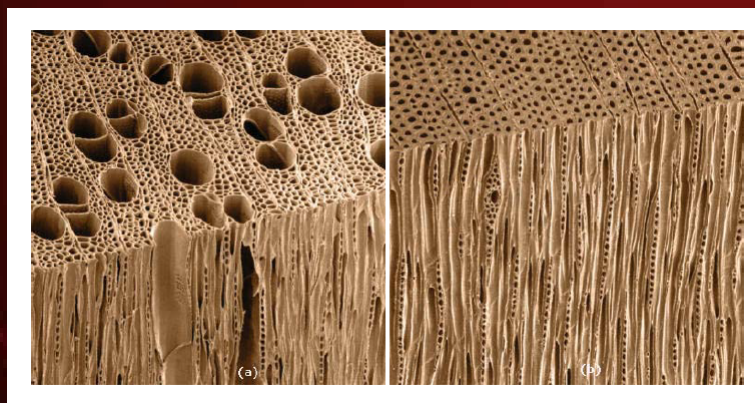


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Anatomical structure of hardwoods and softwoods

- Hardwoods – vessels | Softwoods – tracheids



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Monocots

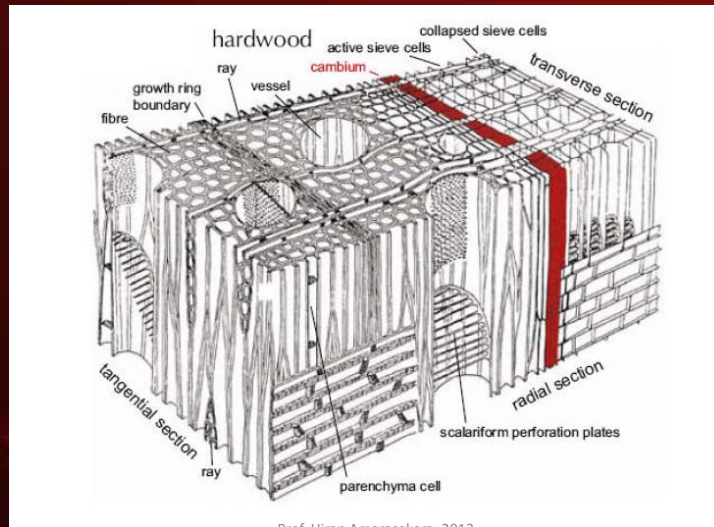
Palms (coconut,
Palmyra)
and
grasses
(bamboo,
rattan)



Gross features of wood

Wood is made up of cells

Microscopic structure of hardwood

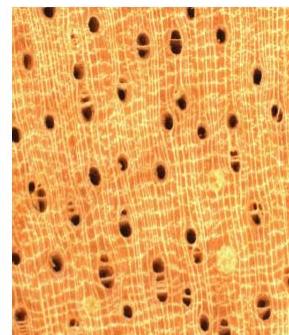


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Wood identification is based on anatomy and gross features of wood

- Birch
- Rubberwood



Reticulate parenchyma
(Rubberwood)

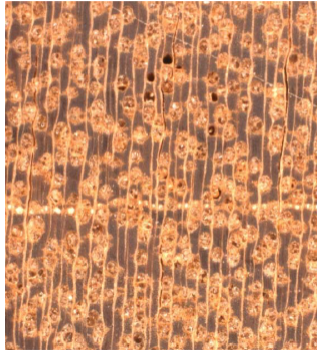
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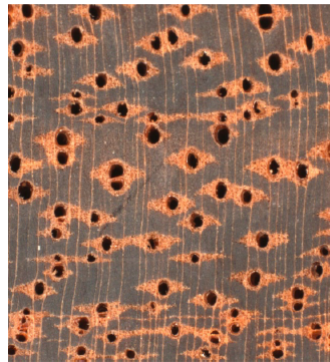
Identify using end grain

- Tangential resin canals
- Aliform paranchyma

Balau



Kempas



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Kempus and Tualang



Anatomy of unknown timber



From reference collection (Tualang)

