Minnesota Dairy Health Conference

University of Minnesota

College of Veterinary Medicine

Veterinary Continuing Education

May 19-20, 2010
St. Paul, Minnesota

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5-STEPS TO DESIGNING THE IDEAL TRANSITION COW BARN

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Introduction

Over the last few years, my colleagues in the Food Animal Production Medicine group at the University of Wisconsin-Madison have used our clinical experiences troubleshooting fresh cow health problems on farms, research conducted by other groups and our own research findings, to formulate a plan for designing transition cow barns which results in optimal health and performance. In this article, I will summarize the planning process we have devised and used successfully to create these new facilities.

Where to start?

The planning process starts with one simple question:

'How am I going to manage my cows at the point of calving?'

In order to limit the risk for dystocia and stillbirth, and avoid movement and social upheaval within the critical period of 2-7 days before calving, there are only two possible strategies:

1. Move cows from a prefresh pen with freestalls to an individual or group calving pen at the point of calving – refereed to as 'Just-in-time-calving'.
2. Manage socially stable group pens throughout the prefresh period and calve in the prefresh pen, which in this scenario is a bedded pack.

Each strategy has some advantages and disadvantages laid out in the table below that should be discussed before continuing with the plan.

Table 1. Comparison of two strategies for managing the cow at the point of calving

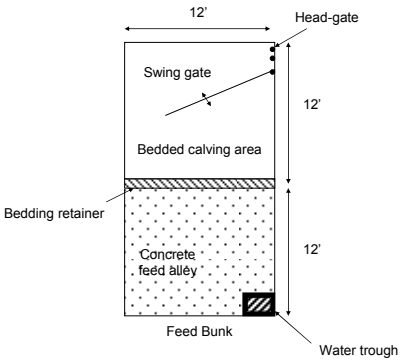
Just-in-time-calving	Parameter	Socially Stable Prefresh/Calving Group Pen
Freestalls and individual or group bedded pack	**Type of Housing**	A series of group bedded packs
15% less roof space required, but more concrete and stall construction costs	**Space Requirement and Cost of Construction**	15% more roof space required, but less concrete and stall construction costs
Limited to stall bedding and bedding for individual or group calving pen	**Bedding Costs**	High due to the use of multiple bedded packs
Need to check prefresh pen hourly 24/7	**Need for supervision**	Less need for constant supervision
Elevated if workers move cows too early	**Risk for dystocia**	Decreased, as cows do not have to be moved when they are in labor
Good, provided excellent bedding management in the calving pen(s)	**Disease control**	More difficult and may require separate pens for Johne's cows
Excellent control	**Passive Immunity Transfer**	Depending on level of supervision, opportunity for calves to suck the wrong dam first

Each strategy has different keys for success.

For the Just-in-time-calving approach the keys to success are:

1. Control social structure in the prefresh pen by limiting new additions to a once per week cycle.
2. Utilize sand bedding in the prefresh freestalls to reduce the adverse impact of lameness on transition behavior.
3. Locate the calving pens close to the prefresh pen and away from heavy traffic areas.
4. Train maternity pen workers to identify the stages of labor and monitor what stage of labor the cow is in when she is moved, the time that she is moved to the calving pen, the time when she calves, whether the calving was assisted or not and when the calf received colostrum. Risk for stillbirth will increase if cows are moved to the pen too early (before the water bag shows), the cow is continually disturbed once moved and when workers are too eager to assist. Target stillbirth rate for the herd is 4%.
5. Fresh dry bedding arrives with the cow and leaves with the cow to maintain hygiene in the calving pen.
6. Utilize a correctly designed pen, such as the one shown below in figure 1.

