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Extension Division

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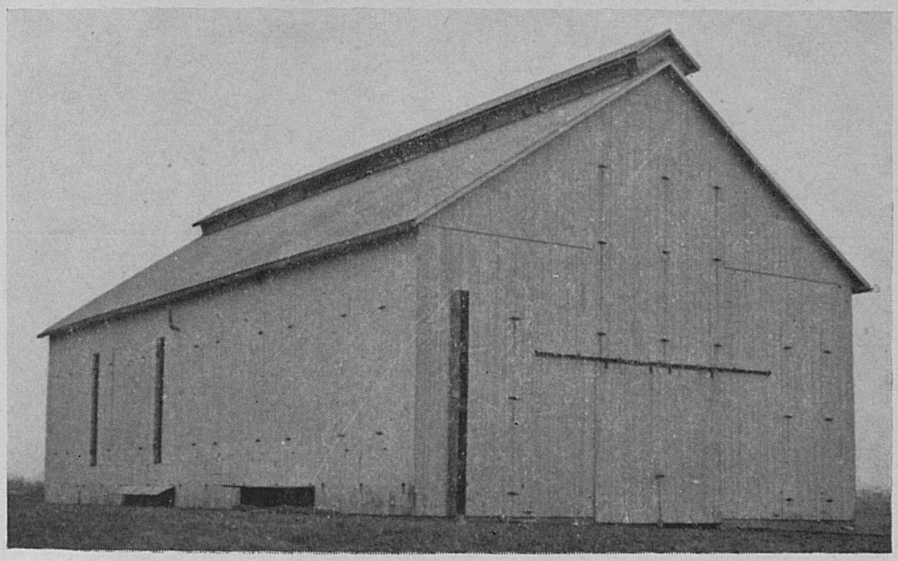
CIRCULAR NO. 335

VENTILATION OF TOBACCO BARNS



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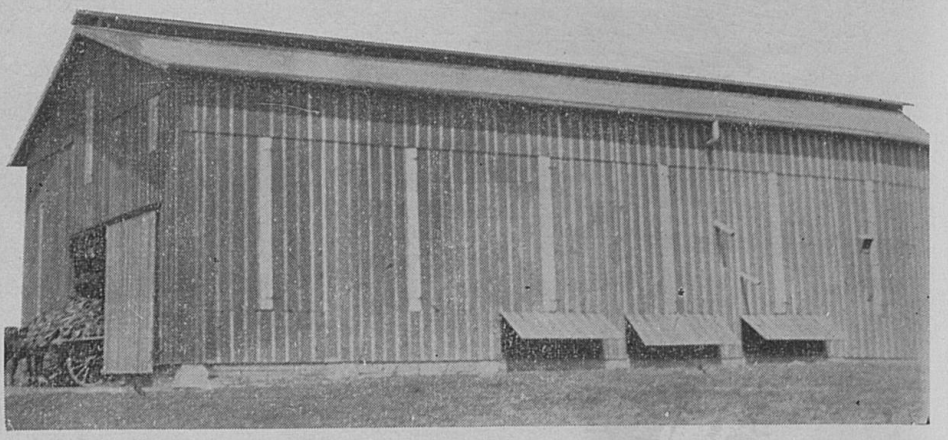
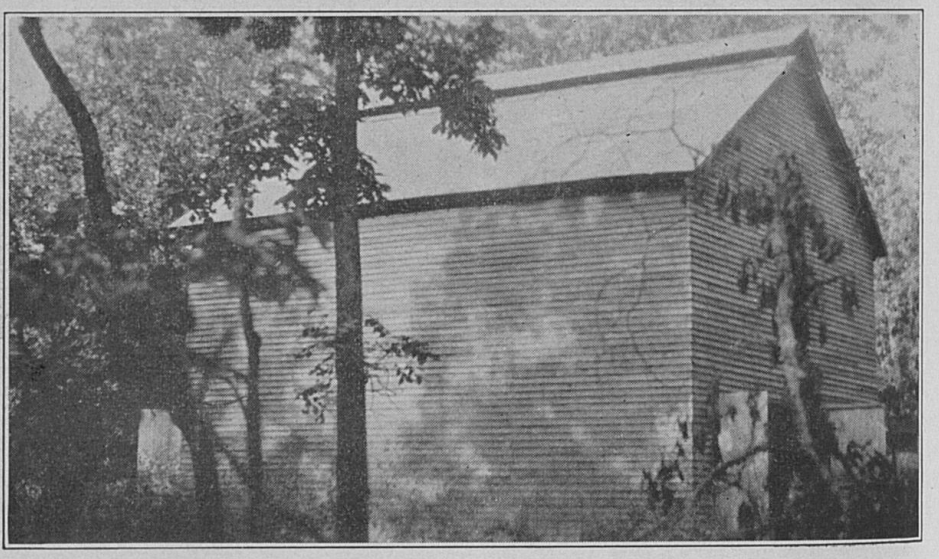


A well-ventilated air-curing barn with ridge, horizontal bottom, and vertical ventilators.



Ridge ventilator on well-located fire-curing barn.

Circular No. 335

VENTILATION OF TOBACCO BARNS

By RUSSELL A. HUNT and JESSE B. BROOKS

Curing is one of the most important operations in the production of tobacco. Successful curing depends largely upon the location and construction of the tobacco barn. In general a site should be chosen which is thoroly drained and sufficiently removed from other buildings to allow free access of air. In erecting a new barn or in repairing an old one, the important things to be accomplished are to construct it as nearly air-tight as possible and to provide a good system of ventilation. Since there are a sufficient number of barns in Kentucky to care for normal crops, the important problem confronting the tobacco grower at present is to improve existing structures by adding controlled ventilators. Most tobacco barns were built before there was definite information concerning the ventilation requirements for successful curing; consequently, comparatively few of them have provision for adequate ventilation in the roof, such as is shown in the cut on the title page. Controlled ventilation is an important feature in providing the best curing conditions.

The amount of ventilation required for a barn is determined by the location of the structure and the type of tobacco produced. A barn located on high ground and fully exposed to the wind and sun requires less ventilation than one in a valley or sheltered by a grove of trees. A barn designed for air cured tobacco, that is for white burley, one sucker or Green River, needs more ventilation than one designed for fire-cured tobacco. If possible, an air-curing barn should be located on a ridge or hill and entirely in the open where there is free circulation of air, whereas a fire-curing barn should be in a grove of trees or valley, sheltered from the wind and sun.

THE NEED OF CONTROLLED VENTILATION

The curing barn should be so constructed and ventilated as to permit rapid changing of air when needed. The tobacco is placed in the barn immediately following cutting, or after wilting, and the curing may be controlled by regulating the ventilation. Water con-

stitutes the greater part of the weight of the harvested plant. During the first stages of curing this water is evaporated from the surface of the leaves, and one of the most important factors in curing is to properly regulate the rate of drying. If the leaf is dried too rapidly, it is killed prematurely, the curing is stopped and the color of the leaf remains green. On the other hand, if drying is too slow, the curing process goes too far, the tobacco either turns a dark red color or, possibly, becomes houseburned. The rate of drying of tobacco depends upon the humidity and temperature of the air and its rate of movement thru the barn.

