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Ventilation for Swine

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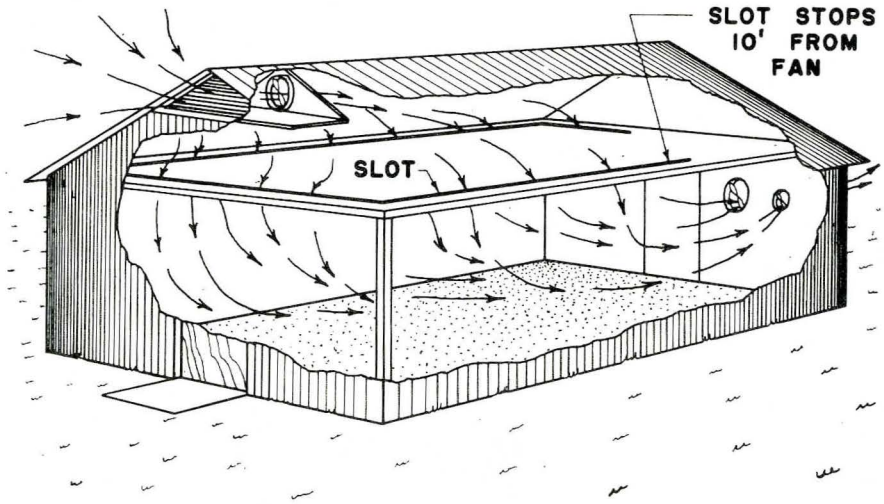

Figure 1. A slot ventilation system provides uniform distribution of air in a farrowing or finishing building.

For Healthy Living Conditions

Ventilation for Swine

By E. A. Olson

To maintain healthy living conditions in hog houses, a good ventilating system is necessary. During winter months a good ventilation system can remove excess moisture from a building, help control odors, and provide fresh air, essential for efficient animal growth.

Ventilation is simply a continuous process of bringing in cold air, warming it so it picks up moisture and then exhausting it to the outside. Warm air can "hold" more moisture than cold air; therefore when it is warmed it has the capacity to absorb moisture from surfaces inside the building. Exhausting this warmed, moisture-laden air outside keeps the building dry and the air fresh. During hot weather good air circulation with electric fans keeps animals more comfortable and increases their rate of gain or feed conversion.

Keys to Successful Ventilation

Cold air brought into the building must be warmed so it can pick up excess moisture. This means that we must be able to maintain the temperature of the building. By insulating the building thoroughly we slow down the loss of heat through the walls, ceiling and floors.

Insulation should be installed in a closed swine building to help assure a satisfactory ventilation system. It will help retain animal heat in the building to maintain a desirable temperature. It also does a more important job. It permits the temperature of the walls and ceiling surfaces to stay close to that of the inside air. Thus, when the warm moist air comes in contact with the inside wall and ceiling surfaces, it isn't cooled very much. Otherwise, the walls and ceiling "sweat"—just as do the exposed windows in your house in the winter.

During severe weather, when a building is partially filled, it may be necessary to have supplemental heat. When the building is nearly filled, the animal heat helps maintain desired temperatures.

Insulation is the first step in developing a successful ventilation system.

How Much Insulation

Insulation is a must to help assure satisfactory ventilation. It will: (1) Hold heat in during winter months; (2) help prevent condensation on inside wall and ceiling surfaces; (3) keep out heat in hot summer months.

The amount of insulation depends on the desired inside temperature, type of construction and your geographic location. Listed in Table 1 are insulation recommendations on various types of wall construction for closed swine housing for Nebraska.

Adequate insulation in the ceiling or under the roof is also important. More insulation is advisable in the ceiling since warm air rises. At least 3″ of insulation is advisable in the ceiling, however 4″ will give better results.

Keep Insulation Dry

Water vapor will have a tendency to move thru wall and ceiling insulation where it will condense and later cause trouble. A vapor barrier should be installed on the warm side of the wall to help eliminate this problem. Most blanket insulation has a vapor barrier, however additional protection is recom-

