Introduction

In most dairy systems cows are housed at some point during the year and in many cases in zero-grazing systems throughout the year. The reasons for housing an animal that is adapted to environmental conditions covering a range of climates is principally ease of management, but also to prevent poaching of grassland and protection from poor weather conditions. Housing has traditionally been designed to ease management and husbandry, in tandem with the demands for increased production, with little regard to the needs of individual animals, or indeed the herd as a whole. The housing facility, of whatever type, should provide protection from adverse weather, and allow ease of movement, with provision of dry, comfortable and clean lying space. Increasing herd size further increases the social stress induced by large numbers of unfamiliar animals, and reduces the attention that the stockman can pay to individual animals. Social space requirements for the dairy cow are not well defined, but should be of concern when grouping animals and designing housing. The housing of beef cattle and of young stock is treated separately at the end of this chapter.

Declining Space

Increases in the size of animals in recent years, through intensified breeding for higher producing animals, have resulted in housing and furniture becoming more and more poorly suited to the cattle housed. This includes: length and breadth of cubicle space, leading to dunging in the cubicle instead of the passageway and an inability to lie down or stand comfortably, partition design impeding comfortable lying, inadequate space in passageways, and restricted access to feed and water. Each of these can affect not only the welfare of the animals, but their feed intakes, levels of production, health and fertility. The opportunity to lie comfortably in a clean area should not be neglected; cows show a strong motivation to lie down (Wierenga and Hopster, 1990; Cooper et al., 2007): dairy cattle lie down for ~7-10 h during the day and night period; individual lying periods are on average 1.5 h long (Figure 44.1). If a comfortable and easily accessible lying area is not available, cows may spend more time lying or standing in dirty passageways (Figure 44.2), which is likely to lead to health problems – udder infection and leg injury in particular.
Flooring

Lameness is becoming an increasingly important factor affecting the health and welfare of the dairy cow. Usually the flooring is of concrete, which with time, and especially when covered with slurry, becomes slippery. Cows have to alter their gait on lower friction flooring (Phillips and Morris, 2000) and this can lead to injury and a disinclination to walk, making them less inclined to visit the feed barrier despite motivation to do so, possibly reducing feed intake and production. Rubber mats have been found to improve the locomotion of both non-lame and lame dairy cows (Telezhenko and Bergsten, 2005). These are expensive, but other methods can be used to reduce the problem. The flooring should be treated to increase friction, by scoring or a pattern of grooves, slurry should be removed regularly and efforts should be made to keep the floor dry. These strategies would also reduce contamination of the floor surface by pathogenic bacteria that can cause hoof problems.

Types of Housing

Modern housing systems, at least in production systems in the developed world, tend to be of either the cubicle or loose straw yard type, or tied stalls. The choice of system is usually dependent on the availability and cost of straw or other bedding material. Higher stocking rates can be supported in the cubicle compared with the straw yard system. A 600 kg cow requires a total area of 9 m² in the straw yard system and a loafing area of 3 m² in the cubicle system (DEFRA, 2006). There should be sufficient cubicle allowance for at least 5% more than the number of cows housed to facilitate the free choice, movement and preferences of the cows. Considerations of health and welfare have been reported extensively for the different housing types. It may be that if management is good, with due regard for the well-being of the cattle, the welfare of the animals need not be dependent on the type of housing system. In short, mastitis problems have been reported more frequently in straw yards than in cubicles, whereas lameness is more likely to be a problem in cubicles. Lameness has been found to be higher in cubicles than in tied stalls (Cook, 2003), and higher in cubicles than in loose housing (Phillips and Schofield, 1994). Within cubicles, the use of straw or rubber mats has no effect on behaviour, but the former type causes less hoof damage (Wechsler et al., 2000). Comparing rubber mats with bare concrete flooring, cows spend significantly more time lying in the cubicles, appear to be more comfortable and show less difficulty getting up and lying down in the former (Haley et al., 2001). Somers et al. (2003) reported a lower incidence of claw disorders in straw yards, though still rather high at 60%, compared with over 80% on concrete flooring.

UK farmers are advised that straw yards should ideally be rectangular, to give more wall area, which cows preferentially lie against, and the back wall should be no more than 10 m from the feeding area (DEFRA, 2006).
In the same source, different cubicle designs and dimensions are reviewed extensively.