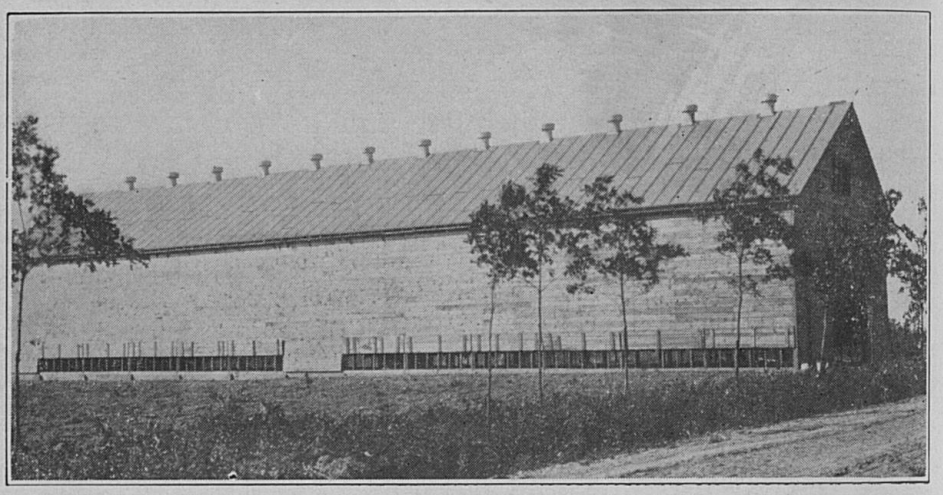


FIGURE 1. Tobacco barn with insufficient ridge ventilation.

The water content of tobacco at the time of cutting and housing may range from 75 to 90 percent of the green weight. An acre of well-ripened tobacco yielding 1,500 pounds of cured leaf weighs when harvested 8 to 12 tons, including the stalks. To cure tobacco successfully, the large amount of water must be removed under such conditions and at such a rate as best allow the other fundamental changes to occur in the leaf. Experience has shown that a well-constructed barn, properly ventilated, provides the means for regulating the humidity during the curing period, thru controlled air movement.

METHODS OF VENTILATION

Many plans have been devised for ventilating barns. Few have been satisfactory under all conditions. The hinged vertical shutter

or side door 10 to 12 inches wide, for each bent, is one of the oldest and most generally used in Kentucky. It is effective only when the air outside the barn is moving sufficiently to cause some circulation in the barn. It is entirely ineffective in hot, sultry weather, when there is little or no air movement. Practically all barns in the areas producing air-cured tobacco are equipped with this ventilator.

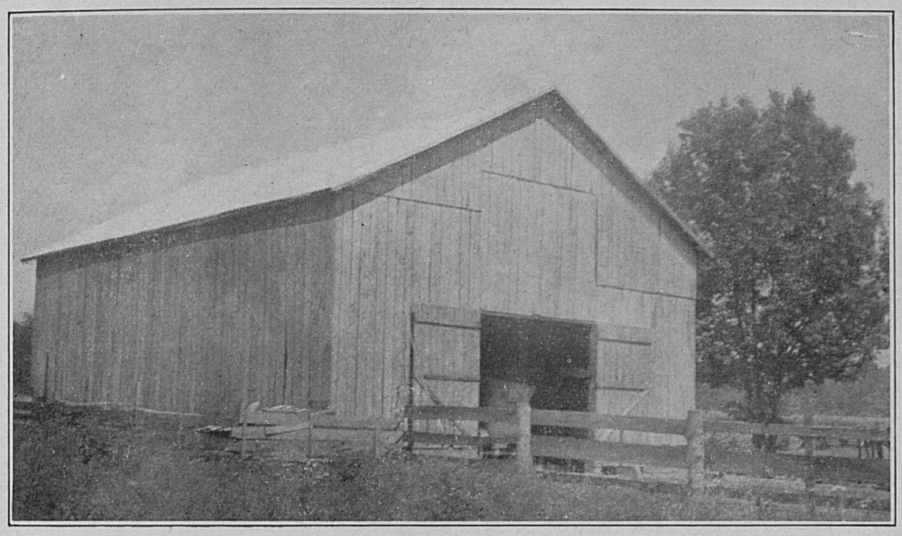


FIGURE 2. An unventilated barn.

The round, metal, roof ventilator, in general use, improves curing conditions when used with the side-door or vertical ventilators, just mentioned. The usefulness of this ventilator depends upon the number placed on the barn and the size of the openings. The most common sizes are the 16″ and 20″, and a few barns have ventilators 24″ in diameter. The approximate areas of opening in the 16″, 18″ and 20″ circular ventilators are 1.4 sq. ft., 1.8 sq. ft. and 2.2 sq. ft., respectively. The common practice is to use only one circular ventilator to each bent of 12 feet. This amount of ventilation is inadequate unless natural conditions are favorable for curing.

Experience has proved that the ridge ventilator, supplemented by horizontal ground ventilators, is highly desirable on barns for curing all types of tobacco grown in Kentucky. In addition, vertical side-door ventilators should be provided on air-curing barns. They are not recommended for fire-curing barns. The ridge ventilator

provides a continuous outlet opening at the top of the roof, from one end of the barn to the other, and when used with the horizontal ground ventilators and side ventilators in air-curing barns permits satisfactory control of air condition and movement. The ridge