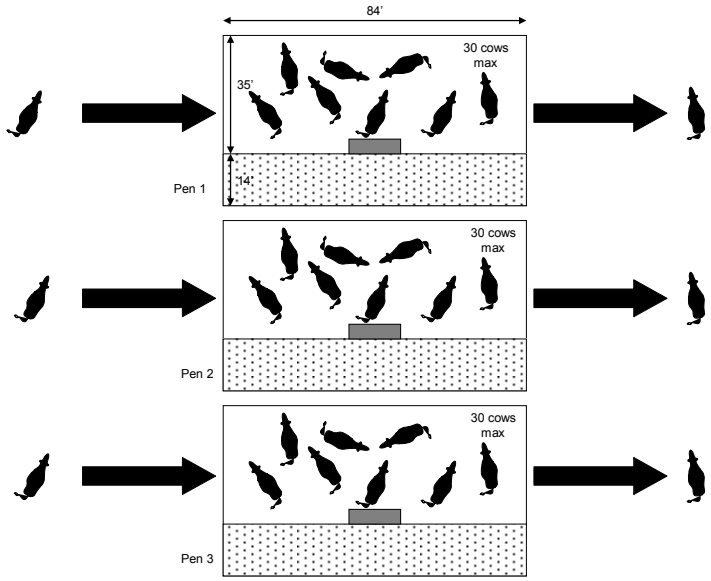
Figure 1. An ideal maternity pen layout, with a concrete apron against the feed bunk in the foreground, a bedded area with sand and straw on top in the rear half of the pen, and a head gate in the far corner. The water trough is located in the near right corner, away from the bedded area.



For the socially stable prefresh/calving group pen, the following is required:

1. A series of bedded pack pens with sufficient numbers to accommodate a weekly group of cows moving from far-dry to prefresh. Therefore, for a 21 day prefresh period, a minimum of three separate pens are required (figure 2).
2. No further animals are added until all of the animals in the pen calve (this is ideal, but in practice a few straggler cows may have to be moved between pens so that the flow can continue from week to week).
3. Each pen is sized to provide a minimum of 100 square feet of bedded area per cow at maximum fill.
4. Each pen is bedded fresh daily, and the whole bed removed once the last cow calves.
5. Sufficient supervision is still required to make sure that there is adequate control of colostrum feeding.

Figure 2. A series of bedded pack pre-fresh pens designed for a 1000 cow dairy. Each pen provides 2940 square feet of bedded area, with a maximum stocking rate of 30 cows per pen. A total of three pens provide capacity to cope with 140% of the weekly average calving rate, with a 3 week pen stay duration. Pens are filled in series – filling pen 1 first to a maximum of 30 cows, then pen 2 and so on. Once the maximum stocking density is reached, no new cows are added. Cows may calve in the pen or in an adjacent calving pen and proceed to the post-fresh group. Once the pen is empty, it is cleaned out and re-bedded and the filling cycle repeats. A fourth pen may be required for over-flow cows or special needs cows.



Once a decision has been made on a strategy for managing the cow at calving time, the planning process can proceed in 5 easy steps:

1. Size groups to accommodate the 90th percentile of the weekly calving rate
2. Provide 30 inches of bunk space 21 days before and after calving
3. Minimize pen moves within the period 2-10 days before calving
4. Provide sand bedded stalls sized to accommodate the size of the cows using them
5. Provide at least one stall per cow (or at least 120 square feet of bedded pack per cow)

Step 1. Sizing the pens correctly

The actual duration of stay within any given transition cow pen (which includes the far-dry, prefresh, maternity, calving, colostrum and postfresh management groups) is determined by two factors; the rate of calving and the target duration of stay in the pen.

Recommendations for pen sizes are typically based on the average flow of cows through the transition facility and do not take into account farm management decisions which vary time spent in the pen. For that reason, many transition cow pens are built that fail to accommodate the normal ebb and flow of calving rate over time. We recommend that a facility would be best constructed to accommodate the surges in calving rate, without compromise to stocking density within the pen. In essence we will be over building to some degree.

