

276-300

UNIVERSITY OF KENTUCKY

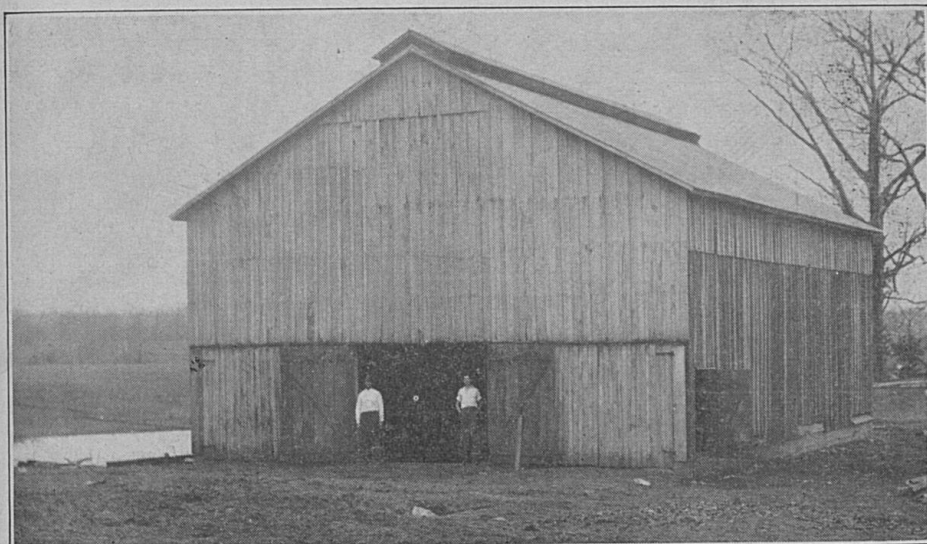
COLLEGE OF AGRICULTURE

Extension Division

THOMAS P. COOPER, Dean and Director

CIRCULAR NO. 279

Ventilation of Tobacco Barns



A well-ventilated tobacco barn.

Lexington, Ky.

June, 1935.

Published in connection with the agricultural extension work carried on by co-operation of the College of Agriculture, University of Kentucky, with the U. S. Department of Agriculture, and distributed in furtherance of the work provided for in the Act of Congress of May 8, 1914.

C
ductio
the lo
a new
be ac
sible
site s
remov
there
norm
growe
contr
Most
tion o
ing,
time
show
an in
by th
duce
the v
or sh
tobac
need
In so

CIRCULAR NO. 279

Ventilation of Tobacco Barns

By RUSSELL A. HUNT and JESSE B. BROOKS

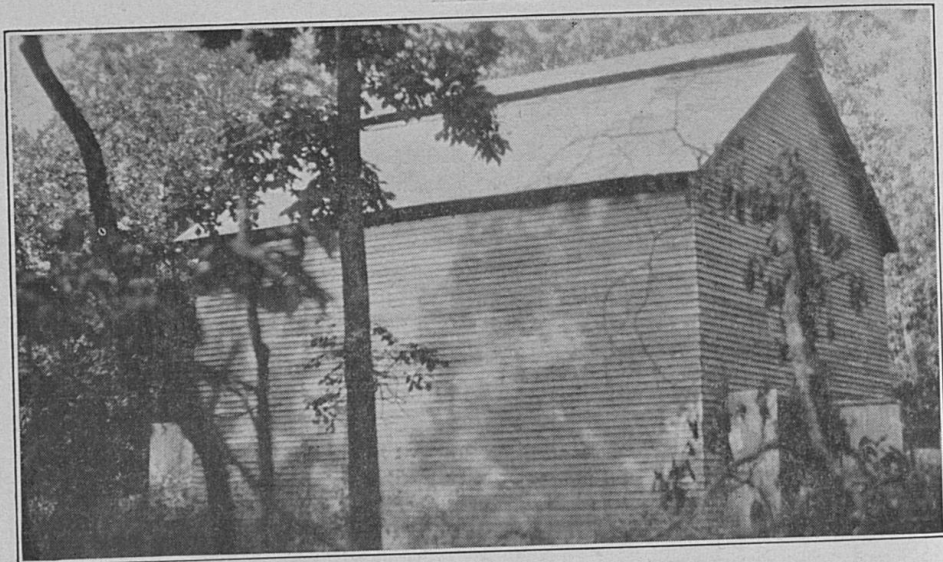
Curing is one of the most important operations in the production of tobacco. Successful curing depends largely upon the location and construction of the tobacco barn. In erecting a new barn or in repairing an old one, the important things to be accomplished are to construct it as nearly air-tight as possible and to provide a good system of ventilation. In general a site should be chosen which is thoroly drained and sufficiently removed from other buildings to allow free access of air. 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 rather than to construct new buildings. Most tobacco barns were built before there was definite information concerning the ventilation requirements for successful curing, consequently, comparatively few of them at the present time have any provision for ventilation in the roof, such as is shown in the cut on the title page, but 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. In so far as 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

