Design of Modern Pig Farms

--1,000 annual commercial pigs population

Abstract: With the growing popularity of pig farming science & technology, the specialized pig farming industry is gradually consolidated and prospered. The mechanized pig farming is a kind of long-run industry, and it is dependent on the basis of the development of technology to a large extent, therefore, the pig farmers should enhance the infrastructure, strengthen the technical training to adapt to the development of pig farms.

Keywords: modern pig farm design, pig farm functional area design, pig production building design, pig houses design, pig farm mechanized equipment, pig farm ventilation, pig farm sterilization, dry-wet pig feeder, pig waterer, buck-billed pig drinker, nipple piglet drinker, pig manure cleaner, guide-frame scraper cleaner
In recent years, with the growing popularity of pig farming science & technology, the specialized pig farming industry is gradually consolidated and prospered. Here is a design program of a modern pig farm, taking the pig farm with annual fattened pigs population of 1,000 as an example, to discuss the design of the farm functions, farm buildings, farm ancillary equipment and farm mechanization, etc. based on mechanized pig farming technology.

**Pig Farm Design Basis**

The pig farm that has annual production of 1,000 fattened pigs, needs 2 male breeding pigs, 83 female breeding pigs, 100 sucking pigs, 1,000 weaned pigs and 370 grown pigs. Mechanized pig production is mainly planned according to the raising technology. Currently, what is widely-used is the all-in & all-out technology on a weekly basis, which adopts segregated early weaning (SEW). SEW is to increase the sow farrowing production, reduce diseases infection and improve piglets health condition by weaning the piglets and breeding them in a clean nursery house that is 250m away from the farrowing house.

**How to Design the Pig Farm**

1. Pig Farm Location

---Long-term plan: Today’s society and urban-rural construction are developing rapidly, and pig farming is a long-run industry, so the farm design should conform to the city development. It is good to set the pig farm in the livestock production base as a part of the shopping basket program, because there will be no worry about demolition. To avoid the dust, smell and noise, the pig farm should be located downwind residential area, above 300-500m away form the residential area and no less than 100-200m away from the traffic trunk line; and the farm should have enough space to have further expansion.
---Pig house position: To make the pig house warm in winter and cool in summer, the pig house have to be located towards the south and there can be a certain deviation depending on the differences of the terrain and latitude. But in the mechanized pig farm, the climate is manually controlled, focusing on centralized management and mechanized production, rather than choosing the pig farm orientation.

---Factors of water, electricity, traffic, etc. The daily water consumption in a mechanized pig farm with 1,000 pigs, is 16t, so clean and stable water source is the first thing to consider when build the farm; generally, the installed capacity of the pig farm is 30kw, and there can not be a power failure, because the power failure will cause troubles of water supply, ventilation & cooling, heating & moisturizing, so stable power supply is the another thing to consider, and a small generator for spare use is necessary in case power failures; everyday feed materials, feces and live pigs, etc to handle in the farm is about 4t, so convenient transportation should be taken into consideration to reduce the transport cost.

---Hygiene and epidemic prevention: In order to keep a good living condition for pigs, the farm site should be in a place having high topography, broad terrain and good ventilation, and also the site should be far away from the residential areas, medical institutions and slaughter houses, etc, with only one in-out way.

---Excreta disposal: If the massive waste can not be disposed timely and effectively, the environment around the pig farm will be polluted, leading to imbalance of ecology. For this reason, the farm should be away from drinking water source and have space for sewage treatment. Combining with the fish farming and crops production and drying the feces to sell as fertilizer are the suggested ways for pig waste green treatment.