We have constructed a plan for sizing transition cow pens that allows us to accommodate cows in pens sized to cope with the normal increase in stocking density for 90% of the time. For 5 weeks a year (10% of the time), the farm will need to modify days spent in the pen to maintain the targets for stocking rate or disease screening will need to compensate for a lapse in prevention. The procedure is as follows:

1. Calculate the weekly rate of freshenings for the herd.

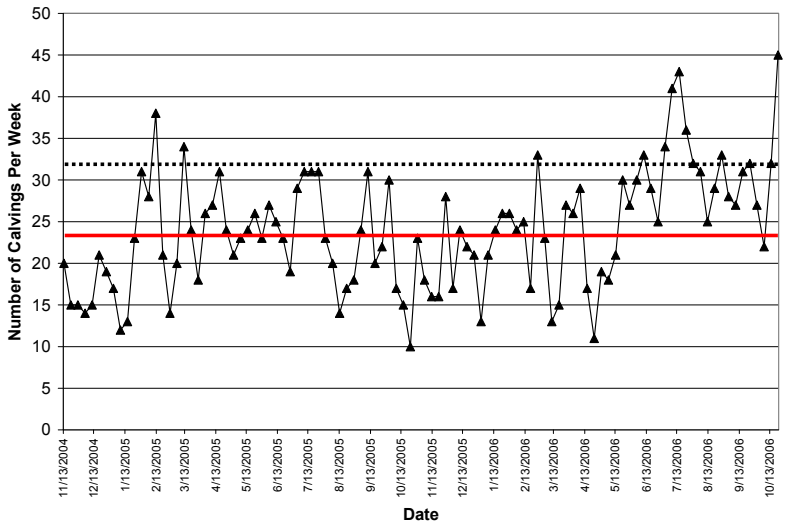
For herds that are remodeling we can graph this in programs like DC305 and file out the data into Excel. For new herds, we can estimate the number of calvings to be 104% of the rolling average number of cows in the herd, and the weekly rate will be this number divided by 52.

For example, a 1000 cow dairy will freshen 20 cows and heifers per week on average.

2. Calculate the 90th percentile of the weekly calving rate.

Below (Figure 3) is an example of the weekly calving rate for a 1200 cow dairy. The dotted line is the 90th percentile threshold (32), below which 90% of the cows calve and above which only 10% of the cows calve. The solid line is the average (24). Note that by definition, if we build to accommodate the average, the facility will be overstocked half the time. The 90th percentile will be sensitive to the size of the peaks in calving rate and the duration of each peak. This needs to be taken into account when selecting the final number of cows calving per week for construction.

Figure 3. Calving rate by week for a 1200 cow dairy with average (solid line) and 90th percentile (dotted line) calculated. Note the recent calving surge has raised the 90th percentile recently. The barn designer needs to consider whether this is a one off, or due to a permanent change in herd size or management.



For new facilities and for expansion herds, we need to use an estimate of the 90th percentile. Using data from 73 large herds we have estimated that 140% of the average weekly calving rate is a reasonable estimate of the 90th percentile.

For example, a 1000 cow dairy would freshen 28 cows and heifers per week for 140% of average (1.4 x 20). Again, this is only an estimate and other factors need to be considered before a final starting number is selected.

3. Determine the target duration of stay in each transition cow pen.

Factors such as target dry days, time of return of heifers to the close-up or far-dry pens, days in prefresh, time in the calving or maternity pen, and days in postfresh need to be decided. These are management decisions that will be farm dependent.

4. Calculate the number of cows in each group.

For example, a 1000 cow dairy wishing to accommodate 28 cows and heifers per week in a postfresh pen sized to accommodate these cows to 21 DIM would need 28/7 x 21 = 84 stalls.

We have brought these ideas together in a pen size calculator spreadsheet. The calculator is shown below for a 1000 cow dairy with a 60 day dry period and 21 days spent in the pre- and post-fresh pens.

	Heifers	Cows	Total
Weekly Calvings (140% of average)	10	18	28
Days in Pre-Fresh Pen	21	21	21
Days in Calving Pen	1.0	1.0	1.0
Days in Post-Fresh Pen	21	21	21
Average Days Dry	NA	60	60
Days pre-calving to return to the dairy	30	NA	30
Far-Off Dry Cow/Heifer Inventory	12	103	115
Pre-Fresh Pen Inventory	29	55	84
Calving Pen Inventory	1	3	4
Post-Fresh Pen Inventory	29	55	84

Once we know the inventory in each group that we need to build for, we can proceed with the rest of the building design.