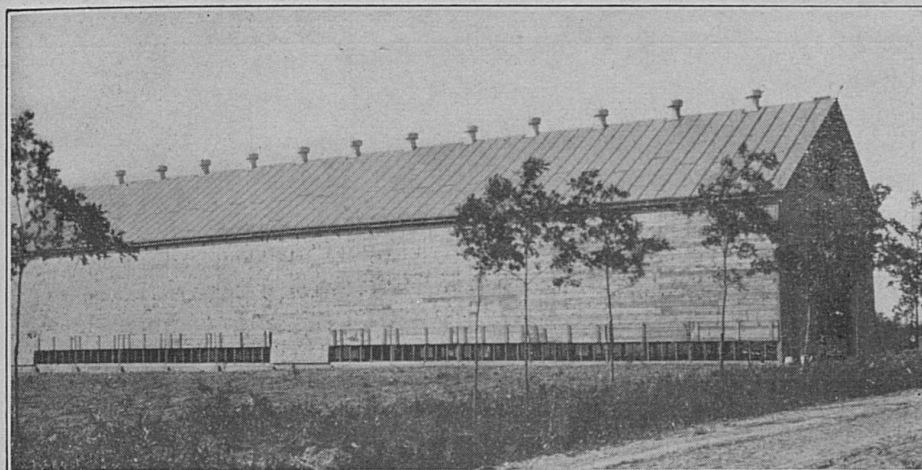
Circulating air is one of the important factors in curing tobacco, and the curing barn should be so constructed and ventilated as to permit rapid changing of air when needed. The tobacco is placed in the barn immediately following cutting, or



Ridge ventilator on well-located fire-curing barn.

after wilting, and the curing may be controlled by regulating the ventilation. Water constitutes the greater part of the ripened 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 on the humidity of the air and its rate of movement thru the barn.

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.



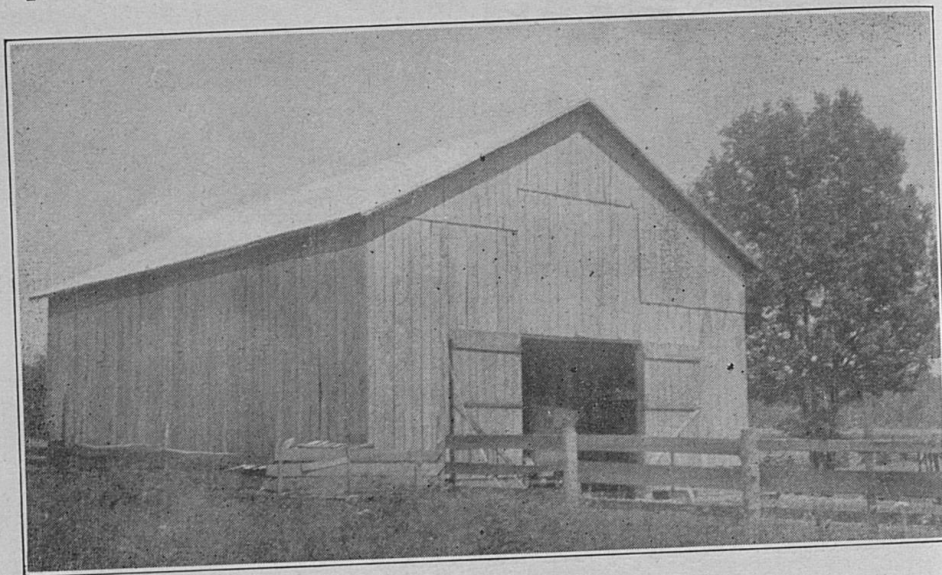
Tobacco barn with insufficient ridge ventilation.

