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THE MO-FLEX SWINE BUILDING SYSTEM

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ABSTRACT

A comprehensive source of information describing current building technologies and systems was required to meet the needs of independent swine producers investing in the swine industry. The MO-Flex Swine Building System was developed as plan packages to fill these building information needs. Plan packages were developed to provide a comprehensive source of information. The plans incorporated flexibility to allow producers to select desired preferences as well as change as their needs changed with the industry.

Keywords: Swine, Mo-Flex, Swine housing.

INTRODUCTION AND OVERVIEW

The MO-Flex Swine Building System was developed to provide Missouri's independent swine producers with a comprehensive, standardized building plan package using current technology. A plan package has been developed for the four stages of swine production: farrowing, nursery,

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grow-finish, and breeding-gestation. A plan package includes 20 - C sheets (17" x 22") of construction drawings and a manual. The drawings show how a building should be built. The accompanying manual provides additional construction and specification details as well as a discussion of the design, operation and maintenance requirements of the building system.

The MO-Flex Swine Building System uses the same basic structural design for all stages of production. The MO-Flex building is a post-frame structure using pre-engineered, commercially available trusses and a built-up post design. The common structure is a nominal 12.2 meter (40-foot) wide building. The building length can be varied to fit the needs of the swine producer and stage of production. Potential benefits of a common structural design include improved quality of construction and reduced building cost because builders will become familiar with the standardized design.

Flexibility and adaptability have been incorporated into the total MO-Flex Swine Building System. Independent swine producers are faced with rapid changes in the industry. These changes may dictate that a building built today for a particular stage of production may best be used for a different production stage in the future. The MO-Flex Swine Building System has addressed this potential change in facility use. The MO-Flex System allows for easy conversion between farrowing and nursery stages as well as between grow-finish and breeding-gestation stages. The limiting factors in converting buildings between stages of production could include the initial building length and possibly the manure handling system.

Manure removal systems acceptable for 21st century swine production include flushing, pit recharge and hairpin gutter systems. All three of these manure removal systems are available with the MO-Flex Swine Building System. These three manure removal systems allow for the potential of adequate indoor air quality within the production unit.

Facility management preferences must be incorporated into the design and construction of a swine confinement facility. The MO-Flex Swine Building System allows for many of the more popular management choices to be utilized. However, the selected management choices have various "trade-offs" and must be evaluated during the final stages of the design process. The remainder of this paper discusses several design characteristics for each production stage of the MO-Flex Swine Building System. The following design characteristics are based on the management preferences of the author.

MECHANICALLY VENTILATED ALL-IN-ALL-OUT FARROWING FACILITIES

1) Manure removal from the animal space must be provided. Preferred methods include 1) flushing with recycled water at least several times a day under raised crates; 2) shallow pit gravity drained and recharged with lagoon water {pit recharge system} and 3) shallow pit gravity drain, liquid manure system.

2) Recommended crate characteristics include: raised above the gutter floor; adjustable side for sow widths ranging from 48 to 63 cm (19" to 25"); adjustable back bar for sow lengths ranging from 198 to 213 cm (78" to 84"); bottom rail should be 24 to 25 cm (9.5" to 10") above crate floor; floor material to separate waste water and manure from animals.

3) Exterior building walls should have a **minimum** insulation level of an R-value of 3.34 K-m^2/W (19 F-hr-ft^2/BTU) {13 cm (5") fiberglass batt insulation and typical frame construction with vapor retarder between inside wall covering and insulation}.

4) Ceiling should have a **minimum** insulation level of an R-value of 5.28 K-m^2/W (30 F-hr-ft^2/BTU) {25.4 cm (10") fiberglass insulation with vapor retarder between ceiling material and insulation}.

5) Building should have 5 cm (2") thick rigid water resistant insulation around perimeter foundation.

6) Interior surfaces should be non-porous so that they are easy to clean. Surfaces need to be durable to withstand repeated high-pressure washings using detergents and disinfectants. Typical surfaces include corrugated galvanized steel, corrugated aluminum and glass-board.

7) Farrowing house temperature should be maintained between 18.3 and 22.2 °C (65 and 72 °F) to maximize sow comfort and performance. Typical air temperature monitoring devices include high-low thermometers and integrated electronic controllers.

8) Baby pig area (creep area) should have an additional heat lamp or heating pad to maintain a baby pig environment at a minimum of 30°C (86 °F).

