



Ethiopian TVET-System



Furniture Making L-I

Based on Sept. 2012 G.C. Occupational standard

Module Title: Selecting Material for Furniture Production

TTLM Code: IND-FMK1 TTLM 0919v1

This module includes the following Learning Guides

LG14: Determine materials requirement

LG Code: IND-FMK1 M05 LO1-LG-014

LG15: Evaluate selected materials

LG Code: IND-FMK1 M05 LO2-LG-015

LG16: Treat affected timber

LG Code: IND-FMK1 M05 LO3-LG-016

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Instruction Sheet	LG14: Determine materials requirement
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This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- Observing relevant safety rules/OHS structure of wood
- Properties of wood
- Differentiating hard wood and soft wood
- Indigenous trees and exotic
- Manufactured material

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- Observe relevant safety rules/OHS structure of wood
- Properties of wood/stock
- Different hard wood and soft wood
- Indigenous trees and exotic
- Manufactured material

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 7.
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1” **in page -.4**
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check
6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

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Information Sheet-1

1- Observing relevant safety rules

Safety rules

Safety ; is appreciation to avoid accident (the person /human being, the wood

General safety rules

➤ **Always dress properly**

- ✚ Over all gown (apron)
- ✚ Eye protection (goggle)
- ✚ Ear protection
- ✚ Dust musk (mouth musk)
- ✚ Head protection (helmet)
- ✚ Hand protection (glove)
- ✚ Foot protection (safety shoe)

➤ **follow direction**

- ❖ study the properties of lumber/timber/wood
- ❖ Arrangement /ordering than separate the timber /wood.
- ❖ Use safe cutting system
- ❖ Clean work shop area
- ❖ Prepared first aid kit (box) in the work shop.
- ❖ Keep your work bench.
- ❖ In general safe all raw materials , machines tools measurements
- ❖ **Learn to us the tools /timber correctly.** Use the timbers for their intended purpose /function.
- ❖ **To avoid horse ply**
- ❖ **Report all accidents** (daily problems)



Self-Check -1

Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Short answer

1. Write the personal protective Equipment(PPE)
2. Write at least four Effective follow direction(OHS)

Note: Satisfactory rating - 3 points

Unsatisfactory - below 2 points

Answer Sheet

Score = _____

Rating: _____

Name: _____

Date: _____

Short Answer Questions

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Introduction:

Wood: is one of the most variable resources of, the world they are 100,000 species in the world. There are more than 320 trees pieces are present (living trees) in forest of Ethiopia, but the only (not all woods) trees are used in furniture products (lumbers) made in manufactures products. Wood is it has different unique, properties, qualities, structures & functions.

I. structure of wood

These features of wood, which can be seen by naked eye many of these can be best, studied on the cut end surface

The age of plant is determined by the number of annual growth ring.

These macroscopic structures of wood describe in to the following groups.