Of this total weight, by far the greater part is water. To cure tobacco successfully, this large amount of water must be removed under such conditions and at such a rate as best allow the other fundamental changes to occur. Experience has shown that the well-constructed barn, properly ventilated, provides the means for regulating the humidity in the curing crop, 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.

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



Unventilated barn.

few barns have ventilators 24" in diameter. The approximate amounts of opening provided by the 16", 18" and 20" circular ventilators are 1.3 sq. ft., 1.8 sq. ft. and 2.2 sq. ft., respectively. The common practice is to use only one circular ventilator to each vent of 12 feet, so the amount of ventilation provided is inadequate unless natural conditions are favorable for curing.

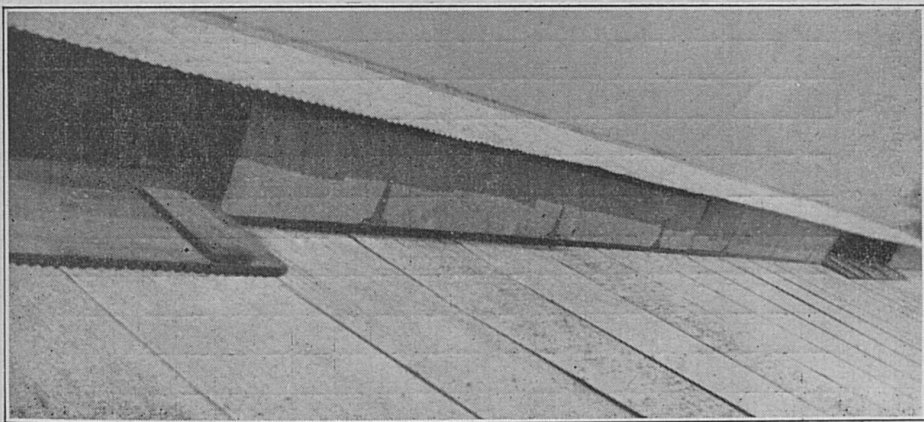
Experience has proved that satisfactory ventilation for the various types of tobacco, suitable for all barns, is provided by the ridge ventilator, supplemented by horizontal ground ventilators. For the air-cured tobaccos it is advisable to provide the vertical side-door ventilators also. The vertical side-door ventilators are not recommended for fire-curing barns.

Comparatively few barns have any provision for controlled ventilation in the roof. However, by the use of barns with the full-length ridge ventilator and the horizontal doors extending

along the entire length of the sides, near the ground, many growers have cured their crops successfully. The ridge ventilator is undoubtedly the best type of top ventilator so far designed, for providing the proper curing conditions in all tobacco barns. It 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, permits of satisfactory control of air condition and movement. The ridge 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.

USE OF VENTILATION

After the tobacco is hung in the barn the water is evaporated from the surface of the leaves and the relative humidity of the air in the barn is increased. Since air of high humidity is lighter than drier air, the moist air rises. In warm, dry



Ridge ventilator partly open.

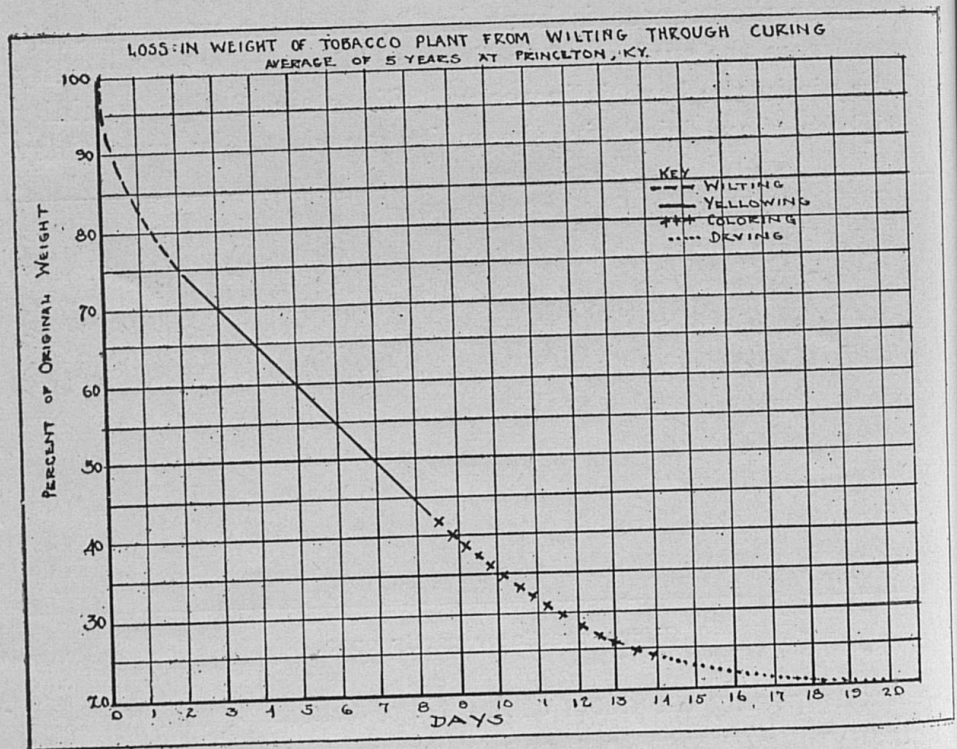
weather, opening the doors of the ridge ventilator and the horizontal ground ventilators, or the vertical shutters on the sides of the barn, usually is all that is needed to provide good curing conditions.