- Many cannot identify imported timber correctly in Sri Lanka

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Growth Rings

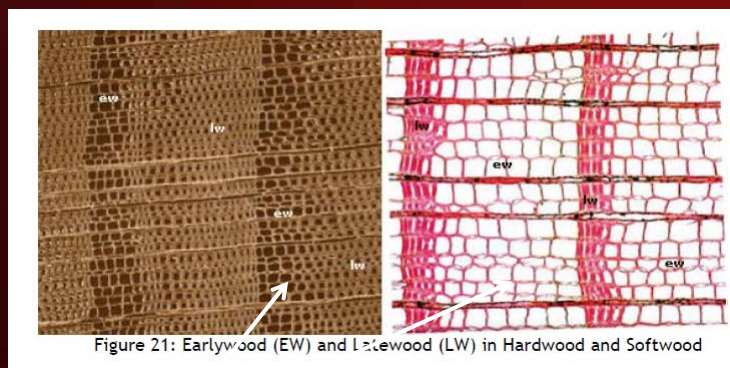


One growth ring is added per year in temperate countries

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Earlywood and Latewood

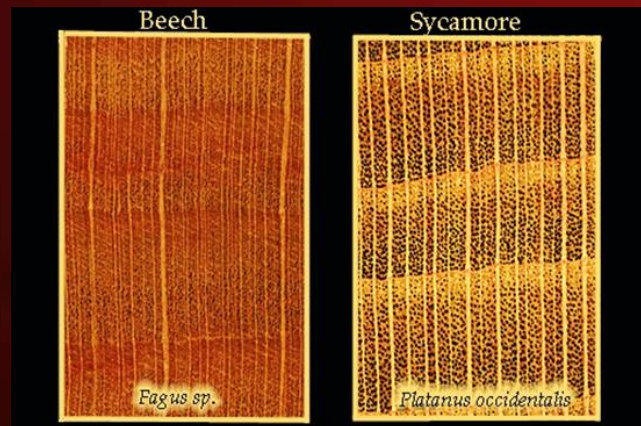


Early wood – light colour, wider cells, thin walls

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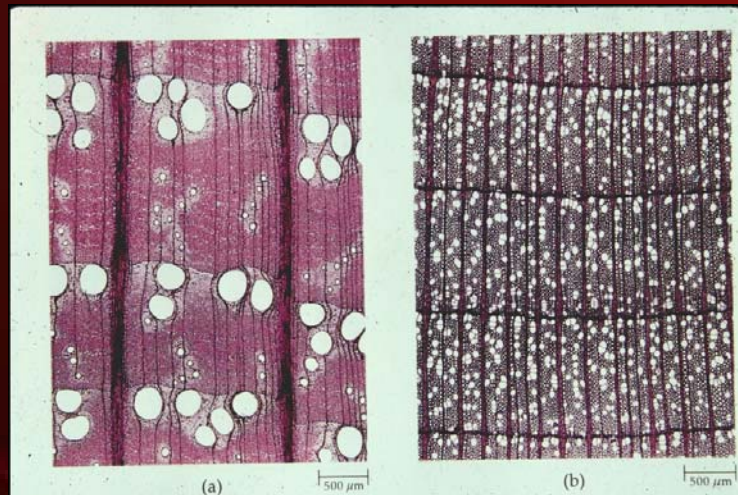
Diffuse porous and ring porous



Ring porous timbers have distinct earlywood and latewood.

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Ring porous and diffuse porous

