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# **DESIGNING DAIRY FACILITIES TO ASSIST IN MANAGEMENT AND TO ENHANCE ANIMAL ENVIRONMENT**

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## **INTRODUCTION**

The buildings and equipment which comprise a dairy operation are there to make the job of caring for the cattle on the farm easier. Labor needs, flow of animals and materials, pollution control, future expansion and management requirements are important considerations in design. These are equally important when decisions must be made about improvement or replacement of aging, obsolete or otherwise inadequate facilities. Planning a new dairy facility is a challenging process in itself. But, compared to trying to decide what to do when saddled with an out-of-date operation, planning a new facility is a piece of cake!

Decisions regarding facilities are all the more difficult because i) facilities are expensive, and ii) the consequences of decisions are with us for a long time. So, we tend to take the easy way out when changes are necessary. We tend to do what is most obvious. We choose a solution which solves an immediate problem. Unfortunately, long-range planning and goal setting may not be a part of the process.

For most dairy farmers, change is continual--a different ration for a group of heifers, an improvement in our herd health program, an updated milking system or the addition of a manure storage. The point is, a dairy farm is no different from any other business--continual change is essential. Moreover, change is imperative to keep up with the competition--to maintain status quo is to fall behind!

Changes in facilities must be continual also. Of course, investments in new or remodeled facilities do not occur uniformly with time. Periodic investments are more likely the norm; e.g., a new heifer barn, a new milking parlor, a new bunker silo, etc. But, if these facility changes are to occur logically and the buildings and equipment on the dairy farm are not to become an obstacle to progress, a predetermined plan is mandatory.

Long-range planning is important to all aspects of a dairy operation. But it is especially important when we think about facilities where the decisions are expensive and are with us for a very long time.

## **MANAGEMENT AND ENVIRONMENT**

A prerequisite to contemplating any change in facilities is to have in hand a current management program for the farm. This management program consists of a planned series of actions based

on current recommendations as applied to a specific situation. The program sets forth all factors related to nutrition, health and growth as well as all other activities of the dairy farm operation. An awareness of the current recommendations of all of the experts is essential. More importantly, since no single program suits everyone, decisions must be made as to how each of these current recommendations applies to the particular farm and, if it does apply, how it will be implemented!

Note that the buildings and equipment which comprise dairy facilities are merely tools which allow essential tasks prescribed by the management plan to be carried out on a regular basis. The buildings and equipment on the dairy farm, in fact, make it possible to implement a management program. Haphazard planning or impulsive acquisition of buildings or equipment will only lead to facilities which impede implementation of updated management plans and hinder future development and expansion.

Viewing the dairy herd as a series of management groups is the primary basis for a management program. A group is simply a collection of animals that have sufficiently similar needs in such areas as nutrition and environment that we can view these animals collectively: i.e., in terms of day-to-day management, we can think of them as the same. As herd sizes grow, it becomes simply too much to think about every animal every day.

Table 1 gives typical management categories for dairy herds of various sizes. Use this table to help determine housing needs for the different groups in the management plan. The numbers in the table are intended as guides. You may need to adjust certain numbers to fit a particular management plan; e.g., as a plan may depart from the criteria set forth in the footnote to Table 1.

View the groupings in Table 1 from the standpoint of the management concepts to be limited, not as rigid rules. Some management groups may be housed in the same building or separate facilities may be provided for each group. Regardless, allow for implementing appropriate management recommendations for each group. Also allow for different requirements for sanitation, environment, etc.

Besides serving as management tools, dairy facilities provide an environment for the animals as well. The calves, heifers and cows on the dairy farm must be given an environment that permit them to grow, mature, reproduce and maintain health. If the basic needs of the animals are not being met, no amount of management can assure success.

While many of these environmental needs may be obvious, the degree to which they are satisfied may vary widely. A lack of understanding about the needs of the animals may lead to an improper environment. For example, a warm barn for calves may have excessively high relative humidity due to a lack of understanding of both the needs of the calves and the design and operation of the ventilation system. Or, an improper environment may result from an inappropriate ordering of the priorities being used for design. For example, the establishment of the environment in a barn may place the needs of people and equipment ahead of the needs of the animals which are to be housed, oftentimes to the detriment of the animals. Environmental considerations include ventilation, pen stalls and beds, access to feed and water and walking surfaces.

Table 1. Typical management categories of a dairy herd<sup>a</sup>. The numbers refer to categories, not group size. Numbers depend upon the management plan.

