Building Better Barns – Seeing the Freestall from the Cow's Perspective

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Abstract

Design and management of the feeding area are important. High stocking densities at the feed bunk increase aggressive competition and keep subordinate cows away from feed. Physical barriers between cows, including head lockers and feed stalls, can help reduce this competition and increase feeding time.

Cows like softer surfaces, for both lying down and for standing upon. Deep-bedded stalls work well for cow comfort, but require maintenance. When it comes to physical structures used to build freestalls, less is more – the hardware we place in the stall is for our benefit, and not the cow's. The more restrictive we design stalls, the less attractive they become for the cow. Use of restrictive stall designs can help keep stalls clean, but to avoid problems with hoof health these designs need to be accompanied by better flooring options, such as softer and drier flooring.

Résumé

Le plan et la régie des aires d'alimentation sont importants. Une forte densité à la mangeoire accroit les contacts agressifs et empêche les vaches moins dominantes de se nourrir. L'utilisation de barrières physiques entre les vaches, incluant les stalles d'alimentation et les cornadis, peut réduire cette compétition et augmenter le temps d'alimentation.

Les vaches préfèrent les surfaces moins dures pour se coucher et se tenir debout. Des logettes avec une litière épaisse fonctionnent bien pour le confort des vaches mais requiert plus de maintenance. En ce qui concerne la structure physique des logettes pour stabulation libre, en mettre moins est plus avantageux car le matériel que l'on installe dans les logettes sert nos besoins et pas nécessairement ceux de la vache. Les vaches trouvent les logettes plus contraignantes moins attractives. L'utilisation de logettes contraignantes peut faciliter la propreté des logettes mais, pour éviter des problèmes de santé des onglons, il est nécessaire d'inclure dans les plans une surface de meilleure qualité, moins dure et plus sèche.

Introduction

Producers spend millions of dollars building indoor housing for dairy cattle, with the aim of providing a comfortable environment for their animals - one that ensures adequate rest, protection from climatic extremes, and free access to an appropriate, well-balanced diet. Despite these laudable aims, housing systems do not always function well from the perspective of the cow – poorly designed and maintained facilities can cause injuries, increase the risk of disease and increase competition among herd mates for access to feed and lying space. In this paper we review recent studies on the feeding, standing and lying areas we provide to dairy cows, and show how these can be better designed and managed to prevent some of these problems. Our work has generally evaluated housing systems from the cow's perspective by asking how the housing affects cow health (e.g. by reducing the risk of hock injuries), what housing the cow prefers, and how the housing affects behavior (e.g. by reducing competition and increasing feeding time).

Better Feeding Areas

There are several aspects of the feeding environment that affect the cow's ability to access feed, including the amount of available feed bunk space per animal and the physical design of the feeding area. Reduced space availability increases competition in cattle. For example, a recent study by DeVries *et al* showed that doubling feed bunk space from 20 (51 cm) to 40 inches (102 cm) reduced by half the number of aggressive interactions while feeding.[5] This reduction in aggressive behavior allowed cows to increase feeding activity by 24% at peak feeding times, an effect that was strongest for subordinate animals.

In addition to the amount of available feed bunk space, the physical design of the feeding area can also influence feeding behavior. One of the most obvious features of the feeding area is the physical barrier that separates the cow and the feed, and new research shows that some designs can reduce aggressive interactions

at the feed bunk. For example, Endres *et al* compared the effects of a post-and-rail versus a headlock feed line barrier on the feeding and social behavior of dairy cows.[8] Average daily feeding time (about 4.5 hours per day) did not differ, but during periods of peak feeding activity (90 minutes after fresh feed delivery), subordinate cows had lower feeding times when using the post-and-rail barrier. This difference in feeding times was likely due to positive effects of the headlock barriers in reducing competitive interactions; there were also 21% fewer displacements at the feed bunk with the headlock barrier compared to the post-and-rail barrier. These results suggest that using a headlock barrier, reduces aggression at the feed bunk and improves access to feed for subordinate cows.

