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Planning a Central Farrowing House

John E. Mentzer
Agricultural Engineering Department

Cooperative Extension Service, Purdue University, Lafayette, Indiana
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GENERAL

A new central farrowing house represents a large, long term capital investment. If this investment is to be an asset to the overall farm operation, the management of the entire farm must be considered in deriving the decision to build and in establishing the size of the enterprise. Farm management is beyond the scope of this publication; anyone wanting more information on this subject should contact the local County Extension Office.

Naturally the farrowing house is sized to fit the swine operation, but two aspects of size must be considered: the total number of sows to be farrowed and the number of farrowings per year.

It is difficult to use a building as efficiently as it appears to be theoretically possible. For disease control, the farrowing house should be thoroughly cleaned after each farrowing and left vacant at least for two weeks. If the breeding period extends over a three week period, the farrowing period will be of the same duration. The available nursery facilities will influence the weaning practices and the age at which the pigs may be removed from the farrowing unit.

A new central farrowing house will cost from $400 to $600 per sow to build and equip. The building must be used at least 4 times per year to justify this investment. Since the annual fixed cost is nearly constant, a greater number of farrowings would logically reduce the building cost per pig produced. However, since labor for farrowing during the planting and harvest seasons may not be available, good management on some crop farms may dictate not more than four uses per year.

FARROWING SCHEDULES

Six Farrowings per year—2 month cycle

If a 2 month farrowing cycle is adopted with a three week breeding period and the farrowing house is to be vacant for two weeks between farrowings, the sows and pigs must leave the building 6 weeks after the farrowing begins. The pigs may vary in age from 3 to 6 weeks, and a nursery for pigs of 3 weeks of age must be available. The nursery may either accommodate the sows and pigs or pigs only in the case of early weaning. If the nursery facilities will accommodate pigs 2 to 3 weeks of age, it is possible to use approximately 15 per cent of the farrowing stalls twice during the farrowing period. Breeding should be confined to a 3 week period to avoid continuous farrowing and allow the building to be vacant for a couple of weeks between farrowings.

4 Farrowings per year—3 month cycle

If a 3 month farrowing cycle is practiced, the pigs will vary from 6 to 10 weeks of age by the time the farrowing house must be vacated. The farrowing house may be used as a nursery, but additional nursery facilities will permit double use of some of the farrowing stalls. The breeding season may be extended slightly with this schedule.

4 Farrowings per year — 2 month and 4 month cycle

This concept simply drops two farrowings per year during the spring and fall from the six farrowings per year schedule. This gives a two month interval between farrowings during the winter and summer and a four month interval
during the planting and harvest season. This schedule seems to fit crop farms well since it minimizes farrowing house labor demands during the peak labor seasons for crops. Nursery facilities are required; but if these facilities are properly designed, they will reduce the capacity needed for finishing the animals.

8 Farrowings Per Year—6 week cycle

This is a very tight schedule that could easily result in continuous farrowing. If a three week breeding period were used and the building were to be vacant for two weeks, some of the pigs would have to leave the farrowing house at one week of age. It is obvious that some modifications in management and facilities must be made for this schedule. By using two farrowing units, the breeding period is essentially reduced for each unit. A nursery is required, and one farrowing stall is provided for each sow. Each of the units would operate on the 6 week cycle, but one of the units would lag behind the other unit by a week and a half or one half of the breeding period.

BUILDING SIZE

A central farrowing house appears to be justified for operations of 24 or more sows. From this minimum size of 24 sows, the operation may increase to the limit of labor and management. The most efficiencies of size in construction have been gained with a building capacity of 30 farrowing stalls. For small operations, portable housing systems seem to be more economical.

It is logical to build multiple units for large farrowing houses, but two or more units may be constructed under the same roof and divided with a permanent wall. An area between the units may also be made into a convenient utility room. A system of multiple units permits the sows to be divided into groups according to farrowing date, making it possible to more accurately schedule the use of the farrowing house.

