

UNIT III - BUILDING CONSTRUCTION

Lesson 5: Floors and Subfloors

Competency/Objective: Describe how to construct a floor and subfloor.

Study Questions

1. What are the members used in floor framing?
2. How are the joists set in place?
3. How is the subflooring installed?
4. How does load determine the type of flooring and subflooring used?

References

1. *Agricultural Structures (Student Reference)*. University of Missouri-Columbia: Instructional Materials Laboratory, 1999, Unit III.
2. Transparency Masters
 - a) TM 5.1: Parts of a Floor
 - b) TM 5.2: Bridging
3. Activity Sheet
 - a) AS 5.1: Diagramming Flooring
4. Job Sheet
 - a) JS 5.1: Joist Layout

UNIT III - BUILDING CONSTRUCTION

Lesson 5: Floors and Subfloors

TEACHING PROCEDURES

B. *Review*

Lesson 4 described the various types of fasteners and fastening systems used in construction. When building a structure, one of the first uses of fasteners is constructing a floor. This lesson concerns itself with wood or wood-metal combinations for the floor framework and subflooring. The basics of floor construction, including the members used and their assembly, will be explored.

C. *Motivation*

Before the class period, construct a small model of a floor to display its basic components, including the sill, header joists, joists, bridging, and subflooring. The model can be made using balsa wood, small strips of pine, or Popsicle sticks. It should be small enough for the students to handle and pass around.

D. *Assignment*

E. *Supervised Study*

F. *Discussion*

1. Ask students if they can think of some terms associated with constructing floors. Discuss the following terms. Use TM 5.1 to show different floor members. TM 5.2 illustrates bridging.

What are the members used in floor framing?

- a) Crawl space - space between the ground and the first floor in structures without a basement
- b) Sill plate
 - 1) Piece of material, usually made of wood or metal, that is attached to the foundation
 - 2) Usually a 2-inch thick board that is 4, 6, or 8 inches wide
 - 3) Place where the building frame attaches to the foundation
 - 4) Supports the floor joists
- c) Girder or beam
 - 1) Large piece of dimensional wood, a combination of dimensional wood and plywood, metal, or some fabricated combination of metal and wood
 - 2) Supports the weight of the structure at certain points along its length
 - 3) Supported by posts
- d) Post - wood, metal, or concrete support for girders
- e) Header joist
 - 1) Attaches to the sill to form a box sill
 - 2) Attaches to the ends of the joists
- f) Joist
 - 1) Wood or metal member that rests on the sill and supports the first layer of flooring and the weight of the structure
 - 2) Typically made of 2" × 8", 2" × 10", or 2" × 12" boards
- g) Bridging
 - 1) Small wooden or steel pieces fitted in pairs between the joists
 - 2) Crossed to reduce movement of the joist and help distribute weight

- h) Subflooring
 - 1) First layer of material applied over the floor joists
 - 2) Commonly some type of sheathing material, usually plywood, particle board, or waferboard
 - 3) 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
 - 4) Lies under the finish floor
 - i) Underlayment
 - 1) Second layer of material attached to the subflooring to strengthen the floor
 - 2) Usually made of plywood
2. Explain the procedure used to set joists in place. Have students complete JS 5.1.

How are the joists set in place?

- a) Attach a sill plate to the foundation or basement walls.
 - 1) The sill plate is most commonly attached to the foundation with anchor bolts.
 - 2) Once the sill plate is bolted down, marks can be made on it to indicate the placement of joists.
 - b) Cut the header joist to length and nail it 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 to form a box sill.
 - c) Set the stringer joists on edge and fasten them to the header joists using nails or screws.
 - 1) The joists are spaced an even distance apart, usually 16 inches measuring from the center of one joist to the center of the next.
 - 2) If a joist will be below a weight-bearing wall, another joist should be placed against it for added strength.
 - d) When joists meet at a beam, use a metal joist bracket and bolts to attach the ends of the two joists together.
 - e) Add bridging between joists.
 - 1) Metal bridging pieces may be used.
 - 2) 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.
3. Describe the procedure for installing subflooring. Hand out AS 5.1.

How is the subflooring installed?

