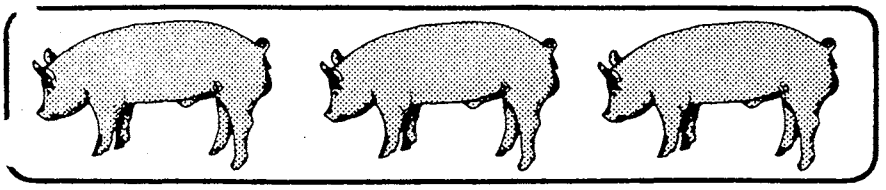
AGRICULTURAL EXTENSION SERVICE • UNIVERSITY OF MINNESOTA



Swine Update

VOLUME 1, NO. 4 APRIL 1983

IN THIS ISSUE:

Midwest Plan Service Swine Housing and Equipment Handbook

A newly revised Midwest Plan Service Swine Housing and Equipment Handbook (MWPS-8) has recently been sent to all County Extension Offices. This updated edition has been expanded to include layout designs for farrowing, nursery, growing, finishing, gestation and breeding facilities; as well as information on site selection, remodeling and combining buildings, cooling systems, natural ventilation, utilities, and grain feed centers. An excellent summary of design data is given on pages 3 and 4 which can be used to answer a majority of the common swine housing questions. Copies can be obtained by sending $5 plus $.30 tax to: Extension Agricultural Engineering, 201 Agricultural Engineering Building, University of Minnesota, St. Paul, MN 55108. Swine producers, building contractors, and other agricultural personnel working in the swine area will all find this publication a worthwhile investment.

Summer Ventilation and Cooling

Swine facilities are often poorly ventilated during periods of warm temperatures since most facilities are designed for cold weather operation. Swine producers tend to open a door or several windows in order to "get by" during a hot spell. Unfortunately, stress on hogs due to hot weather is much more common and more economically significant than losses during cold weather. These losses are often subtle reductions in feed intake which results in significant drops in production. Thus, it is important to correctly design and manage ventilation systems during warm temperatures and possibly consider cooling systems during extreme hot weather.

The first thing that one must consider in the design of a summer ventilation system is adequate air exchange. Ventilation rates for swine, on a per head basis, are given in Table 1. The hot weather ventilation rates, listed in Table 1 are based on the assumption that the inside temperature will be no more than approximately 3°F higher than outside conditions. In order to lower this to 1° or 2°F, the hot weather

ventilation rates would need to be roughly doubled. This small reduction in air temperature is probably not detectable by the animal and greater cooling effect would be realized by installing circulation fans rather than additional exhaust fans.

Table 1. Swine Ventilation Rates*

Animal Type	Weight lb	Cold Weather Rate	Mild Weather Rate	Hot Weather Rate
			cfm per head (additional = total)	
Sow and litter	400	20	+60 = 80	+170 = 250
Prenursery pig	12-30	2	+8 = 10	+15 = 25
Nursery pig	30-75	3	+12 = 15	+20 = 35
Growing pig	75-150	7	+17 = 24	+26 = 50
Finishing pig	150-220	10	+25 = 35	+50 = 85
Gestating sow	325	12	+28 = 40	+60 = 100
Boar	400	14	+36 = 50	+100 = 150

*Adopted from Table 7, page 34 of MWPS-8, 1983 edition.

Probably of more importance than quantity of airflow through a mechanical ventilation system in the summer is air distribution and velocity in a swine facility. To obtain an effective summer ventilation system, one needs air inlets evenly distributed throughout the barn to provide for good air mixing and correctly sized (1 sq. ft. for every 800 cfm's of fan capacity) to provide for adequate air velocities to aid in cooling. One should not open up large doors or windows during normal summer conditions when the exhaust fans are operating. This practice will reduce the vacuum or negative pressure in the building and air will no longer come in through the design air inlets at adequate air velocities to provide distribution and cooling. Only under extremely hot temperatures when the ventilation system fails to maintain acceptable conditions, should large openings be provided. During this time exhaust fans can be turned off and air circulation fans provided inside the room to provide air velocity over the animals. This may include such equipment as plastic air tubes, floor or ceiling-mounted circulation fans, or large diameter ceiling or "Casablanca" fans. Generally greater cooling will result by adding some type of air circulation system inside the room rather than adding more exhaust fans.

