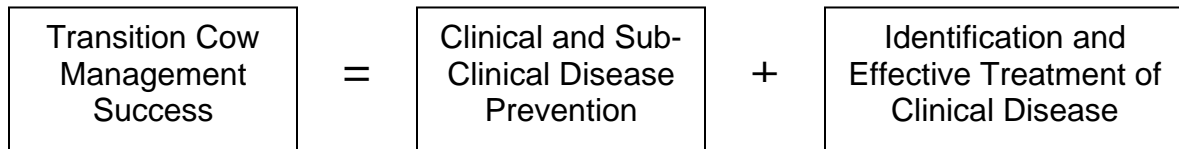


Makin' Me Dizzy – Pen Moves and Facility Designs to Maximize Transition Cow Health and Productivity

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Introduction

The success of a particular dairy herd's transition cow program is the sum of the strategies used by the herd to prevent sub-clinical and clinical disease and the ability of the health workers in the herd to identify and successfully treat the clinical disease that occurs, so that future production and health of the treated individual is minimally affected. Across the dairy herds that we visit, we will see success resulting from effective prevention, effective treatment, and a combination of the two.



This paper will examine current thoughts on the prevention of clinical and sub-clinical disease through grouping and housing and discuss the steps required in the planning of a new facility.

The Importance of Change in DMI

On average, 13.3% of cows in each herd were sold or had died by 60 days in milk (DIM) in 115 well-recorded DC305 herds in North America. This is used as a crude monitor of fresh cow health. In these same herds, death loss averaged 8.4% rate of displaced abomasums was 7.0%. These numbers far exceed what we should be able to achieve as an industry and raise questions about the effectiveness of current transition cow feeding and management practices.

Interestingly, UW researchers have recently made the case that it may not be the absolute level of DMI at calving which is important for the prevention of metabolic disease, but the change in DMI during the last few days of gestation (Figure 1). This will be affected by a range of animal, dietary and management factors. Only around 30% of the variation in change in DMI may be explained by diet and animal factors, suggesting that management factors account for 70% of the variation.

Recently, workers at the University of British Columbia have shown that cows with mild and severe metritis have significantly lower DMI than healthy cows, not only at the time that the disease is recognized, but also for several days prior to calving. This suggests that the factors

which trigger disease in the early post-partum period are already exerting an effect on the cow and her feeding behavior prior to calving.

This paper will focus on recent findings from our field investigations that shed light on some of the management factors which may influence change in DMI.

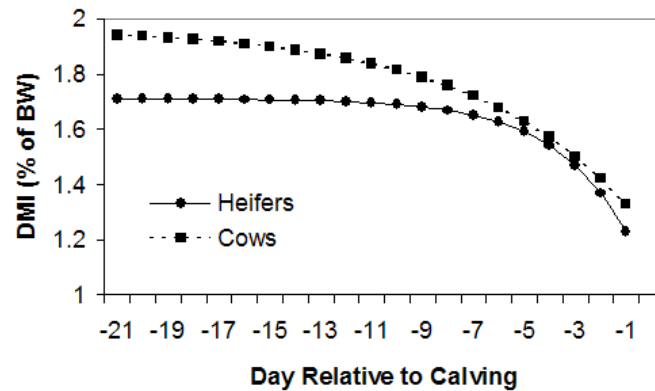


Figure 1. Predicted dry matter intake (DMI) of heifers and cows during the final three weeks of gestation (from Grummer et al., 2004).

Management Factors that Influence Transition Cow Health

We have focused on the interactions between four main transition management factors:

1. Duration of exposure to the close-up ration and to the herd-mates within a group
2. Movements between pens
3. Feed space per cow
4. Stalls per cow

