

BUILDING PARTS AND DESIGN

Unit Goals:

The goal of this unit is to assist the student in developing the skill of identifying building components and design features.

Unit Performance Objectives:

Upon completion of this unit the student will be able to:

1. Identify foundation components.
2. Differentiate between new and old systems of floor joists.
3. Identify framing components and roof styles.

Teaching Outline

I. Foundations

- A. The footing transfers loads supported by the structure to the soil. It must be so designed that the soil will support this weight without the building settling. Footings set on solid, undisturbed soil will not be affected by uneven settling of the soil, which often happens on recently filled soil. Where ground freezes, the footing should be placed below the normal frost line. This depth varies but can be obtained from local building contractors. A footing below the frost line will not be affected by heaving due to ground freezing.

In buildings where load bearing walls are used, a continuous footing is used. Where loads are supported on posts or poles, a separate footing or pier is used. Continuous footings form level surfaces on which to erect foundation walls.

- B. A foundation starts at the footing and extends above the ground line, usually to the ground floor of the structure. It must be material resistant to decay; the common materials are concrete or concrete masonry. For pole construction, pressure-treated poles are the foundation structure. Pressure-treated post and beam construction may be used for continuous foundations.

When materials other than masonry are used for the walls, anchor bolts must be used to connect the two materials. In monolithic concrete walls the anchor bolts are spaced 6 feet to 8 feet apart and the bolt head buried 6 inches in the concrete. In concrete block or brick walls, bolts should be spaced 6 feet to 8 feet apart and at least 14 inches into the cores of the block. The exact spacing should be adjusted so bolts will come between joists or studs to allow tightening of the nuts.

1. Frame buildings - Foundation components (TM - 1)
 - a. Inverted tee foundation
 - b. Piers
 - c. Pier posts
 - d. Mud sill
 - e. Floor joist
 - 1) New system - 4" x 6", 4' on centers, supported every 5'
 - 2) Old system - 2" lumber (size dependent on span), 16" on centers, supported at ends by girders or foundation
 - f. Slab (TM - 2)
2. Block building - Use footing-block forms wall stem and wall

II. Floors (sub floor)

- A. Wood (TM - 3)
1. Plywood
 2. Tongue & groove (T & G) 2" x 6"
 3. 1" x 6"
- B. Concrete

Suggested Learning Activities

- General
1. Field trip to building under construction.
 2. Have students visit a building under construction and determine the nominal size for each building component.
- I.
3. Students identify components of foundation at building site or from plan set.
 4. Students sketch and label components.

Suggested Resource Materials

1. Local builder; Practical Farm Buildings, Boyd, The Interstate.
2. Local builder; Practical Farm Buildings, Boyd, The Interstate.
3. Community or local builder.
TM - 1
4. TM - 2

III. Walls (TM - 4)

A. Purpose

1. Support the vertical load caused by snow or rain on the roof or weights carried by the floor
2. Resist lateral loads caused by grain, potatoes, onions, and other bulk material piled against the wall
3. Keep out rain, snow, and wind

B. Frame components (TM - 5 and TM - 6)

1. A network of members, either steel or wood, to support the load
2. An outside surface to keep out rain, snow, wind, or other elements which would affect or destroy the contents in the building
3. An inside surface necessary to contain the materials or animals in the building, or to satisfy aesthetic values in a dwelling

C. Masonry walls may be either poured concrete, concrete block, or brick. For farm buildings the walls support the load and are the inside surface and outside surface. When insulation is needed in the wall, an additional structure must be applied, usually to the inside surface.

1. Concrete masonry units (TM - 7)

- a. Concrete masonry units are made 4", 6", 8", 10", and 12 inches wide and 4 and 8 inches high. The 8 x 8 x 16 inch block is most commonly used in farm construction. The first of these dimensions is the width; the second, height; and the last, length.
- b. Some manufacturers make special corner blocks, half blocks, jamb units, headers, and others.
- c. Actual block sizes are slightly smaller than the nominal size to allow for a 3/8" mortar joint. Each dimension is 3/8" less than normal.

2. Dimensioning concrete masonry walls

- a. It is possible to build with 8 x 8 x 16 inch units without cutting blocks if all dimensions are divisible by 8. Cutting blocks because of improper dimensioning is a waste of materials and is time-consuming for the mason. Cut pieces of block also detract from the appearance of the wall. Any wall or section of wall with the following dimensions can be built with full and half blocks:
- b. A dimension with an even number of feet (2 ft., 4 ft., 12 ft., etc.).
- c. A dimension with an even number of feet plus 8 in. (4 ft. 8 in., 10 ft. 8 in.).
- d. A dimension with an odd number of feet plus 4 in. (3 ft. 4 in., 7 ft. 4 in., etc.)

3. Pilasters (TM - 7)

- a. Under certain conditions it is necessary to provide added stiffness to block walls. Roofs and floors fastened securely to the walls give some support. Pilasters should be used to provide added stiffness in buildings that are longer than 2-1/2 times their width and that have no crosswalls. Pilasters are usually spaced as follows:

For an 8-in. block wall, 12 ft. center to center
For a 10-in. block wall, 15 ft. center to center
For a 12-in. block wall, 18 ft. center to center

Suggested Learning Activities

1. Given approximate building dimensions determine the exact dimensions of the building if it is to be built of uncut 8' x 8" x 16" block.

Suggested Resource Materials

1. See Teaching outline

III. C. 4. Lintels (TM - 7)

- a. Lintels are reinforced beams used over doors, windows, and other openings. Lintels should bear 8 inches on the wall on each side of the opening.
- b. Precast lintels are sold by most concrete block manufacturers. They can also be cast on the site.

5. Roof Anchorage (TM - 8)

- a. Roofs must be securely anchored to prevent high winds from lifting them off. Roofs are anchored by inserting 1/2 x 18 in. bolts in the cores of block 4 feet apart. In the core where the bolt is located, stuff paper or other material 20" into the core. Put in a small amount of concrete, insert the bolt with a big washer, and fill the core with concrete.
- b. When the concrete has hardened the roof plate is drilled and placed. The nuts are drawn tight to hold the plate securely to the wall. Rafters and trusses should be firmly attached to the plate with framing anchors, strap ties, or other strong ties.