The maintenance of your fan ventilation equipment is important as we move from the cold to the warm weather season. The designed air inlets should be opened completely for summertime operation and checked for clogging either with insulation or debris. Rusted louvers or dirty shutters can restrict fan capacity by as much as 40 percent and should be lubricated with graphite. The small continuous running fan, although not a

major contributor to the total airflow rate, should have its shutters or louvers removed as they serve no purpose. One should also readjust thermostats on larger fans to assure that fans do indeed operate at the correct temperature limits.

Even with a properly designed summer ventilation system with additional air circulation fans, one still can realize reduced performance and possibly severe stress in sows, boars, or finishing hogs. Several cooling system techniques can be employed for use during the extremely hot conditions that do occur even in our northern climate. These include the addition of a sprinkler system inside a confinement facility, the use of an evaporative or "swamp" cooler, and the concept of zone cooling for crated animals.

Sprinklers

Sprinklers are the easiest and probably least expensive means of providing a cooling system in a confinement hog operation. In the design of a sprinkler system it is important to select non-corrosive nozzles which furnish a solid cone of water droplets and not a fog. The intent is to wet the animals then allow a period of time for them to dry. This allows for substantial cooling since a great deal of heat is removed during the evaporation process. Table 2 shows the water requirements and nozzle sizes for a sprinkler system while Table 3 lists the pipe sizes for different flow rates. Since a sprinkler system needs to wet the pigs for two to three minutes out of every hour, a control system similar to that shown in Figure 1 must be provided. One should provide a line strainer with a replaceable cartridge filter in the system to remove any sediment or foreign matter which would create a problem in the nozzles.

Table 2. Nozzle Sizes for Sprinkler System*

Pigs per Pen	Water Requirements (gal/hr)	Nozzle Sizes: Operating 2 min/10 min gal/min	gal/hr	Operating 1 min/30 min gal/min	gal/hr
10	0.2	0.017	1	0.10	6
20	0.4	0.033	2	0.20	12
30	0.6	0.050	3	0.30	18

*Taken from paper entitled "Summer Ventilation Requirements and Considerations" by L. Bynum Driggers and presented at the 1983 American Pork Congress.

Table 3. Water Line Sizes for Sprinkler Systems*

Pipe Size, ID	Class 160 PVC	Class 200 PVC	Schedule 40	Schedule 80
3/4"	7 gpm	6 gpm	4.5 gpm	3.5 gpm
1"	13 gpm	13 gpm	9 gpm	7 gpm
1 1/4"	25 gpm	23 gpm	18 gpm	15 gpm
1 1/2"	35 gpm	32 gpm	28 gpm	23 gpm
2"	55 gpm	55 gpm	50 gpm	45 gpm
2 1/2"	85 gpm	80 gpm	70 gpm	65 gpm

*Based on maximum pressure drop of 2 psi per 100 ft. or velocity less than 5 feet per second. Taken from paper entitled "Summer Ventilation Requirements and Considerations" by L. Bynum Briggers and presented at the 1983 American Pork Congress.

