

Gestating Sows in Deep-bedded Hoop Structures

Mark S. Honeyman, associate professor of animal science;

Jay Harmon, assistant professor of agricultural and bio-system engineering;

Don Lay, assistant professor of animal science; and

Tom Richard, assistant professor of agricultural and bio-system engineering

ASL-R1496

Summary and Implications

A small demonstration sow herd has been housed during breeding and gestation in a deep-bedded hoop structure. Conception rates, number of pigs born alive, and birth weights were excellent. These results indicate that hoops provide a realistic alternative for housing gestating sows. A discussion of the decision considerations related to animal environment, sow behavior, bedding and manure, and feeding systems is included. Seven distinct floor plans are included. Hoop structures are a new, viable alternative housing system for gestating sows.

Introduction

During the past 2 years, hoop structures or hoops have become a popular alternative for housing finishing pigs in Iowa and the upper Midwest. The hoops, which originated in the prairie provinces of Canada, are low cost and easy to erect. They rely on the use of large amounts of bedding to absorb the pig feces and urine and also for the pig sleeping areas. Farmers who build hoops for pigs also are attracted because of the versatility of the structures. Many producers also are considering using hoops to house gestating sows. Iowa State University (ISU) has housed gestating sows in a hoop for more than 1 year at the ISU Armstrong Research and Demonstration Farm, Lewis, Iowa (Pottawattamie County).

Methods

Breeding and gestation phases are housed in a hoop structure (37 ft x 70 ft). The hoop structure is oriented north-south and consists of 6-ft wooden side walls and an arched tubular frame covered by a polyethylene cover or tarp. The structure is marketed by Cover-All,¹ Clarinda, Iowa, and was erected by the farm staff during fall 1995. The floor plan (Figure 1) includes lockable feeding stalls

with front access doors, a feeding and service alley, a deep bedded area for the group-housed sows, bedded boar pens nearby and pen partitions that could be raised and lowered to match the height of the bedding pack. The feeding stalls and energy-free waterers were placed on a raised (18 in.) concrete platform. A wooden observation deck was built along the outside of the north end of the structure to accommodate visitors. All floor areas of the hoop structure are concrete. Access for adding bedding is from the south end. The north end is closed in winter with a fabric curtain. The south end was partially closed in winter. Large, round bales of cornstalks are used for bedding. Swedish guidelines for bedded space of 27 sq ft per gestating sow were followed. The structure is naturally ventilated and drippers were installed over the feeding stalls to aid in cooling the sows on hot days.

During gestation the sows are fed daily in individual feeding stalls with rear gates that can be closed after the sows have entered the stalls. The feeding stalls offer the advantages of individual gestation crates: individual feeding, control of the sow for vaccinations and artificial insemination, and easy sorting of sows. The group housing helps stimulate estrus and reduce stress on the sows by allowing them to live in groups. Fighting is minimized by using feeding stalls and introducing new sows to the groups at optimum times, such as at farrowing.

Two groups of Yorkshire x Landrace F1 gilts were brought into the hoop during 1996. Each group contained approximately 14 gilts. Two Hampshire boars also were brought into the hoop. The two groups of gilts were kept separate. A combination of hand mating and artificial insemination was used. A total of six breeding periods and gestations (two groups three times) have occurred.

Results and Discussion

Performance of sows in the Armstrong Research Farm hoop. The breeding/gestation hoop worked well. The cornstalk, big round bales for bedding were easy to use and were unraveled by the sows into absorbent bedding. The sows were fed daily in the feeding stalls. The summer of 1996 was generally mild. Ventilation and sow comfort was adequate at all times. The drippers were used occasionally. The sows were generally quiet and content. No stereotypic sow behavior was observed, i.e. unnatural sow behaviors that result from environmental stress.

Conception rate was excellent (>95%) for six breeding periods. Farrowing rate was also excellent (>95%). The manager reported that heat or estrus checking and detection was "different" than in a confinement breeding unit. Once the manager was acclimated to the hoop arrangement, heat detection and breeding went well.

¹ Mention of company or product names is for presentation clarity, and does not imply endorsement by the authors or Iowa State University; nor exclusion of any other products that may also be suitable for application.

