pork industry handbook

Michigan State University Extension

Swine Growing-Finishing Units

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The term "growing-finishing" pigs describes that range in weight from as low as 40 lb. to market weight. The age range is from about 8 wk. to 23 to 28 wk.

The age range is usually split into two groups. When this is done, pigs spend about 8 to 10 wk. in a growing unit and the last 8 to 10 wk. in a finishing unit. Each group is kept in a separate room or facility. Splitting them into groups is consistent with a trend toward "all-in/all-out" management of growing-finishing units.

Pigs moved to the grower unit in winter at 40 lb. need a minimum temperature of about 70°F. A grower unit needs better environmental control than the finishing unit in cold weather with supplemental heat required in cold climates.

Desired Environment

The desired temperatures for growing-finishing pigs are similar to what is shown in Table 1.

Table 1. Suggested temperature range for growing-finishing pigs.

Age, wk.	Pig weight, lb.	Approximate suggested temperature range,°F
9	46	73-82
10	56	70-82
11	68	68-80
12	80	66-80
13	92	64-80
14	104	62-80
15	116	60-78
16	128	58-78
17	141	56-78
18	155	56-75
19	171	54-75
20	187	52-75
22-mkt.	215 & up	50-75

Temperatures

Pigs have the ability to adjust to temperatures outside the range shown, but they are most productive within the range. In extremely cold weather it is better to let the temperature drop slightly and keep the humidity down than it is to cut back on ventilation.

When using the all-in/all-out principle, the ventilation opening thermostat can be changed once a week to match the age and weight of the younger pigs. Today's controllers permit more exact control than was possible previously.

The use of bedding allows temperatures to drop from 5° to 8° F below the above low values in Table 1 and still keep the pigs comfortable.

Relative Humidity

Try to maintain the relative humidity between 50% and 60% to minimize the growth of disease microorganisms. Some disease microorganisms grow rapidly at humidities above 60% while others grow well at low humidities. When ventilation is sufficient to keep the humidity below 60%, other contaminants, such as gases and respirable dust, tend to be low as well.

High relative humidities promote rapid corrosion of metal equipment, creating an additional expense. High relative humidities also lead to more rapid deterioration of the electrical system, contribute to condensation problems, and accelerate destruction of wood and truss plates when trusses are exposed.

Gas Levels

Suggested allowable concentrations of the three common gases found in swine buildings are as listed in Table 2. These concentrations are easily achieved with an adequate ventilation system. At higher concentrations, each of these gases can be detrimental to animal and human health and to productivity.

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Table 2. Suggested maximum gas levels in swine buildings.

Gas	ppm
Ammonia	10
Carbon dioxide	3000
Hydrogen sulfide	5

Dust

Dust is an irritant that can increase respiratory problems in both swine and humans. Several options are available to help control dust.

Dust that settles on equipment and building components should be periodically washed down to keep it from being picked up and returned to the air. Adding fats or oils to the feed can remove more than half of the total room dust. Equipment to remove dust from the air is being studied and may be available in the future. In the meantime, persons who spend extended periods in enclosed facilities would be wise to wear dust masks.

Building Types

A variety of buildings are used for both growing and finishing pigs. The buildings used can be classified as one of four general types:

1. Open front shed, outside concrete.
2. Enclosed building, naturally ventilated year-round.
3. Enclosed building, fan ventilated in winter–naturally ventilated the rest of the year.
4. Enclosed building, fan ventilated year round.

Open Front with Outside Feed Floor (Fig. 1 & 2)

Bedding is recommended during winter in cold climates. Slope inside the floor 1/4 in. per ft. if bedding is used. Consider having enough building height to use a skid loader or small tractor for cleaning.

Collect runoff at the lower end of the outside floor as required to meet state and federal pollution requirements. Provide a curb or collection alley to contain the manure.

Locate the waterer near the mid-point or lower part of the outside floor. Locate the feeder near the shed, unless it must be filled from the lower end of the pen. Additional shade may be needed in hot weather.

