What is Happening in Facility Design to Improve Cow Comfort and Health?

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Take Home Messages

- Deep bedding is much better for the cows than mattresses**.**
- Deep bedding requires an effective system of filling and daily management.
- Cows should rest at least 12h per day; sensors can measure this.
- Commercially available sensors will change the management of dry cows and transition.
- A Cuddle Box provides an essential infrastructure for calving pens, and for the optimal care of the newborn calf.

Comfortable Free-stalls: Introduction

In free-stall housing, the resting comfort and the amount of time cows spend lying down per day is decided by the design aspects and management of the free stalls. To assess this, a systems approach is necessary. In a systems approach, one takes the combination of multiple factors into account.

Vetvice/CowSignals uses the following approach to assess free-stalls. We articulate these as success factors. This means that we formulate the standard they should apply to. Comfortable free-stalls ensure that cows can lie down as much as they want, which is probable as well as good for them. When cows lie down their feet are not pressured; they rest and dry up.Lying cows are out of the way for the rest of the herd. This increases the social comfort in the walkways. And thus for all cows in the group it increases the effective access to feed, water, cowbrushes, etc.

Social research in the Netherlands indicates that public opinion about dairy farming is partly based on the perceived intentions of the whole sector

regarding values such as “being respectful and caring for the animal”. Working together in the industry to ensure excellent resting facilities for all cows and young stock creates trust and appreciation amongst the public. The public does not want industrialization of dairy farming, as it is contrary to the perceived welfare of the animal. This judgement is also based on perceptions like ‘natural’ and ‘the cow not being a machine’.

■ Construction and Management of Free-stalls

Please note that the dimensions are decided by the size of the cows in the herd. So all dimensions in this articles are starting points and are related to a bench mark cow. In practice, the starting point should be decided based on the dimensions of the cows in the herd. Measure a sample of the herd and decide the dimensions of the bench mark cow. This reference cow is used to establish all dimensions and positions of the free stall components at first installment.

When designing a new barn, it is wise to check that large size cows will also fit comfortably in the adjusted stalls, so that the farm has the flexibility to milk larger sized cows than it is milking at that moment.

After 2 to 4 weeks, the dimensions can be adjusted. Of course this can be done earlier, if there are strong reasons for it.

Dimensions of the bench mark cow used by Vetvice Barn Design in The Netherlands in 2018 are stated below. All stall dimensions stated in this review refer to the bench mark cow however should be adjusted if your cows are larger or smaller.

- Holstein Friesian
- body weight: 700 kg
- withers height 1.49 m
- nose to hook bones: 2.50 cm
- front shoulder joint to hook bones: 1.70 cm
- hookbone width: 61 cm
- width of abdomen: lactating: 79 cm, dry: 82 cm

Dimensions are based on measurement performed by Vetvice trainees on commercial dairy farms.

■ Success Factors for Comfortable Free-stalls

The success factors are listed in order of priority. This means that this list can be used in the decision making process for improving existing free-stalls or designing new free-stalls.

Bedding

Bedding must be very soft for landing and lying, and should provide excellent grip for the hooves.

This is a subjective measurement. It can be tested by pushing your hock into the bedding, the knee-test and the back-of-hand rub.

The knee-test consists of letting yourself drop onto your knees on the bedding a couple of times. The landing should be soft and comfortable.

During the back-of-hand rub, you rub with the back of your hand over the surface of the bed in the area where the hocks of the lying cows touch the surface. Again, this should be a soft and comfortable experience.

Head Space

The front side of the free-stall should provide space for the cow to stick her head out forward and swing it up and down, while standing up and lying down.

For this, there must be no barriers between 10 cm and 90-100 cm in the front of the stall. When she swings her head, a mature cow will move her nose forward up to 75 cm, and perhaps more. The length of a mature 700 kg HF cow is about 2.50 m from her pin bones to her snout.

Double rows of free-stalls, head-to-head, should be at least 5.30 m long and optimally 5.50 m.

Standing and Lying Space

The position and design of the neck rail determines the standing space, and the position and height of a brisket locator determines the lying space.