The sows had large litters of heavy pigs. Average number of live pigs born for four farrowing groups (first, second, and third parity) was 10.9 pigs per litter. Average pig birth weight was 4.3 lb/pig. Average number of stillborn pigs was low (.4 pigs/litter). Average farrowing interval was 7.6 days.

Overall, these performance results indicate an excellent environment for the gestating sows. However, the sow groups were not mixed and no new sows were introduced into the groups. Also all sows in the group were the same age and approximately the same size. For group housing of sows to be widely adopted, research and experience in mixing sow groups and introducing individual sows or replacement gilts to the group is needed.

Environmental considerations. The performance efficiency of breeding pigs may be affected by the environment in which they are housed. Reproduction efficiency of boars and sows is generally unaffected by cold temperatures unless scrotal frost-bite occurs with boars or gestating sow feeding level is too low. Sows and boars housed in colder conditions will require additional feed. The recommendation is 0.8 lb of additional feed per every 10 degrees colder than 55°F.

Hoop structures are designed to serve as cold housing. Heat is not added to the structure and the indoor air temperature will generally remain 5 to 10 degrees above the outdoor temperature. During winter the north end of the hoop will generally remain closed. Air comes in through slots on either side of the frame walls, rises to the top of the hoop, and moves out the south end, which remains open. If the structure is closed too tightly the humidity will build up and cause possible respiratory problems. Sows remain comfortable in cold conditions because they can modify their environment with the use of bedding and huddling with other animals. They will, however, require more feed because they will use more energy to maintain homeothermic conditions. A high-quality bedding source is essential to the success of this structure.

Hot weather is much more harmful for breeding performance. Boars that are exposed to an elevated effective temperature will experience poor semen quality for a 6 to 8-week period that begins 2 to 3 weeks after exposure. Sows are more heat tolerant except during the first 2 to 3 weeks of gestation and during the last 2 weeks before farrowing. Litter size and weight may be severely affected during these periods.

During summer months both ends of the hoop should be left open to allow air flow through the structure. Boars and sows should be maintained with effective temperatures below a daily average of 80°F and below 86°F as a maximum. To achieve this, less bedding will be used and an interval sprayer or dripper system will probably be necessary. This may prompt the sow to

burrow into moist places in earthen floors, resulting in a problem during clean-out.

Behavioral advantages and disadvantages of group housing sows. Group housing of sows in bedded systems such as the hoop structures has several advantages for sow health and welfare. One of the most potent stresses in livestock production is created by preventing the animal from controlling aspects of its environment. This lack of control is characteristic of most livestock production systems, and it is responsible for an unduly high level of stress that affects health, reproduction, and welfare. By providing bedding to group housed sows, each animal can control its microenvironment by burrowing down into the straw if it's cold or lying on top when it is hot. In addition, bedding allows the sows to root through and ingest some of the bedding. This satisfies two important drives. Pigs have an inherent drive to root and if drives are prevented the animal experiences frustration resulting in stereotypic behavior. Although stereotypic behavior has been shown to help the animal cope, it is indicative of a suboptimal environment. The stress imposed by this environment can have implications to sow health. By ingesting some of the bedding the animal fills its stomach, squelching the hunger it may feel. Today's swine are bred to grow rapidly which requires a high drive to eat. An animal that has a high drive to eat and is prevented from doing so will be chronically hungry and stressed. This drive is particularly accentuated in gestating sows that are limited about 4–6 lb/day which is only 30–50% of their appetite. Another benefit of providing the sow with bedding is that it decreases the level of aggression amongst the herd. Rooting through the bedding provides the animals with daily activity preventing boredom and, therefore, aggression. Housing sows in groups also encourages normal reproductive behavior. Sows displaying estrus can stimulate other sows to express estrus.

However, group housing of swine is not all advantageous. Because the sows are housed together they are able to fight with one another and will obviously do so. This is a problem at the time of mixing sows or introducing new sows. If the sows are kept in stable groups fighting is minimal. The challenge occurs when new sows must be introduced to the group in which case fighting will occur. More research is needed in this area to determine how to decrease the amount of fighting during this critical time.

The final challenge to group housing of swine is controlling feed intake of individual animals. Group feeding can encourage aggression as well as result in a disparity of feed intake. Thus far, the best solution to this problem is to stall feed. This may require more labor. Electronic feeders also are available to individually feed sows housed in groups. In general, group housing of sows requires an active management strategy, but the

benefits to sow health, reproduction, and welfare are deserving.

