



pork industry handbook

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Michigan State University Extension

Flooring for Swine

Authors

Jay D. Harmon, Clemson University
Arthur J. Muehling, University of Illinois

Reviewers

Earl Dotson, Des Moines, Iowa
Albert J. Heber, Purdue University
Ray and Helen Helms, Oakley, Idaho
Frederick W. Koenig, MidWest Plan Service
Joseph M. Zulovich, University of Missouri

The development of slotted floors has been a dominant factor in making modern pork production practical. Slotted floors make pens self-cleaning, leaving them clean and dry. The reduction of labor associated with clean, dry pens accounts largely for the feasibility of this kind of production.

The question as to what type of floor to install in a building depends upon how management intends to handle the manure. For example, if manure is to be handled as a solid or semi-solid product, the floor will usually be solid. If manure is to be handled as a liquid, the floor will usually be partially or totally slotted.

Since slotted floors reduce the labor associated with most nonslotted floors, many buildings have been remodeled for slotted floor usage, and new buildings are nearly always designed with either totally slotted floors, partially slotted floors or floors with open flush gutters.

How Much Slotted Floor

Studies have generally shown no difference in performance when comparing similar buildings with partially slotted floors to those with totally slotted floors during summer conditions. Studies in Nebraska have shown decreased feed efficiency with an increased percentage of slotted floor area during the winter. The initial floor cost increases slightly as the amount of slotted area increases, thus some floors for growing-finishing (G-F) pigs are from one-third to one-half slotted. However, many new G-F facilities are totally slotted since many producers want to avoid the messy pens of partially slotted floors during hot weather. For systems which store manure in under-house pits, partial slots are impractical due to limited manure storage capacity. Where 6- to 8-inch wide slats are used, fully slotted floors may be recommended. Building

dimensions, pen arrangements and the manure handling system will be factors in deciding how much of the floor should be slotted.

Claw injuries have been shown to be greater on total slats than on partial slats. However, the effect of claw injuries on growth rate appears to be slight. Claw injuries to breeding swine, however, often lead to more significant problems. Studies have shown that wider slats (8 inches) reduce claw injuries and clean as well as narrower slats. Solid flooring with some type of nonslip surface generally is recommended when used for breeding pens. However, slotted floors also are used successfully in some breeding units.

Since partially slotted floors also are partially solid, it is important for labor reduction and pig performance that pigs develop desirable dunging patterns. Pen shape is not important to dunging patterns on fully slotted floors. Assuming a long, narrow pen, there are construction and management factors that are important in developing good dunging patterns. Perhaps no single item is fundamental, but rather several factors combined appear to have an additive effect of training the pig. Following is a list of factors important to training pigs.

Typical excretory behavior of a pig is characterized by the following activities:

- It assumes an unstable posture.
- It seeks an area away from distractions to prevent being bumped, disturbed or surprised.
- It goes to an area opposite or away from the feeder since the focal point of animal activity is around the feeder.
- It seeks a corner since the risk of being disturbed is less.
- It uses its excreta as a means of thermal adjustment especially when temperatures go beyond its upper comfort zone. This results in messy pigs and pens.

In winter, pigs usually dung where it is cool and drafty and sleep where it is warmer and draft free. In general, pigs dung in the least comfortable part of the pen and sleep where it is the most comfortable.

Recommendations for improving the dunging behavior of growing-finishing pigs housed in pens with partially slotted floors are as follows:

- Use rectangular pens with a length to width ratio of 2 1/2:1 or 3:1.
- Use solid partitions beside the sleeping area.
- Provide mesh partitions beside the slotted or dunging area.
- Locate the feeder as a part of the partition in the sleeping area.
- Locate the waterer in the desired dunging area.
- Provide a 1 1/2- or 2-in. step down from sleeping to dunging area.
- Use a proper stocking density.
- Feed on floor in desired sleeping area for two or three days post-arrival.
- Wet the desired dunging area for two or three days post-arrival or place fresh manure in dunging area.
- Use sprinklers over desired dunging area in summer.
- Restrain pigs in desired dunging area for about 10 minutes after first placing pigs in pen.

Additionally, in cold housing it is best to:

- Use hovers over sleeping area in winter.
- Do not use bedding with slotted floors.

