Developing Dairy in IOWA

As Iowa dairy producers remodel their facilities, many are expanding their operations. Most expansions combine existing and new facilities. These producers are favoring freestall barns and pit parlors. Whether building new or remodeling existing facilities, dairy producers must base their decisions on their present facility situation and their future goals for their dairy farm and family.

Looking to the future, many Iowa dairy producers are remodeling their operations to increase profitability and labor efficiency, improve working conditions, add a family member, or meet other quality-of-life needs. Proper planning prevents poor performance; this is very true when remodeling dairy operations. Talk to others who have remodeled and consider bringing in outside consultants to assist in planning the project.

Three priorities for dairy facilities

Cow comfort is priority one. Shortcomings in cow comfort can be a costly mistake. Stalls are getting longer and wider for good reason. For optimum profit, a cow should be eating, drinking, milking, or lying down chewing her cud. Milk quality and cow health often are related to cow comfort.

Dry matter intake is priority two. Focus on proper feed bunk design, feed quality and type, lighting, ventilation, and good water quality and quantity. Each pound of dry matter intake above maintenance is worth 2 to 2.5 pounds of milk. Proper facility design is crucial to dry matter intake and thus, profit.

Labor efficiency is priority three. If things don't flow, labor can be a time management problem. Identify and eliminate labor bottlenecks in the remodeled operation. In addition to cash flow, consider the people flow, feed flow, air flow, manure flow, cow flow, equipment flow, milk flow, water flow, and how well the dairy will flow with the remodeled operation.

Design considerations

Freestall barn design affects cow comfort, dry matter intake, and labor efficiency. A curb height of 10" is recommended. A higher curb inhibits ease of entry and exit and increases teat injury. A lower curb increases manure in the stall. If sand is used in the stalls, a 2x10 can be used to form the curb. If mattresses are used in the stalls, a 2x8 would give the proper height.

Stalls should be 46" to 52" wide for lactating Holstein cows. For milking cows, the recommended width is 48", but up to 52" may be considered for large or pregnant dry cows. Nine feet of effective stall length is recommended in new construction. The minimum stall length in renovations is 7'6" if the design allows proper lunging into an adjacent stall. Eight feet is preferred. The freestall should slope to the back 3 to 4 percent (1" to 2"), which improves drainage and rising ability. Lateral slopes of 3 percent or greater tend to result in most cows lying in the same direction with their backbones uphill to prevent teat injuries. Cows have a difficult time getting up in freestalls that are sloped down to the front.

The brisket board should be installed at a minimum of 66" from the back of the manure curb for mature Holstein cows, but preferably 70" in new construction. Typically, the neck rail is mounted 44" to 50" above the bedded stall surface, directly above the brisket board. Do not use brisket boards higher than 4" above the stall

IOWA STATE UNIVERSITY
Extension and Outreach

PM 2040 June 2009

If retrofitting freestalls into a present shed or barn, present dimensions may dictate design. Three, four, and six-row designs are most common when building new. When considering a two or four-row versus a three or six-row barn, compare cost estimates from builders.

surface. After cows are trained, adjust the neck rail back or forward according to observed behavior.

Freestall divider design offers a number of options including side lunge, wide loop, and straight loop. The loop should be designed to allow less than 12" of space between the end of the divider and the manure curb. If barns have stalls of varying lengths, then stall dividers of varying lengths must be selected. Otherwise, the incidence of cows backing into neighboring stalls increases.

Freestall dividers are not created equal. Stall dividers with a 32" to 38" opening are appropriate because they allow the neckrail to be 44" to 50" above the bedded surface and the bottom rail to be 9" to 12" above the bedded surface so that legs aren't caught under the divider.

Fenceline feed bunk design assists dry matter intake by allowing cows to eat in a grazing position. Bunks should be designed to allow a 19" to 21" throat height and a neck rail 48" above the cow platform and 8" forward of the feeding curb. The feeding platform should be 3" to 6" higher than the cow platform.

Ventilation affects not only air quality, which by itself is a major factor in dry matter intake, but also affects herd health by decreasing the moisture (bacteria) load in the building. If the moisture cannot leave, it can cause major heat stress problems in the summer and cause damp hair coats in late fall, winter, and early spring, and lessen a cow's insulation ability.

In naturally ventilated buildings, the ridge opening should be 2" for every 10' of building width. On six-row barns, the ridge opening should be 2.5" to 3" per 10' of building width. The eave opening should be half the ridge opening on each side, but preferably curtain sidewalled for opening during summer.

