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State of the Art Free Stall Designs: Do They Allow Lame Cows to Maintain Normal Patterns of Stall Use?

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Abstract. Time budgets for 59 mature Holstein cows were obtained using video analysis over a single 48 h period in 4 two-row free stall housed dairy herds, milked twice a day. Stall design differed only in stall base type with 2 herds with Pasture Mat® rubber crumb filled mattress stalls and 2 herds with Pack Mat™ stalls – consisting of 2 inches of sand over a mattress. Both stall base and locomotion score significantly influenced stall standing behavior. Lame cows on Pasture Mats lay for less than 12 h/d and stood in the stall in excess of 4 h/d. In contrast, while lame cows on Pack Mats maintained lying times at 13.1 h/d and stood in the stall for less than 2 h/d. The Pack Mat design appears to be very beneficial for lame cows, while Pasture Mat failed to allow lame cows to maintain normal patterns of stall usage. However, the addition of foam to improve surface cushion of the Pasture Mat appeared to improve stall use by both lame and non-lame cows in one herd.

Keywords. Cow comfort, lameness, mattress, sand.

Introduction

Despite our improved awareness of the effect of stall design on dairy cow behavior, builders have been slow to accept the recommendations on stall dimensions and design made by Anderson (2003) and Cook and Nordlund (2005) which call for different sizes of stall for dairy cows of different maturity, body size and stage of lactation. Farmers and engineers correctly point out the risk of building a stall which becomes excessively soiled and potentially injures the cow. Indeed, while studies by Tucker (2003) have effectively improved our understanding of how cows react to changes in the design of each component of the stall, there is little information on the impact of these changes on the economics of the dairy and the well-being of the dairy cow.

The greatest effect of poor stall design may be on lame cows within any given herd. Cook et al. (2004) demonstrated how lame cows housed in barns with rubber crumb filled mattress freestalls stood longer in the stalls – two to three times longer than non-lame cows, depending on the severity of lameness, and lay for less time than non-lame cows. In contrast, lame cows housed in similar barns with deep bedded sand stalls showed no significant change in stall use behavior. We have suggested deep sand facilitates the rising and lying movements of lame dairy cows, allowing them to maintain normal stall resting times in excess of 12 h/d. This may explain, at least in part, the much lower prevalence of lameness observed in sand stalls compared with mattress stalls (Cook, 2003; Espejo et al., 2006).

A group of companies have joined to make a package of stall improvements termed the 'Comfort Zone™', which incorporates many of the findings of stall behavioral research over the last 5 years. This study aimed to determine if Comfort Zone™ freestalls with improved dimensions and freedom of movement allow lame cows to maintain time budgets similar to non-lame cows by comparing daily activity times obtained from lame and non-lame cows in herds with a geotextile rubber crumb filled mattress (Pasture Mat®; Promat Ltd) stall surface, with similar cows in herds with a few inches of sand over a similar mattress stall surface; the so called Pack Mat™ design. The second aim of the study was to observe the behavioral response of large mature Holstein cows to Pasture Mats® fitted with a premium foam pad (Premium Pad™) to improve surface cushion.

Materials and Methods

A group of four TMR fed herds were selected which had converted existing barns to Comfort Zone™ design freestalls. All herds milked cows twice a day and housed cows in a 2-row pen, with a high yielding group pen size of 60 to 100 cows. Freestalls measured 2.9 m (9.5') long, 1.22 m (48") wide with a plastic Poly Pillow™ brisket locator 13 cm (5") high located 1.78 m (70") from the rear curb. The 'Y2K' divider loop (Artex Fabricators Ltd) was used which has an interior loop diameter of 0.89 m (35") placing the neck rail at 1.27 m (50") above the stall surface. Two herds had a rubber crumb filled mattress (Pasture Mat®; Promat Ltd), and two herds had a Pack Mat™ – which consists of the same mattress located 2 inches below the rear curb to allow 2-3 inches of sand bedding on top.