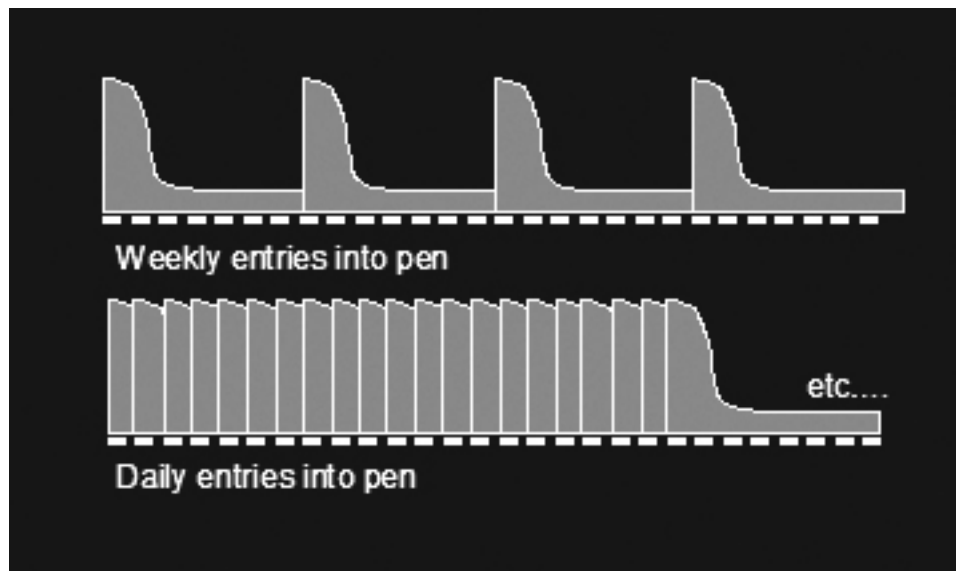
Large free stall housed dairy herds have developed a system of management that involves moving animals between groups to facilitate feeding, breeding and health management. Moving cattle between groups brings about a considerable change in behavior and a period of increased interaction for about 48 h before social stabilization and the development of a stable hierarchy. These changes may have a negative effect on milk yield and health in the moved individuals. Effects on milk production for mature cows moved after the transition period are small and short-term in nature. However, not all movements between groups should be considered equal, and the effect on individuals; first lactation animals and subordinate animals in particular, during a high risk period, such as the transition period, may be greater and last for longer. Although detected changes in milk yield may be small, there may be longer term effects on health that have yet to be identified that are of greater significance.

Transitioning the Rumen or the Cow?

Much credence has been given to the idea of transitioning the rumen for some undefined time period, to allow the papillae to develop and maximize nutrient capture when the cow is fed a lactating cow diet. We believe that this concept has perhaps been over-sold to the industry when cows are fed North American type diets, with the result that many nutritionists will protect time spent on the close-up ration 'transitioning the rumen' while allowing stocking density to exceed target.

These close-up groups are typically managed with weekly additions – characterized by 2 days of social turmoil and 5 days of stability (Figure 2). Stays of 4 days or less will be characterized by social disruption through most of the entire stay, whereas longer stays allow for acclimation to both rations and herd-mates – which may be of particular importance for heifers. In a one group short dry period strategy, benefits may accrue not only from increased consistent exposure to a close-up type ration, but from a reduction in group changes.

Figure 2. Graphic depicting the social turmoil profile of agonistic interactions in a pen characterized by weekly entries of new cows compared to a pen with daily entries.



Short Stay - High Throughput Groups

It is suggested that the ideal time to move the cow prior to calving is 12-24 h. However, a growing amount of field collected data and experience suggests that this timing is difficult to manage in practice. Predicting calving time is unreliable, and cows may remain in the maternity pen for 3-7 days rather than 2-3 days as expected. Although the cows in a spacious maternity pen, lying down on a well managed bedded pack, may appear to be in an ideal environment for freshening, we believe that the timing of the move to the maternity pen is critical.

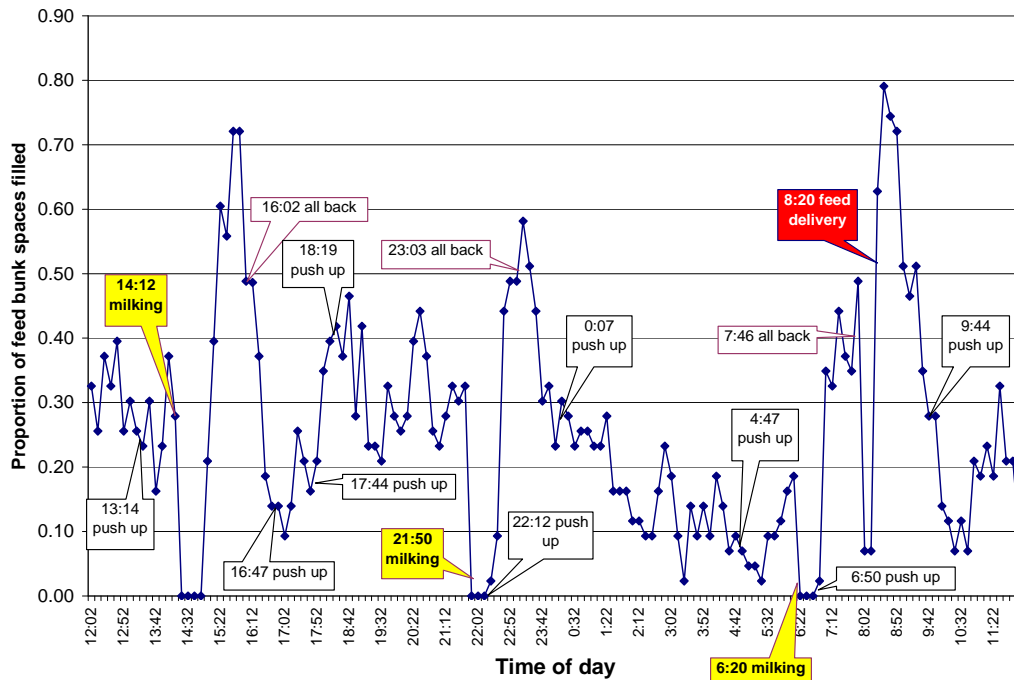
Unlike the close-up pen, cows in the maternity pen are subjected to daily additions of new herd-mates (Figure 2), which ensures that the maternity pen is rendered in a continual state of social turmoil. In addition, feed and water management in these pens is often less than desirable. Compared to cows moved within 2 days of calving, field investigation data show that NEFA concentrations are elevated in a greater proportion of cows moved into the maternity pen 3 days or more before calving, and there appears to be approximately a two fold greater risk for ketosis and DA. Risk of removal from the herd in early lactation appears to be elevated three fold. Effects on milk yield are greater for heifers than for mature cows.