6. Mortar (TM - 8)

- a. Mortar bonds the masonry units together. It must be chemically stable and resist rain penetration and damage by freezing and thawing. Mortar must have sufficient strength to carry all loads applied to the wall for the life of the building.
- b. Masonry cement is widely used in home construction for all types of masonry walls. It is a one-package product containing all necessary ingredients except sand. Table 9-5 gives the recommended masonry cement mortar mixes. Water is added until the mortar is plastic and handles well under a trowel.

IV. Roofs (TM - 9)

- A. The style of roof should be selected to keep out wind, rain, and snow. The structure of the roof and the roofing material depend on the slope, load to be supported, life desired, and preference of the owner-builder.

1. Shed
2. Gable
3. Gambrel
4. Gothic
5. Hip
6. Combination

B. Rafters and trusses (TM - 11)

1. Spacing - 2' on centers normal
2. Dimension depends on span and load
3. Types
 - a. Common rafter
 - b. Hip rafter
 - c. Valley rafter
 - d. Hipjack
 - e. Valley jack
 - f. Cripple

Suggested Learning Activities

Suggested Resource Materials

Suggested Learning Activities

1. Review roof parts and design a roof with as many different rafters as possible.

Suggested Resource Materials

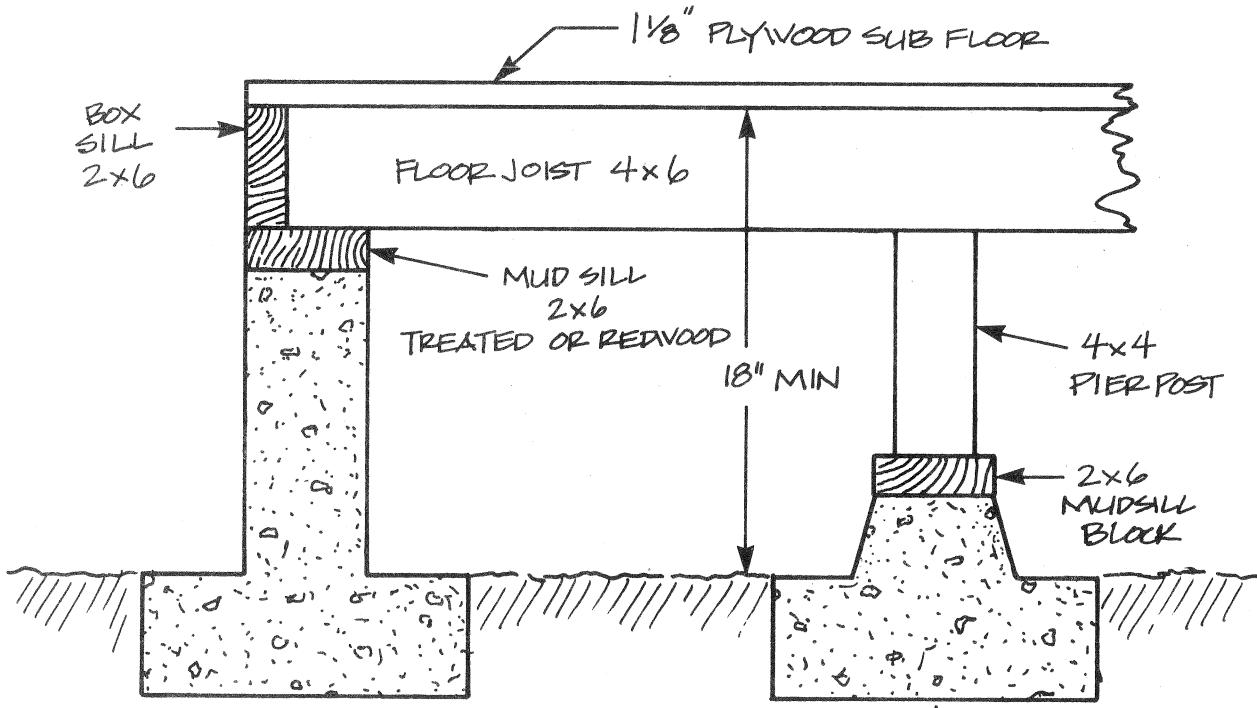
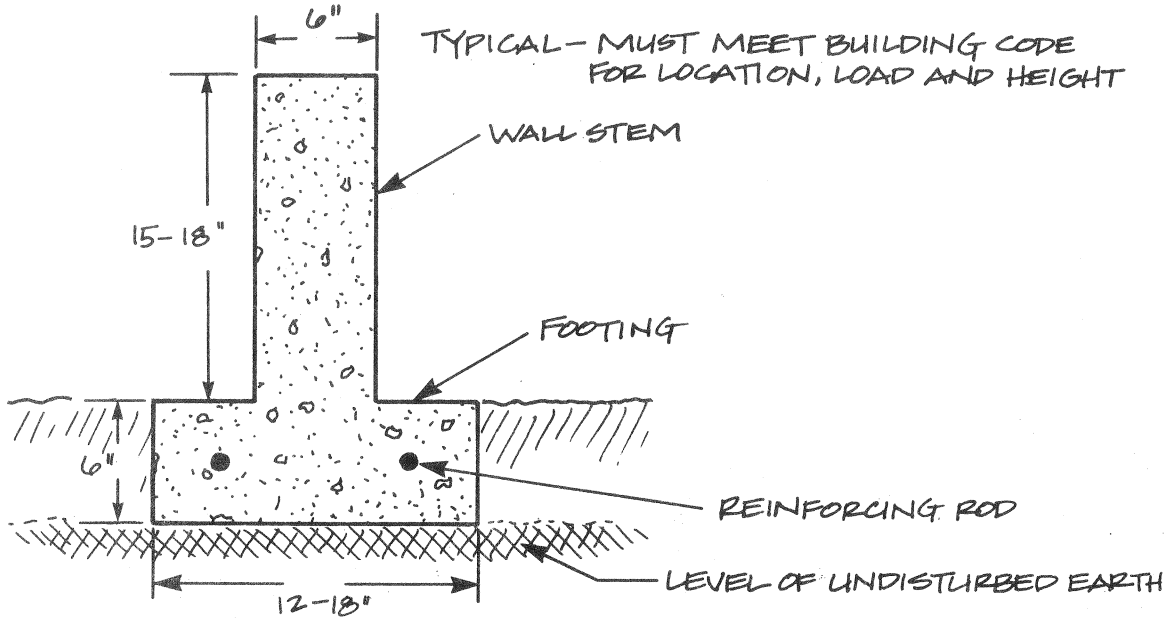
1. TM - 10

Student Evaluation

Have students identify foundation and building components from sketches.
(TM - 6, 10)

Have students differentiate between new and old system of floor joists.