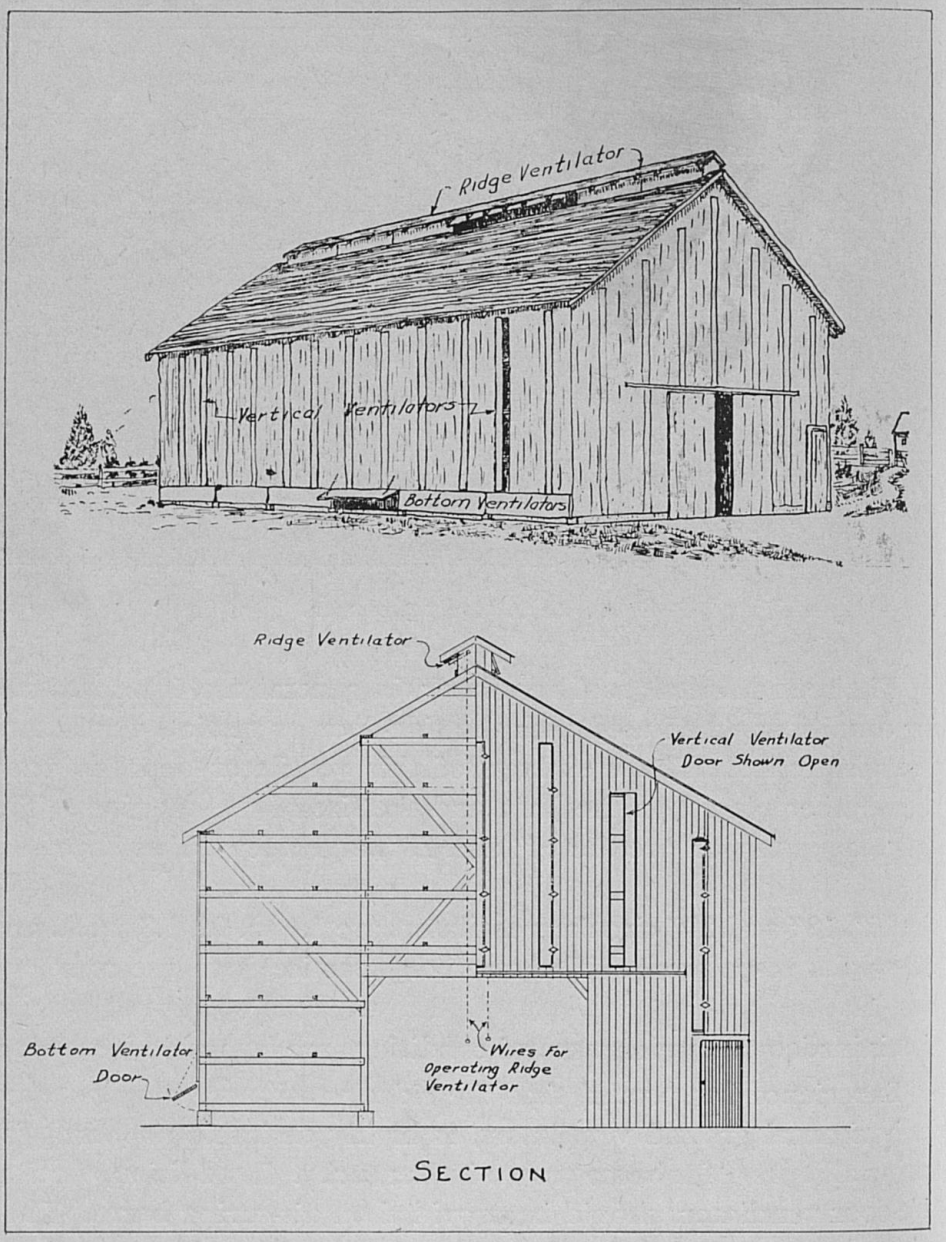


FIGURE 3. Method of ventilating air-curing tobacco barns.

ventilator is recommended because it is simple to construct, easy to operate and, when constructed according to the specifications herein recommended, provides sufficient opening for thoro ventilation.

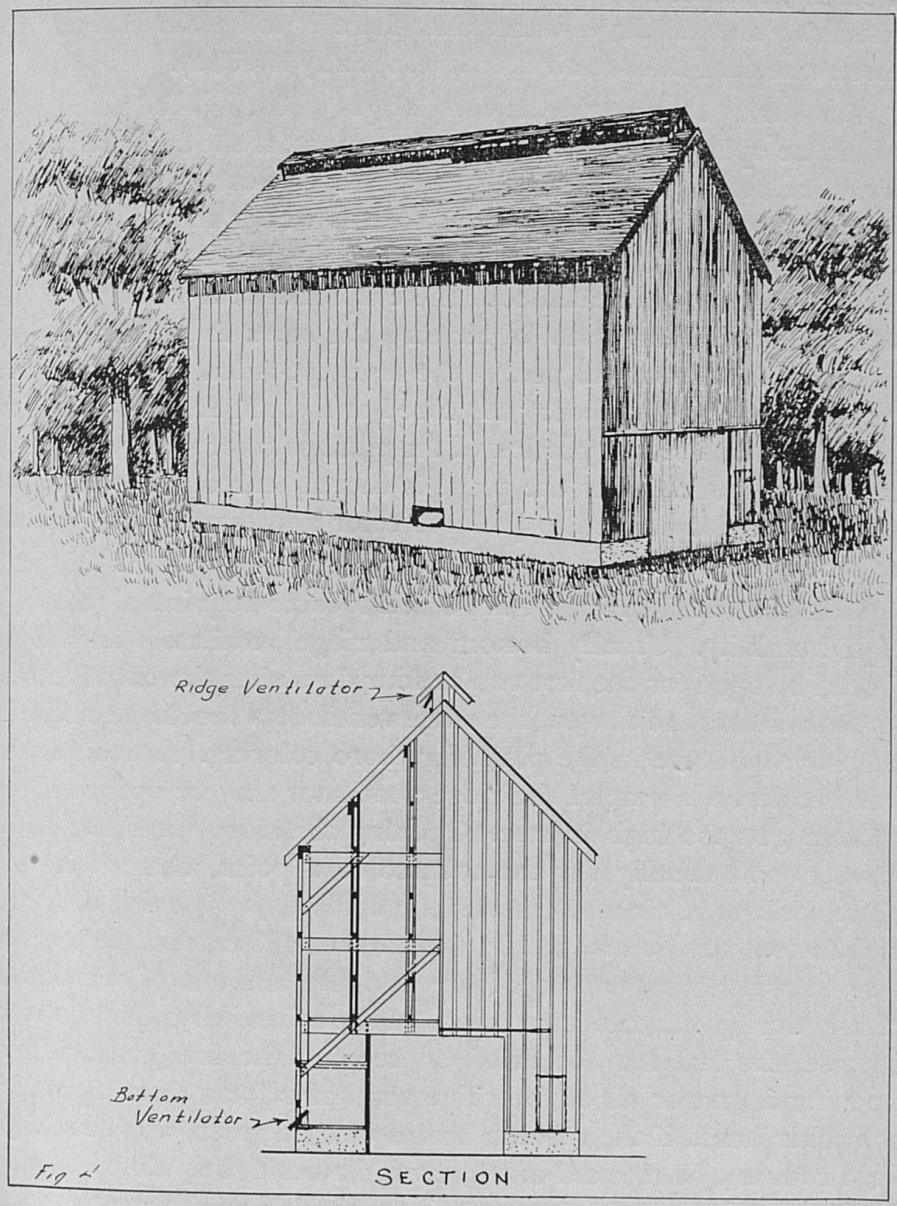


FIGURE 4. Method of ventilating fire-curing tobacco barns.

USE OF VENTILATION

It is necessary to use even the best system of ventilation intelligently to obtain good results. The proper operation of the ventilators and doors varies with the type of tobacco, weather conditions, stage of curing, and method of curing. In general, in the early stages of curing, irrespective of type of tobacco, ventilators should be open when the outside air is warm and there is some movement, and closed when the outside air is cool, especially if windy.

For burley tobacco, in the early stages of curing, the ventilators should be open thruout the day and at night, if the air is relatively dry, but closed at night during rainy or foggy weather and also during the day if the air outside the barn is wetter than that inside. Ridge ventilators should always be open when heat is being used. Heat in the barn increases both the evaporation of water from the tobacco and the movement of air thru the barn; ample ventilation, therefore, is necessary to permit the moisture-laden air to leave the barn. When burley tobacco has cured and changed from yellow to straw or buff color, the portion of the plant so colored should be dry enough to rattle. After the plant is thoroly cured, the ventilators should be tightly closed to preserve color and quality and prevent damage from wind.

