

Cubicle Housing for Dairy Stock



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Cubicle Housing for Dairy Stock

Cubicles are by far the housing system of choice for dairy cows in Ireland. It is important to think long term because cubicle houses are typically in operation for over 40 years.

Cubicle housing needs to meet three key parameters: adequate space per cow, comfortable and clean cubicles and provide adequate feed space per cow. There needs to be at least one cubicle space available per cow. There are other issues such as ventilation that are beyond the scope of this document.

Space per cow

The target accessible space is 8m² per cow, this includes the area of the cubicles themselves and any passageways cows can access. For example the combined area of the cubicles and passageways in a 100 cow cubicle house would be 800m². The design of the house also needs to minimise the risk of bullying, by having more than one route to feed, water etc. Cows do not like rubbing up against each other as they move around the cubicle house. This has become very evident to a number of farmers who have built a slatted tank and feed barrier outside the existing cubicle house and provided cows a spacious environment – most of the cows wanted to exit ‘stage left’ as it were.

Comfortable and clean cubicles

Cows can spend up to 14 hours per day lying down, they will only do this if they have a comfortable place to lie. Cow lying time is important as it facilitates the manufacture of milk but it also provides for rest and the recuperation of cows during the dry period. A comfortable lying area will also reduce the risk of lameness in dairy cows. It is also important that the cubicles are clean (and easy to clean) to ensure good animal health.



- 1 Kerb
- 2 Base with mat (+lime)
- 3 Brisket board
- 4 Cubicle division
- 5 Neck rail
- 6 Head rail (strap)

Figure 1: Elements of a cubicle

In Ireland we typically use a concrete surface covered with a mat or mattress. Cubicles need to be cleaned twice per day and the area in contact with the udder needs to be covered with lime or sawdust mixed with lime. This is particularly important when cows are vulnerable to infection – when lactating, in the early dry period and in the period pre calving. It is also important to minimise the risk of infection in the context of reducing the need for anti-microbial dry cow therapy.

Feed space per cow

Cows like to behave as a herd, they all strive to eat together. Inadequate feed space can impact animal health and welfare by creating competition for food resulting in extra pressure on hooves, and risks for pregnant cows etc. It will also be harder to divide up the herd by body condition score and stage of pregnancy so that cows can be fed accordingly. The recommended feed space is 0.6 to 0.7m per cow depending on barrier design. It may be possible to justify a shed with a lower feed space allocation provided measures are taken to protect cows with lower body condition scores, lower ranking animals in the herd and cows approaching the end of their first lactation that are still growing.

Cubicle Divisions

Cubicle divisions facilitate the correct positioning of cows in cubicles while providing ample room for cows to lie down, get up etc. The division needs to be high enough to discourage cows from turning around in the cubicle.

Neck Rail

The neck rail gives stability to a line of cubicles while discouraging cows from attempting to walk through head to head cubicles.

Brisket Board or Pipe

The brisket board helps cows to position themselves in a cubicle. A rounded brisket board 6 to 10cm above the lying surface is recommended. This facilitates cows that might like to stretch a leg forward.