Step 2. Provide adequate bunk space pre- and post-fresh.

Using the above requirements we know from the predicted inventory how many cows are in each pen and we can calculate the feed bunk length of each pen knowing that we need to provide 30 inches of bunk space per cow in the pre- and post-fresh pens. Currently we put the bunk requirement for far dry pens at 24 inches, but given the longer duration of stay in these pens we have built barns with less space and 3-row stall layouts for this group.

For example, a 1000 cow dairy would need a 21 day prefresh pen feed bunk that was 84 x 2.5 feet = 210 feet long.

To accommodate our requirement for bunk space, transition cow pens should be built with only 2 rows of stalls – either tail to tail or head to tail or head to head.

For ease of cow identification, head to tail is preferred for farms where pen workers need to check cows for signs of labor every hour. Pens of around 30 stalls split with a 26 foot crossover

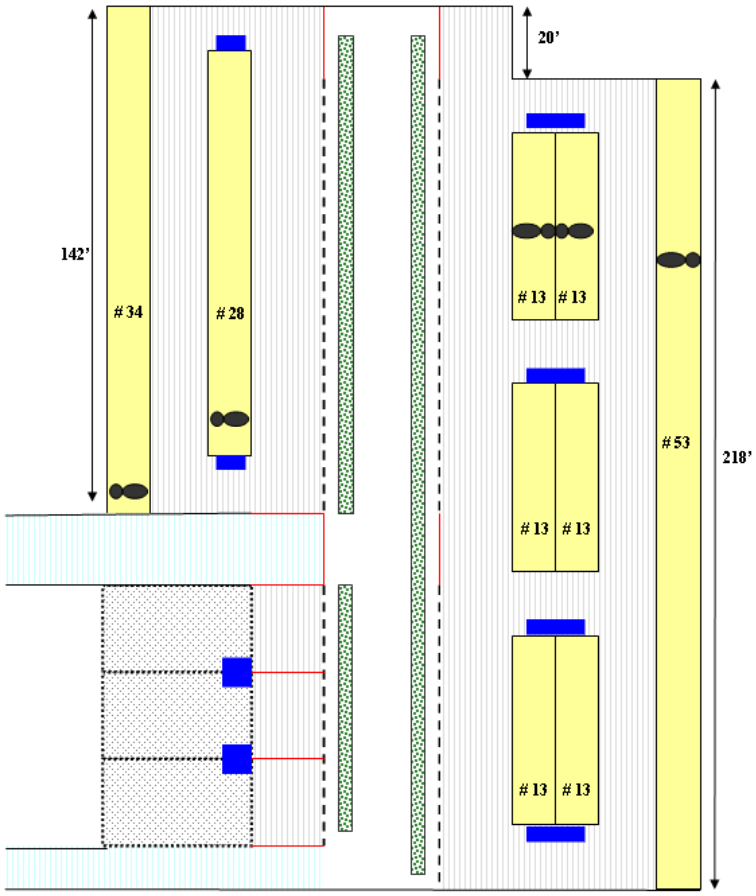
with a water trough in the middle provide flexibility to cope with changing numbers of cows in each group over time.

Step 3. Minimize pen moves 2-10 days before calving

This will depend on the answer to the first question regarding whether Just-in-time-calving will be used, or a prefresh/calving pen. Different solutions have been found for different farms.

