Selecting Lumber

Unit A. Mechanical Systems and Technology

Problem Area 3. Construction Systems

Lesson 8. Selecting Lumber

New Mexico Content Standard:

Pathway Strand: Power, Structural and Technical Systems

Standard: **VIII:** Plan, implement, manage, and/or provide support services to facility design and construction; equipment design, manufacture, repair, and service; and agricultural technology.

Benchmark: **VIII-B:** Follow architectural and mechanical plans to construct building and facilities.

Performance Standard: **1.** Identify and select appropriate building materials. **3.** Construct with wood and metal.

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Explain how to produce and process lumber and wood products.

2. Discuss the grading and selection of lumber.

3. Explain the process of sizing, buying, and storing lumber.

List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany the lesson:

> Burkybile, Carl. *Lumber: Grading, Selection, Buying, Using, and Storing*. University of Illinois: Information Technology & Communication Systems (U3055).

> Burkybile, Carl. *Lumber Transparency Set*. University of Illinois: Information Technology & Communication Systems.

> Phipps, Lloyd J., et al. *Introduction to Agricultural Mechanics,* Second Edition. Upper Saddle River, New Jersey: Prentice Hall Interstate, 2004. (Textbook, Chapter 8)

List of Equipment, Tools, Supplies, and Facilities

> Writing surface
> Overhead projector
> Transparencies from attached masters
> Copies of student lab sheets
> Lumber samples including plywood, wafer board, particle board, hardboard, paneling, and pegboard.

Terms. The following terms are presented in this lesson (shown in bold italics):

> Bending strength
> Board feet
> Common boards
> Compression strength
> Dimension lumber
> Dressed lumber
> Factory or shop lumber
> Green lumber
> Hardboard
> Hardness
> Hardwood
> Kiln-dried lumber
> Linear feet
> Nominal or rough lumber
> Paneling
> Particle board
> Pegboard
> Plain sawing
> Plywood
> Quarter sawing

Seasoning
Select or finish boards
Softwood
Stiffness
Structural lumber
Toughness
Veneer
Wafer board
Worked lumber
Yard lumber

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Show samples of various sizes of lumber and examples of wood products such as plywood, particle board, and wafer board. Ask students questions to spark their interest in learning about selecting, grading, buying, and storing lumber. What happens between cutting down a tree and you buying the wood as lumber? How is lumber graded? How can you determine which type of lumber to buy? How should lumber be stored?

Summary of Content and Teaching Strategies

Objective 1: Explain how to produce and process lumber and wood products.

Anticipated Problem: How are lumber and other wood products produced and processed?

I.   After trees are cut down they are transported to the sawmill. The logs are soaked until sawing time to prevent checking, cracking, and warping. After removing the bark, the wood is cut into standard lengths and widths and is referred to as lumber. Logs are either plain-sawed or quarter-sawed. *Plain sawing*, cutting the log on a tangent to the growth rings, is faster with less waste resulting in lower cost lumber. It produces a flat or slash-grained lumber that is used for most buildings. *Quarter sawing* lumber, produced by cutting the log perpendicular to the growth rings, results in lumber less likely to warp, shrink, and swell. Since quarter-sawed edge or vertical grained boards have a prettier grain, they are often used to make furniture. After the lumber is cut, it is ready to be dried. *Seasoning* is the process of drying lumber to the point where it is ready to use. *Green lumber* is freshly cut lumber with 20 percent or more moisture. Lumber can be stacked outside with spacers to allow air flow between layers. Air drying takes from one to three months and typically reduces moisture content to 15 percent. *Kiln-dried lumber* uses a large oven or kiln to dry the lumber to 6 to 12 percent moisture. Starting with high steam and low heat the kiln gradually adjusts to low steam and high heat to remove moisture without creating cracks in the lumber. After drying,

the lumber in some cases is used rough, also referred to as unmilled or unplaned. *Dressed lumber* is smoothed and given uniform dimensions by running it through a planer.

A. Dried and planed lumber can be processed into a variety of wood products such as beveled siding, tongue-and-groove flooring, trim, molding, etc.

B. *Plywood* is a wood product made of a series of plies or layers (3, 5, or 7) glued together with the grains of adjacent layers arranged at right angles to each other to form a 4 × 8 sheet. By gluing layers so that the grain runs in opposite directions the strength is maximized.

