Dairy Housing Management, Volume 1, is the fourteenth in a series of management manuals published by Veepro Holland and the first of two volumes on dairy housing. A more detailed description about ventilation and manure handling will be described in Volume 2. These Veepro manuals are intended to provide a useful management tool to all those associated with the dairy farming industry worldwide. Dairy cattle have to be well-housed to benefit optimally from their genetic potential. No single booklet can cover a subject as diverse and complex as dairying. Nor will probably everyone associated with dairying agree on all points covered in one publication. But we of Veepro Holland believe the combination of this manual and other publications on the subject may broaden your practical knowledge about appropriate dairy housing management and will subsequently contribute to a healthy and highly productive herd. Veepro Holland is indebted to those who contributed to this manual, particularly ing. Dolf Smits, housing specialist of the Institute of Agricultural and Environmental Engineering (IMAG-DLO) at Wageningen, and ing. Albert Pieters, farm buildings and structures specialist of the Applied Research Station for Animal Husbandry (PR) at Lelystad, for their constructive criticism. We would like to thank Rinke Oenema, Head of the Farm Mechanisation and Farm Buildings Division of the IPC Livestock/Dairy Training Centre ‘Friesland’ at Oenkerk, for his valuable assistance in the preparation of this manual. Many thanks also to those associations and publishers who permitted us to use various data and illustrations.

VEEPRO HOLLAND
INTRODUCTION

The best way to fully utilize the genetic potential of dairy cows is to create an ideal environment, with the emphasis on cow comfort to optimize animal health and performance. Animal welfare is more than just feeding, taking care of animals and ensuring good health. It is essential that housing, feeding and general care are in balance with the needs of the animals. Besides this, the correct set-up of dairy housing and its components is of major importance with a view to the final results.

A correct set-up of dairy housing contributes positively to the cow’s production performance and above all ease of management. It is recommended to compare the cost of remodeling with that of replacing an old building for new facilities. If remodeling is more than one-half to two-thirds the cost of replacement, constructing a new barn may be the better choice. For example, converting a stanchion barn to free stall housing is usually not practical due to insufficient ventilation and the high cost of conversion. At the most an existing barn can be used as a calf-maternity or as a storage barn.

It is essential that good forward planning in regard to design, engineering and financial aspects be done. Dairy managers should timely consult professionals whom they confide; dairy management consultants, extension services, bank managers, and so on, to ensure that the establishment of new dairy housing is feasible under the given circumstances. The main emphasis in the housing manuals will be focussed on free stall housing systems for dairy cows.

MANAGEMENT PLAN

An absolutely essential first step in designing suitable dairy housing is having a management plan based on the current recommendations for good dairy management. Such a plan should include different groups of dairy cows and young stock for feeding and handling. It is recommended to develop a long-term plan based on opportunities and allowances for future expansion. Table 1 lists the various management categories for different sizes of dairy herds (see page 4).
CAREFUL PLANNING

New facilities should provide comfort and ease of management in regard to dairy cattle and young stock, with the emphasis on logistical movement of animals, personnel, feeds and manure. Making the working conditions smoother and more attractive helps in realizing greater efficiency. Time is money, so always try to increase labour efficiency. The dairy housing system should fit the climatical differences and be divided into housing systems according to climatical zones. Never overlook the fact that a dairy operation has to be managed for 365 days throughout the year.

There are a number of basic elements to be considered when planning any dairy housing system, regardless of location and environment. So let us first discuss the basic elements in planning your dairy housing facilities.

The climatical conditions, particularly temperature, humidity, rainfall, snow and wind are all affecting the design of dairy housing or shelter and necessitate great variations among the various housing systems. The emphasis should always be on having clean, dry and comfortable free stalls to provide animals with protection and comfort in most systems, except those in extremely hot climates.