Floor configurations in farrowing houses vary with producer preference. Research results provide scant guidance in selecting a farrowing house floor design. A wide variety of products exist which meet the needs of the crated sow and litter. These include combinations of flooring types which attempt to meet the thermal needs and the manure handling needs of each.

Slat Width and Spacing

The most desirable dimension for slats depends upon material and size of pigs (Table 1). Slotted floors should be designed to minimize pig injury while maximizing cleanliness. In general, the larger the pig, the wider the slats that may be used without sacrificing performance and cleaning characteristics. Concrete slats may be made or are available in various widths. Concrete slats used for farrowing generally are 4 to 5 inches wide, nursery slats 4 to 6 inches wide, and G-F slats 5 to 8 inches wide. Some of the metal and plastic slats for small pigs are as narrow as 1 inch or less. Use of concrete slats in nurseries is rare.

Factors such as amount of slotted area may influence the decision on what width slat to choose. Slat widths of 7 to 8 inches have been used very successfully for gestation and G-F pigs. Slat widths of this width definitely require a full inch spacing.

For slotted-floor nurseries, the slat spacing should be either narrow enough so the pigs cannot get their legs caught at all, or wide enough (1 inch) so they can easily get their legs free should they step in the slot. Generally a narrow spacing is required of narrow slats, and a wider spacing, up to 1 inch, is required of wider slats. When the wider spacing is used in the farrowing crate, a grate covering should be used at the rear of

the sow at farrowing time to cover the openings. If the slat openings at the rear of the farrowing crate are not covered immediately prior to farrowing, and for several days following, the manager has no way of knowing if the sow has voided the placental tissue as it would go directly into the manure pit. A retained placenta may result in certain health problems for the sow and litter, so the manager must know if and when the placenta is passed. Using a grate to overlay the wider slots at the rear of the farrowing crate until the pigs are a few days old also allows the baby pigs to adapt to slotted floors in stages.

Table 1. Suggested slat spacings.

Farrowing	3/8 inch, except at rear of sow where 3/4 to 1 inch opening may be used.
Nursery (20 to 40 lb pig)	1/2 to 1 inch, depending on width of slat; wider slat/wider opening.
Growing-Finishing (40 to 260 lb pig)	3/4 to 1 inch, narrower slats of material other than concrete may use narrower openings. Wider slats, 5 to 8 inches, need 1 inch opening.
Breeding herd	1 to 1 1/8 inch.

Slat Direction

In most phases of production, slats placed so the openings are parallel to the long dimension of the pen or crate appear to favor pig comfort and mobility (Figure 1). Nursery, G-F, and gestating swine appear more mobile and comfortable when walking on slats that are parallel to the long dimension of the pen as opposed to slats that are placed at a right angle.

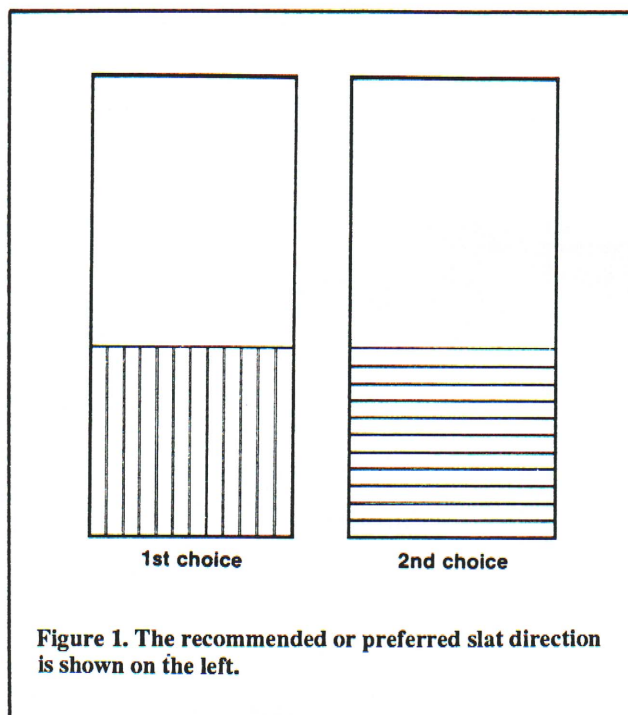


Figure 1. The recommended or preferred slat direction is shown on the left.

