Chapter 5: Calf Housing

Outline:

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Video related to Chapter 1. Calf Housing:

- **Calf Housing**

Factsheets related to Chapter 1. Calf Housing:

- **Calf housing**
- **Automated milk feeders and calf group housing**
- **Calf ventilation and thermoregulation**

1. Considerations for the design process

Ensuring a hygienic, dry, and comfortable environment with high air quality is a top priority to optimize calf growth and health. Additionally, the facility should be labour efficient, facilitating easy cleaning, sanitation, feeding and care of the calves while ensuring safety and well-being for both calves and caregivers.

Several management factors, along with the farm's replacement plan, guide the design process of youngstock housing. Once a management plan is established, the next step involves exploring alternative housing options that align with such a plan and creating a functional and practical facility. Considerations such as herd size, calving interval, calving seasonality patterns, conception rate, culling rate, and calf mortality, among others, will help accurately size and plan the facility.

Some key management considerations that impact the design of youngstock housing include:

- Age groups, number of calves
- Individual or group rearing strategies
- Cow-calf contact (<1hr, 1hr or 24-48 hr contact, prolonged contact)
- Feeding system
- Health, biosecurity measures, isolation, and quarantine areas
- Storage requirements for feed and bedding
- Strategies for cleaning, disinfection and manure management (water access, floor slopes, pen layout)
- Water storage, treatment, and heating
- Ventilation, temperature control, air quality, lighting
- Space and comfort
- Technology integration (monitoring devices, automated feeding, connectivity, power sources, drainage)
- Future herd expansion

In this chapter, general housing design considerations and principles will be explored, while excluding discussions on management strategies. Please refer to the **2023 Dairy Code of Practice** for nutritional and health related recommendations and requirements and consult your advisory team.

2. Newborn calf (within first 24 hours of life)

Newborn calves require a hygienic, dry, and warm environment. Ensure the areas where calves are born and placed following birth are hygienic, dry, and warm. Newborn calves are susceptible to cold stress below 10 °C to 15 °C, and their thermoneutral zone is approximately 15 °C to 25 °C (50 °F to 77 °F).

Design the facility to help implement the desired management plan for this age group. For instance, ensure the layout enables timely colostrum feeding and navel disinfection and minimizes drafts.

2.1. Cuddle Box

Exploring design elements like the Cuddle Box can complement the chosen management plan. The Cuddle Box **(Figures 1 and 2)** promotes natural behaviours between the dam and her newborn calf while addressing practical considerations like hygiene, a low-stress and safe environment and ease of handling. Some features of the Cuddle Box include:

- The newborn calf can be placed in a separate clean space within the feed trough or bunk, reducing contact with manure and providing a more hygienic environment.
- The design allows the cow to eat and drink immediately, and with the addition of headlocks, the cow can be milked while she is tending to her calf. This can be particularly beneficial for administering colostrum promptly.
- The ‘box’ design can be removable, doubling as a trolley for convenient calf transportation to another area.

Figure 1. CowSignals © designs of a calving area with a 'Cuddle Box' for the calf. If you wish to know more visit www.cowsignals.com

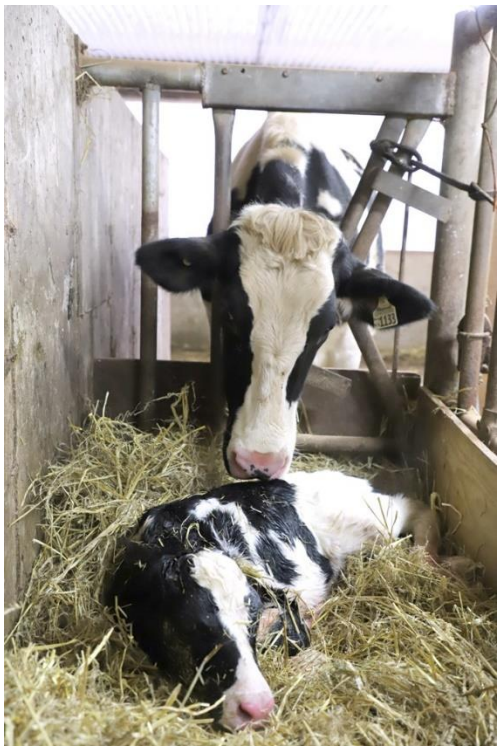

Figure 2. Example of a calving area with a Cuddle Box for the calf

2.2. Pens and resting area for newborn calves

The resting area for calves under 1 day of age requires a cleaned, sanitized, and warm environment. Depending on the farm's management plan, newborn calves may be placed in individual pens or in pairs.