During rainy or foggy weather, when the air is practically saturated with moisture, ventilation alone is ineffective. Under these conditions some artificial heat is needed. A small in-

crease in temperature—that is, 10° to 15° above the outside temperature—assists curing in two ways: First, warm air holds more moisture than cool air; for example, a rise in temperature of 20° practically doubles the water-holding capacity of air. Second, as soon as the air is heated, it rises and passes out thru the ridge ventilator opening, carrying away excess moisture. The air which enters thru the bottom openings becomes warm and continues the process.

LOSS OF WEIGHT IN CURING

Tests made at the Western Kentucky Substation at Princeton, with fire-cured tobacco, indicate the rate of loss of weight in curing tobacco, due to evaporation of water from the plants.

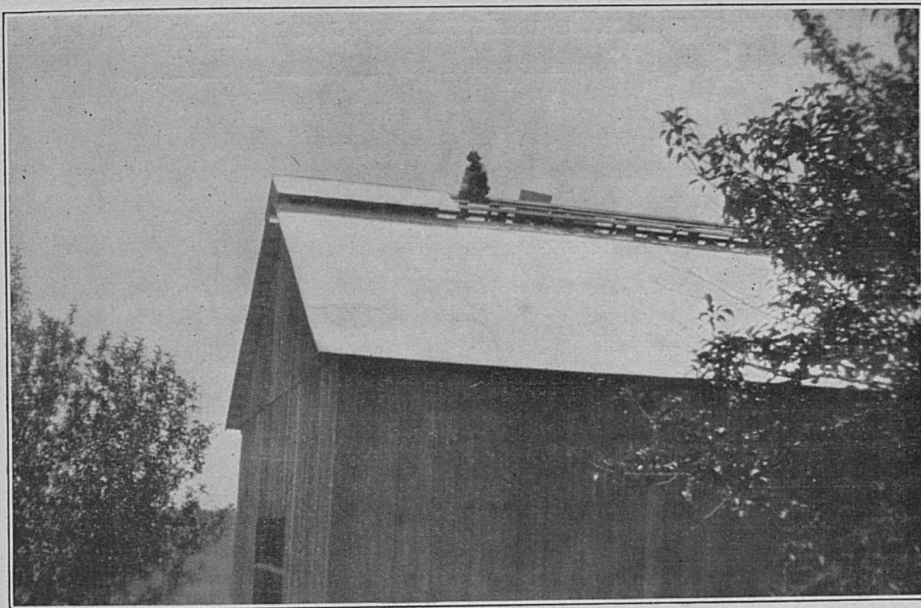


Loss of weight during curing.

These tests were made in a ventilated barn having both the ridge and horizontal bottom ventilators. The figures given herein are the average results of a few representative sticks of tobacco from five crops, beginning in 1928 and continuing thru 1932.

These figures 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 mentioned a few sticks of fire-cured tobacco were cut and hung and immediately weighed and then re-weighed daily until completely cured. From these weights it was found that for each hundred pounds of tobacco



Building the ridge ventilator.

freshly cut and hung on sticks, 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. From these studies it was found that 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-cured tobaccos, tho not to burley. The rate of loss of weight by loss of moisture is shown by the graph on page 8. 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.