- a) Place the sheets of subflooring at 90-degree angle to the joists.
 - 1) The edge of the sheet should rest on a joist, covering half of the joist.
 - 2) Another sheet of subflooring can then be joined next to the first sheet, with both sheets attached to the joist.
 - 3) The sheets of subflooring should be placed with a gap of at least $\frac{1}{8}$ of an inch between them to allow for expansion and contraction of the sheets due to temperature changes.
 - b) Attach the sheets of subflooring to the joists with the fasteners about 8 to 12 inches apart.
 - 1) Using more fasteners will decrease later "squeaking" from subflooring that is loose.
 - 2) If extra holding strength is desired, glue may be placed on the tops of the joists before the subflooring is laid down.
 - c) When placing subflooring on a large floor, stagger or offset the place where the seams come together to give more strength to the floor; this may require cutting a smaller piece to start one strip of subflooring.
4. Emphasize that the floor must be able to support the load of the structure, so load will affect how the flooring is constructed.

How does load determine the type of flooring and subflooring used?

- a) Load is the weight carried by any part of a structure.
 - 1) Dead load
 - (a) Vertical weight of a structure

- (b) Consists of the total weight of all the permanent parts of the structure, including the foundation, footings, lumber, and electrical and plumbing apparatuses
 - (c) Act constantly
- 2) Live load
 - (a) Temporary and intermittent
 - (b) Weight or pressure from static and dynamic loads
 - (c) Static load - from anything occupying the structure, such as livestock, equipment, or stored products
 - (d) Dynamic loads - from the operation of equipment like a tractor or handling equipment in the structure
- 3) Environmental load - caused by natural factors, such as wind, snow, and earthquakes, that result in weight or pressure
- b) To determine what materials and spacing to use in the flooring, calculate dead load plus the maximum expected live load.
 - 1) Average loads - joists placed 16 inches apart with $\frac{3}{4}$ -inch subflooring
 - 2) Heavy loads
 - (a) Joists spaced only 12 inches apart with 1-inch subflooring
 - (b) Often place two layers of subflooring on the joists for additional strength
 - (1) Increases the thickness of the subflooring to $1\frac{1}{2}$ inches or more
 - (2) Placed at a 90-degree angle from the first layer
 - (c) Require wider joists; 2" \times 12" joists can be used if the loads are very heavy
 - (d) Need metal members, large timbers, or combinations of metals, dimensional lumber, and possibly plywood
- c) Several sources of information are available to help select the right materials and construction for different loads.
 - 1) Tables in construction reference books
 - 2) Manufacturer's recommendations that either are on the material or are made available by retailers
 - 3) Commercially prepared plans