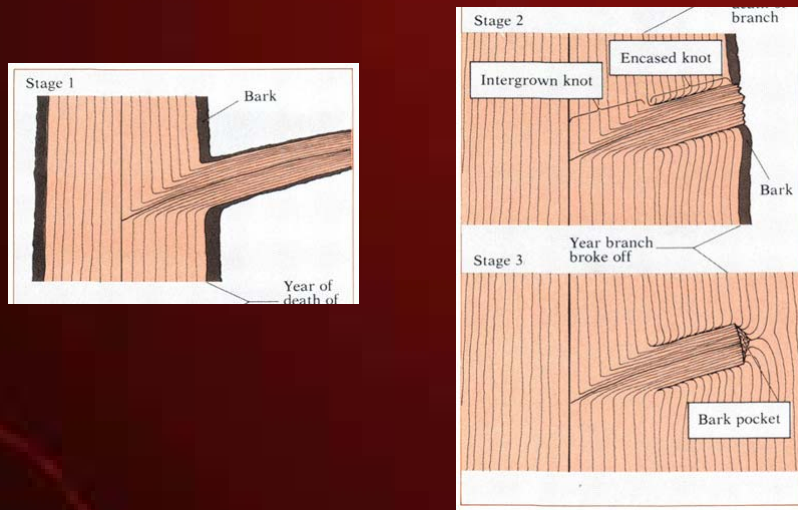


Many Sri Lankan timbers are diffuse porous

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Knots are embedded branches



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Knots

Knot in Hardwood and Softwood

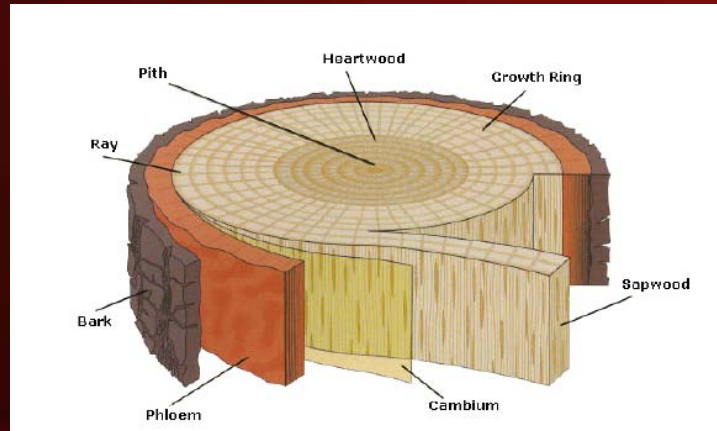


Pruning can reduce formation of knots in trees

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Sapwood and Heartwood



Heartwood is darker and more durable

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Wood is
anisotropic

Different
properties along
3 planes

1. Transverse
2. Radial
3. Tangential

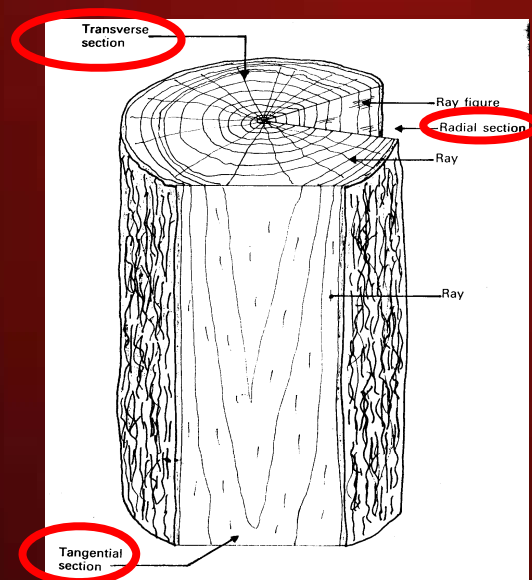


Fig. 12 Log sections:
Transverse = End Grain
Tangential = "Plain Sawn"
Radial = "Quarter Sawn" or "Rift Sawn".

