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Design Information for Housing Special Dairy Cows

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Abstract. *To maintain high levels of productivity, worker safety and environmental protection it is essential for the dairy manager to meet the particular needs of every cow on every day. The majority of cows on a dairy will live, eat and work as part of a production group in the main dairy housing facility. However there are several categories of special cows based on age, stage of lactation, reproductive status, health and management that must be accommodated by the designer and builder of a modern facility. As herds become larger and management demands for improved cow care increase there are usually several animals requiring similar needs so a variety of small "special cow groups" emerge. These special groups or categories of cows may be called early and late dry cows, immediate pre-fresh, maternity and immediate post-fresh cows; treated and convalescing cows; and special attention, high risk or mobility cows. Designs that are sensitive to the variety of*

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needs and flexible enough to accommodate changing management requirements are the goal of the dairy facility designer.

Keywords. Biosecurity, freestall, maternity, bedded pack, hospital, treatment, dairy cows, transition, veterinary, safety, calving,

Introduction

To maintain high levels of productivity, worker safety and environmental protection it is essential for the dairy manager to meet the particular needs of every cow on every day. The majority of cows on a dairy will live, eat and work as part of a production group in the main dairy housing facility. However there are several categories of special cows based on age, stage of lactation, reproductive status, health and management that must be accommodated by the designer and builder of a modern facility. As herds become larger and management demands for improved cow care increase there are usually several animals requiring similar needs so a variety of small “special cow groups” emerge. These special groups or categories of cows may be called early and late dry cows, immediate pre-fresh, maternity and immediate post-fresh cows; treated and convalescing cows; and special attention, high risk or mobility cows. Designs that are sensitive to the variety of needs and flexible enough to accommodate changing management requirements are the goal of the dairy facility designer.

This paper is based on field experience and observations of the authors, material prepared for a Dairy Practices Council Guideline (Engle and Graves, 06) and other literature. This paper will identify and define the characteristics, needs and numbers of typical special cow groups found on the modern dairy and also discuss design philosophy, methods and spatial requirements to meet these goals.

Facility Design

Facilities for special cows need to be designed with thought given to labor requirements for performing the task required. This is where the herd manager and veterinarian will be spending most of their time. These are typically the highest paid people so it is extremely important that things are convenient for them to make the most efficient use of their time. Transition cows are a group of cows that are particularly important. This refers to the period of time from a 1 – 3 weeks pre calving until 1 - 3 weeks post calving. Prompt proper care during this critical period in a cow’s annual life cycle can be considered the foundation on which a cow builds a profitable lactation and provides a healthy replacement animal.

The most important consideration in designing for special cows is flexibility and multi-use. The needs of herds will vary from herd to herd, through out any given year and also through-out the life of a dairy (brand new, expanding, young herd, older herd...) and based on varying outside influences in any given year. Requirements for calving can easily vary 20 -35% during any given year. It is important to plan for some capacity greater than the optimum to allow for variations in calving and also to allow proper care should larger than normal numbers of cows need attention. Basic items such as pens, bedded pack housing, freestall housing and working lanes can often be used for more than one task.

Herds that are or will undergo expansion will place different requirements on special needs areas; the number and distribution of animals in different categories will likely change. Like a milking parlor, the design for special needs facilities should either leave space for future expansion or provide for the ultimate requirements in advance.

Worker Safety

Worker safety considerations are part of the planning for special cows. Items to consider include animal control measures, methods for workers to escape from aggressive animals, elimination

of pinch point or entrapment hazards between the worker and the animals, good footing for both workers and animals and lighting.

Biosecurity

Biosecurity measures to provide protection from diseases both on and off the farm are also a fundamental design principle. There are two general categories of biosecurity:

- Keeping diseases from entering the farm through animals from off the farm, herd health providers, delivery vehicles, equipment and visitors.
- Preventing on-farm spread of disease among different groups of animals.