Fourteen-foot sidewalls, preferably curtain sidewalled for opening during summer, are recommended for new construction. Barns should be orientated perpendicular to the most prevalent wind during the summer. Summer winds generally come from the south, so the barn should be built with an east-west

This old corn crib was remodeled into a cow maternity barn.

A feedline, using headlocks.

orientation. This orientation also significantly reduces summer heat load. The sun is above the barn in the summer rather than shining in the west side during hot summer afternoons—as happens with a north-south oriented barn. As a general rule, construct new barns 100' from any obstruction.

Preventing bird problems in wooden framed barns has had limited success, since these barns provide places for birds to roost. Steel framed and laminated rafter structures minimize the bird roosting problems and enhance the building's airflow and openness.

Concrete surfaces should be smooth yet have grooves to prevent slipping. Normally, concrete is grooved parallel to the manure alleys, allowing water to flush barns and preventing scraper blades from catching. Some prefer a diamond design so there is a groove every 4 to 6". Grooves should be ½" wide and deep with a sharp edge. Cutting grooves after the concrete is poured and dried often results in cleaner grooves, although the process is a bit more costly. If grooves are floated, make sure they have a distinct edge without abrasive places.

Sand versus mattresses is a common discussion point, since these materials have proven to be the most effective stall bases. An Iowa study conducted by Thoreson and Timms evaluated six different freestall surfaces. The study found that stalls ranked differently by week of trial, with cow preference switching between sand and mattresses. Sand ranked highest in summer, but usage declined from summer to winter.

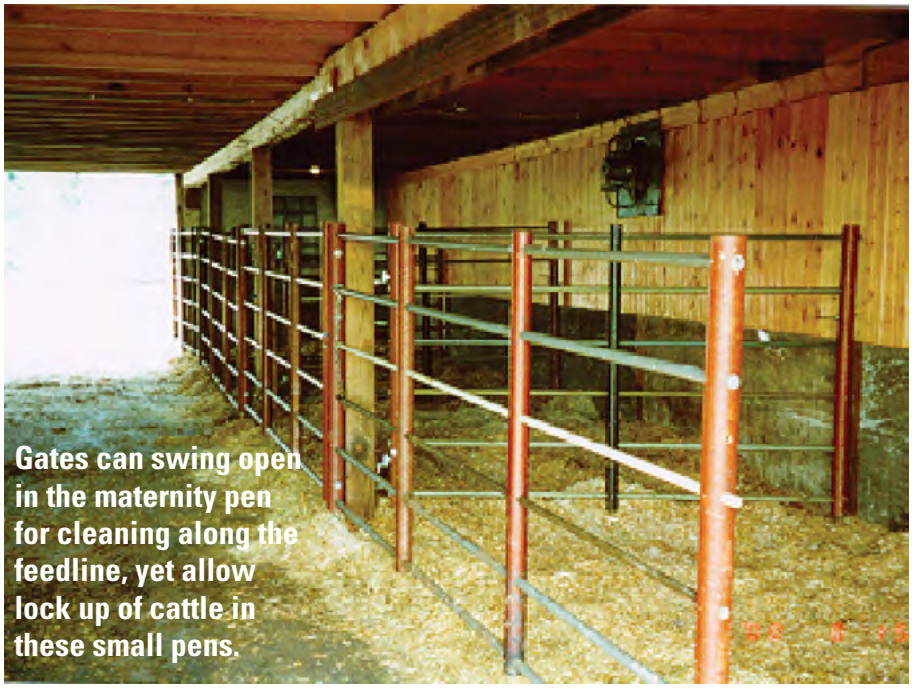
Wisconsin data from 1994 to 1998 compiled by Palmer showed no significant difference in milk production or somatic cell counts between sand or mattresses after an expansion. Producers using sand seemed more satisfied with cow comfort issues but less satisfied with manure management and bedding issues than those using mattresses.

Sand users reported significantly higher satisfaction scores for cow cleanliness and hock damage, whereas mattress users reported significantly higher satisfaction with bedding use and cost and manure management. Culling rates, although not significantly different, showed a slight numeric advantage to sand users.

