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Farm Building Ventilation

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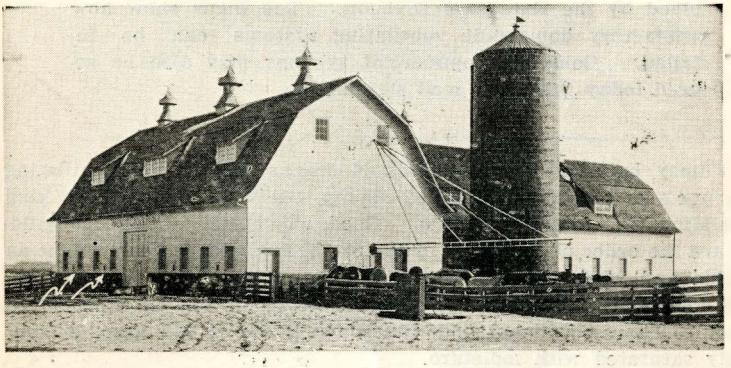

Fig. 3—A barn in Minnehaha County, South Dakota. Note the many fresh air inlets. Without them your ventilating system is worthless.

EXTENSION DIVISION
SOUTH DAKOTA STATE COLLEGE OF
AGRICULTURE AND MECHANIC ARTS
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Cooperative Extension Work in Agriculture and Home Economics, South Dakota State College and U. S. Department of Agriculture Cooperating

BROOKINGS, SOUTH DAKOTA

INTRODUCTION

Proper ventilation of farm buildings is necessary for profitable dairying and stock raising in South Dakota. Dark, ill-ventilated quarters devitalize the stock, stunt their growth and makes them susceptible to disease. A good supply of oxygen is important for the production of milk, beef, pork and for growth and vitality.

This circular is a reply to an ever increasing number of inquiries about the ventilation of farm buildings received by the Extension Division. The plans show how satisfactory homemade ventilating systems can be installed. Complete commercial systems may also be secured today that give good satisfaction.

Flimsy buildings with unbattened cracks will be self-ventilating if a cupola or aerator is provided on top, but very few of these kind of buildings are found any more. Good, substantial and warm buildings are the order of the day. They are being built as nearly tight as possible and when the barn is shut up at night, if no place is provided for fresh air to come in, very little foul air can be expected to go out. The air will not only become foul but it will become completely saturated with moisture.

Basement barns are especially dangerous unless they are well ventilated. A single cow will throw off more than a gallon of water in twenty-four hours. This moisture will be largely carried away if a good circulation of air is provided. If not, it will condense on the walls and ceiling and any objects in the barn that are cooler than the air. Harness may be injured in this way.

HOW FROST IS DEPOSITED

Warm air will carry a very large amount of moisture in it until it comes in contact with a cold body. This contact cools the air, reducing its capacity for holding the moisture and causes moisture to be deposited on the colder body such as the wall or ceiling. In cold weather these bodies will be cold enough to freeze this moisture and frost will result. The poorer the ventilation in the building, the more moisture in the air and naturally the thicker the deposit of frost.

Double Wall Reduces Amount of Frost

If a double wall is provided in a building, leaving a dead air space between, the inside wall will not get so cold and frost will not be deposited on it to so great a degree. This will apply to the ceiling as well. Double windows will have a similar result. No building should be so constructed, however, unless provision is made both for fresh air to come in and for foul air to go out.

A Uniform Temperature From Ventilation

Aside from furnishing fresh air to the stock and helping eliminate the frost nuisance, ventilation keeps the temperature in the building much more uniform, both night and day. Investigation has shown the temperature to vary from below freezing to seventy degrees Fahrenheit during the twenty-four hours, in an unventilated barn. This is bad for livestock.

