

### Lesson 5: Floors and Subfloors

The needs of the structure are the primary factor in determining what type of floor will be best for that structure. This lesson explores some of the basics of constructing floors. However, concrete, one of the most popular types of floors for agricultural structures, is not covered here.

#### Floor Framing Members

Floor framing is the structural portion of the building that rests on the concrete foundation and attaches the building to it. The framing forms the base of the structure. Floors consist of a number of components. Figure 5.1 shows some of these parts.

**Crawl space** - The crawl space is found between the ground and the first floor in structures without a basement.

**Sill plate** - This term refers to a piece of material, usually made of wood or metal, that is attached to the foundation. A wood sill plate is usually a 2-inch thick board that is 4, 6, or 8 inches wide. The sill plate is the place where the building frame attaches to the foundation. It supports the floor joists.

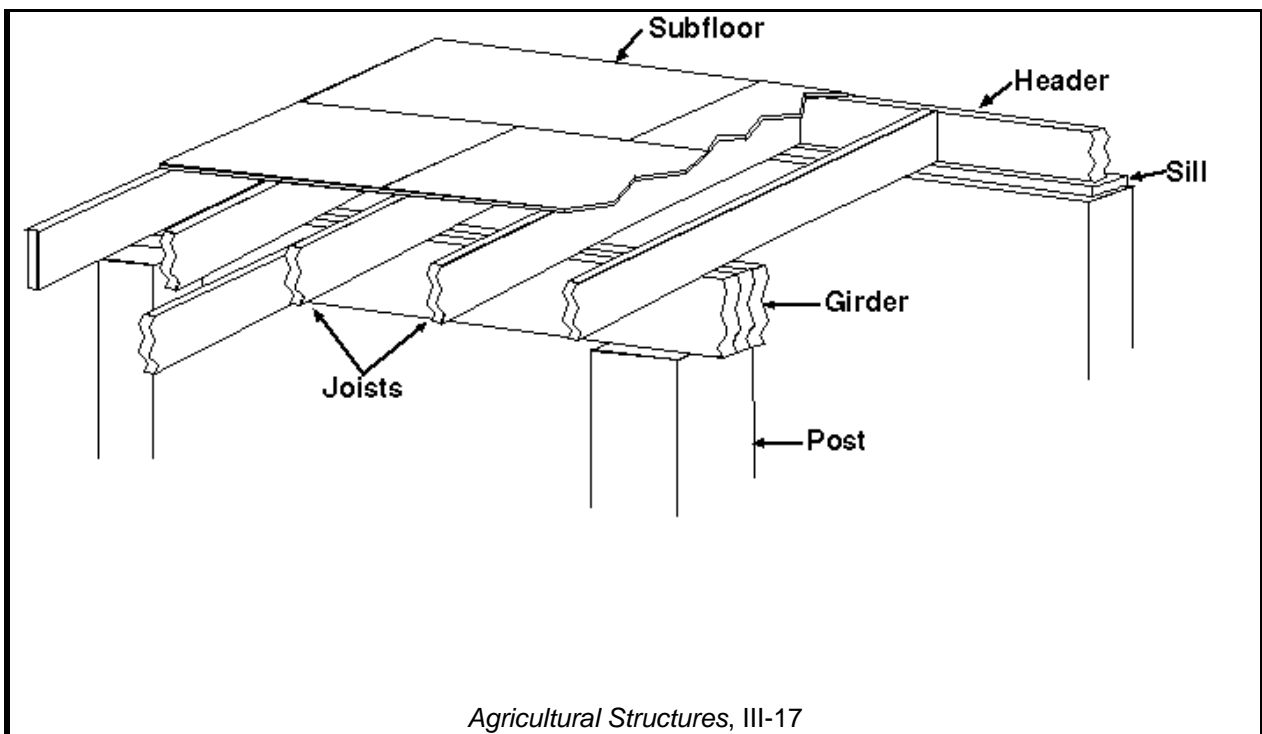
**Girder or beam** - If floors are too wide to be spanned across their full width by one piece of

material, girders or beams are used to support the structure. They may be large pieces of dimensional wood, a combination of dimensional wood and plywood, metal, or some fabricated combination of metal and wood. Girders support the weight of the structure at certain points along their length. These girders are supported at intervals by posts. Girders and their supporting posts are generally used for structures with floor spans of more than twelve feet. The girders are attached together using metal plates and bolts.

**Post** - The posts that support the girders may be made of wood, metal, or concrete. If the supports are made of concrete, they are referred to as concrete piers, while metal posts are often pipes, called pipe columns.

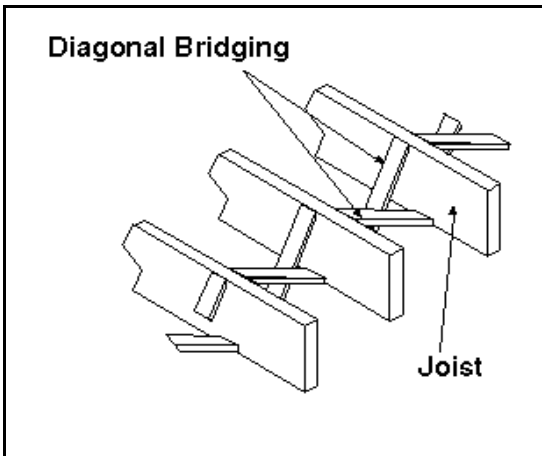
**Header joist** - The header joist attaches to the sill to form a box sill. It also attaches to the ends of the joists.