The successful curing of fire-cured tobacco requires a relatively high humidity. Usually bottom and ridge ventilators and doors should be open for the first two or four days after the barn is filled. As soon as fires are started, the ridge ventilators should be closed to keep the moisture in the plant for thoro coloring. As soon as the leaf is colored, a part of the ridge ventilator may be opened if the tobacco gets too high in case. Opening the ridge ventilator a few minutes will usually dry the tobacco to a point where it is safe. Since the flow of air thru the barn is regulated by opening the ridge and bottom ventilators, and by the amount of heat used, it is necessary to watch the volume of fire and the amount of ventilation closely during the coloring period. If the tobacco becomes too high in case, the leaf may be dried by keeping the fires constant and opening a part or all of the ridge ventilator for a short time. On the other hand, if the tobacco begins to cure green, fires should be kept constant or reduced and the ventilators tightly closed to raise humidity. If necessary, water may be sprinkled on the ground, walls

of the barn, fuel, and even the tobacco itself to restore proper humidity. After coloring is complete, it is necessary to lower humidity to avoid molding of the stems and to prevent house-burn. Opening ridge ventilators for a short time once or twice daily will suffice. After the crop is colored and dried to the point of safety, all ventilators should be kept closed. In smoking dark tobacco, ventilators should be tightly closed to keep in the smoke.

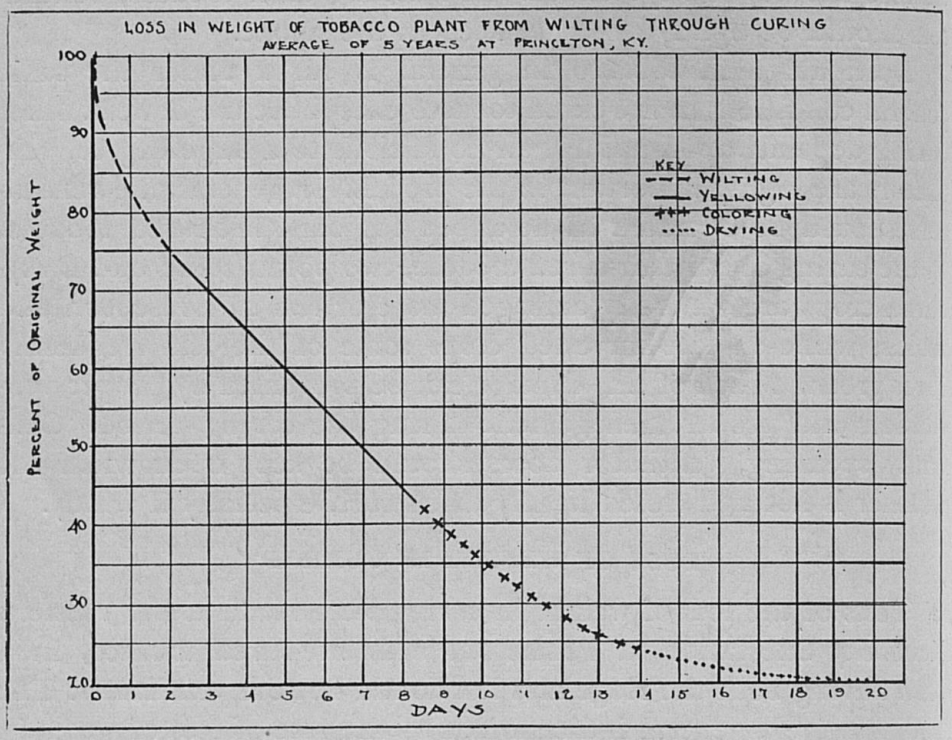
Dark air-cured tobacco in general is cured under the same general conditions as fire-cured tobacco except the use of heat. Since curing depends upon natural air conditions to a large degree, ventilators are highly important in the process. In general, the ventilators should be operated as described for dark fire-cured tobacco. In the curing of dark air-cured tobacco, two points stand out. Early-cured crops are generally damaged more or less by houseburn and molds, while in late-harvested crops some of the leaf frequently cures green. Much of this damage can be prevented by proper ventilation and proper management during the curing period. Generally speaking, ventilator doors should be kept open when the weather is hot and closed tightly when cool, especially if windy.

LOSS OF WEIGHT IN CURING

Tests of the loss of weight in curing were made at the Western Kentucky Substation at Princeton, with fire-cured tobacco, in a barn having both the ridge and horizontal bottom ventilators. The findings give a general indication as to the rate of loss of water in curing tobacco but they should not be regarded as standard for all conditions and crops.

In each of the five years, 1928 to 1932, inclusive, a few sticks of tobacco which had just been cut, were immediately weighed and then re-weighed daily until completely cured. From these weights it was found that for each hundred pounds of tobacco when freshly cut, seventy-five pounds remained when wilted, fifty-three pounds when yellowed, twenty-five pounds when colored, and eighteen pounds when the leaf and stems were dry, but the stalks still green. Or, for a single stick of tobacco weighing thirty pounds when cut, twenty-two and one-half pounds remained when wilted, sixteen when yellowed, seven and one-half when colored, and five and one-half when the leaves and midribs were dry. Approximately two-thirds of the original weight was lost by the evaporation of water

during the first ten days the tobacco was in the barn. This would mean for each acre of fire-cured tobacco housed, there would be an average loss of 800 gallons of water, by the time the leaf was cured. It should be borne in mind that these studies were made with fire-cured tobacco but results obtained also probably apply to dark air-



Loss of weight of dark tobacco during curing.

cured tobaccos, tho not to burley. The rate of loss of weight by loss of water is shown by the graph on this page. Starting with 100 percent on the first day as the original weight the drop is to 18 percent on the 20th day. This graph shows *average conditions only*. The loss of water from individual crops undoubtedly would show considerable variation, according to the size of the plants housed and weather conditions during curing.

TO BUILD A RIDGE VENTILATOR ON AN OLD TOBACCO BARN

Two types of ridge ventilator are illustrated in Plans No. 1 and No. 2. There is very little difference in the cost of building these. They may be used with all kinds of roof coverings, but it is difficult to fit the doors and hinges of plan No. 1 to roofs covered with sheet

metal. Plan No. 2 has the following desirable features: (1) the door when open is held against the bottom edge of the rafters and is protected from sun and rain; (2) the hinges placed at the top edge of