The foregoing discussion assumes a rectangular shaped pen. Slat direction in totally slotted floor buildings will be influenced by other factors such as construction costs. However, placing the slats parallel to natural traffic flow, so that the

pigs will walk down a slat rather than across it, is worth considering. This also is true for farrowing and gestation crates or stalls, even though the animal is not allowed free movement. However, footing becomes a major consideration in farrowing and gestation crates.

Floor Materials

Wood, concrete, metal, and plastic all have been used effectively for slotted floors.

Wood slats have the lowest initial cost and also the shortest life. Oak is best, but other hardwoods such as hickory and maple can be used. Pig performance may be reduced by variable spacing resulting from warping (particularly likely to happen with slats which are less than 3 in. wide), wear, careless installation, insecure fastening, and uneven heights. Wood slats can become quite slick. Their maximum life expectancy is between two and four years and even less in areas of intensive use, such as around feeders and waterers. Wood slats are difficult to clean and disinfect between groups of pigs due to porosity of wood. The short life span, difficulty in maintaining uniform spacing and cleanliness factors make wood a less economically attractive material than commercially available flooring. Wood, however, may be used effectively in portable buildings which have low levels of use or are intended as a first step to getting pigs off of dirty lots.

The recommended dimensions for wood slats are shown in Figure 2. The "A" dimension must be greater than the "C" dimension so the spacing will not become clogged. The slats usually are formed by ripping a rectangular timber on the diagonal, resulting in a vertical edge and an inclined edge. A second vertical cut should be made cutting off the sharp edge made by the diagonal cut.

Concrete slats are the most durable and have worked well especially for all hogs over 40 lb, including gestating sows. While they can be used for smaller pigs and during farrowing, other flooring materials work better for small pigs due to the tendency of concrete to remain cold. Flooring combinations are available which use concrete under the sow and other materials in the creep area in order to provide better piglet comfort. This type of flooring provides the comfort benefit to the piglets while at the same time providing a durable surface under the sow.

Concrete slats can be precast by a concrete products plant, and commercial forms are available for casting the slats in place. Precast slats have the advantage of quality control during proportioning the mix, casting the slat, and curing. Some concrete products plants are forming gang slats (two or more slats connected into one section) which can be up to 5 ft wide with 8- to 12-foot long sections.

Recommended dimensions for concrete slats (Figure 3) are 5 to 8 inch tops with 4 to 5 inch depths (5 inch depth required for 8 and 10 ft lengths).

The 1/4 inch bar in the top of the slat can be omitted when slats are cast in place and not moved. Use at least a 7 1/2 bag mix of air-entrained concrete with a 2 to 3 inch slump, and a maximum aggregate size of 1/2 inch. A slight pencil-round edge can be provided by edging the slats with a 1/4 inch sidewalk edger. This will prevent chipping and further reduce foot injuries. Give the slats a smooth, steel-trowel finish to reduce leg and knee abrasions. This is particularly necessary for farrowing and nursery floor slats. For proper curing, protect the slats from drying out for five days by covering with plastic, by spraying on a curing compound, or by covering with a wetted layer of straw.

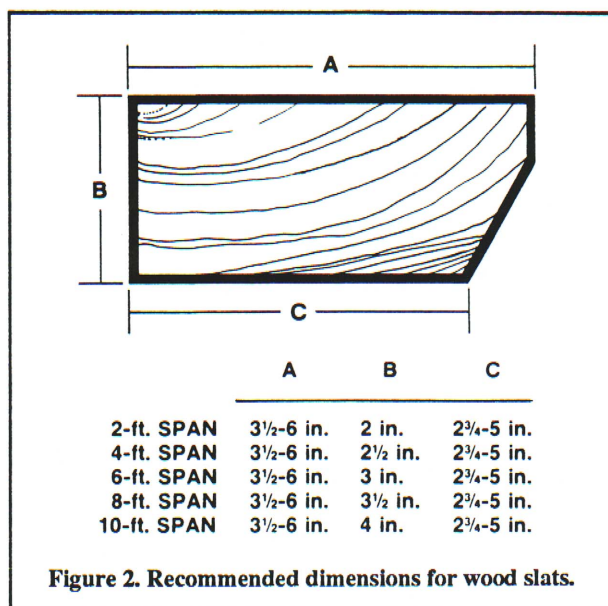


Figure 2. Recommended dimensions for wood slats.