Layout and design considerations. Many questions about housing sows in hoops are still unanswered. The Swedish guideline for bedded floor space required is 27 sq ft. Current designs follow this guideline approximately (usually at least 24 sq ft of bedded area per sow).

Other common design questions are:

- How should hoop-housed sows be fed?
- What pen layout should be used? How many sow can be in a pen?
- Should the bedded area be paved with concrete or left as compacted soil?

Feeding system selection is a major decision with group-housed sows. Four major choices are available:

- feeding stalls,
- electronic feeders,
- interval feeding, and
- floor feeding.

Usually the feeding area is elevated 12–19 in. above the floor of the bedded area to keep the bedding off the feeding platform.

Individual, lockable feeding stalls take up considerable space (about 12 sq ft per stall). Stalls cost about \$100 each and can require more labor. The feeding stalls have lockable rear gates that the sows access to eat. They also have front gates to easily remove the sows to go to the farrowing house or to the breeding pens. The key advantage of feeding stalls is that they allow individual management (feeding, vaccination, AI, etc.) of group-housed sows.

Electronic feeders are an automated way to feed and manage sows individually. The electronic feeders use a small amount of space. However, an electronic feeder requires a major capital investment and ongoing maintenance and management. Electrical power surges and lightening can cause problems with the computer.

An interval feeding program allows sows to eat *ad lib* for a certain duration of time every 2 or 3 days. A fenced feeding pen with self feeders is required. Groups of sows are allowed to enter the feeding pen for a certain length of time every second or third day. This feeding approach is low labor, inexpensive, and uses a small amount of space. At least one feeding space is needed for each sow fed, although extra spaces may be beneficial. The manager has no control over feed intake by the individual sow. Sow aggression may occur around the feeders.

Feeding on the floor is low labor (especially with automated feed drops), inexpensive, and uses a moderate amount of space. The manager has no control over individual sow feed intake. Sow fighting and aggression is encouraged because the larger aggressive sows get more feed. Feeding is on a daily basis. Individual sow management is difficult.

All types of feeding systems are used in hoops.

Feeding stalls are commonly used in Europe where group housing of sows has been widely practiced for many years. Even though feeding stalls are not common in the United States, the authors suggest that feeding stalls are an excellent choice when housing sows in hoops.

Pen layout is dependent on feeding system. Several layouts are shown at the end of this article. Number of sows per pen or group is a factor of farrowing room/house capacity and conception rate. Pens should be at least 15 or 16 ft wide to minimize control by aggressive sows and allow timid sows to pass freely.

The question of whether to pave with concrete the bedded area has not been resolved. Sows will root in soil if not rung. The extent of deep rooting is not known. There are other intermediate flooring surfaces such as crushed, packed limestone that may be adequate. More experience in this area is needed.

Bedding management and manure handling. After the initial bedding is added to the structure, the sows spread most of the bedding themselves. Preferred dunging areas are quickly established by the animals, and additional bedding is normally added in those locations to absorb excess moisture. The nutrients and moisture contributed by the manure help initiate incidental composting, which generates some heat in the bedded back. Under winter conditions this situation is optimal for the sows, with added warmth from the decomposing bedding increasing comfort levels. However, during summer this additional heat is unwelcome, and may reduce animal comfort.

The bedding is normally cleaned out 1 to 4 times per year depending on bedding quality and stocking density. At that time the manure/bedding mixture is either directly spread on fields or stored for later use. Because this is a solid manure handling system, storage requirements are minimal, although there is some concern about nitrogen leaching from storage, especially during high rainfall. Composting is likely to occur if the manure is stored for any length of time, and will provide volume reduction and nutrient stabilization prior to field application. Such composting will occur with minimal management if the material is piled in windrows about 6 ft high and 12 ft wide. Bedding from gestating sows in hoops tends to be much drier than that from finishing pigs, and moisture is likely to limit the extent of composting unless additional manure or water are added to the piles.