1. Pith
2. Sap wood
3. Heart wood
4. Bark
5. Growth ring
6. Modularly rays

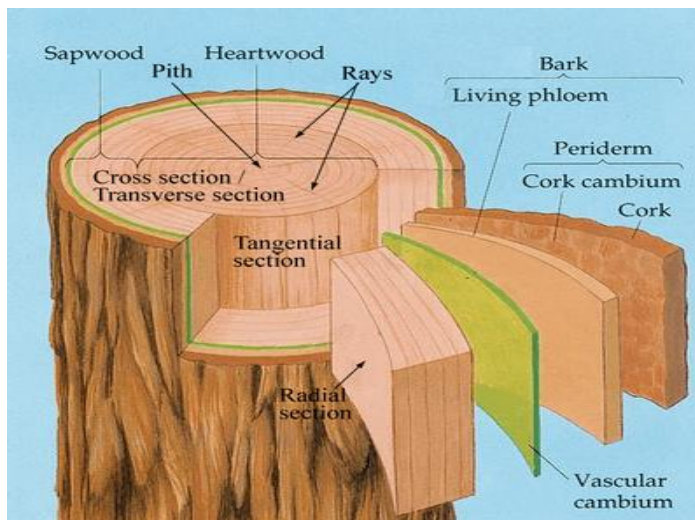


Fig 1 the cross sectional part of the wood

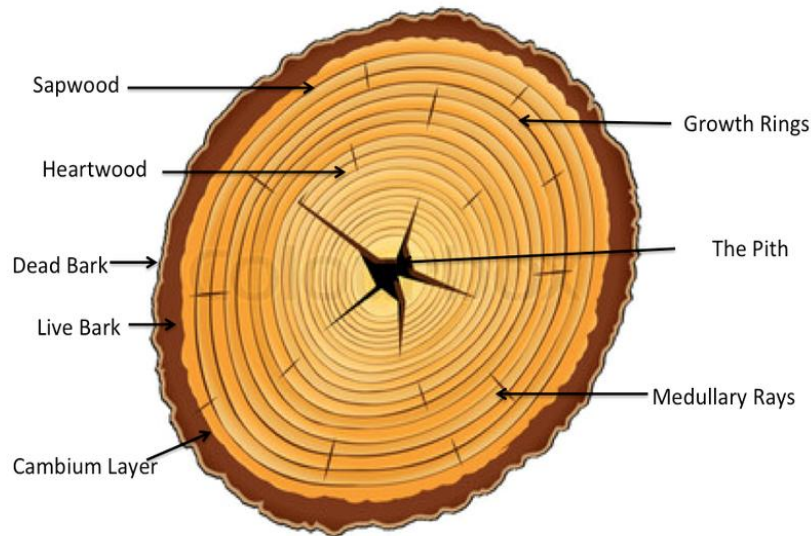


Fig 2 the cross sectional part of the wood

1. **Pith:** is the inner (internal) smallest soft mass of tissue plant. Its size, shape, colors, structures vary in different species. Colors light brown, yellowish, and grayish.
2. **Sap wood:** The light colored outer portion of a tree log consists of the youngest growth ring. It has storage & conduction of sap (nutrients).
3. **Heart wood:** is the dead tissue which does not take any active part in the life of the tree except to provide mechanical rigidity to the stem & support the crown. Heart wood is more durable than sap wood. The greater durability of heart wood is often attributed to the presence of chemical deposits, such as gums, resins & oils.
4. **Bark:** it varies in thickness, color, appearance in different species.

It has two regions

- I. **Outer bark** protected zone of corky nature consists of dead & dying cells. Smooth cells, fissure, Cracks.
- II. **Inner living portion**, which is actively associated with conduction & storage of food materials, for growth.

The arrangement of the parts from inner age to outer age is

The age of plant is determined by the number of annual growth ring.

5. **Growth ring:** These are concentric rings, which usually represent the wood formed during growing season, including annual rings.



Self-Check -2

Written Test 2

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Matching

A			B	
	1	Hard wood	A	The middle part of the tree used of Lumber
	2	Soft wood	B	The central part of the tree
	3	Moisture content	C	The amount of water in the wood
	4	Pith	D	The layer of growth one year
	5	Annual ring	E	Broad flat leaves,
	6	Heart wood	F	Strong and dark color part of the tree
	7	Trunk	G	Light color and soft tissue
	8	Sap wood	H	Needle/ tin leaves

Note: Satisfactory rating - 8 points

Unsatisfactory - below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____

Date: _____

Types of wood

There are over 320 timber species found in Ethiopia,

Wood separated into two broad groups based on seed types:

1. **Soft wood (gymnosperms)**
2. **Hard wood (angiosperms)**

Soft wood (gymnosperms)

Softwood is collected from conifer trees which are evergreen having needle-shaped leaves. these are generally gymnosperms.

- There are coniferous /cone bearing trees, ever green trees.
- .They has open grained texture, which is easier to work on than hard wood.
- .Do not shed their leaves seasonally.
- .They grow quite quick
- .Have lighter colored than hard wood.
- .They can be growing in plantations to provide a continuous supply of timber.
- They need to be protected from insect attack.
- The timber they provide need, to be protected from the weather by paint, varnish, preservative.



Fig 1 Soft Wood Tree

2. **Hard wood**

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Hard wood trees (angiosperms) Hardwood is obtained from deciduous trees (loses leaves in autumn). They are basically angiosperms.

Hard wood trees have broad, flat leaves These trees lose their leaves every year known as deciduous.

Hard wood presence of vessels or pores, which can be distinctly seen on the transverse (cross) section.

- They are called **deciduous trees** /shed leaves, yearly seasonally.
- They are harder to work on by hand tools, than soft wood.
- It has darker colored.
- They are slow growing & ca not is cultivated.
- They are more expensive to use for timber.
- They are selected for their decorative appearance.
- The additional microscopic features of wood cells are; Vessels /pores, fibers & cambium layer.



Fig 2 **Hard wood tree**



Self-Check -3

Written Test Differentiating hard wood and soft wood

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Multiple Choice: Identify the letter of the choice that best completes the statement or answers the question

1. There are more the _____species of wood present in the forest
A,230 B,310 c, 320 D,220
2. from the following species of wood all are hard wood except one
A, Woira B, Arselbons C, Sombo D, Wanza
3. _____ is more recommend material for furniture production
A, wood product B, non wood product C, Metal D, Plastic
4. _____ is the lower part of the tree take water and food from the ground
A, Crown B, Root C, Trunk D, non

Note: Satisfactory rating - 4 points

Unsatisfactory - below 3 points

Answer Sheet

Score = _____

Rating: _____

Name: _____

Date: _____

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Indigenous trees in Ethiopia

Wood is one of the most widely used products of nature. There are over 320 timber species found in Ethiopia, but only a few of them are familiar and over utilized both locally and commercially. Increasing demand over time has reduced the supply and the search for lesser known species as substitutes, become imperative, in order to save the rapidly depleting forest of the well known species. Although there is a great possibility of investigation for lesser known species, for suitable diversified use.