In addition, a fifth herd was filmed with freestalls bedded with Pasture Mats® fitted with extra padding (Premium Pad™), in a 3-row pen. Stalls in this herd were 1.37 m (54") wide to accommodate large registered mature Holstein cows, while all other dimensions were the same as described above. All barns were stocked at or below one cow per stall.

Filming was carried out from May 2005 to May 2006. Cows in the high yielding pen or equivalent on each farm were filmed for a 48 h period, using four Sony DCRTRV900 miniDV video cameras (Sony Corporation, New York City, NY) mounted in the adjacent pen across the central feed alley to cover the entire high group pen and set to capture 1 s of video recording every 30 s.

Figure 1. A typical 'Comfort Zone™' design freestall with a wide divider loop, high neck rail and freedom for the cow to front or side lunge uninhibited.

Fifteen cows were selected for behavioral tracking before the start of filming on each farm, based on ensuring an even distribution of locomotion score (LS) 1=non-lame, 2= slightly lame and 3=moderately lame cows, using the system described by Nordlund et al. (2004). The time spent by each cow performing each activity per day was calculated. These activities included time lying in stall; time standing in stall (including perching [standing with the front 2 feet on the stall platform and the rear 2 feet in the alley]); time standing in the alley, time drinking; time feeding; and time milking between departure and return to the pen. For ease of comparison between herds with different milking times, all time budgets were converted to a fixed milking time of 2 h/d.

Access to DHIA records permitted analysis of herd production trends before and after fitting the new stall designs.

Mixed effect models were created to determine the effect on cow behavior of the different stall base types by locomotion score. Only the four 2-row barns were included in this analysis. Analysis of covariance was performed for each behavior using PROC MIXED in SAS version 9.1 (SAS Institute, Inc., Cary, NC), with stall and locomotion score forced into all models. Differences recorded between least squares mean activities for each locomotion score and stall surface combination were tested using Fisher's protected least significant difference with a level of significance of $P < 0.05$.

Results and Discussion

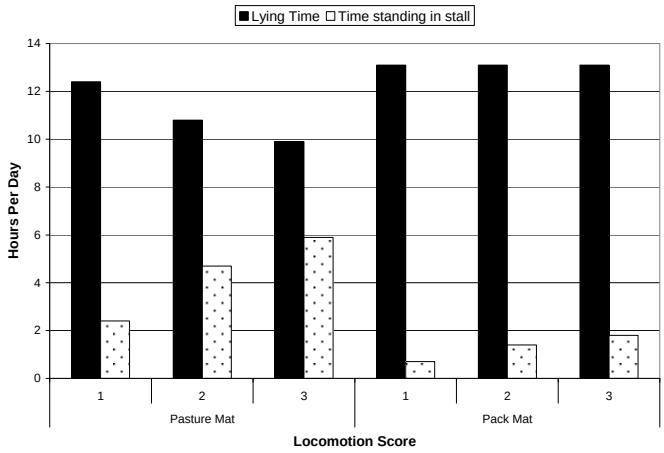
Both stall base and LS significantly influenced stall standing behavior (P=0.03, stall base; P<0.01, LS). Least squares mean daily lying and standing times in the stall for 59 cows are presented in Figure 2 for the four 2-row herds with uniform stall dimensions. The first question to answer was 'Do Comfort Zone™

freestalls fitted with Pasture Mats® allow lame cows to maintain normal time budgets and behave like non-lame cows?'. Non-lame cows on Pasture Mats® lay for 12.4 h/d and stood in the stall for 2.4 h/d. These activity times are similar to that reported previously for non-lame cows in mattress freestalls (Cook et al., 2004). The effect of LS can clearly be seen however, with LS2 and LS3 cows increasing time spent standing in the stall and decreasing lying time. So, well designed freestalls with appropriate stall dimensions and no lunge or rising obstructions fitted with Pasture Mat® stall bases failed to allow lame cows to behave normally and maintain more than 12h/d of rest, despite improvements to lunge and rising room.