As it comes directly out of the hoop structure, the high degree of variability in the bedded pack makes it difficult to predict manure nutrient contributions to crop fertilization needs. Whereas manure from the dunging area has clear fertilizer value, the high-carbon/low-nitrogen status of the drier bedding may lead to nitrogen immobilization and crop stress if applied during or immediately prior to the growing season. Mixing the material to achieve a higher degree of uniformity would improve this situation, and such mixing currently occurs

to some degree if the bedded pack is piled for storage or composting prior to field application. Additional mixing, such as would occur during turned windrow composting, appears likely to offers a considerable benefit with this material. Trials to examine the effect of storage, mixing, and composting on manure nutrient levels and uniformity are planned for the coming year.

Hoop gestation layouts. Figure 1 illustrates the layout for the breeding and gestation hoop structure at the Iowa State University Armstrong Farm. This system, while it works well, is relatively expensive due to a large amount of concrete, low animal density, and high equipment cost. However, it fills a niche because it is designed for a small herd. Constructing a crated gestation barn for this size herd would most likely be impractical. The environment within the hoop is generally not consistent from end-to-end, so animals in different pens will experience different environments.

The gestation in Figure 2 is designed for two groups of 32 sows. Feed stalls are placed on a raised concrete pad at the end of the hoop. Feeding stalls are placed so that only one group of sows at one time may be allowed to feed. This design minimizes the equipment cost by allowing feeding stalls to be shared but some space is wasted to accommodate the feeding stalls. Shared feeding stall usage on a daily feeding system will probably require some added labor.

Figures 3 and 4 are designed for interval feeding. Figure 3 shows four groups of 25 that share a feeding

area in the center of the building. This design minimizes the area devoted for feeding but animals will be exposed to different conditions depending on where in the system they are housed. Added labor may be required because more than one group may need to be fed in a day. Figure 4 was designed for two groups of 36 sows. This allows more of a uniform environment but requires more area be devoted for concrete.

Figure 5 has a concrete pad on which feed is dropped for feeding. This system is simple and probably one of the most inexpensive designs. However, individual conditioning of sows is sacrificed and the groups of sows will be exposed to different environments.

Electronic feeding is used in Figure 6. Areas are created to hold gilts being trained in the system. The electronic feeder sets on a concrete pad and is connected to a sow holding area that can be used for sorting and loading out sows. This system is relatively simple but the cost of the electronic feeder is relatively high. This system holds 65 sows.

Figure 7 illustrates a relatively simple feeding stall system for 64 sows. This system is efficient and simple. The main disadvantage is the cost of the feeding crates.

Acknowledgments

The authors gratefully acknowledge and appreciate support by the Leopold Center for Sustainable Agriculture and the Wallace Foundation for Rural Research and Development.

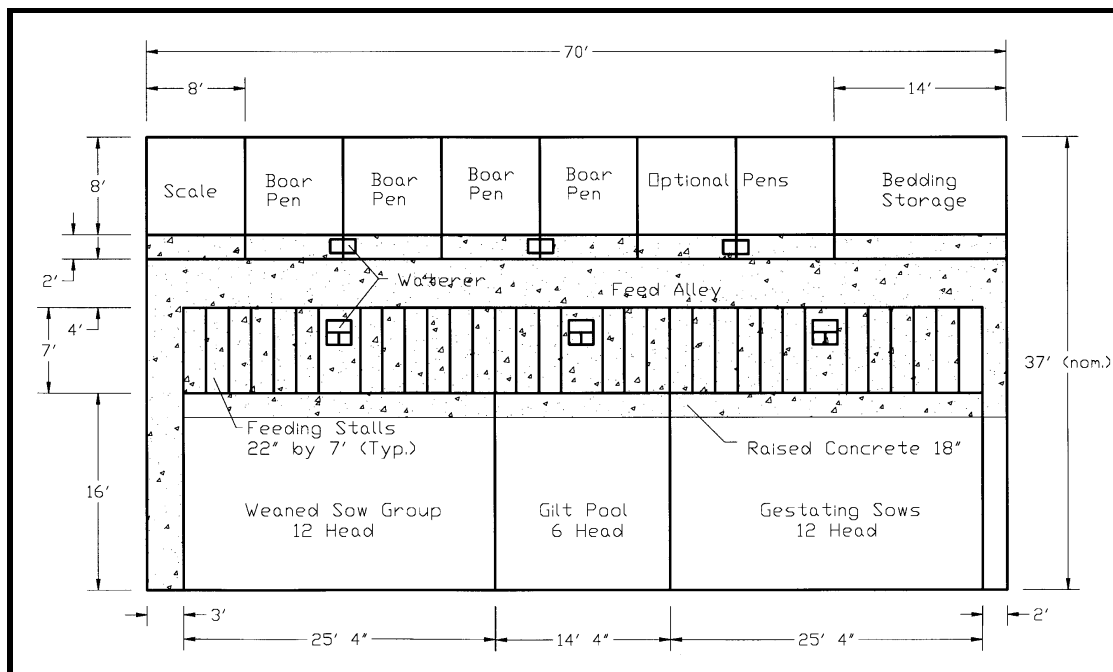


Figure 1. Breeding and gestation layout used at the ISU Armstrong Farm.