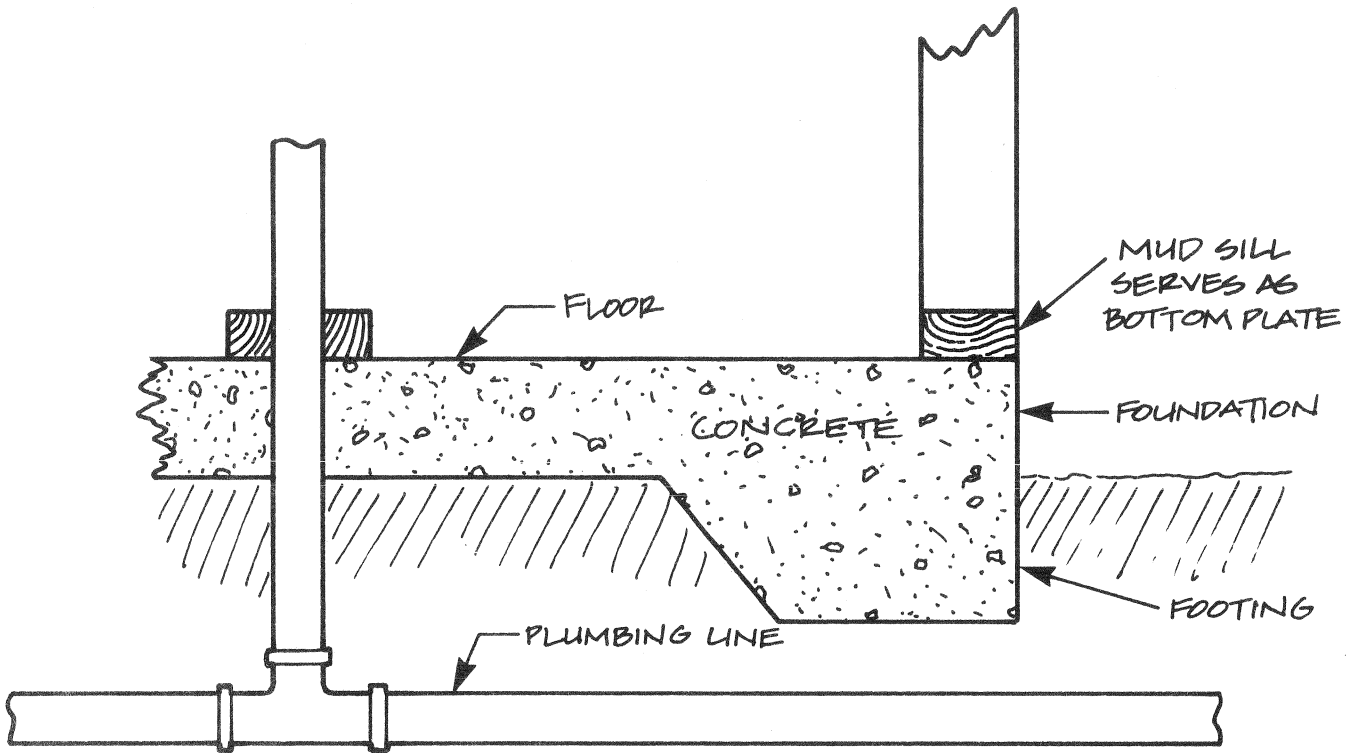
INVERTED TEE FOUNDATION



NOTE: OLD STYLE (2" JOISTS 16" O.C.)
 MINIMUM CLEARANCE 18" FROM
 BOTTOM OF JOIST TO SOL.