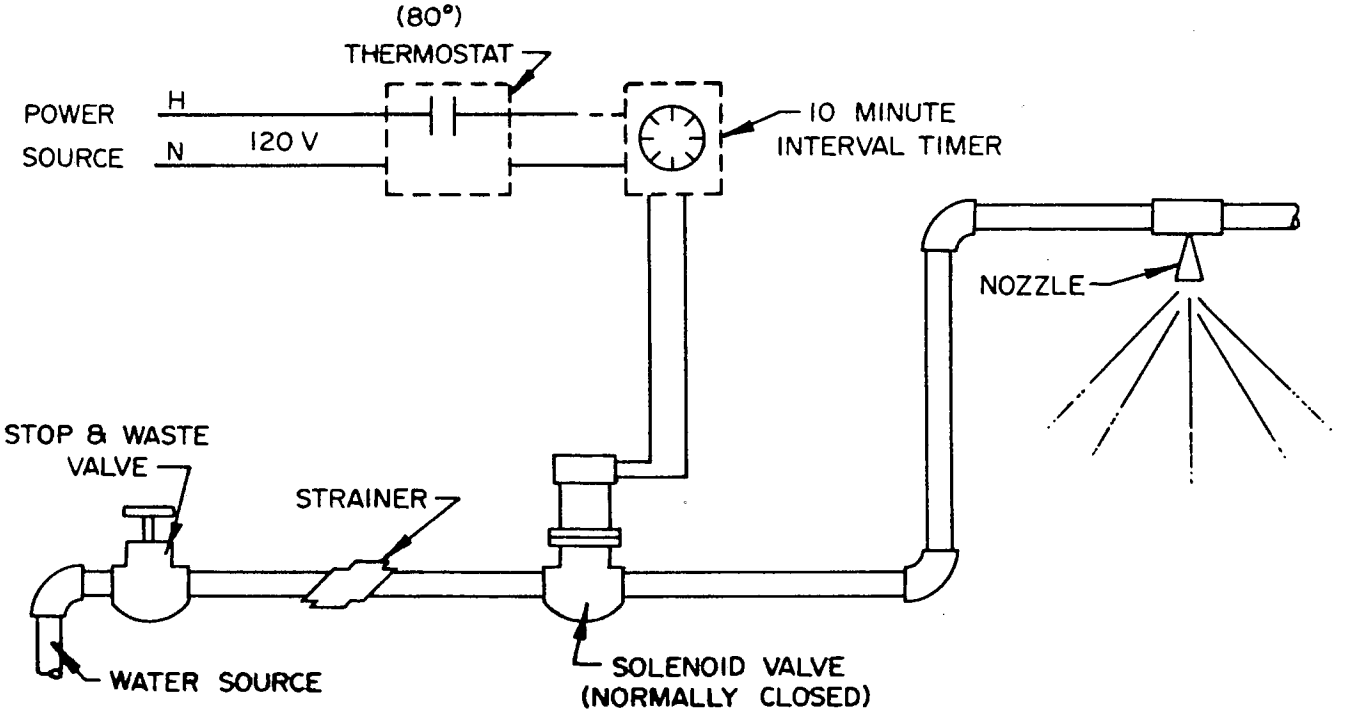


Figure 1. Control System for Sprinklers in Swine Buildings

Evaporative Coolers

Evaporative or "swamp" coolers use heat from the air to vaporize water which increases relative humidity but lowers the air temperature. Evaporative coolers are more effective in dry climates than in moist regions. However, even in areas that have high relative humidities, evaporative coolers may be effective during the hotter part of the day since generally at this time moisture levels are relatively low. The

effectiveness of evaporative coolers in Minnesota varies from a drop of nearly 10°F from the maximum July temperature in the southwest to 6°F in the northeast.

An evaporative cooler involves a fair amount of investment since it usually consists of some type of fibrous pad (generally cellulose) which has water dripping through it on a continuous basis (see Figure 2). Water is contained in a tank, equipped with a pump, to provide for continuous circulation. A filter is needed in the water circulation system to remove any debris that enters the system. Also, a copper sulfate solution is generally added to the water system to control algae buildup. Since water is constantly evaporated, salts and other impurities will buildup in the system, thus requiring either continuous or periodic flushing to remove any sediments.