In a second study we retested the effects of these two types of feed bunk barriers, but did so over a range of stocking densities.[10] Cows were tested with the barriers described above, but using stocking densities of 2.6, 2.0, 1.3 and 0.68 ft/cow (0.81, 0.61, 0.41 and 0.21 m/cow; corresponding to 1.33, 1.00, 0.67 and 0.33 headlocks/cow). Daily feeding times were higher and duration of inactive standing in the feeding area was lower when using a post-and-rail, compared to a headlock feed barrier. As well, regardless of barrier type, feeding time decreased and inactive standing increased as stocking density at the feed bunk increased.

Cows were displaced more often from the feeding area when the stocking density was increased, and this effect was greater for cows using the post-and-rail feed barrier. Again we found that this effect was greatest for subordinate cows, particularly at high stocking densities. Clearly, overstocking the feed bunk decreases time spent at the feed bunk and increases competition, resulting in poor feed access.

New work has now shown that providing additional partitions ("feed stalls") between adjacent cows provides additional protection while feeding and allows for improved access to feed.[4] Providing a feed stall resulted in less aggression and fewer competitive displacements, effects that were again greatest for subordinate cows. This reduced aggression allowed cows to increase daily feeding time and reduced the time they spent standing in the feeding area while not feeding. Thus the provision of more bunk space, especially when combined with feed stalls, improves access to feed and reduces competition at the feed bunk, and this effect is strongest for subordinate cows. These changes in feed bunk design and management could help reduce the between-cow variation in the composition of ration consumed; under conventional systems, subordinate cows can only access the bunk after dominant cows have sorted the feed.[6] The use of a barrier that provides some physical separation between adjacent cows can reduce competition at the feed bunk. A less aggressive environment at the feed bunk may also have longer-term health benefits; cows engaged in aggressive interactions at the feed bunk are likely at higher risk for hoof health problems.[11]

In addition to a suitable place to feed, cows need access to well designed and managed standing and lying areas, as this is how cows spend the majority of their time. We now turn to these below.

Better Lying Areas

Our work on lying areas for cattle has focused on two aspects: the surface cows lie down upon and how the stall is configured.

Lying surface

A growing body of research has now demonstrated that the surface we provide for cows is one of the most important factors in designing a suitable lying area. First and foremost, the housing we provide should not cause injuries or other health risks to the cow. Although this sounds obvious, too often poor design leads to preventable health problems. For example, in some of our group's first work on cow comfort we found that cows on farms with mattresses (and little bedding) have more severe hock lesions than do cows on farms using deep-bedded stalls.[18] Although similar results have now been found in other research[19] and most dairy professionals are aware of the risks of poorly bedded mattresses, too often this surface continues to be used.

Cows also clearly prefer lying surfaces with more bedding, and spend more time lying down in well-bedded stalls. In a more recent experiment we examined the effect of the amount of bedding on the time spent lying and standing by cows housed in freestalls[13]. Each stall was fitted with a geotextile mattress, and bedded with one of three levels of kiln-dried sawdust (0, 2.5 and 20 lb [0, 1.1 and 9 kg]). Cows spent 1.5 hours more time lying down in the heavily bedded stalls. In addition, cows spent less time standing with only the front legs in the stall when the mattresses were heavily bedded. These changes in both standing and lying behavior indicate that cows are hesitant to lie down on poorly bedded mattresses.

These differences in stall comfort may also account for a second important health problem: cows housed on mattresses also have a higher incidence of clinical lameness (24%) than those housed in deep-bedded sand stalls (11%).[3] The lying surface can also affect udder health, and many studies have now shown the advantages to cows of using sand or other inorganic bedding as a way of reducing the growth of bacteria associated with environmental mastitis.[20]

Making the decision to provide a well-bedded surface is just the first step in achieving a reasonable level of cow comfort – this surface must also be properly main-

tained. In a series of experiments we documented how the sand level declines in stalls that are not maintained, and how this decline reduces stall use by cows.[7] Sand levels in deep-bedded stalls decrease over a 10-day period, with the deepest part at the center of the stall. Lying time by cows also declines as the stall empties: every inch decline decreased lying time by about half an hour per day. Contact with concrete while lying down may explain lower lying times in deep-bedded stalls with less sand, and this concrete also affects leg health. Lesions on the point of the hock are common in deep-bedded stalls,[12] likely due to contact with the concrete curb when stalls are not well maintained.