Following the guidelines outlined by the 2023 Dairy Code of Practice **(**[**Dairy Code of Practice 2023 - National Farm Animal Care Council**](#)**)**, the calves' living space should facilitate easy movement,

allowing them to stand up, turn around, stand fully upright, adopt sternal and lateral resting postures, and have visual contact with other cattle. In addition, calves must not be tethered unless housed in hutches that provide access to an area outside the hutch.

Keeping these considerations in mind, the ideal size for newborn calf pens is a minimum of 28-30 ft^2. Beyond adequate space, the pen should have ample dry bedding material such as straw, sawdust, or wood shavings. This not only ensures cleanliness but also provides warmth, comfort, and insulation from the cold floor and allows the calf to nest into the bedding effectively.

Figure 3: Illustrates individual pens for newborn calves, featuring solid sides and an open end to facilitate airflow without causing drafts, *Source: Ferme Mystique S.E.N.C.*

For a quick look at calf housing, see the following factsheet: **Calf housing**

2.3. Management of temperature and air quality

As newborn calves struggle with regulating body temperature, it is critical to provide a warm and dry environment to prevent cooling and susceptibility to disease. Some solutions to improve conditions include the use of:

- Heat lamps (note that these carry a fire risk)
- Calf blankets/jackets
- Drying pens or rooms (note that these need to be properly cleaned and sanitized between calves)
- Warming boxes (note that these can be a source of contamination and disease transmission if not properly cleaned, sanitized, and disinfected after each use)
- Thermostats for monitoring

In addition, ensure effective airflow to minimize the accumulation of unwanted or harmful gases such as ammonia and CO_2, as well as contaminants. Avoid using airtight partitions in pens to prevent the formation of a microenvironment that could compromise air quality.

For a quick look at ventilation and thermoregulation for calves, see the following factsheet: **Calf ventilation and thermoregulation**

3. Pre-weaning calf (from 2 days of life until weaning)

Ensuring a comfortable, well-ventilated, hygienic, and dry environment is fundamental for the successful health, growth, and development of calves during this critical stage. When planning calf housing, it is important to consider regional climate and temperature variations and how they may impact the housing environment and the functioning of the equipment. The thermoneutral zone for calves over one month old is approximately 0 °C to 23 °C (32 °F to73 °F). Maintaining a facility with an appropriate temperature for pre-weaned calves ensures that the energy they consume is utilized for better growth, development, and immune function rather than being diverted to maintain their core temperature. If this poses a challenge, adjustments in budget and management should be made to account for additional feed, ventilation, and labour requirements that extreme temperatures may create.

3.1. Housing type

The two primary calf housing systems for this age group include:

3.1.1. Indoor housing

Indoor housing facilities are enclosed structures (roofed structures with four closable sides), with or without an insulated exterior and can feature various types of ventilation **(See Chapter 7. Ventilation and Thermoregulation)**. They are a separate facility or part of the main building where adult cows are housed. Insulated housing enables calves' thermoregulation and can provide an optimal thermal environment given adequate management of stocking density, ventilation, temperature, relative humidity, and air circulation, among others.

Some advantages of insulated housing include increased feed efficiency, easier to maintain an optimal temperature of water and milk, and a more work-friendly environment during extreme weather conditions. Some disadvantages include higher construction costs, a potentially higher microbial charge, and the challenge of controlling air quality and heating expenses.

Figure 4: Indoor, insulated, pre-weaned calf facility with a positive-pressure air tube ventilation system, featuring waterers placed in a feed alley for easy access and to maintain a dry bedded area, *Source: Ferme Caribou*

3.1.2. Outdoor housing and others

The definition of outdoor calf housing is housing that does not involve a roofed structure with four closable sides. For example, calf hutches under a roofed structure with less than four closable sides would be considered outdoor housing. The following considerations should be taken into account when calves are housed outdoors.

- Cold temperatures can be tolerated by calves with proper weather protection, including shelter, dry and ample bedding, minimal drafts, and provision of optimal nutrition.

- Provide sufficient space for abundant, clean, and dry bedding to effectively insulate calves, reduce heat loss, and facilitate nesting. Ensure there is enough bedding, preferably long straw, to obscure calves' legs when they are lying down (**See Figure 3**; Refer below to University of Wisconsin-Madison nesting score system described in **the Dairyland Initiative website**).

- Calf jackets can provide additional warmth, particularly in wet and windy conditions, but extended use (>2-3 consecutive days) may lead to moisture buildup.

- Consider supplemental warmth through heat lamps or heaters.