The second question to answer was whether 2 inches of sand bedding over the top of a mattress; the Pack Mat™ design, delivers similar benefits to lame cows as deep sand bedding. Non-lame and lame cows achieved daily lying times of 13.1 h/d. Although the effect of LS was significant, the increase in time spent standing in the stall for LS2 and LS3 cows was less than for non-lame cows on Pasture Mats®. In-fact, non-lame cows on Pack Mats™ hardly stood in the stall at all, at only 0.7 h/d.

These data suggest farmers can use the Pack Mat™ design freestalls to save on sand bedding use, while still achieving the lying time benefits of deep sand for lame cows.

Figure 2. Least squares mean daily lying time and standing time in the stall (h/d) by locomotion score (1-3) for 59 cows in 4 barns; 2 fitted with Pasture Mats® and 2 fitted with Pack Mats™, with identical stall dimensions and designs.

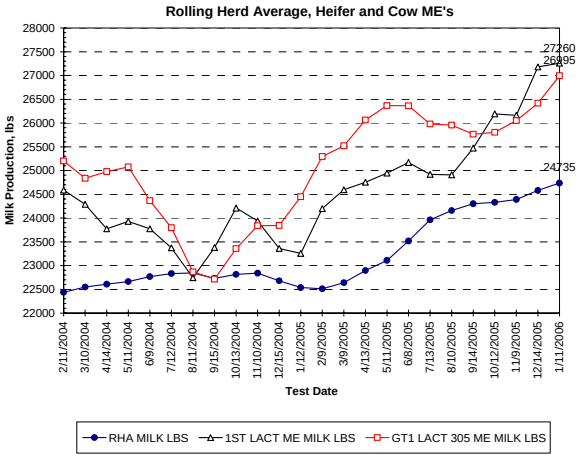


The result also confirms the hypothesis that it is the nature of the stall surface and not other stall design factors which impacts the time budget of lame cows, Cook et al., (2004). The cushion and traction of sand (even 2 inches of sand over a mattress in this study) allows cows with sore feet to rise and lie with reduced pain and difficulty, allowing them to maintain resting times. Obviously, there is an increased cost associated with handling sand laden manure, but some of these costs may be off-set by improvements in cow comfort and milk production.

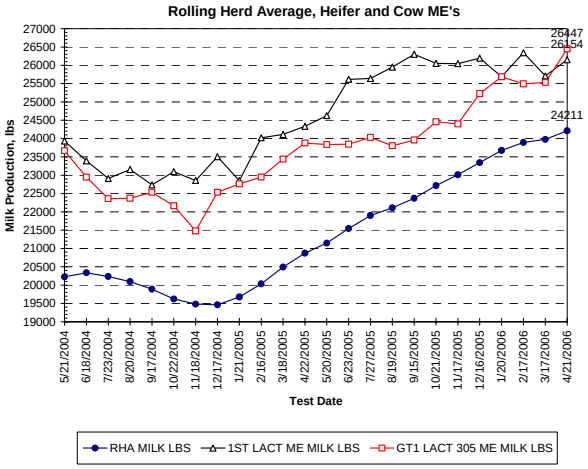
Figure 3 shows the rolling herd average and ME305 milk production by parity (first lactation and mature cows) for the two Pack Mat™ herds, which moved cows from tie stall barns to Comfort Zone™ designed freestall barns in mid-late 2004.

Figure 3. DHIA milk production data; rolling annual average, mature equivalent (ME) 305 day milk production by parity (1st lact and lactation greater than 1 (GT1)) for 2 Pack Mat™ herds (A and B) after moving the cows from tie stalls to the new freestall barn in mid-late 2004.