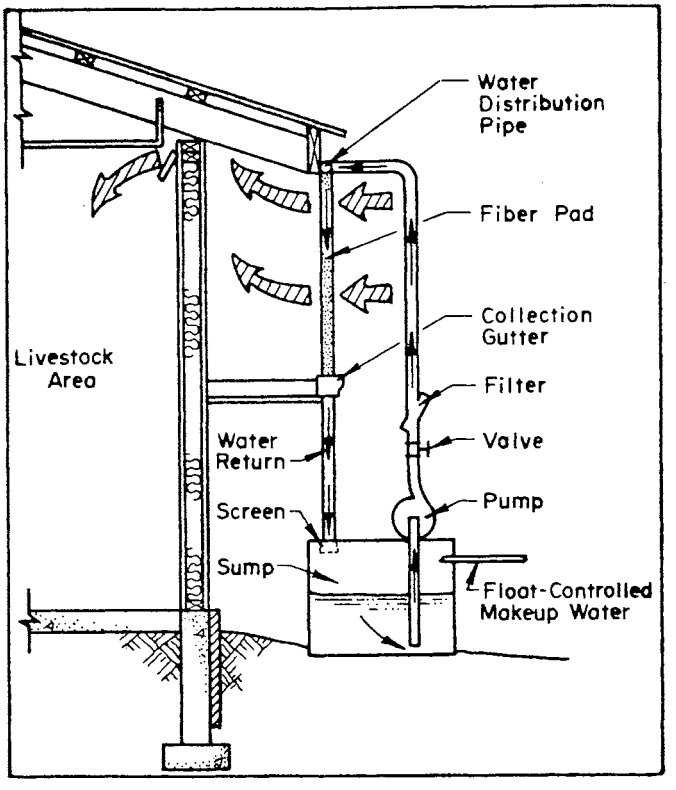


Figure 2. Evaporative Cooling System (taken from MWPS-8, 1983 edition).

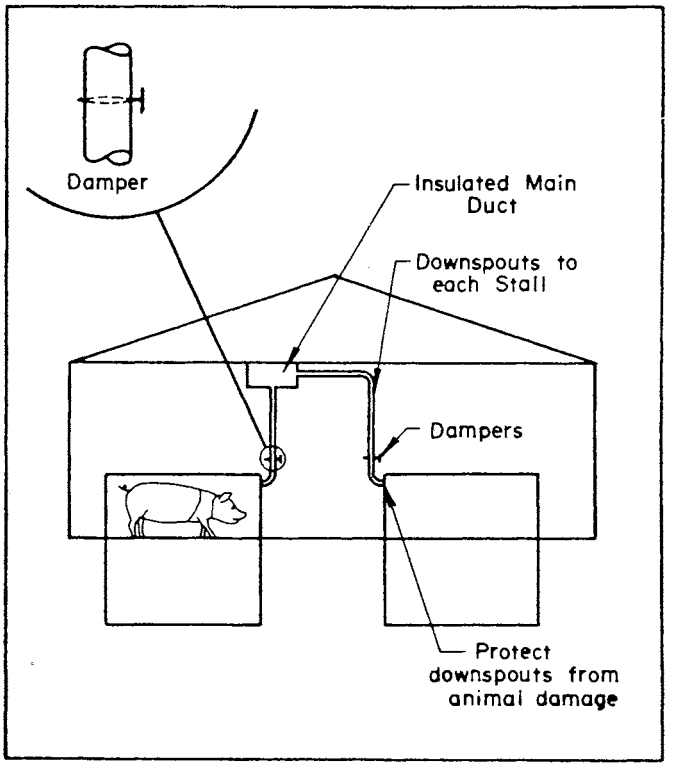


Figure 3. Zone Cooling System (taken from MWPS-8, 1983 edition).

Zone Cooling

Since a hog loses a majority of its heat by evaporation from its respiratory tract, a considerable cooling effect is realized by moving air over an animal's head. This is what zone cooling does for a sow in a farrowing or gestation stall. The design of a zone cooling system is shown in Figure 3.

