10 Things You Need to Know Before Building a Compost Bedded Pack Barn

Interest in compost bedded pack barns continues to increase globally because of the potential benefits of added cow comfort and a positive environmental impact. When managed properly, the compost bedded pack barn is an excellent option for dairy cattle housing (top image). However, when it is mismanaged, it is a potential train wreck (bottom image).

Compost bedded pack barns are not for everyone. The risk for mismanagement is higher for a compost bedded pack barn than for a free-stall barn. When a compost barn is not working the way it's supposed to, somatic cell count, clinical mastitis and feet problems will flourish.

We have observed that every time the compost bedded pack barn becomes popular in a new region, the dairy producers in the area think they can do it differently than dairy producers in other parts of the world because "it's different here." While it is true that the environment, the economy and other factors may allow for different management strategies, the basic principles of managing a compost bedded pack barn hold true across the globe. Cow and compost biology are the same everywhere. Just like with all management practices, we can learn from the successes and failures of others.

The difference between a compost bedded pack barn and a conventional bedded pack barn is that we are actively managing a composting process by adding oxygen to the bedding material by stirring it 2–3 times daily. Composting creates heat that dries the bedding material, which provides the cows a clean, dry place to lie down. This keeps cows clean, maximizing their udder and foot health. A side benefit of composting is that it reduces bedding costs; the better a pack is composting, the less bedding (which adds carbon) is needed. The goal is to maintain a moisture level of 45–55% and an internal pack temperature above 130° F. How do we build a barn to achieve this goal? What follows is a summary of concepts to consider in building a compost bedded pack barn.

1. Spacing

Space per cow is essential. Cows constantly add manure and urine to the compost bedded pack, and higher-yielding, larger cows add more manure and urine. Greater cow density also increases pack compaction and reduces oxygen exposure, which the aerobic compost bacteria need. More space per cow reduces the use and costs of bedding. We now recommend a minimum of 125 square feet of pack space per cow, with 150 square feet of pack space per cow being ideal for lactating Holstein cows. The compost barn is unforgiving of overstocking.

2. Barn orientation

Compost bedded pack barns should be oriented east-west. Barn orientation has a significant impact on the natural light patterns within a dairy barn. An east-west orientation has the least sunlight penetration into a barn and is highly recommended for compost bedded pack barns. With an east-west orientation, the sun moves over the top of the barn through the day. With a north-south orientation, the sun moves over the broader sides of the barn, which creates more light intensity in areas where the cows rest or eat. During heat-stress conditions, cows will move away from areas with more light and move toward darker parts of the barn. Bunching behavior in compost bedded pack barns is much more common and more pronounced in north-south-oriented barns than in east-west-oriented barns. In extreme situations, cows may only use 10–20% of the provided space. This behavior occurs almost exclusively during heat-stress conditions. As such, we strongly recommend an east-west orientation when constructing a new compost bedded pack barn. The first picture below shows even cow distribution in an east-west-oriented barn, while the picture beneath it shows bunching behavior in a north-south-oriented barn.

3. Cooling and ventilation

An open ridge vent (shown at the top of the next column) is critical for maximizing natural ventilation. Our preference is to provide an open ridge with a cap. A continuous ridge vent opening of at least 3 inches for every 10 feet of the building roof width is recommended, with a minimum opening of 12 inches for barn widths of less than 40 feet. If a cap is placed above the ridge, the distance between the roof and the cap should be 3/4 of the ridge opening. Often, this cap is placed so close to the roof that it defeats the purpose of the ridge opening by choking air through the cap. An overshot roof can provide reasonable air removal when the opening is high enough. However, good air removal only occurs when wind moves across the higher side. When wind moves toward the opening, it actually forces air back into the barn.