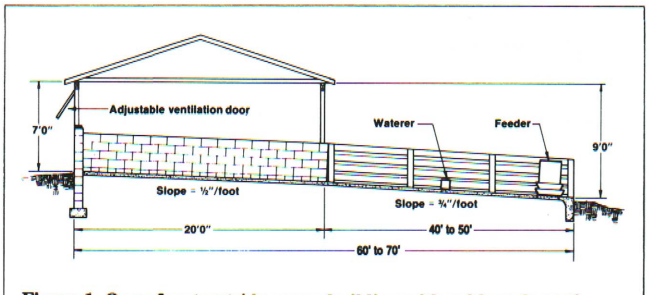

Figure 1. Open front outside apron building with gable style roof.

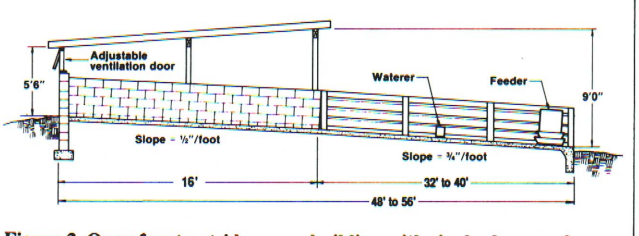

Figure 2. Open front outside apron building with single slope roof.

Enclosed Buildings

The trend has been toward the use of naturally ventilated buildings for larger hogs. Temperature-actuated door and curtain controllers make it possible to achieve an environment similar to that possible with fans. The most difficult times to control the environment are during extreme cold in winter and extreme heat in summer and during rapidly changing weather in fall and spring. Some producers, therefore, use exhaust fans to provide a more uniform temperature in cold weather and use mechanical or natural ventilation for the rest of the year. In hot weather, circulating fans and sprinklers can provide comfort.

Building Construction

Building Width

Inside an enclosed building with a single row of pens, the building width is generally from 24 to 30 ft. (Fig. 3, 4, 5, and 6). With two rows of pens, the width will range from 40 to 48 ft. (Fig. 7, 8, 9, 10, and 11).

Pen Layout

A common concern with having a partially slotted floor and open gutter flush floor buildings is the dunging habits of the pigs. The slotted or gutter portion is intended to be the dunging and waste collection area and the solid floor the resting area. Both ventilation air patterns and pen layout can influence how clean the pigs keep the solid floor resting area.

The following are suggestions for pen design and management to help train pigs in partially slotted pens, or pens with open flush gutters.

1. Use a solid partition over the solid floor resting area, and along the alley adjacent to resting area.
2. Provide a vertical or horizontal bar, open gate over the slotted floor or flush gutter area.
3. Place waterers near, or over, the slotted or flush area.
4. Provide a 2 to 3 in. step-down from the solid to the slotted area or a 4 to 6 in. step-down to the gutter flush area.
5. Wet the slotted floor immediately before moving pigs into the pen and sprinkle feed on the resting area.
6. Adjust ventilation air movement as needed to make the resting area the most comfortable area for the pigs throughout the year.
7. For small pigs, use a hover over the resting area in cold weather.
8. Locate feeders on the solid floor area close to the slotted area. This allows the use of a crowd gate to keep the resting area matched to the size and number of pigs in the pen.
9. Flush often (once each 30 to 40 minutes) in open gutter flush systems.

All of the above will have no influence when the most comfortable part of the pen is the waste collection area, because that is where the pigs will rest; and they will dung on the solid part of the floor. In cold weather, the resting area must be kept draft-free with the colder ventilation air brought in over the dunging area. In summer the resting area should have good air movement. It may take intermittent sprinklers in the dunging area with paddle fans in the resting area to encourage proper resting and dunging habits during summer months. The dunging area must be the most uncomfortable area for the pigs at all times.

Pen dimensions are not as critical with totally slotted floors, and the feeder and waterer locations are also of less concern.

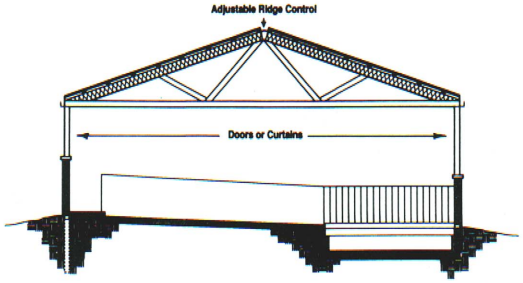

Figure 3. Insulated roof option for single row of pens, partial slats.