2. Functional Area Design

---The mechanized pig farm overall layout is arranged from the perspective of solid hygiene & epidemic prevention system and production management. Usually, the pig farm is divided into several districts according different functions and they are
production buildings, including farrowing house, breeding pig house, finishing house, etc; auxiliary production buildings, including feedstuff plant, water tower, boiler plant, warehouse, switch house, veterinary office, slaughter house, pig loading stand, etc; production management buildings, including executive office, living quarters, etc. The auxiliary production buildings and the production management buildings should be separated from the production buildings to avoid and control epidemic; but the production management buildings should be arranged around the production buildings to facilitate the production. The production buildings and the auxiliary production buildings should be in the downwind area and lower than the production management buildings in terrain, and the veterinary office and the manure storage pond should also be in the downwind area and lower than the production buildings.

---The modern pig farm set the specialized pig houses according to different production requirements, such as breeding house, farrowing house, nursery house, etc. The distance between pig houses should be no less than 20m, and the houses should be linked by paths and aisles, reducing the distance of water, electricity and heating supply circuits to improve work efficiency. The piggery layout should be proper enough for pigs to move around; the nursery house and fattening house should be in the place with convenient transport for product conveying.

---The breeding pigs and the finishing pigs should be separated by a epidemic prevention space, and the breeding pigs should be in the downwind area. The feedstuff plant and the pig loading stand should be set in the boundary of the production area to avoid foreign vehicles entering the production area, which is good for epidemic prevention. Plant trees around the farm to adjust the micro-climate.

3. Production Building Design

---Piggery building: In the process of piggery graphic design, calculating the breeding quantity and the fencing quantity in every production period according to the mechanized technology, is the first step. Taking the farm with annual production of 1,000 market pigs as example:
Breeding amount: SEW shortens the nursing time, and the annual birth of one sow increases to 2.3 births/year (usually it is 2.1 births/year). For annual 1,000 market pigs, the amount of breeding sow is:

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\frac{1000}{2.3 \text{ births/year}} \div 10 \text{ heads/birth} \div 90\% \div 95\% = 40.85 \text{ heads} = 51 \text{ heads},
\]

which is 10 heads less than usual raising technology (90% is the survival rate of suckling pigs, 95% is the survival rate of piglets). If there are 51 sows, there should be 2 boars, so the weekly birth is:

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51 \times 2.3 \text{ births/year} \div 52 \text{ weeks} = 2.256 \text{ births},
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that is every week there will be 2.256 sows mated and 2.256 sows farrowed, and the born piglets is:

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2.256 \times 10 \text{ heads/birth} = 22.56 \text{ heads}
\]

Weekly market pigs: 22.56×90%×95%=19.29 heads≈19 heads

Annual market pigs: 19×52=988 heads

Fencing amount:

- Boar stalls: the number is 2, the acreage of each is 5.04㎡ (2.4m×2.1m)
- Gestation crates: breeding sow qty. – farrowing sow qty = 51 – (3 weeks×2.256 heads/week ) = 44.2 heads, taking the number of 43 for the factor of replacement gilts, and the area of each is 1.26㎡ (2.1m×0.6m).
- Farrowing crates: the pregnant sows are transferred to the farrowing crates 1 week prior to giving birth; clean and sterilize the farrowing crates 3 weeks before farrowing and 1 week after farrowing. The number is:
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  2.256 \times 5 = 11.3, \text{ taking 11, and acreage of each is 4.07 ㎡ (2.2 m×1.85 m).}
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- Nursery crates for new-born piglets: 6 weeks for nursery and 1 week for cleaning & sterilizing. The number is:
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  2.256 \times 8 = 7.896, \text{ taking 8, acreage of each is 8.1 ㎡ (3 m×2.7 m).}
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- Growing & breeding crates: 6-week growing period (1-week cleaning & sterilizing) and 11-week breeding period.
  The number of growing crates is:
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  2.256 \times 6 = 13.536, \text{ acreage of each is 16.2 m² (5 m×2.2563 m).}
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  The number of breeding crates is:
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  2.256 \times 11 = 24.816, \text{ taking 13, acreage of each is 24 m² (5 m×4.8 m).}
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4. Graphic Design of All Kinds of Pig Houses

