Freestall Housing Or Not?

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Many dairy operators are being forced to consider new housing systems to comply with environmental regulations and to further fine tune management for continued profitability. Operators who have been successful with open-air ìdry lotî dairies are faced with a decision of confining animals under roof in freestall barns. This is a 'gray' decision; there are no 'black and white' answers. But comparing the following information against your farm and your management style should make your decision easier. Basic areas to consider when making this decision include:

- Opportunities and challenges in managing freestall systems
- Returns (dollars back to management)
- Freestall design and maintenance

Freestalls are not new technology to many parts of the country. Confined housing has been a common practice in the upper Midwest and northeastern United States for many years. However, adapting these designs to the south and southwest U.S. has presented some challenges. Traditional barn designs have been modified for cooling during summer and more mechanical maintenance in larger herds. A survey of ten dairies in Central Texas was used to collect information on these adaptations. Information was used to support or adjust management considerations for cow comfort, reproduction, labor, and manure handling.

Freestall Management Considerations

Every dairy operator has their own management style. Likewise, the following aspects of freestalls will vary in their impact on each individual dairy.

Cow comfort is considered both an opportunity and a challenge of freestall systems. Being on concrete constantly is hard on cows. Poorly designed and maintained freestalls can reduce cow comfort and increase stress. Freestalls are not ìfreeî stalls; they require care. To achieve an advantage over open lots, you must spend time on bedding management, hoof care, heat detection, and general environment of the barns. Most managers report needing about a year to adjust to the more intense management required in the freestall system. It is important to remember the goal of any housing system is to provide comfortable lounging. A quick visual assessment of cow comfort in a freestall barn is use of stalls. Cow comfort can affect culling rate and cow cleanliness, both of which can influence bottom line. Comfort in a freestall barn will be affected by stall management and cooling.

Culling. Two interesting observations came out of our survey. The first was that culling rates tended to be reduced; initial culling rates averaged 49.4% and decreased to 37.1% after moving into freestall barns. The second observation was that body weight of cull cows increased. One dairy estimated this at approximately 150 pounds per cull cow. Assuming an average body weight of 1400 pounds per cow, this would give an increase of about 10% in cull cow income.

Cow cleanliness. In confinement, you design and maintain the cowís bed. Since the condition of bedding is less dependent on weather than in open lots, cows will be cleaner in a freestall system during periods of inclement weather. In most arid regions, these periods of mud can be quite short and vary widely year to year. Individual freestalls help you place the udder where you have control of bedding cleanliness and moisture. Docking or trimming tails may be necessary for keeping cows clean in a flushed freestall barn. With good bed management and stall use, many producers in freestall barns have eliminated wash pens.

Bedding. Bedding must be maintained throughout the year in the freestall system; however, it will take less bedding to maintain a lying area in a freestall than in an open lot. Lying space per cow in a stall averages 32 square feet per cow (4í x 8í stall), whereas lounging space under shade in drylots averages 40 square feet per cow. However, most of the year bedding is not needed in open lots, so you must calculate your own bedding requirements.

The main purpose of bedding is to provide cushion and improve animal comfort. Bedding materials may be categorized as either organic or inorganic. Many traditional and non-traditional materials exist in each of these categories. Bedding mate-

rials in Central Texas range from 100% sand to 100% compost, with varying combinations in between. Other material used in combination with sand or compost includes gin trash or hulls (usually rice or peanut). Initially, sand was the material of choice due to its inorganic nature; however, producers that have changed bedding source to all, or combination of, organic material have done so for logistic reasons. These reasons include: wear on equipment; lagoons filling up with sand and being more difficult to manage; and bedding material expense.

Management area	Opportunity	Challenge
Cow comfort	Environment control Eliminate seasonal mud	Cooling during periods of heat Increased time on concrete
Reproductive management	Increased animal density	Heat detection
Efficiency of space	Decreased travel distance	Increased animal density
Labor	Increased automation	Increased labor requirement
Manure management	Decreased run-off to capture	Wetter product

Bedding use in freestalls in Central Texas averages 30 pounds of material per cow per day, with a range from 15 to 42 pounds. Differences are due to frequency of bedding stalls, type of material utilized and whether or not mattresses are used.