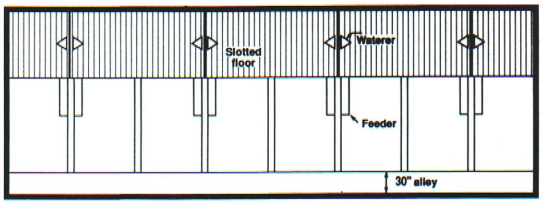

Figure 4. Partially slotted floor building with a single row of pens.

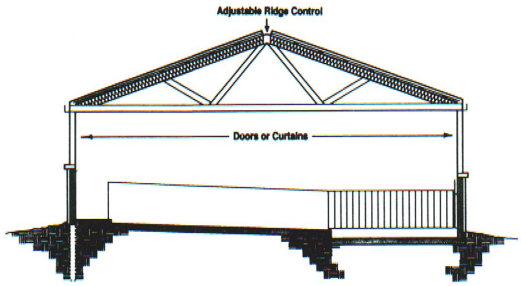

Figure 5. Floor layout for open gutter unit. Gutter is either flushed or scraped.

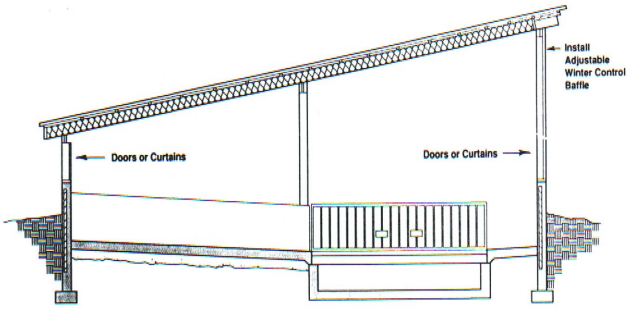

Figure 6. Single slope roof, partial slats building.

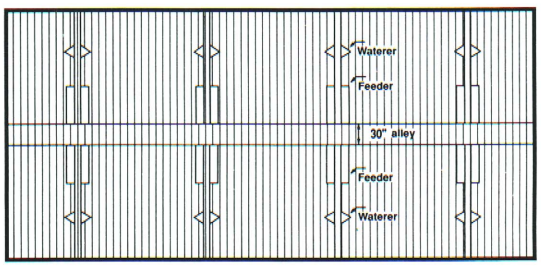

Figure 7. Totally slotted floor building with a center alley.

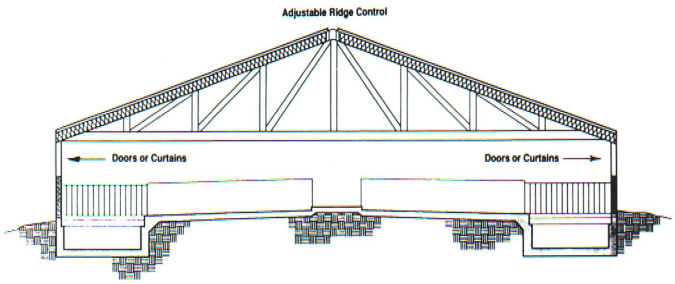

Figure 8. Insulated roof option for two rows of pens, partial slats.

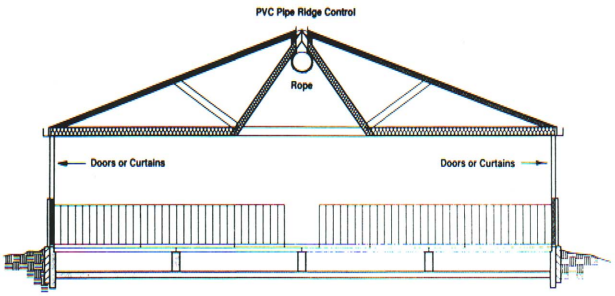

Figure 9. Continuous, sloped center chimney building.