Cubicle Mat or Mattress

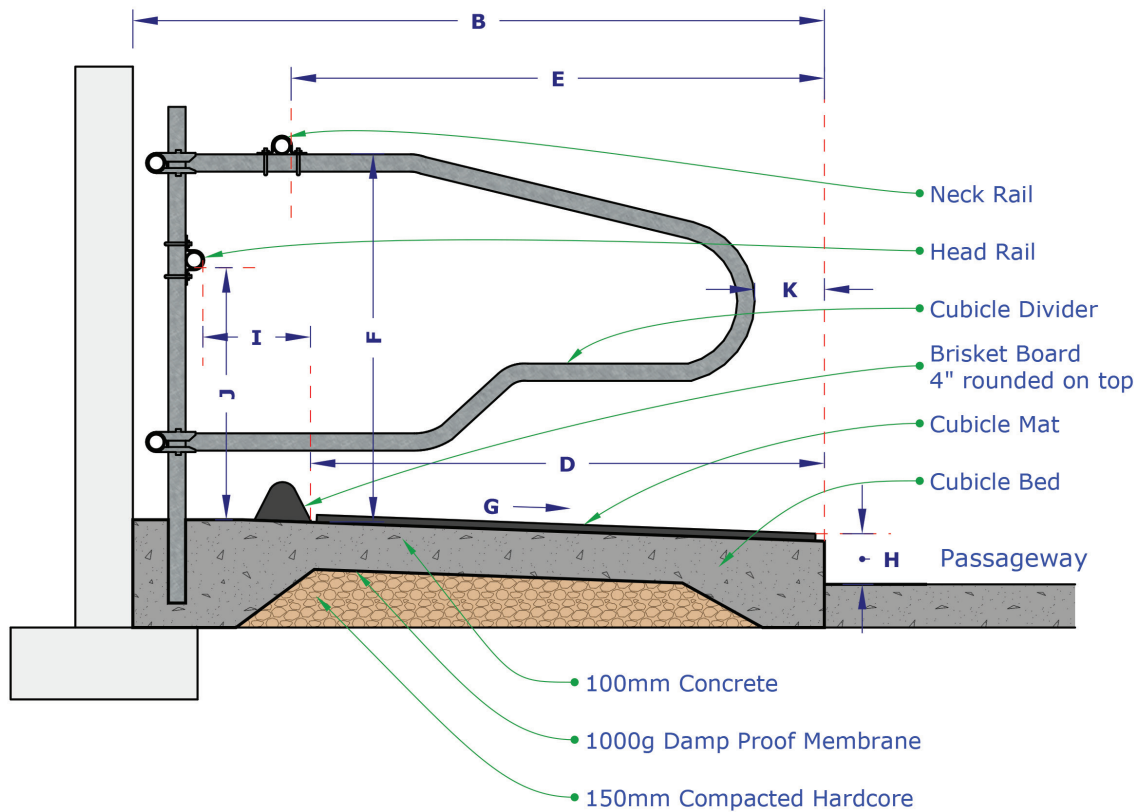
Mats or mattresses need to be **soft** ('give' without compressing completely), non-slip, non-absorbent, durable (ability to recover shape after repeated use or compression over many years) and easy to clean. Lime and sawdust may be applied to the mat for hygiene and absorbency. Spreading lime or sawdust on concrete without a mat will **not** provide a comfortable bed for livestock. The European Food Safety Authority (EFSA) recommends that mats or mattresses be covered with approximately 5cm of dry bedding material in order to improve comfort and increase cow lying time. A deep bed of sand can be very comfortable and work well. Sand beds are not very popular in Ireland because of the difficulty of extracting sand from slatted tanks.

Kerb

The kerb or cubicle step facilitates the separation of the cow from the passageway.

Strap or Head Rail

The strap* as shown in the Figure 1 is necessary to stop cows moving too far into the cubicle and possibly getting caught. It is very important for head to head cubicles and where cubicles are 2.4 to 2.6m long. *a bar is an option but the strap is preferable due to less risk of injury.



**Features and dimensions of cow cubicles (metres)
(dimension for 540kg, 580kg & 650kg Cow)**

Specifications (m)		Bodyweight (kg)		
		540 kg	580 kg	650 kg
A	Width (centre to centre)	1.17 (1.25 if alongside a wall)		
B	Length (against a wall)	2.4	2.6	2.8
C	Length (head to head)	2.21	2.4	2.55
D	Brisket board from kerb	1.66	1.7	1.73
E	Neck rail from kerb	1.76*	1.8*	1.83*
F	Neck rail height above bed		1.25+	
G	Slope of cubicle bed	5% (100-125mm rise on 2.4m bed)		
H	Bed height above passage floor	0.175 including mat (c. 0.15 without mat)		
I	Head space	0.62	0.67	0.68
J	Head rail/strap height	0.72	0.77	0.78
K	Rear of cubicle divider to kerb	0.23 max.		
* Can be 0.1m less (i.e. 540kg between 1.66-1.76m etc.)				

Figure 2: Cubicle bed dimensions for various cow weights (metres unless indicated)

Cubicle Passageways

Cubicle Passageways require the following:

- 3 to 3.6m between two rows of cubicles (2.74m may be adequate for a 3 bay, 14.4m long house)
- 4m alongside a feed barrier (where the barrier is parallel to the cubicle passageway)
- 4.3m alongside a feed barrier if cows are also backing out of cubicles
- In head to head cubicles it is a good idea to have a 'cap' of concrete between the two mats/ mattresses (between brisket boards) to facilitate cleaning out. Ideally cows should not need to walk through a cubicle house when moving from grazing ground to or from the milking parlour.