INSTRUCTIONS FOR BUILDING A RIDGE VENTILATOR ON AN OLD TOBACCO BARN

Step 1. Remove the roofing for a width of 24 inches on each side of the ridge. Metal roofing may be cut with a bolt cutter, heavy tin snips, or by using a shingling hatchet as a chisel. If the metal or composition roofing removed is in good condition, it should be saved for covering one side of the ventilator top.

Step 2. Remove the sheathing. If 2" x 10"s or 2" x 12"s are to be used as false rafters, leave a 4" board on each side of the ridge, and remove the rest to 24" from the top of the ridge. See Fig. 7. If 2" x 4"s are to be used as false rafters, remove all the sheathing to 24" from the top of the ridge. See Fig. 8.

Step 3. Build the ridge ventilator.

For barns 24 feet wide, or less, use 2" x 10" false rafters, to give an opening 10 inches wide.

For barns more than 24 feet wide, use 2" x 12" false rafters, to give an opening 12 inches wide.

For false rafters, 2" x 4"s may be used, as shown in Fig. 8, and the ventilator door openings should be made 10 inches wide or 12 inches wide, according to the width of the barn.

Cut the rafters for the roof of the ventilator 36 inches long. Bevel or undercut the false rafters at eaves at such an angle (depending on pitch of roof) that the doors drop of their own weight when the ropes are released.

If 2" x 10"s or 2" x 12"s are used as false rafters, place them as shown in Fig. 7, over every other original rafter, or about 4' apart.

If 2" x 4" false rafters are used, place them as shown in Fig. 8, over each original rafter or about 2' apart.

These rafters are cut and fastened together on the ground, then set in place and tied to the original rafters, as shown in Figs. 7 and 8, with 1" x 6" or 2" x 4" pieces.

Step 4. Sheathe the top of ventilator solid, allowing sheathing to overhang false rafters two inches.

If using 2" x 12"s or 2" x 10"s as false rafters according to Fig. 7, place a 2" x 4" block under outer sheathing board midway between false rafters to prevent sagging of ventilator top. The 2" x 4" blocks should be placed in line with the lower ends of the false rafters so that doors close tightly against them.

Cover ventilator with wood shingles, composition roofing or galvanized roofing.

Step 5. For the ventilator door, use a 1" board as wide as the ridge ventilator opening and as long as one bent of the barn. This should be cleated on the inside and painted on both sides to prevent warping.

Fasten this board to the roof with 4" galvanized strap hinges, so that it closes against the ends of the false rafters. (See note below Figures 7 and 8.)

Step 6. Fasten galvanized awning swivel one-inch pulleys on the tie blocks, placing them as high as possible, so as to make the door close easily.

Fasten a rope, to each end of the ventilator door with screw eyes or eye bolts or a staple (refer to Figs. 7 and 8).

Run the ropes thru the pulleys. Preference is given to small awning rope to use around pulleys. From ropes to ground, wire may be used to save expense.