The milking parlour and the adjoining office complex is the centre of activity in most dairies. Pay sufficient attention to the location of the milking parlour and its cow traffic to and from the parlour. The parlour should be located in a way allowing cows to move freely without interference of gates and other obstacles. The holding area of the milking parlour should be sized according to pen

| Table 1 Typical management categories of a dairy herd based on uniform calving throughout the year, a 13-month calving interval, 50% female calves, all male calves sold at birth, 5 percent of calves lost at birth, and replacement of 25 pregnant heifers per 100 cows. |
|---------------------------------|---|---|---|---|---|
| **Herd size**                   | 40 | 80 | 150 | 200 | 500 |
| **Mature cows**                |    |    |     |     |     |
| Cows in milk                    | 16 | 33 | 62  | 83  | 208 |
| Dry cows                       | 4  | 7  | 13  | 17  | 42  |
| Total mature cows              | 20 | 40 | 75  | 100 | 250 |
| **Calves and heifers**         |    |    |     |     |     |
| 0 - 2 months                    | 1  | 3  | 6   | 8   | 20  |
| 3 - 4 months                    | 1  | 3  | 6   | 8   | 20  |
| 5 - 8 months                    | 4  | 7  | 13  | 17  | 42  |
| 9 - 12 months                   | 4  | 7  | 13  | 17  | 43  |
| 13 - 15 months                  | 2  | 5  | 9   | 12  | 30  |
| 16 - 24 months                  | 8  | 15 | 28  | 38  | 95  |
| Total young stock               | 20 | 40 | 75  | 100 | 250 |

Housing facilities should provide comfort and ease of management in regard to dairy cattle.
capacity and the milking rate per hour of the parlour. Cows should be held for maximally 1½ hours in the holding area. Fast and smooth cow movement through the parlour is essential. The **feed rack** should provide sufficient feed bunk space for each mature cow. It is recommended to emphasize logistical lines (one-way traffic) when feeding various groups of cattle and have feeding lanes wide enough for ease of movement of feeder mixer wagons. The **service and cow traffic lanes** should allow for easy mechanical cleaning, so corners and obstacles should be avoided. The **planning of manure management** is an important part of a complete dairy system. Manure handling, storage, transport, and land application must be compatible with hygienic milk production and pollution regulations. Always provide **plentiful fresh and good-quality drinking water** for cows throughout the dairy facility. In open-air systems protect water troughs with a shade structure and a concrete slab around the troughs to avoid muddy conditions. Provide a water storage reservoir of sufficient capacity for cleaning and other purposes. Separate **treatment and maternity pens** and situate them close to the milking parlour for ease of management. Never use free stalls or the milking parlour for treatment of cows. It discourages proper use of these facilities. It is recommended to separate **dry cows and pregnant or breeding heifers** from the milking herd by providing separate housing and care to minimize herd health problems when these animals move into the milking herd.

**SELECTING THE SITE**

When establishing a new dairy facility with free stalls, choose the most favourable site and pay attention to the topography of the land whenever and wherever possible. Above all, analyze the prospective site with respect to soil conditions, drainage, mains water and electricity supply, and good accessibility for trucks. Study your local weather records and pattern throughout the year, and make optimal use of sunlight in hot climates. In case of open air corral systems make sure you plan your shade structures at a 90 degree angle to the path of the sun for drying purposes underneath the shade structure. The prevailing wind direction must also be taken into account to oppose the main door openings of barns and ventilation inlets against prevailing winds.
DAIRY HOUSING SYSTEMS

In temperate and colder climates enclosed free stall barns provide an ideal protection for cows and personnel on a year around basis. Locating buildings with adequate interspace helps to provide good ventilation. Orient dairy housing openings away from prevailing winds and locate windbreaks on the wind side about 20 meters away from the barn structure. In semi-arid climates rows of roofed free stalls provide necessary protection cover and comfort for cows. In hot climates, shade structures with evaporative cooling and without free stalls, provide sufficient protection from extreme heat and rain.

Always pay sufficient attention to the ease of movement of cows, with the emphasis on logistics. Cows should be able to move to and from the milking parlour without using the feed or free stall lanes of different groups of cows. You should be able to milk, feed, clean a manure lane or load a second batch of cows into the milking parlour’s holding area without interference of another group of cows. Cows need to be moved without interference from obstacles. To minimize efforts when moving cows, design your housing and gate system in a way allowing you to walk freely from one end of the housing system to the other end without opening any gates.

The free stall housing system contributes significantly to labour saving. The following housing systems will be discussed:

- enclosed free stall barn system for temperate and cold climates;
- roofed open free stall system for Mediterranean and arid climates;
- open air corral system for tropical climates.

Enclosed free stall barns

These barns have a self-contained system combining all basic facilities in either an insulated (warm) or uninsulated (cold) barn structure. The decision as to whether a cold or warm barn is to be built should be based on complete appraisal of environmental conditions and management goals to be met.