Figure 3: Cows stretched out & comfortable (the kerb is 150mm high excluding the mat and the brisket pipe is 100mm in diameter, both facilitating cows that want to stretch out).

Figure 4: Cubicles need to be comfortable for cows to both lie in and stand in, notice how few cows are in the passageway.



Figure 5: 500kg cows on average in head to head cubicles that are 4.3m (two x 2.15m cubicles) long. These cubicles are very comfortable with a high level of occupancy. They are however, too short for bigger cows. High yielding cows (kgs fat & protein) will be 'big' in terms of body capacity so the width of the cubicle is also important.

Concrete Surface Finish

The concrete on passageways needs to be comfortable for cows to walk on, provide adequate grip and be reasonably clean when scraped. Cow's feet are flat and relatively soft and they do not like walking on a 'cobble stone' type surface.

Passageways scrape better if they are fairly level- dung pads are pulled along a film of liquid. We do not however, want puddles of liquid on passageways so a slope of 0.5 to 1% (1:200 to 1:100) is recommended. The cubicle beds would be set up to match this so there is a consistent kerb height.



Figure 6 shows a suitable concrete finish (for passageways) produced by the 'bullfloat' on the right **Figure 7** The grooves are parallel with the long axis of the building and the scraper track. The concrete surface is level, the grooves are close and have well defined edges. It is often recommended to have the grooves at right angles to the main direction of animal movement, this is not the case here but the density and quality of the grooving will compensate. This grooving will provide good support to cows backing out of cubicles.