1. Soft woods of Ethiopia (with botanical name and family)

No	Local Name	Botanical Name	Family
1	Zigba	Podocarpus falcatus	Podocarpaceae
2	Tid	Juniperus procera	Cupressaceae
3	Arslebanos	Casurina equisetifolia	Cupressaceae
4	Patula	Pinus patula	Pinaceae
5	Radiata	Pinus radiata	Pinaceae

2. Hard wood timbers of Ethiopia (with botanical name and family)

No	Local Name	Botanical Name	Family
1	wanza	Cordia africana	Boraginaceae
2	Woirra	Olea europaea	Oleaceae
3	Bissana	Croton macrostachyus	Euphorbia
4	Tukur inchet	Prunus africana	Rosaceae
5	Kosso	Hagenia abyssinica	Rosaceae
6	Sombo	Ekebergia capensis	Meliaceae
7	Keraro	Aningeria altissima	Sapotaceae
8	Bahirzaf	Eucalyptus spp	Myrtaceae
9	Dogma	Syzygium guineense	Myrtaceae
10	Kerkaha	Arundinaria alpina	Gramineae



Identify features of soft wood trees & industrial importance

1. **Zigba** The bark of zigba is grey to pale-brown & has both horizontal & longitudinal fissures, it has white cream colors. An irregular pole-brown area in the center of the trunk, it is comparatively light, 0.52 density fine texture & even. It is easy to work non-resinous with no smell

2. **Tid)**: Bark of tid is pole brown & fibrous, cracking & peeling in long narrow strips. Close grained, sweet smelling & durable wood. Its density 0.538, easy to work, heartwood is very durable & almost complete resistance to termite, due to the clears in it contains.

3. **Arslebanos** Is hard, strong & corky bark reddish color & has course grain being prettily marked with dark veins, it is easy to work.

Is very good for cabinet work & veneers, its bark can use as an astringent, as a dye & for tanning purposes.

4. **Patula)**: Sap wood is barely distinguishable from heart wood, both being a uniform white color, growth rings are very clear.

5. **Radiata** : Crocodile bark, timber has pole colored sap wood, clearly distinct from pinkish brown heart wood, it is resinous.

Light building & general construction, long fiber pulp for all craft paper, pole, posts, paneling & fire wood.

• Identification of hard wood:

1. **wanza** bark of wanza wood is dark brown & fibrous, the sap wood is white & it has coarse grain, it is easy to work, takes a good polish, it has density of 0.417.

Heart wood deep brown, an even texture, in damp condition it can be warped.

2. **Woir**a Bark of woir is slight rough & grey white. The heart wood is brown with irregular grey brown markings, which give it a very beautiful appearance. Its average density is 0.90, it is as lightly

3. **Bissana** Bark of Bassano is grey. It has a strong spicy smell. 0.499 densities have uniform texture nearly except very narrow strips.

4. **Tukur inchet**) : It has dark brown bark, uniform texture, fairly heavy & hard, 0.818 density straight & even grain. It has high resistance to fungi & insect attack & easy to work. It is difficult to season splitting & warping.

5. **Kosso** : Bark red brown, it has straight grain, 0.552 density.

Good for furniture cabinet work, floor, veneer.

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6. **Sombo** - Bark sombo is smooth, gray, fine grain

Very suitable for decorative furniture, cabinet making, brown brush heads handle, veneer & interior carpentry.

7. **Keraro** . Grey colored bark, wavy grain, 0.529 density, and good polish.

Used for carpentry & joinery, interior purpose, ply wood, veneer, furniture production.

8. **Bahirizaf** . smooth & blush grey color, longitudinal splits, high resistance to decay, dense, hard. It has short lines (not seen by eye naked).

Widely used for building fencing, electric transmission, telephones, tool handles, chip board (chip wood),

paper making, and veneers, ply wood, make carpentry & furniture.

9. **Dogma** . The bark of dogma is grey to dark brown, fairly smooth, slightly split –

longitudinal & scaling in rectangles, 0.767 densities. It is strong very durable & easy to work, spilt in the log.

10. **Kerkaha** . Stem of kerkaha is hallowing with grey smooth, light brownish bark Uses for building purposes, making chairs, coffee tables & baby beds.

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**Self-Check -4****Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Matching

A			B	
1	Bark red brown, it has straight grain, 0.552 density	A	Patula	
2	Grey colored bark, wavy grain, 0.529 density, and good polish.	B	Eucalyptusp	
3	Bahirzaf	c	Kerkaha	
4	Sap wood is barely distinguishable from heart wood, both being a uniform white color, growth rings are very clear.	D	Kosso	
5	Arundibaria alpine	F	Keraro	

Note: Satisfactory rating - 5 points

Unsatisfactory - below 4 points

Answer Sheet

Score = _____

Rating: _____

wood material adhesive-bonded together. Logical basis for classifying wood composites are

1. Plywood
2. Particle board
3. Medium density fiber board(MDF)
4. Oriented strand board(OSB)
5. Glue laminated timber(GLUE LAM)
6. Laminated veneer lumber(LVL)
7. Cemented board

1. **Plywood**:- plywood is term applied to glued wood construction built of veneers in such a manner that the grain of each veneer is at right angles to that of the adjacent veneer in the assembly. This method is called the cross-banded construction. The most significant advantage is the modification of strength properties. Plywood may consist of any odd number of plies. The simplest structure is of three plies.

