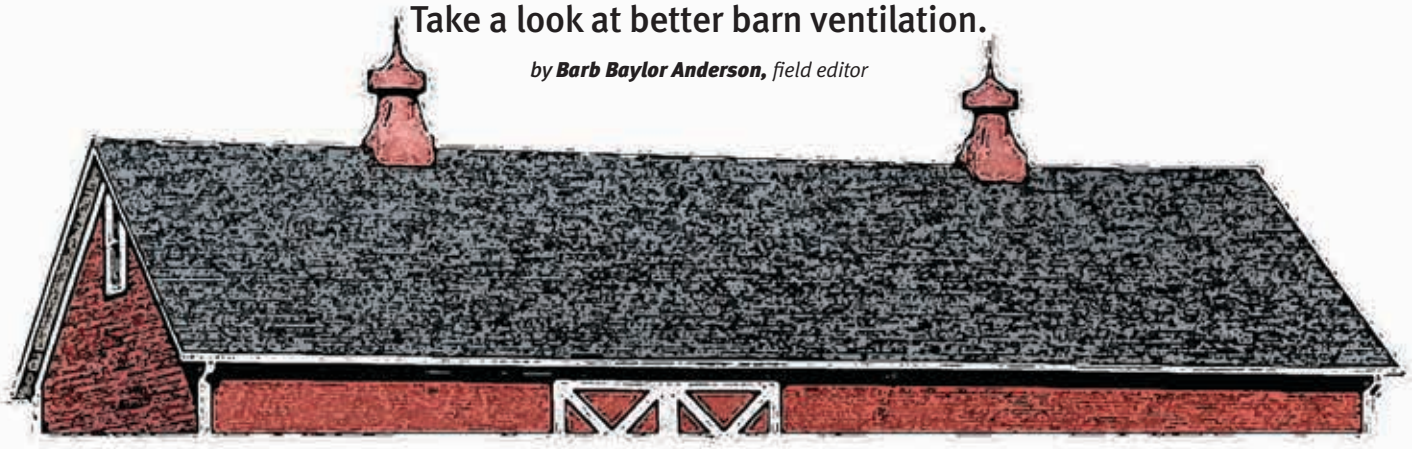
Managing Indoor Air Quality

Take a look at better barn ventilation.

*by **Barb Baylor Anderson,** field editor*



Is barn ventilation on your production efficiency checklist? Environmental specialists and ag engineers say it should be. Making the right adjustments to manage air quality, airflow and temperature in your buildings can improve cattle performance and minimize health problems.

"Applying appropriate ventilation methods and principles will provide good air quality, control moisture levels and moderate temperatures," says Jay Solomon, University of Illinois Extension environmental and energy stewardship educator. "Proper management is the key to success."

Morgan Hayes, University of Illinois Ag and Bioengineering Department clinical assistant professor, says producers often neglect ventilation because they are not sure what can be done or they consider ventilation a minor issue. "But it does affect the bottom line," she asserts.

Improve quality and performance

Hayes recommends producers begin by calculating the ventilation rates needed for the animals in the barn or other structure. Ideal ventilation rates are based on the number of animals, animal size and age, and weather, and are measured in cubic feet per minute per animal. For example:

Animal	Ventilation rates (cubic feet per minute)	
	Cold	Hot
Calf, 0-2 months	15	100
Heifer, 2-12 months	20	130
Heifer, 12-24 months	30	180
Cow, 1,400 lb.	50	470

Appropriate ventilation in all of these scenarios should control both air quality and humidity. When it comes to air quality, Solomon says odors and gases such as ammonia, carbon dioxide, carbon monoxide, methane and hydrogen sulfide may irritate cattle. Some of these are released by the animals themselves, and some may come from manure or other substances in the barn.

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>
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►"If you have dust and high humidity in your barn, you probably have poor ventilation," says Jay Solomon, University of Illinois Extension environmental and energy stewardship educator.

Hayes stresses ammonia is a primary concern.

"If someone comes into your barn and can smell it, you should check the levels. It is possible you are just used to the smell," she says. "A noticeable ammonia smell indicates a need to increase air exchange, especially in the winter."

