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Characteristics of low-profile cross-ventilated freestalls

Abstract

The first low-profile cross-ventilated (LPCV) freestall building was stocked in fall 2005 in North Dakota. There currently are 3 other LPVC freestalls operational and 6 others under construction. The LPCV building offers some of the advantages of natural ventilated and tunnel ventilated freestalls. Natural or conventional tunnel ventilation buildings normally have from 2 to 6 rows of freestalls. The first LPCV building was an 8-row configuration, but wider LPCV buildings with 10, 12, 16, or 24 rows of freestalls are being considered. Low-profile cross-ventilated freestall buildings are another option for dairy cattle housing. These facilities allow producers to have more control over the cow's environment during all seasons of the year. They also allow cows to be located closer to the milking parlor, reducing time away from feed and water.; Dairy Day, 2006, Kansas State University, Manhattan, KS, 2006;

Keywords

Diary Day, 2006; Kansas Agricultural Experiment Station contribution; no. 07-118-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 965; Dairy; Cooling systems; Cross ventilation

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CHARACTERISTICS OF LOW-PROFILE CROSS-VENTILATED FREESTALLS

J. P. Harner¹, J. F. Smith, and R. Millner²

Summary

The first low-profile cross-ventilated (LPCV) freestall building was stocked in fall 2005 in North Dakota. There currently are 3 other LPVC freestalls operational and 6 others under construction. The LPCV building offers some of the advantages of natural ventilated and tunnel ventilated freestalls. Natural or conventional tunnel ventilation buildings normally have from 2 to 6 rows of freestalls. The first LPCV building was an 8-row configuration, but wider LPCV buildings with 10, 12, 16, or 24 rows of freestalls are being considered. Low-profile cross-ventilated freestall buildings are another option for dairy cattle housing. These facilities allow producers to have more control over the cow's environment during all seasons of the year. They also allow cows to be located closer to the milking parlor, reducing time away from feed and water.

(Key Words: Cooling Systems, Cross Ventilation.)

Characteristics

The low profile results from the roof slope being changed from a 3/12 or 4/12 pitch common with natural ventilated buildings to 0.5/12 or 1/12 pitch. Figure 1 shows the difference in ridge height between 4-row natural ventilated buildings and an 8-row LPCV

building. Contractors are able to use conventional warehouse structures with the LPCV building, which reduces the cost of the building. The interior components and space per cow for resting, socializing, and feeding in a LPCV building is similar to a 4-row building. Figure 1 illustrates the differences in land space requirements between the two, 4-row natural ventilated freestall buildings and an 8-row LPCV building.

Many dairies are currently tunnel ventilating freestall buildings. The traditional tunnel ventilation has moved air parallel to the ridge of the building. The challenge remains how to maintain air in the cow space. The air tends to move toward the alleys, ceiling, or feed lane, where there is no interference from cows. Some dairies have installed baffles to redirect air into the cow space. The bottom of the baffle, however, cannot interfere with normal operation of the bedding and feeding equipment. The LPCV building moves air perpendicular to the ridge or across the building. Because air is moving across the building, the baffles may be strategically located to move air back into the cow space without interfering with equipment. The bottom of the baffle is 8 to 10 feet above the floor, depending on the number of baffles. This compares with 12- to 13-ft openings in tunnel-ventilated freestalls. Baffle design and placement is critical to minimize the static pressure encountered by the fans. As static pressure increases, fan per-

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formance decreases. The LPCV building is continuously ventilated mechanically, so emergency backup power must be available.

Figure 2 shows an end view of an 8-row LPCV building. Pads are placed continuously along one side of the building, and fans are placed on the opposite side. There is more space available for placement of fans and evaporative pads parallel to the ridge rather than perpendicular because the equipment doors typically are placed in both end walls. Figure 3 shows a layout of an 8-row LPCV building with tail to tail freestalls. From a top view, this design simply places two 4-row freestall buildings side by side and eliminates the space between the buildings for natural ventilation. One potential advantage of the LPCV or tunnel ventilated buildings is that cows are exposed to nearly constant wind speeds. Inside the building, the air velocity or wind speed will normally be less than 8 mph during peak airflow. The ventilation rate is reduced during cold weather, so wind speed is reduced to less than 2 mph.