Centralization with portable Buildings

Portable buildings are more economical for small producers and for farrowing less than 4 times per year. However, some aspects of centralization with portable buildings can reduce labor and eliminate drudgery. By locating port-

able houses on a conveniently placed concrete slab, many of the chores can be done more efficiently, and mud can be eliminated during inclement weather. Slotted floors have effectively been used with individual houses. By constructing a slotted floor pen (porch) in front of the individual house, daily cleaning of the pen is eliminated. The manure from under the floor is handled with a tractor scoop when the houses and pens are moved from the site after farrowing. During warm weather, flies and odors can be a problem with this arrangement.

Pens vs. Stalls

Most aspects of farrowing stalls with conventional concrete floors appear to be equal to or slightly better than pens. Farrowing stalls are compatible with slotted floors, and most new farrowing houses are being equipped with farrowing stalls.

Most farrowing stalls are 5 feet x 7 feet, but some are longer. The feeder and water of some extend past the front of the stall. Equipment should be selected before plans for the farrowing house are established so that the alley dimensions can be adjusted accordingly. The center alley should have a clearance of 4 feet. The outer alleys may vary according to their functions. If carts are to be used for conveying manure or feed through the alleys, the alley should be from 3 to 4 feet wide. If a head-to-head arrangement, as in the case of slotted floors, the outer alleys would be used primarily for observation and handling animals, and a clearance of 30 to 36 inches would be sufficient but could be reduced slightly if the space is critical.

Inside or Outside Feeding

With conventional concrete floors, there seems to be little difference whether the sows are fed in the stalls or outside; slightly less time is required to feed in the stalls, but additional equipment for feeding inside increases slightly the initial investment.

In the past, outside feeding has been practiced because the sow would carry most of her manure outside reducing the task of cleaning. It was also felt that the exercise was beneficial to the sow and that the sows could establish their peck order before they were grouped in the nursery with their pigs. However, research has not shown
that the exercise or opportunity to establish peck order are of significant value.

Feeding outside is still an acceptable system with conventional floors (See Figure 1). Some producers have disliked the system because of the time involved, and the problem of getting the right sow in the right stall. Returning sows to the stalls can be simplified if the sows are handled in small groups; and if other chores are to be done while the sows are feeding, the time is not as important.

SLOTTED FLOORS VS. CONVENTIONAL CONCRETE FLOORS

With proper design and construction there is no significant difference in animal performance between slotted floors and conventional concrete floors. Excessive death losses and injuries have occurred on poorly designed slotted floors. Drier conditions can be maintained for the pigs on slotted floors which should improve animal performance, but research has not proven this to be significant.

The slotted floors will separate the manure from the animals, but the method of handling the manure after it passes through the slotted floor will determine whether slotted floors are an improvement. Liquid manure systems are normally used in conjunction with slotted floor systems and have been working reasonably well when managed correctly. The amount of manure produced in a farrowing house is relatively small and frequent hauling is not required if the storage pits have a reasonable capacity. This lets the operator schedule manure hauling according to work load.

The building layout as shown in Figure 3 can be used either for slotted floors or conventional floor systems, and a conventional concrete floor system of this type can be converted to slotted floors.

When practicing inside feeding on concrete floors, tail-to-tail arrangement will simplify the manure handling and is normally used. When using slotted floors, manure handling is not a major problem; and a head-to-head arrangement simplifies feeding and is preferable. However, some slotted floor and pit arrangements dictate a tail-to-tail orientation. The head-to-head arrangement permits the sows to be handled in separate groups when feeding outside.

The costs of slotted floors are variable and difficult to precisely estimate, but $100 per sow appears to be realistic. Research indicates that man time for farrowing may be reduced by approximately 30 per cent or about 1 to 1.5 hours per litter by the use of slotted floors. The economic feasibility of slotted floors will depend on the number of uses per year, the initial cost, the amount of labor saved and the price of labor. Table 1 has been developed to help each producer make an economic evaluation of slotted floors.