- Some advantages of uninsulated housing: limited microbial growth, more flexible management of ventilation, and lower building costs.

- Some disadvantages of uninsulated housing: increased costs for bedding, feed, and milk and water temperature control. In addition, greater labour and management considerations for cleaning (especially in the winter) and the need to mitigate heat stress in the summer.

- Uninsulated housing examples: hutches, shelters/sheds, greenhouses, and old barns.

If using uninsulated, outdoor housing like hutches, consider some strategies to mitigate heat stress during the summer, as this type of facility can create a greenhouse effect:

Provide shade:
- Place hutches in the shaded areas, with the front facing north or east, to minimize direct sunlight exposure.
- Consider covering hutches with a reflective fabric during hot weather to redirect sunlight and prevent overheating.
- Adding a roof over hutches helps reduce radiation exposure during hot weather. Ensure a sufficiently high roof, at least 3 meters (Kovács, 2018), to facilitate air circulation, provide shade and prevent heat buildup.

Improve air circulation:
- Openings in the hutch structure allow for air circulation and cooling. Elevating the back of the hutch, for example, by placing an 8-inch concrete block under the back wall of the hutch (**Figure 7),** enhances venting of hot air and gases, contributing to improved air circulation.

The 2023 Dairy Code of Practice recommends specific considerations for housing calves in outdoor hutches. The key points include:

- Freedom of movement and social interactions: Hutches should allow untethered freedom of movement and support social interactions among calves.
- Tethering guidelines: Calves may be tethered ONLY if housed in hutches that provide access to an area outside the hutch.
- Physical contact: It is required that calves have physical contact with another calf unless there are health reasons, or they need protection from inclement weather.

Figure 5: Ample and deep bedding for pre-weaned calves, promoting effective insulation and nesting, *Source: Ferme Mystique S.E.N.C.*

Figure 6: Example of group-housed calves with natural ventilation option, *Source: Ferme Karona*

Figure 7: Improved air movement by elevating the back of the hutches with concrete blocks, *Source : Ignacio Cervantes.*

3.2. Individual, pairs, and small group housing

Calves can be housed individually, in pairs or groups. According to the 2023 Dairy Code of Practice, pairing or grouping calves by 2 to 3 weeks of age has shown various behavioural, cognitive, and performance advantages. Furthermore, research indicates no clear difference in disease transmission or calf mortality risk observed between small groups (<8 to 10 calves) and individual housing when optimal management and air quality are maintained. Therefore, starting from April 1, 2031, aligned with the **Dairy Code of Practice**, healthy, thriving, and compatible calves must be housed in pairs or groups by 4 weeks of age.

Beyond movement, providing adequate resting space is key. Adequate resting space not only promotes calves' wellbeing and growth but also facilitates optimal air quality and ventilation. Recommendations for the resting space for pre-weaned calves include:

- Providing a minimum of 3.3 m^2 (35 ft^2) of bedded space per calf.
- Place Individual and group housing 3 feet (0.9 m) from an exterior wall of the building to prevent direct drafts on the young animals.
- For group housing, plan for small groups of <8 to 10 calves to ensure proper monitoring, feeding and reduced competition **(Figure 6 and 8**).

In addition to resting space considerations and regardless of the chosen housing strategy (individual, paired or group), optimal management practices are key to ensure the comfort, health, and growth of calves. Key aspects include:

- Maintaining equipment sanitation to prevent pathogen spread.
- Implementing effective cleaning protocols for resting and feeding areas to ensure a hygienic environment.
- Prioritizing housing conditions with adequate temperature, humidity, and ventilation to ensure optimal air quality and allow calves to maintain their thermal comfort.
- Practicing proper colostrum management to support the calf's immune system. Additionally, incorporating environmental enrichment practices, such as presenting feed in various forms and locations, is crucial. Implementing these environmental enrichment measures for calves from 6 weeks of age onwards contributes to behavioural development, biological functioning, and stress coping, promoting overall well-being.

Choosing between individual and group housing before 4 weeks of age involves several management and design considerations. Factors to consider include feeding equipment and strategies, disease

transmission, health and feeding monitoring, and the impact of socialization among others. Given the unique characteristics of each farm, it is highly recommended to consult your advisory team to explore customized strategies and design elements that align with your specific farm.

When considering individual housing for calves before 4 weeks of age weeks old, it is recommended to:

- Provide openings at the front and back of the enclosure to allow air to circulate through the pen and avoid creating a microenvironment where air remains stagnant.
- Avoid adding panels over the pens to maintain effective ventilation and prevent stale air from accumulating.
- Limit the number of rows of individual pens to one or two to reduce the risk of bacteria and pathogen transmission between calves.