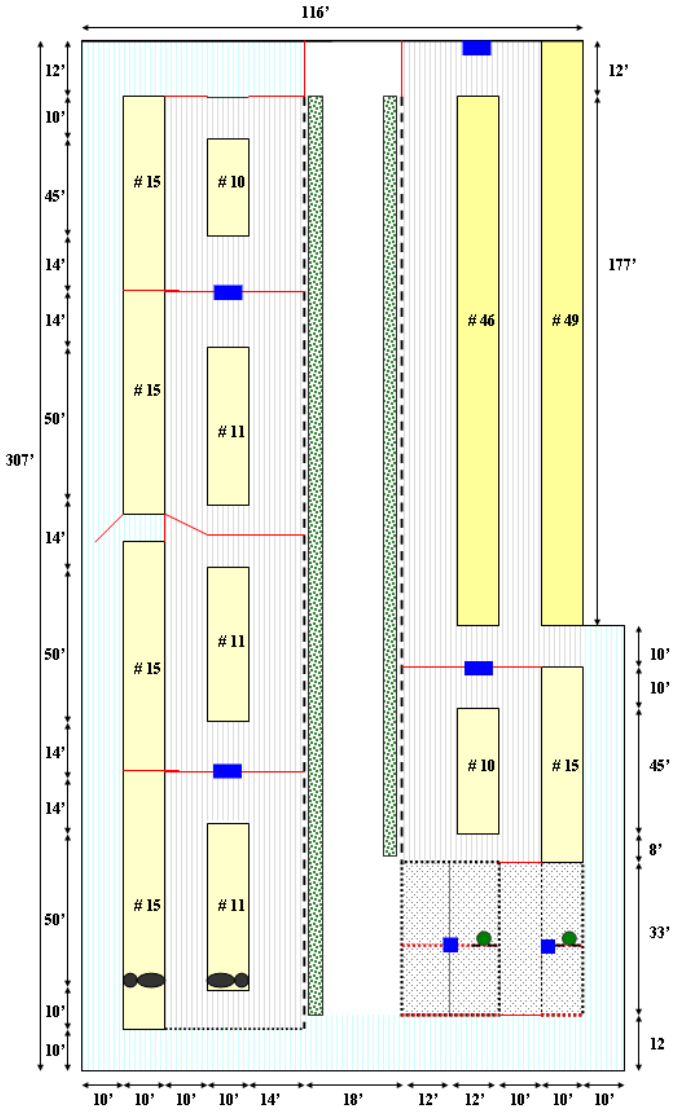
For example, the farm in Figure 4 opted for Just-in-time-calving in individual calving pens. In this strategy the prefresh pen is loaded with cows once a week in order to reduce social turmoil in the last week before calving.

Figure 4. Once weekly loading of 2-row head to tail prefresh pen in an 800 cow dairy with individual calving pens and a 3-row far dry pen.



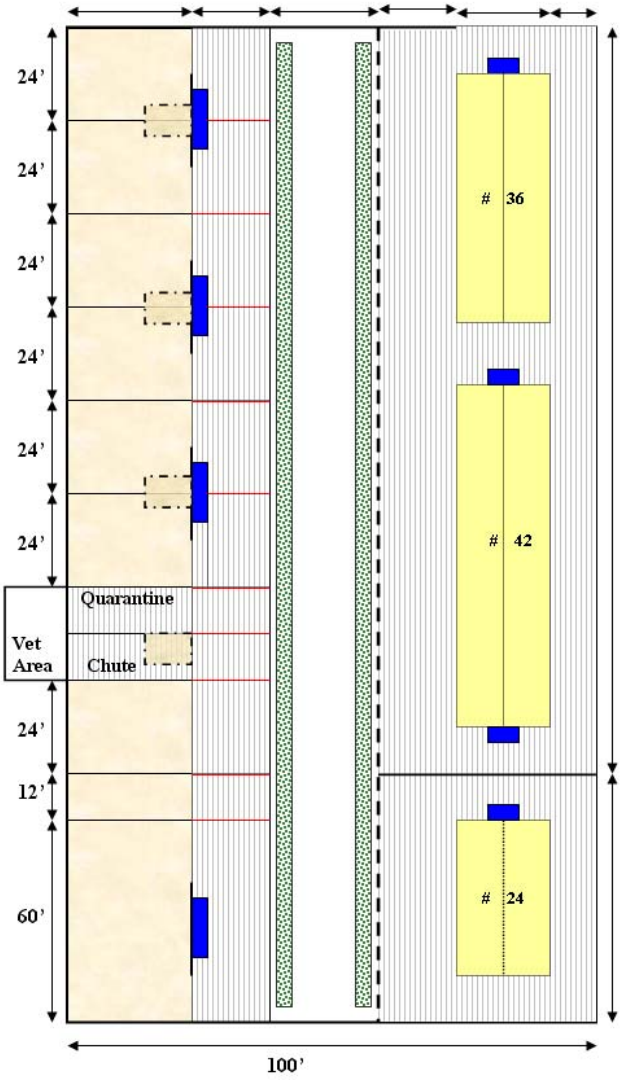
In the farm shown in Figure 5, while they retained individual calving pens, they decided to create socially stable mature cow pens throughout the dry period with the provision of 5 x 25 cow pens. The pens are loaded at dry off, locked at 25 cows maximum and allowed to empty before refilling. Heifers are managed in a separate group pen.