Cooling. In confinement housing, cows are in shade during hot days and protected from the elements during bad weather. Although you also have the option of fully controlling the environment in the freestall barn through mechanical ventilation, the increase in animal density presents a challenge in cooling during periods of heat. Site and barn design can have a tremendous impact on the logistics of cooling. It may be difficult to move enough air through freestall barns with eaves less than 10 feet high. Fans throughout the barn are becoming common to help cool cows, as well as water misters over feed lanes. Use of cooling systems over beds presents challenges in avoiding wet stalls.

Reproductive Management

Animal density. With increased animal density and well-lit facilities, heat detection and health monitoring should be easier. However, poor hoof care, slippery freestall alleys, and lack of attention can make these management concerns more difficult. Unsure footing in crowded, slippery freestalls can reduce expression of heat in cows. One comment heard about the change in bedding source from 100% sand to 100% organic material was the change in footing on alley surfaces in a flushed barn. Use of sand (as complete or partial bedding material) appears to provide additional footing in alleys around beds.

Heat detection. Besides maintaining good footing and healthy hooves, time must be dedicated to heat detection to assure a desirable calving interval. Allowances must be made for environmental changes in freestall compared to drylot. Heat detection may be improved by practices such as tail chalking and date reminders marked on the hip of the cow for easy visual identification. Use of exercise lots with breeding pens may also increase observation of heat. Barn modifications such as wider rear alleys may increase cow activity and enhance heat detection in confinement.

Space and Investment

Cow area. While open lots allow 500 square feet per cow, a freestall barn will only require 100. Even with outside ìexerciseî lots added, the freestall system takes about half the space of an open lot. Information from herds in Central Texas suggests the space requirement in drylots to be closer to 600 square feet per cow, while the average space in a freestall ranged from 75 to 113 feet. Reducing space per cow to this extent can save 30 to 40 acres on a 1,500-cow dairy.

Additionally, confined housing will reduce daily travel distances to and from the parlor. For example, consider a 480-cow drylot dairy (4 pens with 120 cows per pen). Using 600 square feet per cow, this gives a 4-pen area of 540 x 550 feet (Figure 1). Cows in this system would average 3240 feet of travel each day in a 3x milking routine. Considering conversion to freestall housing, the producer has two options: (1) a facility for the same number of cows (simple cow conversion) or (2) expansion to 1440 cows, utilizing the same land area. The first option (similar cow number) would utilize a barn of 500 x 100 feet (100 feet per cow). Using these dimensions, travel would be reduced approximately 44% for these cows as compared to the former drylot situation. Applying the same logic to

the second option (similar land area with expansion in animal numbers to 1500 cows), travel distances could be reduced 34% per cow per day compared to the original dry lot layout.

Initial investment. Cost estimates for open lot systems constructed in 1997 average about $375 to $400 per cow. Freestall systems cost about twice that. Investment in Central Texas averages $700 per stall (range of $400 to $1000). Differences between costs depended on hired contractors (some dairies did much of the work themselves) and use of existing feed lanes. A freestall barn shell costs about $4.50 square feet. Concrete floors and curbs will add about $1.50 square feet. At 100 square feet per cow, thatís $600. Add to that freestall divider loops, lockups, other fencing, and limited manure removal equipment and cost is about $700 to $900 per cow.

Labor

Some studies indicate an even trade of labor and maintenance between open lots and freestalls. Freestall maintenance is usually a combination of mechanical and manual labor. Producers in Central Texas reported an increase of 20% in labor charges per cow per year. Maintenance of freestalls averaged 2.4 minutes per cow per week compared to 2.0 minutes per cow per week in drylot. Reports of bed management schedules varied in both routine and amount of time spent. By far, most freestall labor was associated with bed maintenance and bedding.