Growth rings and grain

- Growth rings

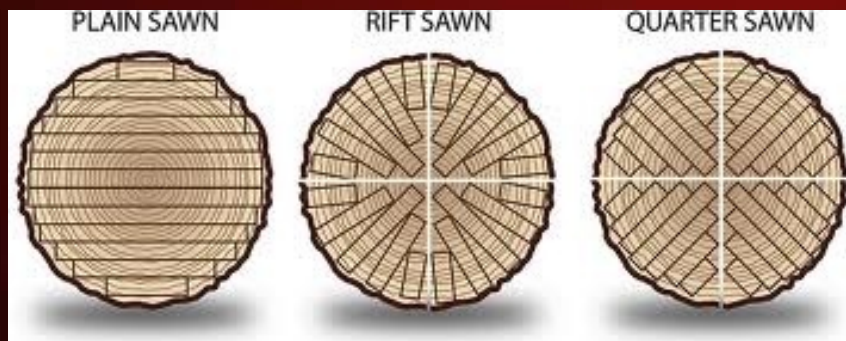


- Grain



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Sawing methods and grain

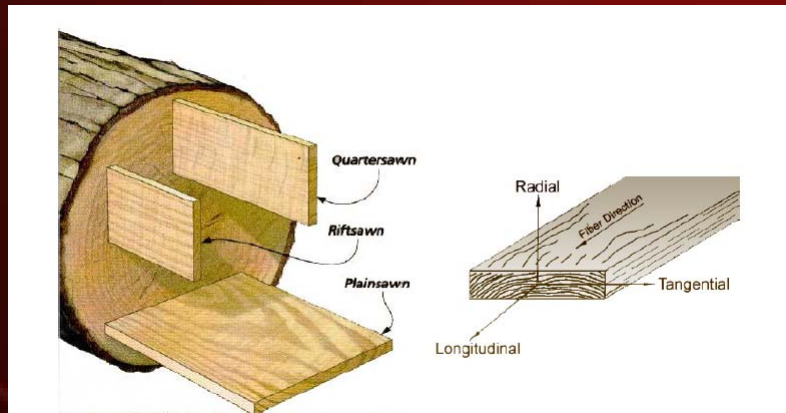


Most sawn timbers are **Plain Sawn** in Sri Lanka

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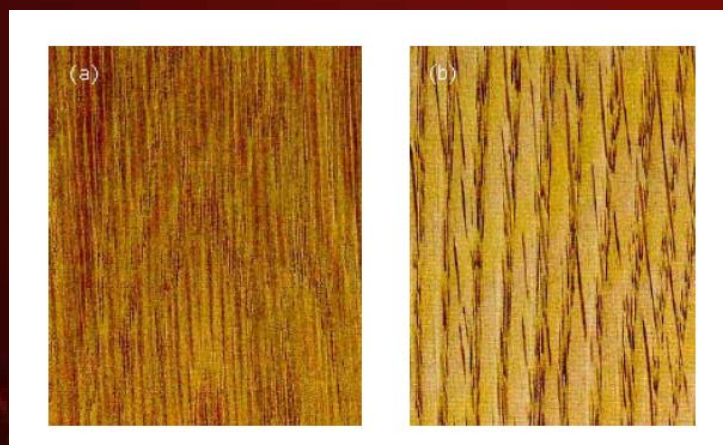
Sawing and grain



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Fine grained wood and coarse grained wood

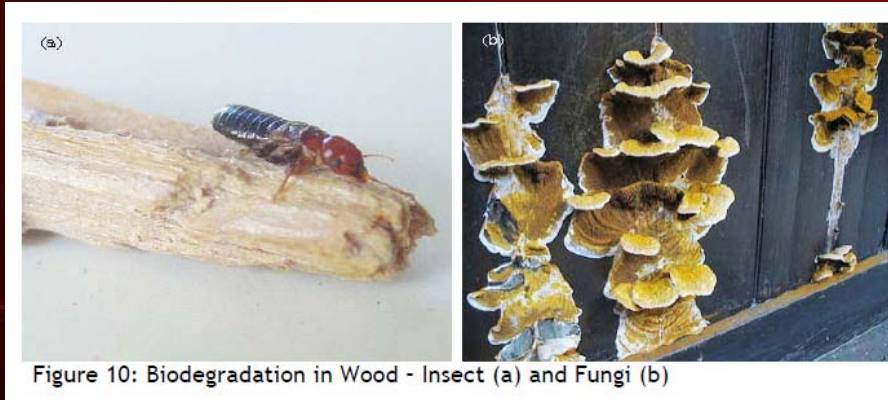


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Enemies of wood

Insects and Fungi



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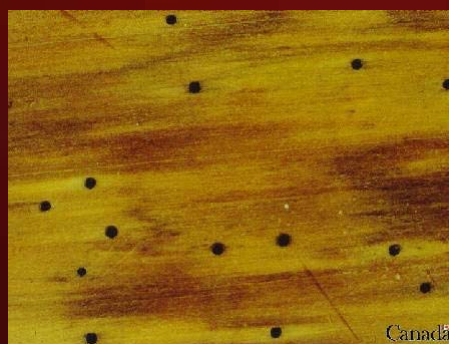
Insect attack by Beetles