INSTRUCTIONS FOR PUTTING IN THE HORIZONTAL INLET VENTILATOR DOORS

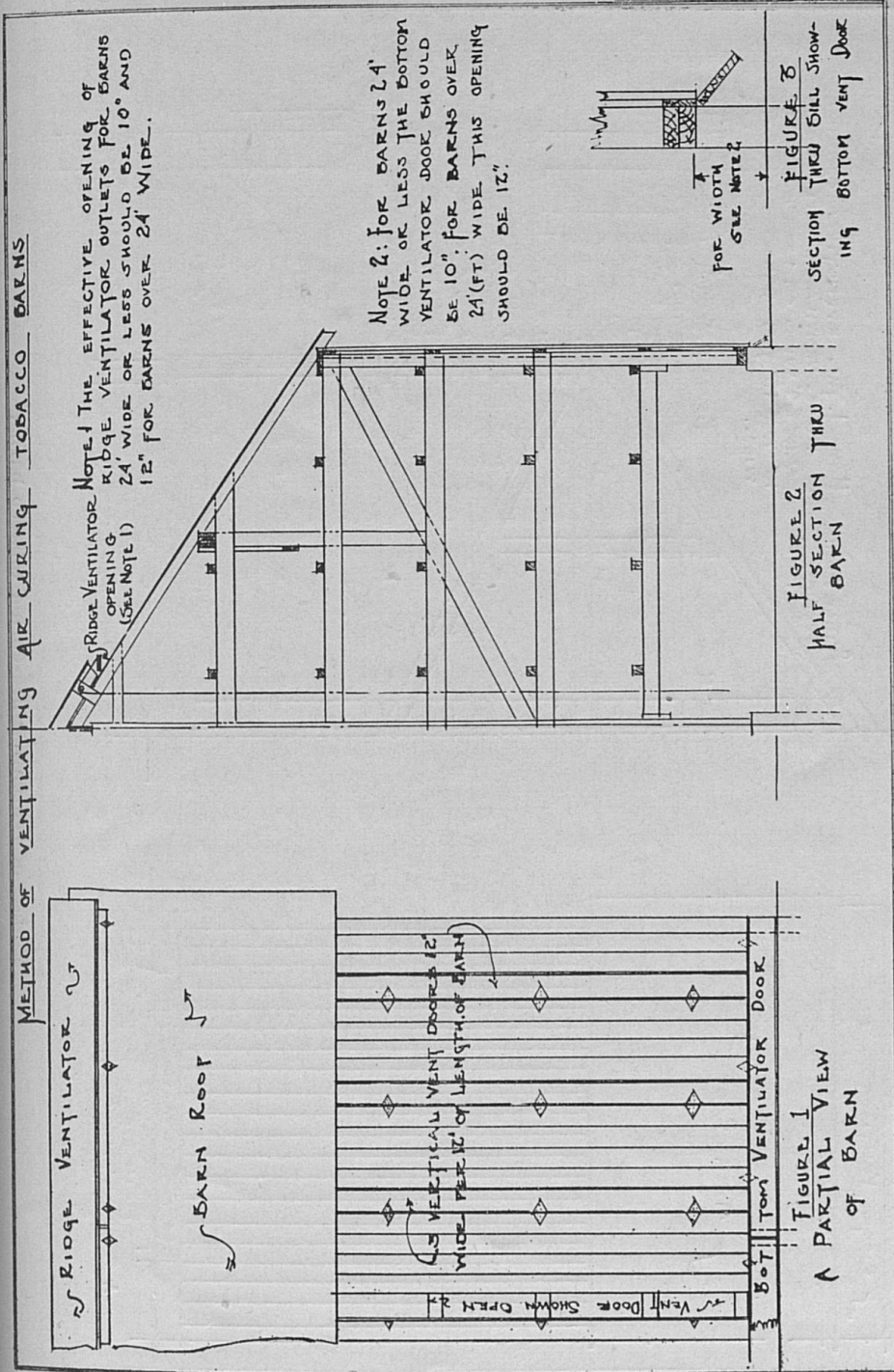
The horizontal inlet ventilating doors at the base of the barn walls on each side should run full length of the barn. For barns 24 feet wide or less, the width of the horizontal inlet doors or opening should be 10". (Refer to Figs. 3, 6 and 6a.) For barns over 24 feet wide, this opening should be 12". (Refer to Figs. 3, 6 and 6a.)

Figs. 6 and 6a suggest methods of placing the bottom ventilating doors in the fire-curing barn so that the air is directed above the fires. Fig. 6 shows how bottom ventilation is provided by building up a tight partition of matched boards on 2" x 4"s which are driven into the ground. A door is then hinged on the plates so as to drop and close the space between the outside wall and this partition. Fig. 6a—A 2" x 4" is cut and notched into mud blocks next to ground so that a door can be hinged to it and shut against the base plates as indicated. It is well to paint all exposed wood at the base of the barn where it is exposed to the weather. The opening of the doors in either plan can be regulated by use of a chain and two nails.

INSTRUCTIONS FOR PUTTING IN THE VERTICAL VENTILATOR DOORS FOR BARNs FOR AIR-CURED TOBACCO

Vertical ventilator doors are not recommended for fire-curing tobacco barns. On air-curing barns, however, three vertical 12" vent doors are provided with each 12 feet of length of barn, on each side. (Refer to Fig. 1.)

METHOD OF VENTILATING AIR CURING BARNs
TOBACCO BARNs



Method of ventilating air-curing tobacco barns.