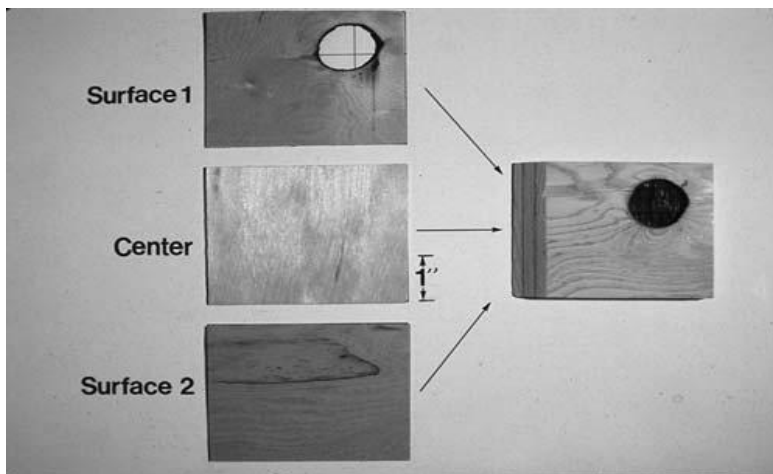


fig 1- Thin veneers used to make plywood.

2. **Particle board or Flake board or wafer board**- Wood can be broken down into particles of various size and glued together to produce particleboard.

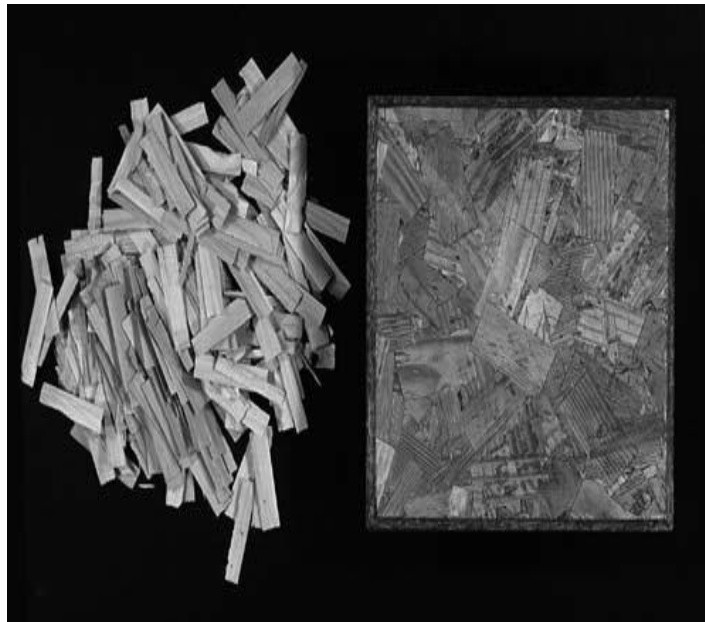


Fig 2 Particles used to make particleboard.

3. Fiber Board- Wood can be broken down into fiber bundles and single fibers by grinding or refining. In the grinding process, the wood is mechanically broken down into fibers. fibers from the refiner go through a dryer and a blow line, where the adhesive is applied, and then formed into a web, which is pressed into a board.

1. Low-Density Fiberboard (LDF)- has a specific gravity of between 0.15 and 0.45
2. Medium-Density Fiberboard (MDF)- has a specific gravity of between 0.6 and 0.8
3. High-Density Fiberboard (HDF)- has a specific gravity of between 0.85 and 1.2

4. Oriented strand board(OSB)- is manufactured by strands of wood glued parallel to the length. oriented strand board (OSB) is produced using different lengths and sizes of strands. OSB is produced from shorter strands.

5. Glue laminated timber(GLUE LAM)- Structural glued-laminated beams can be made using thick, wide wood members and are used as structural elements in large, open buildings.

Typically the laminates are 25 to 50 mm in thickness. a specific gravity of 0.4 to 0.8.

6. Laminated veneer lumber(LVL)- LVL is closely related to plywood and In contrast with plywood, all veneer is typically oriented in one direction, under proper temperature and pressure in a stationary or staging hot press, or in a continuous hot press.

. The thickness of the LVL can be from 21 to 75 mm and is available in lengths up to 25 m.