About the neck rail: a curved neckrail is preferred. Position this at an angle of max. 45˚ with the horizon. Vertical distance to the bed: 1.25 m (open space). Diagonal distance to the curb: approximately 1.22 m.

Flexible Neckrail (even better): chain covered with a tylene hose, with a spring at one or both ends. Can be positioned at 1.15 m vertical distance from the bed. Diagonal distance to the curb: 1.25 m.

In free stalls that provide excellent grip to the feet of the cows and a soft landing, the cows are more capable of dealing with a neck rail that is positioned too far backwards or too low.

The brisket locator should be no higher than necessary to stimulate the cows to lie down in the back of the bed: 10 cm higher than the surface. The brisket locator should not have sharp edges because cows will put their legs on top of it. In free stalls with a head rail, often a brisket locator is not needed.

When a cow lies down, her front knees are resting about 30 cm in front of her shoulder. This means that for the bench mark cow the brisket locator should be located about 2.00 m in front of the curb.

Width

The free-stall should be wide enough for the cow to comfortably lie down. Dr. Neil Anderson (OMAFRA) set the standard of 2x the width of the pelvis measured at the hook bones. His standards come to about 1.22-1.25 m centre-to-centre width of a free-stall for lactating cows. Dry cows have bigger abdomens and need free-stalls that are 10 cm wider

Shape of the Divider

The head of the cow should be guided forward and the divider should not cause any injury.

When the dimensions and bedding are at standard, the shape of the divider is not much of an issue. It should position the cow straight in the free stall and it should stimulate the cow to swing out her head straight forward. When a cow swings her head to the side while she lies down, her back end will move to the opposite side and she will end up lying diagonally. Lying down diagonally is a major risk factor for developing injuries from the free stall divider.

Keep the fronts of free-stalls as open as possible; guiding the head movement forward is a subtle thing. As cows are social animals and prey animals, they want to see other cows and have an excellent overview of their surroundings. And as their noses are the point where they exhale humid air and want to inhale fresh air, excellent ventilation at the front of free-stalls is very important and should not be disturbed by any unnecessary construction.

Beside this, the dimensions of the divider are to a high extent decided by functionality: mounting the divider, keeping the free-stall together and bringing

the neck rail in the right position. The preferable option is to mount each divider or set of dividers on a separate post. This construction doesn't require horizontal pipes for mounting purposes.

■ Management of Resting

Enough resting time is essential for confined dairy cattle. In general, 12 hours per day is regarded as the minimum for lactating cows, but more is better. For dry cows, a minimal threshold has not been established, but indications are that this is also 12 hours per day.

Commercially available sensors for automated heat detection can measure resting time and thus enable the farm manager to manage it. Scientific research on using sensors for this purpose has only started recently (discussed later in this review)

Data on resting behavior needs to be interpreted, as it changes during the lactation and over parities. In early lactation, cows spend more time eating and have less time available for resting. First lactation cows eat slower than adult cows, which also reduces the time they spend resting. Expectations are that this knowledge will develop rapidly over the coming years.

On farms with deep bedding, the daily resting time rapidly decreases when the level of the bedding is too low. So daily resting times provide a clear signal to the farmer: level of bedding is OK, or beds need to be filled up.

Bedding

Bedding needs to be dry, most certainly the top layer in the area where the udder rests.

Based on experience with our clients, deep bedding is better for cows than mattresses. Successful working with deep bedding requires:

1. Understanding of the principle and how to start up;
2. Keeping the level higher than the curb;
3. An easy way to perform daily maintenance, preferably mechanical;
4. An easy way to fill up bedding material, mechanically;
5. A cheap bedding material.

■ Common Issues and Problems in Dairy Facilities

Cows are put into a new facility where the free-stalls are dramatically changed

Cows need up to 4 weeks to get used to a different way of getting up and lying down and some cows may never adapt. In this adaptation period, cows can get stuck in the free stalls and end up in uncomfortable positions. There are common anecdotes from dairy farmers about cows standing up in an awkward way in pasture the first weeks after they are put into pasture again, following a long winter season in a barn with poorly dimensioned free-stalls.

