Cow Comfort

By Dan F. McFarland

Increase sidewall, end wall and ridge openings, raise the roof and add fans to increase air exchange.

Increase Air Exchange in Naturally Ventilated Barns

The mantra for modern naturally ventilated dairy buildings is high, wide and open. Proper building location, orientation and management, provides air exchange for air quality at cow level. Many cows are housed in old, low structures, with limited sidewall and ridge openings. Trees, structures and topography can block natural air flow. This affects air quality and animal comfort, especially in summer.

Air exchange is necessary to control moisture, gases and pollutants during all seasons, and to remove excess heat during warm weather. Dairy cows may respire five to seven gallons of moisture per day in hot weather. This moisture, plus evaporation from alleys, can create uncomfortable and unhealthy conditions. As temperatures rise above 70°F, suggested air exchange is to replace the building volume once every minute. Circulation fans do not encourage air exchange and have little benefit. They are simply "egg beaters" that stir stale air.

An advantage of natural ventilation is that wind speed and direction, as well as animal heat, drives air exchange. A disadvantage is that wind speed and direction, as well as animal heat, is needed to drive air exchange. Building design, location, exposure, orientation and management play a role in the success or failure of naturally ventilated barns.

Seek a competent, experienced consultant or Extension educator and installer familiar with dairy ventilation design, and select quality components that give dependable performance and service.

Increase sidewall, end wall and ridge openings: Naturally ventilated barns should act as a shade pavilion during warm weather, with all sides open. Air exchange is challenged if less than seven square feet of sidewall opening per cow is available on the prevailing wind side. Remove solid coverings from side and end walls, especially at cow resting level, to improve the building's ability to breathe. Many people have said they were knocked back by hot air rushing out the building when they loosened sidewall panels. At the building's peak, the most restrictive ridge opening should provide 2 to 3" per 10' of building width, with 12" minimum.

Raise the roof: Although not the most economical alternative, increasing sidewall height to 12 or 14 feet improves air exchange. Extra height provides more sidewall opening per cow, increases inside building volume and may improve air quality.

Add fans: Exhaust fans provide more predictable air exchange to cows. Exhaust fans remove stale air by developing slightly lower static pressure inside the building, which draws fresh air outside in, and distributes it to cows through well-placed inlet openings. Some fan systems can be successfully used in older, naturally ventilated barns to improve air exchange and cow comfort during summer. An air exchange of at least one per minute, with good distribution throughout the animal space, is necessary.

Tunnel Ventilation: Designed properly, tunnel ventilation can provide rapid air exchange to control moisture, gas and pollutants levels, and remove excess heat. Air movement associated with air exchange can also enhance the cow's ability to reduce heat. Fans located at one end of the building draw fresh air from the opposite end. Fan capacity is determined by multiplying the building cross section by the desired air speed of four to six miles per hour (mph). If the building is longer than 500 feet, select a faster air speed to achieve one air change per minute. If fan capacity or quality is skimped, system performance will be disappointing. Provide approximately 2 square feet of inlet area per 1,000 cubic feet per minute (cfm) of fan capacity. Since air tends to follow the path of least resistance, getting air to resting cows is a challenge in freestall barns, especially barns longer than 200 feet. Provide enough inlet area uniformly across the end wall, rather than just door openings in line with cow and feed delivery alleys. If stall rows are located along the outside walls, a 4-inch wide opening at stall bed level is necessary. This inlet area, along with any sidewall openings used for cow traffic, must also be factored into the total fan capacity required. Sidewall, ridge and eave openings normally used for natural ventilation must be closed when the fans operate. Tunnel

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Figure 2. Lameness and leg injuries

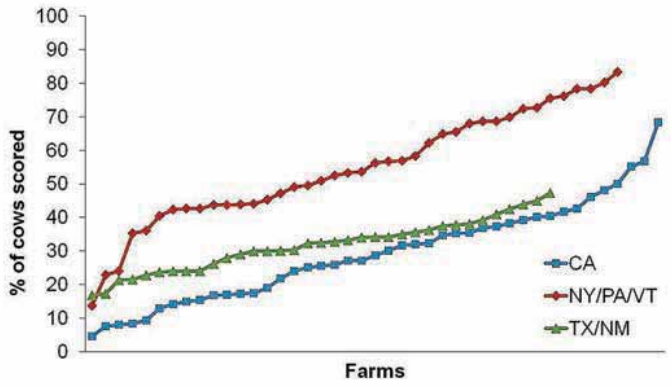

Figure 2. Prevalence of lameness in the high producing, mature cow pen on herds in the three US benchmarks: free stalls in the Northeast (n=40), free stalls in California (n=43) and open lots in Texas/New Mexico (n=35) (von Keyserlingk et al., 2012).