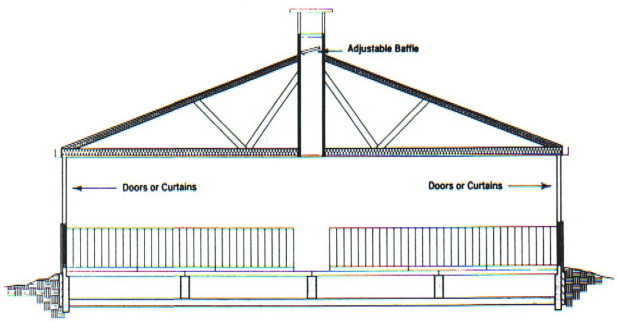

Figure 10. Intermittent square chimney building.

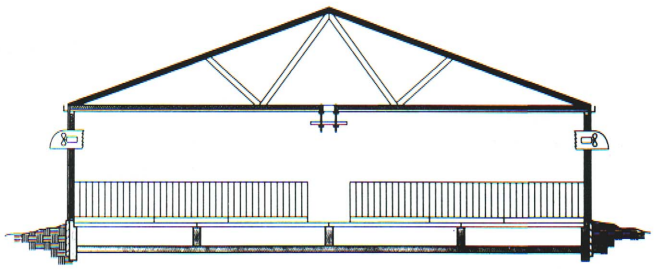

Figure 11. Year-round fan ventilated building. Minimum insulation under the roof reduces heat pickup in hot weather.

Insulation

Use the indicated insulation values for your climate, (Fig. 12 and Table 3).

Table 3. Suggested R-values for enclosed buildings.

Climate	Suggested R-value	
	Wall	Ceiling
Cold	14-20	25-35
Moderate	14	14-20
Mild	5	5

Always use perimeter insulation 18 to 24 in. below ground level for moderate and cold climates. Rodent proof barriers are required on all insulation less than 24 in. below grade. Earth sheltering complements, but does not replace, insulation.

The building must be adequately insulated to prevent condensation on surfaces and to allow enough ventilation to keep the humidity in the desired range in winter. With adequate insulation, no extra heat is required to maintain the temperature except during severely cold days or when housing very young pigs. Repair or replace insulation damaged by rodents.

For more detailed information, see PIH-65, *Insulation for Swine Housing*.

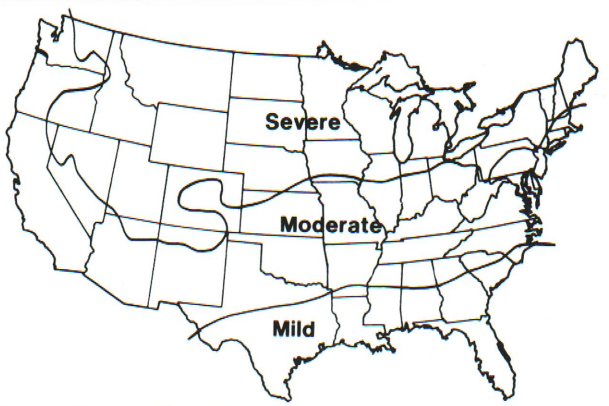

Figure 12. Approximate climate zones.

Table 4. Suggested minimum space per pig.

Pig weight, lb.	Enclosed building	Shed with outside lot	
		Inside	Outside
		---------Sq. ft./head--------	
40-100	4-5	5	8 - 10
100-160	6-7	6	10 - 12
160-220	8-9	8	12 - 15
over 220	10	9	14 - 16

Alley Width

A 30-in. wide alley is usually sufficient. An alley too wide will permit pigs to turn around when being moved. A wider feeding alley may be needed if a feed cart is used.

Waterers

Make sure pigs have access to water (Table 5). Lack of sufficient water can reduce efficiency and rate of gain. Inadequate waterer space, restricted flow, or partially plugged waterers are the most common reasons for a lack of sufficient water. Locate waterers in the area of desired dunging.

Provide sufficient waterers and check the flow rate of nipple waterers at least once a month. Use a cup and stop watch to determine flow rate.

Table 5. Water requirements.

Item	Pig Weight	
	40-125 lb.	125-230 lb.
Pigs per nipple or cup	12-15	12-15
Nipple height, in.	15-24	24-30
Flow rate, quarts per minute	0.5	0.7
Daily water consumption, qt.	6-10	8-12

Water consumption varies with air temperature. Higher rates are needed in hot weather.