The system consists of a main air duct with downspouts to the crated animals. One can move either uncooled, evaporatively cooled, or mechanically cooled air through ducts down to the animals. The amount of airflow per animal is given in Table 4 depending on the type of air used in the system.

Table 4. Airflow for Zone Cooling Swine*

	Airflow for:		
Type of Animal	Uncooled Air	Evaporative Cooled Air	Conditioned Air
Farrowing sow	70	40	36
Gestating sow	35	20	15
Boar	55	30	20

*Adopted from Table 15, page 49 of MWPS-8, 1983 edition.

Table 5 lists the downspout sizes for a zone cooling system that will provide an air velocity of 800 feet per minute (9 mph).

Table 5. Downspout Sizes for Zone Cooling*

Airflow	Area	Inside Dimensions	
cfm	sq. in.	WxH, in.	Diam, in.
10	1.8	1-1/2x1-1/2	1-1/2
15	2.7	1-3/4x1-3/4	2
20	3.6	2x2	2-1/2
25	4.5	2x2-1/4	1-1/2
30	5.4	2x2-3/4	3
35	6.3	2x3-1/4	3
40	7.2	2x3/4	3
45	8.1	3x2-3/4	4
50	9.0	3x3	4
55	9.9	2x3-1/2	4
60	10.8	3x3-3/4	4
65	11.7	3x4	4
70	12.6	3x4-1/4	4
75	13.5	3x4-1/2	4
100	18	4x4-1/2	6
125	22.5	4x5-3/4	6
150	27	4x6-3/4	6

*Adopted from Table 16, page 50 of MWPS-8, 1983 edition.

Water Quality Publication

A new Extension publication entitled "Water Quality for Livestock and Poultry" (Extension Folder 646) is presently available at your local County Extension Office. This publication, written by Roger E. Machmeier, Extension Agricultural Engineer, discusses the levels and effects of such drinking water contaminants as nitrates, sulfates, microorganisms and pesticides. It attempts to aid in the identification of the particular contaminant, gives you a relative idea of the various concentration levels which will cause a problem in swine, and offers some possible solutions to the problem. The publication also identifies other agencies and personnel (i.e., county health service or veterinarians) which can assist you in identifying and solving your water quality problems.

Hog Finishing Facilities

Over the past decade, there has been a concentrated effort into improving the design and performance of swine farrowing and nursery facilities. There has been a lack of emphasis into the design and management of growing and finishing facilities during this same period. This has resulted in both poor performance and higher than necessary mortality at this stage of production.

The design and management of growing and finishing swine facilities is getting a new look because of the growing interest in naturally ventilated buildings. A recent poll taken by the National Pork Producers Association indicated that over 30 percent of the hogs in the United States are now finished in some type of naturally ventilated facilities. This is not to say that growing and finishing facilities which are mechanically ventilated are obsolete. In Minnesota's northern climate, it is not recommended that pigs under 80 pounds be placed in a naturally ventilated facility during the winter months. Thus, if a swine producer buys feeder pigs on a year around basis, he would need a mechanically ventilated structure at least for the growing stage of production. If, on the other hand, a farrow to finish producer has the necessary facilities to get the pigs up to 80 pounds in the wintertime, a naturally ventilated facility may fit his situation very well.

Table 6 lists the three different types of housing which can be used in the growing and finishing stages. These include the environmentally controlled facilities, modified open front units, and open front shelters with an outside lot. For Minnesota conditions, the open front with outside lot has limited use and is generally not recommended. High labor requirements, especially during the winter months, is the major reason for its limited use. The modified open front, which is naturally ventilated, generally comes either in the gabled roof or monoslope design. Either system can be successfully managed although the gabled roof design will perform better under a wider range of temperature and wind conditions than the monoslope unit. It must be remembered that the modified open front system of either design requires a greater amount of management (i.e., opening and closing ventilation doors) than the mechanically ventilated units. As Table 6 points out, the mechanically ventilated system does have

a higher operating cost due mainly to the electrical cost of running ventilation fans. It has been observed that average yearly performance is similar for the environmentally controlled and the modified open front units.