PIERS
 5' ON CENTER

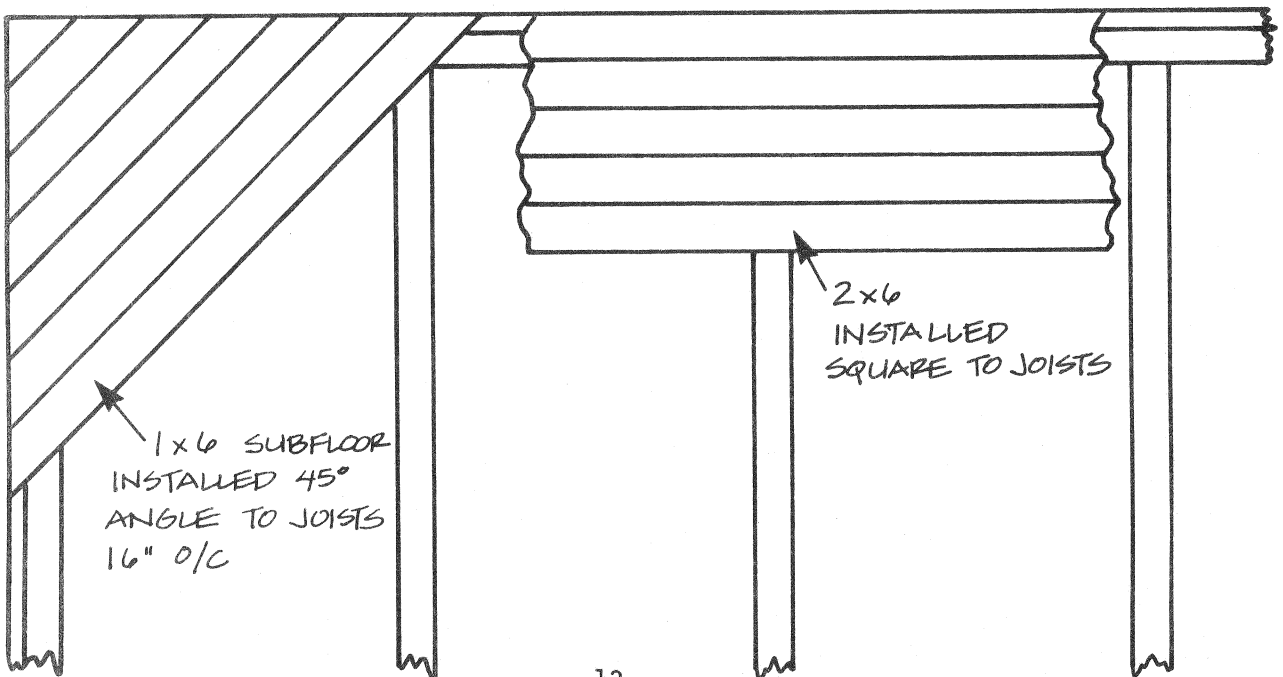
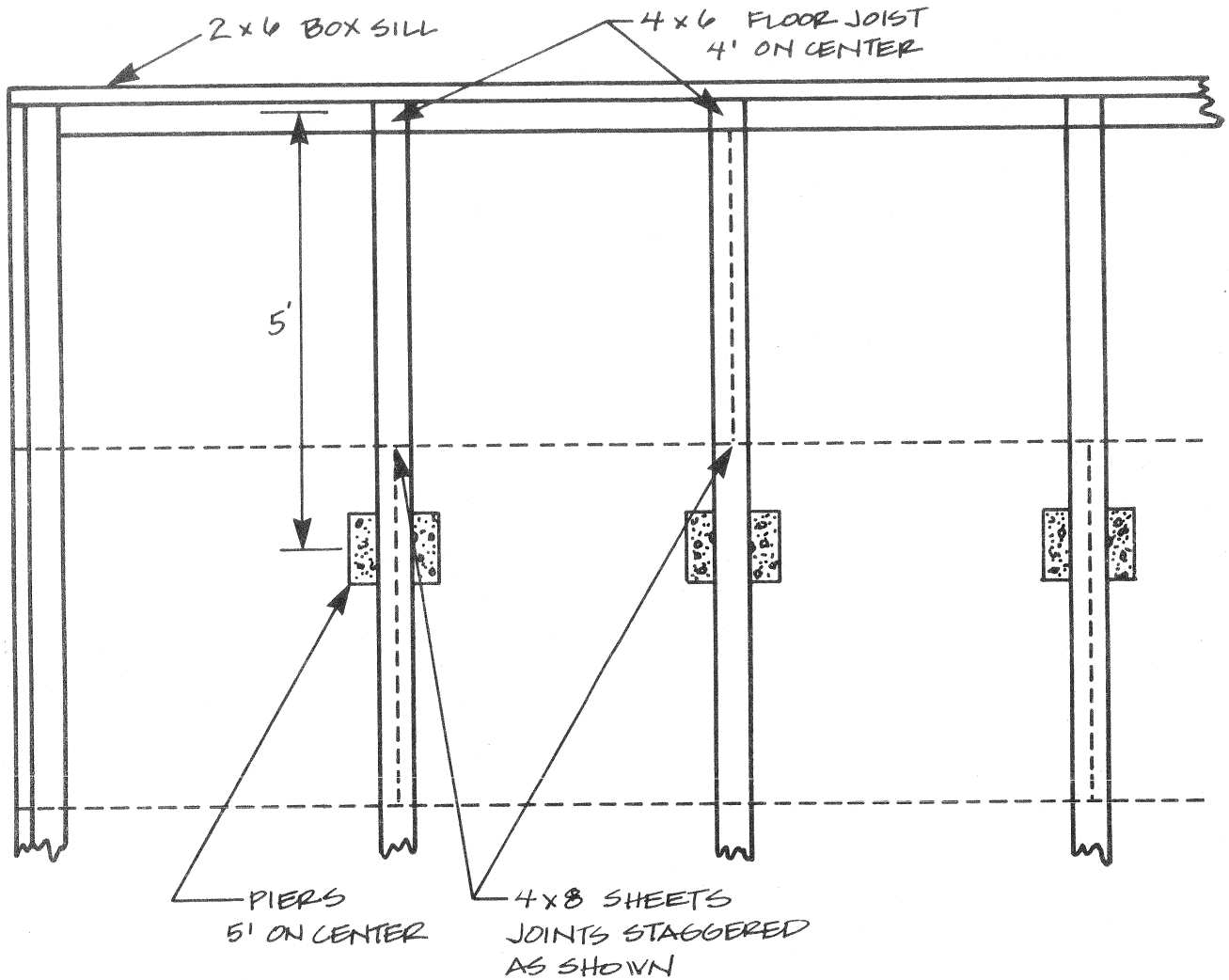
SLAB FOUNDATION



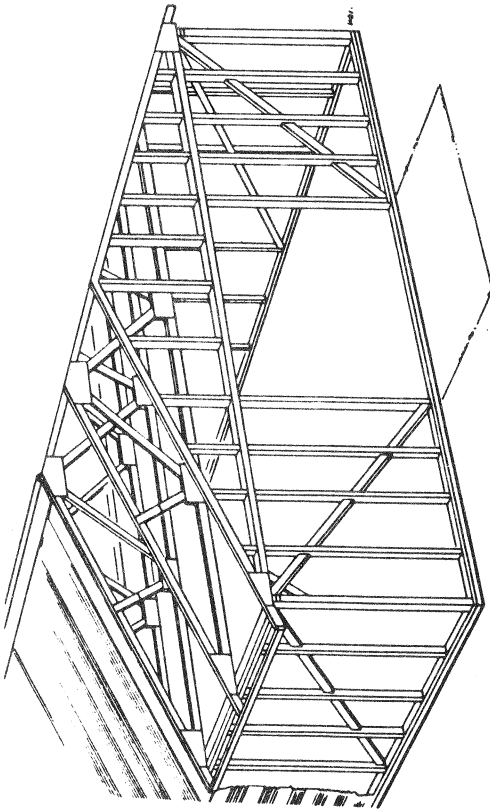
PLUMBING EXTENDS THROUGH
CONCRETE AT PARTITION