Nowadays, many dairy farmers worldwide find enclosed, well-ventilated cold dairy barns adequately suitable for moderate and cold climates. Cows can easily withstand low temperatures, providing the animals are kept dry and free of drafts. The humidity level within the barn should constantly be maintained at a reasonably low level, as otherwise it may have a depressing effect on milk production. When sufficient natural ventilation is provided, humidity can be controlled without any forced ventilation. Prevailing winds should be taken into account in relation to the door openings. Having
doors on each long side of the barn allows for added ventilation during periods of warm weather. Figure 1 gives a cross-section of such a barn.

**Roofed open free stall housing**

The roofed free stall housing system is an ideal system for both the Mediterranean and arid climates. If properly designed, this system offers a very efficient method for handling small and large dairy herds at a low investment per cow. It is easily expandable as the herd increases. The design should vary according to climatic conditions, so the main emphasis should be on offering protection from rain, snow, wind, sun and heat.

With a view to cold winds, rain and snow problems in winter, it is best to provide as much protection as possible in the form of windbreaks or roll-away curtains and closed partitions between free stall rows. It is recommended to orient the structures North and South to take advantage of the warming and drying effects of the sun. Warm climate application should provide an open shade structure above the free stalls for maximum air movement and effect of cooling.

For ease of cleaning it is recommended to concrete areas of high cow traffic, such as where feeding and watering takes place. Drainage ditches should be considered to control precipitation and should run to acceptable settling tanks or manure lagoons. Individual lots or pens should house between 50 and 125 cows, depending on the size of the milking parlour and the capacity of the holding area. Herds should be divided into milk production groups or according to the stage of lactation, and different groups for young stock.

**Open-air corral housing**

The design of open air corral systems depends largely on the climatic condition in the dairy farming area. Prevailing problems in heat stress and muddy conditions have compelled dairy farmers in certain areas, especially in hot and humid climates, to provide more protection in the form of shade and paving of high cow-traffic areas. Shade to protect against solar radiation will improve cow comfort and reduce stress. Figure 2 shows a typical barn cross-section for open-air corral housing.

Adequate evaporative convection cooling is necessary to help lactating cows to get rid of their body heat. New developments in evaporative fan cooling have been very successful. The coolers are specially designed for dairy operations in hot and humid climates. The system is used in open barns and under corral shade structures on a dirt surface. It injects a very fine controlled amount of
water into the air stream in relation to temperature and humidity. It produces a very fine mist to prevent accumulation of water on the surface. The fine mist particles stay suspended in the air and evaporate before deposited on the ground, thus consequently cooling the surrounding air. The air movement cools the cows by convection and dairy farmers in these regions are now achieving top milk production and better reproduction performance.

ADVANTAGES OF FREE STALLS

There are several characteristics of the free stall housing system accounting for its wide acceptance in most areas worldwide. It is an ideal time-saving system and above all contributes to cow comfort. Free stalls give substantial savings on bedding materials. Besides this, the individual resting areas result in cleaner cows and fewer udder problems. The cows are free in their movement, which enables dairymen to manage more cows.

Free stall design for cow comfort
The design of free stalls has a great influence on the cows’ health and consequently on their performance. An optimal resting place is essential for cows, because they are resting for many hours daily. Free stalls should provide sufficient space to allow cows to rise and lie down easily. A cow, rising naturally from a lying position lunges forward about 60 to 70 centimeters in transferring most of her weight forward to help raise her hind quarters. To achieve this natural movement, a cow must have enough space to thrust her head forward. If she cannot lunge forward far enough, it will be more difficult for her to rise on her hind legs. If restricted too much, she will rise on her front legs first, like a horse, risking udder damage.

With the above in mind, the free stalls must be well-designed and engineered, and be of dimensions necessary to minimize the chances of leg injuries and teat damage. The special-designed and improved free stall partitions have in common that cows can easily rise as a result of a higher degree of free movement. The cow should not be bothered too much by stall partitions or any other components. An open front end of the free stall allows for ease of movement, as it offers sufficient space.

If the front side of the free stalls is closed by a sidewall, rising will be more complicated. In such a situation the cow is unable to move properly forward and therefore additional space is needed for the thrust of the cow’s head during rising.
The size of mature cows. Wider free stalls cause smaller cows to move too much or even turn around, and consequently their dung may pollute the bedding. Too narrow free stalls will complicate the cow’s rising and lying down, with the risk of teat damage and leg injuries. In addition, narrow free stalls are uncomfortable and will discourage their use. This problem may even cause cows to lie down in the traffic lanes.