Figure 5.2 *Platypus parallelus*, an ambrosia beetle borer of the family Platypodidae



Figure 5.3 Black stained bore holes and tunnels of ambrosia beetle infestation



Canada

Insect attack - Termites



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Fungal attack – mold and staining fungi



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Fungal attack – rotting fungi



Fungal attack can be prevented by maintaining
dry conditions

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Durability of a timber can be changed by wood preservation



CCA treatment @ Finlay Rentokil, Wattala (2009)

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Creosote treated Poles @ State Timber Corporation

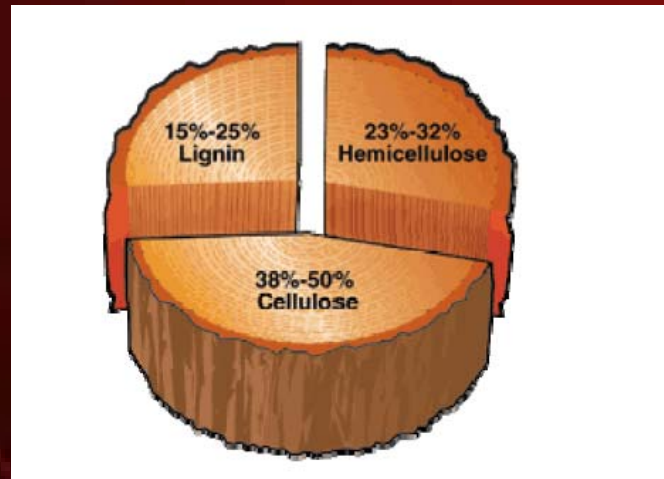


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Properties of wood

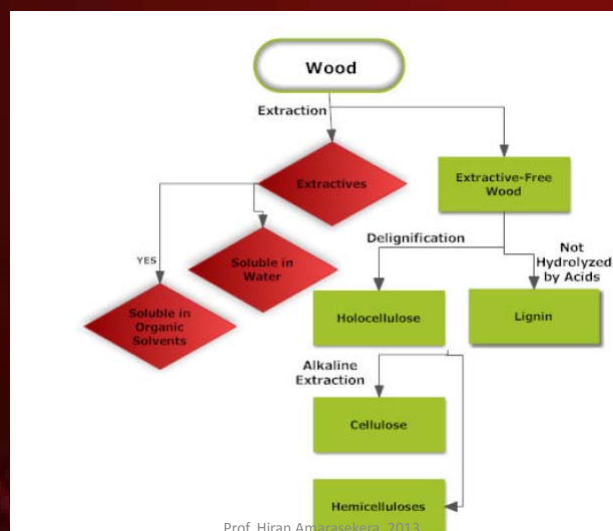
Chemical Composition of wood



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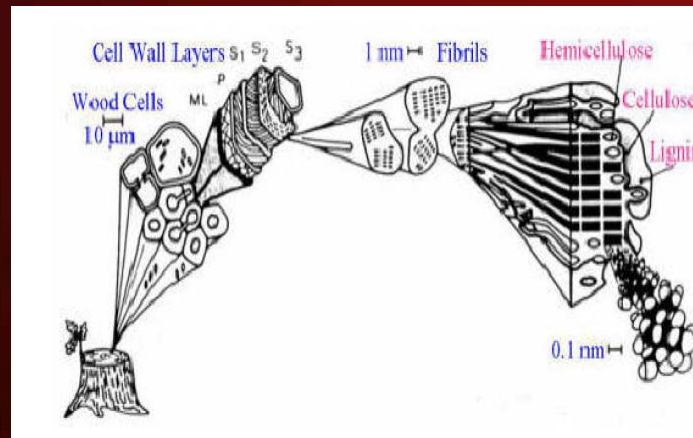
Separation of chemical constituents of wood



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'Steel reinforced concrete' analogy to structure of wood