Table 1. Estimated use cost of slotted floors for farrowing

<table>
<thead>
<tr>
<th>Initial Cost per Sow</th>
<th>Annual Costs per Sow</th>
<th>2 Farrowings per Year</th>
<th>4 Farrowings per Year</th>
<th>6 Farrowings per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ 50</td>
<td>$10</td>
<td>$5.00</td>
<td>$2.50</td>
<td>$1.70</td>
</tr>
<tr>
<td>100</td>
<td>20</td>
<td>10.00</td>
<td>5.00</td>
<td>3.40</td>
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<tr>
<td>150</td>
<td>30</td>
<td>15.00</td>
<td>7.50</td>
<td>5.00</td>
</tr>
</tbody>
</table>

*Annual cost is estimated to be 20 per cent of new cost.

ALLEY ARRANGEMENT

Figure 1 is an example of a single alley layout which makes efficient use of building space and is suitable for feeding the sows on the outside slab twice daily. Since it is difficult to get to the front of the sows, it would normally not be used for feeding and watering the sows in the stalls.

The use of slotted floors can greatly reduce the time required for cleaning of the stalls and completely eliminate the main purpose for feeding outside.

When practicing outside feeding, a single alley between two rows of stalls is sufficient; but when feeding inside, it is desirable to have access to both ends of the farrowing stall. Some single alley farrowing houses have been converted to slotted floors with the sows head to head, and the sows are backed into the stalls. Since cleaning would be extremely difficult, this technique should not be used for solid floor systems.

Figure 2 is an example of a cross alley arrangement which is very convenient for feeding the sows outside. Each row of sows is handled
Figure 1. Farrowing house with enter alley and outside feeding

Figure 2. Cross alley farrowing house

Figure 3. A three alley farrowing house

as a small group simplifying sow handling. The sows should be grouped in sections to the sows within a group farrow as nearly as possible at the same time.

This building (Figure 2) may be extended in units of 18 feet or 8 farrowing stalls. It is necessary to drop one stall from the interior rows for the rear alley.

A section of a building such as Figure 2 may be used for nursery by converting the rear stall in each section to a creep, removing the other farrowing stalls, and extending a divider through the alley from the outside fence. This arrangement has frequently been suitable for converting existing buildings to farrowing houses.

A three alley arrangement (see Figure 3) does not use building space as efficiently as a single alley layout, but provides the operator with access to both ends of the farrowing stalls for feeding inside and permits easier handling of the sows for outside feeding. Feeding slabs may be constructed on one or both ends of the building. Even when feeding inside, a slab at one end of the building is convenient for holding sows before farrowing.

Concrete Floors

The floor in a farrowing stall should be sloped to drain the liquids from the stall in the most direct route possible and prevent pooling of the liquids in the stall. Where alleys are at both ends of the stall, it is logical to use a double slope floor (see Figure 4). Never have the floors slope crosswise of the stalls. When there is only a single alley along the rear of the stall, the floor is sloped in the direction of the alley (see Figure 5).

If the sows are fed and watered in the stall or the pigs are kept in the stall for several weeks
after farrowing, the single slope does not work well because the spilled water and urine produced in the front of the stall must drain through the length of the stall. It is possible to install a drainage system along the front of the stall when there is no front alley, but these drainage systems are frequently stopped, if bedding is used, and can be difficult to clean.

A curb from 1 inch to 5 inches high along the edge of the alley prevents pooling of the liquids in the rear of the stall and manure from oozing into the stall when the alleys are scraped. A crown in the alley runs the liquids along the edge of the alley by the curb and not in the center of the alley where the operator walks. The alley should be sloped about 1/8 inch per foot to a drain or to the outside.

Some problems have been encountered in farrowing stalls with pigs skinning their knees while nursing on concrete floors that are not bedded. Although an extremely slick surface is not desirable, the area where the pigs nurse should have a steel trowel finish. A light treatment with a steel trowel should eliminate the gritty wood float finish but not make the floor extremely slick. The remainder of the concrete floor should be finished with a wood float. All concrete should be proportioned, placed, finished and cured according to accepted concrete standards.

**Partially slotted or fully slotted floor**

With the sow essentially in a straight jacket, the location of the manure is fairly well defined at the rear of the stalls. Unfortunately, the pigs are not this easily controlled, but generally they seem to eliminate wastes in the front of the stall. Also, spillage and overflow from the waterer will occur in the front of the stall. One approach to slotted floors is to slot the entire area and all wastes can pass into the pit. Another approach is to use a slotted area along the front and rear of the stalls which are the most common areas where waste accumulates. In some cases, the front section of slats maybe omitted, but the floor should be sloped to the front.