Other research conducted in Europe demonstrated that cows showed definite preferences for some types of mattresses and that cow preferences changed over time. The results suggested that cows need time to adjust to some types of mattresses, and other mattresses get harder and less comfortable over time. Some producers put 2" of foam rubber on top of the ground rubber tubing to alleviate hardness of the mattress.

Mattress-based freestalls are popular, with a cost of $75 to $150 per stall. Mattresses should provide animal traction and be waterproof and durable enough to withstand animal traffic. The expected useful life is four to seven years.

Mattresses need some type of absorbent bedding applied to them. The initial cost of sand-based stalls is much lower. However, more labor is required to maintain sand, and sand has adverse effects on manure handling and storage, resulting in high maintenance costs. Some custom manure haulers refuse to



Gates can swing open in the maternity pen for cleaning along the feedline, yet allow lock up of cattle in these small pens.

Compare the initial and annual costs of remodeling and building new facilities. The costs to remodel may be lower than building new. However, producers need to ask themselves whether constraints or compromises will cause higher annual costs, even though initial remodeling costs were lower.

haul sand-laden manure or charge extra for the service. Sand users using sand savers made of secured tires, rubber, or plastic honeycomb webbing report cutting sand usage 40 to 60 percent.

Flexibility in new facilities is best obtained with equal sized pens that can be subdivided into multiple pens, with island waterers serving as the dividing points. By removing two gates, an employee can change a pen from housing two smaller groups to one large group.

Manure management and environmental regulations will continue to impact remodeling decisions. Developing manure management plans and determining the feasibility of skid steer or automatic scraping and flush or slotted floors are large investment decisions. Consult proper engineering assistance and consider future expansion plans. A manure pit can become too small too fast as a herd grows. Also, it can tend to tie a system to a certain location and even limit future expansion. Design with flexibility in mind.

How many rows of freestalls are necessary? Barns with one, two, three, four, five, or six rows of freestalls have been designed successfully depending on the needs of the operator and present facility layout.

If retrofitting freestalls into a present shed or barn, present dimensions may dictate design. Cow kennels (one row of freestalls with a roof) also are an option, though more so for cheap heifer, late lactation, or dry cow housing, especially alongside cow yards or barns.

Three, four, and six-row designs are most common when building new. Five-row freestall barns also can work when the design includes two rows on one side for early lactation, higher producing cows, and three rows on the other side for later lactation cows. The design of the roof on a five-row barn is more of a challenge due to placement of the ridge opening.

When considering a two or four-row versus a three or six-row barn, compare cost estimates from builders. A four-row barn can be overstocked up to 20 percent with no impact on production and producer perception of cow comfort. However, a three or six-row barn, when stocked at 100 percent capacity, already is stressing bunk space and feed alley space. When considering various designs, take these factors into account, along with the ability to split pens.

Recently, cross-ventilated freestall barns with a very low roof pitch have been introduced. Typically they are two 6-row barns placed next to each other, and large fans are used to draw air across the barn. This enables the doors on the ends to be used regularly without major interference with the ventilation system. Common width is 240'.

Headlocks or cow management rails also are common discussion points when remodeling or building new. Headlocks usually run about $60 per headlock, which must be compared to the cost of a separate treatment area, plus any labor savings over time.

Headlocks allow cows to eat while being treated in familiar surroundings with little time wasted. Headlocks can minimize “boss” cow syndrome at the feed bunk and decrease wasted feed. Manure from restrained animals is handled in the normal procedure.

Palpation rails, on the other hand, are much cheaper initially; cows are restrained in a herringbone fashion with minimal investment. Labor requirements, availability of feed and water, the effects of additional stress, plus handling of manure necessitate that cows handled through a management rail need to be treated abruptly.

Research has shown no significant difference in cows eating from headlocks versus a post rail feeding system. If headlocks are used, slope the headlock top toward the feed bunk 3" to 4" to allow more room for the cows to reach for feed.

Remodel or build new?

Compare the initial and annual costs of remodeling and building new facilities. Quite often the costs to remodel are lower than building new. However, producers need to ask themselves whether constraints or compromises will cause higher annual costs even though initial remodeling costs were lower.