9) Continuous minimum ventilation must be provided throughout the year using a small ventilation fan {Typically a 20 to 35 cm (8" to 14") fan matched with an appropriate air inlet system for proper air distribution}.

10) The ventilation system should be capable of maintaining the inside temperature within 2.8 °C (1 to 1.7 °C preferred) {5 °F (2 to 3 °F preferred)} above outside temperature in warm and hot weather. For example, when the outside temperature is 29.4 °C (85 °F), the inside temperature should be no greater than 32.2 °C (90 °F).

11) Integrated electronic controls monitor indoor air temperature and automatically activate heater or ventilation fans as needed to maintain desired indoor temperature.

12) Evaporative cooling for sows should be provided by a drip-cooling system which is electronically controlled to operate when the inside temperature rises above 27.8 °C (82 °F).

MECHANICALLY VENTILATED ALL-IN-ALL-OUT NURSERY FACILITIES

1) Manure removal from the animal space must be provided. The preferred methods include 1) flushing with recycled water at least several times a day under pen floors; 2) shallow pit gravity drained and recharged with lagoon water {pit recharge system} and 3) shallow pit gravity drain, liquid manure system.

2) Recommended pen characteristics for nursery pigs 3 weeks to up to 11 weeks of age include: arranging pens into a single deck; locating an alley next to each row of pens; providing 0.18 to 0.28 m2 (2 to 3 ft2) per pig; housing 10 to 20 pigs (1 to 2 litters) per pen; selecting washable and durable pen partitions and gates; using an easily cleaned floor material throughout the pen to separate waste water and manure from pigs.

3) Exterior building walls should have a minimum insulation level of an R-value of 3.34 K-m2/W (19 F-hr-ft2/BTU) {13 cm (5") fiberglass batt insulation and typical frame construction with vapor retarder between inside wall covering and insulation}.

4) Ceiling should have a minimum insulation level of an R-value of 5.28 K-m2/W (30 F-hr-ft2/BTU) {25.4 cm (10") fiberglass insulation with vapor retarder between ceiling material and insulation}.

5) Building should have 5 cm (2") thick rigid water resistant insulation around perimeter foundation.

6) Interior surfaces should be non-porous so that they are easy to clean. Surfaces need to be durable to withstand repeated high-pressure washings using detergents and disinfectants. Typical surfaces include corrugated galvanized steel, corrugated aluminum and glass-board.

7) Nursery room temperature should be maintained at 29.4 °C (85 °F) during the first week for newly weaned pigs. The desired temperature is then reduced about 1.7 °C (3 °F) each successive week until the room temperature reaches 18.3 to 21.1 °C (65 to 70 °F). Typical

air temperature monitoring devices include high-low thermometers and integrated electronic controllers.

8) Continuous minimum ventilation must be provided throughout the year using a small ventilation fan {Typically a 20 to 25 cm (8" to 10") fan matched with an appropriate air inlet system for proper air distribution}.

9) Continuous minimum ventilation should be capable of being increased as pigs grow. Minimum ventilation rate requirements increase three fold for pigs growing from 3 to 11 weeks of age.

10) The ventilation system should be capable of maintaining the inside temperature within 2.8 °C (1 to 1.7 °C preferred) {5 °F (2 to 3 °F preferred)} above outside temperature in warm or hot weather. For example, when the outside temperature is 32.2 °C (90 °F), the inside temperature should be no greater than 35 °C (95 °F).

11) Integrated electronic controls monitor indoor air temperature and automatically activate heater or ventilation fans as needed to maintain desired indoor temperature.

NATURALLY VENTILATED ALL-IN-ALL-OUT GROW-FINISH FACILITIES

1) Manure removal from the animal space must be provided. The preferred methods include 1) flushing with recycled water several times a day (about every 2 hours for best indoor air quality) under concrete slats; 2) shallow pit gravity drained and recharged with lagoon water {pit recharge system} and 3) shallow pit gravity drain, liquid manure system.

2) Recommended pen characteristics include: using totally slatted pen floors; providing 0.74 m^2 (8 ft^2) per pig; housing 15 to 25 pig per pen; selecting durable and non-solid pen partitions and gates.

3) Exterior insulated building walls should have a **minimum** insulation level of an R-value of 3.34 K-m^2/W (19 F-hr-ft^2/BTU) {13 cm (5") fiberglass batt insulation and typical frame construction with vapor retarder between inside wall covering and insulation}.