C. *Particle board* is a 4 × 8 sheet made by gluing wood chips, splinter, and sawdust together. Because it is hard and brittle, it is used under countertops and in some furniture. While particle board is cheaper than plywood, it needs to be cut with a carbide-tipped blade and warps quickly when it gets wet.

D. *Wafer board*, also known as OSB board and chip board, is made by gluing wood chips to form 4 × 8 sheets. Since it is cheaper and more water resistant, wafer board is replacing plywood as roof sheathing and subflooring.

E. *Hardboard* is made by gluing wood fibers into sheets. Since it is hard and brittle, it should be cut with a carbide-tipped blade and it does not hold nails well. It may be used as tabletops or shaped in long boards to use as siding. *Pegboard* is hardwood with a series of uniformly sized and shaped holes. Pegboard is useful as a hand tool organizer. Pegboard hooks of various sizes are available at most hardware stores.

F. *Paneling* is a ⅛ or ¼ inch sheet of wood or hardboard with a wood grain surface. Cheap paneling may be hardboard with wood grain contact paper on the surface.

G. *Veneer* is a thin layer of material that is glued to an inferior quality material. While high quality furniture is generally solid wood, low cost furniture is often particle board with a veneer wood grain surface layer.

Having students read the suggested chapters in the reference will be a good start in helping them fully understand this topic. Bring in a log to show growth rings and talk about how the wood is processed into lumber. Use TM: A3–8A to reinforce how lumber is cut from logs. Show samples of lumber and various wood products (plywood, particle board, wafer board, paneling, hardboard, pegboard, veneer, etc.) and talk about how they are used. Take a trip to the lumber yard to see products that are available locally and get an idea of the prices.

Objective 2: Discuss the grading and selection of lumber.

Anticipated Problem: How is lumber graded and selected for use?

II. Wood for lumber is divided into two broad categories, "softwood" and "hardwood". These terms refer not to the hardness of the wood, but to the type of tree they come from. *Softwood* is lumber cut from coniferous (cone-bearing) evergreen trees with needle-like leaves. *Hardwood* is lumber cut from broad-leaved (deciduous) trees that drop their leaves in the fall. Fine furniture is typically made from hardwood. Since construction lumber is generally softwood this unit will focus on softwood grading. Softwood grading is based on appearance,

strength, or a combination of the two. Defects such as knots, checks, splits, decay, stains, and insect holes can affect both the appearance and the strength. Softwood grading classifies lumber according to use: yard lumber, structural lumber, and factory or shop lumber. **Yard lumber** (less than five inches thick) is used for ordinary construction and general building purposes. **Structural lumber** (two inches or more in nominal thickness and width) is stress tested and used as joists, beams, stringers, posts, timbers, and truss members. Structural lumber, for the most part, is wider and thicker than dimension lumber. **Factory** or **shop lumber** is used in doors, window sashes, foundry patterns, and general cut-up purposes.

A. While blueprints may specify stress rated structural lumber for some framing components, most building is done with yard lumber. Yard lumber includes select or finish boards, common boards, and dimension lumber. **Select** or **finish boards** are graded A through D based on appearance. They are typically one inch thick (1 × 4, 1 × 6, etc.) used as an inside surface to be coated with varnish or paint.

B. **Common boards** are one inch thick, 2 to 12 inches wide, and graded on a combination of appearance and strength from number 1 common to number 5 common.

C. **Dimension lumber** is two to five inches thick and two inches or more wide graded on strength and stiffness. Dimension lumber grades are construction, standard, utility, economy, and economy stud. Graded lumber will have a grade mark that includes the grade, moisture content, species of the tree, the mill where processing was done, and the certification mark indicating the association that graded the lumber.

D. When purchasing plywood, the grade is based on the outer plies. Interior plies are all grade D. The grade is based on the presence of knots, knot holes, and surface plugs. Exterior plywood has waterproof glue while interior plywood has only water resistant glue. Application with only one exposed surface can be graded A–D or A–C. Signs and cabinets need A–A with two good sides. Roof sheathing is usually construction grade plywood (CDX).