Therefore, exposure to a short stay-high throughput group within 2 days of calving, and the social turmoil and potentially reduced DMI that this creates, along with the associated physiological changes that follow, such as elevated NEFA, appears to be a significant risk factor for fresh cow health problems.

Bunk Space per Cow

When designing facilities we typically define one headlock as one feed space. However, when we look at feeding patterns of dairy cows in pens, and use this definition we find that it is rare to see all the headlocks/feed spaces occupied.

Figure 3. Graph of the proportion of headlocks filled through a period of 24 hours in the high production mature cow pen on a typical commercial dairy with 3-rows of stalls. The headlocks were spaced at 24 inches on center (from Mentink and Cook, 2006).



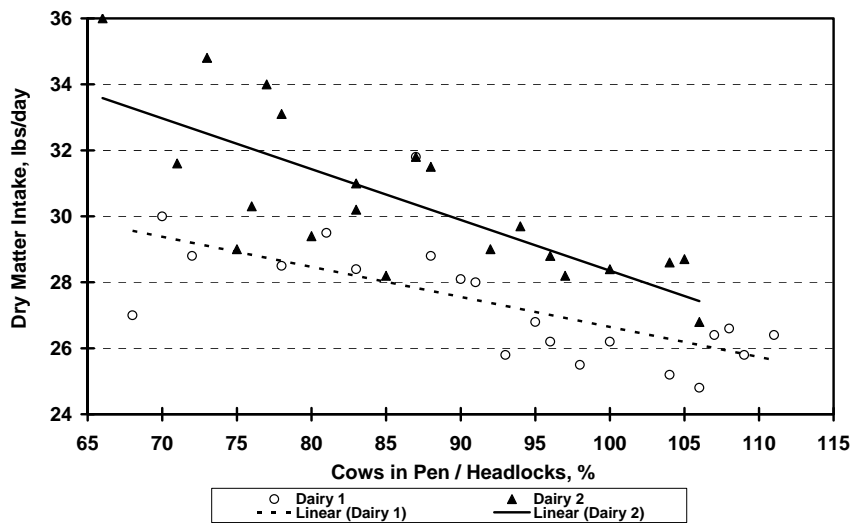
Peak bunk use is observed after fresh feed delivery and after each milking and this rarely exceeds 80% of headlocks filled. We believe that this is due to the design and dimensions of each feed space, and it is becoming very clear that mature lactating dairy cows, especially

pre-fresh cows, are wider than 24 inches. Thus, if we are to allow feed access at peak times to the maximum number of animals we should stock 24 inch headlocks at 80% maximum, or use 30 inch headlocks, or provide 30 inches of bunk space per cow during the transition period, whatever the bunk design. Even this recommendation may not be enough in post and rail systems where dominant cows may position themselves parallel to the bunk and take up feed space for several cows at one time (Figure 7). So, from observations of cow behavior, we see that the cows are telling us that they need 30 inches of bunk space at peak feeding activity, but is it economic to do this? We have evidence from several on-farm experiences that it is.