4) Ceiling, if used, should have a **minimum** insulation level of an R-value of 5.28 K-m^2/W (30 F-hr-ft^2/BTU) {25.4 cm (10") fiberglass insulation with vapor retarder between ceiling material and insulation}.

5) Insulated roofline, if used, should have a **minimum** insulation level of an R-value of 3.34 K-m^2/W (19 F-hr-ft^2/BTU) {13 cm (5") insulation with vapor retarder between inside covering and insulation}.

6) Building should have 5 cm (2") thick rigid water resistant insulation around perimeter foundation.

7) Interior surfaces should be non-porous so that they are easy to clean. Surfaces need to be durable to withstand repeated high-pressure washings using detergents and disinfectants. Typical surfaces include corrugated galvanized steel, corrugated aluminum and glass-board.

8) Building sidewalls are constructed to use ventilation curtains. These curtains allow for non-mechanical ventilation during mild and hot weather.

9) Grow-finish indoor air temperatures should be maintained at 18.3 to 21.1 °C (65 to 70 °F). Typical air temperature monitoring devices include high-low thermometers and integrated electronic controllers.

10) Continuous minimum ventilation must be provided throughout the year.

11) The natural ventilation system should allow the building to be opened such that the inside air temperature is maintained within 2.8 °C (1 to 1.7 °C preferred) {5 °F (2 to 3 °F

preferred)} above outside temperature in warm and hot weather. For example, when the outside temperature is 29.4 °C (85 °F), the inside temperature should be no greater than 32.2 °C (90 °F).

12) Evaporative cooling should be provided for all animals by either a drip or a spray/sprinkler cooling system which is electronically controlled to operate when the inside temperature rises above 27.8 °C (82 °F).

BREEDING AND GESTATION FACILITIES

1) Manure removal from the animal space must be provided. The preferred methods include 1) flushing with recycled water at least several times a day under concrete slats; 2) shallow pit gravity drained and recharged with lagoon water {pit recharge system} and 3) shallow pit gravity drain, liquid manure system.

2) Gestating sows should be housed in individual crates over partial slats. Individual crate housing provides not only the best reproductive potential but also allows for individual care of gestating sows.

3) Exterior insulated building walls should have a **minimum** insulation level of an R-value of 3.34 K-m^2/W (19 F-hr-ft^2/BTU) {13 cm (5") fiberglass batt insulation and typical frame construction with vapor retarder between inside covering and insulation}.

4) Ceiling should have a **minimum** insulation level of an R-value of 5.28 K-m^2/W (30 F-hr-ft^2/BTU) {25.4 cm (10") fiberglass insulation with vapor retarder between ceiling material and insulation}.

5) Building should have 5 cm (2") thick rigid water resistant insulation around perimeter foundation.

6) Interior surfaces should be non-porous to allow for long life. Typical surfaces include corrugated galvanized steel, corrugated aluminum and glass-board.

7) Building sidewalls are constructed to use ventilation curtains. These curtains allow for non-mechanical ventilation during mild weather and/or allow for emergency ventilation during power failures.

8) Breeding and gestation facility indoor temperatures should be maintained at 15.6 to 18.3 °C (60 and 65 °F). Typical air temperature monitoring devices include high-low thermometers and integrated electronic controllers.

9) Breeding area of the facility should allow for an individual mating system. The MO-Flex Swine Building System includes a new breeding system layout.

10) Continuous minimum ventilation must be provided throughout the year.

11) The ventilation system should be capable of maintaining the inside temperature within 2.8 °C (1 to 1.7 °C preferred) {5 °F (2 to 3 °F preferred)} above outside temperature in warm and hot weather. For example, when the outside temperature is 29.4 °C (85 °F), the inside temperature should be no greater than 32.2 °C (90 °F).

12) Integrated electronic controls monitor indoor air temperature and automatically activate heater or ventilation fans as needed to maintain desired indoor temperature.

13) Evaporative cooling for all animals should be provided by either a drip-cooling system or an evaporative pad cooling system which is electronically controlled to operate when the inside temperature rises above 27.8 °C (82 °F).

SUMMARY

The MO-Flex Swine Building System was developed to provide independent swine producers access to 21st century facility technology and understanding. The building system incorporates a common structural design to potentially help the construction industry improve quality and reduce construction costs. Flexibility to convert facilities from one stage of production to another was also incorporated to allow operations to adjust production on a given site without losing significant facility investment.