Wood has high strength to weight ratio

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Wood Moisture content

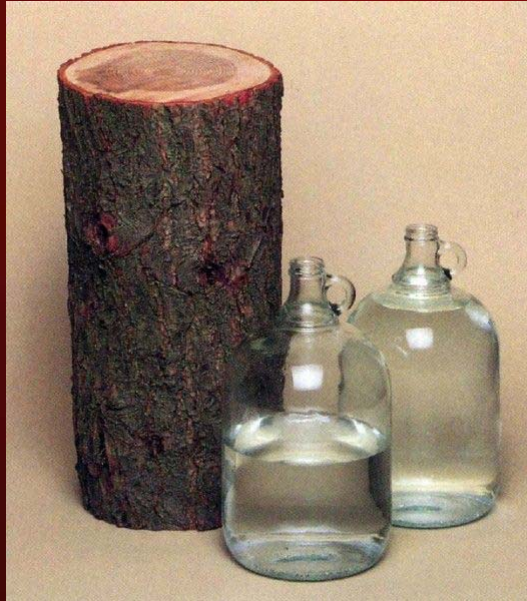
- Wood is Xylem, water conducting tissue in tree
- Living trees may contain more than 200% moisture content

$$\text{Moisture content} = \frac{\text{weight} - \text{dry weight}}{\text{dry weight}}$$

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Moisture in wood



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Moisture meters



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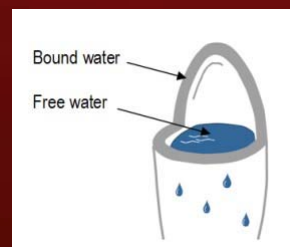
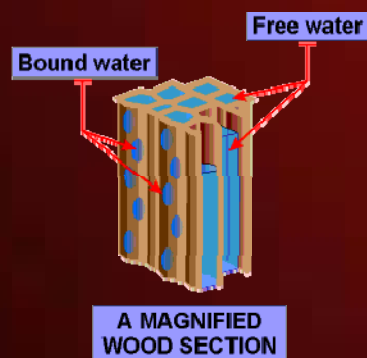
Removing moisture by Air seasoning and Kiln seasoning



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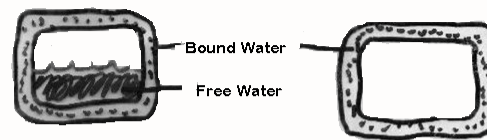
Free water and bound water in wood



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Fiber saturation point



FIBER SATURATION POINT –

ALL FREE WATER IS REMOVED AND ALL BOUND WATER IS STILL PRESENT

GENERALLY CONSIDERED TO BE 30 %

$$MC = \frac{\text{Wet Weight} - \text{Dry Weight}}{\text{Dry Weight}} \times 100\%$$

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- Wood holds moisture in two ways: as free water in cell cavities and as bound water in cell walls.
- As wood dries, free water is expelled first. When this is all discharged, the wood reaches what is termed its fiber saturation point (FSP).

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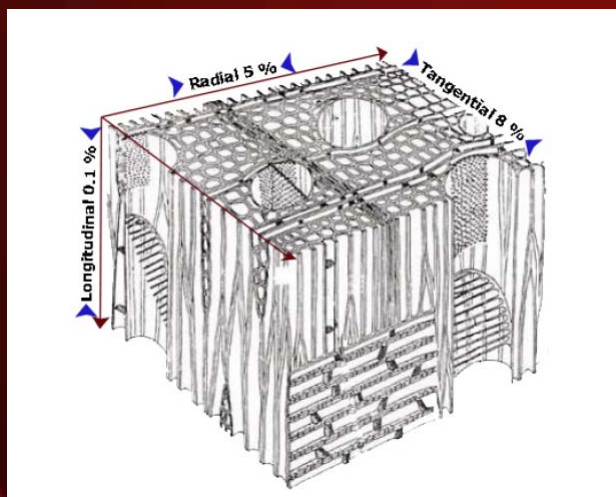
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- At FSP, the cell cavities are empty, but the bound water remains, permeating the cell walls.
- For most woods, the FSP occurs between 23 percent and 30 percent moisture content.
- At the fiber saturation point, there is no dimensional change in wood