E. When selecting the grade of lumber to purchase, use the lowest quality of lumber suitable for the purpose. Inexperienced buyers should depend on the advice of an experienced, reliable lumber yard employee to make grade purchase decisions.

F. Selecting lumber to match the job requires a knowledge of the characteristics of each species of wood. Siding for a house requires good nailing and weather resistant qualities. For house framing members, emphasis is placed on strength and stiffness. In furniture construction, attractive appearance, freedom from blemishes and flaws, desirable wood grain, hardness, and resistance to warping are important. White woods (white pine, fur, and spruce) and yellow pine are the most popular species used in construction.

G. A good understanding of wood properties is essential for intelligent lumber selection.
   1. **Hardness** means that the wood is solid or firm, and will not dent or scratch easily. The weight of dry wood is a good indicator of its relative strength. Freedom from warping and bowing is important. Ease of cutting and nail-holding power should be considered.
   2. **Bending strength** is the ability of lumber to be bent without breaking.
   3. **Stiffness** is the ability of wood to resist bending under load.

4. **Compression strength** is the ability of a piece of lumber to resist being mashed or squeezed together by weight applied against its ends.
5. **Toughness** is the ability of the wood to withstand sudden shock. Tough wood refuses to break when subjected to repeated shocks, jars, or blows.

Refer students to readings in the recommended texts. They provide complete information on the content of this objective. Compare softwood and hardwood samples. Discuss the basis for determining lumber grades. Look at grade marks on lumber and plywood. Explain all the information (mill identification, grade, species, certification mark, and moisture content). Use LS: A3–8A to ensure student understanding of the grade stamp. Use TM: A3–8B to show lumber grading categories. TM: A3–8C lists wood properties that might be considered in selecting a species of wood to use. TM: A3–8D compares characteristics of commonly used softwoods. Determine lumber characteristics that are important in various job applications, then recommend a species of wood that fits the job.

Objective 3: Explain the process of sizing, buying, and storing lumber.

Anticipated Problem: How is lumber sized, purchased, and stored?

III. Wood products may be purchased green (over 20 percent moisture), air dried, or kiln dried. They may be rough, dressed, or worked lumber. **Nominal,** or **rough lumber**, is lumber as it comes from the saw (unplaned). Most lumber is planed before it is sold. Planed lumber in also called surfaced, dressed, and milled. The difference between nominal and dressed dimensions of lumber is the result of planing, and shrinkage that occurs during drying. **Worked lumber** is wood that has been shaped (trim), matched (tongue-and-groove), or patterned (molding).

A. The project planner uses the actual planed dimensions (¾ × 3½ , 1½ × 7¼, etc.) to determine the number and length of boards needed, but nominal dimensions (2 × 4, 1 × 6, etc.) are used when ordering lumber. Softwood nominal widths are 2, 3, 4, 6, 8, 10, and 12 inch. The standard available lengths are even feet from 6 to 20. Lumber with nominal thickness of 1 inch is actually ¾ inches while 2 inch lumber is actually 1½ inch thick. To find the actual width for nominal widths of 6 inches or less drop ½ inch. For nominal widths of over 6 inches drop ¾ inch to find the actual width.

B. Common boards and dimension lumber is bought and sold by the board foot or per thousand feet. **Board feet** = thickness × width × length divided by 12. Molding and trim boards are sold by the linear feet or running feet, rather than board feet. **Linear feet** is simply length in feet without regard to thickness or width. Plywood, particle board, hardboard, pegboard, and paneling are generally sold by the 4 × 8 sheet. Thickness of these sheets vary through a range of ¼, ³/₈, ½, ⁵/₈, to ¾ inch. All of these materials are priced either by the square foot or by the sheet. Other building materials, such as roofing and siding, are sold by "the square". "The square" actually means 100 square feet of surface coverage.

C. Do not order large quantities of lumber long in advance of the time it will be needed. If delivered lumber must be stored for a period of time, care should be taken to avoid warp-

ing, staining, and moisture absorption problems. Lumber should be neatly stacked using stickers or spacers every few rows to allow air circulation. If stored outside, keep the stack relatively level, off the ground, and covered with moisture-resistant covering like plastic.

