Cow Comfort and Lameness—Design of Cubicles

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Introduction

Plenty of room, a soft dry bed and minimum hardware to interfere with cow body movement are the essentials of a comfortable cubicle. Cubicle design has always been of topical interest to farmers, veterinarians and buildings designers, but its development since its inovation in 1960 has been mainly experimental. This has lead to a variety of design and dimensions, which seem to take little account of animal needs and attributes. Some cubicles can cause injuries to cow legs, joints and pelvis. Also cows housed in inadequate cubicles can become excessively dirty, either by defecating into cubicles or by refusal to use cubicles and lying elsewhere on slurry covered surfaces. Some design faults on their effects on the cow are shown in Appendix 1. This "handout" presents cubicle dimensions based on resting, eliminative and spatial requirements of Friesian dairy cows and also gives some guidence on management and bedding of cubicles.

Dimensions of the Cubicle Base

Length

Inadequate length is the main reason why some cows refuse to use cubicles, stand or lie only partially in the cubicle or have difficulty in rising. The length of the base should be related to the size of the cows. Referring to breed or to an average size for the herd is not recommended as half the cows in the herd would find the cubicles too short. On the other hand, cubicles of sufficient length to accommodate the largest cow in the herd may be too long

APPENDIX I INJURIES AND CAUSES

Cow injuries/ behaviour	Likely causes: Narrow cubicle	Short cubicle	Lower rail low	Lower rail high	Top rail low	Protruding kerb	Headrail set more than 500 mm from front	Low headrail	Head-to-head division rail too high	Broken concrete base	Uneven hard base	Slippery base	Lack of bedding	Brisket board incorrect	Rough/new concrete
Swelling Knee (carpus)							*	*	*	*	*		*		*
Hock (tarsus)	*	*				*				*	*		*		*
Pelvis	*		*	*											
Abdomen			*												
Shoulder	*		*						*			*		*	
Pin Bone		*				*						*	*		
Neck								*							
Bruised ribs	*		*												
Cut teats	*	*			*		*	*	*	*	*	*	*		
Rising front first		*		*		*			*	*		*		*	
Difficulties rising	*					*	*	*	*	*		*		*	
Lying over a kerb	*	*					*								

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for the majority of cows. This could occur, especially if there are only a few very large animals in the herd. To decide the cubicle length suitable for the majority of cows in the herd it is recommended that an average of the body weights of the largest cows (representing 20 percent of the herd) should be taken, using a weigh crate or weigh band. The measurements 'A' and 'B' shown in Figure 1 could also be made on these cows and the weights and dimensions fitted to those in Table 1 to arrive at a suitable cubicle length.

Figure 1. Location of measurements on cow's body.

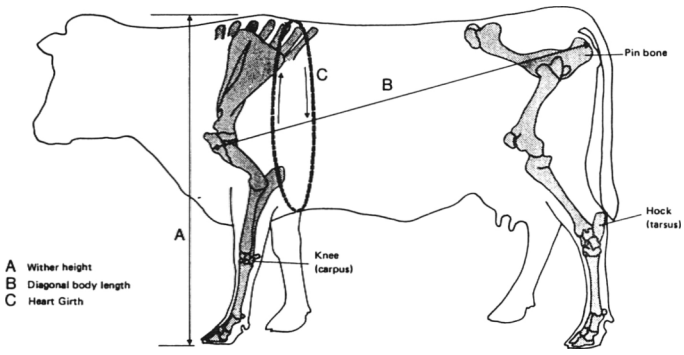
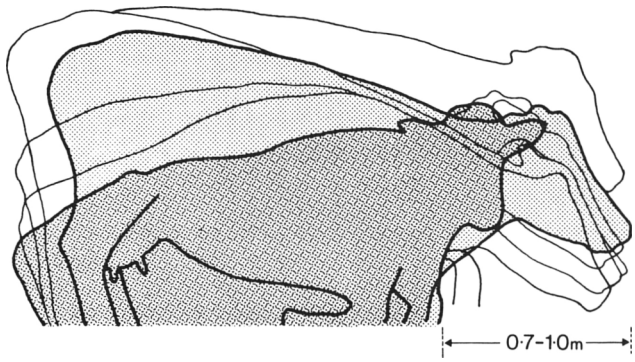


TABLE 1. Relationship between chest girth, body weight, diagonal body length and cubicle length.