Designers must consider both aspects of biosecurity when designing and locating special needs facilities. Special needs animals can be both the source of disease that will put other animals in jeopardy as well as some of the most susceptible animals to diseases from other sources. Wolfgang et al (2003) reviewed issues related to biosecurity on dairy farms and also stated that the design and layout of these facilities could be a help or hindrance in implementing good control practices. They also proposed division of facilities, management activities and animals according to relative risk zones of high, medium or low to enhance comprehension and implementation of biosecurity programs on a dairy farm

Location

Location of special needs facilities in relation to the rest of the facility is very important. Many times the special needs housing areas are in several different barns. While this is workable it will add labor and require more transferring of animals from barn to barn. It is usually best to locate special needs facilities close to the milking center so these cows have a short distance to travel to the parlor and back. Also sorting cows is most easily accomplished as they are leaving the milking parlor. However, the sorting activity or location should be far enough away from the parlor exit that the milking routine is not disrupted. Also, areas where intensive and perhaps distressing treatments are performed should be located so cows traveling to and from milking or in the holding area or parlor are not distracted.

There are a variety of destinations for cows after separation from the return lane. The first stop may be a short term holding or catch pen where animals are held long enough for a quick examination and treatment before returning to their housing group or directed to another area with facilities for longer term holding or treatment. Animals not treated immediately and returned to their normal housing area may be moved to an intermediate holding area while awaiting a visit by a veterinarian, hoof trimmer or breeder before being returned to their housing group. A third group may require separation from their usual milking group for several milkings due to required treatment or convalescence. Animals in these areas should have access to water, feed and comfortable resting.

Layout and Characteristics

A special needs area should be planned to allow easy separation and transfer of cows as needed to pens or work areas in the special needs barn. Design and build special needs barns with similar criteria for ventilation, resting areas and floor surfaces as other freestall and loose housing barns. Provide excellent lighting, 25 – 35 foot candles, for good observation of animals and even more in high work areas. Drive along feeding and straight-line manure scraping or flushing consistent with the other barns on the farm is best. Cow transfer lanes should run the length of the building so pens can be divided as needed and the cows from each pen can be

transferred from one location to another without traveling through another pen. Remember that when the herd is expanded the special needs barn needs to expand in direct proportion. A total of 10% - 12 % of the mature cows are commonly in these groups. The barn needs to be easily accessible for employees, veterinarians, service vehicles and trucks for loading and unloading cows.

A new collection of dairy idea plans (Graves et al, 2006) is available from NRAES and has a variety of layout suggestions for special needs barns.

Existing Facilities

It is always tempting to try and “make do” with existing underused facilities. This must be approached with care and skepticism. Often underused facilities are available because they weren’t satisfactory for the milking herd and may be equally unsatisfactory for special cow use. Inconvenient, poorly designed and uncomfortable facilities will not promote good cow care and comfort. If these facilities are inconvenient to use it may lead to performing special needs activities in the milking parlor or housing area, both practices which are discouraged from a milk quality, worker safety, cow safety and cow comfort standpoint. Also, it is essential that these special cows have the best available environment to live in, including ventilation, heat stress control and comfort for resting and moving around.

Sizing Special Needs Facilities

Ultimately the size or capacity of various special needs components must be determined. The expected or actual calving experience of the dairy is a place to start. This must then be adjusted to account for expected variation. A study by Stone (2000) documented that the number of calvings per month is highly variable on most farms. In a perfect world a 700 cow herd would have 58 calvings per month, however this studied indicated that the actual number of calvings varied from a low of 33 to a high of 88 per month (Figure 1) This variation makes sizing transition facilities very difficult.