Bed maintenance. Freestall condition must be observed frequently. Stall beds should be maintained regularly to encourage cow acceptance. Dairy cows are reluctant to use uncomfortable freestalls. Proper longitudinal slope needs to be maintained to encourage stall use. A level stall bed allows cows to move too far forward in the stall. If the front of the stall is lower than the rear it may be difficult, or impossible, for the cow to exit on her own.

Manure and wet spots should be scraped from beds frequently. An opportune time to perform basic bed maintenance is while moving cows to the milking center or while observing for breeding and general health. It usually takes very little time and goes a long way towards stall acceptance and cow cleanliness.

Bedding schedule. Bedding rate and frequency vary with the producer and the type of bedding material. Our survey reported 60% of producers bedded stalls on a weekly basis, 30% every other week, and 10% on a 3-week schedule. Bedding schedule appears to be independent of bedding material and more a factor of management preference. Producers without a bedding schedule are typically “told” by their cows when the bedding layer is inadequate, since cows may be reluctant to use freestalls, preferring to lie in the scrape alley. When this happens, cows are usually dirty and have mastitis “flare ups”. Lack of a good bedding layer may also increase the amount of cow movement in the stall and lead to entrapment under a partition.

Figure 1: Example layout of a drylot dairy.

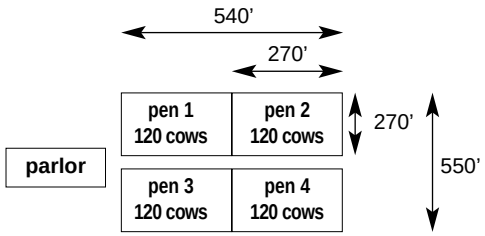


Figure 2: Drylot conversion into a freestall barn, option #1 (one freestall for all 480 cows @ 100 sq.ft. per cow.)

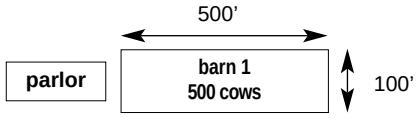
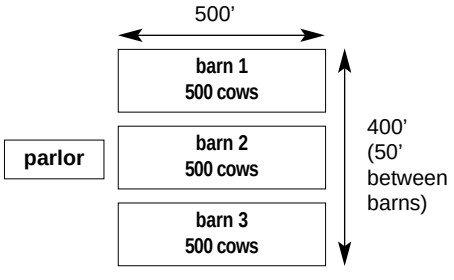


Figure 3: Drylot conversion into a freestall barn, option #2 (expansion of all pens into freestalls; site now houses 1,500 cows).



Manure Management

Surface area collection. With cattle confined to barn floors, there is less risk of rainfall traveling through manure areas and contributing to uncontrolled runoff. Even with outside exercise lots, the area exposed to

runoff is less. You need only collect manure and wastewater generated in the freestall facility. Rainfall subject to contamination, that must be collected and stored, can be controlled through roofing and gutters. In water deficient locations, roof runoff can be collected, diverted, or used elsewhere on the dairy. Considering the surface area collection differences in an area that receives a yearly average of 30 inches of rainfall, confined housing would reduce collection area needed by 4,687,500 gallons of storage (23,148 cubic yards of dirt to move). While this storage facility would be a one-time cost, on-going costs for continual pumping and management must be considered as well.

Product handling. Manure management in a freestall can be quite different from that in drylot. In a flush system, water content of manure is much greater. Additionally, if sand is used for bedding the end product will have more sand. Manure handling systems may evolve to include solid separators, settling basins, or both to avoid filling up lagoons with solid material. Eighty percent of producers surveyed in Central Texas used settling basins, with 30% managing manure through a separator or a sand trap prior to entry into settling basins. These producers reported an average of $36,000 spent on additional manure handling equipment for managing manure in their freestall systems.

What Does It Mean?