Figure 8: Small group pen for pre-weaned calves, *Source: Ferme Belvallée inc.*

3.3. Feed and water space

The design and setup of housing for pre-weaned calves should consider key factors such as the milk feed system, dry feed, and water access. Proper placement and space allocation for these elements impact hygiene, daily intake, ease of cleaning, prevent cross-contamination and competition among the calves. Starting from day three, calves should always have access to water and feeders to encourage solid food intake. Additionally, install floor drainage to remove urine and maintain a dry bedded area, particularly when using automatic milk feeders

To support the health and growth of pre-weaned calves, consider the following recommendations:

Feed Space (Milk Feeding):

- For automatic milk feeders, provide a 3 m (10 ft) standing area, raised by 3 in to help maintain a clean, dry space. In addition, teats should be at the calf's shoulder height, around 61 cm (24 in) off the ground (Figure 8).
- For bucket feeding, position the buckets low, 30 to 40 cm (12- 16 in) from the floor, for easy access. In addition, ensure appropriate floor drainage and slope, especially underneath the bucket area to keep the bedding and floor dry.

Feed Space (Dry Feed):

- Allocate at least 30 cm (12 in) of feeding space per calf in group housing to minimize competition.
- Position troughs or buckets for dry feed 10 to 15 cm (4-6 in) away from milk or water sources to reduce dry feed spoilage.
- The feed manger floor should be elevated 8 to 10 cm (3-4 in) above the calf alley.
- The feed manger wall should have a height of approximately 1/3 of the calves' hip height, above the calf alley floor. This translates to a throat height of about 30 to 40 cm (12- 16 in) above the calf floor for easy access. If headlocks will be used, check with manufacturers for the height of the headlock's bottom rail.

Water Space:

- Provide pre-weaned calves with access to clean, fresh drinking water at all times from the first days of life.
- Place water sources where they are easily accessible for calves while also ensuring convenient access for caregivers to facilitate regular cleaning.
- Place water buckets, nipple drinkers, or water troughs at an accessible location but ideally away from the bedded area, and no higher than 40 to 45 cm (16-18 in) from the floor, approximately 1/2 of the calf hip height (Figure 4).
- Provide approximately 5 cm (2 in) of accessible water perimeter per calf
- Offer at least two water locations per pen with one that exposes young calves to the same system used in the post-weaning pen.

Adjustments can be made based on the specific needs, group sizes, and observed behaviours. Regular monitoring is essential to ensure all calves have sufficient access to feed and water. For nutrition and feeding management recommendations and requirements, please refer to Section 3.3 in the **2023 Dairy Code of Practice.**