**Joist** - A joist is the wood or metal member that rests on the sill and supports the first layer of flooring and the weight of the structure. Floor joists are typically made of 2" × 8", 2" × 10", or 2" × 12" boards.



## Building Construction

**Bridging** - Bridging are small wooden or steel



pieces fitted in pairs between the joists. They are crossed to reduce movement of the joist and help distribute weight. Figure 5.2 illustrates bridging.

**Subflooring** - Subflooring is the first layer of material applied over the floor joists. The most common subflooring is some type of sheathing material, usually plywood, particle board, or waferboard. The material typically has a thickness of at least  $\frac{1}{2}$  an inch and is usually  $\frac{1}{2}$  or  $\frac{3}{4}$  of an inch. Thicker material or dimensional lumber may also be used. The subflooring lies under the finish floor, which is the final layer of flooring consisting of vinyl flooring, carpeting, wood, linoleum, or other types of flooring.

**Underlayment** - The underlayment is a second layer of material attached to the subflooring to strengthen the floor. It is usually made of plywood. Sometimes a heavy subflooring is used and the underlayment is not necessary.

### Placement of Floor Joists

Construction of a floor begins with attaching a sill plate to the foundation or basement walls. The sill plate is most commonly attached to the foundation with anchor bolts embedded in the concrete. Once the sill plate is bolted down, marks can be made on it to indicate the placement of joists. The spacing of joists varies with the weight of the structure, dimensions of the material, and type of material.

After the sill is in place, the header joist should be cut to length and nailed in place along the

outside perimeter of the sill plate. The header joists should be attached standing on the 2-inch edge of the board. They will then form a box sill. Header joists tie the other joists together, increasing the strength of the floor.

The joists running the length of the floor are called stringer joists. The stringer joists are also set on edge and are fastened to the header joists using nails or screws. The joists are spaced an even distance apart, usually 16 inches measuring from the center of one joist to the center of the next. This spacing determines the final strength of the floor. If a joist will be below a weight-bearing wall, another joist should be placed against it for added strength.

If the joists are longer than 8 feet, support beams or girders are typically placed under the joists to help support the structure. When joists meet at a beam, a metal joist bracket and bolts are used to attach the ends of the two joists together.

Bridging is added between joists. Metal bridging pieces may be used, or boards may be cut and nailed in place to join the bottom of one joist with the top of the adjacent joist, forming an "X" between the two joists. Bridging decreases the movement of joists from side to side, allowing the floor to give when weight is placed on it. Cross bridging will also strengthen the joists, helping to support the weight of the structure.

### Installation of Subflooring

Once the joists have been fastened together, the subflooring can be installed. The sheets of subflooring are placed at a 90-degree angle to the joists. The edge of the sheet should rest on a joist, covering half of the joist. Another sheet of subflooring can then be joined next to the first sheet, with both sheets attached to the joist. The sheets of subflooring should be placed with a gap of at least  $\frac{1}{8}$  of an inch between them. The gap will allow for expansion and contraction of the sheets due to temperature changes. If this gap is not included, the edges of the subflooring may work upward due to the pressure.

The sheets of subflooring are typically attached to the joists with the fasteners about 8 to 12 inches apart. Using more fasteners will decrease later “squeaking” from subflooring that is loose and moving up and down against another sheet or the shank of the fastener. If extra holding strength is desired, glue may be placed on the tops of the joists before the subflooring is laid down.

When placing subflooring on a large floor, the place where the seams come together should be staggered or offset to give more strength to the floor. Staggering the seams may require cutting a smaller piece to start one strip of subflooring.

### Load and Types of Flooring and Subflooring

Load is the weight carried by any part of a structure. Load can be classified into three categories: dead, live, and environmental. Dead loads refer to the vertical weight of a structure. They consist of the total weight of all the permanent parts of the structure, including the foundation, footings, lumber, and electrical and plumbing apparatuses. Dead loads act constantly. In contrast, live loads are considered to be temporary and intermittent. Live loads are the weight or pressure from static and dynamic loads. Static loads come from anything occupying the structure, such as livestock, equipment, or stored products. Dynamic loads come from the operation of equipment like a tractor or handling equipment in the structure. Environmental load is caused by natural factors, such as wind, snow, and earthquakes, that result in weight or pressure on a structure.

To determine what materials and spacing to use in the flooring, calculate dead load plus the maximum expected live load. If the floor will be supporting average loads, the joists can be placed 16 inches apart with  $\frac{3}{4}$ -inch subflooring. If heavier loads will be placed on the flooring, the joists should be spaced only 12 inches apart with 1-inch subflooring. For heavy loads, two layers of subflooring will often be placed on the joists for additional strength, increasing the thickness of the subflooring to  $1\frac{1}{2}$  inches or more. The second layer of subflooring is placed at a 90-degree angle from the first layer. Heavier loads also will generally require wider joists, and 2"  $\times$  12" joists can be used if the loads are very

heavy. For heavy loads, metal members, large timbers, or combinations of metals, dimensional lumber, and possibly plywood are needed to construct floors.

Several sources of information are available to help select the right materials and construction for different loads. Tables are available in many construction reference books to determine the ideal components for a building's total load. Most manufacturers of the materials used for this type of construction have recommendations that either are on the material or are made available by their retailers. Commercially prepared plans usually contain all the information necessary to purchase suitable materials and construct a building.

### Summary

Floor framing forms the base of a building and attaches the structure to its foundation. Floors consist of many members that must be carefully constructed in order to provide the proper support for the structure. Loads will determine what materials are used and how the floor is constructed.

### Credits

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