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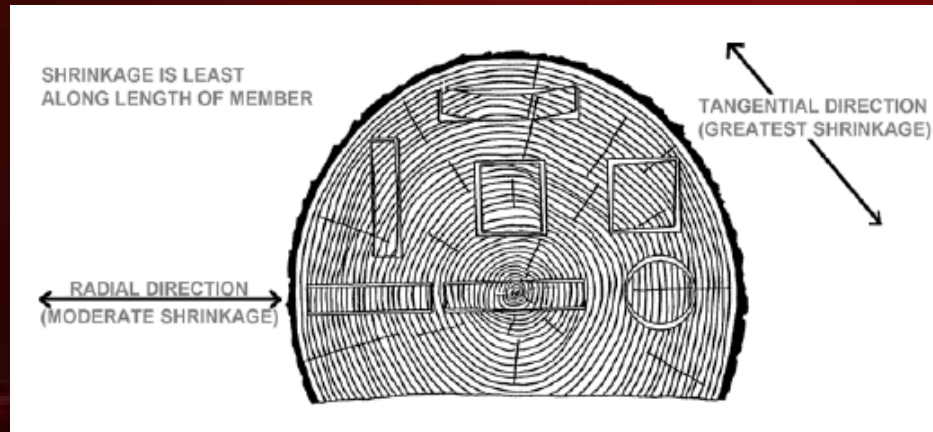
Differential shrinkage in wood



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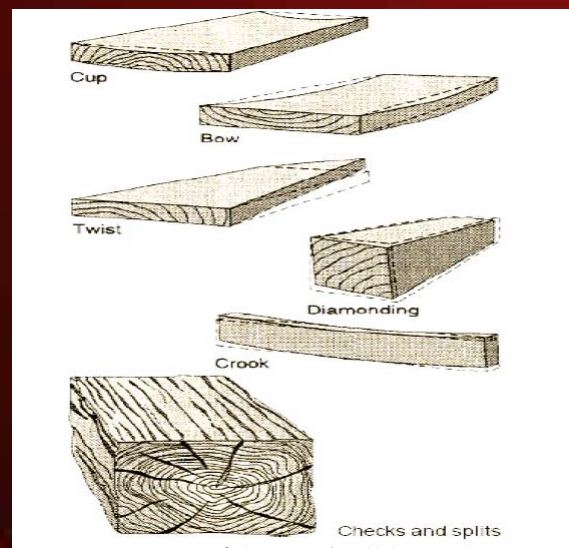
Shrinkage and distortion affected by direction of growth rings.



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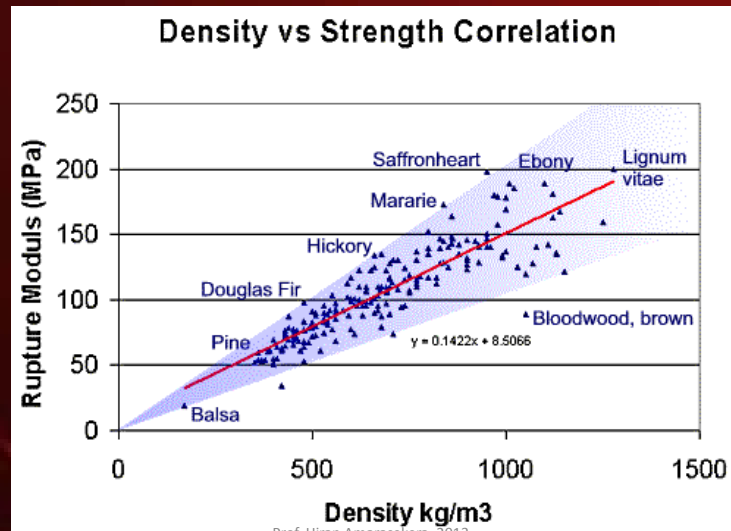
Warping and splitting in drying



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Density is related to strength



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Density of Sri Lankan Timbers