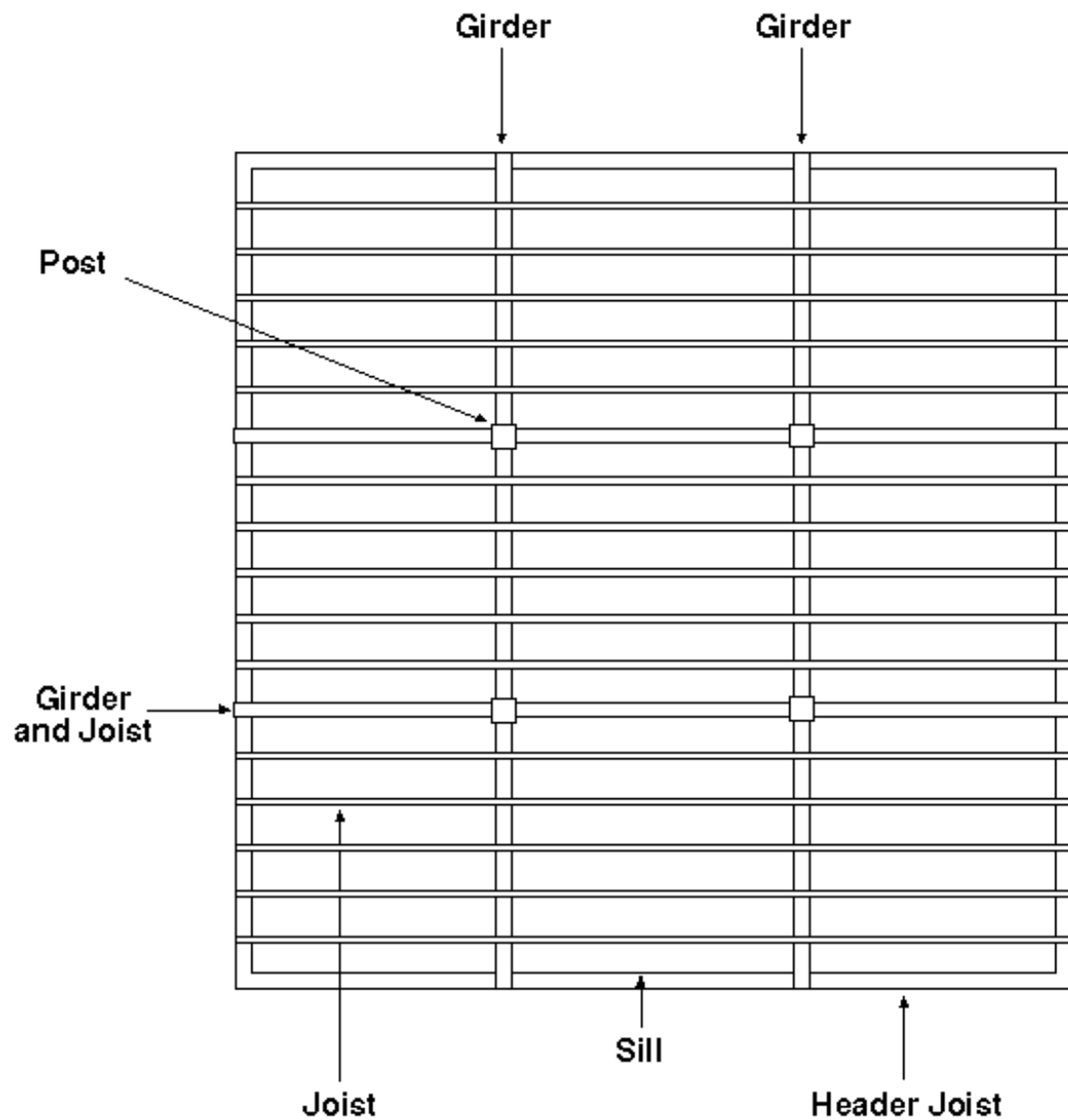
G. ***Other Activities***

If possible, schedule a field trip to a construction site where a floor is under construction.

H. ***Conclusion***

Floor framing is the structural portion of the building that rests on the concrete foundation and attaches the building to it. Floors have a number of different parts that are constructed to support the building. An extremely important factor to consider when constructing floors is load. Load will determine the size and type of materials needed and their spacing.

I. ***Answers to Activity Sheets***



J. *Answers to Evaluation*

1. b
2. d
3. e
4. f
5. c
6. a
7. c
8. b
9. d
10. d

11. Another joist should be placed next to it for added strength.

12. To allow for expansion and contraction of the sheets due to temperature changes
UNIT III - BUILDING CONSTRUCTION Name _

Lesson 5: Floors and Subfloors Date _

EVALUATION

Match the word on the right with the description on the left.

- | | |
|---|-----------------|
| 1. _____ Member that rests on the sill and supports the first layer of flooring | a. Subflooring |
| 2. Member attached to the foundation and the flooring system | b. Joist |
| 3. Member that rests on the sill and attaches to the ends of the joists | c. Girder |
| 4. Pieces placed between adjacent joists | d. Sill plate |
| 5. Member that supports the joists across the span of the flooring | e. Header joist |
| 6. Layer of material placed on top of joists | f. Bridging |

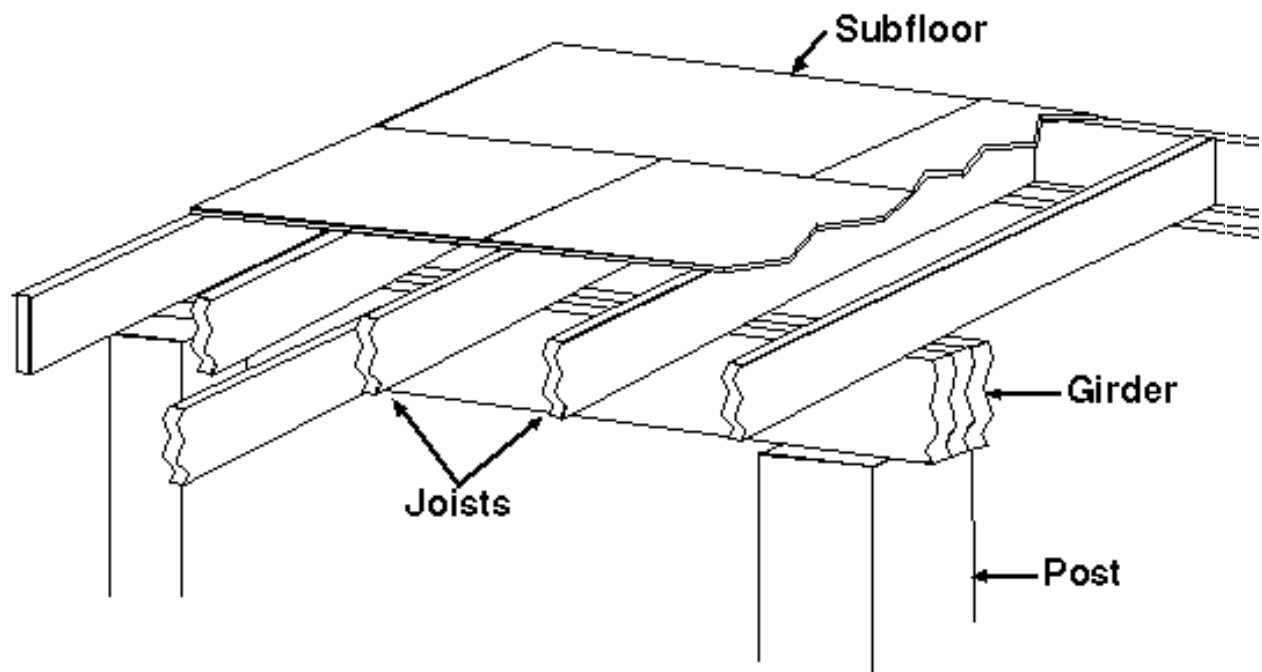
Circle the letter that corresponds to the best answer.