Keep nipple waterers at least 12 in. apart. Set nipple waterers at a 15 degree angle downward unless otherwise indicated by the manufacturer. Position nipples at a height between the middle and top of the pigs' front shoulders. Limit the pressure going to the nipples to 30 psi. A pressure reducing valve is desirable in most instances. Locate water lines away from incoming air to prevent freezing.

Feeder Space

Any restriction of the pigs' ability to eat whenever hungry can slow the rate of gain. Floor feeding can increase the time to market from a week to 10 days. Floor feeding can be used successfully, if knowledge of feed intake patterns is established and management skills are adequate.

If space at a self-feeder is limited, the daily gain can be slowed for at least some of the pigs. Provide one feeder space for each four or five pigs. For example, a six-hole feeder can feed a pen of 24 to 30 pigs, and an eight-hole feeder can feed a pen of 32 to 40 pigs.

Pen Partitions

Avoid partitions or gates that permit pigs to climb the fence with their front feet. A hog panel with rectangular openings is an example of a partition that has caused foot injuries.

Solid pen panels are desirable on the solid portion of partially slotted floors. Solid concrete, concrete filled block, plastic planks, oak and similar durable wood can be used if joints are installed flush so pigs cannot find a spot to start chewing.

Vertical or horizontal bar gates or panels are suggested for any open partitions such as over the slotted area or open flush gutter.

Partitions should be 32 in. high in the growing area and at least 36 in. high in the finishing area.

Inside Wall Linings

Any wall within the pens should be of a pig-proof material. Walls along alleys should also be somewhat pig resistant, but they are not subject to as much damage as pen walls.

Concrete, fiberglass reinforced plastic, recycled plastic, and properly protected plywood are examples of suitable materials. Use moisture resistant materials, so dust and cobwebs can be cleared from walls and ceiling occasionally. See PIH-32, *Building Materials and Equipment for Swine Facilities*.

Manure Handling

Slotted floors (partial or total) are most common in enclosed buildings. Some producers use a solid floor with a dunging alley and scrape with a tractor or skid loader 2 or 3 times a week (See Fig. 3). Scraping requires extra labor to close and open gates (pigs are held in the upper part of the pen), and good sanitation is hindered because the pigs are exposed to manure longer. Another option is open gutter flushing. The building design would be similar to that in Fig. 3.

Some hand scraping of the solid area should be anticipated. Be sure the total manure management system complies with local, state, and federal requirements. Increasing concerns about water quality are putting added pressure on producers to manage all manure and runoff in environmentally sound ways year-round.

Manure Handling, Slotted Floors

The floors in enclosed buildings may be partially or totally slotted as shown in Fig. 4 and 7. A partly slotted floor should be about 1/3 slotted with a minimum slotted width of 8 ft.

Space below the slotted floor may be:

1. Deep pit, usually 6 to 10 ft. deep.
2. Mechanical scraper, 10 in. to 24 in. deep.
3. Gravity drain (pull-the-plug), 18 in. to 24 in. deep.
4. Flushing system, 8 in. to 24 in. deep.
5. Pit recharge, 32 in. to 36 in. deep.

Deep Pit

1. May be less total investment as storage under a building costs less than a formed storage pit outdoors.
2. Odors and gases are more of a problem even with a good pit ventilation system. Pit tubes or ducts are more effective than pit wall fans.
3. Agitation of the pit prior to emptying can produce dangerous concentrations of toxic gases. Operate ventilation system at maximum capacity when agitating or emptying pits.

Mechanical Scraper

1. Requires some maintenance.
2. Can remove manure from the building daily or more often.
3. Higher ammonia levels can occur in the building unless water is added after each scraping. This volume of water must be accounted for in sizing manure storage.

Gravity Drain

1. Sometimes called a "pull-the-plug" gutter.
2. Manure accumulates from 1 to 2 weeks before plug is pulled.
3. Gutters with a Y, V or U shaped bottom drain well, but a rectangular shape is easier to construct and the trend is towards using it.
4. Plugs have been placed at both ends of the flat bottom gutter to help in cleaning. A plug at one end is pulled to drain the gutter, and at the next draining, the opposite end plug is pulled. An adaptation of this is the hairpin gutter (Fig. 13).
5. Hairpin gutters need less drain pipe to transport the manure to storage than gutters with a drain on each end.