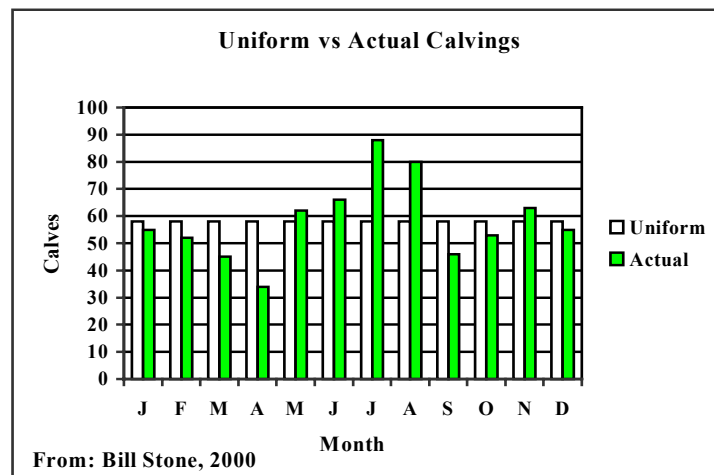


Figure 1. Number of monthly calvings on an example 700 cow herd.

Figure 2 shows the incidence and severity of overcrowding on the study farms. As can be seen in the graph only 10% of the herds surveyed had zero months out of the year that their prefresh group was not at least 25% overcrowded. At the same time at least 12% of the herds indicated the prefresh group was 35% overcrowded for 3 months per year. Given this data the common recommendation has become to design transition facilities to accommodate 25% to 35% more animals than would be estimated using uniform calving.

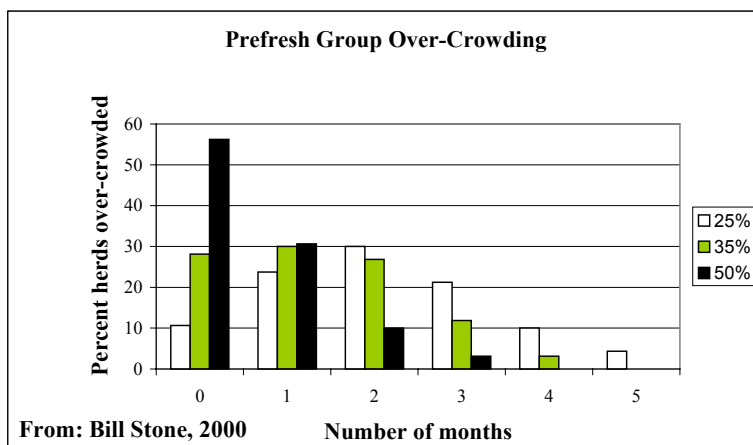


Figure 2. Months that the prefresh group would be over-crowded by an estimated 25%, 35% or 50%.

The length of the dry period can also impact the size of dry cows facilities. This is illustrated in Table 1 for 60 and 45 day dry periods. Notice that the number of far off dry cows is different for the two dry cow periods but the number of cows in the prefresh and postfresh groups is not. In this example every animal that calves spends 21 days in the prefresh group and 14 days in the postfresh group regardless of the total length of the dry period. Variations in numbers of calvings per month as illustrated in the previous figures will change the number of animals in the prefresh and postfresh groups. Note that for this example the pens were increased by 30% to account for variability in calvings.

A simple spread sheet can be developed using the following formulas to calculate different requirements based on length of dry period and also variability in calvings.

- Monthly calvings = (total herd size)(1.05) / 12
- Total dry cows (perfect calving) = [(length of dry period)/30] (monthly calving)
- Housing space dry cows (design) = (perfect calving number) (1 + over sizing value)
- Housing space far-off dry cows = [(length dry period – length pre-fresh)/length dry] (total design dry cows)
- Housing space pre-fresh cows = (length prefresh)/(length dry) (total design dry cows)
- Housing space post-fresh = (length postfresh/30) (monthly calvings)(1+ oversize value)

Table 1 Special Needs Sizing Chart

Length Dry Period (days)	Group	Total Herd Size								
		75	100	150	200	300	400	500	750	1000
60	Far-off Dry	11	15	22	30	44	59	74	111	148
	Prefresh	6	8	12	16	24	32	40	60	80
	Postfresh	4	5	8	11	16	21	27	40	53
45	Far-off Dry	7	9	14	18	27	36	46	68	91
	Prefresh	6	8	12	16	24	32	40	60	80
	Postfresh	4	5	8	11	16	21	27	40	53

- Based on the total cows in the herd (milking plus dry).
- Assuming you need to freshen 5% more than total herd size on an annual basis to maintain herd size.
- Assuming 21 days prefresh.
- Assuming 14 days postfresh.
- Sized 30% larger there uniform calving to accommodate variable calving rate.