It is commonly thought that because dry cows are not lactating and DMI is lower, the close-up group can be overstocked relative to feed bunk space. We do not believe that this is the case. Unfortunately it is rare to see good research done monitoring the effect of overstocking on DMI, milk production and health. However, we are compiling many field experiences which confirm our suspicions. Some of these are given below:

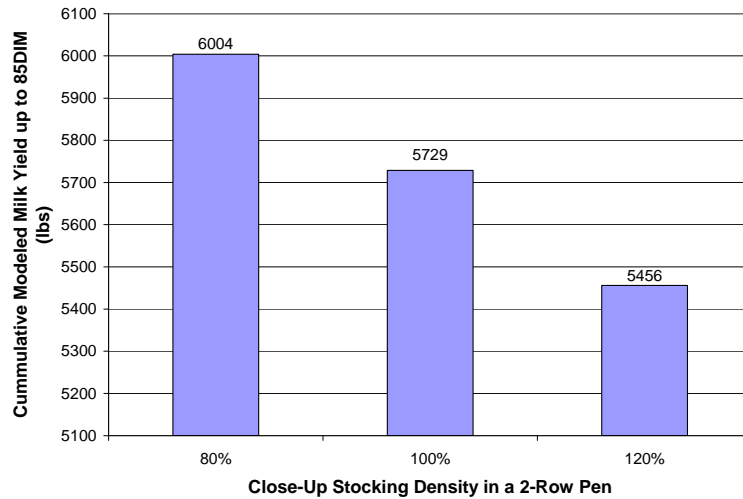
1. Reduced group DMI was documented in two dry cow lots fed identical close-up diets when cow numbers in the pre-fresh groups exceeded around 85% of headlocks. (Figure 4).

Figure 4. Group average dry matter intake of pre-fresh dry cows on two New Mexico dirt lot dairies and stocking density of headlocks on 24-inch centers. Unpublished data from Kenn Buelow.



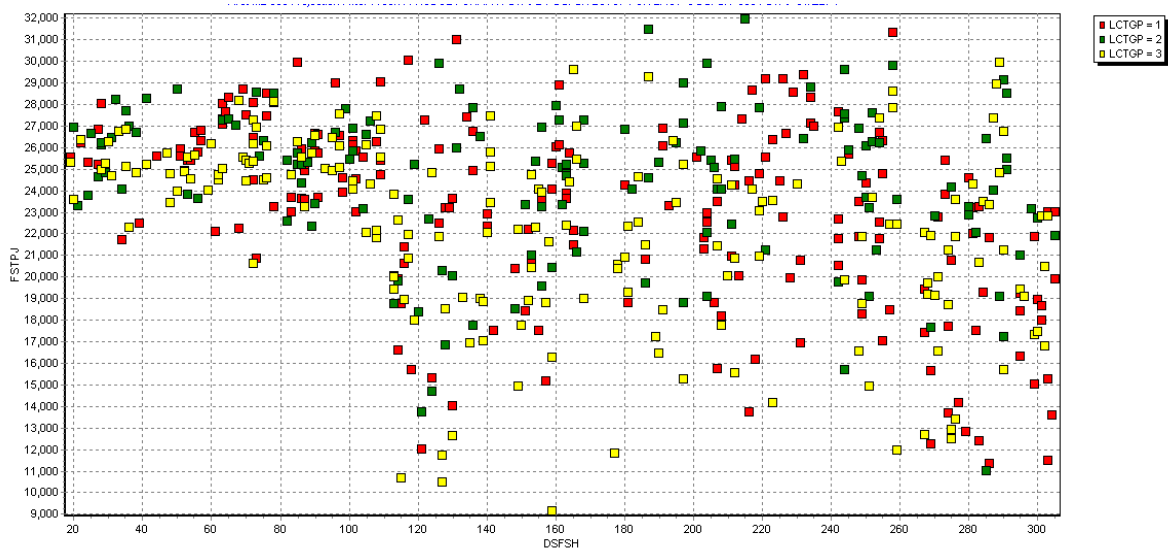
2. The impact of over-stocking in a pre-fresh group housed in a 2-row pen on a 1600 cow facility was greater for first lactation animals penned with mature cows. There was a 6.5 lb per day increase in milk production over the first 80 days of lactation in first lactation animals stocked at 80% with respect to stalls, compared to overstocking at 120%. Over the first 85DIM, the milk production deficit amounted to 548lbs.

Figure 5. Modeled cumulative milk yield up to 85DIM for first lactation heifers in a 2-row pen at three levels of stocking density pre-fresh and no overstocking post-fresh. Unpublished data from Gary Oetzel.



3. In an 800 cow dairy, pre-fresh stocking densities were improved from 120% to 85% of stalls in a 3-row pen, and post-fresh stocking density was reduced from 100% to 80% of stalls, and 120% to 100% of headlocks. Heifers and mature cows were mixed, and there was a two stage post-fresh group for 1-10DIM and 10DIM to 30DIM. Note the change in variation of first test 305 day milk projections. There is a reduction in the proportion of low producing cows. Note that the low rank cows are mixtures of mature cows and heifers – not just heifers alone.