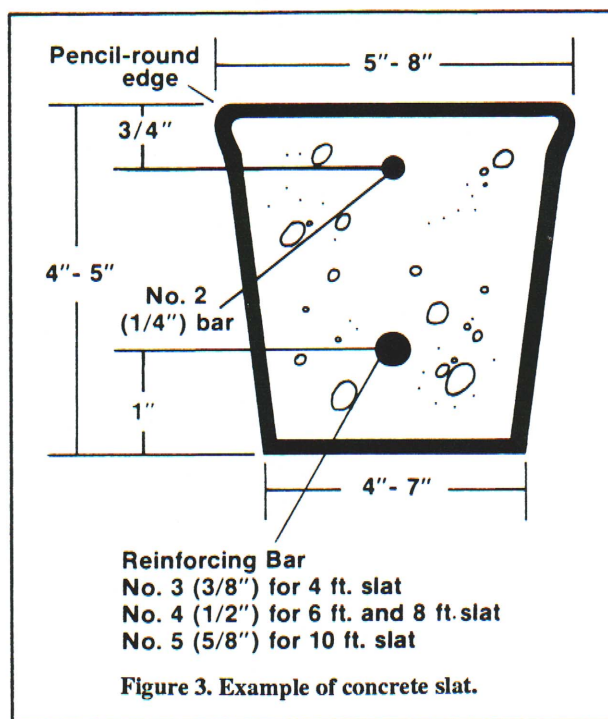


Figure 3. Example of concrete slat.

Solid concrete floors are occasionally used alone or in conjunction with open flush gutters or partial slats. A slope of 1/2 inch/ft toward the gutter or slatted area is recommended for under-roof growing-finishing and breeding-gestation facilities. Solid concrete flooring is not generally recommended for farrowing or nursery facilities due to the increased labor necessary for cleaning and additional heating problems. However, if solid concrete floors are used in farrowing or nursery facilities, bedding should be used on floors sloping 1/4 inch/ft. Outside aprons should slope away from the building at the rate of 1/2 inch/ft to 3/4 inch/ft.

There are three metal flooring products that are popular. These are woven wire, triangular bar and coated metal. All three types perform well in farrowing and nursery facilities.