The design of free stalls has a great influence on the cow’s health and productivity.
COMFORTABLE BEDDING

Good bedding materials are essential for cow comfort. They contribute to better udder health and help to prevent leg injuries. Besides this, proper bedding has an insulating effect, which contributes to cleaner udders and consequently to a better milking job, and above all, improved milk quality. As one can imagine, the impact of 650 kgs of bodyweight hitting a solid concrete floor is heavy without any doubt. Therefore, free stalls should be provided with enough soft, dry and hygienic bedding material.

The use of short and fine bedding material reduces the amount of bedding dragged into the passage (manure) alley and is of importance for the manure-handling system in use. To keep the bedding materials inside the free stalls, a heavy galvanized about 10 centimeters wide slab, bending slowly upwards over the passage alley, could be installed on top of the curb. This curb rail reduces spillage of bedding material, providing some more length of the stall, and keeping the cow’s tail free from the passage alley. An alternative solution could be to install a 1½” iron pipe on top of the curb. A drawback of installing such a pipe would be the accumulation of manure and liquids against the pipe and eventually of bacterial

A soft and dry bedding place can be achieved by using:

- chopped straw, wood shavings and saw dust;
- rubber mats;
- bedding mattresses.

Chopped straw or other materials

In case chopped straw, sawdust or other fine materials are applied, it is recommended to use bedding in layers of about 3 centimeters. It is important to obtain

| Table 2 The recommended dimensions of free stalls in centimeters for dairy cattle of 550 to 700 kg live weight. |
|--------------------------------------------------|------------------|
| free stall (sidewall of building) | 240 - 250 | 110 - 115 |
| free stall (inner row) | 220 - 230 | 110 - 115 |
| free stalls (double row) | 440 - 460 | 110 - 115 |
| passage alley between rows of free stalls | 220 - 250 |  |
| cow alley behind the feeding rack | 300 - 350 |  |
Good-quality dry bedding materials that are not mouldy and are dust-free. The bedding should absorb as much moisture as possible. Wood shavings should be without splinters. Bedding materials should be stored in a moisture-free area to prevent mould. Twice daily checking of bedding materials and removal of dung contributes to the cleanness of stalls and cows. This system requires topping-up of 0.5 to 1 kg per cow daily.

**Rubber mats**

The rubber mats are a good insulation medium between the concrete floor base and the cow. Free stalls equipped with rubber mats equally require bedding material for good resting. These stalls require about 0.25 kg of bedding material per cow daily. The rubber mats should be of the following specifications:

- when rising or lying down the cows should have sufficient grip (slip-proof) on the mat;
- a profiled top side for better holding of the bedding material;
- easy to clean;
- a high lifetime of at least 10 years.

For hygienic reasons rubber mats laid direct from a roll in free stalls with suspended partitions are preferred to single stall mats. Single mats might go hand in hand with accumulation of bedding and manure between rubber mats in stalls and eventually underneath the mats. On top of this, rubber mats from a roll are easier to install.

**Bedding mattresses**

This is a relatively new method for better resting and has already been successfully tried out by many dairymen worldwide. These bedding mattresses provide an insulated bedding surface which is natural, resilient and very comfortable for cows in the process of lying down. The mats are shock-absorbent, thus eliminating the risk of injury. The thickness of the mattresses is about 8 to 10 centimeters; the mattresses must be on a solid concrete floor base to provide a satisfactory cushion.

Good mattresses consist of uniformly sized and shredded rubber, which maintains its natural resilience. These granulates are sandwiched into a tubular, tough, machine-stitched durable fabric. The mats are protected by a tough top mat and are designed in such a way as to resist tearing, stretching, deformation or loss of shape. The to cover mat should be of a special-designed fabric to avoid physical damage to the mattress and to prevent abrasion of the cow’s skin. Small amounts of dry bedding on top of the mattress helps to keep the surface dry and contributes to cleaner cows.
SUMMARY

The set-up of a dairy farm is of major relevance to the final results of your dairy operation. A well-designed logistical system should be at the basis for excellent housing. The free stalls should be provided with properly designed partitions and comfortable bedding for improved cow comfort and udder health.