METHOD OF VENTILATING FIRE-CURING TOBACCO BARN

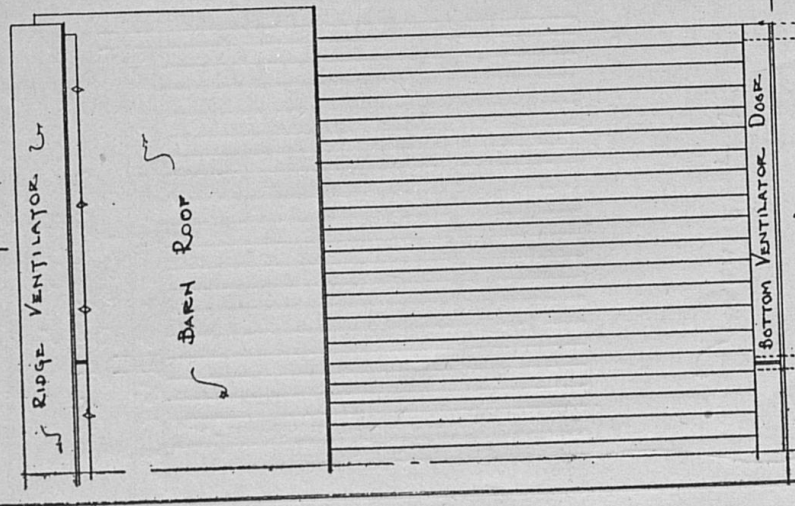
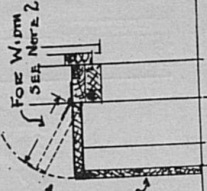


FIGURE 4
A PARTIAL VIEW
OF BARN

NOTE 1. THE EFFECTIVE OPENING OF RIDGE VENTILATOR CUTLETS FOR BARN 24' WIDE OR LESS SHOULD BE 10' AND 12' FOR BARN OVER 24' FT WIDE.

FIGURE 6. SECTION SHOWING BOTTOM VENTILATING DOOR MATCHED LUMBER



NOTE 2. FOR BARN 24' WIDE OR LESS THE BOTTOM VENTILATOR DOOR SHOULD BE 10' WIDE FOR BARN OVER 24' WIDE THIS OPENING SHOULD BE 12'.

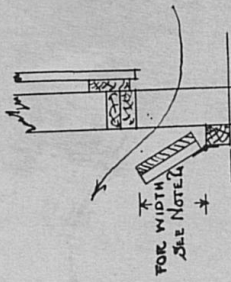


FIGURE 6A.
SECTION THROUGH SILL SHOWING BOTTOM VENT DOOR

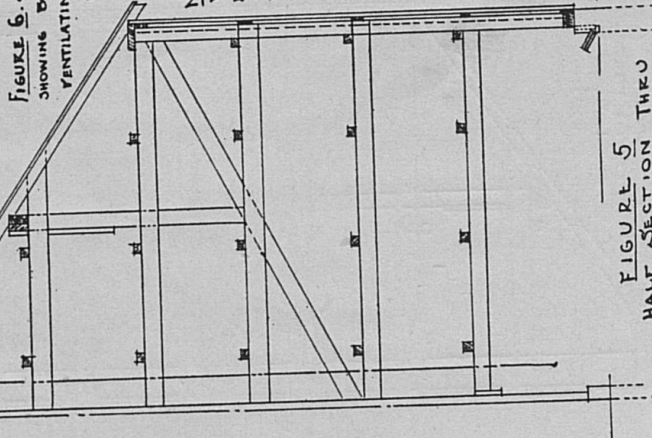


FIGURE 5
HALF SECTION THROUGH BARN

Method of ventilating fire-curing tobacco barns.