AERATORS ALONE ON TOP OF THE BARN OR HOG-HOUSE WILL NOT VENTILATE IT

It is a mistake to install cupolas or aerators alone on top of a building for housing livestock and expect them to ventilate it. Arrangements must be made for both foul air to go out and for fresh air to come in. Fresh air must come in to push the foul air out if a good circulation is to be had. If fresh air inlets are provided (see figures) the fresh air will readily crowd its way in because it is

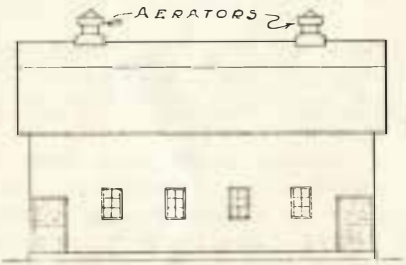

Fig. 1—This barn is not ventilated because there are no fresh air inlets. When the doors are closed like this, little fresh air will get in. Fresh air must come in to crowd the foul air out.

heavier than the foul air in the building. As it crowds its way in, it will force the lighter air out.

BRINGING IN THE FRESH AIR

Whatever is done in the way of ventilating, let the fresh air in. The fresh air should be brought in so there will be no direct draft on the stock and the flues should be arranged so there will be no back-draft. We do not want any tendency for the foul air to go out where the fresh air should come in.

The best type of inlet for this climate is one that opens in just above the foundation on the outside of the building. It is shown in all the figures. If the stock faces in to the center of the barn, it is a common practice to carry the fresh air to the center of the barn between the joists and open it out just above the feed alley. (See figures 6 and 11. The outside opening should be screened. Registers may be secured from barn equipment companies for both outside and inside openings if desired.

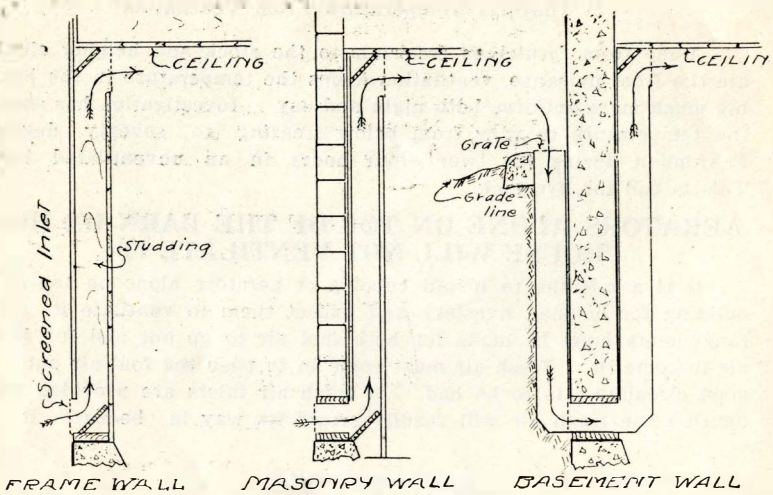

Fig. 2—Ways of bringing fresh air in under different conditions. In the frame wall it may go up between the studding. In a masonry wall, a flue as large as the opening is built to take it up just on the inside. This flue may be built in the wall. The principle is the same in all of these. Frost will be deposited on these flues somewhat as they are cold. If desired the walls may be insulated as in Fig. 6

Number of Fresh Air Inlets

It is good practice to put in smaller fresh air inlets and more of them if the cost is not a limiting factor. They are usually inexpensive. A 60 foot barn should have six to ten inlets. The total cross-sectional area of inlets should at least equal the total cross-sectional area of the foul air outlets. Some manner of regulating the inflow of air should be provided. The registers mentioned above provide for this. Homemade checks may be installed similar to those used in stovepipes for checking the draft.

The Location of Fresh Air Inlets

If several small inlets are used, they may be distributed around the building so as to reach all parts directly. Inlets on the north and west are most efficient, because the wind is usually coming from these directions when the stock is in the barn and when ventilation is most needed. It is during cold weather that our barns are usually shut up tight and we need ventilation. More inlets should be provided on these two sides for this reason. (See picture on cover). It is also more important to be able to regulate the inflow of air through the inlets on these two sides.

TAKING THE FOUL AIR OUT

The manner of taking the foul air out of a building will depend somewhat on the type of building. If aerators of sufficient capacity are installed on top of the buildings and fresh air inlets are provided, a good circulation is assured; that is, providing, of course, the foul

air can get to the aerators freely. The haymow will be ventilated as well with this system.

This system is, of course, the simplest and least expensive of any. The objection is that it will be colder than if foul air flues are installed as shown in the figures 5 and 6 below. It may be tried, and if found too cold the foul air flues can be put in later.