Needs of Medium and Long-Term Special Cows

Cows that are under stress because of calving, illness or injury will benefit from having a low stress living area. Items that can reduce living stress include:

- Small number of cows in a group
- Free movement without being jostled and shoved by other cows
- Easy continuous access to fresh feed and water
- Confident, slip free walking conditions
- Plenty of space in freestalls or on a bedded pack to recline and rise again
- Freestalls or bedded pack space enough to always have a place to lie down
- Clean dry well bedded resting area
- Plenty of fresh dry air
- Dry draft free conditions in the winter time
- A shady breezy location during hot weather

The tendency in dairy construction is to maximize space utilization, “How many cows can I fit?” “How small a freestall can I use?” are common questions during the design process. Experience suggests that when dealing with special cows an important ingredient is “extra space.” Many dairy managers and experts seem to agree that extra space in the form of large freestalls, more stalls than cows, larger bedded area per cow, extra feeding space and wider travel lanes helps cows “get on their feet again.”

Extra space on a bedded pack and in bedded pens and plenty of bedding can increase the comfort and cleanliness without the necessity of intensive and frequent grooming and cleaning. Large freestalls and plenty of space per cow on bedded packs are recommended for special cows. This is a result of increases in cow size and the physical needs for cows to recline and rise in a natural stress free manner. While difficult to quantify, benefits from extra space also include increased cleanliness, health and productivity. More densely populated packs and smaller pens require more frequent grooming, bedding addition and cleanout to keep cows clean and comfortable. Also, the variability of numbers of animals can result in areas being lightly populated at some times and still over populated at others. If a facility is built to accommodate the best of times, it will be too small when there is a higher than normal number of calvings or sick cows requiring attention.

Wide ranges of space recommendations are suggested in this paper. The higher number is not considered excessive and the lower number should be considered something to tolerate only when extra labor and bedding is available to assure clean and comfortable cows. A 12 x 12 pen (144 sq ft) is the minimum size recommended for one animal. When this pen is occupied for more than a couple of hours and a calving occurs things can be pretty messy. There is no reason to assume that because there are 10 cows on a bedded area the space provided for each cow should be drastically reduced from that provided in a traditional pen.

Veterinary Office and Storage Area

An office and storage area for veterinary activities, equipment and supplies needs to be located in close proximity to where the most work will be done. There should be provisions for the following items.

- Excellent lighting
- Convenience outlets
- Telephone
- Heating and air conditioning
- Computer
- Refrigerator
- Hot and cold running water
- Wash sink and wastewater disposal
- Drug storage
- Semen tanks
- Desk and filing cabinet
- Supplies
- Parking for veterinary vehicle
- Waste disposal for veterinary/medical waste

This area should be near special treatment and restraint areas where extensive health care procedures such as surgeries will likely take place. In cold climates it is advisable to have part of

the treatment area heated. Also, plan for how these cows will be milked. This could be small parlor for all cows with nonsalable milk or simply some single milking units for sick or mobility challenged cows. Easy access to and from the regular milking parlor is required for cows that will return there for milking.