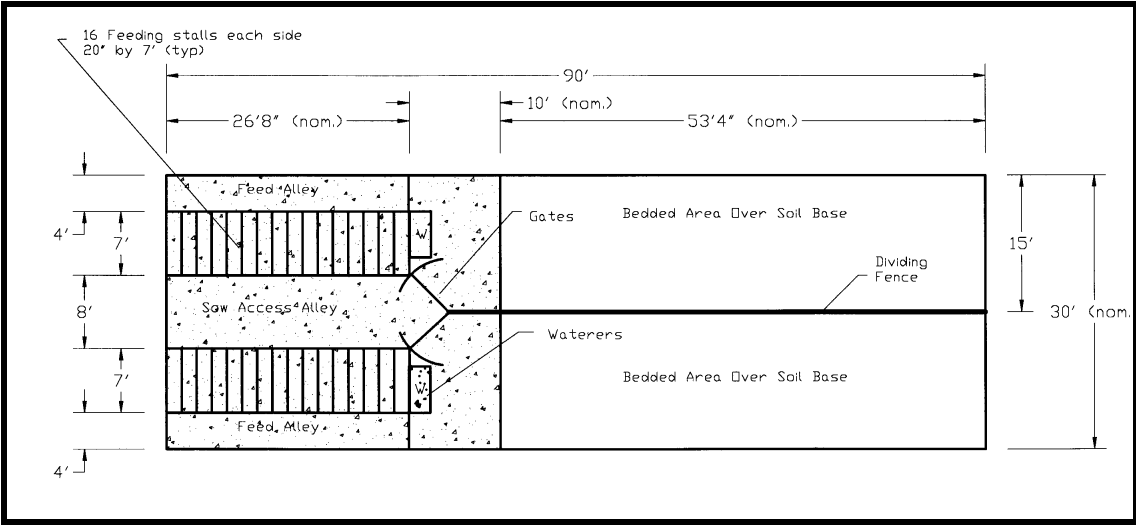


Figure 2. Hoop housed gestation with shared feeding stalls for two groups of 32 sows.