Both the partially and fully slotted systems have been employed with favorable results by swine producers in Indiana (Figure 6). Bedding is eliminated in both systems and some type of correction in environmental control must be substituted for the elimination of bedding. Drafts are not necessarily induced by slotted floors, but if uncontrolled air movement does occur on the floor, drafts could be more of a problem on the slotted areas. The partially slotted floor does provide a solid section for the pigs to lie. Underfloor heat can be employed with some types of partially slotted floors to compensate for the bedding, but this does not seem to be practical with fully slotted floors.

When weaning at 4 to 6 weeks, manure may build up on the solid area of the partially slotted floors.

**Slat Materials**

**Concrete:** Concrete slats are dimensionally stable and easily cleaned and have a long service life, but concrete is more expensive than wood. Concrete slats may either be homemade or purchased precast. When making homemade slats with ready mix concrete, specify the following: 7.5 bag mix with a slump of 2 to 3 inches, maximum aggregate size of 1/2 inch and a 28 day test strength of at least 3500 pounds per square inch. The steel should be located accurately in the forms and the concrete should be vibrated as placed. Crown the top surface slightly (Figure 7).

**Wood:** Wood is inexpensive, easy to obtain and install, has a tendency to warp, is difficult to thoroughly clean, and has a relatively short service life. Oak or hickory slats should last four or five years in a farrowing house. Excessive warping of the slats causes a variation of crack width creating a very effective "pig foot catcher." Warping can be maintained within acceptable limits by fastening the slats securely to supports not more than 2 feet apart. Warping will not be as serious if seasoned lumber is used (Figure 8).

**Steel:** In addition to various types of steel slats, quarry screen and flattened, expanded steel mesh (1/4 inch, 9 gage with smooth upper face) have been used. The quarry screen and steel mesh have worked exceptionally well in partially slotted floor arrangements, but corrosion has been a serious problem with steel.

**Slat Width and Spacing**

There are two approaches to the design of slotted floors. One is to use a slot narrower (3/8 inch) than a pig's foot. Since the pig may step on any part of the slotted floor system with the narrow slots, the slot width is not critical. However, quarry screen and narrow slats are normally used only at the front and rear of a farrowing stall with wide slats or a solid section under the sow.
Another concept of slotted floors employs a \( \frac{3}{4} \) inch slot which is wider than a pig’s foot. Although a pig may get his foot in this size slot, it does not become fast and can be withdrawn. This approach forces the pig to walk on the slats and requires the use of a wide slot, 4 inches to 5 inches wide. For a couple of days immediately after farrowing, baby pigs may get two or more legs in a wide slot and be unable to move. Therefore wide slots are ordinarily restricted in use to the rear and front of the farrowing stall, and the area behind the sow is covered for a couple of days after farrowing (Figure 16).

Do not use slot widths between \( \frac{3}{8} \) inch and \( \frac{3}{4} \) inch for farrowing. This range of slot widths will permit a pig’s foot to enter and become fast.

Wide slots will not become clogged as quickly as narrow slots. The sow’s manure will not work through a slotted floor system until the pigs become active, and provisions for scraping the sow manure into the pit should be made (Figure 17).

The most common slotted floor systems are illustrated in Figures 6 through 15. In general for fully slotted floor systems, wide slats with narrow slots (\( \frac{3}{8} \) inch) are used, but \( \frac{3}{4} \) inch slots may be used behind the sow (Figure 15a).

Partially slotted systems generally use either wide slats with wide slots, \( \frac{3}{4} \) inch, or a combination of narrow slots and narrow slats. Quarry screen or flattened expanded metal has worked very effectively in partially slotted arrangements.

### Alleys, Floors and Floor Level

Ordinarily in new construction the alleys are slightly above grade level and near the level of the slotted floors, but the elevation of the alleys may vary with respect to the slotted floors. When remodeling, it is sometimes more economical to build the pit on an existing floor, elevating the sows (Figure 9). The alley may be at the existing floor level if head clearance is critical.