Whichever system is used, cows should have unimpeded access to feeding and drinking facilities, with neither next to the bedding area, as this can lead to soiling and poor cleanliness, with concomitant health and welfare problems.

**Drinking Water**
Dairy cows require large amounts of drinking water, often in excess of 100 kg per day. This is affected by milk production, dry matter intake, ambient temperature (Murphy et al., 1983), stage of gestation and lactation, age, breed and size of the cow, and salt in the diet (Fraser and Broom, 1997). As with feeding, there are likely to be peak periods of intakes during the day, such as after milking. There should therefore be sufficient access to water so that at these times cows are not restricted in their consumption. Such an impediment to cows drinking fresh water when thirsty would have an adverse effect on their welfare, particularly of subordinate cows, but also on their level of milk production. Intakes can be further affected if the water is not clean.

**Feeding Area**
The feeding area should have a sufficient face so that all of the cows can feed simultaneously – at high stocking rates feeding times are reduced and displacements of animals from the feeding barrier are increased, and the use of a barrier at the feed face can reduce competition (Huzzey et al., 2006). It has been suggested that for a 600 kg cow this accessible face per cow should be at least 0.67 m (DEFRA, 2006).

**Cleanliness**
Cleanliness and a suggested scoring system to assess the cleanliness of cows are reviewed by Hughes (2001). Animal cleanliness is affected by the cleanliness of the bedding, feeding areas and passageways, stocking rate, cubicle design and dimensions, type of bedding, health and diet of the cows (and so firmness of the faeces), and ventilation (reducing humidity). This ought to be better in cubicle housing, but not if the cows are lying in passageways, or standing in slurry for long periods. Self-operated cleaning brushes can be provided for the cows, which they seem inclined to use if given the opportunity (Figure 44.3). Cleanliness not only affects the health, including lameness, mastitis and metritis, and welfare of the cows, but dirty cows increase the burden on the milking staff, who will have to spend more time cleaning the animals prior to milking, and also increases the likelihood of contamination of the milk.

**Ventilation**
Ventilation has in the past been neglected, but is now integral to the design of buildings. Old buildings may need to address this problem, and ventilation can be improved with the use of fans, which will need to be well maintained, in cases where there is insufficient natural ventilation. Good ventilation in the housing improves the means of providing appropriate air movement, reduces humidity, reduces heat, and reduces the build-up of dust, noxious gases, principally ammonia and carbon dioxide, and microorganisms. If ventilation is poor a range of health problems can result: heat stress, respiratory diseases and mastitis in particular. In addition, the health of the farm workers and the surrounding environment can be adversely affected. Phillips et al. (1998) reviewed and suggested means of measuring emissions and ventilation rates in livestock buildings.

**Lighting**
Lighting should be sufficient for the cows to confidently move and explore their surroundings; cows have shown
an aversion to darkened passageways (Phillips et al., 2000). There should be provision of a greater intensity of light, available at all times, for the accurate observation of stock by the stockperson. The provision of light should follow the normal daily rhythm of light as much as possible, although increased yields have been observed from increasing the day length through artificial lighting (Dahl and Peticlerc, 2003). The spectrum and intensity of light should also be considered.

**Heat and Cold Stress**

Cattle are more temperature-tolerant than other farm animals. Their thermoneutral zone is generally wide, and often extends to quite low temperatures. The range of thermal neutrality varies between breeds and individuals with different productivity. At ambient temperatures higher than 25°C, cows show increased stress (Wise et al., 1988) and reduced production (Berman et al., 1985), feed intake, condition and fertility (Wilson et al., 1998). Detection of discomfort from heat stress includes increased respiration rates and increased drinking. Heat stress can be minimised, and feed intake increased, with the use of misters or sprinklers and fans (Lin et al., 1998) and shading exposed areas. The use of water for cooling ought to be used only in the collecting area or passageways, as wetting the bedding will have adverse consequences on the quality and microbial contamination of the bedding material. Cold stress should not be disregarded, but the dairy cow is a cold-hardy animal, with an estimated lower critical temperature of -20°C for the cow in peak lactation, although increased metabolic rate for the production of heat requires a higher maintenance energy, and the flow of digestion is increased (Young, 1981). The lower critical temperature is also affected by the level of activity and locomotion.