7.Cemented board- The most apparent and widely used inorganic-bonded composites are those bonded with Portland cement. Portland cement, when combined with water, immediately reacts in a process called hydration to eventually solidify into a solid stone-like mass. Successfully marketed Portland-cement bonded composites consist of both low-density products made with excelsior and high-density products made with particles and fibers



Self-Check 5	Written Test
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Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

A			B	
1	Low-Density Fiberboard	A	GLUE LAM)	
2	may consist of any odd number of plies	B	specific gravity of between 0.15 and 0.45	
3	High-Density Fiberboard	C	has a specific gravity of between 0.6 and 0.8	
4	Glue laminated timber	D	Ply wood	
5	Medium-Density Fiberboard	F	HDF	

Note: Satisfactory rating - 5 points

Unsatisfactory - below 4 points

Answer Sheet

Score = _____
Rating: _____

Reverence

- ❖ Visual hand book of wood work.
- ❖ General W-work (Grade 9-10)
- ❖ The essential Guide to wood work.
- ❖ Motive wood work Technology.
- ❖ General wood working by CHRIS H. GRONEMAN/ Third Edition
- ❖ General wood working by CHRIS H. GRONEMAN/ Six Edition



This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

1. production plan
- 2 Moisture content of timber
- .3 density and working properties of timber: hardness...:
- 4 Defects of timber
- 5 Evaluation qualities of timber requirements

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- production plan
- Moisture content of timber
- .density and working properties of timber: hardness...:
- Defects of timber
- Evaluation qualities of timber requirements

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Manufacturing Process(production plan)

manufacturing process. Oriented strand board is made from long, narrow strands, with the strands of each layer aligned parallel to one another but perpendicular to strands in adjacent layers, like the cross laminated veneers of plywood. It is this perpendicular orientation of different layers of aligned strands that gives OSB its unique characteristics and allows it to be engineered to suit different uses.

1. Stranding Process

Typically, logs are debarked and then sent to a soaking pond or directly to the stranding process. Long log disk or ring standers are commonly used to produce wood strands typically measuring 15 - 25 mm wide, 75 - 150 mm long, and 0.3 - 0.7 mm thick.

2. Drying Process

. The introduction of new drying techniques allows the use of longer strands, reduces surface inactivation of strands, and lowers dryer out feed temperatures. Dried strands are screened and sent to dry bins.

3. Adhesive Application or Blending

The blending of strands with adhesive and wax is a highly controlled operation, with separate rotating blenders used for face and core strands. Typically, different resin formulations are used for face and core layers.

4. Mat Formation

Mat formers take on a number of configurations, ranging from electrostatic equipment to mechanical devices containing spinning disks to align strands along the panel's length and star-type cross-reinters to position strands across the panel's width. All formers

5. Hot Pressing

In hot pressing, the loose layered mat of oriented strands is compressed under heat and pressure to cure the resin. As many as sixteen 3.7- by 7.3-m (12- by 24-ft) panels may be formed simultaneously in a multiple-opening press. A more recent development is the continuous press for bored . The press compacts and consolidates the oriented and layered mat of strands and heats

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it to 177°C to 204°C (350°F to 400°F) to cure the resin in 3 to 5 min. OSB is usually made with thicknesses ranging from 10 to 32 mm.

6. Sawing and cooling-

Generally 80 % of OSB panels are sold unhanded, therefore small capacity sanders are required. we can cut the OSB in desired length and width. and leave it for cooling some time.

Self-Check -1	Written Test
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Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. 2. What is Mat Formation

Note: Satisfactory rating - 3 points

Unsatisfactory - below 2 points

Answer Sheet

Score = _____
Rating: _____



Information Sheet-2

Moisture content of timber

- Moisture content of wood is weight of water in wood expressed as a fraction, usually a percentage, of the weight of oven dry wood.
- The difference in the two values is assumed to be due to loss of water by evaporation during drying.

❖ Moisture content is determined in the laboratory by weighing method & can be calculated by this formula:

1. Sensory method
2. Pin method
3. Weight method

1	Sensory method	
2	Pin method	
3	Weight method	$MC\% = \frac{\text{Initial weight} - \text{Oven dry weight}}{\text{Oven dry weight}} \times 100\%$

$$M.C = \frac{WG - WD}{WD} \times 100$$

M.C = moisture content

WG = weight of green wood (before drying)

WD = weight of oven dry wood (after drying)

- $MC\% = \frac{\text{Initial weight} - \text{Oven dry weight}}{\text{Oven dry weight}} \times 100\%$



- It should be noted that the moisture content is expressed as a percentage of the oven-dry weight rather than as a percentage of the original weight.
- This type of MC determination is called MC% on dry basis

Moisture content: The moisture content (m.c) wood of the weight of water contents expressed as a percentage of oven-dried (OD) wood. In the growing tree moisture is of great importance as it is necessary condition of its life. When the tree is cut down & made in to the lumber, the wood is immediately begins to lose its moisture.

Wood dried up to **8 – 12%** moisture content is best for construction,

furnishing & other uses. The process of drying of timber is called seasoning.

1. **Moisture conductivity:** There are two types of water present in the wood.

- Free water, held by capillary action inside the free spaces in the cells & fibers.
- Absorbed water (bound water), which is intimately absorbed by the substances of the cell walls.