If the slotted floors are more than approximately 12 inches above the alley at the rear of the stalls, a portable ramp is required for getting the sows in the stalls. Farmers report the sows cooperate better than would be expected and that the arrangement is satisfactory.

Either a fully slotted floor using concrete slats (Figure 15a and 15b) can be used with this pit or a partially slotted floor (Figure 15c) which is supported on wood joists. A pit such as this would have approximately 50 days storage per foot of depth, neglecting spilled water from the foun-

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**Figure 6. Slotted floor system in use**

**Figure 7. Cross section of a concrete slat**

<table>
<thead>
<tr>
<th>Length</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>Reinforcing Bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>4’</td>
<td>4’</td>
<td>3 1/2”</td>
<td>3”</td>
<td>No. 3 (3/8”)</td>
</tr>
<tr>
<td>6’</td>
<td>4’</td>
<td>4”</td>
<td>3”</td>
<td>No. 3 (3/8”)</td>
</tr>
<tr>
<td>8’</td>
<td>5”</td>
<td>4 1/2”</td>
<td>3”</td>
<td>No. 4 (1/2”)</td>
</tr>
<tr>
<td>10’</td>
<td>5”</td>
<td>4 1/2”</td>
<td>3”</td>
<td>No. 5 (5/8”)</td>
</tr>
</tbody>
</table>

**Figure 8. Cross section of a wooden slat**

<table>
<thead>
<tr>
<th>Length</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>4’</td>
<td>2”</td>
<td>2 1/2”</td>
<td>1 3/4”</td>
</tr>
<tr>
<td>6’</td>
<td>2 1/2”</td>
<td>3”</td>
<td>2”</td>
</tr>
<tr>
<td>8’</td>
<td>3”</td>
<td>3 1/2”</td>
<td>2 1/4”</td>
</tr>
<tr>
<td>10’</td>
<td>3 1/2”</td>
<td>4”</td>
<td>2 1/2”</td>
</tr>
</tbody>
</table>

Maximum span of a rough 2” x 4” flat is 6’.
Maximum span of a dressed 1” x 2” flat is 1 1/2’.
tains. If the waterers run over, the storage time would be substantially reduced. A depth from 24 inches to 36 inches provides adequate storage and appears to be practical under most conditions.

A single pit for two rows of sows reduces construction costs. Normally standard 8 inch concrete slats are used, but it is possible to support other flooring systems on beams spanning the pit (Figure 10).

A partially slotted arrangement that may be applicable for remodeling is shown in Figure 11. Manure can be scraped or flushed easily from the building (Figure 11). In a partially slotted floor system either section of slotted floor can be used at the front of the sow or a solid concrete floor can be sloped to the front of the stall (Figure 12). Both should be connected to a large pit with tile. The outlet of the tile should be above the liquid level in the large pit. Slotted floor over a small pit should be easily removed for the cleaning of the pit.

**Manure Handling**

When solid floor systems are used, the manure is generally handled as a solid with conventional manure handling equipment, and the manure is spread on agricultural land for disposal.

Most slotted floor operations have adopted liquid manure systems for handling the manure. The manure, urine and water collected in a pit beneath the slotted floors is generally a fluid of pumpable consistency. The pit should have at least enough capacity for storing the manure during one farrowing cycle. About five gallons of manure, urine, and waste water is produced per sow per day. This allows for some waste water, but excessive losses from the fountain can drastically increase the total liquid production.

The pit floor should be relatively flat, the slope should not exceed 6 inches per 100 feet. This minimizes the water needed to provide a liquid cover for the manure to reduce odors, control flies, and improve pumping. The bottom of the pit should be covered with water before being used.

Although not highly profitable, spreading the manure on agricultural land still seems to be one of the most satisfactory methods of manure disposal. Lagoons have been used; some have been satisfactory, but others have created serious odor and neighbor problems.

Most producers use a vacuum tank for pumping, hauling and spreading the manure.
ENVIRONMENTAL CONTROL

General

The control of environment is most critical at farrowing time. As animals age, they rapidly gain the ability to adjust to wider variations in environment. A farrowing house should be equipped for better control of environment than other hog buildings.

