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Ventilation for Swine Buildings

Cooperative Extension South Dakota State University

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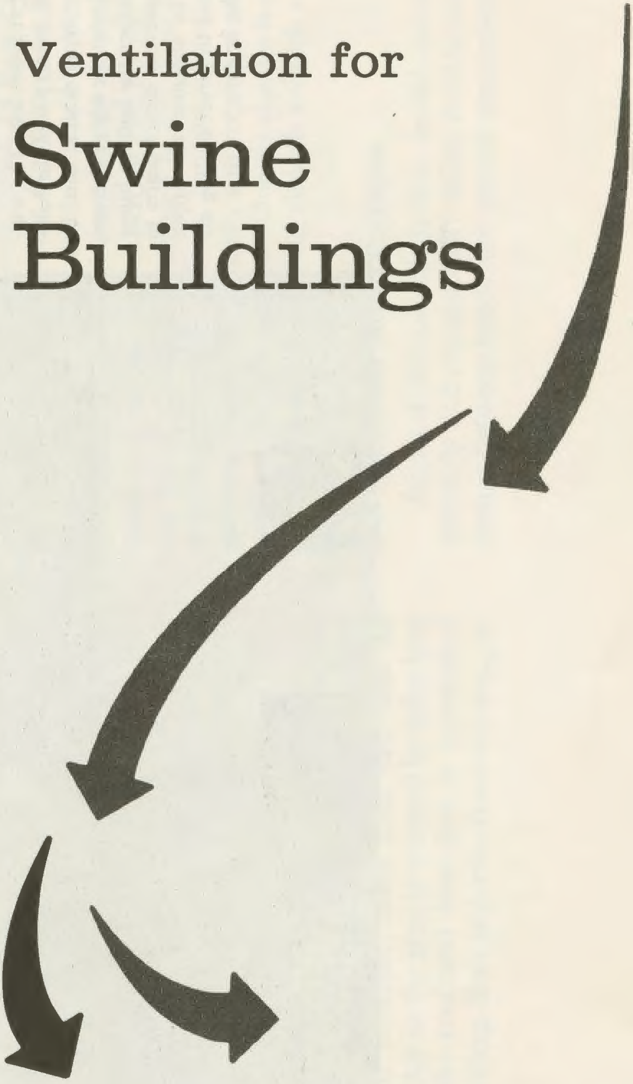

Cooperative Extension Service
South Dakota State University, Brookings
United States Department of Agriculture

Ventilation for Swine Buildings

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The trend in swine housing toward multiple farrowing systems and confinement growing and finishing units has resulted in a need for an increased amount of environmental control. Close control of temperature, relative humidity, fresh air and sanitation have become a matter of prime importance. Of these, temperature control, relative humidity and fresh air through proper insulation and ventilation require precise planning and designing in swine housing systems.

Ventilation is needed to remove moisture produced by the animals as well as to control temperature and odors. A properly planned ventilation system requires an adequately insulated building, good air distribution and some form of supplemental heat to maintain inside temperatures during cold weather.

INSULATION REQUIREMENTS

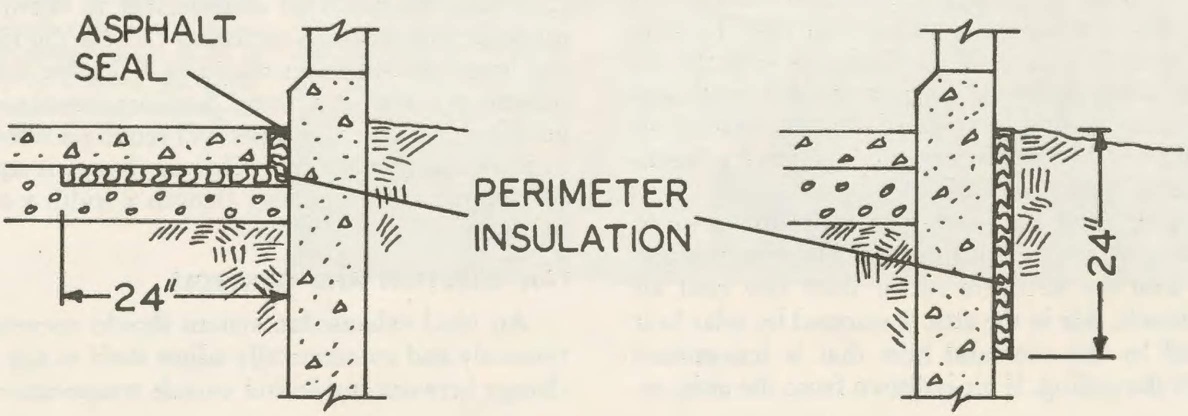
Insulation reduces the flow of heat through walls and ceiling of a structure. Reduction of heat loss provides warmer wall-surface temperatures which decrease the possibility of moisture condensation or frost accumulation on the interior of the structure. Adequate insulation also conserves heat needed for proper ventilation during cold weather.