Figure 5. Socially stable mature cow dry pens (5 x 2-row pens) with individual calving pens and a separate heifer pen.



Finally, the farm in Figure 6 created socially stable bedded packs in which prefresh cattle calve where heifers may be grouped separate from cows.

Figure 6. Socially stable prefresh group bedded packs (6) with calving in the same pen, a hospital are and 2-row freestall pen for fresh cows.



Step 4. Sand bedded stalls sized to accommodate the cow

Sand is the optimal bedded surface for the dairy cow and provides cushion, traction and support at the time when the cow most needs it. Lame cows sharply increase the number of lying bouts at the point of calving compared to non-lame cows. If these individuals are still in a freestall we believe that it is preferable for the stalls to be bedded with deep sand, to improve comfort at this time. We currently discourage Just-in-time-calving coupled with mattress freestall prefresh pens.

Prefresh cows are the heaviest widest cows on the farm and require the largest stalls. Mature Holstein prefresh cows should have stalls at least 50 inches wide, preferably 52-54 inches. This creates problems in mixed age groups with heifers grouped in the same prefresh pen. However, I believe it is foolish to punish 2/3 of herd in order to make sure that the stalls are small enough for heifers to stay clean. Most farms choose to compromise with a 50 inch wide stall and remove manure from the rear of the stalls more frequently. Ideally, strategies that provide different size stalls for separate mature cow (52-54 inches) and heifer groups (46-48 inches) can be utilized.

Post-fresh stalls for mature Holsteins are usually sized at 50 inches wide.

Step 5. Provide sufficient stalls and bedded pack space

For prefresh cows and maternity cows, bedded packs should provide 120 square feet per cow minimum. Because the bedded area should not be deeper than 35 feet, this usually results in ample bunk space and typically the area occupied by the pack is 15% larger than the area occupied by an equivalent freestall layout. Waterers should be located in the bedded area, but shielded so that the cow must drink from the concrete feed alley side (Figure 7).

Figure 7. Bedded pack layout with ideal waterer location.

Prefresh cows decrease lying times by around 3h/d in the last week before calving compared to far dry cows. At this time, they do not need to be competing for a stall, so we recommend at least one stall per cow throughout the transition period.

Conclusions and Economics

A 1000 cow facility built to accommodate the 90th percentile of average weekly calving rate, would require 61 more stalls than a facility built to accommodate the average. At $3,500 per stall, this equates to $213,500 or $214 per cow.

For us to convince the farm (or the banker) to build this barn, you would need to believe that a facility built to accommodate 90% of the ebb and flow of calving rates would provide 1337 lb more milk per cow than a facility that is overstocked 50% of the time, to pay back the extra cost in one year. Of course – the deal is even better than that, because we can pay off the barn over 5 years, making the required increase in milk only 280lb per cow. In the facilities we have been involved in planning, using the design principles discussed here, improvements in fresh cow health, reduced drug costs and increased productivity have more than covered the increased investment.

We have the opinion that when it comes to transition cows you either pay at the beginning – to build the facility that encourages health and productivity, or you pay at the end, with broken cows and elevated culling rates. The choice is easy from our perspective and that of many Wisconsin dairy farmers that have already acted on our recommendations.