Cow body weight (kg)	Chest girth (m)	Diagonal body length (m)	Cubicle length (m)
375	1.68	1.36	2.00
425	1.75	1.41	2.04
475	1.81	1.46	2.08
525	1.87	1.50	2.12
575	1.93	1.54	2.16
625	1.98	1.58	2.20
675	2.04	1.62	2.24
725	2.09	1.65	2.28
775	2.14	1.68	2.30
825	2.18	1.72	2.33

Recommendations of the cubicle length are based on photographic studies of cow rising movement and the body weight/size relationship. The forward space demand as shown in Figure 2 for a large (up to 800 kg) dairy cow to accomplish rising movement is 0.7 m to 1.0 m.

Figure 2. Forward space demand of rising movement (800 kg Friesian cow)



The recommended length of the cubicle base could be reduced by 0.2 m provided cows have free space in front of the cubicle, for example, in head-to-head layouts. In such arrangements space sharing can take place between cows. It is important to ensure that any dividing rail or dwarf wall separating head-to-head cubicles should not be higher than 230 mm. In addition, a top rail set at 850 mm and fixed to the front of the cubicle divisions is needed to stop cows walking through, or getting trapped under the headrail.

Width

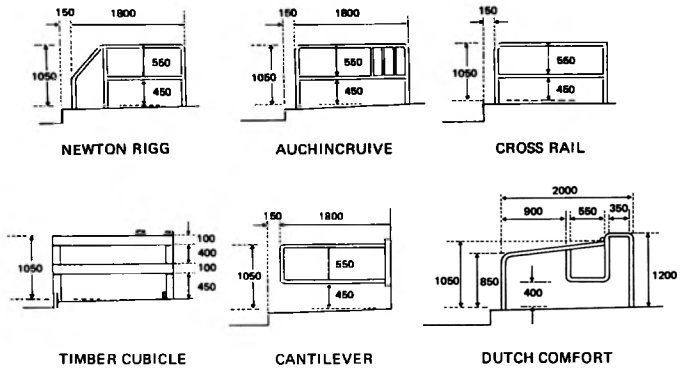
The clear width between divisions should be 1.2 m. This recommendation is related to observations of duration of resting periods of mature in-calf dairy cows given as free choice of 1.0 m, 1.1 m and 1.2 m wide cubicles. Compared with 1.0 m width, cows spent significantly more time lying down in 1.1 m and 1.2 m wide cubicles. Cubicles housing cows of 475 kg or less should be reduced to 1.1 m clear width.

Cubicle Divisions

Since the innovation of the cubicle system a number of designs have been evolved. Some examples and construction details are shown in Figure 3. Provided that the length and width of cubicles are suitable for the cow's body size, the types shown are satisfactory. Divisions such as the 'Dutch Comfort' type allow more space sharing between adjacent places. This is achieved by cows being free to insert the head and neck through the front of the division and swing the head. This movement helps the cow to move its body forward and to rise on its hind legs. Absence of any side restriction in the pelvic region means more comfort for cows while lying down or rising.

The critical dimension common to all types of division is the height of the lower rail. The distance from the cubicle base to the underside of the rail should be 400-450 mm. Rails set lower can cause serious injury, whilst those set above 450 mm allow smaller animals to lie partially under

Figure 3. Some cubicle divisions for dairy cows.



the rail which consequently interferes with rising movement. A twisted polypropylene rope can be used instead of a bottom rail, but it must be kept taut.

Headrail and Brisket Board

Headrails should be easily adjustable and located at a height of 150 mm to 250 mm below that of the withers. The top of the brisket board should not be higher than 100 mm above the base level to prevent injuries to legs or interfere with normal rising movement. A wooden board (50 mm x 100 mm), with rounded edges, fixed to the cubicle base is adequate. Brisket boards or headrails should be set at a distance equivalent to ¼ of the base length, from the front of the cubicle. In the case of the headrail this distance may have to be reduced if the headrail is set lower than the minimum recommended distance of 150 mm below withers height.

Head-To-Head Cubicles

In this arrangement cows should be allowed to launch through the front of the cubicle to aid their rising movement. The division rails should be set at 230 mm above the floor with the top rail set at 850 mm to prevent the cows walking through. These dimensions have been arrived at from photographic studies of cow movement on pastures.

Cubicle Frontage

Lack of head-space, or "launching-space," and small cubicles, can make cows adopt a devient form of rising movement; in particular rising after the fashion of a horse. This can lead to overloading of joints and teat damage. This shortcoming can be corrected on the inner row of cubicles facing the feeding passage where the solid frontage should be removed to within 250 mm above the cubicle base. The top rail should still be installed at 850 mm height to prevent cows pushing through. Any splashing of slurry from the feeding passage will be negligible but the cows will be free to launch forward to get up.