Resting behavior in stalls with dividers that give the cows a lot of freedom, like plastic sticks, is also decided by the amount of cows compared to the amount of available free-stalls. In barns that have many more free-stalls than cows, the chances that a cow will enter a stall without a cow in one of the neighbouring stalls is quite great. So she can easily lie down diagonally. In barns where the free-stall to cow ratio is close to 1 to 1, very often there is at least one cow in a neighbouring stall and often there is a cow in both. In these situations, the neighbouring cows force the cow to lie down straight.

Cows in an Existing Barn

Too many cows lying diagonally

1. The neck rail is too far back, forcing the cow to stand diagonally before lying down. Bring the neck rail forward, and/or use a curved neck rail.
2. The brisket locator is too far back, forcing the cow to lie diagonally. Bring the brisket locator forward. Reduce the height when it is higher than 10 cm over the surface.
3. The cow cannot swing her head straight forward. When she swings her head to the side while lying down, her hind side will move to the other side and she will end up lying diagonally.

Thick hocks

The surface of the free stall is too hard. Make it softer. Weak cows, sick cows and cows with low BCS (Body Condition Score – no fat coverage and few muscles) are most at risk for this.

Bald hocks (hair loss)

The surface of the beds is too abrasive. Make is less abrasive by choosing softer bedding or using (much) more bedding material.

Bald and thick front knees

The surface in the front of the free-stall is too hard. Make it softer.

The neck rail is too low or too far back, forcing the cows to walk backwards on their front knees when they stand up. This is also a risky situation for cows getting caught up in the front of the free-stalls. Put the neck rail in the right position.

If cows have bumps and/or wounds on their back, the following may be happening:

1. cows are lying diagonally;
2. free-stalls are too narrow;
3. poor design of the free-stall divider;
4. all of the above

■ The "Cuddlebox" Concept

Rule No. 1 for Effective Treatments (Hulsen) says "one person should be able to set one cow ready for treatment in one minute, and then treat her right in one go. A Cuddle box (Figure 1) provides the infrastructure for this in a calving pen".

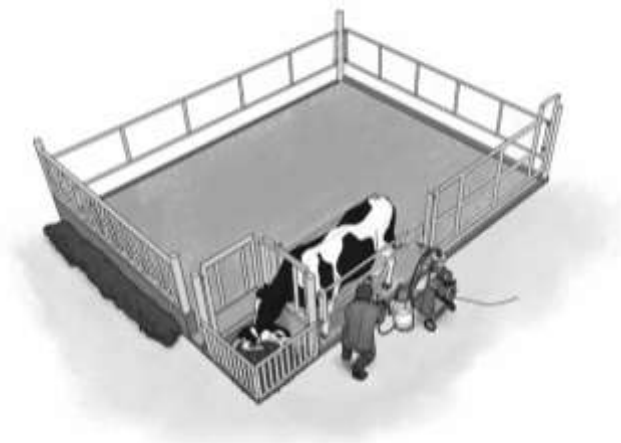

Figure 1: Cows Signals Cuddlebox

Catch and fixate a cow within one minute

The extendable swing gate enables a herdsperson to drive even a shy first calving heifer in a corner and fixate her with a chain behind her legs. This makes it very easy to quickly check the position of the calf and estimate whether it can be born spontaneously.

The urge to 'get the calf out now that we have caught the heifer' will be much less. This should bring down the amount of unnecessary and too-early events when assisting delivery. Assisting with briths is correlated with heavy calves, and that is a risk factor for disease and mortality of the calf. In addition it is a risk factor for trauma of the birth canal, ketosis and metritis of the dam.

Providing birth help itself is a risk factor for heavy birth: the birth canal might not be fully dilated when traction is applied, the birth process might be too heavy on the calf (continuously pulling for a long time span), the care taker might be causing trauma of the birth canal with his hands and arms, and not use adequate lubricant, etc. Too reduce these risks, there are two aspects to manage:

1. Tt must be very safe and easy for the care taker to fixate and catch the cow and to handle and treat her;

2. The care trainer must be well trained and using the most optimal procedures, tools and techniques.

Treat cow and calf together

Immediately after calving, the calf can be put on a layer of fresh feed in the box in front of the cuddle box. Fresh feed is a hygienic environment for the calf, as it does not contain manure. In the straw pen the calf will easily take in pathogens from manure, from the bedding and from the skin of the cow when it is searching for the udder.