More milk production is likely. Less production fluctuation through the year is possible as cow environment is more controlled. Although several studies have projected freestall systems to increase daily milk production by 5-8 pounds of milk daily, our data was quite variable. The length of time these herds had been in freestalls dictated the amount of data available to evaluate changes. Several of the herds we evaluated had been in the new facility less than one year and were still undergoing many management changes. Production records from the herds that had been in the facility for longer periods of time (greater than one year) suggest an increase in herd milk production. It appears that response is not immediate and a transition period is necessary to see returns in milk production.

Theoretical increase in production with freestalls is the result of better feed efficiency, lower somatic cell count, cow comfort, and more stable environment.

Pays in 6 of every 10 years. Studies in Florida and Texas show that freestalls are ìon the bubbleî compared to open housing. Freestalls will net about $35 per cow-year return in higher production, better milk quality, and feed savings. The extra income will exceed the extra costs in 6 years out of 10. Certainly, with dry weather and moderate temperatures the more expensive housing would not pay, but given the variability of weather and management, freestall housing is a modest gamble with pretty good odds.

Design Considerations

Freestall dimensions. Dimensions of a freestall should allow adequate space to enter and exit easily, and rest comfortably. Stalls which are too short or too narrow are not readily accepted by cows and they find other places to rest, such as the scrape alley. On the other hand, stalls that are too long or wide may lead to dirty conditions since cow position is not controlled.

Size and weight of cows within a group can vary considerably. Freestalls should be sized to allow the largest cows to use the stalls easily and rest comfortably. In the discussion which follows "average" sized Holstein cows, are assumed to weigh from 1,300 to 1,600 pounds. Several excellent publications have specific recommendations for freestall designs (see Supplemental Information list at end of manuscript).

Stalls. An unconfined rising cow, such as in pasture, lunges forward, shifting weight, allowing the hindquarters to be raised more easily. Observations indicate that cows prefer to lunge forward, rather than to the side, given the opportunity. Cows can exit a freestall successfully and without injury, when lunging to the side, but seem more tentative and careful about their movements.

Since it takes about 30 inches of head room for a cow to rise comfortably, the recommended freestall length for Holstein cows is 7 feet 6 inches for stalls with an open front, and 8 feet for stalls with a solid, or slatted, front barrier. In stalls of proper length, a brisket board and adequate stall base slope helps position the cow in the stall, and keep the back of the stall cleaner.

Many housing arrangements place freestall rows head-to-head. A combined stall length of 15feet allows cows to rise comfortably with minimal contact, also providing plenty of head space while resting, which is important for air circulation in hot weather. The affect of "boss" cows may also be reduced compared to stalls with a shorter combined length.

For Holstein cows a stall width of 4 feet is adequate for animal comfort and minimum chance of injury while the cow is entering, resting in, and exiting the stall. Cows larger than 1,600 pounds may benefit from stalls which are 2 to 4 inches wider. Smaller framed cows which weigh less than 1,300 pounds are less likely to turn around in stalls which are 2 to 4 inches narrower. Stall partition height and design are also very important for cow positioning and prevention of injury.

Rear curb. Measured from the scrape alley floor, the rear curb should be 8 to 12 inches high. Dirty stalls typically result from a lower curb due to manure overflow from alley scraping. With curb heights greater than 12 inches some cows may drag teat ends on the curb while entering and exiting the stall, causing some health concerns.

The stall side edge of the rear curb should be sloped or rounded to reduce the chance of injury. The stall base should reach the top of the rear curb to encourage drainage. Sometimes the base is recessed 2 inches to help hold the bedding layer in place. However, it will also capture manure and urine and require more maintenance.

Slope of base and bedding. A gradual slope from front to rear of the stall is necessary to provide drainage and also helps position the cow. Dairy cows seem to prefer lying with their front slightly elevated. Cows may work their way forward in stalls which are level or slope forward. This usually leads to dirtier stalls and makes it more difficult for the cows to rise. Recent observations indicate that a 6 % slope (5 inches in an 8 feet stall) is preferred to keep resting cows toward the rear of stall.