Table 6. Finishing Building Types*

Summer performance of the three types is about the same. Approximate rank.

Building Type	Initial Cost	Winter Performance	Operating Cost	Labor Requirements
Environmentally controlled	Higher	Higher	Higher	Lower
Modified open-front	Lower to medium	Higher	Lower	Lower
Open-front outside lot	Lower	Lower	Lower	Higher

*Adopted from Table 2, page 20 of MWPS-8, 1983 edition.

No matter if the facility is mechanically ventilated or naturally ventilated, one should consider continuing the all-in all-out concept, which many producers are practicing in the farrowing and nursery facilities, into the growing and finishing stages of production. From the standpoint of facility design, this may mean dividing a finishing unit into two or three separate rooms rather than building one large area. Several facilities have been designed with these management practices in mind with resulting lower mortalities and better performance of the hogs. If feed costs can be reduced even slightly, it will represent significant savings, since feed is by far the largest expenditure in finishing market hogs.

Remodeling Existing Buildings for Swine Housing

Many existing farmstead buildings can be remodeled into successful swine facilities. Other times, however, the only benefit of remodeling is saving the cost of the building shell, which is a relatively small percentage of the total construction cost. Thus, it is necessary to first determine if a facility is economically worth remodeling.

Some of the decision factors to consider when deciding to remodel or not are location, structural soundness, physical size, and compatibility. One should never remodel a facility which is physically located on the other side of the farmstead from your other swine buildings or in a poorly drained area. The barn must have a good foundation, solid walls, and an adequate roof. One should not try to determine the size of a swine facility based on the available space in an existing building. If a larger swine facility is desired than what an existing structure can accommodate,

one should either build a new unit or look at other facilities. An existing structure should be compatible to what you want it to become after the remodeling process. In other words, an old machine shed works best for finishing or gestation since it is easy to modify to natural ventilation or light insulation. Likewise, old dairy barns are better adapted to conversion into farrowing and nursery units since mechanical ventilation and waste handling systems are easier to incorporate.

Once the decision is made to remodel the facility, one needs to consider the following items: layout, manure handling, insulation and ventilation. The arrangement of pens or stalls in a remodeled facility is an important consideration. One should avoid trying to squeeze in too many crates or pens which makes labor requirements excessively high compared to those designs where "extra" stalls were left out. Many times the arrangement of pens or placement of stalls is dictated by existing suppports or other physical limitations which makes efficient traffic patterns and complete use of all space difficult. Often how manure is handled in a remodeled swine facility dictates the amount of labor required to operate the facility. As a rule, it is not recommended that a pit be built in a facility due to the high cost and difficult construction techniques. Generally, either a gravity drain type system or scrape system is more adaptable to a remodeled facility. One should carefully check the insulation values of walls and ceilings to make sure that condensation does not occur on those surfaces during cold conditions. In all but finishing facilities one needs a minimal insulated wall in order to provide a dry surface in mechanically ventilated systems. In the remodeling of machine sheds or outside pole buildings into naturally ventilated swine units, it is generally recommended that the underside of the roof be insulated to prevent dripping. Finally, the ventilation of the remodeled facility needs careful consideration. It is best to approach the ventilation in a remodeled unit as you would in a new system. This would include the selection of an adequate number and capacity of fans as well as sufficient inlet area and location to give good distribution. One should add supplemental heat which will maintain a constant air temperature in the facility if it is a farrowing, nursery, or gestation facility with individual stalls.

Extension Folder 588 entitled, "Remodeling Ideas for Farrowing Facilities" is available at your County Extension Offices and discusses the points raised in this discussion. Further information on deciding if a facility should be remodeled is given in the Midwest Plan Servie Swine Handbook (MWPS-8).

Larry D. Jacobson

Prepared by Larry D. Jacobson, Extension Agricultural Engineer.