SUB-FLOOR LAYOUT

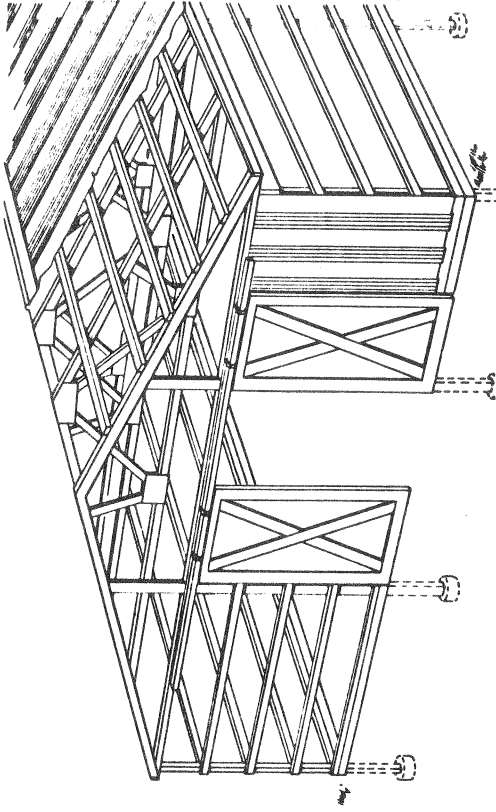
TM-3



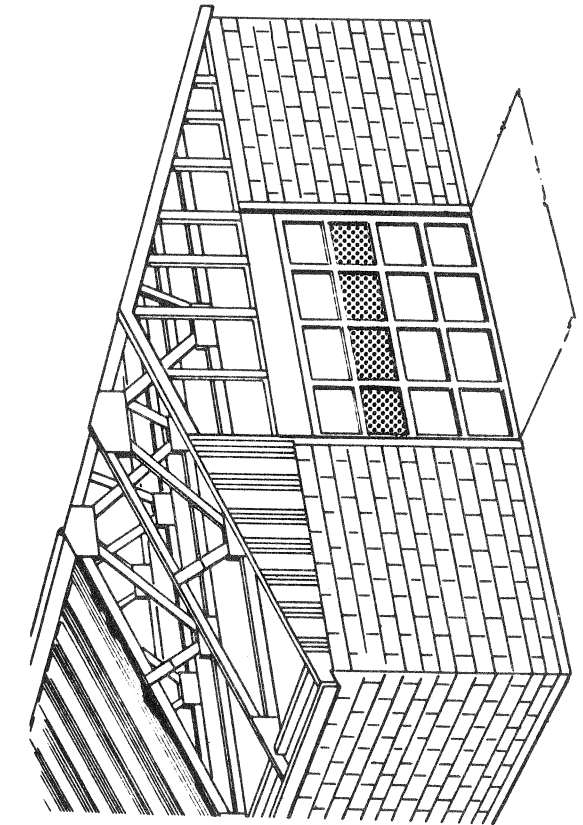
TYPES OF FARM BUILDING CONSTRUCTION



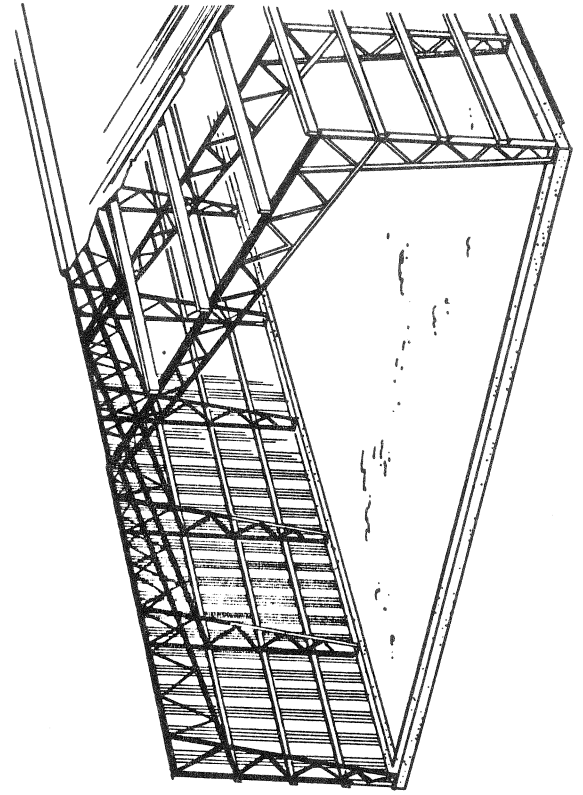
STUD FRAME CONSTRUCTION



POLE FRAME CONSTRUCTION



CONCRETE MASONRY CONSTRUCTION