In South Dakota a reliable recommendation is to insulate walls with at least a 2-inch blanket type insulation or equivalent (R value of 7.4). A minimum of a 4-inch blanket (R value of 14.8) is recommended for the ceiling. A vapor barrier should always be installed between the insulation and the inside sheathing of the building. Materials such as 4-mil polyethylene, asphalt-impregnated paper and metallic foils are effective vapor barriers. To provide a warm floor in farrowing houses install perimeter insulation under the floor and between the floor and foundation. Usually expanded polystyrene or foamglass is used for this purpose. Figure 1 shows typical installations of perimeter insulation.

AIR DISTRIBUTION

While moving the desired amount of ventilation air through the building is necessary, this in itself will not assure satisfactory ventilation. It is vitally im-

Figure 1. A typical installation of perimeter insulation (left). Alternate method (right) of installing perimeter insulation in an existing building.



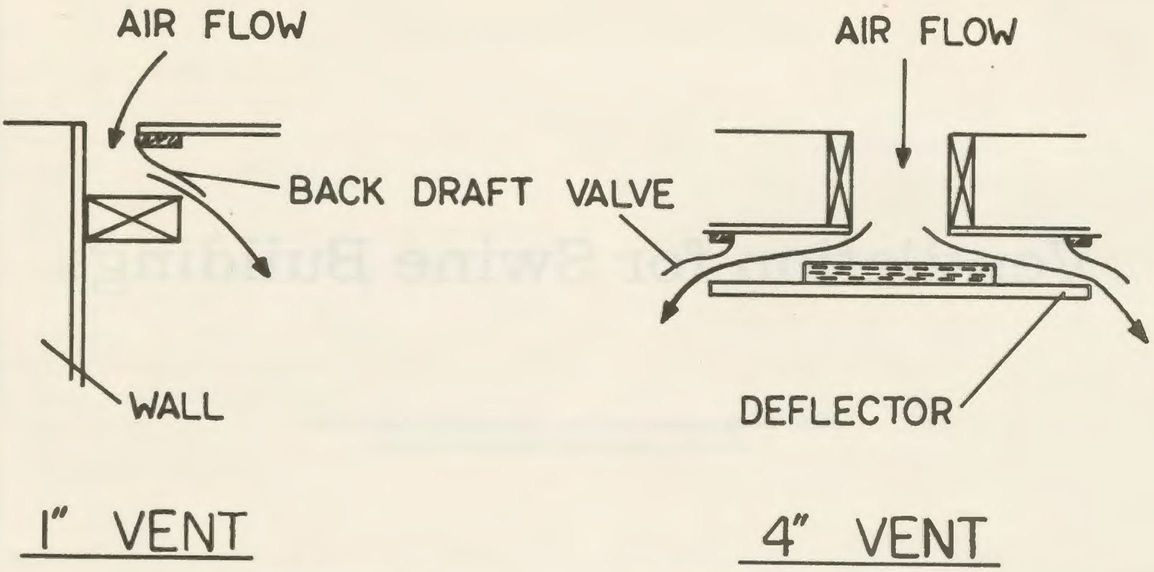


Figure 2. Slot intake construction in buildings up to 32 feet wide (left). Slot intake construction in buildings more than 32 feet wide (right).

portant that the incoming air is uniformly distributed to remove moisture from all areas of the building and to eliminate drafts.

The most widely accepted ventilation system consists of an exhaust fan or fans, which remove stale air and moisture, and fresh air inlets to distribute the air uniformly to all parts of the building. Fans for winter ventilation are normally on one wall, usually on the south or east side of the structure. Fresh air inlets are in the ceiling or on the side of the building opposite the exhaust fans.

The inlets must be situated so as to direct fresh air to all parts of the building. Fresh air should enter at a low velocity near the ceiling and directed in a manner to prevent drafts. Inlets should not be within 8 feet of exhaust fans.

Design criteria should include a 20-inch length of 1-inch slot (20 square inches) inlet per sow and litter in the farrowing house. A growing unit will require 4 inches of 1-inch slot inlet per animal and a finishing unit will require 6 inches of inlet length per animal.