Figure 6. Change in first test 305 day milk projections following changes in pre and post-fresh stocking densities. Unpublished data from Paul Meagher.



We believe that stocking density relative to inches of bunk space per cow impacts DMI in subordinate cows in a group – these cows do not eat when they want to eat and their feeding behavior is affected adversely. Fresh cow health and performance is the most important consequence of this variable measured during transition.

We therefore recommend that all transition cow pens have only two rows of stalls as we would have to severely under-stock a 3-row pen to achieve this feed space target. The economics of building a stall that a cow will not use are unsound! We also recommend against post and rails in favor of headlocks in transition pens, provided that heifers have experienced headlocks previously. If not, then a section of bunk without head locks needs to be provided for these animals to get access to feed.

Figure 7. Comparison of bunk use between headlocks and post and rail feeding barriers – note the angle of the cows relative to the bunk and the empty feed ‘spaces’.



When spikes in calving occur during the year it is interesting to investigate the response of the herd manager. Some will maintain stocking rates in the pre- and post-fresh pens and reduce time spent in the pen, while others overstock and protect time on the rations.

We favor protecting inches of bunk space per cow above all other factors.

Stalls per Cow

Increasing the number of cows per stall potentially leads to a reduction in lying time and we recommend not exceeding one cow per stall. However, unlike the feed bunk, where maximal use is limited to short periods of time in the day around milking and fresh feed delivery, stall use can be spread out over a greater time period. This allows subordinate cows to compensate for overstocking to some degree by increasing lying time during periods of the day when high rank cows are otherwise engaged. This compensation may explain why some herds appear to tolerate stocking rates up to 115% in 2-row pens without apparent ill effect. However, because of the extra challenges transition cows face around calving time, we believe that each cow should have access to one usable stall during the transition period.

We also need to consider the ‘effective stall stocking density’. With small 45” wide stalls, it is common for the rumen and legs of one cow to overlap adjacent stalls, potentially reducing the use of these stalls (Figure 8). For that reason, stalls should be sized appropriately to the size of the cows occupying them. Stall width is a compromise depending on the size of the cows housed and whether heifers are to be mixed with cows pre-fresh. Width recommendations range from 48” on center for heifer groups to 54” for a dedicated mature cow pre-fresh group in Holstein dairy herds.

Figure 8. Compare the lying position of these large 1800lb Holstein cows in a 48” wide stall (left) and a remodeled 54” wide stall (right). Note that the wider stall allows the cow to stay within the confines of the resting area of the stall.



Sizing the Pens Correctly

The duration of stay within any given transition cow pen (which include the far-dry, close-up, maternity, calving, colostrum and post-fresh management groups) is determined by two factors; the rate of calving and the 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 hypothesise 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, providing the following minimum space requirements:

1. At least one stall per cow
2. At least 30 inches of bunk space per cow for pre- and post-fresh pens
3. At least 24 inches of bunk space per cow for far-dry cows and heifers

- At least 120 square feet of bedded area per cow in calving pens

For 5 weeks a year (10% of the time), the farm will need to modify days spent in the pen to maintain the above targets for stocking rate, and for other periods, these targets will be exceeded.

So what are the planning steps?

- Calculate the weekly rate of freshenings for the herd.

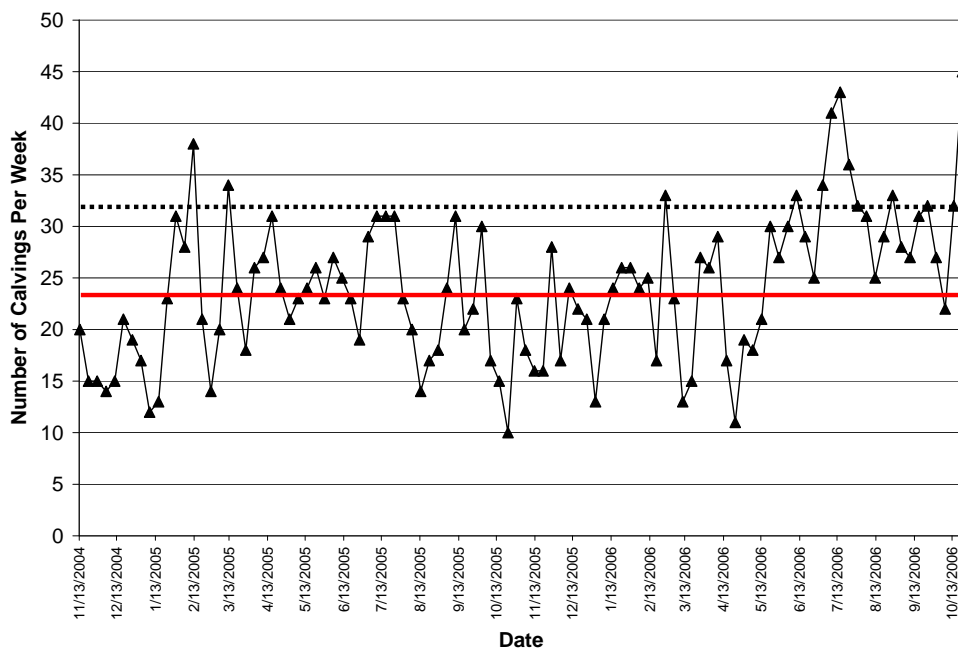
For herds that are remodeling we can graph this in programs like DC305 and file out the data into Excel. For new herds, we can estimate the number of calvings to be 104% of the rolling average number of cows in the herd, and the weekly rate will be this number divided by 52.