Frequently and erroneously temperature is used as the sole indicator of environment. Although temperature is an important factor, humidity and air velocity should not be neglected. The baby pig needs a relatively warm, draft free, dry environment; the sow should have a somewhat cooler environment. Therefore, a farrowing house should be designed and equipped to control temperature, humidity and drafts within practical limits and, when possible, two different environments should be created: one for the sow and one for the pigs.

Temperature

Winter-Heating

It is difficult to state a specific optimum temperature for a farrowing house because the optimum temperature will depend on the management practices, floor system, et cetera. Generally a temperature of from 50-60°F seems to be satisfactory, but it may be necessary to adjust these slightly according to specific circumstances.

Since bedding serves as a partial cover for the pigs and an insulator between the pigs and the floor, the farrowing house may be slightly cooler if bedding is used. If fully slotted floors are employed eliminating the underfloor heat and bedding, it could be necessary to maintain a slightly higher temperature depending on the level of radiant heat used in the creep.

During winter operations, it is relatively simple to create two different environments for the pigs and the sow. Ordinarily the air temperature is maintained near the optimum for the sow, and infra-red heat and/or underfloor heat is added to the creep areas for the pigs only. Supplemental heat also attracts the pigs away from the sow reducing the possibility of overlay.

Space Heat—Some form of space heat is normally required to maintain the desired air temperature in the building. It makes little difference what type heating system is employed for this role as long as it accomplishes its purpose (Figure 18). Although relatively crude stoves and furnaces have been used satisfactorily, it seems desirable to use an automatically controlled system with a reasonably good air distribution
system. An air duct system is generally not necessary for air distribution, but the heater should have a fan for circulating the air. In large buildings, more than one heater may be employed to give acceptable distribution. In a tight, well-constructed, and well-insulated building, space heaters should have approximately 3000 BTU/hour rating for each sow capacity.

Creep Heat or Supplemental Heat—Ideally heat should be provided above and below the baby pigs in the creep area, but the use of both floor heat and overhead infra-red heat increases the installation and operation costs. Overhead infra-red heat is frequently the sole source of creep heat with satisfactory results. If underfloor heat is used, infra-red heat should also be used, but the infra-red heat should be turned off after the pigs are a few days old. A heat lamp is commonly used at the rear of the sow at farrowing time, supplying heat for the pig when needed most (Figure 19).

One 250 watt heat lamp with bedding has long been the standard used for the creep area in the farrowing house which was maintained at approximately 50°F. When no bedding and no underfloor heat is employed, it could be advantageous to either increase the building air temperature above 50°F or increase the level of radiant heat in the creep area.

As the pigs age, the level of heat can be reduced, but the pigs should not be subjected to a rapid change in environment. If the pigs are to be moved to an open front nursery or finishing building, from the farrowing house, the temperature in the farrowing house including creep heat should be gradually reduced to that of the outside conditions.

Either electric heating cable or hot water can be used for floor heat. In both cases, the heat level should be sufficient to maintain a slab temperature of approximately 85°F. The temperature can be reduced gradually to approximately 70°F when the pigs are 3 weeks of age.

**Summer Temperature Control**

A hot climate (85°F or above) surrounding the sow during farrowing can seriously affect the performance and health of the sow because it retards the dissipation or loss of body heat. Since mechanical air conditioning does not appear to be practical, little can be done to control the temperature, but some improvement in environment can be achieved by controlling air movement and wetting the animals. Because of the young pigs, wet conditions are undesirable in the far-
rowing house, and spraying the sows is generally not encouraged. However, in extremely hot conditions it could be effective as an emergency device.

There is a wide fluctuation of temperatures during summer farrowing. A rapid drop in temperature can contribute to chilling of the pigs even during the summer particularly if there are drafts. During the cooler summer conditions, it may be necessary to use some supplemental heat. This is an advantage since the heat attracts the pigs away from the sow and reduces the overlay problem. It is important to reduce the ventilation rate and protect the pigs from drafts as the temperature drops.