**Calf Housing**

Housing calves represents something of a welfare conflict. Rearing them in individual pens is better for their health, while rearing them in groups reduces the suffering of social isolation in what is a herd animal. Socially housed calves have more space, engage in normal social behaviour – both while calves but also into their adult lives. There may also be reduced labour costs in cleaning out one large pen rather than several individual pens. However, in early life calf mortality is caused primarily by digestive disorders and, slightly later, by respiratory problems. The commonest cause of these is infection from conspecifics, so keeping them separated makes sense from a health and economic point of view. It is also easier for the stockman to notice problems with calves, including feed intake, if he observes them in isolation and provides the feed and water individually. Most intensive units continue to keep calves in individual pens for these reasons. However, strategies to balance these demands are also common. Many units house calves individually, but then move them into group pens after around a week, by which time the greatest risk of disease is thought to have passed. A further refinement has been suggested by Chua et al. (2002) whereby calves are housed in pairs. This has no adverse effects on scouring or feed intakes, and the range of normal behaviours is higher than in individually housed calves. Whatever the system, the pens should be spacious, the calf should at least be able to turn around even in an individual pen, secure and safe, and they should be frequently cleaned with dry bedding provided. Calves should have easy access to water and feed, not always possible with automatic feeding devices. Calves are more vulnerable to cold temperatures and the pens should be well protected from draughts and from precipitation.

**Beef Cattle**

Beef production in the Baltic Sea region is relatively small compared with other parts of Europe and particularly the American continent. However, where beef animals are kept they are increasingly kept outdoors, and the cool and wet climate in this region might be a cause of stress to these animals. The welfare of animals kept in these conditions has been thoroughly reviewed by Ekesbo (2009). Outside, in a cool climate, is perhaps as close to their natural environment as such a thing is likely to be, at least for northern European breeds (Figure 44.4). Cattle, but not newborn calves, are unlikely to suffer from cold stress as the rumen is a source of considerable heat, they are able to acclimatise to cooler temperatures, and grow thicker coats and lay down an insulating layer of subcutaneous fat for the winter, at least as long as they are dry. Insulation of the coat is much reduced when wetted, so animals housed outdoors should have some shelter.
that provides a dry environment. If a coniferous wooded area is included in the area available to the cows they are able to use this cover, but in the long term such repeated usage can damage the roots and the trees and kill them, reducing the protection available. Constructed structures are most likely to be used. The design of these shelters should be such that precipitation and wind in combination, the worst situation, do not reach the lying area. Wind screens alone do not offer sufficient protection. There should be enough space in the shelter so that all the cows can fit inside it, and they should know where it is. The flooring should be well drained. Cows prefer to lie on a dry surface, and if forced to lie down on a damp floor will lose heat rapidly. Problems are more likely to arise from poor management rather than the system itself. Simply covering the floor lightly with straw, or worse no covering at all, on a poorly-drained surface will not suffice. This will soon become a mudbath. The shelter should be clearly accessible, and the cattle may need to be taught to use it. Introducing a novel temporary shelter at the beginning of the winter is no strategy, as learning to use a shelter in bad weather is considered an acquired behaviour in cattle (Ekesbo, 2009). However, this is quite simply done by offering hay in the shelters to encourage their use and familiarity.

Conclusions

Dairy cattle spend at least some of their time indoors, and some herds can be housed throughout the year. The housing is usually either in cubicles or in loose housing with straw yards. In terms of the relative merits of these systems, cow health is probably better in the former system and cow welfare and likelihood of injury is probably better in the latter system, although much depends on the local stockmanship and management rather than the system itself. Particular problems include the fact that cows have become larger animals in recent years, outgrowing the space and furniture of their housing. The expense of updating the furniture to make housing more suitable is often too great and the cows suffer stress as well as health and injury problems, and production can be reduced as a result. Drinking water and feed availability, cleanliness, ventilation, lighting and control over the internal climate are all considerations.

Calves are usually housed indoors either individually or in groups. Again, there is a conflict between health and welfare; individually housed calves are less likely to become infected with contagious agents, whereas group-housed calves are able to behave more normally and this improved normalcy is carried on into their adult behaviour. Beef cattle are somewhat different and in the Baltic region spend most, if not all, of their time outdoors. This is on the whole fine, as the cow has evolved to thrive in such conditions, but shelters should be provided, for wet and windy weather in particular. The cows should know where these shelters are, should know how to use them, and they should have sufficient dry area in which all of the herd is able to lie down comfortably.
References

Chapter 44


Chapter 45