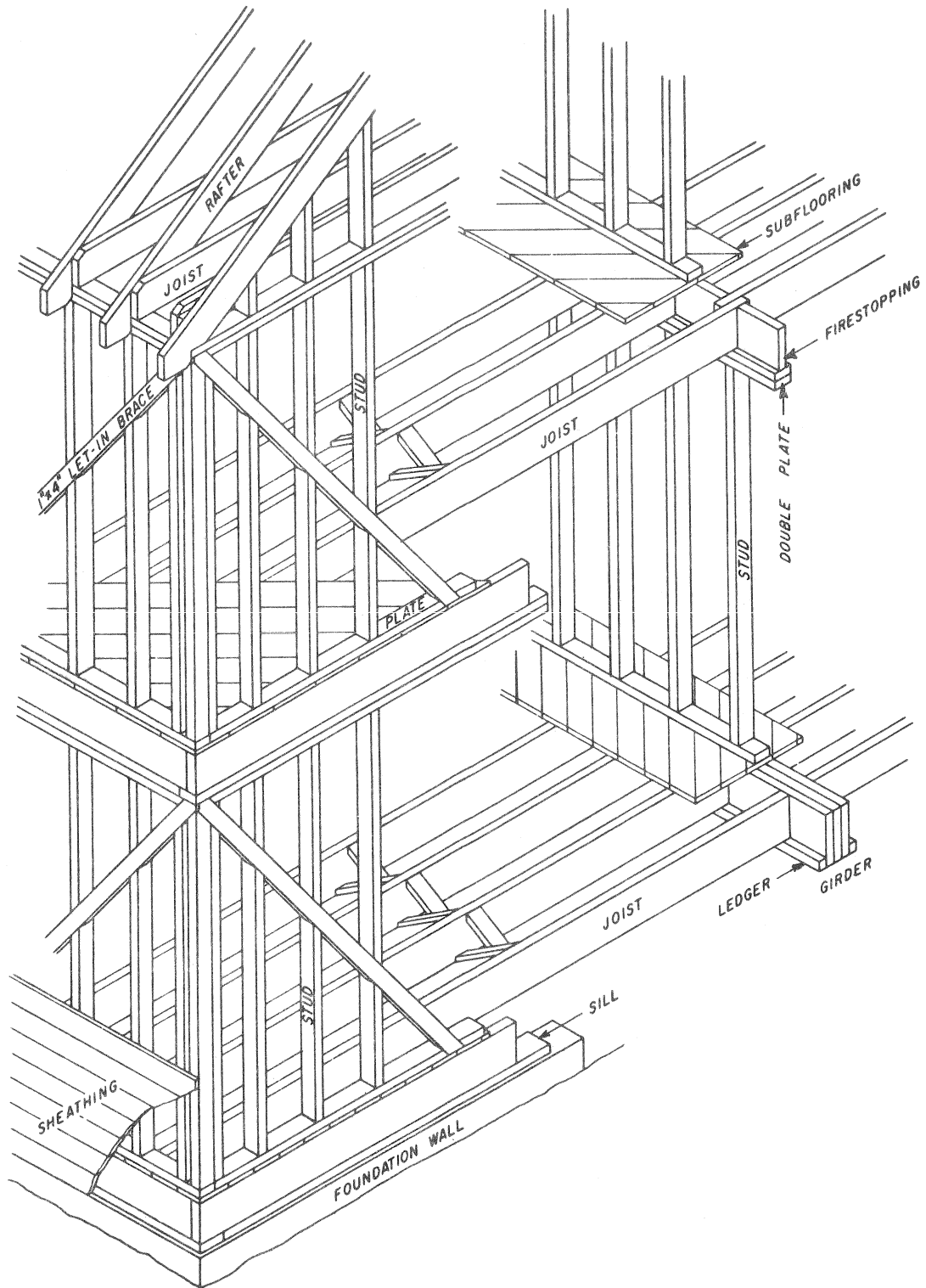


RIGID ARCH CONSTRUCTION

TM-4

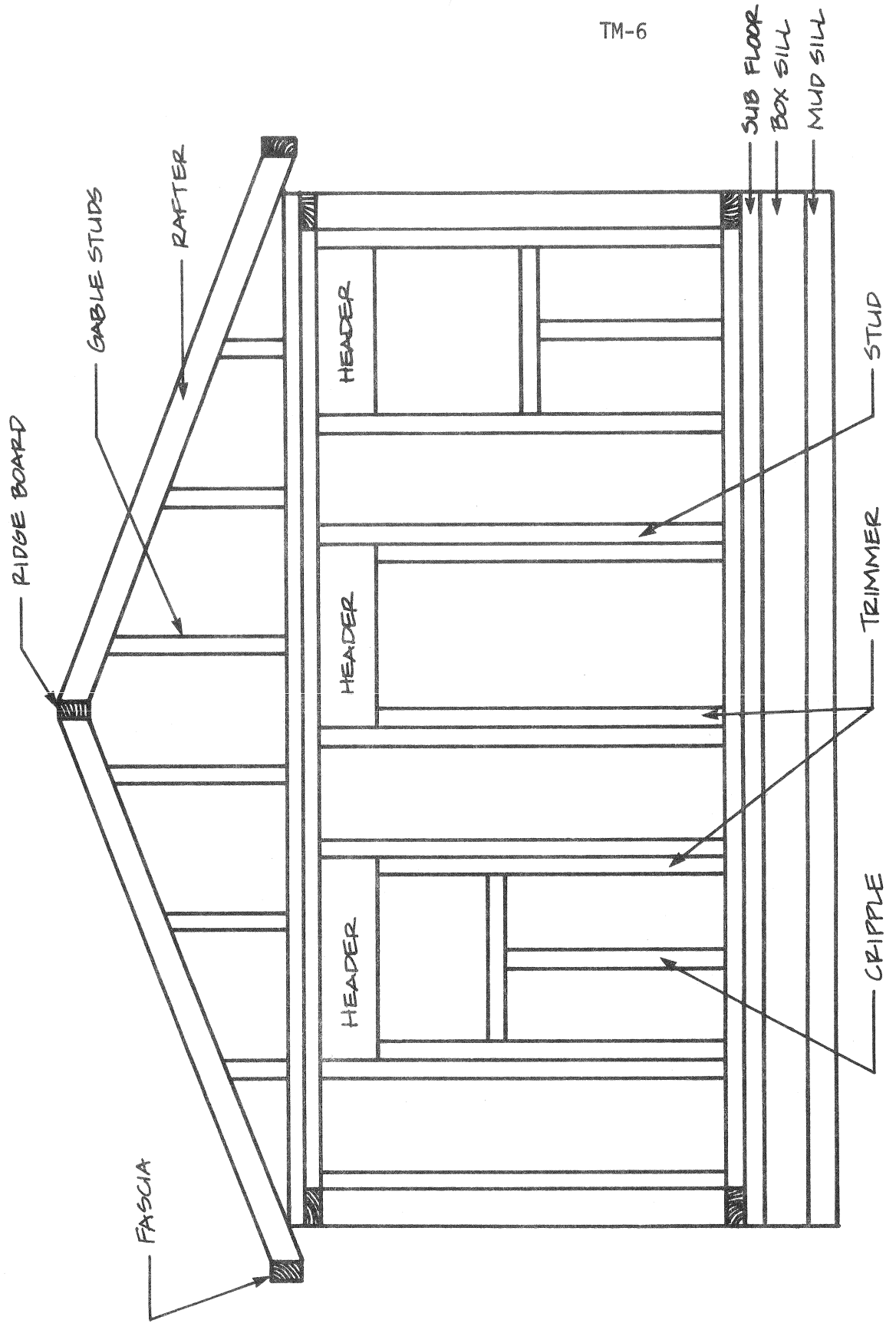
PLATFORM FRAME CONSTRUCTION

TM-5



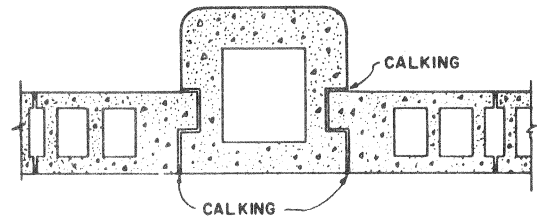
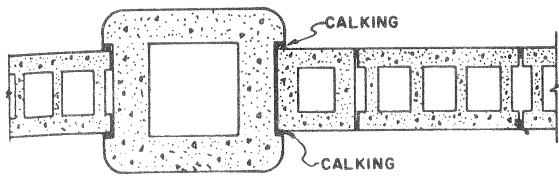
FRAME COMPONENTS