Properly positioned fans help cool cows and dry bedding material. Inadequate or improperly placed fans are one of the biggest issues observed in compost bedded pack barns. Fan selection and spacing should be decided upon when designing the new barn, not after it's built. Regardless of the type of fans chosen, spacing is critical to avoid dead spaces. HVLS fans should be spaced 2–2.5 times the diameter of the fan. In other words, a 20-foot HVLS fan will cover 40–50 feet horizontally and vertically. Panel fans need to be spaced longitudinally down the barn at no more than 10 times their blade diameter width. For example, 48-inch fans should not be placed more than 40 feet apart. Side-to-side spacing of fans should be 6–10 feet between fans.

Sidewalls should be constructed to allow for at least 12 feet of open space for airflow above the retaining wall or outside curb for barns that are less than 40 feet wide, while a 14-foot height is recommended for barns wider than 40 feet. Eave overhangs should be equal to 1/3 the height of the sidewall to keep rain from reaching the pack, and install roof gutters to reduce the likelihood of roof runoff blowing into the pack.

4. Bunk space

Feed and water space are often overlooked during the construction of a compost bedded pack barn. Provide a minimum of 24–30 inches of feed bunk space per cow, 4 inches of water access per cow and at least two separate water locations per pen. Do not reduce feed and water access in an effort to build a low-cost facility. Because cows defecate and urinate more around feed and water (as seen in the picture on the left below), they should have access on the alley side. Alley-only access minimizes excess moisture in the pack and keeps water cleaner. It also eliminates the need to alter the waterer height as the pack depth changes. Some type of physical separation between the pack and the water, like what is shown in the picture on the right below, is necessary.

Cows will generally use the resting space provided more efficiently when they have multiple entry access points

along the long side of the rectangular resting area. Concrete feed alleys should be 16 feet wide, with access to the bedded pack located every 50 feet and at each end. This is wider than what is typically recommended for freestall barns because cows need to access water and feed simultaneously.

5. Retaining walls

The perimeter of a bedded pack is often surrounded by bedding retaining walls, which keep bedding material in the barn and provide more manure storage. These walls may consist of cast-in-place concrete, moveable concrete panels, highway guardrails or wooden panels. Early compost bedded pack barns used 4-foot retaining walls for manure storage and to keep bedding within the structure. Practical experience and computer modeling have demonstrated, however, that 4-foot retaining walls block air flow to cows lying down. Current recommendations are to use a 2–2.5-foot retaining wall instead to improve cow-level air flow. An 8–12" curb separating the bedded pack from the feed alley is recommended to provide physical separation between the feed alley and the pack area, which is helpful in managing pack moisture. A fence above the curb rather than a wall is also recommended.

6. Management

Packs should be stirred or tilled at least twice daily, 365 days a year. This process provides oxygen to the compost bacteria and removes fresh cow manure from the pack surface. Many different types of tillage equipment can work effectively; however, the best results are observed with specialized roto-tillers that reach at least 12–18" deep, like the one pictured below from LVI Manufacturing. This type of equipment can provide deep tillage but may also easily break apart clumps of material where there is no internal moisture.

7. Storage

Bedding availability and price often vary seasonally. Establishing a dedicated location for storing bedding during low availability or high pricing can be extremely beneficial.

8. Bedding material

Dry, fine wood shavings or sawdust are the gold standards for compost bedded pack barn bedding. Kiln-dried sawdust is a fine, coarse material that provides a suitable ratio of surface area to volume, is easy to till, and absorbs and holds liquids well. If green sawdust is used, the amount necessary will be higher than when using the kiln-dried variety, as its higher water content reduces the amount of water that can be absorbed. Cedar should be avoided because it contains oils and organic materials that inhibit the microbial activity necessary for composting. The size of bedding particles is particularly important for regulating microbial access to the food source: manure and urine. Moderate particle size, neither too fine nor too course, is preferred. Alternate bedding materials with large particles do not work well and should be finely chopped. Finely processed corncobs, soy straw or flax straw, ground through a 3/4-inch screen, have performed well. Peanut hulls, almond shells, kenaf, coffee husks and rice straw are also viable alternatives to sawdust. Such fine materials may be used in a mix with sawdust to stretch the sawdust supply.