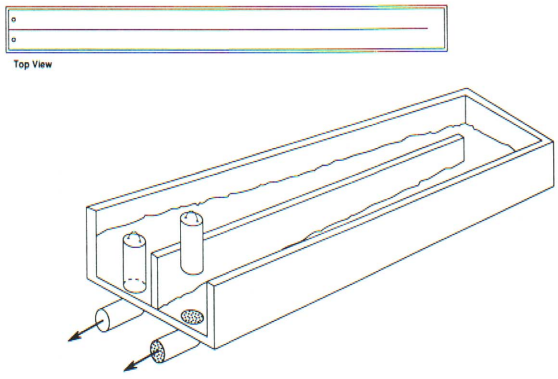

Figure 13. Hairpin shape of gravity drain gutter.

Flushing Under Slats

1. Large amounts of water are required, so a lagoon must be used.
2. Cleans manure from the building more completely than other systems.
3. Salt can accumulate in pipes, screens and pumps, restricting capacity, if water is recycled from a lagoon.
4. An irrigation system is normally required to distribute the manure in the fields.
5. A gutter wider than 5 ft. should be divided into two smaller channels for adequate cleaning.

Pit Recharge

1. Requires less pumping of water than flushing.
2. Less cost than flushing by eliminating all flushing tanks.
3. Requires a lagoon for storage.
4. Advantages are similar to flushing.

Manure Handling, Open Gutter

An open dunging area in a pen may be cleaned by flushing or by hand or mechanical scraping.

Open Gutter Flush

1. Building cost is less than for slotted floors.
2. Low in-house odors.
3. Pigs are attracted to running water and are easily trained.
4. There is some cooling benefit during hot weather.
5. Pigs are exposed to any live disease microorganisms and additives in recycled water.

Open Gutter Scrape

1. Similar to partially slotted floor with a scrape gutter where slats would be located.
2. Need 5 to 6 in. step-down for gutter.

For further information on manure handling systems see: PIH-95, *Gravity Drain Gutter Systems;* PIH-105, *Scraper Systems For Removing Manure From Swine Facilities;* PIH-62, *Lagoon Systems For Swine Waste Treatment;* and PIH-63, *Flushing Systems For Swine Building.*

Ventilation

The ventilation system used must be designed so that the dunging area is the most uncomfortable part of the pen and the resting area is always the most comfortable, regardless of outdoor weather. In a partially slotted floor, the resting area should permit no drafts during the winter and yet provide air movement for cooling in the hot summer. In a totally slotted floor pen there should be a comfortable area in the pen at all times even though that location in the pen can change as the weather changes.

Cold incoming air that is more likely to cause a draft should be directed toward the dunging area.

Incoming summer air should provide air movement over the resting area in hot weather. Problems occur with a sudden temperature drop. If the cooler air drops in the resting area, the pigs will change their dunging patterns to the dismay of the producer.

Natural Ventilation

Natural ventilation (or non-mechanical ventilation) depends on wind pressure (natural breezes) and thermal buoyancy (warm air rises) to move air through the building. There must be inlets and outlets as with any ventilation system.

To help control wind currents in a naturally ventilated building, it is sometimes necessary to install solid partitions across the width of the building. Install a divider for buildings longer than 75 ft.

Provide openings on the windward side that can be opened in summer but closed in winter. Openings on the downwind side should be capable of meeting both winter and summer ventilation requirements. Provide openings on the end walls for improved hot weather ventilation.

Doors or Curtains

The side openings in a naturally ventilated building should be easy to control because of the rapidly changing temperature and wind direction which occurs in much of the country. The trend has been toward the use of curtains. A simple curtain works well in mild climates (Fig. 14). An insulated curtain is being used in cold climates (Fig. 15). In moderate climates an insulated curtain may be used on the north side of the building with an uninsulated curtain on the south. Another option is to use insulated doors on the north instead of an insulated curtain.

A folding curtain can be a haven for mice during the time the curtain is folded for several months in warm weather. Run the curtain up and down every week to combat the problem.