Ventilation

A reliable system for winter and summer ventilation are essential for successful operation of a farrowing house. Since ventilation is an integral part of the farrowing house, it should be planned as part of the building. The primary purpose of ventilation during the winter is the control of moisture and during the summer the control of temperature. While performing these primary functions, the ventilation system will also provide fresh air and help control odors.

For further information obtain AE-63 from your Extension Agent.

Winter

A sow and litter of pigs will produce approximately 1 pound of water vapor per hour. Although this does not sound large, this rate of moisture production will release 60 gallons of water vapor per day in a 20 sow farrowing house. Failure to properly control the moisture in a farrowing house can contribute both directly and indirectly to disease problems and rapid deterioration of the building.

Ventilation was not as serious a problem in older buildings as in newer ones because the older structures normally had a lower animal density and were not as tightly constructed and therefore let the moisture escape.

The best known system for controlling the moisture in a livestock building during winter operation is ventilation. The basic concept of ventilation is relatively simple: as cold dry air enters the building a like volume of warm moist air is discharged from the building (Figure 20). As the entering air is warmed, its moisture holding capacity is increased and the air that is exhausted from the building retains more moisture than the entering air. Note: heat is required to warm the incoming air.

The moisture contained by the incoming air will vary with the temperature of the incoming air. Colder incoming air has a greater net capacity for moisture when it is heated to inside conditions and exhausted from the building. Lower rates of ventilation are needed at lower temperatures, but greater amounts of heat are required. As the incoming air temperatures rise, a greater amount of air must be moved through the building, but less heat is required.

The amount of moisture produced in a farrowing house depends on the number and size of the animals housed. The amount of air needed to remove a specific amount of moisture depends on the condition of the incoming air and the departing air. Since these factors are continually changing, the rate of air movement for the removal of moisture is also variable. Generally, fans are selected for the maximum air needs, assuming the house is full, and operated intermittently when less ventilation is needed. For winter ventilation the fans should have a capacity of approximately 75 CFM (cubic feet of air per minute) per sow and litter.
10 MIN. INTERVAL TIMER

ATTIC INLET SYSTEM

Figure 22. Ten minute interval timer

Figure 23. Attic inlet system

Excessive ventilation rates can cause drafts and wide fluctuations in temperature, and insufficient ventilation will permit a moisture build-up causing condensation on the floors, ceiling, and walls. Some producers who have used large summer fans for winter ventilation have a much greater capacity than needed for winter ventilation and have encountered serious problems.

Ideally, the ventilation rate would be continuously adjusted to the rate of moisture production and the conditions of the air, but this is difficult and expensive to accomplish. A reasonable degree of control can be obtained with relatively simple economical devices.

Logically, one would try to control the fans so as to control the moisture by using a humidity sensing device, such as a humidistat. However, humidists have not proven satisfactory in livestock shelters. The hair sensing element contained in humidists is not accurate after it becomes coated with dust. Therefore, it is necessary to resort to thermostats and 10 minute interval timers to control the fans.

For best control, two or more fans should be used, depending on the size of the farrowing house. It is possible to use a fan with two delivery rates in lieu of two fans. When using two fans, one should be rated at approximately 33 per cent of the total desired capacity. The other fan or fans will provide the remainder of the capacity.

One fan having approximately 33 per cent of the desired ventilation capacity will be operated practically continuously when controlled with a thermostat (See Figure 21). This fan will only

be shut off when the temperature drops drastically under the desired operating temperature.

The other fan (or fans) will be turned on as the need is indicated by a thermostat or by a 10 minute interval timer (Figure 22). Control of this fan with a thermostat is not adequate, since the heater thermostat will likely be set close to the temperature of the fan thermostat. If the fan thermostat is set below the heater thermostat, the heater and the fan may operate continually. If the fan thermostat is above the heater thermostat, the fan may not run at all during the cold weather. The 10 minute interval timer wired in parallel with the thermostat permits the operator to manually adjust the fan to ventilation needs of the house regardless of the temperature as well as retaining thermostatic control.

