Flooring for Swine – Pork Industry Handbook
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Issued July 1985
6 pages

Extension Bulletin E-1285 Revised July 1985

pork industry handbook

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Flooring for Swine

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The development of slotted floors has been the dominant factor in making modern swine production practical. Slotted or partially 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 somewhat upon how management intends to handle the waste. For example, if wastes are to be handled as a solid or semi-solid product, the floor will usually be solid. But if wastes are to be handled as a liquid, the floor will usually be at least partially slotted. Since slotted floors materially reduce the labor associated with most non-slotted floors, many existing buildings, and perhaps most buildings of the future, will have slotted floors or floors with flush gutters.

How Much Slotted Floor

Studies have generally shown no difference in performance when comparing partial versus total slats during summer. During winter, Nebraska studies showed an increase in feed requirement per unit gain with increasing amounts of slotted floor. For this reason, and because the initial floor cost increases slightly as the amount of slotted area increases, many floors for growing-finishing (G-F) pigs are from one-third to one-half slotted. This amount of slotted floor works well where the pen length is 24-26 ft., with about 10 ft. of this being slotted. Pen widths, in this case, are usually 8-10 ft. Wider or squarer buildings, with a center or off-center alley and pens on both sides with partially slotted floors, require more management to train pigs to dung on the slotted area. Where 6-8 in. wide slats are used, fully slotted floors may be recommended. Buildings with a single row of pens, with the alley along the front or back with partially slotted floors, generally result in good dunging patterns. Thus, building dimension or pen arrangement may be a factor in deciding how much of the floor should be slotted.

Injuries to the claws have been shown to be greater on total slats as compared to 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 in.) reduce claw injuries and clean as well as narrower slats.

Since partially slotted floors are also partially solid floors, it is important for labor reduction and pig performance that pigs develop a desirable dunging pattern. 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 toilet training pigs. 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 toilet training pigs.

Typical excretory behavior of pigs includes the following activities:

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

Recommendations for improving the dunging behavior of growing-finishing pigs:

- Use rectangular pens with a length, width ratio of 2½:1 or 3:1.
- Have 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 2-in. step down from sleeping to dunging area.
- 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 hovers over sleeping area in winter.
- Use bedding board in conjunction with bedding in fall-winter-spring situation.
- Use sprinklers over desired dunging area in summer.
- Restrain pigs in desired dunging area for about 10 minutes after first placing pigs in pen.

The floor configuration in farrowing houses varies among builders. Research results provide scant guidance in selecting farrowing house floor design. Houses with total, partial, or no slats can be managed successfully. Many houses have 24-30 in. of slats at the rear of the crate, and 12-18 in. of slats at the front, with the middle section being solid. The present trend appears to favor elevated farrowing crates with total wire floors.

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 4-5 in. wide, nursery slats 4-6 in. wide, and G-F slats 5-8 in. wide. Some of the metal and fiberglass slats for small pigs are as narrow as 1 in.

Table 1. Suggested slat spacings.

Farrowing crate	⅜ in., except at rear of sow where ¾-1 in. opening may be used.
Nursery (20-40 lb. pig)	½-1 in., depending on width of slat; wider slat/wider opening.
G-F (40-220 lb.)	¾-1 in., narrower slats of material other than concrete may use narrower openings. Wider slats, 5-8 in. need 1 in. opening.
Gestation or Boars	1-1⅛ in.

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

For slotted floored nurseries, the slat spacing should be either narrow enough so the pigs cannot get their legs caught at all, or wide enough (1 in.) 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 in., 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 pit. Since a retained placenta may result in certain health problems for the sow and litter, the manager must know if and when the placenta was 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.

Slat Direction

In most phases of production, slats that are placed so the openings are parallel to the long dimension of the pen or crate appear to favor pig comfort and mobility (Fig. 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.

The foregoing assumes a rectangular shaped pen. Slat direction in totally slotted floored 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 is also true for farrowing and gestation crates or stalls, even though the animal is not allowed free movement.