Herd A



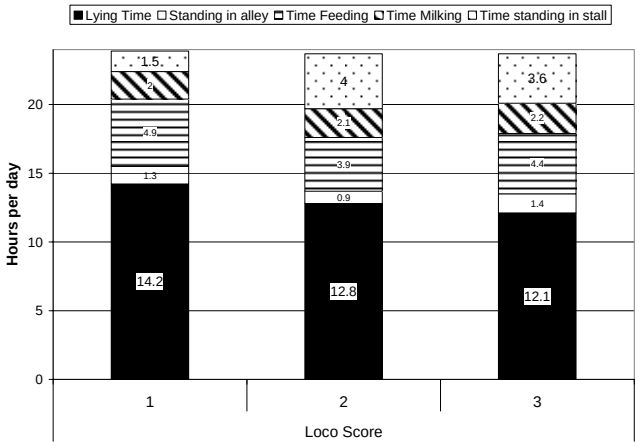
Herd B



Rolling herd average milk production increased in both herds by over 1,135 Kg (2,500 lbs) per cow. Obviously improved nutrition could also be a major component of this change, but both herds have noted significant improvements in lameness and cow health associated with the change in housing.

In the fifth herd filmed, with improved surface cushion (Premium Pad™) and wider stalls, time budgets followed the familiar pattern of increased time spent standing in the stall with increasing LS (Figure 4). However, the cows in this herd had some of the highest daily lying times observed in a herd milking twice a day – with non-lame cows lying down for over 14 h/d on average. While stall standing time increased to around 4 h/d in LS 2 and 3 cows, these cows were still able to maintain mean daily lying times of over 12 h/d.

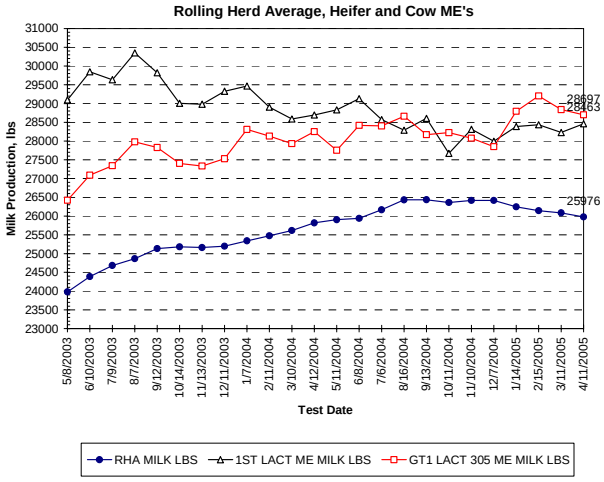
Figure 4. Least squares mean activity (h/d) by locomotion score for 15 cows filmed in a herd milked twice a day with wide stalls (1.37 m (54")) and Pasture Mats® fitted with an extra foam pad (Premium Pad™) to improve surface cushion.



These data raise the question of whether, by improving the cushioning properties of a mattress, we can reach the point where lame cows are able to use stalls and maintain adequate resting times similar to those achieved on sand beds. This subject will be the focus of follow-up studies.

Milk production trends in the herd fitted with the Premium Pad™ stalls are of interest. Stall improvements began in November 2003 in a step-wise manner, starting with the mature cow pen before remodeling the first lactation heifer stalls one year later. Note while first lactation heifer MEs decline or stay flat up to the time of their remodel, mature cow ME305 milk production increases by around 900 Kg (2,000 lbs) to the point where the mature cow performance passes the heifers on an ME basis. In this herd, both groups of cows were on the same TMR fed diet, suggesting the improved cow comfort was the primary driver improving productivity.

Figure 5. DHIA milk production data; rolling annual average(RHA), mature equivalent (ME) 305 day milk production by parity (1st lact and greater than 1 (GT1)) for a herd fitted with Premium Pad™ freestalls where the stalls in the mature cow pens were remodeled in November 2003, while the first lactation heifer pen was remodeled late 2004..



Conclusion

Pack Mat™ stalls, with 2 inches of sand over a rubber crumb filled mattress provided both lame and non-lame cows with an environment where they could maintain resting times over 12 h/d. Despite the improved stall design, providing uninhibited lunge space and more freedom of movement, Comfort Zone™ design stalls fitted with Pasture Mats® did not allow lame cows to rest adequately. However, improvement in surface cushion of the mattress, by use of the Premium Pad™ suggests resting time may be improved for lame cows. Cow comfort improvements appear to be associated with improvements in milk production, especially in mature cows.

Acknowledgements

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