During the process of seasoning the free moisture evaporates away at first till a point is reached where most of the free water is removed & only the absorbed moisture is left. This point is known as fiber –saturation point (FSP) & its importance lies in the fact that wood starts shrinkage only after this point is reached, due to the shrinkage of the wood substances by loss of the absorbed moisture.

The process of wood drying consists of evaporating moisture from the surface & moving it from the internal layers to the surface ones.

The wood will stop drying only when the moisture content corresponds to the temperature & humidity of the surrounding air. At this stage, the amount of moisture in the wood is called the equilibrium moisture content (EMC).

Moisture content % =

$$\frac{\text{Initial (wet weight (A)) - final (dry weight (B))}{\text{Final or dry weight (B)}} \times 100$$

Or

$$\text{MC \%} = \frac{\text{Initial (wet weight (A)) - Final or dry weight (B)}}{\text{Final or dry weight (B)}} \times 100$$

For example, if a sample has a wet weight of 25.24 g (A) and a dry weight of 19.12 g (B), then:

$$\text{MC \%} = \frac{A - B}{B} \times 100$$

$$\frac{25.24 \text{ g} - 19.12 \text{ g}}{19.12} \times 100 = 32\%$$

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**Self-Check -2****Written Test 2**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. _____ is the best method of seasoning

- A, Air / Natural seasoning
- B, Kill seasoning
- C, Oven seasoning
- D, All are correct

2. Moisture content is

- A , The amount of water present in the wood
- B, Draying of wood
- C , seasoning of wood
- D, All are correct

3. How to determine the amount of moisture content of the wood

- A , By Cancer method instrument
- B, by Pin Method instrument
- C, waiting method
- D, All

4. _____ A process of reducing moisture from the wood

- A, moisture content
- B, Seasoning
- C Cutting the wood
- D Cross section of the tree

5. The correct formula of weighting method is

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A, $W = \frac{G_i - G_f}{G_f} \times 100\%$

B, $W = \frac{G_f - G_i}{G_i} \times 100\%$

C, $W = \frac{G_i - G_f}{G_i} \times 100\%$

D, $W = \frac{G_f - G_i}{G_i} \times 100\%$

Note: Satisfactory rating - 5 points

Unsatisfactory - below 4 points

Answer Sheet

Score = _____

Rating: _____

Name: _____

Date: _____

Short Answer Questions

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**Information Sheet-3**

density and working properties of timber: hardness.

Properties, which determine the appearance, feel of wood:

Color: The color of wood determines the appearance of an article, so it very important in manufacture of furniture & in finishing. It is very variable features, change of colors, darkness light, & steaming air.

1. **Gloss (luster):** Gloss depends up on the ability of cell wall for reflect light. This property not presents in all timbers. Wood can also be given an artificial glass by varnishing, polishing or waxing. Identity timbers.
2. **Texture:** Texture pertains to the relative size of the cells & their proportion in unit volume. It described as fine, course, even & with intermediate shades. Fine texture is associated with smallest size of cells. Course with larger cells. Fine textured wood takes polish easily; even textured woods are less decorative than uneven textured.
4. **Grain:** Grains pertain to alignment of cells or direction of fibers with regarded to vertical axis of the tree. Grain may be straight, irregular, diagonal, spiral, inter locked & curly (wavy).
6. **Figure:** Refers to the distinctive pattern produced on longitudinal surfaces of timber as a result of arrangement of different tissue & direction of the grain, decorative at different surfaces.
8. **Smell (odor):** The smell of wood depends up on oils, resins & tannin (compound) materials that are present in the wood. The heart wood contains a greater amount of this substance & therefore has a stronger smell. In green wood, the smell is stronger. After the wood has dried, it becomes weaker, it changes, most be of coniferous woods contains resin & has a very strong smell.

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Self-Check -3

Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Short Answer Questions

1. List the Properties, which determine the appearance, feel of wood:

I. _____

II. _____

III. _____

IV. _____

V. _____

Note: Satisfactory rating - 5 points

Unsatisfactory - below 4 points

Answer Sheet

Score = _____

Rating: _____

Name: _____

Date: _____



Defects of timber

Durability is the property of wood to remain sound. It is also sometimes described as the measure of time during which wood remains unaffected by the attack of fungi, insects or other wood destroying agents.

Causes of Non Durability :-

The chief causes of non durability of timber are

1) FUNGI:-

Fungi are the worst enemies of wood. They gain admittance by means of spores and germinate in the wood cells, and send out minute thread like growths known as hyphae. Insects:-

Insects reduce the durability of wood the worst of these are the termites, known as white ants, these insects destroy wood by eating the softer timbers and cell contents. One inside, they destroy the wood rapidly. Other insects which destroy the wood are the borer beetles and some other common insects.

2) Animals:-

. These animals are provided with two shelled like Cutters which revolve slightly in two directions and thus wear away the wood. They are found in brackish water, in harbors and river.

3) Mechanical Wear & Tear :

The use to which the timber is put, results, in course of time, in its wearing off due to mechanical friction and abrasion. Although not natural agents, they are nevertheless important in the life of timber.