Sort Pens and Stacking Lanes

Cows needing attention are often diverted from the return lane after milking. This may be by manually operated gates or computer controlled selection gates. Cows may be diverted into a stacking lane that runs parallel to the return lane or to a holding or sort pen. There needs to be enough space to hold all sorted cows while they are waiting further handling or treatment. At a minimum a sorting facility should be sized to hold one side of the milking parlor. Cows that require only quick attention can be cared for and immediately returned to their milking group. Other cows may be kept in the sort pen or diverted to another holding pen. Cows should not be kept standing and away from water any longer than the normal milking period on the farm.

When possible a sort or holding pen should have water and feed and allow cows to lie down. The importance of access to water, feed and resting increases with the length of time a cow is held in a pen. Headlocks are important if the pen will be used for initial examination and simple treatment.

A short term holding pen needs to have at least 20 square feet of area per cow. This is slightly more room than provided in a milking parlor holding area so heat stress in warm weather and cow fatigue anytime will be a concern. It does not provide adequate room for cows to lie down so occupancy should be kept to less than 1 hour. These pens need to have gates hinged in such a way that the cows can be corralled into a single alley that leads to the equipment being used. Using the radius of the gate with beveled corners and lanes help to accomplish this. Remember to have easy access for people so they have the ability to get in and out of the pens and the ability to handle cows without getting trapped or reaching through fences. Cleaning of this area needs special consideration; provide ways to keep it clean with a minimum amount of handwork. Flushing can be the most convenient way to clean this area. A large volume wash down hose may also be used for clean up. Often a combination of hand scraping and hosing provides a labor efficient method and reduces water use and wastewater disposal. Slopes and elevations along with manure collection points are critical to get the job done effectively.

Following are common reasons for sorting cows:

- Bad milk
- Injury
- Regrouping
- Breeding
- Hoof trimming
- Dry off
- Culling
- Vaccination
- Pregnancy check
- Sick

- Computer identified variance

Treatment and Handling Facilities

It is beyond the scope of this guideline to provide detailed design and construction information for treatment and handling facilities. Some of the equipment that may be used and the space requirements follow:

- Palpation rail - the front and rump rails are approximately 4' apart with the neck rail about 32" above the floor with an upper rail 18" above it. The rump rail is about 40" above the floor. There needs to be about 2' of space for their heads in front of the rail and about 4' of work space behind them. Plan about 30" of length for each cow to be held plus space for entrance, exit and positioning gates.
- Single lane chutes with raised walkways beside them work well for giving injections. These need to be about 32" wide and the walkway needs to be high enough so workers can reach over the fence and not through it.
- Wide alleys or rectangular catch pens with headlocks along one side can be used to temporarily lock up several cows for neck and head access. Enticing cows into these headlocks may be a problem.
- Squeeze chutes with head gates are often used for more extensive work. These are about 3' wide and 8' long. Leave at least three or four feet on all sides for work area. Also provide space for a table to keep tools, medication, and records accessible while handling these cows.
- Hoof trimming table or chute – This may be a permanently installed unit or a portable one. If a portable unit is used there needs to be easy access for getting it in and out of the barn. Tilt tables require about 12 x 12 feet of floor space for the table and work area. Trim chutes require about the same space as squeeze chutes. Portable chutes may require extra space for the transporting vehicle. Holding areas for animals awaiting trimming and leaving the trimming unit are also required.

Sick Cow Group

An area to treat and handle downer cows and other serious health problems is also needed. A pen for one cow should be at least 12'x12' with gate partitions, water bowls, and a feed trough. The pen should include a lockup and gate arrangement that allows one worker to easily catch a cow for close examination. Use long gates instead of fixed pen sides whenever possible to provide better access while working on cows. There should be special equipment for supporting and manipulating sick or downer cows such as an overhead lift system or other cow support aid. Include easy access to these from outside the building for delivery or removal of cows that are not mobile.

Close-Up and Maternity Pens

Consider the expected calving interval when designing maternity areas. Typical herds will need space enough for about 5% of the mature cows at any one time. To allow space for close-up heifers increase this to 7% of the mature herd size. Even more maternity space may be required for herds that are in a growth mode or have extreme non-uniform calving intervals. If calculations indicated a uniform calving of 10 animals per month it would not be unusual to have months with only 5 and others with 15 cows calving.