The recommended texts provide good introductory information on the content. Assigned readings will be helpful to students Show samples of 1 × 3, 1 × 4, 1 × 6, 1 × 8, 1 × 10, 1 × 12, 2 × 2, 2 × 4, 2 × 6, 2 × 8, 2 × 10, and 2 × 12. Compare nominal and actual dimensions. Teach students how to figure board feet (LS: A3–8B). Show molding and trim samples and talk about linear feet. Show plywood, wafer board, and other 4 × 8 sheets. Talk about purchasing by the sheet or by the square foot. Use TM: A3–8E to help show how lumber is sized, TM: A3–8F to show how lumber is sold, and TM: A3–8G to show how lumber is stored.

Review/Summary.
Review how trees are processed into lumber and other wood products such as plywood, wafer board, etc. While looking at trees, remind students that softwood comes from evergreens and hardwood comes from deciduous trees. Review the criteria used to grade lumber. Compare the properties of lumber produced from various species of trees. Review the proper storage of unused lumber.

Application.
Select the correct grade and appropriate species of wood to use for a variety of potential projects.

Evaluation.
The attached written test will be helpful in evaluating student comprehension.

Answers to Sample Test:

Part One: Matching

1 = g, 2 = d, 3 = j, 4 = e, 5 = f, 6 = i, 7 = a, 8 = h, 9 = b, 10 = c

Part Two: Completion

1. Softwood, hardwood
2. green
3. Nominal, rough, dressed, milled
4. lowest grade
5. yard lumber, structural lumber, factory or shop lumber
6. outer, waterproof, water resistant
7. linear or running, board
8. sheet or square

Part Three: Short Answer

1. a. Plain sawing is cutting the log on a tangent to the growth rings. This technique is faster with less waste resulting in lower cost lumber. The result is flat or slash-grained boards.

    b. Quarter sawing is cutting the log perpendicular to the growth rings resulting in lumber less likely to warp, shrink, and swell. The result is edge or vertical grained boards.

2. To store lumber, place it in a relatively level stack off the ground and cover the stack with plastic.

Test

Lesson A3–8: Selecting Lumber

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

a. common boards	e. particle board	i. structural lumber
b. dimension lumber	f. pegboard	j. wafer board
c. dressed lumber	g. plywood	
d. hardboard	h. select or finish boards	

_____ 1. Wood product made of a series of layers glued together with the grain of adjacent layers arranged at right angles to each other to form a 4 × 8 sheet.

_____ 2. Made by gluing wood fibers into sheets.

_____ 3. Made by gluing wood chips to form a 4 × 8 sheet.

_____ 4. Made by gluing wood chips, splinters, and sawdust into a 4 × 8 sheet.

_____ 5. Sheet of hardboard with uniformly sized and shaped holes.

_____ 6. Lumber that is stress tested.

_____ 7. Lumber that is 1 inch thick and graded number 1 through 5.

_____ 8. Lumber that is 1 inch thick, used inside, and graded A through D.

_____ 9. Lumber that is at least 2 inches thick and commonly used in building construction.

_____ 10. Lumber that has been planed.

Part Two: Completion

1. _____ is lumber cut from coniferous (cone-bearing) evergreen trees with needle-like leaves and _____ is lumber cut from broad-leaved deciduous trees that drop their leaves in the fall.

2. Lumber that contains 20 percent or more moisture is referred to as _____ lumber.

3. _____ or _____ lumber is lumber as it comes unplanned from the saw. After the lumber is planed we refer to its dimensions as _____ or _____.

4. The key to sensible, economical construction is to use the _____ _____ lumber suitable for the job.

5. The three softwood classification categories are _____ _____, _____ _____, and _____ _____.

6. In plywood grading, the _____ layers are graded and either _____ or _____ _____ glue is used.

7. Molding and trim is sold by the _____ foot while dimension lumber such as 2 × 4's is sold by the _____foot.

8. Plywood is sold by the _____ or _____ foot.

Part Three: Short Answer

Instructions. Provide the word or words to complete the following statements.