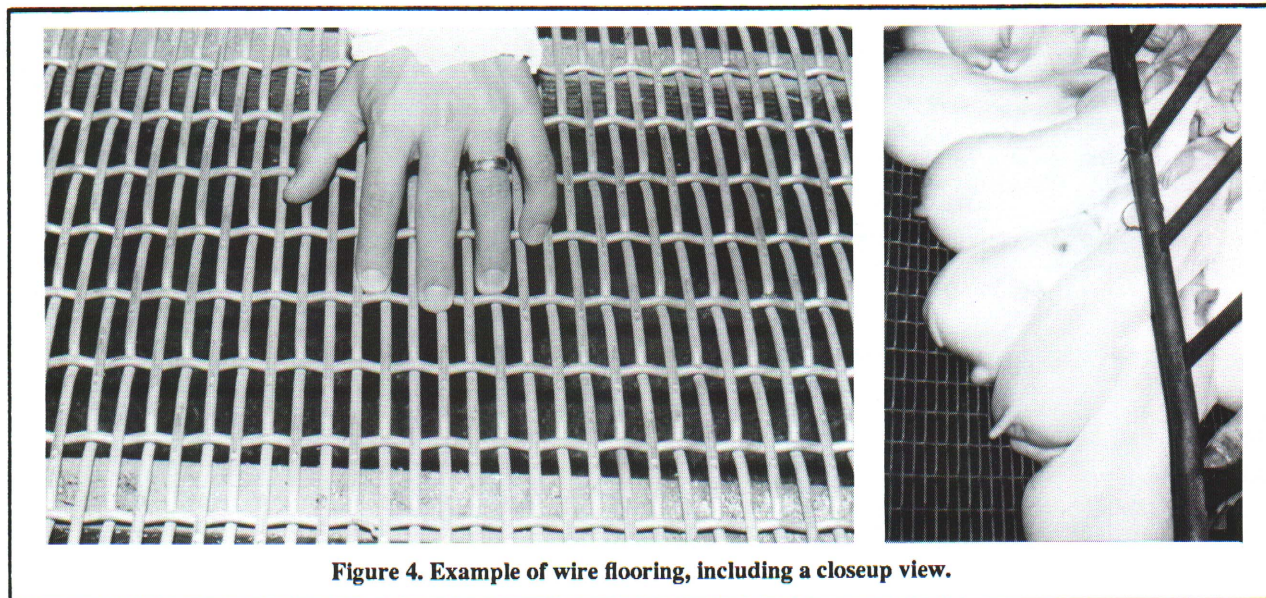


Figure 4. Example of wire flooring, including a closeup view.

Woven wire flooring (Figure 4) is used predominantly in farrowing and nursery facilities and generally is made from galvanized wire in three sizes. Farrowing facilities generally use 5 ft by 7 ft sheets of 5/16 inch wire flooring. Spaces between wires are 3/8 inch by 2 inches. Nursery facilities generally use 4 ft by 8 ft sheets of 3 or 5 gauge wire flooring. Three gauge wire has a diameter of 0.243 inches and five gauge has a diameter of 0.207 inches. Both have 3/8 inch by 1.5 inch openings between wires. Three gauge is more durable than five gauge and therefore has become much more common in nursery facilities.

Most bare wire floors are galvanized. They can be galvanized before the wire is woven or the floor can be hot dipped after completion. Galvanizing before weaving is preferred because this results in all the wire being coated, even where it crosses. The amount of support under the flooring is at least as important as the gauge used. Inadequate support may allow floors to sag or even collapse. In most cases support spacing of 12 to 16 inches is adequate. The ratio of open to solid floor area and the level of pig traffic determine how rapidly fecal material moves through the flooring. Generally sow stools accumulate to some degree on all-wire floor and baby pigs' stools do not. Preventing constipation by adding laxative ingredients, such as beet pulp, bran, or Epsom salts to sow diets is beneficial in reducing constipation and fecal accumulation.

Triangular bar flooring (Figure 5) has become popular in nursery and farrowing buildings. Triangular bar flooring is typically constructed on a self-supporting truss frame thereby eliminating the need for support frames. This product is made of multiple triangular bars welded point-down to a frame. It is generally fabricated from hot rolled, round steel 7/16 inch stock. It is then cold rolled to an even sided bar with flat sides and rounded corners. The flooring surface is 50% open. Bars are 3/8 inch wide on the top surface. Farrowing flooring is constructed with bars running the length of the crates. Depressions in the bars assist with sow footing with additional indentation sometimes added to further aid footing.

Triangular bar flooring cleans more easily than woven wire because of the smaller area for water droplets to gather on the underside. The self-supporting frame gives this flooring an advantage over other types of metal flooring because of the

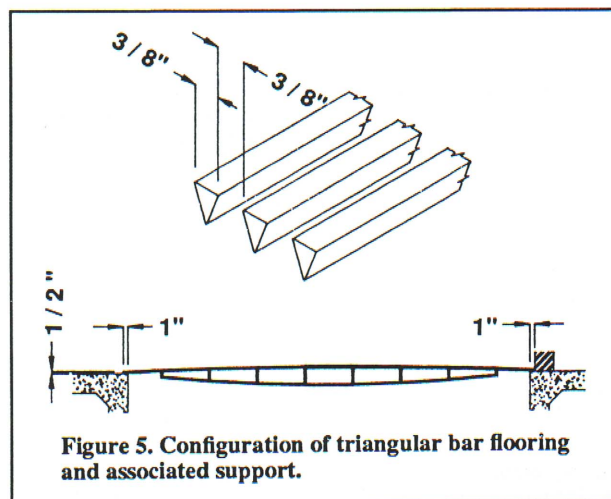


Figure 5. Configuration of triangular bar flooring and associated support.

reduced amount of hardware required. The nursery flooring version of this product performs quite well. Farrowing crate flooring can be relatively slick even with slip resistant surfaces. Triangular bar is less abrasive than woven wire if triangle corners are rounded. An additional advantage is the option of built-in heat pads which are available from some manufacturers.