Stall configuration

Most indoor housing provides more than just a lying surface for the cows. Typically the space is designed to encourage the cow to lie down in a specific location, and to use the stall in such a way that feces and urine does not soil the stall. Unfortunately, most attempts to constrain how and where the cow lies down also reduce cow comfort, as illustrated by the studies described below.

Although some excellent recommendations for stall dimensions are now available, too often new constructions and renovated barns fail to provide appropriate space. We have conducted several experiments that show how stall size and configuration affect standing and lying times. For example, in one study we tested the effect of stall width on cow behavior, by providing cows access to free stalls measuring 42, 46, or 50 inches (107, 117, or 127 cm) between partitions.[14] Cows spent an additional 42 minutes per day lying in the widest stalls, likely because they had less contact with the partitions in these larger stalls. Cows also spent more time standing with all four legs in the wider stalls, reducing the time they spent standing partially (i.e. perching) or fully on the concrete flooring available elsewhere in the barn.

In addition to stall width, neck-rail placement is important for managing standing behavior. Both the height of the neck rail and its distance from the curb affect standing;[15] more restrictive neck-rail placements (lower and closer to the rear of the stall) prevent cows from standing in fully in the stall, again increasing the time cows spend on concrete flooring elsewhere in the barn. The neck-rail is designed to 'index' the cow in the stall while she is standing, but the brisket board achieves this function while cows are lying down. Unfortunately, brisket boards also discourage stall use'– cows spend 1.2 hours per day less time lying down when stalls have a brisket board, compared to when using stalls without this barrier.[16]

Keeping cows out of the stall obviously helps keep the stalls clean. We found that both the narrow freestalls and the more restrictive neck rail placements reduced the amount of fecal matter than ended up in the stall. Although dirty stalls are undesirable, readers should be aware that stall cleanliness alone is a poor measure of stall design. Freestalls that have higher occupancy rates are most likely to contain feces. Thus, well-used stalls require more stall maintenance, just like other equipment used on the farm.

One challenge in creating suitable freestalls for cows is that this one structure is supposed to do it all. According to popular thinking, when cows are not in the parlor they should be eating or lying down. Unfortunately, no one seems to have explained this to the cows: in a number of studies we have found that even when cows have access to well-designed stalls they spend only about 12 hours a day lying down. Cows spend the other 12 hours a day on their feet, and we need to take this into account in designing suitable housing.

In most barns the surface for standing outside of the stall is wet concrete – a known risk factor for hoof health.[1] Cows can use the stall as a refuge, providing a dry, softer surface for standing. However, this increases the likelihood that cows will urinate and defecate in stall. The common response by barn designers has been to make the stalls more restrictive (as described above), forcing cows back into the concrete alley, and explaining in part why lameness is now the most prevalent and costly health problem for cows housed in freestall barns. With our current barn designs we are stuck with two bad choices: use restrictive stalls that keep the stall surface cleaner but force cows back onto the wet concrete, or use more open designs and increase frequency of stall maintenance. Of these two options we favor the latter, but there may also be a third approach – improving the standing surface elsewhere in the barn.

We have now completed a series of studies on alternative flooring surfaces in dairy barns. In this work we have concentrated on the area where cows stand to eat, as cows spend about half of their standing time in this area. The results of these studies show that cows prefer to stand on softer surfaces. In one study we gave cows the choice of standing on concrete or softer surfaces, and cows spent the majority of their time standing on the softer flooring.[17] This study also showed that when cows did not have the choice, they spent more time standing when they had access to the softer surface. In this study and in an earlier experiment[9] we also found that standing times increased when cows had access to a rubber standing surface in front of the feeder. These effects on standing times are only modest, so the development of new standing surfaces remains an important area for future work.

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