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

- Calculate the 90th percentile of the weekly calving rate or 140% of the weekly average.

Below (Figure 9) 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 red line is the average (24). Note that by definition, if we build to accommodate the average, the facility will be overstocked half the time.

Figure 9. Weekly calving rate for a 1200 cow dairy.



For new facilities and for expansion herds, we need to develop an estimate of the 90th percentile. Using data from 60 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).

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 pen, days in close-up, time in the calving or maternity pen, and days in post-fresh need to be decided. These are management decisions that will be farm dependent.

4. Calculate the pen size in terms of number of stalls per cow.

For example, a 1000 cow dairy wishing to accommodate 28 cows and heifers per week in a post-fresh pen sized to accommodate these cows to 14 DIM would need $28/7 \times 14 = 56$ stalls.

5. Calculate the bunk space for the pen.

Knowing the number of cows in each pen and knowing our target estimates for bunk space per cow for each group, we can calculate the total length of the bunk required.

For example, a 1000 cow dairy would need a bunk that was 56×2.5 feet = 140 feet long.

We have brought these ideas together in a pen size calculator for use on farm available at <http://www.vetmed.wisc.edu/dms/fapm/fapmtools/5house/TransitionCowpenSizeCalculator.xls>

The calculator is shown below:

Transition Cow Pen Size Calculator

Herd Size	1000
Weekly rate of freshening	20
140% of weekly freshening rate	28

	Heifers	Cows	Total
Weekly Calvings (140% of average)	10	18	28
Days in Pre-Fresh Pen	21	21	21
Days in Calving Pen	0.5	0.5	0.5
Days in Post-Fresh Pen	14	14	14
Average Days Dry	NA	50	50
Days pre-calving to return to the dairy	42	NA	42
Far-Off Dry Cow/Heifer Inventory	29	77	105
Pre-Fresh Pen Inventory	29	55	84
Calving Pen Inventory	1	1	2
Post-Fresh Pen Inventory	19	37	56
Far-Off Bunk Space (2 ft/cow)	57	153	210
Pre-Fresh Bunk Space (2.5 ft/cow)	71	139	210
Post-Fresh Bunk Space (2.5 ft/cow)	48	92	140
Calving Pens Total Square Footage	82	158	240
Number of non-transition cows			830

Complete the yellow boxes with herd information

Developed by Nigel Cook MRCVS, David Kammel, UW-Madison and Walter Ogburn Pfizer Inc.

6. Decide on maternity pen management system

There are two current approaches to managing the maternity cow. The first involves moving the animal from a free stall housed pre-fresh pen to an individual calving pen when the calf's feet are showing. This approach requires around the clock supervision of the pre-fresh pen and a pen arrangement that makes the move easy for the handler and the cow. Moving cows too early is associated with calving problems and an increased rate of stillbirths.