Brisket board. A brisket board helps define the body and head space of a freestall. A properly placed brisket board helps position the cow to minimize the chance of injury, prevent entrapment, and keep the stall cleaner. It also encourages the cow to keep back in the stall while resting.

The brisket board should project 8 to 12 inches above the top of the stall bed. Shorter brisket boards tend to get covered with bedding material and become ineffective. Brisket boards greater than 12 inches can become an obstruction, which may bother the cow while resting or rising. Typically, the brisket board will be angled forward slightly (approximately 30 degrees from vertical) to follow the contour of the brisket and neck.

Proper placement of the brisket board is essential. Placed too far forward, it becomes ineffective for cow position. Located too far back, cows may be reluctant to use the stall due to lack of adequate body space. Placing the rear edge of the brisket board 66" from the alley side of the rear curb seems to be adequate for Holsteins. Brisket boards are not recommended in stalls which are less than 7' 6" in length, since they may interfere with the space needed for sideways lunging.

Partition design. The freestall partition should guide the cow as she enters and exits the stall, provide protection from other cows while she is resting, and also allow good air circulation. Of course, these functions should be performed without causing injury or entrapment. Consider ease and utility of quick removal (if a cow becomes caught) when selecting a freestall partition. Easy removal also encourages replacement of broken or bent partitions. Proper partition height is essential to encourage stall use and prevent injury. Partition length is important in positioning the cow. Adequate support is essential for satisfactory performance and long service of freestalls. The support should not interfere with lunging space or air circulation. The variety of available shapes and styles of freestall partitions is almost overwhelming. No one shape is suitable for all stall sizes; therefore, the partition shape should be selected based on the dimensions of the freestall and preferences of the producer.

Neck rail. The purpose of a neck rail is to encourage cows to back out of the stall while rising, and to discourage walking too far forward in the stall. Manufacturers take advantage of neck rails to add strength and rigidity to the freestall partitions.

Typical placement is recommended approximately 66 inches from alley side of the rear curb or directly above the brisket board. This location assumes that the top rail stall partition is 42-48" above the top of the rear curb. After installation, watch how cows react to the freestalls. If the neck

rail is placed too low, or too far back, cows may be reluctant to use the stalls. If cows tend to lie too far forward, the neck rail may be located too far forward, or too high. Minor adjustments may be required to improve stall acceptance or keep stall beds cleaner.

Pipe, tubing and cable training rails are commonly found. Cables are not often recommended. While it may be an inexpensive alternative and flex on contact, cables of less than 3/4-inch are commonly used, which may cause injury to vertebrae in the neck. Steel cable can also fray and cause injury. Pipe and tubing should be at least 1 inch in diameter.

A "floating" neck rail is highly recommended. Rather than being fixed to the stall partition, the rail may be pushed up by the cow, resulting in less impact on her neck. The weight of the rail encourages the cow to back out, and the floating rail glides back into place. Floating neck rails may be hinged, placed in guides or hung from a chain.

Stall Bed Alternatives

The primary consideration in selecting a freestall bed should be animal comfort. Comfortable stall beds help keep cows clean, minimize injuries, and reduce stress. The stall bed should also be durable to minimize maintenance required, but not sacrifice animal comfort. No matter what type of stall base is used, bedding is necessary to absorb moisture and manure tracked in from the alley. The following stall bed descriptions are a sampling of some of the most popular stall bed types currently being used.

Earth stall bed. Well-maintained earth bed stalls are a very acceptable alternative. This stall surface is typically tamped soil with a heavy clay content, or stone dust. An earth bed provides some cushion, and also good footing as cows enter and exit.

After a period of use, however, holes and depressions occur which must be filled and leveled. Maintenance is often seen as the major disadvantage of and earth bed stall, but it must be done regularly to insure cow comfort, stall acceptance, and safety. Some producers have overcome this problem by leveling the stall bed regularly with a tractor-mounted leveling rake or tiller. It can also be adjusted to maintain the desired longitudinal slope in the stall, and creates a loose top layer that increases cushion.