The graphic design is based on the pig fence amount and the main principles are: the pig house width is 7.5~11 m with 2 rows for good ventilation and cooling in summer; the length is 60~100 m for easy waste discharge, and to make the most of
lands, there cannot be big difference in length of pig houses.
So, for the pig farm with 1,000 pigs annually, the pig houses sizes should be: 1
replacement breeding boars house (15 m×7.5 m), 1 breeding boars house (15 m×7.5
m), 1 replacement breeding sows house (25 m×7.5 m), 1 non-pregnant sows house
(10 m×7.5 m), 2 pregnant sows houses (25 m×7.5 m), 2 farrowing houses (25
m×10.5 m), 2 breeding houses (25 m×7.5 m), 2 growing houses (25 m×11 m), 2
fattening houses (15 m×11 m).
And there are some points to pay attention to when doing the graphic design:
All the pig houses should be 2-row design so as to manage and prevent epidemic
easily; to get enough sunlight for sterilization and heating in winter, the pig house
should face the south, and if it is restricted by the terrain, the orientation can have
some adjustment between SBW 5°and SBE 15°; from the aspect of ventilation and
epidemic prevention, the distance between the pig houses generally is no less than
9m, should be 2~2.5 times height of the pig houses.

5. Other Buildings Design in Production Area

The other buildings in production area are: pig loading stand, waste loading stand,
feedstuff plant, veterinary office, workers disinfection room, vehicles sterilization
room and roads, etc. And for their designing:

---Set one passageway, workers & vehicles sterilization room, duty room;
---Pig loading stand and waste pond are outside the walls to avoid conveying vehicles
entering into the production area;
---Foreign trucks convey the feed stuff to the feedstuff plant, but conveying to pig
houses is done by the trucks of the production area;
---Roads in the production area are divided into sidewalk, feed conveying way, pig
conveying way, waste conveying way, etc;
---The isolated pig houses should be far away from pig production houses, in the
downwind or side-wind area;
---Water and power sources are close to the pig houses for convenient use and
reduced waste; protect water from pollution and safely use power;
---Pursue integrated process of feces and waste water and recycle them according to
the actual situation; separate rain water and waste water to reduce sewage treatment
capacity.

6. Living Quarter and Office Block Design

The living quarter and office block should be sited in a good location away from the
production area; the office block should be manageable for foreign personnel &
vehicles sterilization.

Piggery Buildings Design

---The foundation: its main purpose is to bear the piggery weight, snows and wind; its embedment depth is determined by the total load of piggery, sub-grade bearing capacity, the ground water level, climate conditions, etc; it must be water-proof and damp-proof to prevent the inner piggery and walls from moist; the top of the foundation wall should be set with damp-proof course to avoid groundwater soaking the wall.

---The wall: it is usually the clay-brick walls, plastering cement mortar outside the wall and 1m wainscot inside.

---The roof: weld steel beam (8 m×1.2 m) by using angle steel (5 cm×5 cm); set up the steel beams with a 2.8m interval between each and place wood purlin (6 cm×9 cm) on them; nail a layer of 2cm plank on the purlin and spread a layer of 3cm polystyrene board; place a layer of plastic film above and below the polystyrene board to wrap it to facilitate ventilation and heating; the last step, cover with asbestos tiles to reduce piggery inner radiant heat.

---The gate: it is for pig getting in and out (height: 2~2.4 m, width: 1.2~1.5 m); set a ramp way outside the gate to help pigs and trolleys in & out and a linen curtain to keep heat.

---The floor: the pig fence is double-row with 1.2 m wide channels centrally located, and the ground inside is leaning to the central channel, which helps the ground dry; a shallow groove with a little slope (the slope is from the west to the east) is arranged on both sides of the channel, making the sewage flow into the sewage pool under the feedstuff plant, then flow out of the wall through the waste discharging channel; the ground of the piggery should be solid, waterproof, smooth, nonskid, easy to clean and sterilize.