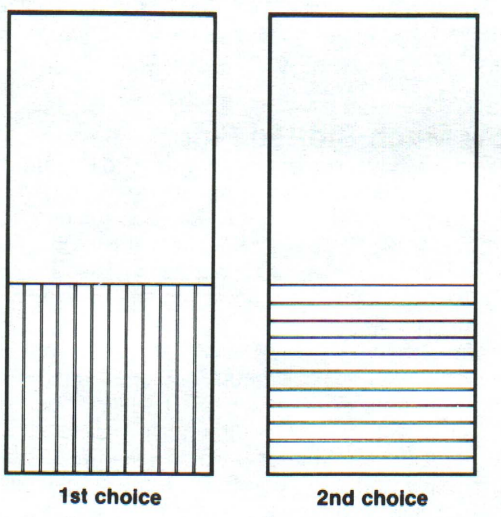


Figure 1. The recommended or preferred slat direction is shown on the left.

Floor Materials

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

Wood slats have the lowest first 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 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 often used in portable buildings or low investment remodeling situations. Because some producers live close to a source of wood that slats may be made from, even with a shorter life expectancy, it may be more economical to use wood slats.

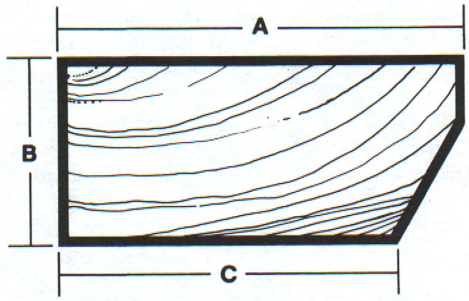
The recommended dimensions for wood slats are shown in Figure 2. The "A" dimension must be greater than the "C" dimension so the spacing will not become clogged. The slats are usually formed by ripping a rectangular timber on the diagonal, resulting in a vertical edge and an inclined edge. A second vertical 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 lactation, slats made of other material appear to work better for small pigs. Concrete slats can be precast by a concrete products plant, or 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) and complete 5 ft. wide and 8-12 ft. long farrowing sections.

Recommended dimensions for concrete slats (Fig. 3) are 5-8 in. tops with 4-5 in. depths (5 in. depth required for 8 and 10 ft. lengths). On solid concrete floors slopes of ½ in. per foot are recommended under-roof for growing-finishing and breeding-gestation. In farrowing situations where the floor is solid, ¼ to ½ in. slope per foot is recommended. Outside aprons should slope at the rate of ½ to ¾ in. per foot.

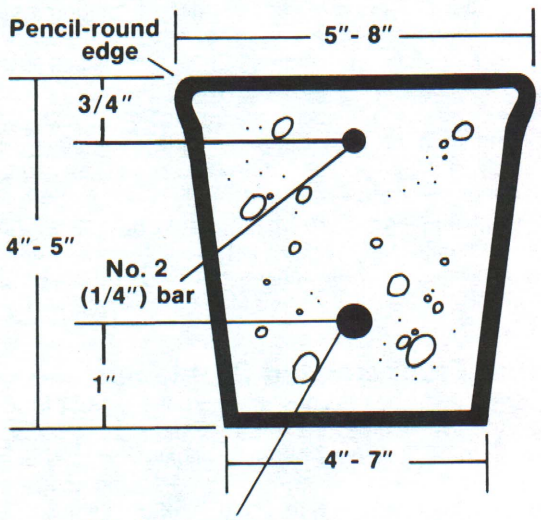
The ¼ in. bar in the top of the slat can be omitted when slats are cast in place and not moved. Use at least a 7 ½ bag mix of air-entrained cement with a 2-3 in. slump, and a maximum-sized aggregate of ½ in. A slight pencil-round edge can be provided by edging the slats with a ¼ in. sidewalk edger. This 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.