TM-6

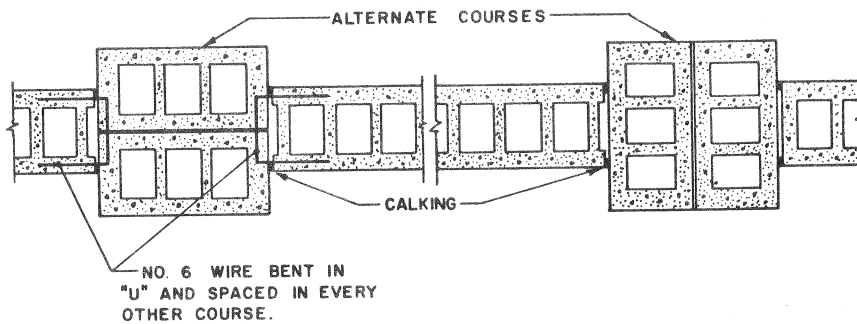


BUILDING PILASTERS

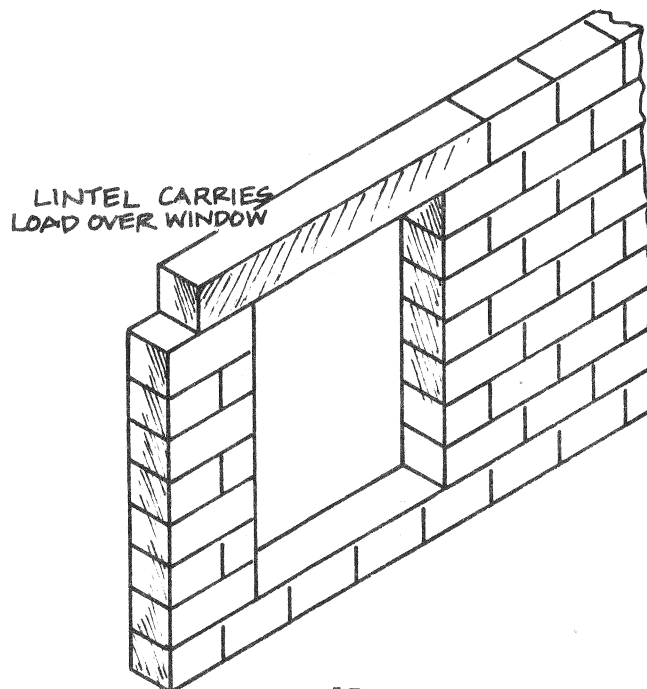
TM-7



PILASTER BLOCKS WITH
CONTROL JOINTS

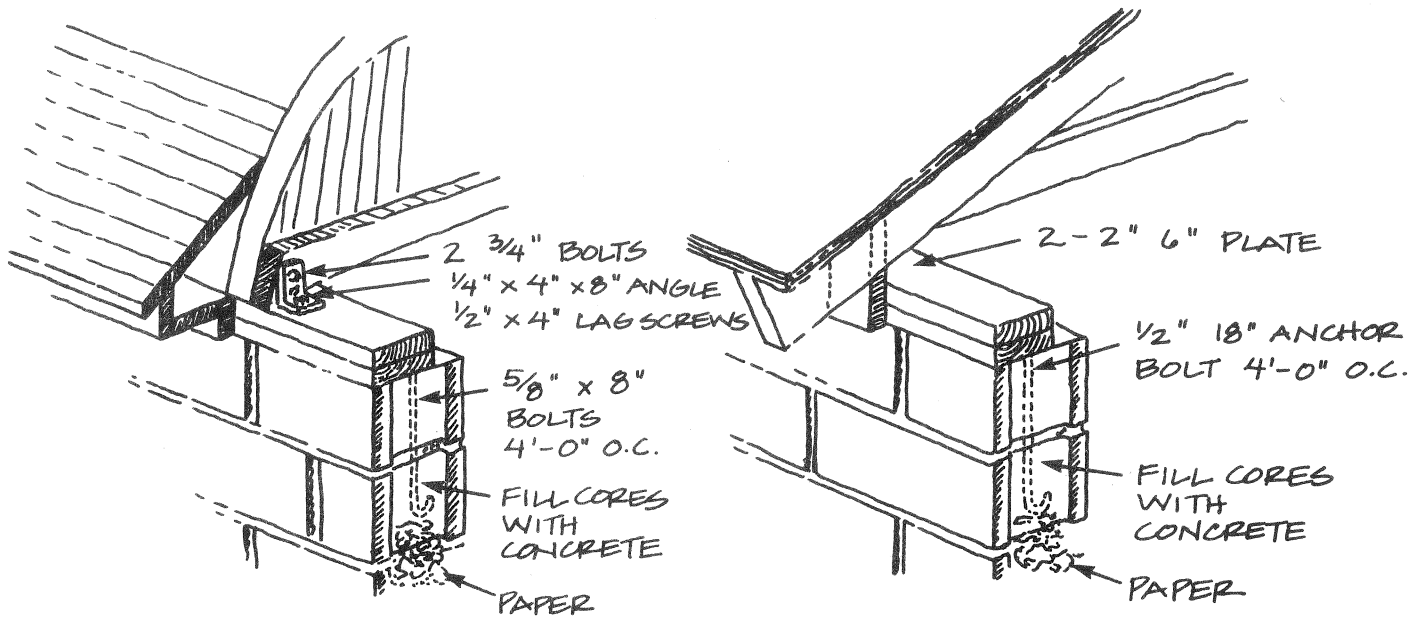


LINTELS FOR MASONRY WALLS



ROOF ANCHORAGE FOR CONCRETE MASONRY WALLS

TM-8



ARCH ROOF

GABLE ROOF

Mixtures for Mortar¹

Type of Service	Cement	Mortar Sand
Ordinary work	1 masonry cement	2-1/2 to 3
High winds, frost, or heavy loads	1 masonry cement 1 portland cement	4 to 5
Ordinary, where masonry cement is unavailable	2 portland cement 1 lime	4 to 5

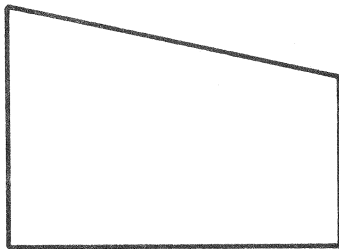
1. Source: Portland Cement Association Form 9.