1. Name and describe the two sawing techniques for cutting lumber from a log.

2. How should lumber be stored if it must be stored outside?

METHODS OF CUTTING LUMBER FROM LOGS

A. Plain sawing

… cut at a tangent to the growth rings

B. Quarter sawing

… cut the log in quarter, cut boards perpendicular to the growth rings

Plain
sawing

Quarter
sawing
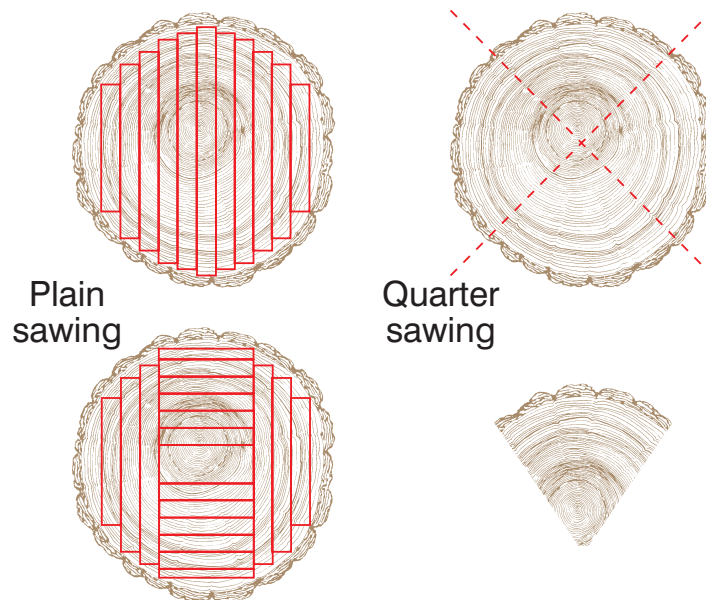
SOFTWOOD GRADING

A. Yard lumber

- used for general construction and building purposes
- always less than 5 inches thick

Select or finish boards

- used for interior surfaces
- graded on appearance
- generally 1 inch thick
- grades A, B, C, and D

Common boards

- used for interior or exterior jobs
- graded based on appearance and strength
- less than 2 inches thick
- 2 to 12 inches wide
- grades 1, 2, 3, 4, and 5

Dimension lumber

- used for general construction framing
- graded based on strength and stiffness by visual examination
- 2 to 5 inches thick
- grades construction, standard, utility, stud, and economy stud

B. Structural lumber

- machine stress tested with rating stamped on the lumber
- graded based on strength and stiffness
- used for some framework components such as joists, beams, stringers, posts, timbers, and truss members
- used where called for in the blueprints

C. Factory or shop lumber

- used in doors, winder sashes, foundry patterns, and general cut-up purposes
- graded based on the area of each piece suitable for cuttings of a certain size and quality
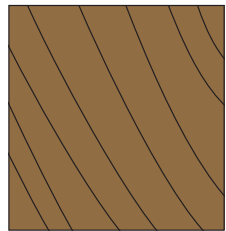
PROPERTIES OF WOOD TO BE CONSIDERED
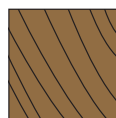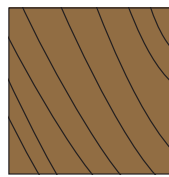
1. **Hardness vs softness**

2. **Weight**

3. **Tendency to shrink an swell**

4. **Tendency to warp**

5. **Ease of working with hand tools**

6. **Nail-holding power**

7. **Bending strength**

8. **Stiffness**

9. **Compression strength**

10. **Toughness**

11. **Resistance to decay**

12. **Ease of finishing**

COMMON SOFTWOODS
...THEIR CHARACTERISTICS AND USES

Species	Characteristics	Uses
White woods (white pine, white fir, and spruce)	Light to medium weight, uniform texture, nearly white, works and nails easily, finishes well, glues easily; resists shrinking, swelling, and warping.	General building and house construction, paneling, trim, furniture, crates, moldings, and plywood.
Yellow pine	One of the heaviest softwoods; high strength, stiffness, and toughness; resists shrinking, swelling, and warping; difficult to shape and nail.	Dimension and structural lumber, such as joists (2×8, 2×10, 2×12), where high strength is important.
Douglas fir	Straight-grained, moderately heavy, very strong, finishes well, minimum of shrinking and swelling, difficult to work with hand tools.	Construction where strength is important (one of the nation's first-line woods for structural purposes).
Hemlock	Light to medium weight, uniform texture, machines well, low resistance to decay. Properties tend to be intermediate between white woods on one hand, and yellow pine and Douglas fir on the other.	Construction lumber, sheathing, doors, planks, boards, subflooring, crates.
Redwood	Light weight, durable, easy to work, naturally resistant to decay.	Outdoor furniture, fencing, house siding, interior finish, paneling.
Cedar	Fresh, sweet odor, reddish color, easy to work, uniform texture, resists decay.	Chests, closet lining, shingles, posts, dock planks, novelties.