During warm weather, the air exchange rate is 60 to 90 seconds. An air exchange is equivalent to replacing all of the air inside the building with fresh air. If the air exchange rate is 60 seconds, then every 60 seconds the fans are moving enough air to completely exchange the air inside the building with outdoor air. The air exchanged is reduced during the winter months. The LPCV building in North Dakota currently has a winter-time exchange rate of 180 to 240 seconds. This facility is managing airflow rates based on ammonia concentrations rather than air temperatures, because average wind speed through the building is less than 1 mph. Measured ammonia emissions at the exhaust fan were between 1.2 and 1.5 ppm, depending on the air exchange rate.

Most dairies exploring the LPCV building are using a scrape system for manure man-

agement. The building manufacturer should be contacted before selection of a manure system. Buildings may be flushed if placed on a 2 to 3% slope. There may be some structural concerns, however, due to shifting rain and snow loads. Depending on roof design and materials selected, some rain or snow may flow to the lower end of the building rather than toward the edge. This creates additional loads near the lower end of the building.

Proper lighting in LPCV building is important because no natural light exists. Research indicates that 10 to 15 foot candles of light are necessary for milk production. High and low bay metal halide light fixtures may not be suitable because of lower fixture mounting heights. Mounting height is determined by the distance from the bottom of the fixture to the work surface. In a freestall building, the work surface is better defined by the top of the loops or feed rail. Most metal halide lights recommend, for optimum light distribution, that the mounting height be 12 to 20 feet, depending on the fixture. The mounting height for florescent lights is 6 to 12 ft, which is better suited for the LPCV buildings. The lighting should be designed based on 25 foot candles of light throughout the building, rather than 10 to 15 foot candles. Bulb lumens or light output tends to decrease over time, especially as fixtures accumulate dust and fly specks. Additional lighting in the building also will create a better environment for employees to perform their tasks.

Low-profile cross-ventilated freestall buildings are another option for dairy cattle housing. These facilities allow producers to have more control over the cow's environment during all seasons of the year. They also allow cows to be located closer to the parlor, reducing time away from feed and water. The footprint of these facilities is smaller than naturally ventilated facilities. Additional research trials are in process to determine the viability of LPCV buildings.

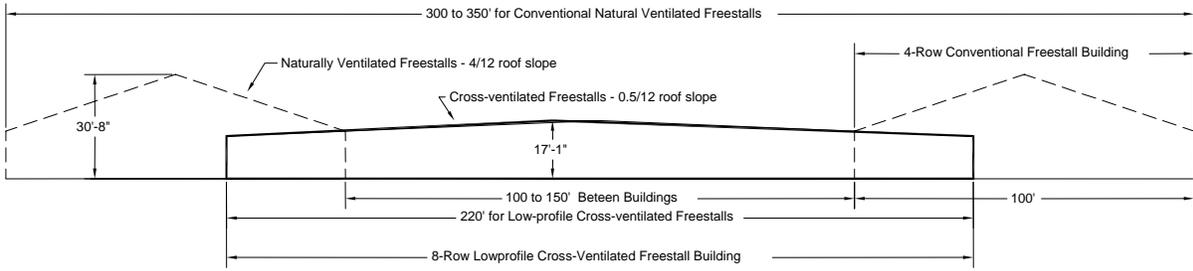


Figure 1. Comparison of the End Views of 8-row Freestalls in Naturally Ventilated Freestalls and 8-row, Low-profile, Cross-ventilated Freestall Building.