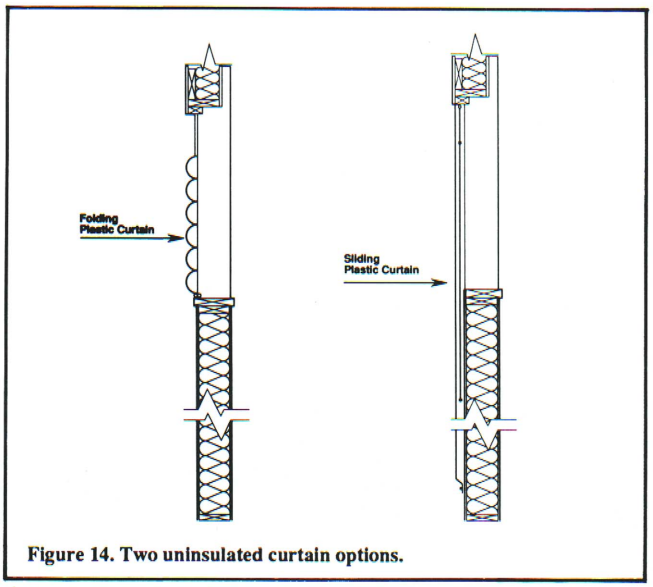

Figure 14. Two uninsulated curtain options.

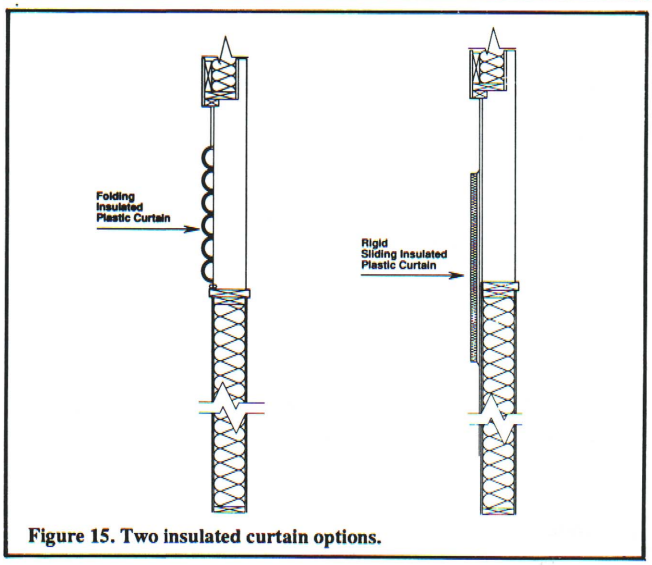

Figure 15. Two insulated curtain options.

Another option is to use a sliding curtain. This requires that the solid part of the wall be at least as high as the width of the curtain. For example, a 4 ft. sliding curtain could be used on a wall that is 8 ft. high. Keeping the bottom of a sliding curtain closed tightly in cold weather is a concern because air enters at the bottom of the curtain.

Insulated doors can pivot at about the center point or slightly above it or be hinged to swing in or out (Fig. 16). Pivot doors prohibit bird screens. A door that swings in may be an obstacle to movement in the alley. If the rear doors require manual control, an alley located along the rear wall provides more convenient access to the doors than may be possible from outside the building.

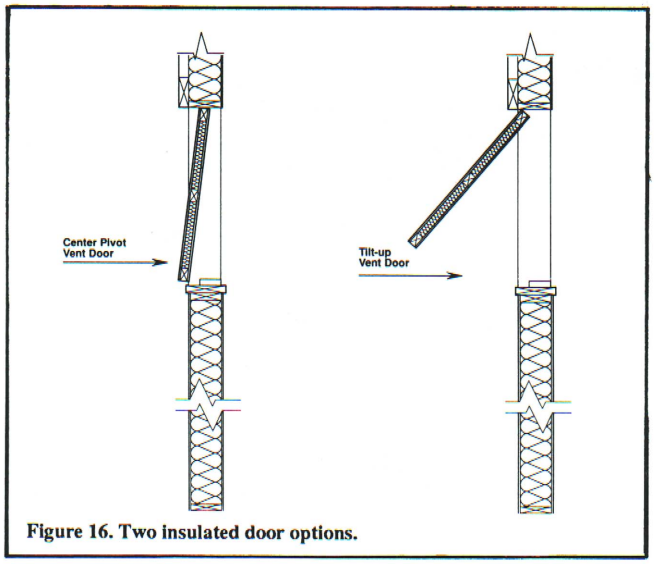

Figure 16. Two insulated door options.