Coated metal flooring generally is constructed of welded wire or expanded metal and then coated with PVC, plastisol or some other plastic substance. Coated metal is used primarily in nursery and farrowing facilities. Although seldom used, heavier gauge expanded metal is available for finishing and gestation applications. The flooring comes in many sizes and weights. Coated welded wire has rectangular openings; coated expanded metal has diamond shaped holes. Farrowing facility flooring often has removable panels under the sow. Some configurations have center sections which are slightly elevated above the creep areas, allowing the flooring to have creep areas better suited to piglet comfort while the sow area is better suited for manure removal and easy floor replacement. Most coated metal products also come in a self-supporting version.

Coated metal flooring was developed to be nonabrasive and provide good slip resistance while at the same time providing cleanability. When used in farrowing crates it does not clean as readily behind the sow as other flooring. Coated metal is corrosion-free as long as the plastic coating is nonporous. Cuts in the coating provide an opportunity for corrosion. Many companies have warranties which do not cover coated metal flooring used in farrowing crates without wear pads under the front of the sow, indicating that durability may be a problem with heavier animals. The newest innovation for coated metal floors uses hollow core metal to circulate fluid through the floor to warm the creep areas or cool the sow area.

Many observations show improved results when suckling and nursery pigs are produced on elevated floors, either coated or uncoated, when compared to floor level production. The reasons for improved livability include:

- Separating excreta from pig area more rapidly
- Drier floor area
- Warmer air level
- Less drafts
- Less abrasive material than concrete

There is no evidence that baby pigs perform better on coated versus uncoated mesh. There is some evidence that uncoated wire results in more severe body lesions to the sow than coated floors, but lesions may occur regardless of floor type, especially when sows lose condition rapidly during lactation. Metal, fiberglass, or plywood overlays in the front half of the farrowing crates usually reduce shoulder lesions to the sow. Solid overlays in the baby pig sleeping area, both in farrowing and nursery situations, are necessary if temperatures and drafts are not controlled.

Plastic slotted flooring has been improved during recent years. Plastic floors have the advantage of being warmer than concrete and metal, and they also clean readily. Some plastic slats may be somewhat slick for sows and hogs over 100 lb. Many of the plastic flooring products come in modular sections. These sections, which range in size from one foot square to 1 ft x 2.5 ft, generally interlock with surrounding modules and are mounted on steel, fiberglass or other supports. The modular concept gives flexibility in tailoring flooring areas to animal requirements in situations such as farrowing house flooring.

The individual slats in plastic flooring should be tapered from top to bottom to allow proper cleaning (Figure 6). Crevices between modular units may be difficult to clean and can create some sanitation concerns. Some brands of plastic flooring become slick when damp, but others have avoided this problem by making adjacent slats at two slightly different levels (Figure 6). This serves two purposes. Traction is increased and manure can pass more easily through the openings. Plastic flooring is much easier to handle than concrete or metal floors due to its lightweight modular design. Installation is thereby relatively easy, but it is very important to anchor sections. A self-supporting variety is not available at the present time.

Floor Smoothness

Concrete floors (solid and/or slotted) that are rough result in more injury, lameness, and infection than smooth, clean floors. Therefore, concrete floors or slats should have a machine trowel finish. Concrete slats with smooth surfaces and slight pencil-round edges result in fewer claw injuries and

edges that chip less easily. The risk of getting a concrete floor too rough is much greater than getting it too smooth. Problems with floors too smooth are nearly always associated with solid nonslotted areas. In general, if the floor is kept dry, and the slope does not exceed 1/2 to 3/4 inch per foot, it is rare for problems related to slickness to occur.

Sanitation Characteristics

Ease of cleaning depends upon design or shape more than any other factor. If the surface cannot be cleaned thoroughly, that is, all the organic matter removed, then disinfecting is ineffective. Surface material with corners, edges, cracks, and openings where organic material resides cannot be properly sanitized. Concrete is porous and may provide a site for infectious organisms. A concrete sealer may have merit, but controlled studies to enumerate the use frequency or benefit from such a sealer are unknown. In any case concrete sealers should not be used in place of a good disinfectant that has a residual effect.