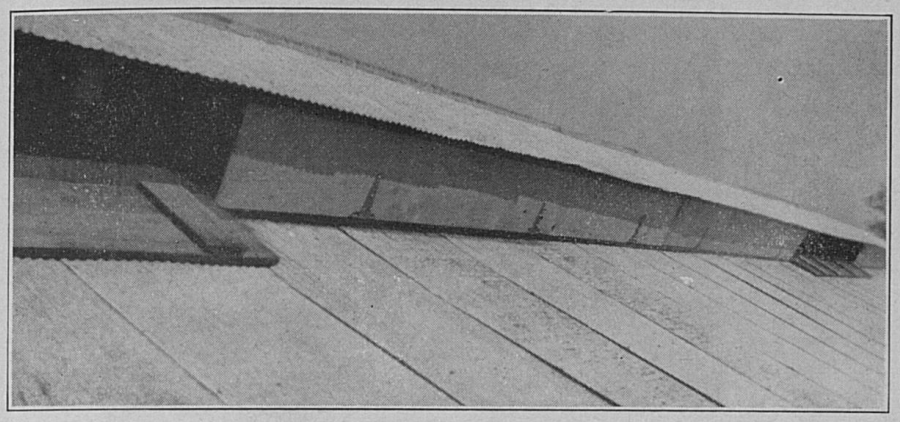


FIGURE 5. Ridge ventilator partly open. (Plan No. 1.)

the door and under the ventilator roof are protected; (3) the door when closed rests against a flashing board which prevents the leakage of rain and snow under it, the flashings making a tight fit re-

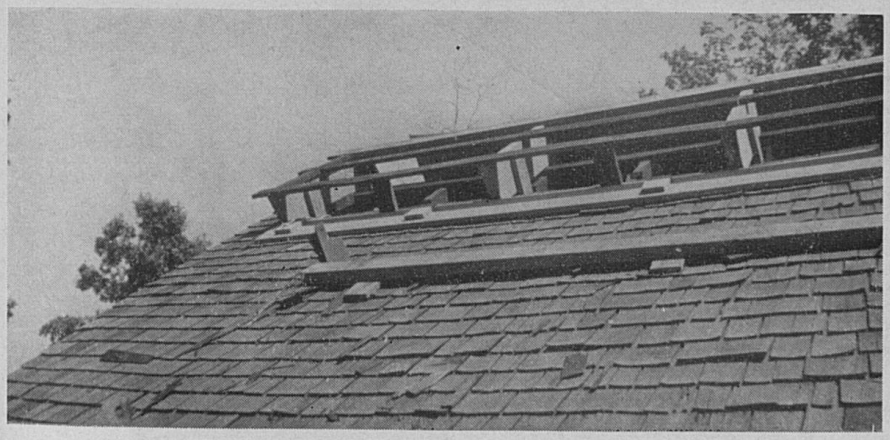


FIGURE 6. Ridge ventilator being constructed on wooden shingle roof according to Plan No. 1, Figure 7, page 12.

gardless of the kind of covering used (see figure 12); (4) simple levers and door springs are used instead of pulleys and ropes to hold the door open and to close it tight.

Step 1. Select the plan, either No. 1 or No. 2, and study it until it is understood.

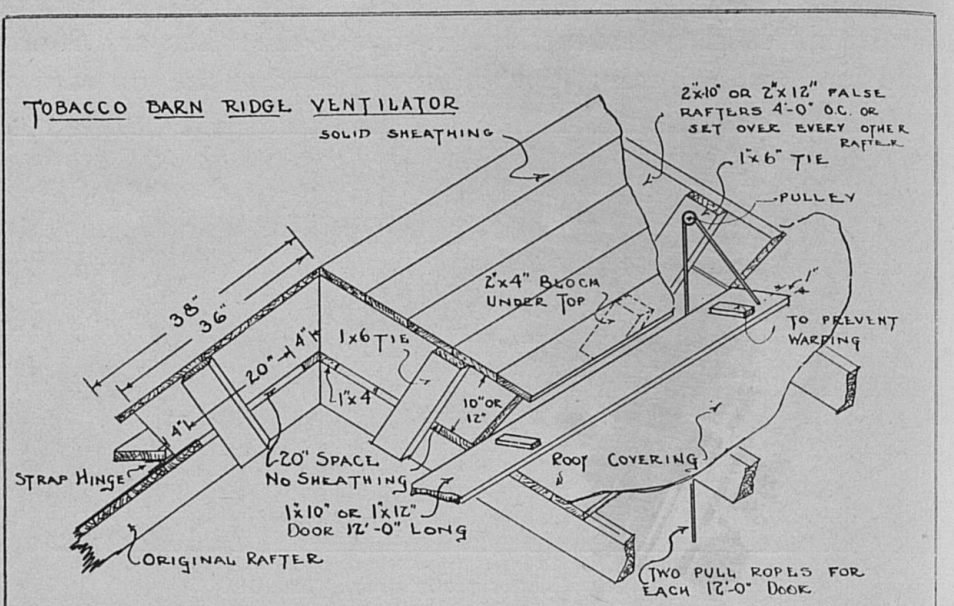


FIGURE 7

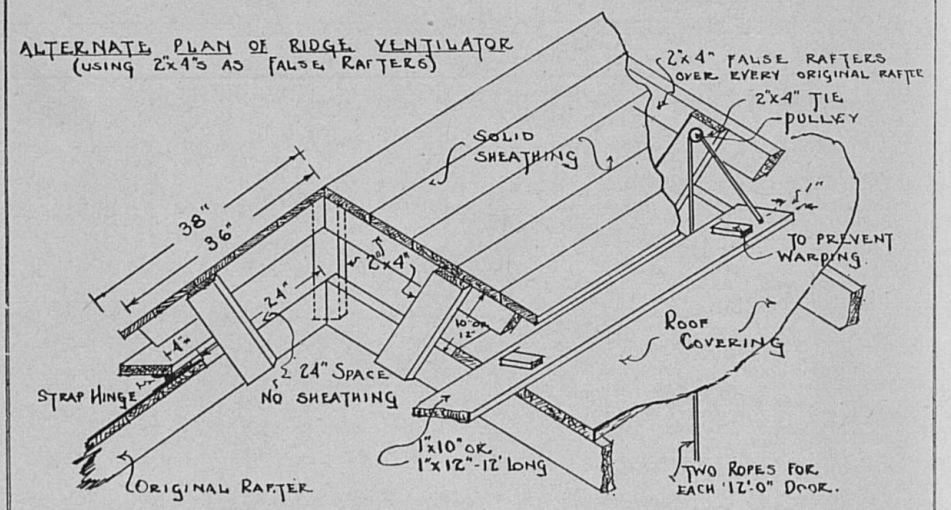


FIGURE 8

NOTE: FOR FIGURES 7 AND 8, RUN VENTILATOR OPENING FULL LENGTH OF BARN.

FIGURES 7 and 8. Tobacco barn ridge ventilator. (Plan No. 1.)

Step 2. Remove the roofing for the width on each side of the ridge indicated in the plan. Metal roofing may be cut with a bolt cutter, heavy tin snips, shingling hatchet, or an old car spring or bumper sharpened on one edge. If the metal or composition roofing is in good condition after removing, it should be saved for covering one side of the ventilator top.

Step 3. Remove the sheathing. Usually a 4″ board is left on each side of the ridge; however, they may be removed when building according to Figure 8, Plan 1. The sheathing is removed to the width from the ridge shown in the plan.