Then the dam can be fixated in the cuddle box. This is an easy job, as she will want to go in to lick her calf. Now the cow can lick her calf, eat fresh feed and drink water that is provided.

This is the best moment to milk colostrum from the cow. Shortly after calving the dam is still a bit 'high' and very likely to accept to being milked. During calving the brain of the cow releases endorphins into the blood stream, which are hormones with an opioid-type of effect. Shortly after calving the effect of these endorphins is still present.

This is the best moment to feed fresh colostrum from the mother immediately to the calf. The quality of colostrum is the best when the cow is milked

immediately after calving. A large interval between calving and milking colostrum is the main reason for suboptimal levels of antibodies in the colostrum, as measured with a refractometer or Bricks meter.

Fresh colostrum also contains living white blood cells, and leukocytes from the dam. When the calves drinks fresh colostrum, these leukocytes are still alive. They are absorbed and enter the blood stream of the calf. Both in the body of the calf and in the intestine, these leukocytes play a role in setting up the immune system and probably have an effect on the intestinal microflora (microbioma).

The calf can stay in the box as long as the herdsperson wants. It is in a safe environment, it cannot escape and the dam can still lick it. On many farms this reduces the amount of time needed to perform the complete standard operating procedure: “remove the calf, milk the cow and feed colostrum”. This makes it easier to do this job before finishing the rest of the work.

Farmers that work with the cuddle box are very positive about the concept but unfortunately there is very little research published about this topic. One probable reason for the success is that the herdsperson experiences better control, and he or she has a greater chance to milk the cow and feed the calf colostrum immediately after calving.

■ Sensors in Transition Management

In the Netherlands, a multi-year/multi-farm field study was conducted by the Veterinary Faculty Utrecht, Wageningen University, Nedap and Vetvice, called ‘Sense of Sensors in Transition Management’. The aim of this study was to explore and develop the use of commercially available sensors in the management of dry cows and transition management.

Do sensors take over the work of people in taking care of the cows? No way. Sensors provide the possibility to better monitor and care for the individual cow. Furthermore, they add extra information on top of good observations and cow care skills.

Plus, as a stockperson you need to understand cows to be able to manage them well. Sensors and automation can be very helpful, but will never replace practical knowledge and skills.

Often, the first discussion point when talking about sensors in dairy cow management is the identification of sick cows. Yes, sensors can be of help in this process. But with good cow care, the sensors will not often identify a sick cow that the caretaker has not found.

Successful transition management is about ensuring that the cow keeps eating. And so eating is a control point. The care taker will check feed consumption by assessing the rumen fill and the activity of the cow. Sensors can be of help by showing the eating behavior during the first days after calving. And by giving an alarm when a cow has not been eating for say 6 hours in a row.

One of the management questions regarding fresh cow groups, is “when can a cow leave the fresh cow group?” A good answer to this question that can be provided with sensor data is, “when she has been eating well for at least the last 3 days”. The next question is how “eating well” is defined. The default setting for this can probably be 5.0 to 5.5 hours per day and at least 7 eating episodes. But it is relatively simple to work with farm-specific thresholds that are automatically calculated from the data collected from other cows in the herd. This is a better approach than working with default settings.

We know that cows that develop metritis after calving eat for shorter periods during the close up period compared to cows that stay healthy. Results from Sense of Sensors confirms this and shows that these cows already spend less time eating 6 weeks before calving. One of the many questions this study wanted to answer is “why do these cows spend less time eating?”