Metal of various designs (Fig. 4) has been used. Flattened expanded metal (¾ in., 9-11 gauge) has proved to work well for pigs under 40 lb. but has a shorter life when subjected to concentrated traffic of heavier animals. In farrowing crates, lay expanded metal so the long openings are parallel to the sow. Expanded metal with sharp edges should be avoided. Many of the early metal slats did not prove satisfactory because corrosion attacked the steel from the underside and caused failure after two to four years. Treating the underside of metal slats with epoxy paint or similar material extends its life. Steel grate 1-1 ½ in. wide and ¼-⅜ in. thick has worked well when spaced ⅝-¾ in. apart for farrowing and ½ in. apart for nursery units.



	A	B	C
2-ft. SPAN	3½-6 in.	2 in.	2¾-5 in.
4-ft. SPAN	3½-6 in.	2½ in.	2¾-5 in.
6-ft. SPAN	3½-6 in.	3 in.	2¾-5 in.
8-ft. SPAN	3½-6 in.	3½ in.	2¾-5 in.
10-ft. SPAN	3½-6 in.	4 in.	2¾-5 in.

Figure 2. Recommended dimensions for wood slats.



Reinforcing Bar
No. 3 (3/8") for 4 ft. slat
No. 4 (1/2") for 6 ft. and 8 ft. slat
No. 5 (5/8") for 10 ft. slat

Figure 3. Example of concrete slat.

Stainless steel has been popular in farrowing and nursery units. The stainless flooring comes in 8 ½ in. or 12 in. wide planks. Some planks are welded together into a grate, and others are bolted together. Most of the stainless steel sections will span from 4 to 10 ft., depending on the depth of the side flange. A longer life is expected with stainless steel flooring than from plain steel. Porcelainized steel slats are also available.

Aluminum slotted flooring is available in several shapes from narrow "T" section to 8 in. wide punched sections. It cleans very readily, but some can be slick for sows and heavier hogs. Aluminum must be insulated

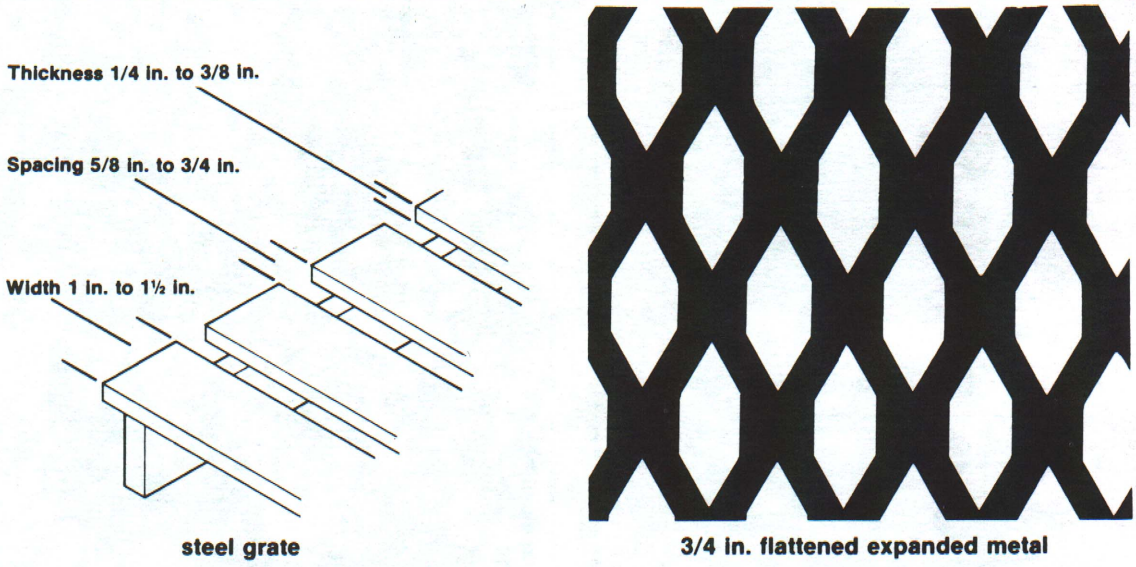


Figure 4. Example of metal slotted floorings.