Construction of Cubicle Bases

Concrete

Cubicle bases require durable concrete which must be laid to the recommended standards of concrete mixes and workmanship: ready mixed concrete is convenient and economical. When ordering ready mixed concrete, the mix designation should be specified. For cubicle bases use mix with 20 mm maximum size coarse aggregate and medium workability (cement 50 kg, damp sand 115 kg and aggregate 195 kg).

When mixing on site use three parts ordinary 'Portland' cement, five parts damp sand and nine parts 20 mm maximum size coarse aggregate. All-in aggregate (pit ballast) should never be used for this application as correct proportions of sand to aggregate cannot be ensured.

Concrete should be laid 100 mm thick on 150 mm of consolidated hardcore to a 75 mm-100 mm fall over the cubicle length. It must be thoroughly compacted, preferably with a mechanical vibrator or tamping beam. After tamping, the surface should be gently smoothed with a flat wooden float just before the concrete begins to set, but still leaving tamp marks. Once the concrete is cured it should be rubbed over with a brick to chip off any minor projections which may cause injuries.

Bitumen macadam

This should be the 'dense' type with a 200 pen value, aggregate size 14 mm. A 6 mm aggregate mix with a 100 pen value can be used only if a specialist surfacing team is employed. A concrete kerb 200-250 mm wide is advised.

Lay the mix, 75 mm thick, on a well consolidated hardcore base to a 75 mm-100 mm fall over the cubicle length. On new bases the macadam should be approximately 12 mm above the kerb to allow for shrinkage. It must be laid as quickly as possible while still warm and pliable. Thorough compaction using a plate vibrator is most important.

Chalk or soil

If used, this should be laid in layers not exceeding 100 mm, well rammed or rolled with a vibrating roller. Material which includes flints should not be used, as this could cause abrasions or lameness. To reduce dust and improve consolidation of the base, chalk should be dampened during laying.

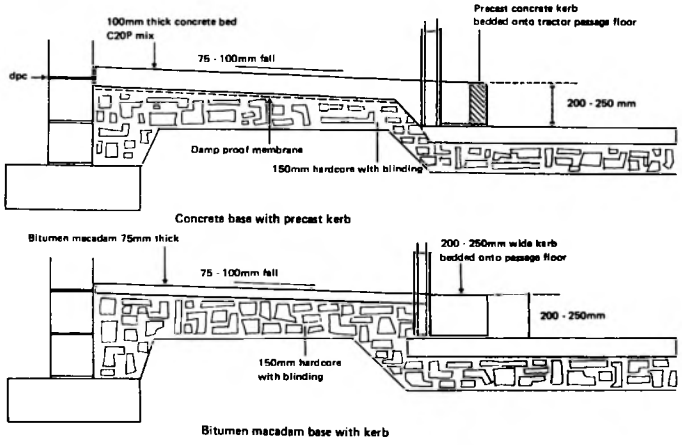
Damp Proof Membrane (D.P.M)

Use of a d.p.m. is recommended on most sites. In circumstances where a high water table prevails a d.p.m. should be placed on blinded hardcore below concrete. Heavy duty PVC sheet (500 gauge) is suitable d.p.m. allowing 150 mm overlaps at the joints.

Base Section

Sections through recommended concrete and bitumen macadam bases are shown in Figure 4.

Figure 4. Sections through alternative cubicle bases.



Mats and Carpeting

Cow mats are available from various proprietary sources and are intended to reduce the amount of bedding required. They may be of rubber, polyester or polyethylene mixtures. Thickness of the mat varies with make from approximately 6 mm to 23 mm and they may be laid as a roll along a run of cubicles or as individual mats. The mats will give some protection against knee and hock damage on a concrete base. Some bedding is necessary to keep the cows in a clean condition and a depth of at least 10 mm is advised to achieve this and to control skidding on a damp surface. The cost of the mat and its installation is extra to the concrete base cost, but there is some reduction in bedding costs. Given a 10 year life and reduced bedding, the total annual cost can be comparable to other systems.

Cubicle Beds, Bedding and Management

Free choice studies with different cubicle bases have shown that cows prefer 'soft type' beds to bare concrete. The most favoured were adequate straw and sawdust or carpeting on concrete, followed by cow mats and bituminous macadam with minimal bedding.

A sufficient quantity of bedding on concrete greatly improves the comfort of the cow and a degree of 'give' is of more importance than insulation. The quantities which will provide a comfortable bed are given in Appendix 2.