COMMON SOFTWOOD LUMBER SIZES

Nominal	Dressed		Nominal	Dressed	
1 × 2	¾ × 1½				
1 × 3	¾ × 2½		3 × 4	2½ × 3½	
1 × 4	¾ × 3½				
1 × 6	¾ × 5½		4 × 4	3½ × 3½	
1 × 8	¾ × 7¼				
1 × 10	¾ × 9¼		4 × 6	3½ × 5½	
1 × 12	¾ × 11¼				
2 × 2	1½ × 1½		6 × 6	5½ × 5½	
2 × 4	1½ × 3½				
2 × 6	1½ × 5½				
2 × 8	1½ × 7¼		8 × 8	7½ × 7½	
2 × 10	1½ × 9¼				
2 × 12	1½ × 11¼				

HOW LUMBER IS SOLD

Wood products can be purchased:

1. Green (20 percent or more moisture)

2. Air-dried (12–19 percent moisture)

3. Kiln-dried (6–12 percent moisture)

Wood products are available as:

1. Rough lumber

   … as it comes from the saw unplaned and unseasoned

2. **Dressed or milled lumber**

    … also called planed or surfaced lumber

    … commonly referred to by nominal dimensions (2 × 4, etc.)

    … sold in widths 2, 3, 4, 6, 8, 10, and 12 inches

    … sold in standard lengths of even feet from 6 to 20 feet
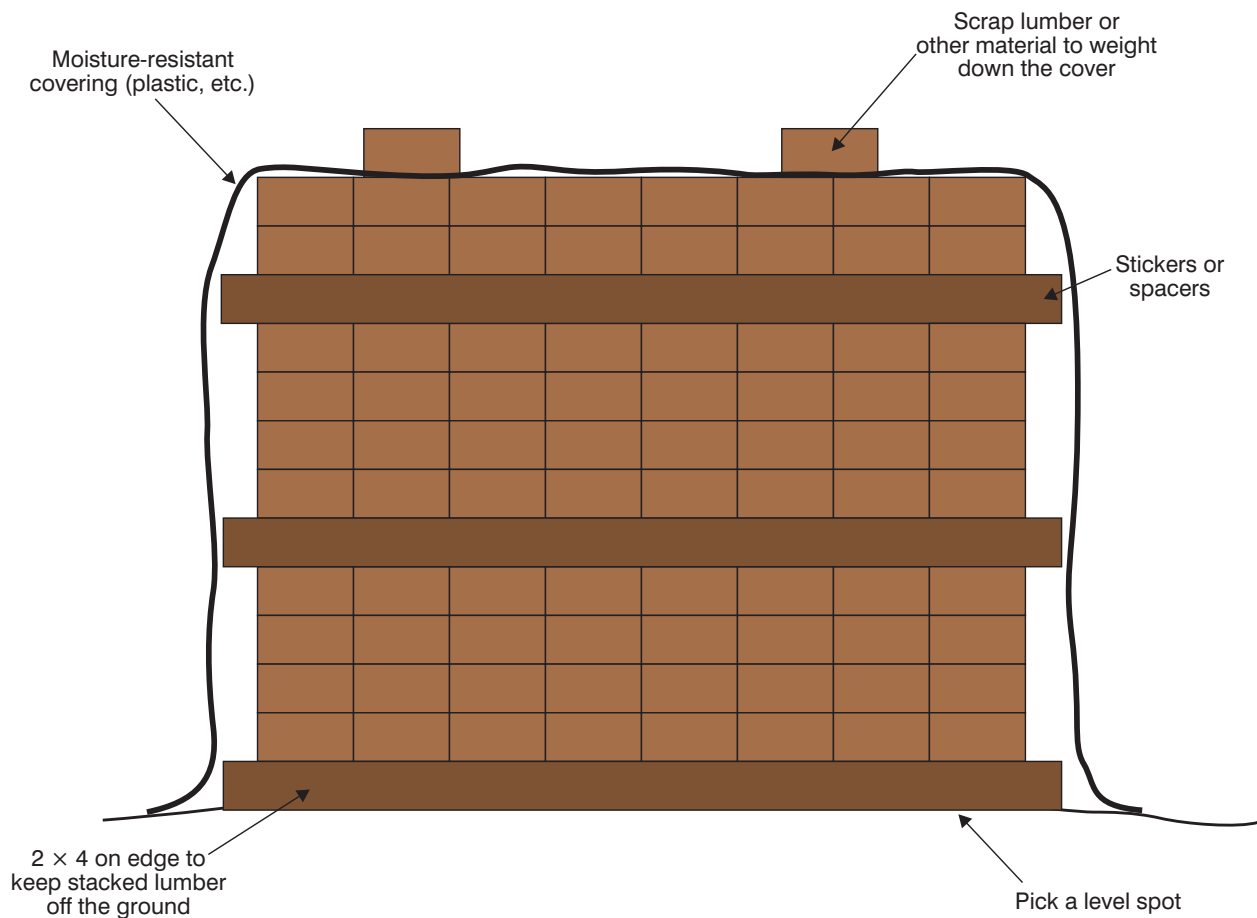
    … longer lengths may be available at higher prices