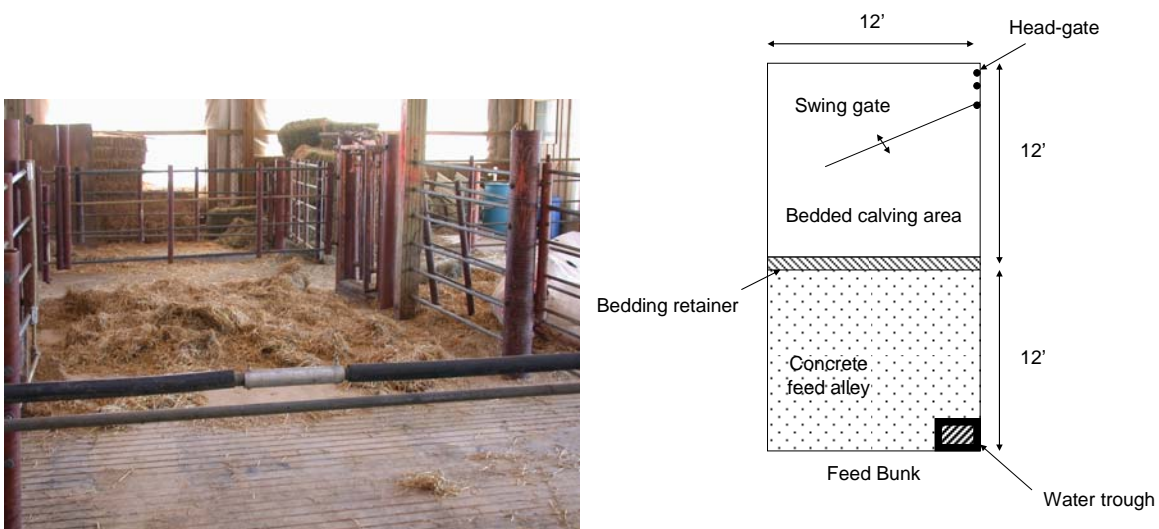
The duration of stay in these pens should be limited to hours rather than days, as delivery of feed and water is often problematic and cows do not benefit from being isolated from the main group for long periods. Pathogens, such as *Mycobacterium* and *Salmonellae* are also excreted at a high rate from peri-parturient cows, creating contamination issues in these pens. Limiting duration of stay reduces exposure.

Calving pens should be located away from busy traffic areas to reduce the amount of disturbance. The bedded area must be at least 12 feet by 12 feet, with a head-lock in one

corner and a gate to facilitate single-handed capture. This area will allow plenty of room for the herdsman to operate behind the cow and use a calving aid (Figure 10).

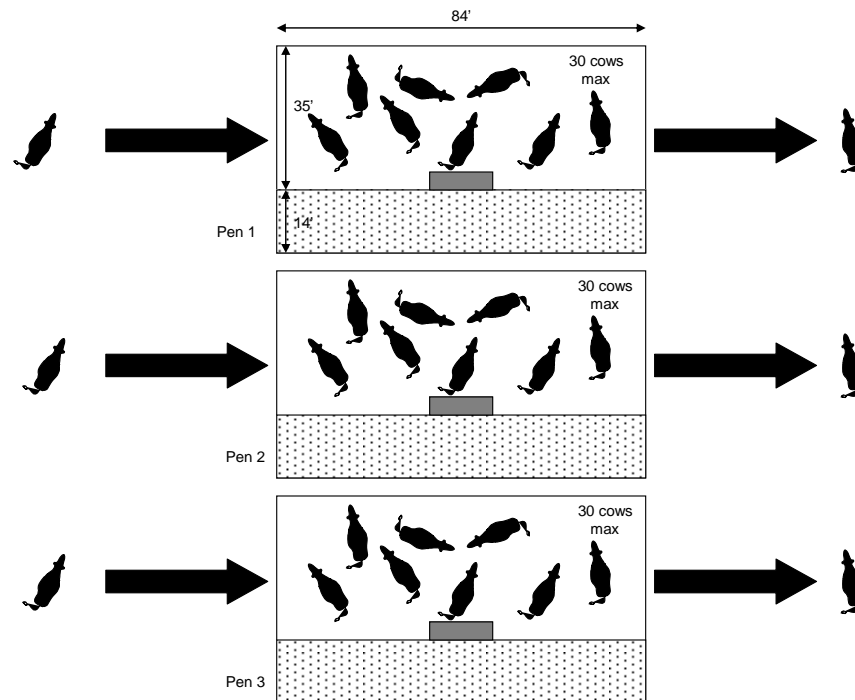
The flooring surface represents a compromise between providing a deep comfortable bed for the cow to lie down upon, with good traction so that the risk of slipping if the cow is weakened is minimized, and the provision of an area which is easy to clean out and re-bed. Concrete delivers the later, but fails on the former. A layer of sand over concrete, with fresh straw on top provides for comfort and traction. The straw must be removed and fresh added for each cow entering the pen, and the sand must be removed and replenished at regular intervals (typically weekly) to avoid contamination problems. Another possibility may be to deep bed with straw on top of a cushioned mat or mattress surface. Locate the water trough so that it is at the opposite end of the pen from the bedded area.

Figure 10. An ideal maternity pen layout, with a concrete apron against the feed bunk in the fore-ground, 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 herds where around the clock supervision of calving is impossible, the second approach to maternity management is to utilize a series of bedded packs that accommodate the cow in a stable group from 21 days before, up to the point of calving. Cows may actually calve on the bedded pack, or be moved to a calving pen if parturition is observed. With observed calving, the pens maybe modified to freestalls, but the general concept remains the same.