- Will the facility cause an extra person to be needed daily for each milking due to a bottleneck in the holding area or parlor, or with the feeding or manure handling system?
- Will cow comfort be sacrificed, causing unclean cows that in turn cause another person to be needed for cow prep?
- Can herd health work through efficient cow management rails or can another system be used so herd health doesn't suffer?
- Will the facility design impact cull rate and production level due to inadequate stall sizing, ventilation, or feed access?
- Will the manure handling system be cost effective with the increased volume of manure?
- Is the parlor designed to optimize cow flow?
- Have the fixed costs (depreciation, interest, repairs, taxes, and insurance) and the operating costs of the facility been considered?
- Does the present or alternative location affect not only costs but risks relative to environment, ventilation, feeding efficiency, neighbors, etc.?

After all things are considered, building completely new may become more financially efficient in the long run. However, it may not cash flow. And, just because it does cash flow is no guarantee that it will be profitable with adequate returns relative to the level of investment, management, and risk one may assume in building a new or remodeled facility. Many operations may remodel with a "terminal" operation in mind.

You must know your future goals, along with present and future production costs, to determine if remodeling, staying the same, or building new is the best choice.

Option: Parlor and holding area

Remodeling dairy barns to a parlor and holding area has made sense to many producers. When financial resources are limited, it is recommended to spend available resources on cow comfort, dry matter intake, and labor efficiency priorities first. Typically, this means putting resources toward a well-designed, remodeled shed or new freestall barn, since that is where the cows spend most of their time.

Although many producers are successfully converting tie stall barns into a parlor, not all tie stall barns make good remodeling projects. But, consider the advantages to this option.

- The milk house system is already in place adjacent to the remodeled parlor.
- Cost savings on the parlor could allow proper investment in the freestall facility.
- If designed correctly, cow flow and milking efficiency need not be sacrificed.
- Parlors in retrofitted barns have been built for under $1,000 per stall (not including milking equipment).
- Swing units can be employed initially by using present 2" line double-looped with 2 percent slope to incorporate a double 8 to double 10 parlor.
- Many stall barns are sized to handle a double 8 parlor with holding area for a 120-cow herd.
- The payback of a parlor in labor savings (time and back/knee bends) can be rapid if it saves an extra person milking.
- Labor savings could make a low-cost parlor cost effective even if only used for several years in a transition phase.

Compare this option to staying with the present operation or building a new parlor. If a newer freestall barn is to be built, it is recommended that cows walk no further than 500 feet to be milked.

For more information on low-cost parlor options, please consult Iowa State University Extension publication *Developing Dairy in Iowa: Transforming a Milking Parlor at Low Cost* (PM 2033). Or, visit this Web site for blueprints, instructional material on design, and operational videos of low-cost TRANS Iowa parlors: www.extension.iastate.edu/dubuque/info/Dairy+Publications.htm.

Option: Heifer housing

Remodeling barns to heifer housing can be a good option if both parlor and freestalls are being built new. Size pens accordingly for small calves, and group newly weaned calves (no more than six to eight per pen) to reduce competition. Keep feed and water away from the resting area or outside if possible. Consider labor, manure handling, and feeding efficiency in the remodeled design and ventilate properly, especially for very young calves. Consult ISU Extension for heifer housing designs.

Stall dimension recommendations are getting bigger as more is learned about cow comfort. Also, cows are getting bigger on average.

Table 1. Transition cow space needs for large breeds

	Pen size (ft.^{2})	Bunk width (inches)	Waterers
Pre-fresh	50[a]	26-30	1 per 25 head
Maternity	144[b]	-	1 per pen
Post-fresh	Freestalls[c]	24-28	1 per 30-40 head

[a]An additional 10′ wide feed alley is needed.
[b]10′ by 14′ or 12′ by 12′
[c]Freestalls should be 48″ wide and 66-72″ from the curb to the <4″ brisket board for Holstein transition cows.

Table 2. Dimensions for post and rail feed systems

Animal Size	Age (months)	Throat height	Neck rail height
300-500 pounds	6-8	14″	28″
500-650 pounds	9-12	15.5″	30″
650-800 pounds	13-15	17″	34″
800-1,200 pounds	>16	19″	42″
>1,200 pounds	Cows	21″	48″

Table 3. Dimensions for freestalls

Animal Size	Length	Width	Brisket Board
300-400 pounds	48-54″	30″	36″
400-700 pounds	60-72″	34″	48″
700-900 pounds	72-78″	38″	52″
900-1,100 pounds	78-88″	42″	58″
1,100-1,300 pounds	88-96″	46-48″	66″
1,300-1,700 pounds	96-108″	48-54″	68-72″

Option: Transition cow facilities

Remodeling dairy barns to transition cow facilities can be a good use for the space. Depending on herd size, a portion of the barn could be made into freestalls to accommodate dry cows by simply removing the center alley. Cows in transition (two weeks prior to calving) would have a separate freestall area, allowing for separate feeding. Is it possible to open the east or south side of the barn to allow for drive-by feeding? If not, consider the labor, manure handling, and feeding efficiencies of transition cow facilities.