Frequent applications of bedding will help the bed remain clean and dry, but the frequency will depend on the initial depth of the bedding and the regular removal of dung pats from the rear of the cubicle. Most types of bedding need 'topping up' two or three times a week with twice daily

APPENDIX II. RECOMMENDED BEDDING QUANTITIES ON CONCRETE BASES.

Bedding Type	Properties	Recommended Minimum depth	Quantity/cubicle/ 180 day winter kg	Frequency of bedding application	Slurry
Straw long	Quite good absorbency preferably barley straw.	50 mm*	250-400	3 x a week*	Scrape to compound. Can block pumps.
Straw chopped	Good absorbency preferably barley straw.	50 mm*	150-200	3 x a week*	Scrape or pump to compound or store. Can block slats and encourage crust formation in store.
Sawdust Shavings Wood fibre	Very good absorbency beware hard chips and chemically treated.	50 mm*	200-300	3 x a week*	Scrape or pump to compound or store. Less problem with blockage or crust.
Sand	Smooth rounded particle. Not too fine and not adhesive.	50 mm*	850-1000	Once every 2 to 3 weeks	Scrape to compound. Can wear pumps and will settle in store.

*** If bitumen bases or mats are used, the bedding depth can be reduced to 10 mm if bedding applied daily.**

**** A minimum of 50 mm must alway be used and maintained to avoid abrasion.**

removal of dung from the cubicle bed, but the lower quantities of bedding used with mats and carpeting require topping up daily. Where mats are used, wet faecal matter can collect under and around individual mats producing unhygienic conditions.

Sand at the recommended depth needs less frequent additions, once every two or three weeks being sufficient provided it is raked over at least once a day.

If sand is used as bedding it should be at least 50 mm deep (ie. level with the retaining lip) to prevent abrasion, especially on udders, teats, hocks and soles of feet.

Dung and soiled bedding should be removed from the cubicle base twice a day. This can most conveniently be carried out when the cows are collected for milking. Excessively soiled beds may require adjustment of the headrail/brisket board.

Factors affecting conditions in the cubicles are:

- frequency of scraping slurry and bedding cubicles,
- milk yield and diet of the cows,
- width of passages or use of slatted passages,
- slurry handling system, and
- type and quantity of bedding used.

The slurry systems can influence the type and quantity of bedding used and should be a primary consideration. Using bedding at less than the recommended quantities and depth on the cubicle base will create difficulties in maintaining cow cleanliness and may cause hock damage.

To avoid fouling of the beds, skidding and the development of soft horn lameness, it is necessary to minimise the quantity of slurry in the passages and other areas. Concrete areas should be scraped at least twice a day and more often if the overall area per cow is limited or if the cubicles are being used by high yielding cows.

Cubicle Beds and Mastitis

Organisms causing mastitis are commonly present in the cow's environment and control of mastitis will be more difficult if housing conditions are not good. Recent investigations have shown that dry cubicle beds have a beneficial effect in reducing the likelihood of teat end contamination by environmental bacteria. The design features and management of cubicles as described will influence the dryness of the beds. Sand can provide a dry bed but requires a lip to retain the 50 mm depth which can cause injuries to ischia.

Teat Damage

Absence of restriction to hind legs to stretch into adjacent cubicles can cause some concern over teat injuries. This is not well founded as most damage is self-inflicted and is caused by narrow cubicles, low cubicle partitions or the lower cubicle rail set too high (above 400-450 mm). The damage occurs as the cows are attempting to get up, and where, due to collisions with the surrounding hardware, they must step sideways to clear the obstacle. Also cows whose udder are lower than 400 mm above the floor (teat/floor distance) are likely to get injured especially around calving down date when the udder is full and rather inelastic.

Resting Behaviour

Quiet cows and absence of unrest in the herd are traditionally associated with milk production. The type of cubicle bedding can influence the duration of time which cows spend in cubicles. Results of free choice experiments have shown that cows prefer dry, soft beds to hard surfaces. (Table) 2. Prolong standing requires energy and also increases exposure of cows hooves to slurry. This leads to soft horn and increased rate of hoof wear.

TABLE 2. Effect of Cubicle Floor on Rest.

Floor Type	Resting time (hours)
Concrete	7.2
Insulated screed	8.1
Rubber mat	9.8
Straw on concrete	14.1
Enkamat-k	14.4

Summary

Spacious cubicles with soft dry beds will help to control "cows' refusals" to use cubicles and reduce injuries to legs and teats. Head-space and space sharing should be allowed. The dimensions of the cubicle base should be related to body weight. Proper design and hygiene is essential to control mastitis, lameness and injuries.