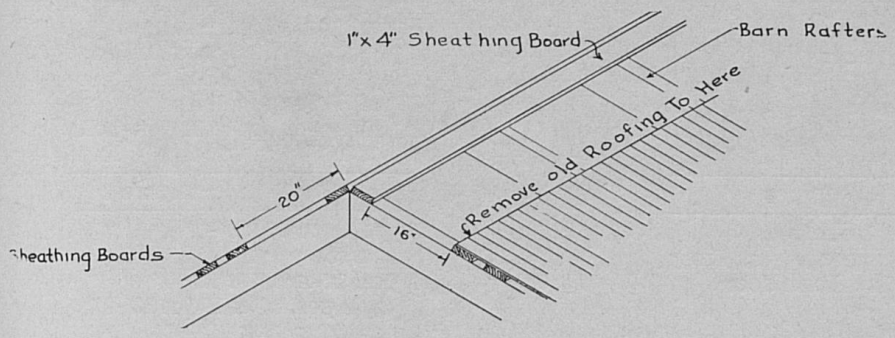


FIGURE 9. Ridge after removal of roofing.

Step 4. Build the ventilator. Cut the false rafters for the ventilator roof 36 inches long. These are cut and nailed together on the ground; then raised to the top of the barn with a pulley. Refer to plan for the spacing of the false rafters. A string line should be used to line in the ends and ridge of the false rafters. A carpenter's level is used to plumb the upright ties in Plan 2, Figure 12.

Step 5. After the rafters have been nailed in place, hang the door as shown in the plan. For the door, use 1-inch boards as wide as the ventilator opening, when building acording to Plan 1. The door in Plan 2 is made 2 inches wider than the ventilator opening in order to cover the flashing board. The doors are as long as one bent of the barn, cleated on the inside, and painted on both sides to prevent warping. After hinging the door, the pulleys, levers, door springs, ropes or wires may be connected and tested for ease of operation. In Plan 2, place a 2″ x 4″ block at an angle between the upright rafter ties for the ends of the door to rest on.

Step 6. Sheathe the ventilator top and cover with wood shingles, composition, or galvanized roofing.

Bill of Material for Each 12 Feet of Ridge Ventilator

Note. Where original roofing and sheathing are used to cover the ventilator top, the amount of sheathing in each bill can be cut one-half. This depends upon the kind of material used for roofing.

Items	If built as in Figure 7
False rafters	3 pcs. 2″ x 10″ x 6′-0″ Or 3 pcs. 2″ x 12″ x 6′-0″
Supporting blocks	1 pc. 2″ x 4″ x 6′-0″
Ventilator door	2 pcs. 1″ x 10″ x 12′-0″ Or 2 pcs. 1″ x 12″ x 12′-0″
Ties	1 pc. 1″ x 6″ x 12′-0″
Cleats	1 pc. 1″ x 4″ x 8′-0″
Sheathing	80 Bd. Ft.
Roofing	80 Sq. Ft.
Hinges	3 pr. 4″ galv. strap hinges
Pulleys	2 pr. galv. swivel awning rope-pulleys, wheel 1″ dia.
Rope	16′ of ¼″ rope
Bolts	2 pair screw-eyes or eye-bolts
Nails (approx.)	2 lbs. 8d, ¼ lb. 6d, and ¼ lb. 10d

Items	If built as in Figure 8
False rafters	6 pcs. 2″ x 4″ x 6′-0″
Supporting blocks	Not necessary
Ventilator door	2 pcs. 1″ x 10″ x 12′-0″ Or 2 pcs. 1″ x 12″ x 12′-0″
Ties	3 pcs. 2″ x 4″ x 10′-0″
Cleats	1 pcs. 1″ x 4″ x 8′-0″
Sheathing	80 Bd. Ft.
Roofing	80 Sq. Ft.
Hinges	3 pr. 4″ galv. strap hinges
Pulleys	2 pr. galv. swivel awning rope-pulleys, wheel 1″ dia.
Rope	16′ of ¼″ rope
Bolts	2 pr. screw-eyes or eye-bolts
Nails (approx.)	2 lbs. 8d, ¼ lb. 6d, ¼ lb. 10d

Items	If built as in Figure 12
Upright rafter ties	4 pcs. 1″ x 4″ x 8′-0″
False rafters	2 pcs. 2″ x 4″ x 12′-0″
Rafter ties	1 pc. 1″ x 4″ x 6′-0″
Boards between rafters	2 pcs. 1″ x 6″ x 12′-0″
Levers	1 pc. 2″ x 2″ x 8′
Flashing board	2 pcs. 1″ x 2″ x 14′-0″
Sheathing	80 Bd. Ft.
Roofing	80 Sq. Ft.
Door cleats	1 pc. 1″ x 4″ x 10′-0″
Ventilator door for 10″ opening	2 pcs. 1″ x 12″ x 12′-0″
Hinges	3 pr. 4″ galv. strap hinges
Flashing for corrugated roof	12 Ft. of ridge roll or end wall flashing
Flashing for V-crimp roof	24 Ft. of flat sheet metal 9″ to 10″ wide
Stove bolts	16 bolts 2½″ x ¼″
Nails	5 lbs. 8d, 2 lbs. 6d, and ½ lb. 20d
Door springs	2 pr.

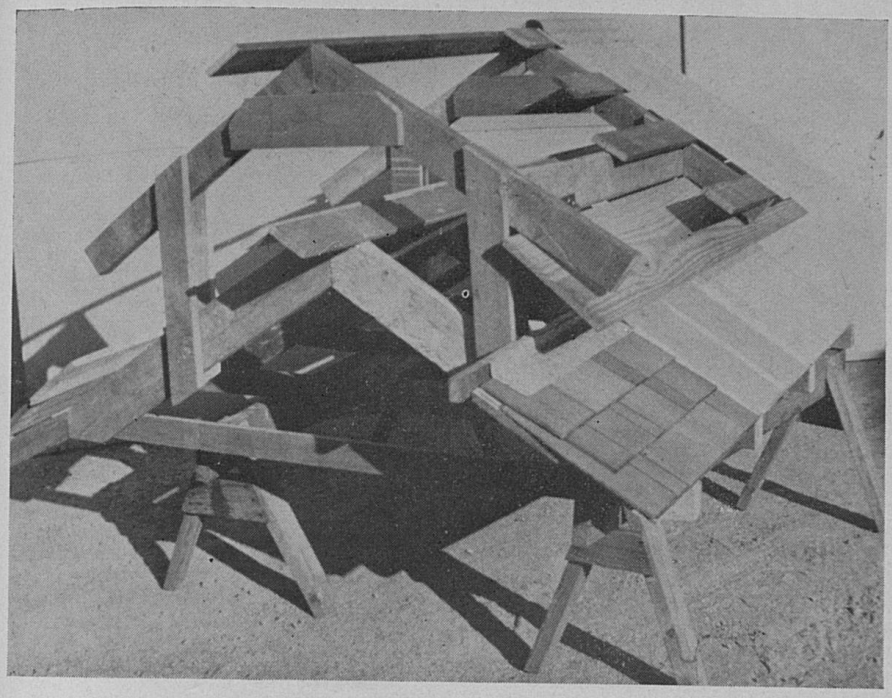


FIGURE 10. Model of ridge ventilator built according to Plan No. 2. Refer to Figure 12, page 16.