Another portion of the barn would be close-up cow maternity pens, designed in 12' by 12' dimensions. Allow one maternity pen for each 25 to 30 cows and possibly a post-fresh pen.

Figure 1 shows a 40' by 80' former stall barn. The post-fresh area consists of 8' by 4' freestalls, an 8' alley and a 10' feeding alley. This could be increased to 12' or 14' by removing two freestalls. Maternity pens are 12' by 12' with an area to gather cows a few days ahead of calving. Pre-fresh could be large (48" wide) freestalls or a bedded pack. Sand should not be used in the maternity area, because cows will consume sand as they lick their calves dry. Either a post and rail or individual lockups could be used on the feeding alley. If the topside faces south, it is possible to feed cows through the wall, thus increasing the capacity of the special needs barn. The transition cow facility in figure 1 would accommodate a herd of 175 to 200 cows.

The current tunnel ventilation system could be left in place. A self-propelled forage wagon would be used to deliver rations. The most frustrating problem with this layout may be working around existing support poles. More modern clear span buildings will work well. A survey of northeast Iowa dairy farms shows that more than 65 percent of farms have tie stall or stanchion barns for their cows.

Figure 2 shows how one maternity pen can be converted to a special handling area or can remain a treatment or pre-calving area. The diagram shows 14" wide worker passageways at strategic locations.

Transition cow space needs depend on the stage of transition the cow is in. Table 1 shows transition cow space needs for large breeds. For more information on transition cow management, consult the ISU Extension Dairy Team Web site at www.extension.iastate.edu/dairyteam.

Freestall housing design recommendations

Fenceline feeding systems enhance cows' dry matter intake. A properly designed feeding system does not inhibit eating time or the cows' ability to reach for feed. Table 2 shows dimensions for post and rail feed systems.

If headlocks are used, then the throat height curb should be lowered 3" to 4" so that the bottom of the lock-up panel does not interfere with the cow's throat.

The final selection of freestall sizes depends on a balance of cow comfort versus maintenance of dirtier stalls. This balance is not as crucial for dairy heifers whose milk production performance is not as dependent on lying time relative to a lactating dairy cow. Longer stalls (9') give cows needed lunge room that will encourage cows to lie down more. Wider stalls (>48") might encourage cows to lie straighter in the stalls. Table 3 shows dimensions for freestalls.

Stall dimension recommendations are getting bigger as more is learned about cow comfort. In addition, cows are getting bigger on average. So to build for the future, plan accordingly for cow sizes, and thus, stall dimensions.

