

### Lesson 3: Building Materials

Many options are available for materials for use in construction, and structures may contain a variety of materials. Evaluating factors such as the project's purpose and the availability and cost of materials will be necessary to select the appropriate materials.

#### Different Types of Building Materials

Agricultural structures are constructed from many types of materials. Among the materials used are wood, metal, concrete, clay bricks and tiles, vinyls, plastics, glass, and fiberglass.

Wood products come in a variety of forms, including boards and plywood. They have many uses, including structural members for building the frames of structures, siding, and floors. Because wood is so common, it is the focus of this unit.

Metal products, such as steel and aluminum, are widely used in agricultural projects, often for structural members, roofing, or siding. Specific uses include support beams, roofing, sealing for the edge of a roof, trim on the corners of buildings, and many others. Metal materials generally are sold to an exact size, since cutting is more difficult than it is with lumber. Metal is also more difficult to patch or repair on a building.

Concrete products are most often found in medium-sized and large structures, usually in the foundation and often in various other parts of the structure. Concrete may also be used for sidewalks, driveways, and other paved areas. Concrete products used in construction include cinder blocks and mixed concrete. Concrete products are generally sold to meet exact specifications.

Clay bricks and tiles are available but are generally used in small quantities for agricultural structures. Bricks are sometimes used to build houses. They are generally used for decorative purposes. Other common uses of clay bricks or tiles would be for a fireplace or for walkways. Clay bricks and tiles can be purchased in many

Other possible classifications of lumber are green or kiln dried. Green lumber is lumber

different shapes and colors. They are difficult to cut or repair.

Vinyls, plastics, glass, and fiberglass have more specialized uses. Vinyl is commonly used for siding on houses. Plastics are used for skylights to allow sun into a building, as well as siding for greenhouses. Glass is used for windows, and fiberglass is used for skylights, greenhouse covers, and for livestock equipment like water tubs.

#### Grades and Types of Dimension Lumber

Dimension lumber refers to wooden building material sawn in lengths, usually starting at eight feet and increasing in increments of two feet. It is uniform in thickness and width. Dimension lumber makes up the framework of wood-frame structures.

As dimension lumber is processed, it decreases in size. Freshly cut lumber will shrink considerably as it dries, up to 1/16 of an inch across its shortest dimension. Surfacing and milling of the lumber, which is standard in the industry, will also claim some of the material. The measurements of the lumber before any of this processing are the nominal dimensions. Afterwards, the material is referred to as dressed.

This loss of material usually amounts to 1/4 of an inch off each side of the width and height. Thus, an eight-foot 2" X 4" is actually 8 feet long, 1½ inches high, and 3½ inches wide.

Dimension lumber is measured in board feet. A board foot is equal to 144 square inches. This measurement can be calculated by multiplying a board's nominal length (in inches), width, and height and dividing this number by 144. An eight-foot 2" x 4" is 5.33 board feet ( $2 \text{ in.} \times 4 \text{ in.} \times 96 \text{ in.} = 768 \text{ in}^3$ ;  $768 \text{ in}^3 \div 144 \text{ in}^3 = 5.33 \text{ board feet}$ .)

Materials used for dimension lumber are classified as softwood or hardwood. This designation is a source of confusion in that it does not refer to the actual hardness of the wood but to the type of tree. Softwood refers to lumber from evergreen trees, such as pine or spruce trees. Hardwood is lumber from deciduous trees, or trees that lose their leaves, like oaks.

with a high moisture content. This type of lumber is sometimes used in agricultural

structures to save on material costs. However, it is prone to warping and twisting as it dries, which makes it undesirable for most projects. With controlled drying, much of this distortion can be avoided, and the material is much more stable. Wood is most commonly dried in a kiln, a sort of oven in which the lumber is heated, often to over 200 degrees Fahrenheit, to reduce moisture to a desired point. For example, wood used for framing is dried to about a 15 percent moisture content. Electronic moisture meters are used to determine the exact moisture content of the dried lumber.

Lumber is sometimes chemically treated for preservation. Treated lumber is more resistant to moisture and will last longer in wet climates. Generally, treated lumber will last at least twice as long as untreated lumber. Chemicals can make wood very rot resistant but require care when used, because they may be toxic. Manufacturer's recommendations should be followed carefully.

After lumber is sawn and dried to an acceptable level, it is assigned a structural grade. In the United States, the American Lumber Standards Committee sets certain standards for grading lumber. Their guidelines are generally applied, and often expanded or detailed, by regional associations such as the Western Wood Products Association or Southern Forest Products Association. These associations may set grading guidelines for the types of lumber produced in their areas.