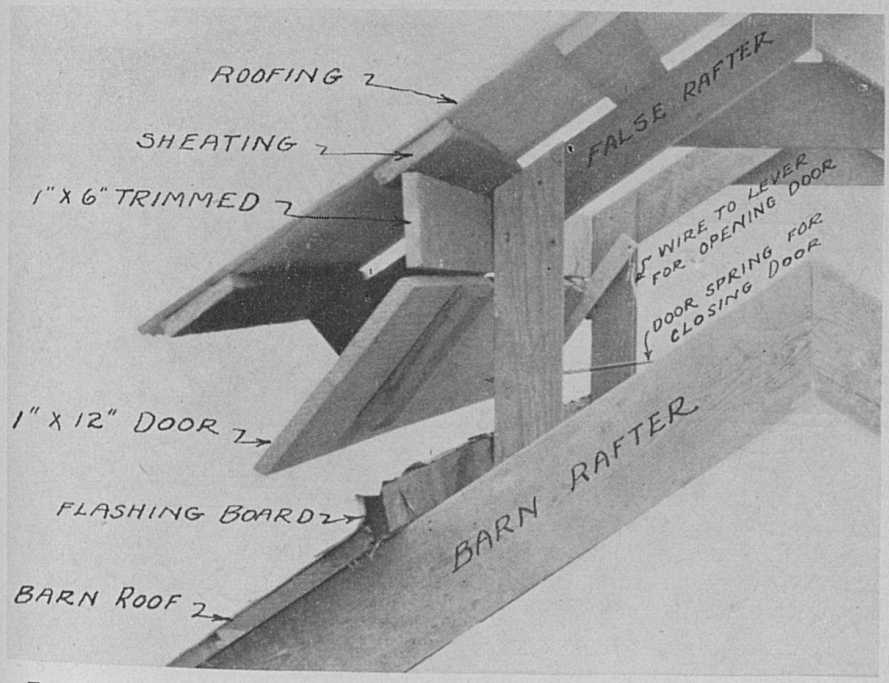
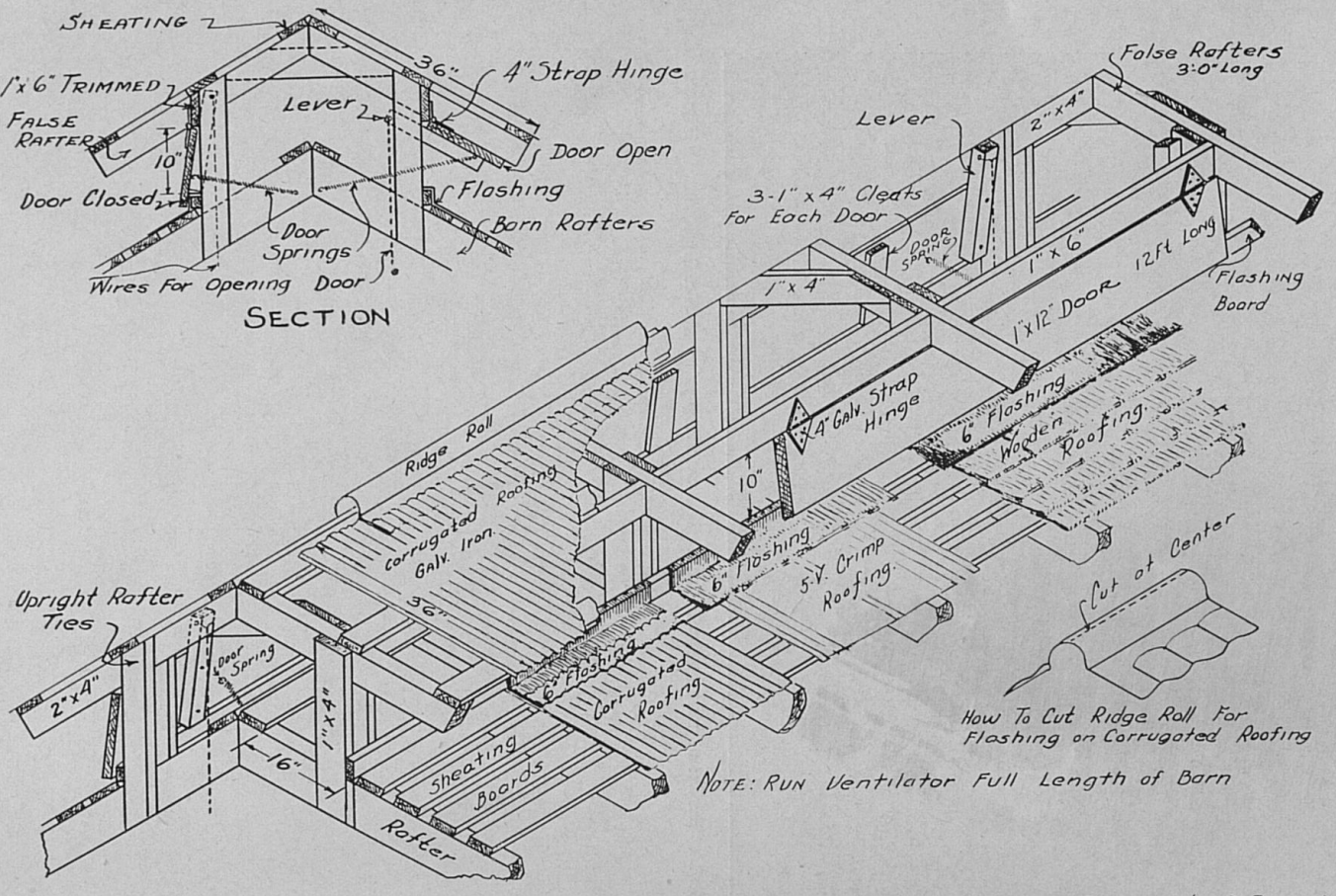


FIGURE 11. Details of ridge ventilator built according to Plan No. 2, 6-foot section shown. A lever and door spring should be placed at each end of a 12-foot door. See Figure 12, page 16.



NOTE: For Corrugated Roofing Make Flashing By Cutting a Corrugated Ridge Roll in Halt, Provide Regular End Wall Flashing Cannot Be Obtained For 5-V. Crimped Roofing Use FLAT Sheet Metal or End Wall Flashing. For Wooden Roofs Use Flat Sheet Metal Flashing

FIGURE 12. Tobacco barn ridge ventilator. Plan No. 2.

NOTE: For Corrugated Roofing Make Flashing By Cutting a Corrugated Ridge Roll in Half, Provide Regular End Wall Flashing Cannot Be Obtained For 5" V Crimped Roofing Use Flat Sheet Metal or End Wall Flashing. For Wooden Roofs Use Flat Sheet Metal Flashing

FIGURE 12. Tobacco barn ridge ventilator. Plan No. 2.