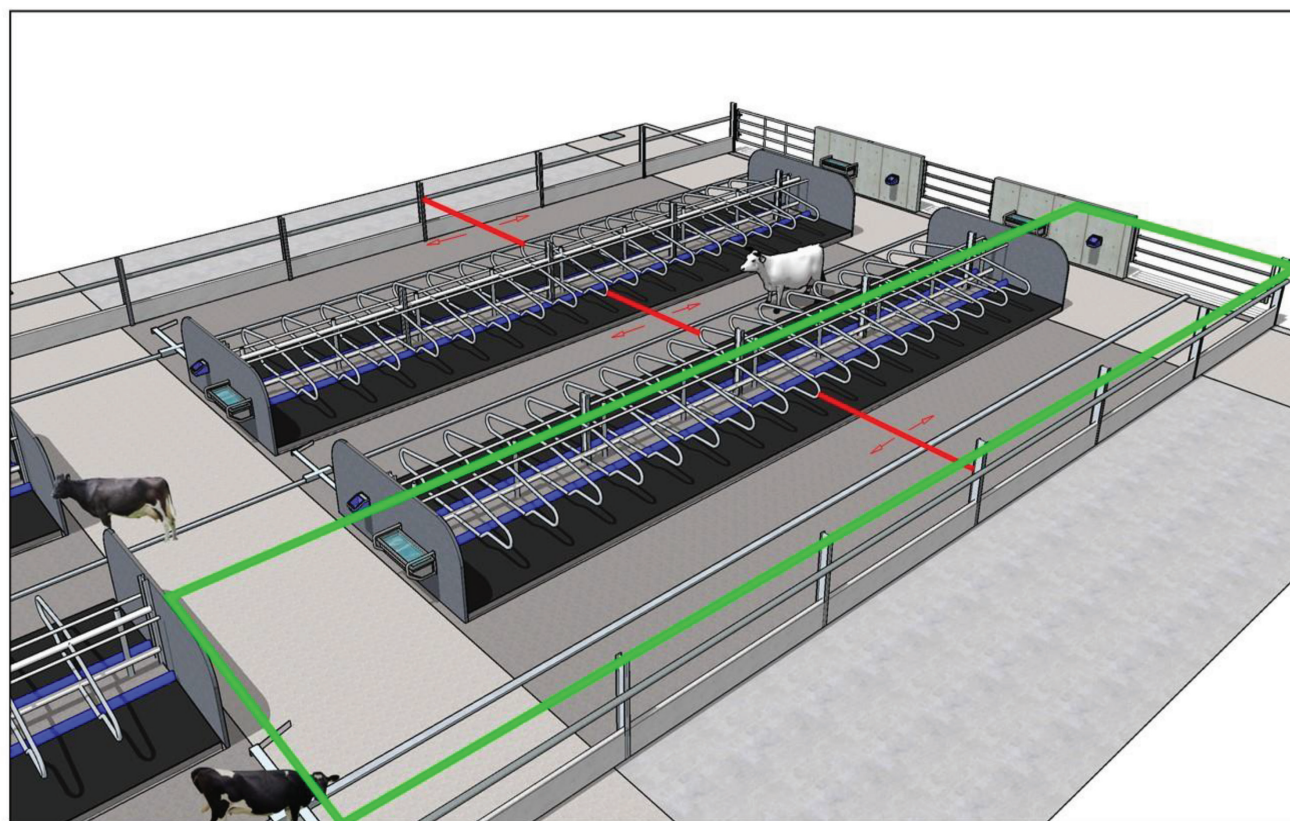
Crossing Points & Water Supply

Figure 8: This photo shows the space where 4.8m or one bay has been left free of cubicles (at one end of the shed) for cows to cross over to the feed passage, to drink or groom and to express 'heat' behaviour. This space would also facilitate moving a big herd of cows. A crossing point is recommended every 16 to 20 cubicles (4 to 5 bays) with a water trough. It is best to pipe in water underground and to protect pipes from frost and from animals (where applicable).

Water pipes with an internal bore of 25mm are suitable for most situations.

Access to water is very important: it is recommended to position troughs at crossover points and not along a feed barrier, the minimum recommended width of the crossing point is 3.5m (3 cubicles left out, 6 in two rows head to head). This will allow cows to pass while an animal is drinking.

The recommendation is to provide adequate trough space so that 10% of cows can drink at any one time. Each cow that is drinking needs 0.45m of trough space = 2.25m for 50 cows (5 x 0.45m). Cows show a preference for water bowls, perhaps because the water is fresher but water tanks are better at facilitating adequate water consumption (more drinking space etc.) so a combination of both can work well. It is recommended that the top edge of the water tank or bowl is 0.7m above the floor for cows, 0.6m for 350kg animals and 0.5m for 250 kg animals.



— Division across the shed

— Division at cross overs

Figures 9: Options for dividing up animals in a cubicle house

Water tanks need to be easy to empty and clean: flip over tanks or having 40 to 50mm plugs work well. Tanks need to be inspected very day and cleaned accordingly. In this regard smaller tanks about 1.2m long work better than larger tanks. A water metre on the supply to the cubicle house and shut off valves for individual water troughs/bowls are recommended. **Figure 9** on previous page shows different options in dividing up animals in a cubicle house into more than one group. The group of cows in the green zone will have the option of drinking from a water trough or bowl. There are no internal walls that take up space- water troughs are mounted on external walls where present. Proprietary cubicle ends or stockboard can be used to protect beds from water splashes.

Plastic Cubicle Divisions



Figures 10 & 11: Looped neckrails and partially plastic cubicle divisions

Plastic cubicle divisions provide a degree of flexibility for livestock. Farmers who have installed them are very satisfied, they may be more expensive than steel cubicles and it may be necessary to initially train heifers in a shed with steel cubicles because plastic cubicles can give them too much freedom. In Figures 10 & 11 the cubicle divisions are partially plastic and partially steel, this is likely to give improved durability.

Design of cubicle housing in relation to the location of the feed passage

Cubicle houses are generally set up to have a centre feed passage with two* or three rows of cubicles on both sides. The advantage of just having two rows on each side is that there will be adequate room for all cows to eat together. In a house with three rows additional feeding space can be provided at one gable end. This will work, in terms of having adequate feed space, in sheds up to 9 x 4.8m bays in length assuming that cows are eating at the gable end in the ninth bay.* See drawings: <https://www.teagasc.ie/rural-economy/farm-management/farm-buildings/animal-housing/housing-design-information/>

Figure 12: Centre feed passage with cubicles on either side



An alternative design is to have the feed passageways external to the building. The feed is dispensed under cover (typically a 2.5m shed overhang) but otherwise the feed passageway is unroofed. A shed with 6 rows of cubicles with external feeding on all four sides can be 13 bays long while providing access for all cows to eat together assuming 0.6m of feed space per cow. The advantages & disadvantages of having an external feed passageways versus a feed passageway down the middle of the building are:

Advantages

- Cost – save approximately €300/cubicle space vs internal feed passage¹
 - Cows in one group²
 - Fully slatted floor at crossovers is achievable
1. This is mainly due to a reduced overall roof area, this could of course be negated if it is found necessary to fully enclose one or all of the external feed passageways.
 2. This is important for automated milking systems although provision can be made for a crossing point in a shed with a centre feed passage.