It is difficult to state the specific humidity at which a farrowing house should be maintained. Generally, humidities in the range of 70 per cent seem to be satisfactory and maintain relatively dry conditions. Since it is difficult to accurately measure relative humidity, most swine producers should use their good judgment and adjust the controls to create relatively dry conditions in the house.

Air Distribution

There are various ventilation systems differing mainly in the method of forcing the air through the building. There are basically two categories of mechanical ventilation: exhaust and pressure systems, and there are several variations of each category.

Although there are many systems that will do a satisfactory job, the “Attic Inlet System” illustrated in Figure 23 is a very common system and has worked well in livestock buildings. This system does require a ceiling in the building.

A good ventilation system should move the correct amount of air and distribute it uniformly.
throughout the building. Improper distribution of the air can create drafts in some areas and dead spots in other areas. The incoming air should not be permitted to fall directly to the floor upon entrance of the building. It is sometimes necessary to baffle the air inlets to deflect the incoming air upward. The cold air will then mix with the warmer air before it gets to the floor.

The installation of solid partitions in the pig creeps and at the ends of farrowing stalls will help to reduce the floor drafts on the baby pigs.

**Summer Ventilation**

The heat produced by the animals in an enclosed building tends to increase the air temperature. During cold weather it is important to conserve the animal heat to help maintain a warm building, but during the summer this increase in temperature could be disastrous. Summer ventilation is designed to remove the animal heat from the building and prevent a temperature rise. Also, air movement by the animals improves the animals ability to dissipate heat from the body making them feel more comfortable.

Natural or mechanical ventilation can be used for summer ventilation. Natural air movement is relatively effective during most of the summer, but there can be periods when there is no air movement. For natural summer ventilation, large openings (4 feet x 2 feet — 8 feet on center, 36 inch above floor level) on each side of the building permits good natural air movement through the building. The openings should be equipped with insulated doors for winter operation.

If natural ventilation is employed during the summer, some auxiliary circulating fans should be available in case the wind is not blowing during hot weather.

During cooler periods, drafts on the pigs are undesirable, and some means of controlling the ventilation as the weather changes is necessary. Control of natural ventilation consists of adjusting the ventilation doors. This is normally a manual operation, but a few producers have devised a cable control system for the ventilation doors.

**Mechanical Ventilation**

A mechanical ventilation system should be designed to change the air in the building 30 to 60 times per hour, or 1 air change per 1 to 2 minutes. For 60 air changes per hour, the fan capacity in CFM (cubic feet of air per minute) is equal to the volume of the building in cubic feet. Fan capacity for 30 air changes per hour would be half the volume. Generally two or more fans are used to deliver the desired capacity since better distribution of the air is obtained with multiple fan arrangements. Although exhaust systems can be used for summer ventilation, pressure fans blowing in seem to be slightly preferable.

If mechanical ventilation is used for the primary ventilation system, an emergency system of natural ventilation should be available in case of power or fan failure. The fans can be easily controlled with thermostats.

If the attic air inlet system is used during the winter, the crack from the attic should be closed during the summer.

**Insulation**

Insulation in a farrowing house performs 3 functions: conserves heat during winter operation, reduces heat gain during the summer, and reduces the possibility of condensation during winter operation. The conservation of heat during winter operation reduces the heat bill. The importance of insulation for this purpose is readily apparent.

The other roles of insulation are not as well recognized but are important. Since the inside surface of an insulated wall is warmer than an uninsulated wall, condensation is less apt to occur on an insulated wall. Condensation occurs on a surface that is colder than dew point. Since dew point of an air vapor mixture depends on the amount of moisture in the air, a combination of ventilation and insulation is necessary for the control of condensation.

The surface temperatures of a building exposed to solar radiation during the summer may rise as much as 50°F above the air temperature. Since the outside of the building is warmer than the inside, there is a movement of heat through the walls and ceiling into the building. The use of insulation retards this heat flow or heat gain, resulting in a cooler building.

A vapor barrier should be used on the inside, warm side of the insulation to prevent moisture migration which leads to condensation in the insulation and paint peeling on wooden siding.

Generally two inches in the sidewalls and three inches in the ceiling of good insulation is adequate for Indiana weather.