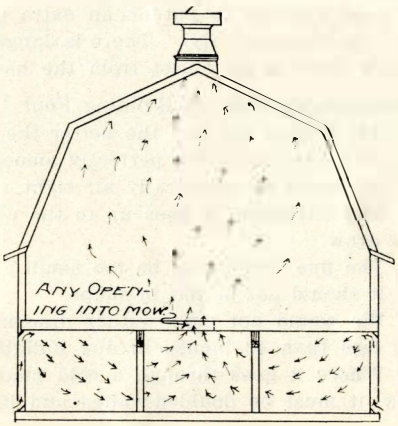

Fig. 4—If fresh air inlets like these are installed in a building with aerators on top, the circulation of air will be good. But the warm air goes quickly up into the mow and if there is not enough stock in the barn, it will be cold at times. Foul air flues can be added at any time if it is cold.

Aerators with Foul Air Flues

The above system with fresh air flues and aerators alone, is apt to be quite cold for buildings having a large overhead space and fewer animals in it, such as a dairy barn. Foul air flues for carrying the foul air up to the aerators may be installed, in this case, which will conserve the warm air. They extend from a point about two feet above the floor all the way to the aerator. This prevents the warm air (which is not necessarily the foulest) from rising quickly to the aerator and going right on out. The heavier fresh air coming in forces the foul air to go down and out through these foul air flues. (See arrows in figures 5 and 6). This plan is that of the late Professor King, formerly of Wisconsin university.

Register at Ceiling

Wherever the foul air out-take flues are used, it is good practice to put in a register, as large as the cross-sectional area of the flue, just underneath the ceiling. (See Figs. 5 & 6). Occasionally atmospheric conditions are such that the draft will not be as good as it ought to be and an opening at the ceiling will let the air out more readily. A poor draft may be due to the temperature warming up outide until

the outside air will not be much heavier than that inside. In this case, all ceiling registers should be opened. If a register is not purchased a door may be cut in the side of the flue and hinged so as to open by dropping down.

Important to Ventilate Haymow

If the foul air flues are connected with the aerators on top of the barn with a tight connection, the haymow will not be ventilated. In this case it is good practice to put on an extra aerator without any flues to ventilate the haymow only. There is danger from spontaneous combustion where there is no outlet from the haymow.

Things to Consider in Building Foul Air Flue

The higher the flue the better the draft.

The flue should be perfectly smooth inside.

It should be practically air tight.

The straighter it goes up to the aerator, the better it will draw.

The flue should not be too small.

It should not be flat in shape.

We would not make either dimension of the out-take flue less than 12 inches in any building.

Where it goes through a cold place, such as the haymow, it must be doubled-walled and insulated.

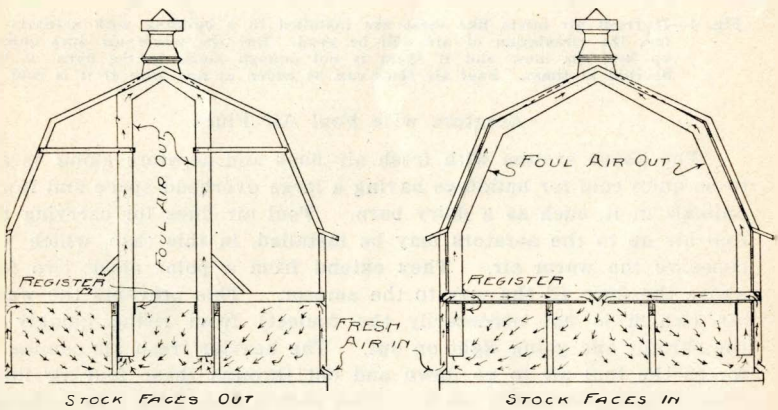

Fig. 5—This barn has a complete system including foul air flues, fresh air flues, and aerators. The foul air flues conserve the air that has been warmed by the stock. With good-sized, smooth, straight, well insulated flues, they give satisfactory results. The foul air flues up the center, like this, are best when it is arranged for stock to "face out." They may be located in the extreme ends of the barn if necessary. Provide an extra aerator in the center to ventilate the mow.