Long lengths of corn stalks, waste hay, and oat, barley and wheat straw tend to retain too much water because they are slow to dry. Moreover, if the waxy outer surface coating remains on wheat straw, water is slower to be absorbed or dried.

9. Bedding depth

When starting a new compost barn, the goal should be to start with 18" of bedding material. The compost process will work better and start sooner if more bedding is used up-front. Packs are typically cleaned out annually in the spring or fall. They should not be cleaned out in the winter. The top layer of bedding may be used as a starter for the next pack; however, caution should be taken when re-using the bottom layer, as that layer is no longer actively composting and may contain opportunistic mastitis-causing bacteria.

10. Mastitis prevention

Surface bedding bacteria levels are high in compost bedded pack barns. Contrary to popular belief, composting heat doesn't reach a high enough temperature to kill mastitis-causing bacteria. For this reason, mastitis prevention strategies are extra important in compost bedded pack barns. Extra attention should be paid to cleaning teat ends during the milking process. *E. coli* and *Klebsiella* vaccines have been beneficial in many cases. Peroxide pre-dips do not appear to work well in compost bedded pack herds.

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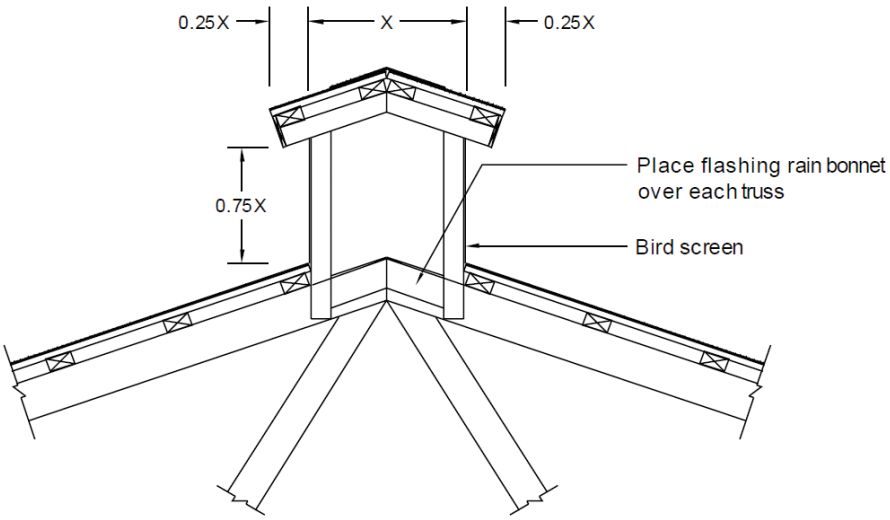
COMPOST BEDDED PACK KEY FEATURE RECOMMENDATIONS



Feature	Recommendation
Pack Space per Cow (Holstein)	Ideal: 125 to 150 sq. ft. Minimum: 100 sq. ft.
Feed Alley Width	16 feet
Roof Pitch	4/12
Ridge Opening Width	3 inches for every 10 feet of building width
Ridge Cap Height	3/4 of ridge opening width
Perimeter Retaining Wall	2 to 2.5 feet
Curb Separating Feed Alley from Pack	12 to 18 inches
Opening Between Top or Retaining Wall and Eave	14 feet
Eave Overhangs	1/3 of the eave height
Entrances	Placed at least every 50 feet
Fan Spacing (HVLS fans)	2X fan blade diameter
Fan Spacing (Panel fans) Side to Side	8X fan blade diameter
Fan Spacing (Panel fans) Within a Row	10X fan blade diameter
Bunk Space per Cow	2 feet
Water Space	3 feet of tank perimeter per 15 cows
Goal Moisture Level	45 to 55%
Pack Temperature @ 8-12 inches below Surface	130 to 150 degrees Fahrenheit
Stirring Frequency	2X daily, 365 days a year
Stirring Depth	18 inches

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