The general guidelines for designing proper dairy farm housing are:

1. drawing up a management plan based on current recommendations;
2. viewing other modern dairy farming systems before making a final decision;
3. consulting professionals at an early project stage to design and engineer the facilities;
4. planning housing facilities, with the emphasis on logistical patterns, animal welfare and cow comfort;
5. selecting a prospective site on basis of soil conditions, drainage, main water and electricity supply, and good road accessibility;
6. providing a safe and stress-free housing environment for dairy cattle of all ages;
7. having free stalls of the correct dimensions for comfortable resting places;
8. installing well-designed and engineered free stall partitions;
9. emphasizing utmost hygiene within free stalls by using sufficient bedding materials;
10. utilizing proper bedding for improved resting and cow comfort.
FURTHER REFERENCES

- The Housing of Dairy Cows and Young Stock, Lecture notes IPC Livestock/Dairy Training Centre Friesland.
- Various articles about Dairy Housing published in the Hoard’s Dairyman magazine.

Earlier publications:

- Reproduction Management
- Young Stock Management
- Foot Care Management
- Feeding Management, Volume 1
- Feeding Management, Volume 2
- Milking Machine Management, Volume 1
- Milking Machine Management, Volume 2
- Proper Milking Management
- Udder Health Management
- Forage Management
- Fresh Cow Management
- Dairy Herd Administration Management
- Successful Artificial Insemination Management
Dairy Training Centre Friesland (DTC-Friesland) is part of IPC Livestock. It is established by various Dutch farmers’ organisations and controlled by the Ministry of Agriculture, Nature Management and Fisheries. The Centre conducts a variety of international training programmes and courses. We also provide consultancy and management services.

All courses have a strong practice-oriented character based on the training concept of **learning by doing**. The practical training is very intensive; one instructor deals with groups of six students and for subjects like milking even with three students only. DTC-Friesland offers training in the following subjects:

- **Dairy Husbandry**
  - machine- and handmilking, milking machines, milk hygiene
  - feeding, ration calculation, feedplans, quality of feedstuffs
  - fertility management, heat detection
  - breeding, use of A.I., culling, body conformation
  - housing, tying/cubicle systems, hygiene
  - health, mastitis control, hoofcare
  - calf rearing
  - farm economics
  - farm administration

- **Forage production**
  - pasture management
  - fodder crops
  - silage making
  - farm machinery

- **Milk processing**
  - manufacture of cheese, butter, yoghurt, ice-cream, etc.
  - milk collection and payment systems
  - marketing
  - management of a dairy unit

- **Sheep husbandry**
- **Dairy goat husbandry**
- **Intensive beef production**
- **Horse keeping and animal traction**
- **Teaching methodology**

Visits to farmers’ organisations, A.I.-stations, Health and Extension service etc., are integrated in the courses to provide a good picture of the dairy sector in the Netherlands.

**AD HOC COURSES**

Our major activity is the organisation of ad hoc courses on request. These training programmes are tailor-made and completely designed according to the requirements of
the client. The courses deal with one or more of the earlier mentioned subjects. Duration of the courses varies from 1 week to several months. The courses are conducted in English. For some special subjects training can be provided in French, Spanish or German. If facilities are available locally, our staff is prepared to conduct courses abroad as well.

SIX-WEEKS COURSE: MODERN DAIRY FARM MANAGEMENT

This course is especially designed for persons in charge of a large-scale dairy enterprise, and includes all aspects involved in managing a dairy herd. The course offers a good opportunity to refresh one’s knowledge and learn about recent developments in dairy farm management.

SIX-WEEKS COURSE: MILK PROCESSING

The course is designed for (assistant) managers of small to medium-sized dairy plants and future staff of new dairy enterprises; i.e. on-farm milk processing. Both six-weeks courses are conducted annually in September. However, for groups of at least six persons it can be organised at any time during the year.

TRAINING FACILITIES AND STAFF

The centre has three farms, each with a different management system. One farm is especially equipped for international courses. The total stock at the three farms includes 240 dairy cows, 50 fattening-bulls, 45 dairy goats, 85 sheep and 12 Friesian horses. Additionally, the centre maintains close relations with twenty neighbouring farms which are used for practical training. Our staff consists of fifty dedicated and well-qualified trainers. All have up-to-date knowledge of modern dairy farm management, and over 70 man-years experience is present in various dairy development projects throughout the world.

ACCOMMODATION

A modern hostel provides full board and lodging in single or double bedrooms. An international kitchen and many recreational facilities are present. Social excursions are organised during the weekends to enable the students to get acquainted with the Dutch culture.

For more detailed information on our activities, please contact:

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