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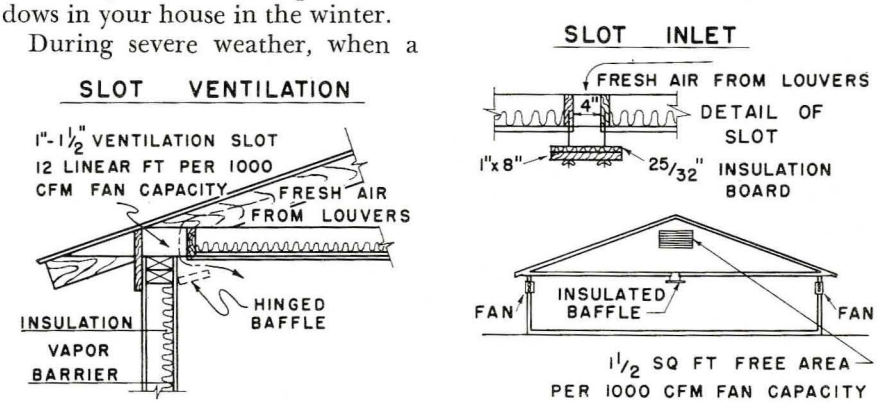

Figure 2. These two diagrams show construction of slot inlet and slot ventilation techniques.

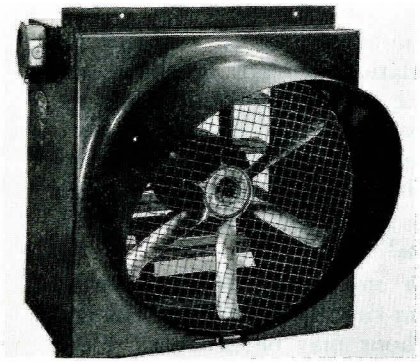

Figure 3. A ventilating fan equipped with a safety guard and a weather protection hood.

Figure 4. Some fans are equipped with backdraft shutters. Shutters may be gravity or motor controlled.

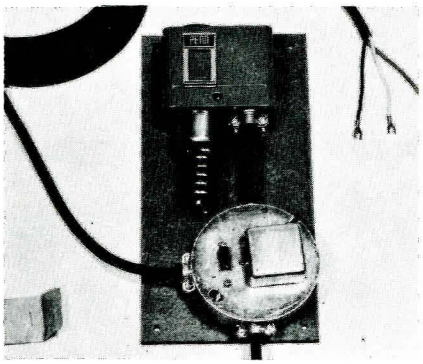

Figure 5. This control panel has a prewired thermostat and switch. It can be used to control a one-speed, constant volume fan.

Ventilation . . .

(continued from page 9)

mended because of high moisture conditions found in a hog house.

On frame or steel construction, after the wall insulation is in place, apply a sheet of 4-mil polyethylene on the inside of the wall framing before the lining is installed. Other suitable materials that might be used include: Aluminum foil, or black roll roofing 55 lb. (*not* red rosin sheathing paper).

A Forced Air Ventilation System

A forced air ventilation system has several parts that must be properly coordinated and correctly sized to give good results. These include: (1) Air inlets; (2) air distribution ducts; (3) fans; (4) controls and wiring and (5) air outlets.

There are two types of ventilating systems: exhaust and pressure. The exhaust system is quite common and will give good results. The pressure system helps reduce drafts and is becoming more common.

Air Inlets

Cold outside air should be brought into the building without producing drafts and uniformly distributed. Several small inlets distributed in the building will provide more uniform air movement than a few large openings.

The ceiling slot inlet system has an opening about 1 inch in width, extending around the building, as shown in Figure 1.

This system is easy to install and can be adapted to new or remodeled buildings. Outside air is brought into the attic thru a louvered screened inlet located in the leeward end of the building. Air flows into the building thru the slot (see Figure 2) where it is distributed uniformly throughout the building. In a farrowing house, a deflector board can be installed below the slot to direct the air across the ceiling.

Air inlets are sized to provide one and one-half square feet of free area for every 1,000 cubic feet of air flow.

Air Distribution Ducts

Air distribution ducts are needed with the pressure and the individual stall ventilation systems. Ducts are connected to an air inlet and can be located high along the walls or under the ceiling of the building. To provide uniform air distribution, adjustable outlets are provided along the ducts. "Sweating" or condensation on the ducts can be prevented by insulating the duct walls. Size ducts with one and one-half square feet of open area for very 1,000 cubic feet of air flow.

Fans or Blowers

Several types of fans are available for ventilating swine buildings. These include (1) single-speed, constant volume; (2) single-speed, dual volume and (3) two-speed, high-low volume. The type selected depends on the capacity needed and the desired operating characteristics. Select a fan to deliver air against 1/8 inch of water static pressure (Table 2), to compensate for resistance of the building and shutters to air flow.