8. Snow contributes to:
- a. Live loads.
 - b. Dead loads.
 - c. Environmental loads.
 - d. Dynamic loads.
9. What is the typical spacing between joists?
- a. 15 inches
 - b. 16 inches
 - c. 17 inches
 - d. 18 inches
10. Subflooring should be attached:
- a. Parallel to the joists.
 - b. Between the joists.
 - c. At the ends of the joists.
 - d. At a 90-degree angle to the joists.
11. Which of the following might be done to help support heavy loads on a structure?
- a. Spacing joists 20 inches apart
 - b. Using subflooring $\frac{1}{2}$ an inch thick
 - c. Using 2" \times 6" boards for joists
 - d. Adding a second layer of subflooring

Complete the following short answer questions.

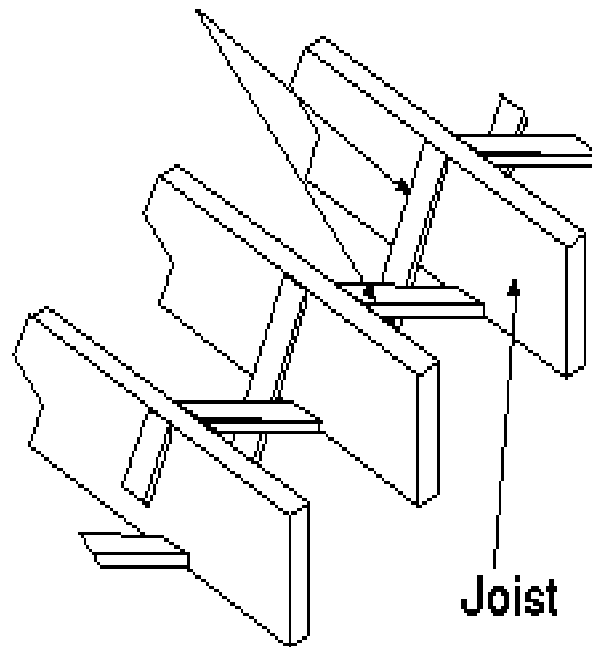
12. What should be done if a joist will be below a weight-bearing wall?

13. Why should sheets of subflooring be placed with a gap between them?



Bridging

Diagonal Bridging



Diagramming Flooring

Objective: Diagram floor layout.

Using the information below, sketch the floor described showing an overhead view without decking. Use a scale of $\frac{1}{4}" = 1'$.

- The floor is to be 24 feet by 24 feet.
- The sill is a 2" \times 6" that is anchor bolted to the foundation every four feet.
- The joists and joist headers are 2" \times 10" material.
- Girders are positioned so that no span extends more than eight feet without support. Support posts for the girders are to be placed every eight feet.
- Bridging is not required for this project.

Lesson 5: Floors and Subfloors

Name _____

Joist Layout**Objective:** Lay out joists for floor framing.**Materials and Equipment:**

10 8-foot 2" × 8" boards
2 10-foot 2" × 8" boards
16d duplex head nails
Circular or radial arm saw
Hammer
Tape measure

Procedure:

For this activity, assume that the sill plate is in place and that the box sill would be connected to the sill plate.

1. Use the 10-foot boards for header joists.
2. Cut the joists to 7 feet, 9 inches in length.
3. Nail the two outside joists to the header joists, making a box.
4. Mark the header joist to indicate the placement of the remaining joists. The joists should be placed on 16-inch centers (16 inches from the center of one joist to the center of the next).
5. Nail the joists between the header joists on both ends, using two nails in each end.