3. **Worked lumber**

    …wood that has been shaped, matched, or patterned for some special use

    … examples: molding, trim, tongue-and-groove flooring, etc.

MAINTAINING LUMBER THROUGH PROPER STORAGE

Scrap lumber or other material to weight down the cover

Moisture-resistant covering (plastic, etc.)

Stickers or spacers

2 × 4 on edge to keep stacked lumber off the ground

Pick a level spot

Neat, off-the-ground, covered stack with spacers to allow air circulation.

(Courtesy, Interstate Publishers, Inc.)

Lab Sheet

Typical Grade Stamp for Common Boards and Dimension Lumber

Mill Identification: Mill identification number or name (12).

Grade: Name, number, or abbreviation. *Standard* is for light framing.

Certification Mark: Symbol of regional trade association that inspected and graded the lumber (Western Wood Products Association).

(Note: ® stands for registered and refers to the certification mark.)

12   STAND

WP ®

S-DRY   D FIR

Moisture Content: *S-Dry* has 19% moisture or less; *MC 15* has 15%; *S-GRN* has over 19%.

Species Mark: A symbol or letters identifying tree species from which the lumber was cut (Douglas fir).

Directions: Enter the missing information in the blanks below.

_____   _____

_____

14   STR

WP ®

S-GRN   Y P

_____   _____

Lab Sheet

Figuring Board Feet, Linear Feet, Sheets, and Squares

Given Information:

Board feet = T" × W" × L' / 12
Linear or running feet = length in feet
Sheet = 4' × 8' or 32 square feet
Square = 100 square feet of coverage

1. Figure board feet:

Pieces	Dimensions (inches)
a. 2	1 × 4 × 12
b. 3	1 × 6 × 18
c. 6	2 × 8 × 16
d. 10	2 × 10 × 14

2. Figure linear feet:

Pieces	Dimensions (inches)
a. 2	1 × 4 × 12
b. 3	1 × 6 × 18
c. 6	2 × 8 × 16
d. 10	2 × 10 × 14

3. Figure sheets needed:

    a. wall 8 × 12

    b. roof section 24 × 40

    c. floor section 32 × 60

4. Figure squares needed:

    a. wall 8 × 40

    b. roof section 24 × 40

Name_____

Lab Sheet Key

Figuring Board Feet, Linear Feet, Sheets, and Squares

1. a. 8 bf
    b. 27 bf
    c. 128 bf
    d. 233.33 bf

2. a. 2 feet
    b. 4.5 feet
    c. 8 feet
    d. 11.67 feet

3. a. 3 sheets
    b. 30 sheets
    c. 60 sheets

4. a. 3.2 squares
    b. 9.6 squares