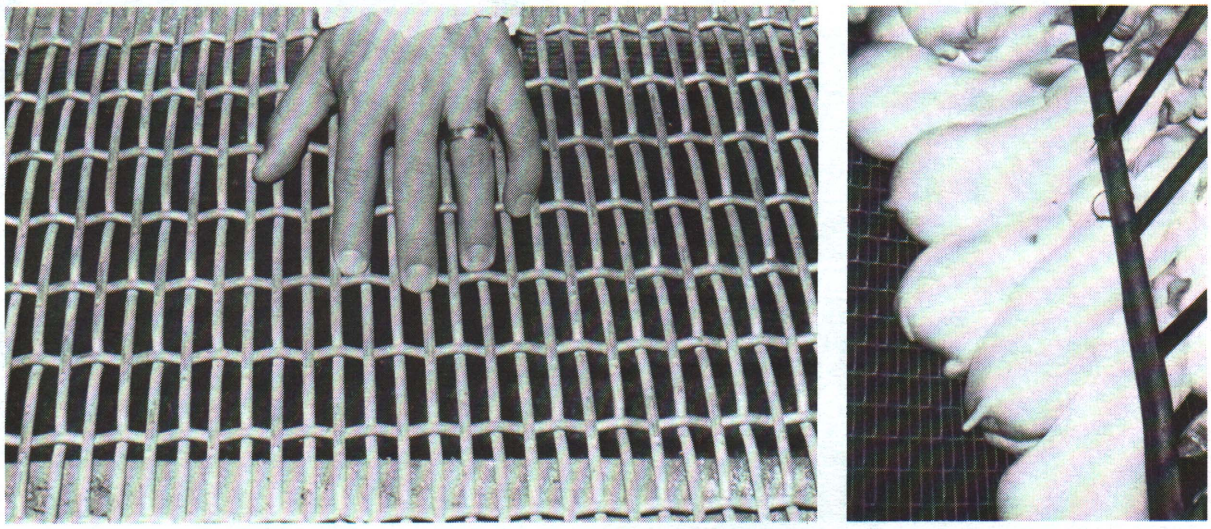


Figure 5. Example of wire flooring, including a closeup view.

from other materials, particularly steel, to avoid corrosion. Aluminum can be quite cold for small pigs.

Wire flooring (Fig. 5), coated and uncoated and coated expanded metal, is rapidly gaining in popularity, especially in farrowing and nursery situations. Figure 6 shows the gauge number, corresponding fraction of an inch, decimal of an inch, and millimeters. Five gauge wire has been the most common for farrowing and small nursery pigs, but much 3 gauge is also being used in these areas. Very little wire is used for breeding and gestation, but 3 gauge is used in some cases. 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 the wire 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 number used. In most cases support spacings of 12 to 16 in. are adequate. The ratio of open to solid floor area and level of pig traffic determine how rapidly fecal material moves through the flooring. Generally sow stools accumulate to some degree on all wire floor, while baby pigs' stools do not accumulate. Preventing constipation by adding laxative ingredients, such as beet pulp, bran, or epsom salt to sow diets is beneficial in reducing constipation and fecal accumulation.

Limited research and numerous field observations are quite consistent in showing 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 among pigs reared on elevated mesh or wire floor include:

- Separating excreta from pig area more rapidly
- Dryer pig/surface area
- Warmer air level
- Less draft
- Less abrasive material than concrete

Fraction of inch	Gauge no.	Decimals of inch	mm	Feet per lb.
7/16		.438	11.12	1.96
3/8		.375	9.53	2.67
5/16	0	.313	7.95	3.84
1/4	3	.250	6.35	6.00
7/32	4	.225	5.71	7.45
13/64	5	.207	5.26	8.81
3/16	6	.192	4.88	10.23
11/64	7	.177	4.50	12.05
5/32	8	.162	4.11	14.36
	9	.148	3.76	17.24
9/64	10	.135	3.43	20.70
1/8	11	.120	3.05	26.17
7/64	12	.105	2.67	34.24
3/32	13	.092	2.34	44.64
5/64	14	.080	2.03	59.17
	15	.072	1.83	72.99
1/16	16	.063	1.60	95.23
	17	.054	1.37	129.53
3/64	18	.047	1.19	170.94
	19	.041	1.04	224.71
	20	.035	.89	308.66

Figure 6. Wire sizes.