Factors Affecting the Durability

The factors which affect the durability of timber are

1) Moisture Content:-

The presence of sap reduces the durability of wood, hence sap wood is less durable than heart wood the actual moisture content of wood is also an important factor in the case of fungus attack. Well seasoned timber is less subject to fungus attack than green timber.

2) Specific Gravity and Hardness

Heavier and harder wood are durable. Hardness repels the attack of insects and borers and borers increases the durability of wood.

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3) Presence of Resins and oils in wood

The content and exudations of wood cells, affect durability content and the presence of toxic substances. Such as oils, gums and resins keep away fungi and insects

4) Use of wood

The use to which the timber is put determines its durability. Wood used in dry location is not liable to decay wood indefinitely kept in submerged water does not rot. Wood lying on the ground and the damp places, with little air circulation liable to decay and rot rapidly.

1. Lumber defects:

Timber is a natural product, which develops through many years of growth in the open environment, where there are changing conditions of weather. It is natural, then that defects of various kinds should develop over the following are the important defects, which are used for lumber grading.

Knots - where a branch grows out from the trunk or a large limb of a tree.

Shakes:- Shakes are splits, which develop usually along the grain while the timber is being seasoned, they are most often found at the ends of boards or logs

Warping- this is caused in wood by unequal shrinkage or expansion across the grain. Due to structure of the wood method of sawing uneven drying or to combination of these various forms of uneven distortions are:

I. Cupping

II. Bowing

III. Twisting

IV. Spring

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Self-Check -4

Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. It is a curvature or distortion along the edge of a board and usually it does not affect the face.

A, Bowing B, Cupping C, Spring D, Twisting

2. where a branch grows out from the trunk or a large limb of a tree.

A Knots B/ Roots C Trunk D Leaves

3. Spits, which develop usually along the grain while the timber is being seasoned,

A Cupping B/ Shakes:- C Twisting D Bowing

Note: Satisfactory rating - 3 points

Unsatisfactory - below 52 points

Answer Sheet

Score = _____

Rating: _____

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Information Sheet-5

Evaluation qualities of timber requirements

qualities of timber requirements

good strength, elastic, thermal, acoustic, electrical and other various choice it provides to meet different structural needs requiring different strength and figures of merit.

The use of wood has, however, certain disadvantages viz.

- I. **Width of boards-** in its normal form of board is limited by the diameter of the log from which it is cut. This can vary from 100 mm to a meter or more depending upon the species of timber, or possibly where very large trees are concerned, the maximum size the saw can accommodate.
- II. **Stability-**Timber, especially large size, is likely to warp, shrink or swell or in other words they do not have good dimensional stability.
- III. **Strength-** Although timber is remarkably strong longitudinally, i.e. with the grain, its strength across the grain is relatively poor. Moreover, even in the direction of its maximum strength, a defect such as a large - these defects affect the quality of wood. Important defects are knots, spiral grain etc.

Self-Check 5

Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Write **qualities of timber requirements**

- I. _____
- II. _____
- III. _____

Note: Satisfactory rating - 3 points

Unsatisfactory - below 2 points

Score = _____

Rating: _____



This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- Arrangement of timbres according their sizes
- Methods of drying/seasoning of timber
- Grading of lumber
- timber treated with chemicals to eradicated wood parasites

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- Arrangement of timbres according their sizes
- Methods of drying/seasoning of timber
- Grad of lumber
- timber treated with chemicals to eradicated wood parasites

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 7.
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1” **in page -.35**
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check
6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Submit your accomplished Self-check. This will form part of your training portfolio.



1 Boards (lumber)

Lumber is divided into hard wood and soft wood. Terms that refers the origin of the hard woods comes from deciduous trees, the terms can be misleading through hard woods are usually harder than soft wood some soft woods are actually harder than so, called hard wood .

Lumber sizing

- Lumber yard and lumber grading association often divided soft wood lumber categories by their sizes. These are
 - ❖ **strips:-** are small pieces less than 25mm thick and 75mm wide
 - ❖ **Boards:-** Are not more than 50mm thick and 100mm wide :- (a standards term for lumber graded by appearance) this appearance is depends on grain structure.
 - ❖ **dimension lumber:** - graded primary for strength is intended for structural framing .this pieces ranges from 50mm –to 100 mm thick and at least 50 mm wide
 - ❖ **Beams:** - structural lumber 100mm thick or more have width at least 500mm greater than their thickness.
 - ❖ **Post** :- are heavy construction lumber with width of 25 mm by 25 mm and longer width must not exceed thickness by more than 50 mm.

Board measuring lumber:- is measured by board foot ,a board foot is a pieces of lumber 1 inch thickness by 12 inch wide by 12 inch long or its equivalent .

- ❖ In empirical system board measured by board foot.
- ❖ In metric system board measured by cubic meter

Soft wood lumber is usually purchased by specifying the **thickness, Width, length and number of pieces**. When number of particular length is required the thickness, width and total number of pieces is ordered hard wood lumber is purchased by specifying the grade, thickness and total number of pieces. Locally you can purchase both soft woods and hardwood by specifying, Thickness, Width, Length and the quantity of lumber that you are looking.