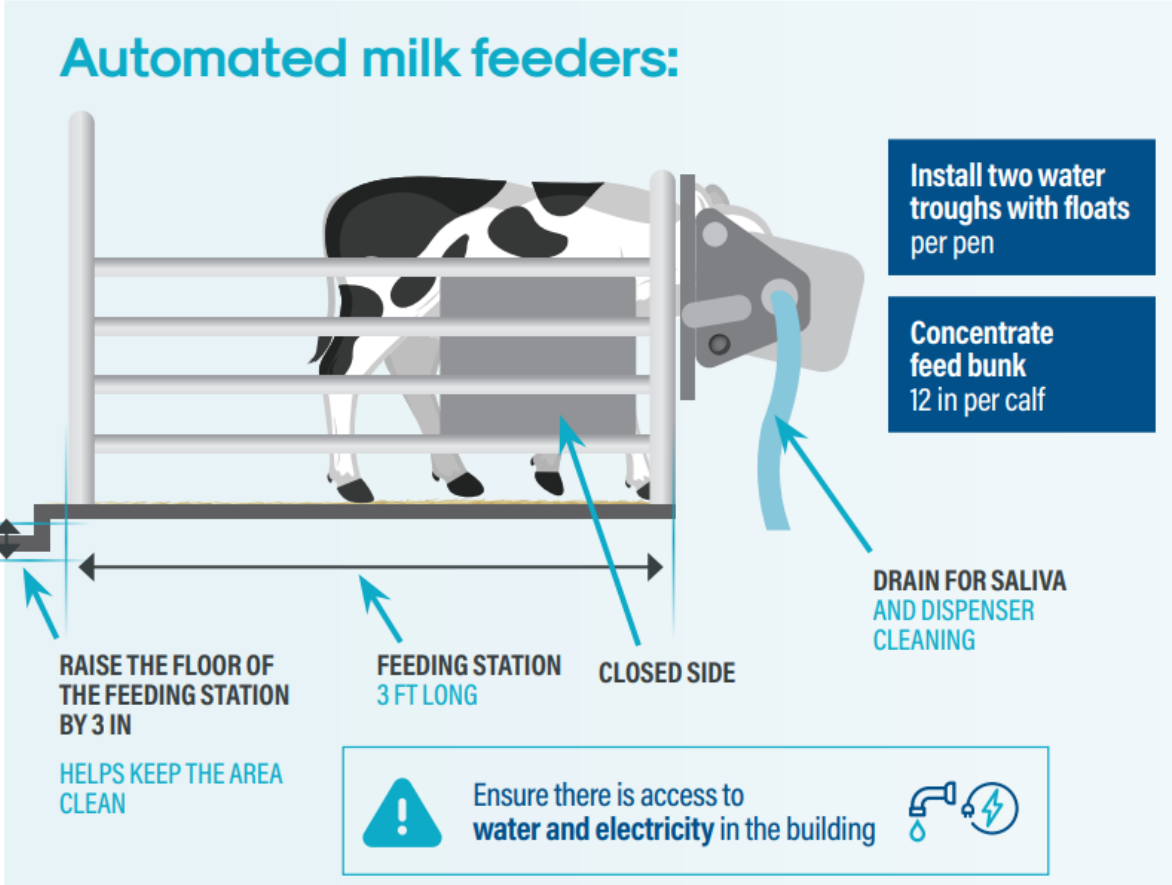

Figure 9: Recommended design for automatic milk feeders, Lactanet 2022
The majority of the advantages and disadvantages are listed in the table below.

For a quick look at ventilation and thermoregulation for calves, see the following factsheet**:**
Automated milk feeders and calf group housing

3.4. Bedding

The quantity and type of bedding in calf housing significantly influence the cleanliness of the resting space, effective nesting **(refer to the UW-Madison nesting score system),** and thermoregulation. Choosing the right bedding material depends on factors like absorbency, cost, availability, and seasonal considerations. For instance, sawdust or peat moss may be used for fly control in the summer, while straw is preferred for insulation in the winter. Unlike with lactating cows, the use of sand is not recommended, as it represents a challenge with manure management and may lead to increased diarrhea. For more in-depth information, please **see Chapter 1 bedding section, Chapter 1 or consult the CDAQ bedding guide**.

3.5. Other considerations for pre-weaned calf housing

Lighting

An extended period of light exposure can have positive effects on calf development, growth, and potentially increased milk production in the first lactation. Maintain light intensity between 160 and

215 lux, with a recommended light duration of 16 to 18 hours daily before weaning and throughout the rearing period.

Calf handling area
A designated calf-sized handling area can be in proximity to the calves' housing. This area could be equipped with a scale for monitoring weight gain, and equipment to facilitate medication administration, caring for injured animals, and enabling procedures like disbudding or dehorning.

Isolation and sick pen
Isolation pens help provide specialized care to sick or weak calves, facilitating early intervention and reducing disease transmission. Key features include:

- Made with suitable materials to facilitate easy dismantling, removal, cleaning, and use.
- Located outside shared pens with drainage directed away from healthy calves.
- Offers access to water, fresh dry feed, and regular milk feeding.
- Additional features include a boot wash station and proximity to medical supplies such as gloves, syringes, stomach tubes, etc.

Effective facility design for sanitation and biosecurity
A well-designed facility layout supports regular hygiene practices and a biosecurity plan. Designating specific areas for cleaning and disinfection of footwear, strategically placing disinfection stations, and creating segregation zones for sick animals all contribute to enhanced biosecurity. Additionally, having proper floor drainage, feed and water equipment, pen walls and floors that are easy to clean and disinfect further promotes a hygienic and safe environment for calf rearing.

For a quick look at recommendations for Biosecurity, see the following factsheet: **Biosecurity**

Flexible planning for space allocation
To ensure adequate space allocation throughout the year and meet minimum space requirements, it is important to consider the following factors:

- Duration in housing units: Determine the length of time calves will spend in each housing unit per age group (for example, 1 to 60 days for dairy heifers and 8 days for bull calves).
- Calving rate variation: Estimate the number of calvings expected throughout different calving periods. Plan for fluctuations in calving rates by providing an additional 20% to 40% space beyond the average year-round calving rate. For example, based on Valacta (Lactanet) data from 2012, a +/- 38% variation of the average inventory was observed in Quebec.
- Breeding rate and calf mortality rate.
- Type of housing per age group (individual or group housing).

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