Cover openings with 3/4 in. to 1 in. plastic mesh screen to keep birds out. The openings could frost over in very cold weather. Tapping the screen gently will usually free the opening.

Ridge or Chimney

The best air outlet for winter exhaust in a naturally ventilated gable roof building is through the ridge or a chimney that exits at or above the ridge. Three types of construction are being used. For milder or moderate climates, an open ridge with insulation under the roof seems practical (Fig. 5 and 8). In cold climates, a system that permits more insulation to be applied easily is a consideration (Fig. 9 and 10). The continuous center chimney building requires more labor to construct than a building that is insulated only under the roof but it allows for the use of loose-fill insulation over the flat or slightly sloped part of the ceiling. The square chimneys, spaced at regular intervals, (16 ft. to 20 ft.) allow the use of loose-fill insulation over nearly all of the ceiling.

During cold weather, when thermal buoyancy controls the ventilation, the exhaust area need not be very large. At high summer temperatures, there is little thermal buoyancy effect because of the small temperature difference between the inside and outside; the main force causing ventilation is the wind. With openings on both sides of the building, most of the air movement is across the building and a large opening at the ridge has only a minor effect.

A single slope roof building (MOF) (Fig. 6) uses the same ventilation principles. Curtains or doors are used for most ventilation control with a small, controlled opening at the upper part of the high wall for cold-weather exhaust control. For more information, see PIH-87, *Cooling Swine;* PIH-120, *Non-Mechanical Ventilation of MOF Swine Buildings;* and PIH-60, *Mechanical Ventilation of Swine Buildings.*

Fan Ventilation

A fan system provides the power to direct the air where it is needed to get proper distribution. Additional inlets may be needed depending upon the building width.

The incoming air is directed by the design of the inlet to a predetermined direction and location. With an exhaust system, the fan creates a negative pressure in the building, and air enters at planned inlets at a speed sufficient for mixing with the inside air before it reaches the pigs. The mixed and partially warmed air should not drop too quickly into the resting area.

In a positive pressure system, the fan blows into a duct system which is used to distribute the air evenly throughout the building.

Combinations of exhaust and pressure systems, sometimes called neutral pressure systems, use one fan on the inlet and another on the outlet.

Fan systems are more precise and can control ventilation to a greater degree than natural ventilation systems, but they require more electricity to operate. The large fans needed for summer ventilation can easily be automated, but require significant amounts of electricity to operate.

In colder climates some producers use fans in the winter to control humidity and odors and use natural ventilation for the remaining months of the year. To successfully ventilate with the winter fans, all openings except for the planned air inlets, must be closed when the fans are being used.

All-in/All-out Concept

One management option to reduce the risk of disease is the concept called all-in/all-out. The entire group of pigs in a room is removed so the room can be given a thorough cleaning before bringing in the new animals. Instead of the growing-finishing building being one large room, it is divided into smaller rooms. At a minimum, this would be divided into a growing room and a finishing room.

Depending on the frequency of farrowing, there might be a need for 4 or 5 rooms. Several rules of thumb have been suggested. One is to have no more than 300 pigs in a room. Another is to put no more than 2 wk. of production of pigs in a room. Careful planning is necessary when adopting this concept, because it requires more initial investment and more exact scheduling.

Summary

No one growing-finshing unit design fits the needs of all producers. When selecting a unit, consider the total system including such things as production efficiency, initial investment, climate, labor and management time available, manure handling, nearness of neighbors and your cropping system. Many farmers are keeping detailed records today and that is certainly providing much needed data in selecting facilities as well as keeping account of production and efficiency parameters. Even though a building may cost more initially, production efficiency can make it more cost-effective in the long run.

The type of unit your neighbor has, or a unit successful in another climate, may not fit your situation at all. Try to pick a unit that will work well for you.