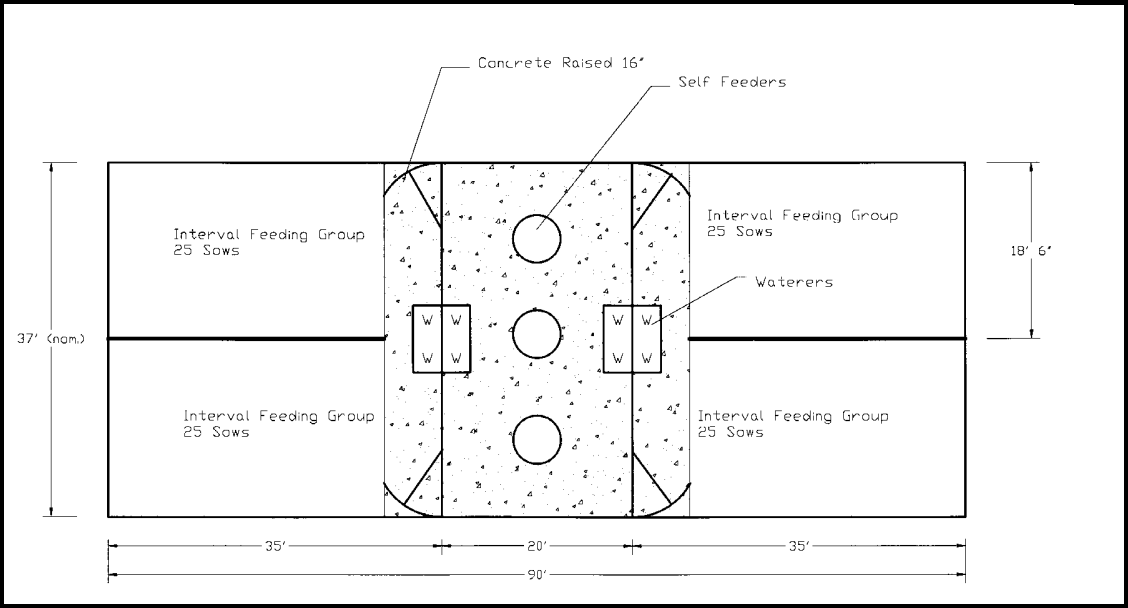


Figure 3. Hoop housed gestation with interval feeding for four groups of 25 sows.

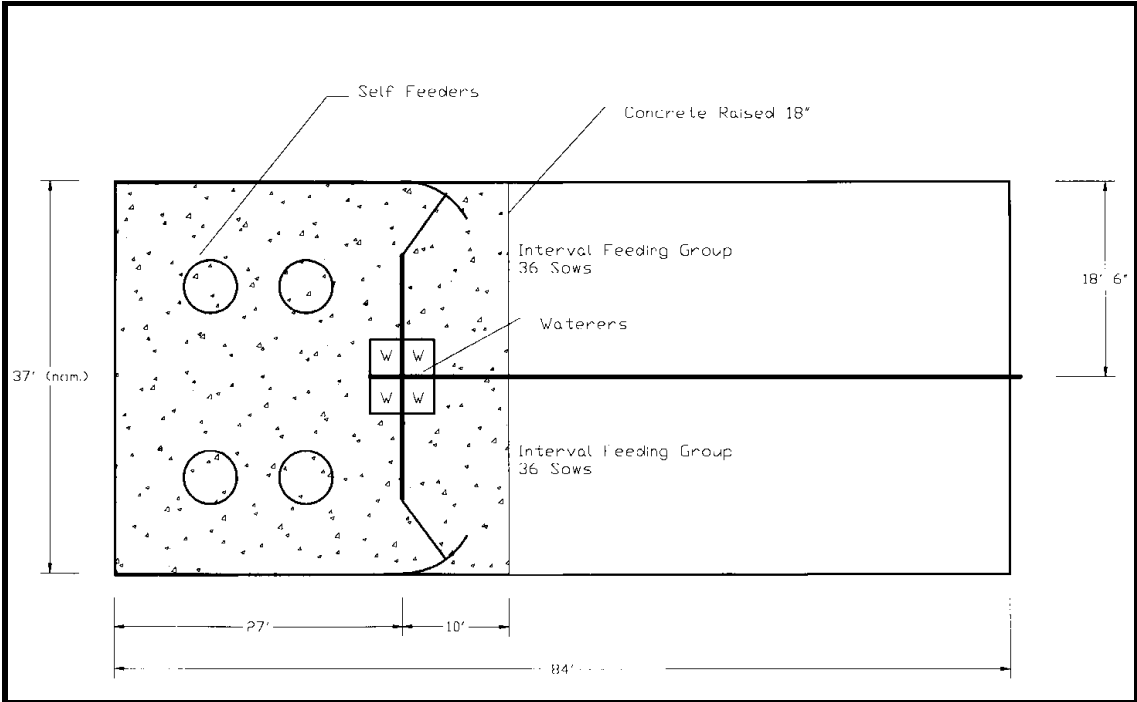


Figure 4. Hoop housed gestation with interval feeding for two groups of 36 sows.