Dust is another issue.

"Dust carries odors and pathogens, so reduce dust particles and replace with fresh, oxygen-rich air," says Solomon. "If you have dust and high humidity in your barn, you probably have poor ventilation."

Moisture is the main management factor in winter. Hayes says condensation caused by high humidity can lower a barn's lifespan. High humidity develops from moisture exhaled by animals; spilled near water tanks; evaporated from skin, manure and urine; and generated by unvented heaters.

"Moisture management is critical in winter. There should be no more than 10 degrees difference between outdoor air temperature coming in and the inside air temperature," says Maria Ines Rivelli Bixquert, Illinois animal science graduate research assistant.

On the other hand, producers must manage both heat and moisture during the summer. "Summer temperatures should be the same in and out," she says. "Heat stress lowers feed intake, causes more standing and less rumination, and alters eating patterns."

Solomon agrees lower performance is likely under conditions where animals cannot cool themselves, but adds that temperature is also difficult to control. He advises producers to maintain temperatures within the thermal comfort zones of the type of cattle in the barn. This range of temperatures is best for maintaining metabolism.

Hayes also shares the range of temperatures

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in the thermal neutral zone to show that cattle can handle much colder temperatures than what producers may realize.

Thermal comfort zone

Animal	Temperature range, ˚F
Calf, <one month	60-75
Feeder, high-energy diet	15-70
Cow, maintenance energy	40-70

Thermal neutral zone

Animal	Temperature range, ˚F
Calf, <one month	50-85
Feeder, high-energy diet	-30-75
Cow, maintenance energy	5-80

Evaluate ventilation options

Producers have several ventilation options — natural, mechanical or hybrid systems — depending on location, type of facility and the animals housed.

"Barns can move a lot of air if managed correctly," says Hayes. "Most natural-ventilation barns are not insulated or designed to hold much heat, but cattle can handle colder temperatures. One spot to consider — some insulation along the roof where it may help with condensation. Even a small amount can make a big difference."

Since natural ventilation depends on weather, air movement varies based on wind and thermal buoyancy. Improperly sized inlets and outlets can lead to drafts and cold air pooling during winter and reduce cooling during summer.

► Morgan Hayes, University of Illinois, says ventilation affects the bottom line.

"It is a function of barn height, wind speed, number of animals, inlets and outlets," says Solomon. "Inlets control air speed and direction in winter, while outlets provide draw for the inlets. The combination ensures air mixing and distribution."

Inlets and outlets vary by size, placement and season. For example, Solomon says inlets might be eaves or sidewalls, while outlets might be ridge vents or sidewalls. Doors, windows, curtains or louvers can be used to move air with manual or automatic controls.

"You should control inlets to ensure sufficient air speed for mixing," says Hayes. "Curtains can control natural ventilation. For winter ventilations, you should rid stale air from the structure with ridge vents. The key with ridge vents is to keep them clean and not cover them."

For feeder cattle and cows, she suggests at least a 2-inch (in.) ridge vent per 10 feet (ft.) of barn width and a 1-in. ridge vent per 10 ft. for young calves. In addition, Hayes says sidewall openings should be a proper height to get airflow. For example, 28 in. for a 30-ft.-

Check with BESS

When investigating ventilation problems, smoke can be a useful tool for evaluating airflow distribution and fan and inlet placement needs in your barn, says Rich Gates, University of Illinois ag and biological engineering professor. He recommends producers also get their questions answered by BESS — the BioEnvironmental Structural Systems Lab at the university.

► "Keeping your system clean is critical, as even one-eighth of an inch of dust can cause a 20% reduction in performance," says Rich Gates, University of Illinois ag and biological engineering professor.

"Not all ventilation fans of the same size have the same performance," he says. "One way to evaluate fans is to use the BESS lab, a free, online database provided by the University of Illinois. BESS is a fan test chamber we use to get performance data so producers can review and compare fan sizes and manufacturers, airflow and other parameters to design and maintain their own correct air inlets and ventilation rates. We test fans for manufacturers according to a stringent third-party process."