Herd size = total cows	75	100	250	400
Calves and heifers	75	100	250	400
0-2 months, 150 lb	6	8	20	32
3-5 months, 250 lb	9	12	30	48
6-8 months, 400 lb	9	12	30	48
9-12 months, 600 lb	14	18	45	72
13-15 months, 800 lb	9	12	30	48
16-24 months, 1,000 lb	29	38	95	152
Dry cows	13	17	43	68
Transition (first 4-14 days)	0-4	1-5	4-9	5-16
Next 40 days (divide in 2 groups)	8-9	11-12	28-30	45-48
Close-up (2-3 weeks prepartum)	2-5	3-6	8-15	16-24
Maternity (individual pens)	3-5	4-6	10-16	16-24
Fresh cows (from 0-7 days postpartum)	1-3	1-4	3-10	4-12
Two-year-olds (305 days) <sup>b</sup>	18-24	26-30	65-75	104-120
Three years and older (305 days) <sup>b</sup>	44	58	145	232
High producers (120 days or less)	15-18	20-24	52-60	80-96
Medium producers	12-15	16-20	40-50	60-72
Low producers	12-15	16-20	40-50	60-72
Sick cows	0-4	0-5	0-13	0-12

<sup>a</sup>Numbers assume uniform calving year-around, 12 months calving interval, first calving at 24 months of age, all males sold at birth, a 30% culling rate, 0% mortality and a stable herd size.

<sup>b</sup>Number of days of lactation.

## ESSENTIAL ATTRIBUTES OF DAIRY FACILITIES

Plans to build a new dairy barn bring to mind structural calculations, concerns about snow and wind loads, questions about the durability of various materials and a general interest in the strength and longevity of buildings. These are important concerns, but there is more to dairy buildings and equipment than bolts, nails, steel and lumber and associated strength properties and structural design. The buildings and equipment on the dairy farm are the tools the farmer uses to implement a management program and to provide the environment for the animals themselves.

Certainly the buildings and equipment on the dairy farm must be designed to last--to stand up under the daily rigors. But equally important is the role that facilities will play in the functioning of the dairy farm--how will the facilities be used, especially in managing the dairy herd and providing a good environment for the animals on the farm.

So, numerous characteristics can be used to describe the buildings and equipment that make up a dairy facility. But, for purposes here, providing an environment for animals that is based on the needs of the animals and giving the dairy farmer the ability to manage the herd according to current management recommendations are of prime importance. Combining the traits related to management and environment leads to a set of attributes which become, in fact, the minimum, basic requirements for a dairy facility. This set of attributes can be used as a standard against which to evaluate existing facilities and as a guide for long-range planning.

Six attributes of dairy facilities apply to all animals:

1. *Equipment for weighing and mixing tested feeds* allows feeding a complete mixed ration to all groups of animals on the dairy farm. Weighing individual feed components, mixing them together and delivering the mixture to a particular group of animals are essential functions.
2. *Handling, restraint and treatment facilities* permit implementation of many management recommendations. Providing restraint facilities for each group of animals on the farm, along with making it possible for one person to sort and separate an animal is a necessary part of the process.
3. *Adequate supplies of feed and water*, besides being of suitable quality, must be easily accessed as a result of proper feed manger and waterer space and design.
4. *Air quality conducive to good health* is the result of proper ventilation. High humidities in winter and heat buildup in summer are avoided. Concentrations of disease organisms, noxious gases and dust are minimized.
5. *Skid-resistant walking surfaces* reduce injuries, improve movement to feed, water and resting areas and enhance estrus detection.

6. *A reasonably clean, dry, resilient bed* upon which to lie down helps maintain a dry erect haircoat for the small calf in cold weather as well as providing the larger cow with a clean, comfortable place to lie down for rest and to relieve stress on feet and legs.

Two additional attributes specific to calves are:

7. *A clean, dry, well-ventilated maternity area* helps the newborn calf get off to a clean start besides being a continuation of the effort to provide a sanitary environment for the cow.
8. *Individual housing for calves up to age of weaning* has proven to be an absolutely essential component of a consistently successful calf raising program. Hutches or large individual pens in cold housing are preferred.

Two specific to heifers are:

9. *Small groups of calves from weaning to 5-6 months of age* minimize size differences among calves during the transition from individual to group housing. Providing transition housing reduces the setback in growth that often occurs after weaning.
10. *Heifers divided into groups* can be managed according to their specific needs and can be fed rations suited to their nutritional requirements.