Fig. 6—This barn also has a complete system. The foul air flues go up the outside but notice they do not touch the outside wall. This arrangement is better for a barn in which the stock face in to a central feed alley. The fresh air comes in the same way but is carried over to the center of the barn between the joists. It will work as well as Fig. 5, if it can be kept as warm through the haymow. All openings to the mow must be closed or the barn will be no warmer than the plan shown in Fig. 4.

It must be insulated if it goes close to the outside of the barn.

It is best if taken up through the center of the building.

No cleat or other projection should extend out into the flue on the inside.

If they are not going to be carefully installed, don't put them in, because the expense will probably be wasted.

A coat or two of paint on the inside will be a paying investment. Yes, it can be done, and it will pay big, too.

AMOUNT OF FRESH AIR NEEDED AND SIZE OF FLUES

The following amount of out-take flue, required to keep the air in the barn sufficiently pure for stock, is figured close enough for all practical purposes. It is assumed that the flues will be installed with care ~~of a smaller number.~~ It is a good practice to figure at least ~~80~~ 30 feet high in a barn. Some allowance has been made for South Dakota conditions. The aerators must, of course, be as large in cross-sectional area at the throat as the out-take flues. They must extend higher than any surrounding objects just the same as chimneys.

Table of size for aerators, fresh air and foul air flues.

1 sq. ft. of cross-sectional area for 5 mature horses
1 sq. ft. of cross-sectional area for 6 mature cows
1 sq. ft. of cross-sectional area for 15 mature hogs
1 sq. ft. of cross-sectional area for 20 mature sheep
1 sq. ft. of cross-sectional area for 200 hens.

Any allowance for young stuff would be figured in proportion to their weight. Figure for the most crowded condition.

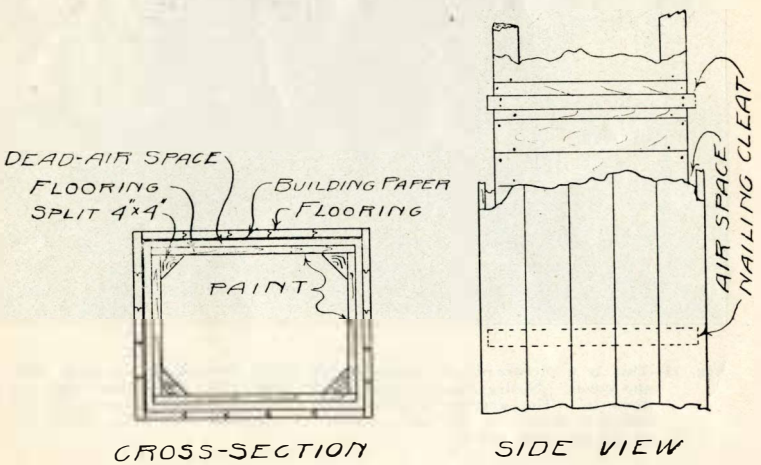

Fig. 7—Showing how the foul air flue is made where it is to pass through a cold haymow. A cold out-take flue draws like a cold chimney. In the warm lower part of the barn, the single inside flue is sufficient. Don't forget the paint on the inside.

Colin's Table of amount of fresh air needed per animal:

	Per Hour Cu. Ft.	Lbs.	Per 24 Hours Cu. Ft.
Horse	141.7	272	3402
Cow	116.8	224	2804
Pig	46.0	89	1103
Sheep	30 2	58	726
Man	17.7	34	425
Hen	1 2	2	29

In practice, we figure enough ventilation for the barn when it is filled to capacity with stock and the inlets may be regulated to take care of a smaller number. It is a good practice to figure at least 80 square feet of floor space for each cow in a barn with an eight and one-half foot ceiling. Figure 100 square feet for each mature horse and 26 square feet for each mature hog under crowded conditions. A barn or hoghouse ought to have an aerator for each 20 to 30 feet of its length.