The number of grades available is variable. Depending on the number and severity of defects, lumber is generally graded 1, 2, or 3 (1 being the highest number grade), possibly with an additional premium or select grade. Each piece of lumber graded is evaluated for the following defects.

- Knots from embedded branches or limbs
- Splits or checks, which are separations of the wood fibers along the grain or across the annular growth rings
- Shakes, or separations between the annular growth rings

- Pitch pockets, which are cavities that have or had pitch in them
- Honeycombing, or separation of the wood fibers inside of a tree
- Wane, which is bark or the absence of wood along the edge of a board
- Blue stain, discoloration caused by a mold-like fungus
- Decay caused by fungi that rots the wood
- Holes from any source
- Warp, usually resulting in bows, cups, crooks, or twists in the lumber

Sometimes other terminology is used to refer to different grades of lumber. For example, "economy" generally is equivalent to grade three.

Some areas may have further designations involving letters or terms such as (S) or Select, (B) or Better, (C) or Common, Choice, or Supreme. These letters may or may not correspond to a number system. If the grade of lumber is unclear, explanations can be obtained from the retailer handling the material.

In addition to a structural grade, dimensional lumber that has been chemically treated is labeled as treated lumber. Treated dimensional lumber for outside use has a tag attached to each piece of material with information about the chemicals used.

One thing to keep in mind when selecting graded lumber is its use. For agricultural structures, near perfect cosmetic appearance usually is not necessary. A considerable amount of money can be saved by selecting suitable material of a lower grade. When in doubt, the structural integrity of a specific grade of lumber can be confirmed by a reputable retailer.

### **Grades and Types of Sheathing Material**

Sheathing materials are generally wood or wood product panels manufactured in one of several ways. The panels are most commonly four feet by eight feet in size, with a thickness of  $\frac{1}{4}$  to  $1\frac{7}{16}$  inches. The measurements of sheathing material are actual and correct.

disadvantages related to strength, cost, and weather resistance. Plywood grading systems vary somewhat depending on the type of material. Softwood plywood grades are assigned by associations such as the APA to sheathing materials manufactured to meet their specifications. The material is rated as to its suitability for interior or exterior use; generally, a rating of 1 indicates that the plywood is for exterior use, while a rating of 2 is for interior use.

Plywood with a rating of "Exposure 1" can withstand moisture but should be used indoors, while "Exposure 2" indicates plywood that should only be used indoors. The quality of the veneer used on the face and back is rated with a letter system shown in Figure 3.1.

A plywood grade stamp from the APA, which supplies a variety of information, appears in Figure 3.2. A span rating may be shown as two numbers separated by a slash. The first number is the maximum span in inches between supporting boards that should be used with this material for roof decking; the second number is the recommended span for floor decking. Other information that appears in the stamp includes the panel grade, exposure durability, and thickness.

The Hardwood Plywood Institute also has a number system used for grading. A rating of 1 or 2 is given to material with a good face and back with careful grain matching. A rating of 3 is assigned to plywood that is structurally sound but has obvious defects and patching. Softwood or hardwood plywood may also be designated G1S, meaning "good one side," or G2S for "good two sides."

Nonveneered panels are manufactured by many manufacturers and from a variety of materials. This industry is very innovative, and new techniques and forms are being developed regularly. Information on grades for these sheathing materials can be obtained from the manufacturer or retailer. They may use a system of grading very similar to that for plywood, but if in doubt, ask.

#### Summary

A variety of materials are used in structures, but the majority of agricultural structures contain some wood products. Wood products come in a wide variety of dimensions and grades. The

The following types of sheathing material are the most common. Plywood is made of thin sheets of wood laminated to a desired thickness. Composite plywood has a wood veneer cover laminated to some form of wood core. Nonveneered panels, such as oriented strand board (OSB), particle board, and wafer board, are all made from wood flakes, chips, or fibers that are combined with suitable resins and glues and shaped into panels. These nonveneered products are not, however, interchangeable with one another; each has advantages or

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actual grades assigned to wood may be indicated by numbers, letters, or names. The system of grading can be confusing: asking the retailer for explanations may be the easiest way to determine the grade suitable for a project.

### **Credits**

Huth, Mark W. *Construction Technology*. 2nd ed. Albany, N.Y.: Delmar Publishers, Inc., 1989.

Lindley, James A., and James H. Whitaker. *Agricultural Buildings and Structures*. Rev. ed. St. Joseph, Mich.: American Society of Agricultural Engineers, 1996.