Three specific to cows are:

11. *Milking cows divided into two or more groups* more likely will receive properly balanced rations suited to their maintenance and production requirements.
12. *Having dry cows in at least two separate groups* allows for variations in body condition and, possibly, adjusting the cow's ration two weeks or so prior to calving.
13. *A properly designed, installed and maintained milking system* is essential to maintaining udder health, especially in high producing cows.

The first six requirements that apply to all cattle relate mainly to management capabilities and environmental considerations. The last seven, which apply to specific categories of animals, involve primarily the ability to separate cattle into groups.

The set of attributes given above represents the minimum requirements for a state-of-the-art dairy facility. They can be used when planning new facilities. But they are useful also when evaluating existing facilities to point up areas where changes would be beneficial. Thus, don't think about buildings and equipment only when considering new construction.

If we understand the function of facilities--how we are using them for management and environment--we may find that we do not even need to build a new barn or make a major investment in remodeling to improve our ability to manage or to improve the animal environment. But, first we must understand the basic requirements--those represented in the list of attributes given above--if we are going to make changes that require the least investment, yet give the greatest return.

## **STEPS IN THE PLANNING PROCESS**

Major transitions on dairy farms often involve large investments in buildings or equipment. Planning for these new facilities must follow a logical process with design of buildings and selection of equipment based on their intended use. Haphazard planning or impulsive acquisition can only lead to facilities which impede implementation of updated management plans and hinder future development and expansion. Here are some steps for a dairy farmer to follow that might contribute to a more successful transition.

### **STEP 1: Formulate a Management Plan**

An absolutely essential first step in the planning for new construction or remodeling is the development of a management plan for the specific farm--a planned series of actions based on current recommendations and an analysis of the current situation. The buildings and equipment which comprise dairy facilities are merely tools which allow essential tasks prescribed by the management plan--all factors related to nutrition, health and growth as well as all other activities of the dairy farm operation--to be carried out on a regular basis.

Developing a management plan is much like writing the specifications for a tool that is to do a particular job--you need the specifications before you can buy the tool. Similarly, selection of the buildings and equipment for the dairy farm can come only after their role in management has been defined. The management plan sets forth all factors related to nutrition, health and growth as well as other activities of the dairy farm operation. Thus, input from experts such as nutritionists, reproductive physiologists, veterinarians, agricultural engineers and others is essential. Consult these individuals for the latest management recommendations. Base the plan on having different animal groups for management purposes. Define the needs of each group according to nutritional requirements, medical treatments and other procedures, and breeding.

Do not let the present situation constrain thinking. Formulate the components of the plan based on the management groups that have been defined and the needs of each of these groups, irrespective of current facilities. Selection of the tools--the buildings and the equipment-- that will be used to implement the components of the plan will come later.

### **STEP 2: Develop a Long Range Facilities**

Develop a long range plan for a dairy farm based on the management plan and visions for the future, ignoring the presence of existing facilities. This is not to suggest abandoning present

facilities--not at all. Rather, this is a time to dream. Just for the time-being, set yourself apart from the present situation and design the dairy facility which will allow implementing the individualized management program and meeting the desired long-term goals. Dreaming doesn't cost much. Neither does putting plans on paper where changes can be made easily.

Choosing a location is an important aspect of this long range facility plan. Again, ignore the presence of existing buildings and equipment. Consider all factors important to farmstead planning such as air movement for ventilation, drainage, wind and snow control, vehicle access, water supply, electric power and security. Take into account environmental factors--acreage available for manure application, proximity of neighbors, etc.

Later on, present facilities will be evaluated in terms of the long range plan in an effort to determine where money spent on facilities can be used to best advantage. Certainly any money spent on facilities must, at least, show a return and be for buildings or equipment that are part of the long range plan. That is to say, improve the present situation while still working towards a long-term goal.

As a rule of thumb, the long range plan should make allowance for doubling herd size in the next 7 to 10 years. For example, if planning now for 100 cows, the long range plan should be based on 200 cows. This increase may never occur. But, if considered initially, it will be easier to accommodate such a change if and when it does happen. An increase in herd size is very likely inevitable; if not now, in the future.

### **STEP 3: Evaluate Present Facilities**

With a management program and long term goals in mind, evaluate present facilities. Make sure the needs of animals are being met (air quality, stalls/bedding, water, floor surfaces, feed mangers, etc.). Determine which of the present facilities are obsolete from the standpoint of management; i.e., identify where existing buildings and equipment (or lack thereof) preclude implementation of essential components of the management plan. Determine where remodeling would bring existing facilities up to date.