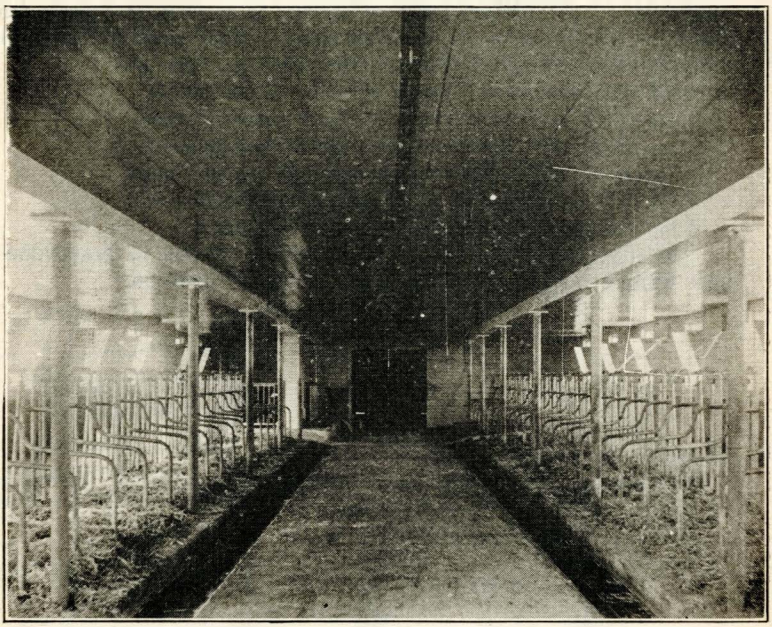

Fig. 11--This is a picture of the inside of the cattle section of the barn shown on the cover. Notice the registers on the side walls where the fresh air flues open in. The arrows indicate some of them. The openings on the outside are shown on the cover plate. A barn 60 feet long should have six to ten of these inlets.

HOGHOUSE VENTILATION

There is no building on the farm that needs ventilation any more than the type of hoghouse that is being built today The pigs are not only suffering for fresh air but the temperature varies greatly, often getting too high, and the frost nuisance is worse in the hoghouse. We cannot expect to build a hoghouse warm, with walls and roof practically air tight, put aerators on top, and expect it to be ventilated.

The Simplest and Least Expensive System

If we put the aerators on top and then put in fresh air inlets, it makes a satisfactory system for a house that has a low overhead space. This system will furnish the most vigorous circulation of air of any as the breathed air rises quickly to the ridge of the house and is pushed quickly out the aerator by the heavier fresh air coming in. (See figure 8). The fresh air is brought in on the same principle as in the case of the barn. Registers must be used in the fresh air flues to regulate the inflow of fresh air, especially on the north and west sides of the building. If registers are not available a "check damper" similar to that used in a stovepipe may be made to fit the fresh air flues.

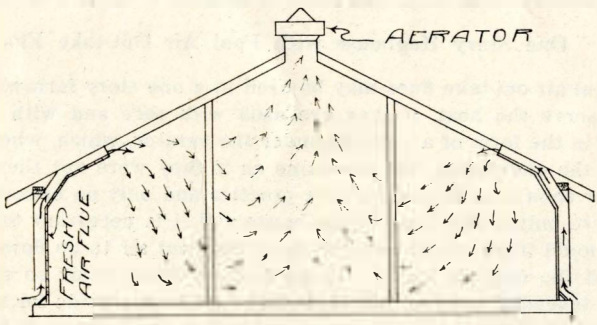

Fig. 8—This system for modern one-story hoghouse insures fresh air and when the inlets are regulated with registers or checks, it is giving satisfaction. There are no foul air flues—just the aerators on top and fresh air inlets.

Hoghouse with Storage Loft Overhead

The hoghouse with the loft overhead is ventilated in practically the same way, except short out-take flues extend from the ceiling of the lower floor to the aerators. (See figure 9). It is best not to make a tight connection of the out-take flue and aerator in this type of building. The out-take flue may be carried up into the throat of the aerator and open space left around for the ventilation of the loft. These out-take flues can also be put in as shown in Fig. 10, if found necessary. Remember that hogs are insulated from cold with layers of fat and are in much greater danger from an ill-ventilated house that gets too warm at times than from a uniformly cool and ventilated one.