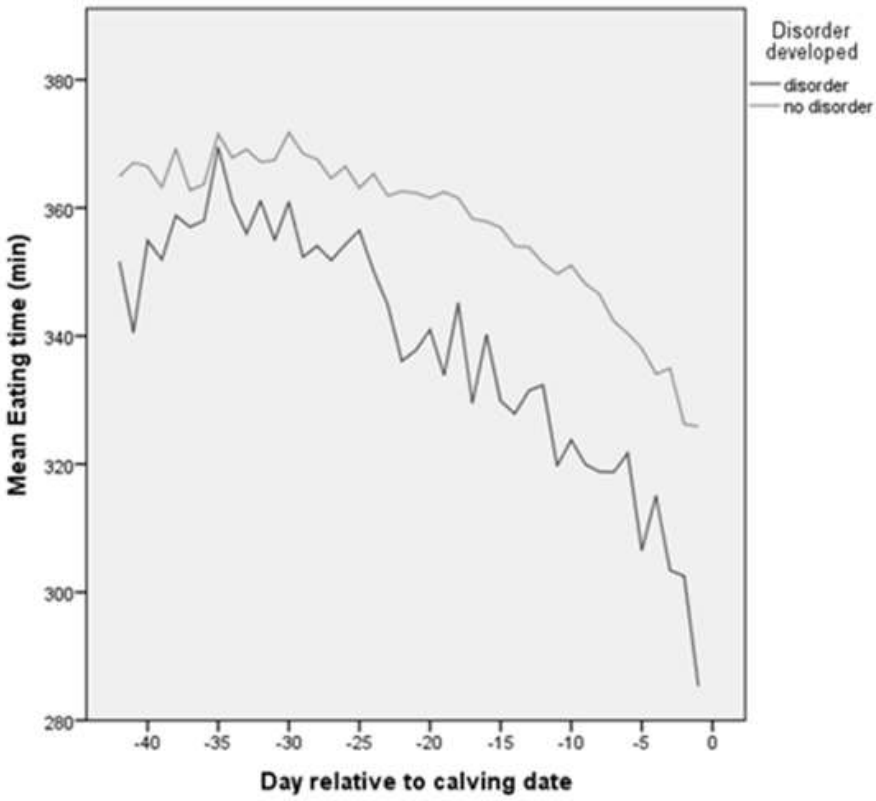

Figure 2. Eating time of cows that developed disorders in the transition period after calving. Cows that developed disorders already spend less time eating up to 8 weeks before calving. Source: Sense of sensors in transition management 2017 (unpublished data).

- Cows that develop disorders during the start of lactation show shorter eating time during the dry period
- Can we identify 'at risk cows' to give them supportive/preventive care?
- Can we prevent problems by ensuring that all cows achieve the target eating time?

The fact that these cows show significantly different behavior creates the option to identify at risk-animals. A farmer can give these at risk animals specific treatments and husbandry to prevent them from developing clinical problems.

One of the end goals is to define success factors for these periods as well as ways to measure them. When the farm has the success factors at level and under control, the health and vitality of transition cows is optimal.

Working with the concept of 'success factors' means that you define success, then you decide what you need to do to reach these goals. This you cluster into areas, or factors, that you can manage. These factors are then called 'success factors'. When your success factors are OK, your results should be OK.

Examples of monitoring points that can be measured with sensors are:

1. Resting behavior
2. Eating and ruminating behavior
3. Behavioral patterns per day
4. Number of steps taken per day
5. Synchronization of behavior[1]
6. Behavior after introducing new animals

'Synchronization of behavior' represents the extent to which a group of animals show the same behavior at the same time (i.e. eating, resting). The idea is that animals that are at risk for 'not eating enough-not resting enough-high social stress', do not show the same behavior as the majority of the group (i.e. they are waiting while the others are eating, they are eating while the others are resting, etc). This is an area of research, so perhaps in future, insights will change.

The presentation and interpretation of this information is again 'under development'. Essentially, it is management data, which means that the evaluation and interpretation is not done on a daily basis, but with longer intervals. Also, it is either done by the responsible manager or his boss, or by an advisor.

Does this make this data less valuable than data 'for detecting a sick cow'? I think it is a lot more valuable, because it provides tools to prevent the cow from becoming sick.

■ Relevant Literature

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