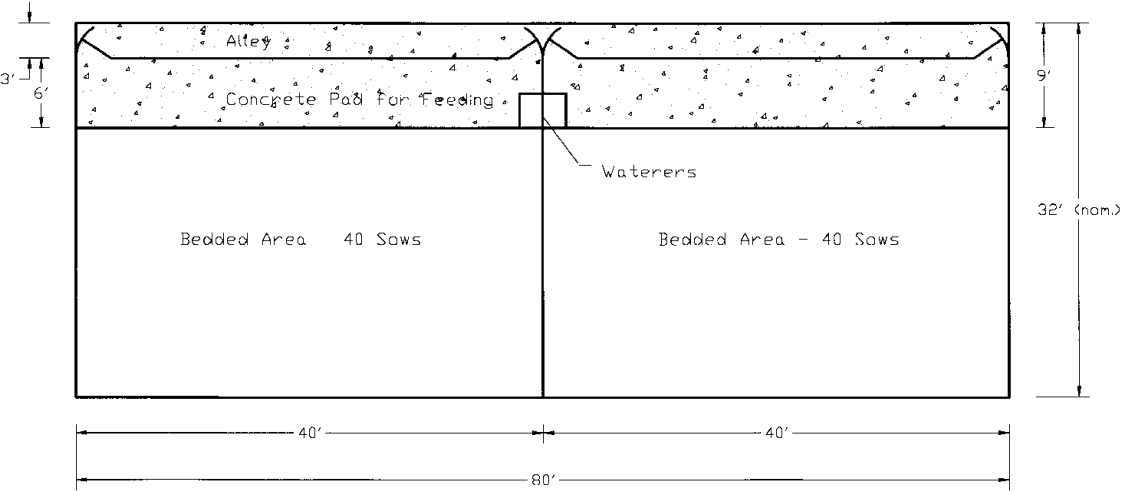


Figure 5. Hoop housed gestation with drop feeding on a raised concrete pad and 40 sows per group.

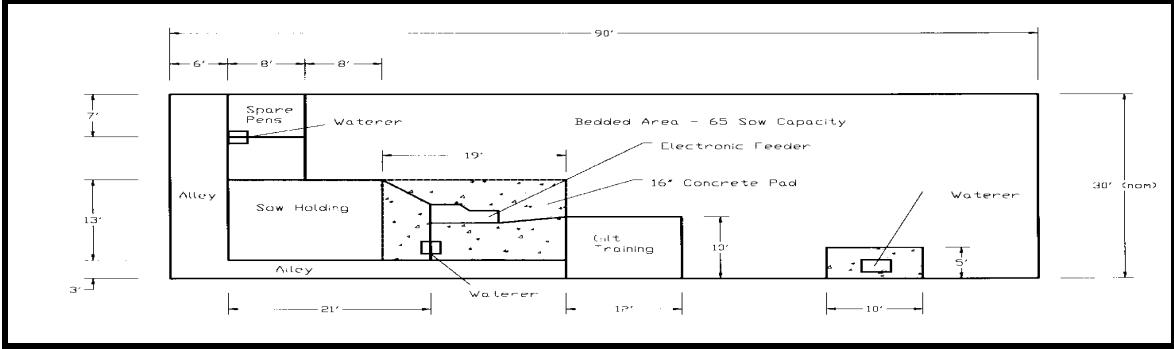


Figure 6. Hoop housed gestation for 65 sows fed with an electronic feeder.

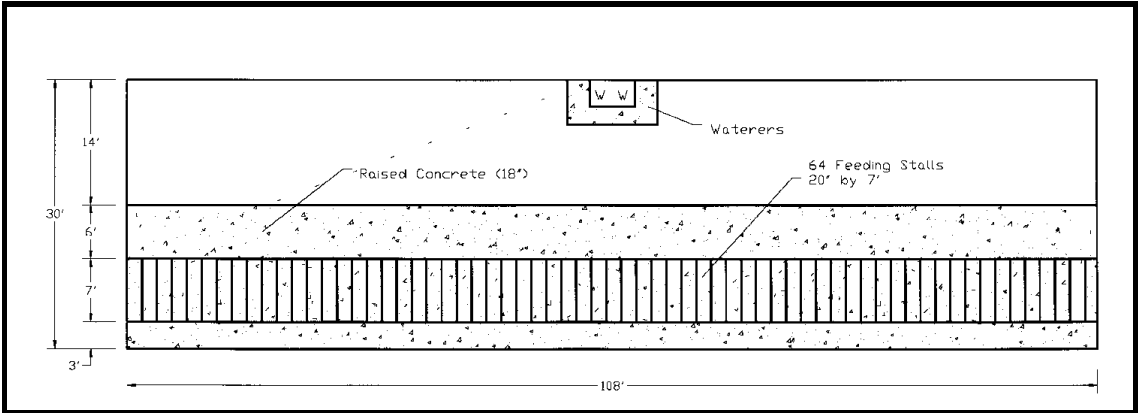


Figure 7. Hoop housed gestation with 64 feed stalls.