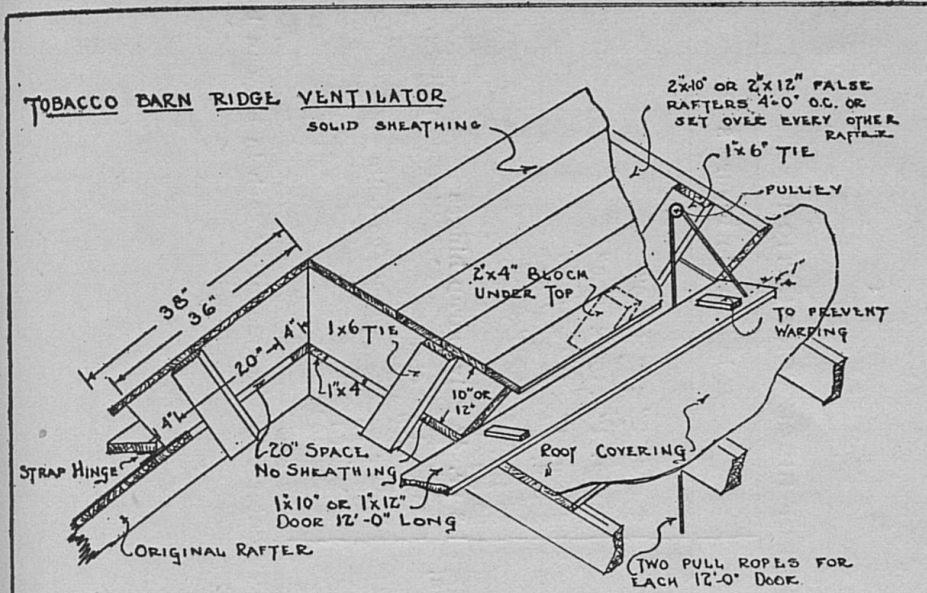


FIGURE 7

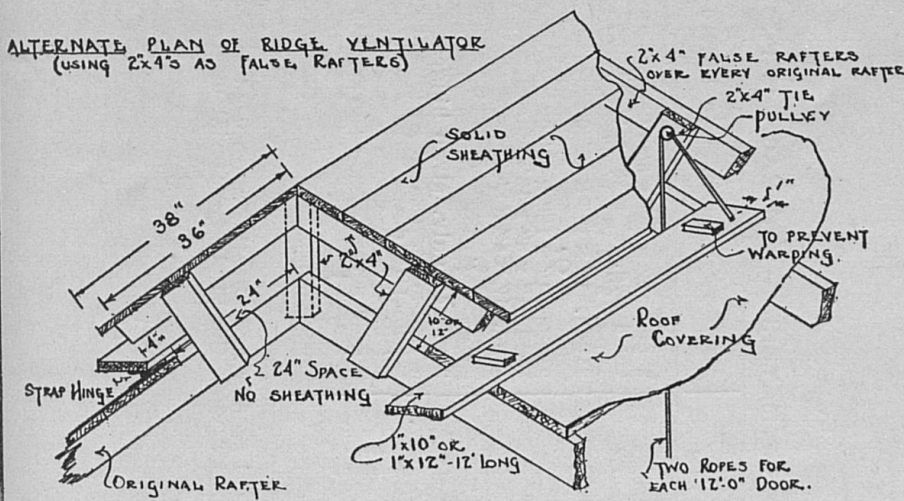


FIGURE 8

NOTE: FOR FIGURES 7 AND 8, RUN VENTILATOR OPENING FULL LENGTH OF BARN -
 USE 10" OPENING AT VENTILATOR DOOR FOR BARN'S 24 FT. WIDE OR LESS.
 USE 12" OPENING AT VENTILATOR DOOR FOR BARN'S OVER 24' WIDE.
 EDGE OF VENTILATOR DOOR SHOULD BE TRIMMED TO FIT UNDER SHEATHING
 BEFORE HINGED.

Tobacco barn ridge ventilator.

Method of ventilating fire-curing tobacco barns.

BILL OF MATERIAL FOR EACH 12 FOOT LENGTH OF RIDGE VENTILATION

Items	If built as in Figure 7	If built as in Figure 8
False rafters	3 pcs. 2" x 10" x 6'-0" Or 3 pcs. 2" x 12" x 6'-0"	6 pcs. 2" x 4" x 6'-0" Not necessary
Supporting blocks	1 pc. 2" x 4" x 6'-0"	2 pcs. 1" x 10" x 12'-0"
Ventilator door	2 pcs. 1" x 10" x 12'-0" Or 2 pcs. 1" x 12" x 12'-0"	2 pcs. 1" x 12" x 12'-0" 3 pcs. 2" x 4" x 10'-0"
Ties	1 pc. 1" x 6" x 12'-0"	1 pc. 1" x 4" x 8'-0"
Cleats	1 pc. 1" x 4" x 8'-0"	80 Sq. Ft.
Sheathing	80 Sq. Ft.	3 pr. 4" galv. strap hinges
Roofing	3 pr. 4" galv. strap hinges	2 pr. galv. swivel awning rope-pulleys,
Hinges	2 pr. galv. swivel awning rope-pulleys, wheel 1" dia.	16' of 1/4" rope
Pulleys	16' of 1/4" rope	2 pair screw-eyes or eye-bolts
Rope	2 pair screw-eyes or eye-bolts	2 lbs. 8d
Bolts	2 lbs. 8d	1/4 lb. 6d
Nails (approx.)	1/4 lb. 6d 1/4 lb. 10d	1/4 lb. 10d

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

Pub
perati
ment
Act of