Treatment of Foot Lesions

Lesions on the surface of the foot are common among growing-finishing and adult swine. The nature and degree of foot lesions depend primarily on type and quality of flooring material and discrepancy in claw size (see Figure 7). The outside claw is nearly always larger than the inside claw. When the difference in claw size is great, the likelihood for more severe lesions on the large digit is greater. Rough, nonresilient floors cause foot lesions as well. Some lesions can be expected under nearly all types of production systems. Often the lesions become infected, causing lameness. When this occurs, therapeutic levels of antibiotics are of little, if any, benefit. A footbath of 5% or 10% copper sulfate is effective. To make a 5% solution, add 4 lb of copper sulfate crystals to 10 gallons of water. To make a 10% solution add 8 lb of copper sulfate to 10 gallons of water. Walking the infected pig through the footbath two or three times a week for several weeks usually results in complete remission of symptoms.

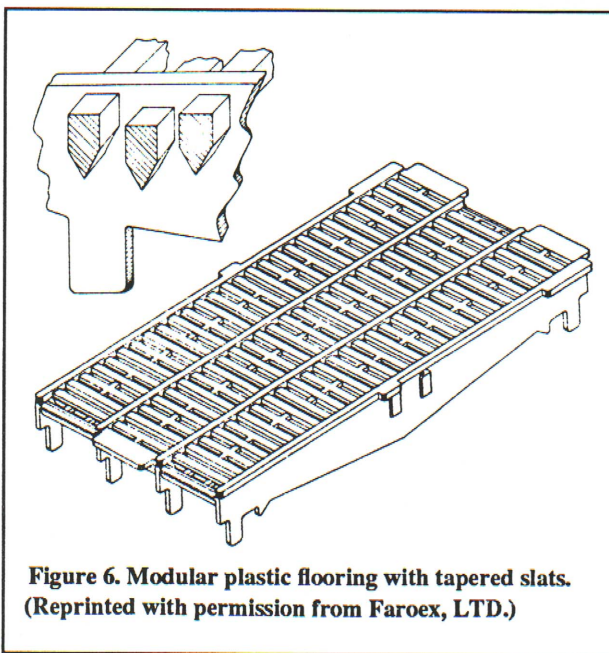


Figure 6. Modular plastic flooring with tapered slats. (Reprinted with permission from Faroex, LTD.)



Figure 7. Claw lesions of this type can be reduced by using wider slats (6 to 8 inches) that have a smooth, flat surface and a slight pencil-round edge. Note the smaller inside toes with few lesions.

Other Floor Related Problems

Knee and hock lesions among baby pigs in farrowing houses have been a problem to some producers, particularly in new buildings. Bedding usually reduces or eliminates the problem. Since most types of bedding cannot be used in a house with liquid manure disposal, other techniques are necessary. Wood shavings, sawdust and shredded newspaper have sometimes been used successfully in sparing amounts on the solid portion of a partially slotted farrowing pen, but extreme caution is advised. Rubber mats and outdoor carpet have been used in the creep area with some success. Important considerations here are durability and ease of sanitation.

Some paints or plastic-like materials applied to the floor in the nursing area of the farrowing crate may aid in reducing knee and hock abrasions to the piglets. A latex-based cement

that can be applied over too rough or too smooth existing floor areas may be obtained in most paint or hardware stores. Only material that is nontoxic to the pig should be used. It also is wise to try these types of materials in a limited number of crates before committing the entire building. Some products of this type may result in a floor that is excessively slick. A liquid adhesive painted on the pigs' knees shortly after farrowing has been reported to have some effectiveness in protecting skin for a period of seven to ten days.

Summary

Decisions on what type of slat material to use should be based upon cost, durability, freedom from maintenance, walking ease for the pig, self-cleaning and sanitation characteristics. Generally, good-quality concrete slats are the most durable and the least expensive. Concrete slats function extremely well in growing-finishing and breeding-gestation facilities. Expanded metal flooring, woven and welded, coated or uncoated, usually are recommended for farrowing and nursery situations. Modular plastic floorings with varied height slats also are recommended for farrowing and nursery facilities. The most important consideration for coated or uncoated wire or mesh and plastic is proper structural support material and spacing. Follow the manufacturer recommendations carefully in this regard.

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