Figure 1. Possible transition cow facility

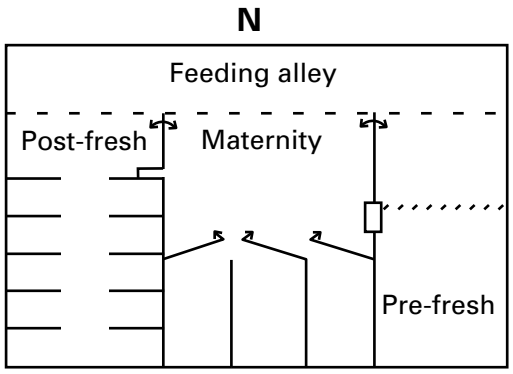


Figure 2. Stall barn special needs area

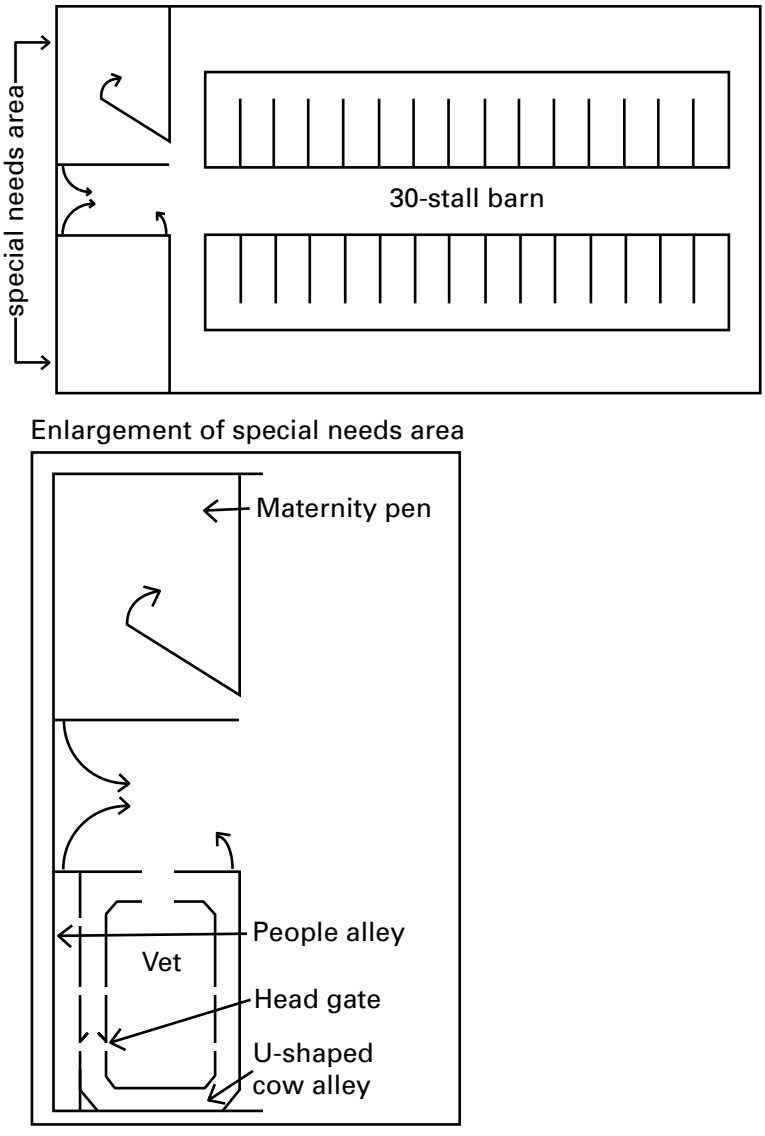


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Figure 3 shows a basic diagram for a three-row freestall barn. A two-row design with a fenceline feeder typically would eliminate the outside row or one of the inside stall sets that are head-to-head. A four-row design would mirror the two-row design with a 16' to 22' wide driveway. A six-row design would mirror the three-row design. If possible, freestall barns should run east to west to reduce heat load in the summer.

Table 4 shows dimensions for large breed cows. For smaller breeds, use the same dimensions for the facility but use the "minimum for renovations" recommendation for the freestalls.

Ridge openings are necessary, even on monoslopes with front overhangs. At minimum, overhangs should cover feed tables in front. Consider shading in back for freestalls against the outside wall.

Figure 3. Three-row freestall barn

FT = Feed table width
FA = Feed alley width
SW = Stall width
SLHH = Stall length, head-to-head
SLO = Stall length, outside wall
AW = Alley width
SH = Sidewall height
CH = Curb height
RS = Roof slope
DW = Driveway width

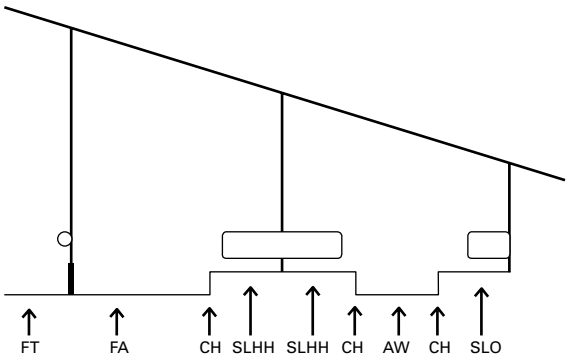

Table 4. Freestall barn dimensions for large breed cows

	Recommended range	Minimum for renovations
Feed table width	3-4′	2′6″
Feed alley width	12-14′	10′
Stall width	48″-52″	
Stall length, head-to-head	7-9′	7′
Stall length, outside wall	8-10′	7′6″
Alley width	8-10′	7′
Sidewall height	14-16′	12′
Curb height	8-10″;	8″[a]
Roof slope	3/12 – 4/12	
Driveway width	16-22′[b]	

[a]Maximum = 12′
[b]Includes feed tables

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File: Animal Science 5 (Dairy)