Disadvantages

- Risk of draughts especially if exposed to the prevailing wind
- Shed has a larger footprint (2 x 5.2m feed passages versus 1 x 6m) and approximately 18 less cubicles in a 11 bay shed
- Can be harder to fit into a yard in that access is needed to the sides of the building
- Bringing silage a distance

Feed Barrier Setup

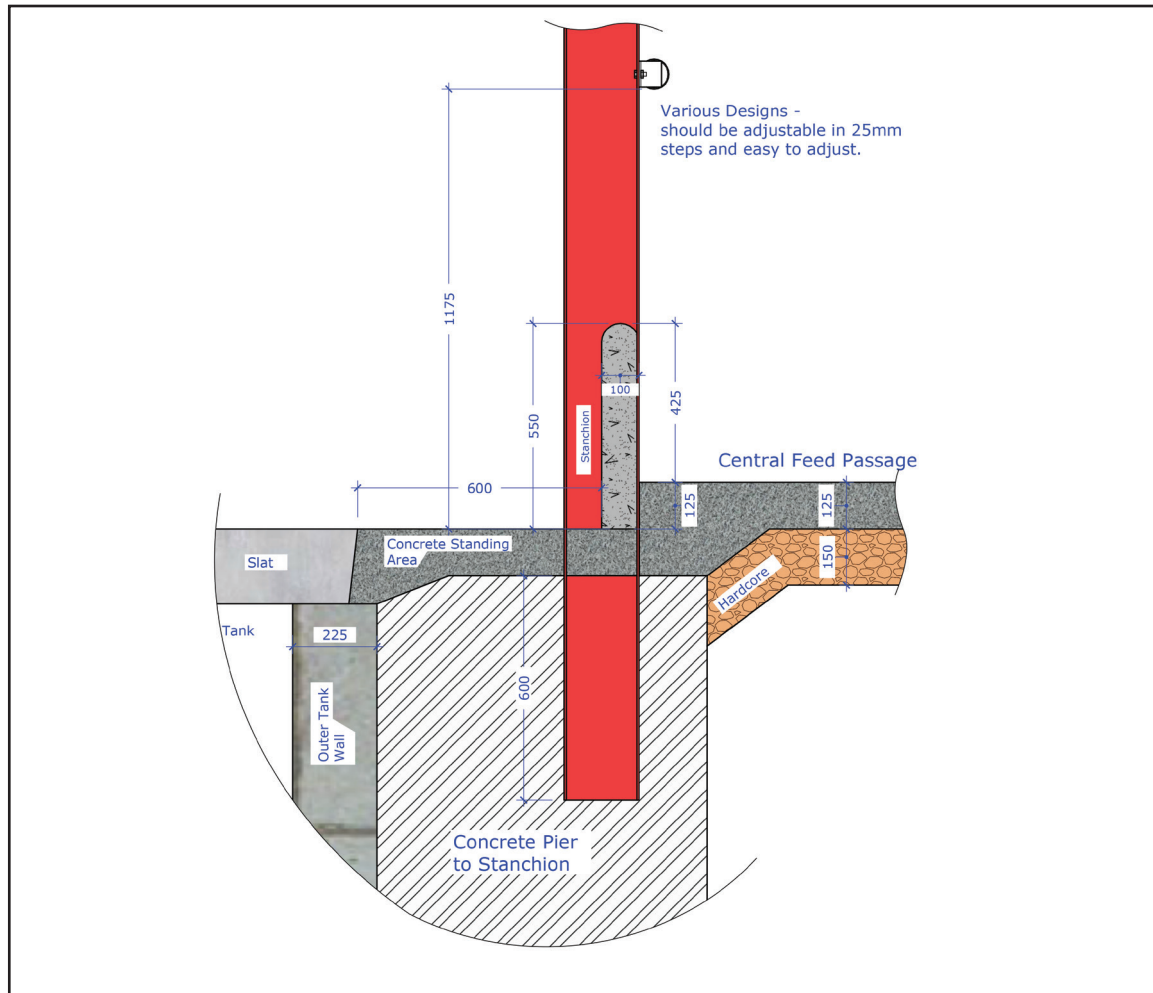


Figure 13: Single rail feed barrier for cows



Figures 14 & 15: Diagonal feed barriers with a 'step' on left and none on the right

A diagonal feed barrier will reduce the amount of forage (baled silage in particular) that is brought in to where cows are standing. The diagonal bars do however reduce how far the cows can reach for feed. This barrier can be designed to avoid sharp angles at the bottom and top of the diagonal bars to reduce ear tag loss. In general a straight rail barrier works well for cows and there is no need for expensive self-locking barriers etc. It is preferable that cows are restrained for individual attention etc. in a dedicated facility so that they do not feel a threat when feeding.