Envision a remodeled building from the standpoint of routine operations such as scraping manure, feeding, moving animals, etc. Look carefully for expected inconveniences while performing routine tasks. Then compare the consequences of perceived inconveniences in the remodeled building to more conveniently performing the same operations in a newly-constructed building.

Identify buildings which show excessive deterioration and equipment in need of replacement or repair. Determine where low-cost improvements are possible. Critically evaluate any planned investment intended to improve existing facilities. Remember, as more money is spent on improving existing facilities, the longer one will be tied to these older facilities; generally, any such investment should have less than a five-year payoff.

Compare the cost of remodeling to the cost of replacing a building. If the remodeling cost is more than 1/2 to 2/3 the cost of replacement, a new building is likely the better choice. Of course, you would consider making a large investment in an existing building only if it were a part of your long range plan.

Examine present facilities in view of the long-range plan--are there components that can be utilized? If herd expansion is involved, consider the conversion of existing facilities to housing for replacements and dry cows with new construction being for the milking herd.

#### **Step 4: Consider the Alternatives**

- a) Do nothing; maintain status quo. But, in doing nothing, you are not staying even; you, in fact, are losing ground on your competition.
- b) Sell out. Look for other alternatives for your future.
- c) Make changes in existing buildings and equipment with the intention that the remodeled facilities will be used to meet the goals of the long-range plan. View these investments as long-term.
- d) Make changes in existing buildings and equipment with the intention that occupying the existing facility is a short-term situation; i.e., any investments will be returned in 3-5 years and a major change may be contemplated at that later time.
- e) Continue to occupy and use existing buildings and equipment with the goal of eventually abandoning these facilities in favor of new facilities elsewhere. Then, investments made in components of the new facility would be as described in the long-range plan.
- f) Build a new facility to satisfy the long-range plan immediately.

#### **STEP 5: Take Action**

Financial resources are a prime factor in determining the course of action. Available resources will be either ample, non-existent or limited somewhere in between. Building new facilities with ample resources is fairly straightforward, while the course of action available with non-existent resources is essentially no action at all. But the usual situation is what to do with limited financial resources, the most complicated situation of all.

Of course, the course of action depends on more than the financial situation. And the combination of possibilities as to what can be done is endless. Extensive planning is essential to arriving at the plan of action best suited to a particular situation. Hopefully, when everything is considered, the ultimate direction will become more or less obvious.

Even with resources available for change, no change may be necessary, or even desirable. Examination of existing buildings in view of the management plan may reveal that no changes are

required. Or, perhaps only low-cost improvements are necessary, say for the purpose of better meeting the needs of a particular group of animals. Or, the farmer may be nearing the age of retirement with no family members to take over the operation. In this case, make low-cost improvements as necessary and do the best with the existing situation until retiring. Even with retirement several years in the future, the financial situation may be such that no major changes will be appropriate or required.

If someone is joining the operation, perhaps on a partnership basis, expansion may be desirable in order to generate additional income. When new construction is required, as in this case, the new construction is usually better devoted to milking cow housing, with existing barns being remodeled for heifers and dry cows. Possibly the new milking cow barn can be sited so as to utilize an existing milking facility (perhaps a stanchion barn converted to a flat barn) thus deferring the construction of a new milking center until a later time. This alternative is especially important if growth is to be gradual.

The course of action may well be divided into two phases. For example, one or more children are of high school age or younger with uncertain desires of becoming dairy farmers. In the short-term, major investments would most likely be avoided, particularly if opportunities for expanding these facilities are limited. To do so ties one to these facilities for the long-term, making it more difficult to move to another location and build a new facility later. Or, elect to build a new facility based on your own future in dairy farming while providing in your plan sufficient opportunities for future expansion to allow one or more to join the business at a later time.

## **SUMMARY**

Changes in the buildings and equipment on a dairy farm should occur only after careful planning. Do not invest in facilities as a substitute for solving a particular problem that is a result of lack of management. Buildings and equipment, new or otherwise, are never an alternative to sound management. Nor should you invest in facilities strictly for the purpose of acquiring facilities; unless, of course, you are in the enviable position of having ample resources to allow you to do so. Rather, invest in facilities that will show a return and facilities that are necessary to fulfill the requirements of a sound management program. Buildings and equipment, in themselves, are no panacea. We are interested in implementing a management program and providing an environment so that the genetically superior cows in our herds of today are able to produce up to their potential. Or, said another way, we do not want our facilities to be the limiting factor to milk production.