Gates advises producers to consider that while direct-drive systems may be less efficient, they have less maintenance compared with motor-drive systems. Adding cones or shrouds for efficiency and shutters or louvers to prevent backflow also is important.

"Keeping your system clean is critical, as even one-eighth of an inch of dust can cause a 20% reduction in performance," he says. More details are found at *http://bess.illinois.edu.*

RESEARCH & INNOVATION

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Manage for disease prevention

Animals housed in close quarters may be at more risk for certain health issues. Cattle producers are encouraged to take a proactive approach to help minimize disease.

"Several respiratory diseases may be exacerbated by confinement, especially if there is not good ventilation. We often see enteric problems like *E. coli,* salmonella, coccidiosis, rotavirus and coronavirus increase in confinement-reared cow-calf operations, as well," says Cliff Shipley, University of Illinois veterinarian.

While confinement may offer shelter from the weather, better access to water and feed, and the opportunity to conveniently observe and handle cattle, it also may generate feet and leg problems, barn temperature and proper wind movement challenges. Such problems can lead to diseases spreading or disease incidence and the pattern of diseases changing.

Shipley recommends a general vaccination program that includes infectious bovine rhinotracheitis (IBR), parainfluenza-3 virus (PI_3), bovine respiratory syncytial virus (BRSV), bovine viral diarrhea (BVD), clostridial seven-way, leptospirosis/vibriosis and other vaccines customized to match farm and management goals. Those possibilities may include Pasteurella/Mannheimia, haemophilus and anaplasmosis vaccines.

"Hot days with no wind movement are dangerous for cattle. Be prepared to use fans and sprinklers," adds Shipley. "Cattle must be able to cool down at night at least, although some weather patterns and humidity just make that difficult to do. Animals need fresh air."

wide barn, 36 in. for a 40-ft.-wide barn, and 8 in. for each additional 10 ft. of width.

Also important is wall height. A minimum 12-ft. height to the eave is needed for wind to move freely. Wide barns need to be 14-16 ft. in height for good air movement. Proper openings on a natural ventilation design won't eliminate odor, flies or birds, but they can deter problems.

Monoslope barns are a natural ventilation option ideal for Midwest producers especially, given that in many locations the wind blows from the north in the winter and from the south in the summer.

"Locate monoslopes with respect to other barns and windbreaks, and site the barn based on wind speed and direction," says Hayes. "Summer winds accelerate into smaller spaces in barns with open wall panels. During the winter, air must enter through at least partially open sidewalls. You don't want to ever close the windward wall completely."

Mechanical ventilation can be used to complement natural ventilation, but it can also be costly.

Hoop buildings also should be sited with big openings on the sides based on wind direction. In fact, hoop buildings may not need fans if sited correctly, adds Rich Gates, University of Illinois ag and biological engineering professor.

"If it is 90 degrees and you can't get it down to 70 degrees with fans, you may need to add sprinklers," he says. "Cross ventilation is an option, but it can be costly."

Hayes says mixing fans can provide a draft over the backs of animals to get more uniform air temperatures. She advises producers to be sure fans are clean and working.

"A stirring fan may increase air speed and create a better mixed condition, but it will not remove moisture or gases. Supplemental fans may be needed to push fresh air in or stale air out, depending on the structure," she adds.

Mechanical ventilation can be used to complement natural ventilation, but it can also be costly. Producers might choose from a negative-pressure system, where fans draw air out of buildings. A positive-pressure system is more forgiving and forces air into the building and out through the outlets, says Hayes. Neutral-pressure systems have fans that force air in and out.

"Mechanical ventilation designed for winter minimums can be a good choice for calf buildings or low-stocked buildings where heat rise may not be sufficient for thermal buoyancy to provide appropriate exchanges," says Hayes.

A hybrid system combines natural and mechanical ventilation. Solomon says, "It is useful to overcome deficiencies in natural ventilation, and it can reduce energy costs on mechanical systems. For example, adding mechanical ventilation to a natural-ventilation building, or having a mechanically ventilated building with large openings for natural ventilation during summer."

Editor's Note: *A former National Junior Angus Board member, Barb Baylor Anderson is a freelancer from Edwardsville, Ill.*