Figure 3. Hock injuries

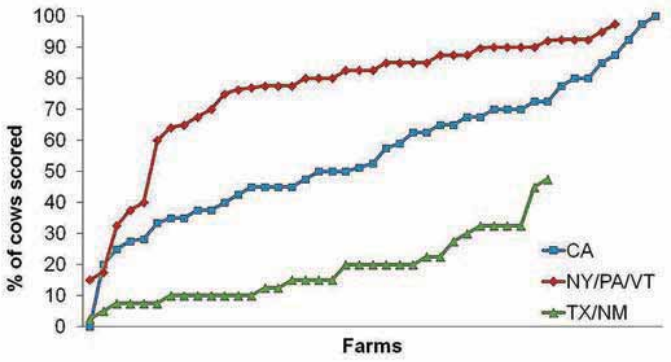

Figure 3. Prevalence of hock injuries in the high producing, mature cow pen on herds in the three US benchmarks: free stalls in the Northeast (n=40), free stalls in California (n=43) and open lots in Texas/New Mexico (n=35) (von Keyserlingk et al., 2012).

cow comfort is achievable in each region, regardless of negative trends.

Cow comfort issues and bottlenecks are multifactorial and herd specific. Look at the dairy system as a whole and include the whole management team, including the producer, herdsperson, consultant, vet and hoof trimmer, in cow comfort discussions. The Novus C.O.W.S. program indicates even small changes, such as moving the neck rail or improving parlor efficiency, can have a significant impact to improve cow comfort and production, which eventually affects the dairyman's bottom line. ❐

Increase air exchange in naturally ventilated barns

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ventilation can provide predictable, rapid air exchange. However, circulation fans may be needed to improve air movement at resting and feeding areas. Tunnel systems are designed for hot weather and not intended for cooler seasons. As fan capacity is decreased, air quality between the inlet and exhaust ends of the building can vary significantly.

Cross Ventilation: Cross ventilation can provide rapid air exchange and air movement at cow level during summer. Fans are placed along one sidewall and draw air across the building width. Air speed should be at least 300 fpm to provide adequate air movement at cow level. The number of fans needed may exceed the number needed for tunnel ventilation. An advantage touted for cross ventilation is that air moves across the barn parallel to the backbone of resting cows, which may move air across a larger area of a cow's body compared to tunnel ventilation. Keeping fresh air movement at cow level can be a challenge, so strategically placed baffles may be necessary. This is a hot weather system. Placing fans in 'banks,' rather than continuously along the sidewall, allows adjustable curtains to be installed between the banks, and can be used in cooler seasons when the fans are not operating.

Exhaust Fans at Peak: Install exhaust fans at the peak to remove stale air and provide predictable air exchange. This system removes excess heat and controls moisture and pollutants. It will not provide the amount of air movement that tunnel or cross ventilation systems do, so circulation fans are necessary at feeding and resting areas. Fans are spaced no further than 40 feet apart along the ridge. Any opening between fans is covered to prevent short circuiting. As with any exhaust ventilation system, the challenge is to provide adequate inlets for good, fresh air distribution. If the sidewalls are mostly open, very little pressure difference between the inside and outside of the barn is developed. Fans still remove stale air, but air movement is not as apparent as with tunnel or cross ventilation. If sidewalls are more closed, provide two square feet of inlet area per 1,000 cfm of fan capacity at cow level, uniformly along sidewalls. This method develops a static pressure difference and may provide more uniform distribution of fresh air. An advantage of this system is that it can provide an air exchange at lower rates during cooler seasons by using variable speed fans, timers or staggering fan on/off.

Pressure ventilation systems: Pressure ventilation systems use fans to force fresh air into the barn through flexible tubes or rigid ducts. Two or more rows of outlet holes, properly sized and spaced, along the tube/duct length distribute air evenly to cows. One square foot of duct cross section is required per 1,000 cfm of fan capacity. Providing one air exchange per minute for summer weather usually requires large holes and duct sizes, but air can be directed toward cow level and may reduce circulation fans. Pressure ducts distribute air approximately 12 feet on each duct side. Duct length is limited, so multiple ducts are necessary in most layouts, especially if the pressure ventilation system is used for more than summer ventilation. Since fresh air is forced in the barn, stale air must find a way out, so adequate sidewall openings and/or similar capacity exhaust fans are necessary. ❐