Slot intakes can be constructed in the building as shown in figure 2. These slots should be constructed so that warm moist air is not drawn into the attic where moisture can condense and soak into the insulation. Reverse flow of air into the attic will normally occur during periods of low ventilation in very cold weather and is prevented by use of a "back-draft valve" (see figure 2).

Drawing fresh air from the loft or attic space of a building offers the advantage of bringing tempered air into the structure rather than raw cold air from outside. Air in the attic is warmed by solar heat absorbed by the roof and heat that is transmitted through the ceiling. If air is drawn from the attic, intake louvers must be provided in the gable ends of the building. Size of the louvers should be based on providing 36 square inches of louver area per 100 cubic feet per minute of exhaust fan capacity.

EXHAUST FAN CAPACITY

The table below gives the required ventilation capacity per pig or per sow and litter for satisfactory cold weather operation.

	Inside temperature (F.)	Fan capacity (c.f.m.)
Sow and litter	50°	80
	60°	50
100 lb. pigs	60°	15
200 lb. pigs	50°	25
	60°	15

Select ventilation fans that are rated to deliver the required amount of air at ⅛-inch static pressure.

Summer ventilation is a matter of removing as much heat as possible from the building and, in some cases, circulating air over the pigs at a sufficient velocity to create a cooling effect. In most cases it is recommended to reverse the direction of air flow and to open the building as much as possible. Ventilation rates must be increased considerably to obtain adequate air movement. Ventilation rate for the farrowing house should be increased to 120 cubic feet per minute per sow and litter. Summer ventilation in growing and finishing units will require a rate equal to 50 air changes per hour. One air change is equal to the volume of the building (length x width x ceiling height).

FAN SELECTION AND CONTROLS

An ideal exhaust fan system should operate continuously and automatically adjust itself to any small change between inside and outside temperature. Unfortunately, no single fan or control will meet this requirement. The best approach is to use a multiple fan system. This system exhausts the maximum amount of air as required in mild weather and can be throttled down by thermostats which stop and start the fans as temperatures fluctuate. Two or more fans, each separately controlled, are required to meet the wide variations between minimum and maximum output for variable temperatures of a typical South Dakota winter.

A fan system for winter ventilation is designed for total capacity operation at an outside temperature of approximately 40°. When the temperature drops to 10° below zero the amount of ventilation should be reduced to about 20% of the maximum requirement. This variability in ventilation requirements can best be met by selecting one fan having 20% of the total required ventilation capacity and a second fan or fans of sufficient capacity to furnish the remaining 80%.

The low-volume fan in an automatic ventilation system may be operated in one of three ways: continuously; controlled by a thermostat; or by an interval timer. In the latter method it is usually connected in a parallel with a thermostat so the fan can be controlled to operate for selected percentages of a given time interval. The high-volume fans are controlled by thermostats and are adjusted to operate when the temperature in the building reaches a predetermined level.

SUPPLEMENTAL HEAT

While proper insulation conserves a considerable amount of heat produced by the hogs, this heat will not be sufficient to maintain an adequate temperature in swine housing during sub-zero weather. Ventilation at a rate sufficient for moisture removal will require more heat than the animals produce. In some housing systems it may be possible to reduce the ventilation rate and accept the fact that for a short period of time an excessive amount of moisture may accumulate in the building. Farrowing systems will require supplemental heat, however, since it is highly undesirable to have the inside temperature drop below 50° or to have moisture accumulate in the building.

Supplemental heat should be planned at the rate of 2,500 B.t.u.'s per hour per sow and average litter in the farrowing house. If supplemental heat is desired in growing or finishing units, it should be at the rate of 425 B.t.u.'s per hour per animal in the growing unit and at the rate of 750 B.t.u.'s per hour per animal in the finishing unit.

Remember that careful management of heating and ventilation controls is necessary to conserve heat. The heating system should operate only when the low-volume fan is functioning, thus the thermostat on the heater should be set at least 5° below the cut-in temperature of the high volume ventilation. No ventilation system is better than its correct design, proper management and efficient operation.

The ventilation inlet in this experimental swine building is indicated at the ceiling in the upper portion of photo. The back draft valve is lifted up slightly to show the inlet slot which in this case is covered by hardware cloth to prevent the back draft valve from reversing. Exhaust fan and controls are on wall at lower left. The window (lower, center) is of the basement sash type which can be hinged either at the top or bottom. In cold weather the bottom hinge is used to prevent direct drafts to the floor. In summer the upper hinge is used to direct cooling air down on the hogs.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U. S. Department of Agriculture. John T. Stone, Dean of Extension, South Dakota State University, Brookings.
4M—4-67—File: 6.2-6—5815

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