Figure 11. 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.

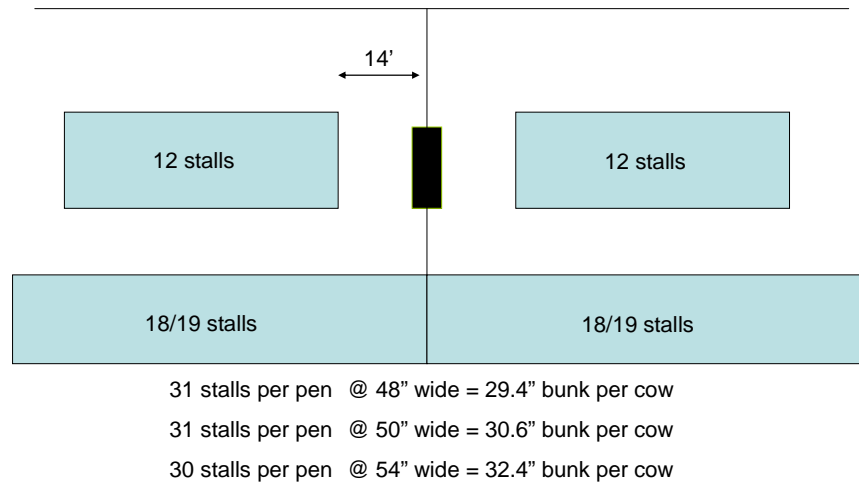


Commonly, herds attempt to move pre-fresh cows to a maternity cow bedded pack or individual calving pen several days before calving. This approach is not recommended because it invokes a pen move within the high risk period from 3 to 10 days before calving. These moves are very disruptive and appear to exacerbate the drop in dry matter intake at this time, increasing the risk for fat mobilization and associated health problems.

So how does this transition barn look?

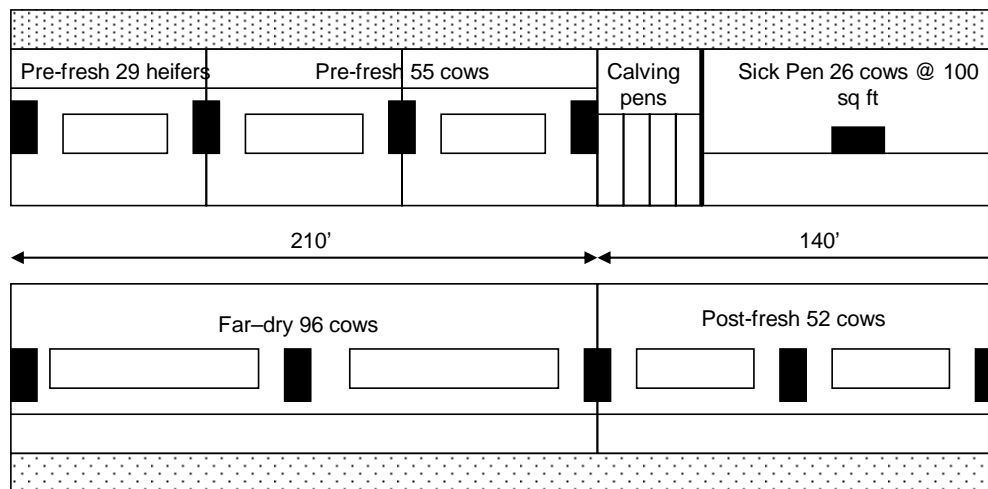
To accommodate our requirements for stalls and bunk space, transition cow pens should be built with only 2 rows of stalls – either tail to tail or head to tail or head to head. For ease of cow identification, head to tail is preferred. Pens of around 30 stalls, split with a 27-28 foot crossover with a water trough and gates in the middle provide flexibility to cope with changing numbers of cows in each group over time. Stall width should be determined based on the size of the cows using the pen.

Figure 12. A 2-row head to tail layout around a cross-over.



An example layout for a 1000 cow facility is given below. It provides for far-dry cows, split groups of pre-fresh cows and heifers, individual calving pens, a post-fresh monitoring pen and a sick cow bedded pack, with a transfer lane around the perimeter.

Figure 13. A special needs barn layout for a 1000 cow dairy



This type of 1000 cow facility, built to accommodate 140% of the average weekly calving rate, would require 61 more stalls than a facility built to accommodate the average. At \$2,500 per stall, this equates to \$152,500 or \$153 per cow. For us to convince the farm 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 1200 lbs 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 5-10 years, making the required increase in milk negligible.