Protective guards must be installed on fans for the safety of people and animals (see Figure 3). Protective hoods over wall mounted fans are also advisable to help keep rain, snow and wind from entering the building. Many fans are equipped with motor-driven shutters to control air flow (Figure 4).

In the ceiling-slot ventilation system two fans are needed. One small fan operates continually to provide a constant air flow and to prevent a back-draft through the slot. A second two-speed fan is also needed for winter ventilation to remove excess moisture, odors and to help maintain uniform temperatures.

Controls and Wiring

Ventilating systems can be automatically controlled with thermostats (Fig. 5) and time-clocks. With a thermostat the control is based on the inside air temperature. The fan will operate only when the air temperature is above the thermostat setting. With a time-clock the fan

Table 1. Insulation recommendations.

Wall Construction	Insulation
Wood frame	2″ blanket or equivalent
Steel frame	2″ blanket or equivalent
Masonry—8″ lightweight block	cores filled with granular insulation
Masonry cavity wall 2-4″ block walls[a]	2″ rigid insulation in cavity
Concrete Tilt-up Sandwich Wall	2″ rigid insulation

[a] Preferred over 8″ lightweight block.

Table 2. Typical capacities of two-speed propeller fans at ⅛ inch static pressure. Consult manufacturers' tables to determine capacities of fans selected.

Fan Horse-power	Revolu-tions per minute	Motor horse-power	*Low* volume cubic feet per minute	*High* volume cubic feet per minute
14″	1725	⅙	445	1300
18″	1725	¼	591	3310
24″	1140	¼	1360	4930
30″	794	⅓	1155	6718

can be set to operate a selected amount of time. For instance, the controls can be adjusted to operate 1 minute in every 10 or 1 minute in every 15. By using time-clocks in conjunction with thermostats considerable versatility can be had by selecting different operating periods for various conditions.

A schematic wiring diagram for a single-speed fan is shown in Figure 6. As indicated, the thermostat is located in the "hot" line to the motor. It is wise to follow the wiring diagrams that the manufacturer furnishes with his equipment.

Be sure to select a fan motor that is protected by an overload device. If the motor does not have a built-in thermal overload, a time delay or a circuit breaker should be used in the circuit, as shown in Figure No. 5. The rating of the overload device should be 1.15 to 1.25 times the curent rating on the motor nameplate.

Plan your control and wiring set-up so the thermostat (s) is located near the animals, but protected from possible damage by them. Locate it near the center of the building about 18 to 24 inches below the ceiling.

For advice on planning your complete wiring system contact a competent wireman or contact the electrification advisor of your local power supplier.

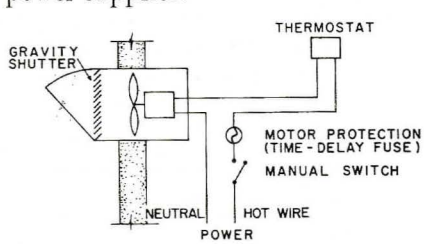

Figure 6. This schematic deagram illustrates the wiring for a thermostatically controlled single-speed, constant-volume fan.

Ventilation Rates

The amount of air required for ventilation depends on the season of year, and on the number and age of swine that are housed. Fan capacities can be determined by the number of air changes per house or by a given air volume for each animal.

For minimum air flow during winter conditions three air changes per hour may be necessary. However, for hot summer conditions as much as 50 air changes per hour may be needed. The fans selected must be able to provide both low and high air flow.

Table 3 gives air flow figures for different weights of swine. Because of the many variable factors involved these figures should not be used as a definite basis for fan selection. Obtain reliable and experienced assistance when selecting and installing a ventilating system.

Table 3. Air flow figures.

Size of Swine	Ventilation rate (cubic feet of air flow per minute)
Sow and Litter	10–80
20 lb. pigs	4–15
100 lb. pigs	10–25
200 lb. pigs	15–30

Remember

For proper ventilation three things are important:

1. A tight, *well-insulated* building with enough animals or supplemental heat to keep the building warm.
2. Dependable electric fans properly selected and installed with adequate controls.
3. Fresh air inlets, correctly designed and located.

If you have a ventilation problem contact a reliable supplier able to give competent recommendations on selection and dependable service. More detailed information on ventilation will also be found in Swine Equipment Plan & Housing Needs, EC 64-731, available from your county Extension agent or from the Extension Service, College of Agriculture, University of Nebraska, Lincoln, Nebraska.

E. A. Olson is Professor, Agricultural Engineering.