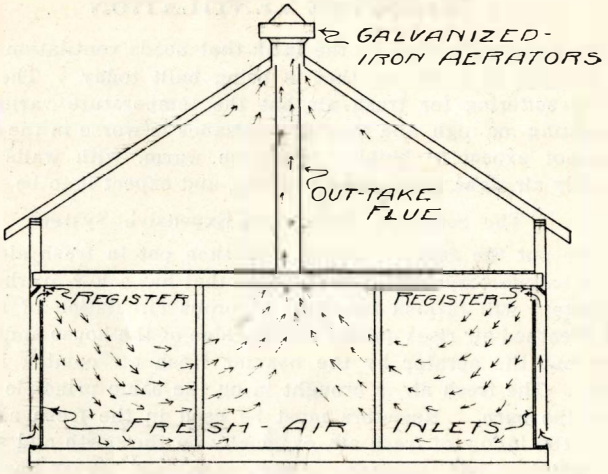

Fig. 9—A practical and inexpensive way to ventilate the two story hoghouse. The out-take flue is of the "Rutherford" type. The principle is practically the same here as shown in Figure 7, since the foul air is taken out at the ceiling in both cases. The inflow of fresh air is regulated by the registers.

One Story Hoghouse with Foul Air Out-take Flue

Foul air out-take flues may be used in a one story farrowing house, to conserve the heat, if they are used with care and with a "safety valve" in the form of a register under the aerator, which, when opened, allows the circulation just the same as if they were not there. This register should be kept open as a practice and only on occasions when there are only a few hogs in the house and it is necessary to conserve heat should it be closed so as to force the foul air to go down and out through the foul air flues. These foul air flues, being so short, can not be depended upon to furnish enought draft to provide for a houseful of hogs and therefore, when the house is full, the register is kept open, allowing the foul air to go direct'y out. (See Fig. 10).

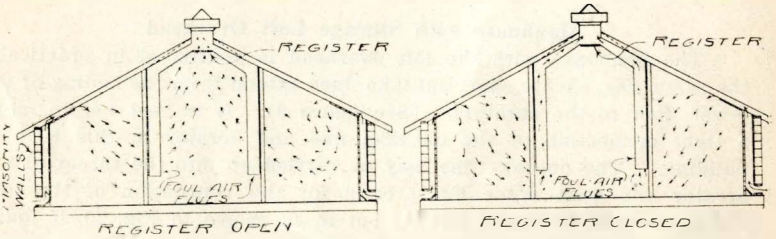

Fig. 10--Foul air flues may be used in the one-story hoghouse if registers are installed as shown. When there are enough hogs in the house, leave the register open so the foul air can go out at the ceiling as shown. With only a few hogs, it will be safe to close the register in very cold weather.

VENTILATION OF OTHER BUILDINGS

SHEEP SHED

The sheep shed should not only be well ventilated, but there is no danger of the building being too cold for sheep. The same plan shown in Figures 7 or 8 for hoghouse ventilation is recommended for sheep. A liberal amount of fresh air has already been figured for sheep and there is no danger in increasing it if desired.

POULTRY HOUSE

The poultry house is the hardest farm building to ventilate. Chickens do not furnish a great deal of animal heat to warm it and they give off an excessive amount of moisture in breathing. It is very important that enough ventilation be provided to keep the house dry.

Probably the most successful methods so far discovered are the "open front" method, the "muslin front" method and the "shutter ventilator" method.

Open Front Method

House 18 or 20 feet square with low overhead space (3½ foot wall on the south and 5 feet high on the north) with combination roof and with double walls and roof. The whole south side (3½'x20') is open except a screen. This system is recommended by Prof. H. L. Kempster of Missouri and has proven practical as far north as Canada. Canvas curtains may be provided to cover part of this open space in emergency.

Muslin Front Method

Muslin curtains over windows may be used on the south side of a house but they should be installed so as to open easily, as they do not allow the passage of air as readily as formerly thought, especially when wet. The writer would recommend their use only in combination with the shutter ventilators described below. Provide one square foot of muslin for every 15 square feet of floor space for the average house.

Shutter Ventilator Method

The shutter ventilator method is becoming very popular. They are installed like windows in the south and should open to let in sunlight. Provide the same amount of shutters as for the muslin curtain.

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