- Example 2m^3 of lumber with the size of $4000\text{mm} \times 250\text{mm}$. How many pieces of the requested size you will get in 2m^3 .

Solution

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4000mm x250mm x 25 mm

$$=4m \times 0.25 \times 0.025 = \underline{0.025m^3}$$

$$\frac{2m^3}{0.025m^3} = \underline{80 \text{ pcs}}$$

0.025m³

Self-Check 1	Written Test
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Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. How many pieces of the requested size you will get in 2m³ lumber with the size of 500mm x300mm

Solution=

2. What is Board measuring lumber

3. what is strips

4. what is Post :-

5. What is dimension lumber

Note: Satisfactory rating - 5 points

Unsatisfactory - below 4 points

Score = _____

Rating: _____

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Seasoning of timber

Seasoning is When wood dried, surface zones dry in advance of the interior because of direct evaporation of the moisture at the surface

Types of Seasoning

1. Air **Seasoning** (Natural drying)
2. Kiln seasoning: (artificial drying)

1.1 Air drying (Natural drying)

Air seasoning consists mainly in making a good stack of sawn timber with help of battens (crossers)

on raised foundations in a clean & dry place, under shade if available {obtained}.As air is the drying

agent, the rate and quality of drying largely depend on the climatic conditions. Even so, losses of timber

through cracking , splitting , warping , decay through fun gay & insect attack can be considerably minimized by paying proper attention to the method of stocking , protection of stocks against the sun & hot & dry winds & sanitary conditions in the

yard. These precautions are all the more important if weather conditions are hot & humidity /hot.

N.B Air drying _ is a method in which lumber is stacked with space between the boards in the open air /in sheds. This lumber is allowed to dry until it has a moisture content of 12 to 15%.

2.1 Kiln seasoning: (artificial drying)

Seasoning consists primarily in drying of wood using artificial heat. The timber is stacked in chambers called seasoning kilns fitted with equipments for manipulation & control of temperature & relative humidity of the drying air

N.B Kiln drying _ lumber is an artificial method. The lumber is placed in an enclosed kiln & hot

**Self-Check 2****Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

- 1.- What is **Seasoning of timber**

2. Write the method of **Seasoning** of timber

3. the best method of seasoning

Note: Satisfactory rating - 3 points

Unsatisfactory - below 2 points

Score = _____

Rating: _____

**Board grading**

- **Yard lumber:** - is used for general building purpose .It is satisfactorily for furniture construction and the common ranging is from A-D.
- **Structural lumber:** - used for heavy construction.
- **Factory and shop lumber** is used for mill work items such as window, doors and moldings.
- **Hard board grading** first and second (FAS) is the best grade of hard wood and yields about 83% or greater than clear cutting .The yield can be determine the grade of lumber, first grade 91% and above and second grade 83%-90%.

Factor to be considered for grading of lumber1. Moister content

- Weighting method
- Pin method
- Sensor method

A. weighting method

The moisture content is the amount of water contained in the wood .the method represented by the formula $w = \frac{G-G1}{G1} \times 100\%$

G1

Where, w=moister content in %.

G= weight specimen before drying

G1= weight specimen after drying

Example a specimen having a weight of 35grms before oven drying and 20grms after oven drying, then calculate the moisture content of the specimen.

$$\frac{35-20}{20} \times 100\% = 75\%$$

**Self-Check 4****Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

- 1.- What is Hard board grading
2. What is Yard lumber: -
3. what is Hard board grading

Note: Satisfactory rating - 3 points

Unsatisfactory - below 2 points

Answer Sheet

Score = _____

Rating: _____

**Information Sheet 5****Timber treated with chemicals to eradicate wood parasites**

Timber treated with chemicals to eradicate wood parasites

- stain fungi do not seriously affect most mechanical properties of wood
- However, wood-destroying (decay) fungi seriously reduce strength by metabolizing the cellulose fraction of wood that gives wood its strength.
- When weight loss by decay fungi reaches 5% to 10%, mechanical properties are reduced from 20% to 80%.
- Because of their irregular burrows many insects and termites may destroy most of a piece's interior while only small holes appear on the surface, and the strength of the piece may be reduced virtually to zero.
- Thus, when strength is important, adequate measures should be taken to
 - (a) prevent decay/insect attack before it occurs,
 - (b) Do not use or replace any wood member in which decay/insect attack is evident

Self-Check 5**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. when strength is important, adequate measures should be taken to

I. _____

II. _____

Note: Satisfactory rating - 1 points

Unsatisfactory - below 1 points

Score = _____

Rating: _____



Reverence

- ❖ Visual hand book of wood work.
- ❖ The essential Guide to wood work.
- ❖ Motive wood work Technology.
- ❖ General wood working by CHRIS H. GRONEMAN/ Third Edition
- ❖ General wood working by CHRIS H. GRONEMAN/ Six Edition

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