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 body lesions may occur regardless of floor type, especially when sows lose condition rapidly during lactation. Metal, fiberglass, or plywood overlays in the front one-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 may be necessary where temperatures and drafts are not well controlled.

Plastic slotted flooring of various shapes has become available during recent years. The plastic floors have the advantage of being somewhat warmer than concrete and metal, and they also clean readily. Plastic slats have been reported to be somewhat slick for sows and hogs over 100 lb. Some slat manufacturers have reported that a characteristic of PVC (plastic) is that it may develop a fatigue factor that is expressed as broken slats or a permanent sag. Because of this, plastic slats are currently somewhat heavier than those sold initially.

There has been recent interest in a 1 5/8 in. wide fiberglass reinforced plastic "T" slat for farrowing and nursery. The fiber strands in fiberglass are reported to interrupt the fatigue factor found in some plastics, thereby making them more durable. Fiberglass may also be slick, making it difficult for heavier pigs to walk. The most popular application for fiberglass and some types of plastic slats appears to be in partially slotted farrowing floors and nurseries. Most of the slotted floor materials used in farrowing and nursery pens could be used in flat-decks and double-deck nursery units.

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

Floor Smoothness

Concrete floors (solid and/or slotted) that are rough have been shown to result in more injury, lameness, and infection than smooth, clean floors. Therefore, concrete floors or slats should have a smoothness about equal to a machine trowel finish. Concrete slats that have a smooth surface and slight pencil-round edge 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. However, a floor can become too smooth as well. Problems with floors too smooth are nearly always associated with solid non-slotted areas. In general, if the floor is kept dry, and the slope does not exceed 1/2-3/4 in. per foot, it is rare for problems related to slickness to occur.

Sanitation Characteristics

How easily various surfaces clean 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 whatever follows is less effective. 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 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 Fig. 7). Claw size is involved since 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 larger digit is greater. Rough, non-resilient floors predispose to foot lesions as well. Some lesions can be expected to occur 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 when properly administered. To make a 5% solution, add 4 lb. of copper sulfate crystals to 10 gal. of water. To make a 10% solution add 8 lb. of copper sulfate to 10 gal. 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.

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 and sawdust have sometimes been used successfully in sparing amounts on the solid portion of a partially slotted farrowing pen, but extreme caution is advised. Secondary surfaces in the farrowing crate in the nursing-creep area have been used with some success. Rubber mats and outdoor carpet are examples. Important considerations here are durability and ease of sanitation.

Some paints or plastic-like materials painted on the floor in the nursing area of the farrowing crate may aid in reducing knee and hock abrasions to the pig. A latex based cement that can be applied over existing floor areas that are too rough or smooth may be obtained in most paint or hardware stores. Only material that is non-toxic to the pig should be used. It is also 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 tissue in this area for a period of one week 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. It is generally conceded that good quality concrete slats are the most durable and the least expensive. Concrete slats function extremely well for growing-finishing and breeding-gestation. Expanded metal, woven and welded, coated or uncoated, are usually recommended for farrowing and nursery situations. The most important consideration for coated or uncoated wire or mesh is proper structural support material and spacing. Follow the manufacturer recommendations carefully in this regard.

Reference to products in this publication is not intended to be an endorsement to the exclusion of others which may be similar. Persons using such products assume responsibility for their use in accordance with current directions of the manufacturer.

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COOPERATIVE EXTENSION SERVICE

Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8, and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Gordon E. Guyer, Director, Cooperative Extension Service, Michigan State University, E. Lansing, MI 48824.

Revised 7:85-3M-KMF-KE, Price 25¢, Single copy free to Michigan residents.