There are a variety of systems that are used for close up animals and maternity.

Common methods include:

- Freestall housing for prefresh animals with adjacent individual maternity pens where cows are put only during calving. Extra large freestalls are recommended for this group. (stall length 114" closed front or 102" open front; stall width 52") The maternity pens should be a least 12'x 12' **Note – using this method requires a high level of management and round the clock observation to prevent cows from calving in the free stalls.**
- Small bedded pack groups for 6 – 10 cows, the cows stay in this area through calving. The mother and calf are removed from this area as soon as possible following calving. These pens need to provide 150 – 200 square feet of bedded pack per cow. Note – this doesn't include the scrape alley along the feed bunk.
- Bedded pack with 6 – 10 cows (100 – 150 sq ft per animal) and adjoining 12'x12' box stalls for calving.

Post-Fresh Cows

Cows need special attention during the first 2 weeks after calving. Providing a separate group and extra attention will typically result in improved performance throughout their lactation. This is about 5% - 6% of the milking string. Provide the best environment possible with space, water, ventilation, and floor surface for these cows to relieve the stress of the calving process.

A group of extra large freestalls and plenty of alley space provides for excellent cow comfort with reasonable labor and bedding demands. Size this area to assure that all cows will have a stall during maximum use periods. This means that for much of the year there will be extra stalls. This extra pampering is usually a good investment for these important animals. For cows that are very unstable on their feet a bedded pack area with 75 – 150 square feet per cow is a good alternative. Fresh cows' udders are very susceptible to dirty resting conditions so larger pack areas or extremely meticulous pack maintenance and bedding are recommended.

Headlocks 30" on center (4 headlocks per 10') provide for space for both the cow and anyone working on the cows in these pens, 27" is considered the minimum headlock spacing. Use hospital or low curb headlocks to minimize the opportunity for a downed cow to choke herself and to facilitate easier extraction of a downed animal.

Special Attention Group

Many times it will enhance the performance of the dairy if there is a group of cows that are kept separate from the main stream cows because of some other special needs. This would include lame, injured, and slow or hard milking cows. This may be about 2% of the milking herd. They are typically housed in freestalls but may be on a bedded pack with 75 – 150 square feet per cow.

Treated Cow Pen

Any lactating cow that has non-salable milk should be kept in a separate group to lower the risk of getting this milk into the bulk tank. These are usually freestalls and require room for about 2% of the lactating cows.

Market Cow and Dry Off Group

Many dairies also have an area that can be used for holding market cows. This area may also be used to hold dry off cows for a day or two while they get a reduced ration to help lower milk production before milking is stopped. This pen needs to hold about 0.5 - 0.7 % of the herd and should provide for water, feed, resting and access to a loading chute.

Isolation Group or Plan

Every dairy should have a plan for handling cows suspected of having an extremely contagious disease. This should be completely separate from the rest of the cows to minimize the likelihood of spread of the disease. In many cases the best way to handle this may be to truck the cow to an unused barn away from the milking animals until the diagnosis is confirmed. A veterinarian familiar with the regulations and practices required to handle cows with infectious diseases should be consulted concerning the best practices for these cows. In most states the state veterinarian or similar office has authority over the ultimate handling of cows with reportable contagious diseases.

Conclusion

When designing a modern dairy cow facility it is important to provide for the needs of a variety of special cows. These special groups or categories of cows may be called early and late dry cows, immediate pre-fresh, maternity and immediate post-fresh cows; treated and convalescing cows; and special attention, high risk or mobility cows. Designs that are sensitive to the variety of needs and flexible enough to accommodate changing management requirements should be the goal of the dairy facility designer. The design must also consider the health and safety of those working with and around and animals and biosecurity measures to minimize the spread of disease among animals on the dairy or moving onto and off the dairy.

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