Table 9-6. Quantities of Concrete Block and Mortar¹

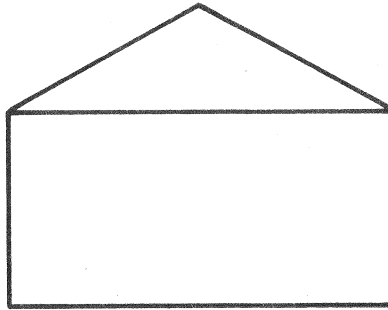
Wall Thickness	For 100 sq. ft. of Wall 3/8" Joint		For 100 Block 3/8" Joint
	No. of Blocks 8 x 16 face	Mortar ² cu. ft.	Mortar ² cu. ft.
8	112.5	8.5	7.5
12	112.5	8.5	7.5

1. Source: Portland Cement Association Form 9.
2. 10% waste included.

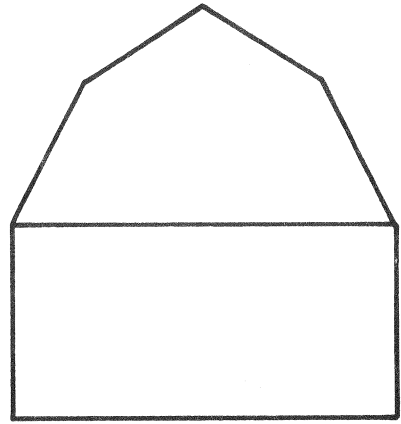
FARM ROOF STYLES



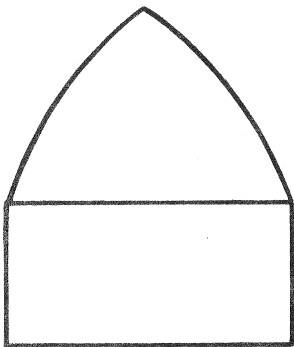
SHED



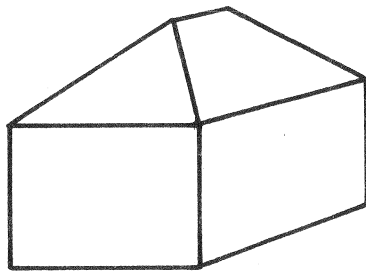
GABLE



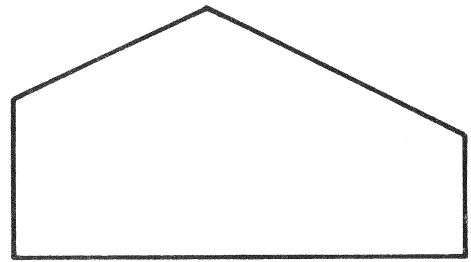
GAMBREL



GOTHIC

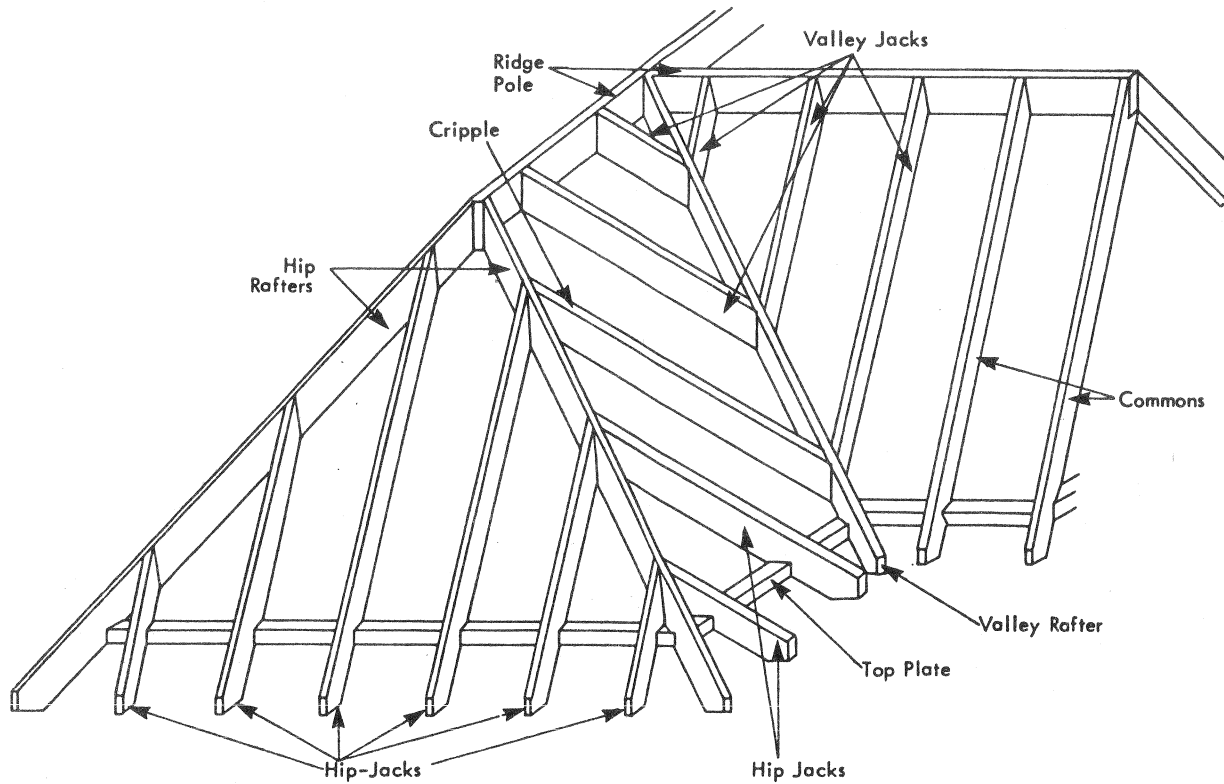


HIP

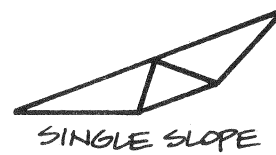
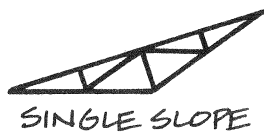


COMBINATION

ROOF PARTS



ROOF TRUSS DESIGNS



General References

Boyd, Practical Farm Buildings, Interstate publishers