Breeding Pigs Playground and Disinfecting Pool Design

Every year the piggery will be in use for 4-5 months and breeding pigs need proper movement for good production, so a breeding pigs playground is necessary. In order not to increase the enclosed piggery building area, the walkway between the pig fence and wall should be 1.3m wide. Disinfecting pool (4 m x 3 m) should be built beside the farm gate, and beside the entrance of every piggery, there must have a 1 m² disinfection pool.

Pig Crates & Stall Design
The enclosures of pig crates & stalls are welded into grated type with hot-dip steel pipes and their height is 1.5m; the area of every pig crates & stall is 3 m². Amisy Machinery is one professional manufacturer of pig farming equipment. The pig farrowing crates, pig gestation crates and piglet nursery crates they supply has solid and flexible design to meet different pig production requirements.

Ventilation and Heating Design
5 windows (70cm×70cm) on the piggery back-wall, 4 air vents (50cm×50cm) on the piggery roof frontier, to exhaust the bad smell. There are several popular equipment from Amisy Machinery for pig house ventilation and heating. The fiber reinforced plastic fan, negative pressure fan, evaporative air cooler and evaporative cooling pad are for ventilation; and the piggery hot blaster heater is brand-new tempering system from Amisy which has a wide applicable area and can maximize thermal emission and transfer it to the piggery in the best possible way to keep energy cost at a minimum.

**Manure Emission Ditch Design**

Set an emission ditch between the 2 rows of pig crates & stalls, whose upper width is 35-40cm and base width is 20cm, and inside of which is troweled with cement. Build an enclosed manure pond at the other end of the emission ditch, and the manure pond exit should be ≥30cm higher than emission ditch exit in height to prevent flies and worms entering the piggery through the emission ditch.

**Pig Farm Mechanical Equipment**

1. **Dry-wet Feed Box**

In the process of dry feeding, the feed box and automatic waterer are completely separated, and when pigs drink water after eating dry feed, it is easy to drop and waste feed. The dry-wet feed box combines the feed box and the automatic waterer, so that pigs can have eat of dry-wet feed with no residue, reducing waste and F/G (feed/gain), increasing pig feed intake and growing rate. Amisy dry-wet pig feeder integrates automatic feeding & drinking function, suitable for both powder feedstuff and feed pellets. The feed can be delivered evenly through the delicate valve, and it also has automatic regulation device. The drinker can make pigs do less running from feeder to waterer, and benefit for a good digestion.
2. Pig Waterer

Use duck-billed drinker or nipple drinker. The duck-billed drinker adopts spring and rubber mat for seal, and has features of less leaking, light weight and avoiding diseases transmission. When pigs drinking water, they hold the drinker in their mouth to get full water flow to reduce waste. The duck-billed pig drinker and nipple piglet drinker from Amisy has been the preferred watering devices for many pig farmer worldwide, and their pig waterer bowl is another advanced device for both piglets and adult pigs watering.
3. Manure Cleaner

Use guide-frame scraper cleaner. The scraper width is 90-240cm, height is 100-150cm, and the manure ditch depth is 20cm. The scraper can be controlled by a timer to set scraping times to keep clean living condition for pigs.

Summary

The living quarters and office blocks are located in the south of the farm, having relatively good surroundings. The production piggery is the center and the auxiliary facilities are built around the production piggery.
This example pig farm applies SEW. The male pig house, non-pregnant pig house, pregnant pig house and farrowing house are in the south, having less pollution; the nursery house, growing house and breeding house are in the north, preventing epidemic. There are 2 roads in this farm, the one in the west is for conveying live pigs and manure; the other in the east is for workers walking and feed carriage, and the 2 roads has no cross to avoid pollution. The pig loading stand and the waste loading stand are in the northwest, having less influence on the whole pig farm. In the open areas in the farm, fruits and vegetables are planted to help greening, and also to help make extra income.

Success or failure of the mechanized pig farming is dependent on the basis of the development of technology to a large extent, namely, it is dependent on the compound feed technology, technology of complete sets of equipment, disease prevention and modern livestock breeding technology. Therefore, the pig farmers should enhance the infrastructure, strengthen the technical training to adapt to the development of pig farms.