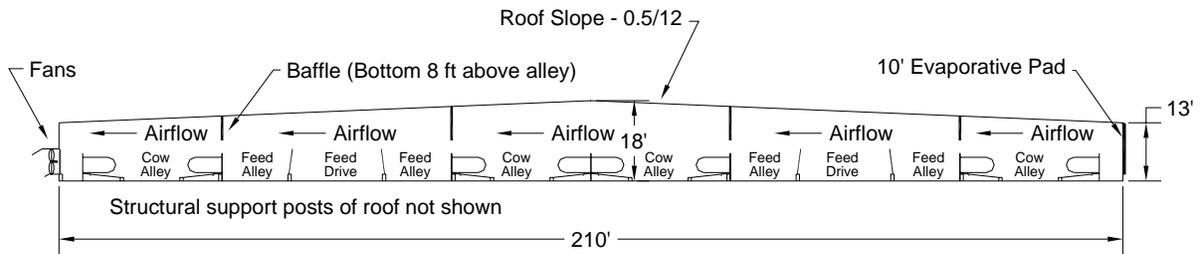


Figure 2. End View of an 8-row Low-profile Cross-ventilated Freestall Building.

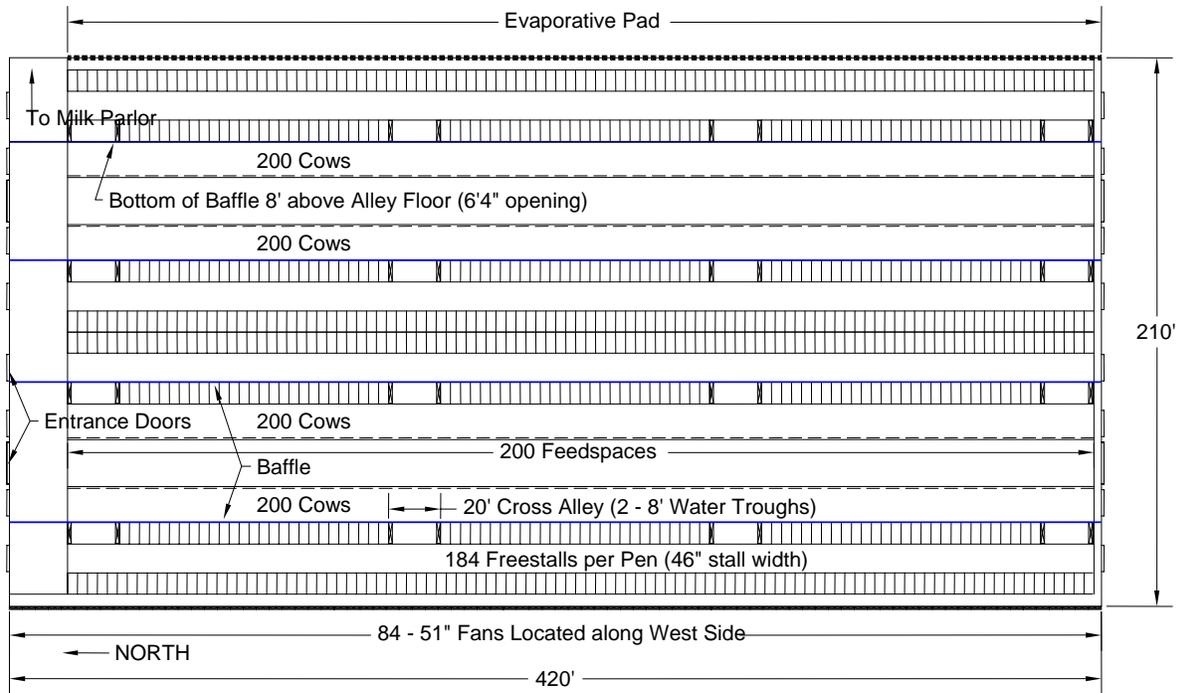


Figure 3. Top View of a Typical Layout of an 8-row Low-profile Cross-ventilated Freestall Building. The building length is adjustable on the basis of cow numbers.