Sand bed. Clean sand makes an excellent base and bedding alternative for freestalls. Since granules of sand tend to move, rather than compact, they will shift to form a comfortable bed which "cradles" the resting cow to support her weight more evenly.

Typically a sand layer of 6 to 8 inches above a well-tamped earth base provides good cushion and drainage. Additional sand should be added when the front of the stall bed becomes level, or lower than the rear.

Since sand is inorganic, it provides a poor environment for growth of bacteria which can cause environmental mastitis. This advantage, combined with excellent cow cleanliness, makes it a popular choice of many dairy producers. Also, sand worked into alleys acts as a non-skid, providing more confident footing.

The major disadvantage cited with using a sand bed is manure management. Sand can settle to the bottom of manure collection pits, storages, and spreaders, making removal difficult. Sand is also abrasive and can cause excessive wear on manure scrapers, pumps, separators, and spreaders.

Fabric-covered or "mattress" stall bed. The fabric covered or "mattress" stall bed provides a comfortable resting surface while reducing overall bedding use. A compacted layer of bedding, approximately 4 to 6 inches is contained under a layer of durable fabric. This fabric is typically woven polypropylene or woven polyester. Various bedding materials such as long straw, chopped straw, hay, sawdust, shavings, and rice hulls have been used as mattress filler (Bickert, 1991). Also, shredded rubber fillers have been used. This filler material forms a resilient base, which provides excellent cushion resulting in good stall acceptance. It is also inorganic and should not support bacteria growth. Unlike organic filler materials, a shredded or crumb rubber base will spring back when weight is removed. This not only reduces packing, but also reduces the amount of material shifting under the fabric, resulting in less maintenance. Dry bedding or limestone must be dusted over the mattress surface weekly to absorb moisture and reduce soiling.

As required, the fabric should be opened and bedding layer leveled and/or added to. Producers say this needs to be done two or three times per

year, or whenever the stall beds appear "lumpy". Many fabric-covered installations have been installed over the past five years. Most report excellent stall acceptance and claim the fabric should last 3 to 6 years with normal use.

Tire stall base. Tires stall bases may be created with earth or concrete bed. Tires help to stabilize an earth bed, reducing the amount of hollowing and material movement created during normal use. Tires also provide additional cushion and help to keep the bedding layer in place.

Some producers have been using earth and tire stall bases for 10 years with very few problems. However, the tires must be installed properly, and with great care, to prevent "tire uplift". The major disadvantage of earth and tire stall bases seems to be difficulty of installation.

A combination of tires and concrete makes a stall base that is accepted quite well by cows and requires very little maintenance. However, a generous bedding layer is still required.

Rubber mats. Rubber mats have been placed on top of, or embedded into, a concrete stall base. Rubber mats only slightly increase the cushion of concrete stall beds and can be slippery, especially when wet. The underside of the mats can also trap moisture and debris creating a good environment for bacteria growth, especially near the rear curb. Some types of rubber mats can become elongated and buckle after a period of use. Mats embedded in concrete may work loose. Rubber mats are often used in barns with slatted flooring in order to reduce bedding use. However, when bedding is reduced, increased incidences of knee and leg abrasions have been observed.

Concrete stall bed. Concrete is the easiest freestall bed to maintain. However, observation and studies indicate that concrete is not preferred by cows. Even heavily bedded concrete stall bases seem to contribute to leg and knee abrasions. Existing concrete stall bases provide an excellent base for the fabric-covered alternative with rubber fill.

Summary

Most producers, in most situations, will find it profitable to produce milk in freestall housing. Unfortunately, this is not always an obvious decision. There are benefits with freestall housing; however, for some it may be more profitable to continue with open housing. The decision should be based on the likelihood that advantages of freestalls would overcome problems a manager faces in open lots. It is clearly a decision to be made considering individual circumstances.

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Notes

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