TO PUT HORIZONTAL INLET VENTILATOR DOORS IN A DARK-FIRED TOBACCO BARN

The horizontal inlet ventilating doors at the base of the barn walls on each side should run full length of the barn. For barns 24

FIGURE 13. Inside view of bottom ventilators built on a dark fire-curing barn as shown in Figure 14, between the concrete blocks that support the barn posts. The middle door is shown partially open.

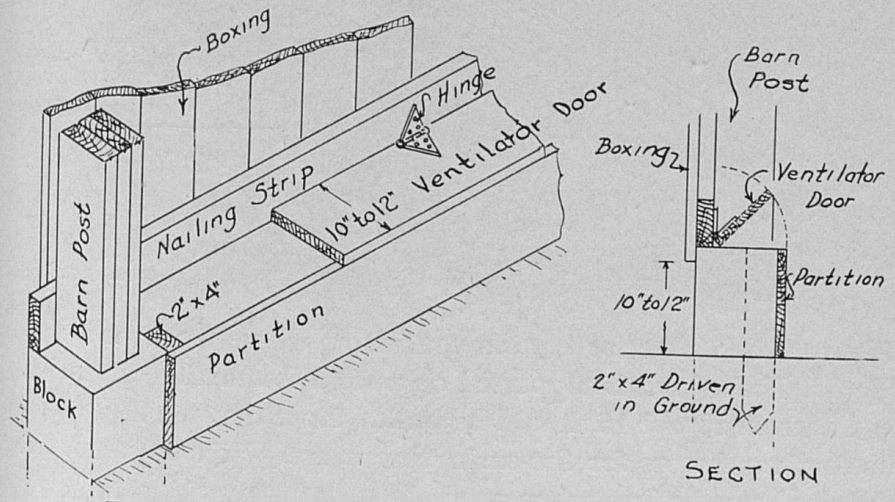


FIGURE 14. Bottom ventilator opening for dark fire-curing barns.

feet wide or less, the width of the effective ventilating opening should be 10 inches. For barns over 24 feet wide, this opening should be 12 inches. (Refer to figures 14 and 16 on pages 17 and 18.)

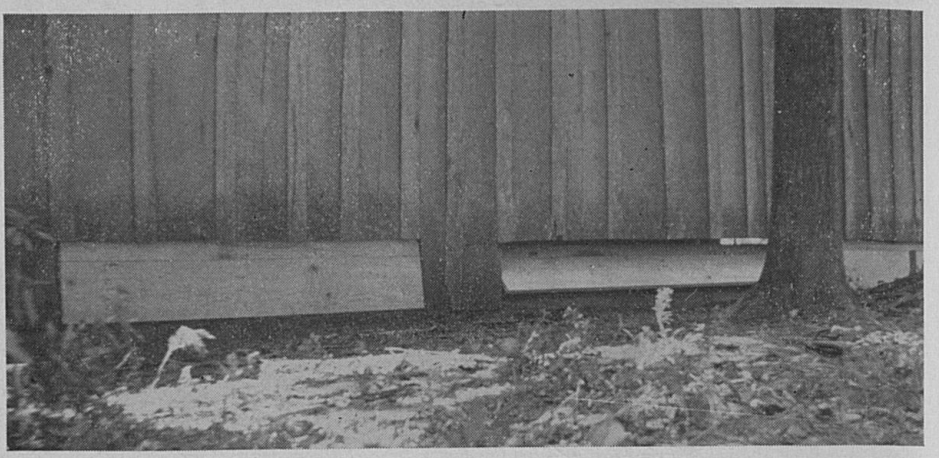


FIGURE 15. Bottom ventilators built on a dark fire-curing barn (according to figure 16) over a solid concrete foundation.

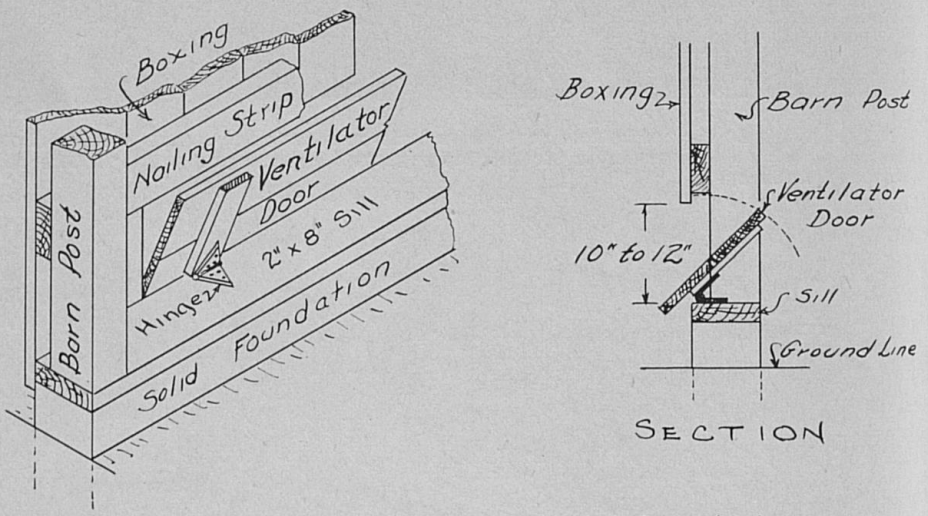


FIGURE 16. Bottom ventilator opening for dark fire-curing barns.

Figure 14 is a plan for bottom ventilators where the barn is set on blocks. If the barn is supported on a solid foundation, a ventilator as shown in Figure 16 should be built. Note that the doors on the bottom ventilators for fire-curing barns are placed so as to direct the air above the fires, when open.

TO PUT IN AIR INLET VENTILATORS IN AIR-CURING BARNS

In air-curing barns, both horizontal and vertical ventilators are used in addition to the ridge ventilator. (See Figure 3.) Two 12″ vertical ventilators on each side are provided for each 12-foot length of barn. The horizontal inlet ventilating doors run full length of the barn. The width of the opening of the bottom ventilators varies from 10″ to 4′.

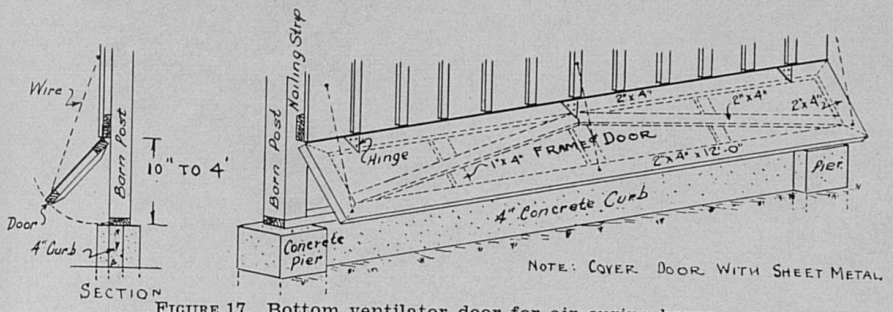


FIGURE 17. Bottom ventilator door for air-curing barns.