Table 01. Classification of timbers according to density

Species	Common Name	Density in Kg per cubic meter
Light (<500 kg/m³)		
<i>Paraserianthes falcata</i>	Albizia	189
<i>Melia dubia</i>	Lunumidella	305
<i>Pinus caribaea</i>	Pine, Rata amba	413
<i>Anacardium occidentale</i>	Kadju	421
<i>Cedrella toona</i>	Toona	424
<i>Cupressus macrocarpa</i>	Cypress	441
<i>Pinus patula</i>	Pine	495
Moderately Heavy (500- 650 kg/m³)		
<i>Hevea brasiliensis</i>	Rubber	513
<i>Pinus insularis</i>	Pine	513
<i>Swietenia macrophylla</i>	Mahogany	559
<i>Eucalyptus grandis</i>	Grandis	575
<i>Artocarpus heterophyllus</i>	Jak	591
<i>Mangifera indica</i>	Mango, Amba	598
<i>Michelia champaca</i>	Ginisapu	613
<i>Gravillea robusta</i>	Sabukku, Silky oak	622

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Density of Sri Lankan Timbers

- Heavy timbers in Sri Lanka

Heavy (> 650 kg/m ³)		
<i>Alstonia macrophylla</i>	Alstonia,	659
<i>Thespesia populnea</i>	Gansooriya	684
<i>Tectona grandis</i>	Teak	745
<i>Eucalyptus robusta</i>	Red gum	755
<i>Eucalyptus microcorys</i>	Tallow wood	781
<i>Eucalyptus globulus</i>	Blue gum	809
<i>Eucalyptus pilularis</i>	Black butt	849
<i>Eucalyptus citradora</i>	Lemon-scented	869

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Mechanical Properties

- Strength
- Elasticity
- Toughness (Less brittle)
- Density is related to many mechanical properties of timber

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Tension in wood Perpendicular and Parallel to grain



Compression strength – Perpendicular and parallel to grain



Bending strength - stiffness



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Wood Based Industries in Sri Lanka

Wood Based Industries

Solid wood

- Sawmilling
- Furniture
- Parquetry

Wood Based Panels (composites)

- Plywood
- Particle board (chipboard)
- MDF
- Pulp and paper

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Sawmilling – Circular saw (Nittabuwa)



Many logs in Sri Lanka end up in a sawmill

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Sawmilling – Frame saw (Moratuwa)



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Furniture



Moratuwa has a traditional furniture cluster

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Furniture – New designs



Furniture industry needs new designs and innovation to compete with imported products

Wooden crafts



<http://www.slideshare.net/sahan/wooden-toys-in-sri-lanka>
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Plywood



There are few private plywood mills mainly based on rubberwood

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Particle board (Chipboard)



Chipboard furniture is very popular in Sri Lanka

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MDF (Fiber board)



One MDF mill in Sri Lanka

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MDF (Fiber board)



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Pulp and Paper



Forestry sector did not produce raw material to
our pulp mills (Embilipiya mill)

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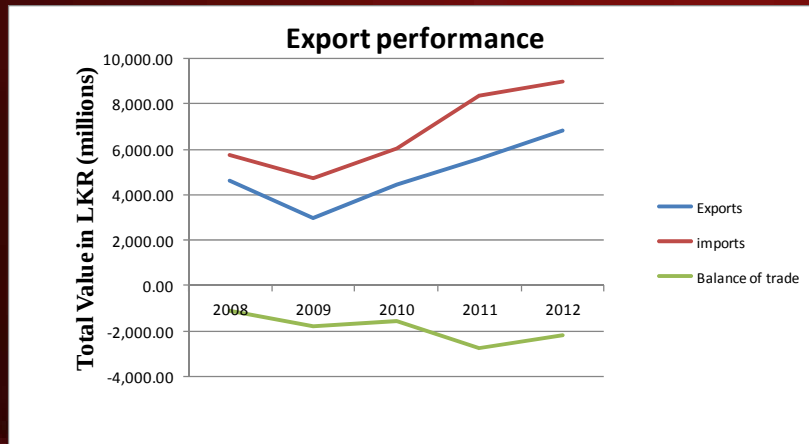
Key wooden products exported from Sri Lanka

- Furniture
- Parquet for flooring
- Brush handles
- Wooden panels
- Wooden toys

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Wooden product exports



- Information Technology Division /Sri Lanka Export Development Board
- H.44 Wood and articles of wood; wood charcoal

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