Feed troughs can be used but waste feed may have to be manually removed and they are more difficult to keep clean than a straightforward feed platform, biofilms can develop on the surface of feed troughs that can contaminate fresh feed. The concrete in contact with the feed can be treated with an approved abrasive and chemical resistant epoxy resin (food grade).

A step adjacent to the feed barrier (75mm high and 400mm wide in Figure 14) may not be a good idea. It may reduce how far the cows can reach for silage and cows will put more weight on the back feet. In most situations the cows put their front feet on the step which allows them to just lift the back feet as a scraper passes by.

If using a step it should only be 40mm high. In Figure 15 no step has been used. Ideally the slot openings would be parallel to the scraper blade especially if dry cows are to be housed, these cows are typically fed medium quality (68 DMD) silage often giving rise to stiff and sometimes 'sticky' faeces which is hard to get into the tank. Preventing manure from building up is important – make good quality silage, have a drop down hose at the end of each scraper run to wash in slurry, manually remove etc. The water supply to these overhead hoses would need to be easy to shut off and the system drained in very cold weather.

Figure 16 shows a build-up of manure at the end of a scraper run: we cannot expect cows to 'walk' this into the tank as it would be deleterious to hoof health. This manure needs to be regularly removed or washed into the tank.



Light & Lighting

Providing plenty of natural light is important for animal health and welfare and to provide a safe, healthy working environment for personnel. It is recommended to have 15 to 20% of the roof cladding as translucent sheeting fitted with safety cages to prevent anyone on the roof from falling through. It may also be feasible to have translucent sheeting on the gable ends where it does not interfere with ventilation.

In terms of artificial lighting the minimum recommended lux level is 50. To minimise electricity costs providing LED lighting is recommended. 1 lux = 1 lumen of light over 1m², each LED watt

typically delivers 90 lumens but this can vary from 75 to 110. For example a shed of 412m² will need 230 watts of LED lights (412m² X 50 lumens = 20,600 divided by 90 = 230 LED watts). This could be delivered by ten 25 watt LED lights while exceeding the target. There are three options with LED lights: cool or white light which is the most popular (closest to daylight), 'warm' which has an orange glow and bright white which has a blue hue.

A lighting plan for the cubicle house should include a facility to turn on a reduced level of light (perhaps 10% of the lights and mainly over the feed passage) in the evening or night time. These lights could be warm LED or yellow lighting. In this way livestock could be inspected without disturbing their natural circadian rhythm. There is a legal requirement to have a period of darkness in the house. Seek professional help from a member of RECI (Register of Electrical Contractors of Ireland). This would include the use of 'jack chains' to position lights at the optimum height.

Environment

Cubical Housing must be well ventilated such that dust levels, temperature, relative humidity and gas concentrations are kept within limits that are not harmful to the animals. New cubicle houses need to have adequate slurry storage for the period of use. This includes the period when animals are housed but also the period when they may be using the facility for supplementary feeding of for example 'zero grazed grass' etc. in the autumn and the spring. There may be spare slurry storage capacity elsewhere in the yard and slurry can be efficiently transferred within the yard, within reason with fixed coupling points, piping etc. Cows have to be temporarily removed from buildings that are receiving slurry (can displace slurry gases) or where slurry tanks are being agitated. There are statutory minimum storage requirements as per the Nitrates Regulations which are the subject of ongoing revision. The relevant Statutory Instruments (S.I.'s) at the time of printing include: 605 of 2017 and 529 of 2020; 113, 393 & 716 of 2022.

There is also an imperative on farmers to reduce ammonia losses to the atmosphere. Regular scraping, every hour if feasible will reduce ammonia losses. This is mainly achieved by getting urine into the tank quickly. The cubicle house can be designed with tanks at both ends of the building and perhaps across the middle. In this way the scrapers will be scraping in both directions and so there will be no idle run.

Problem solving

1. Cows not lying straight?

This can occur where the cubicle bed is too short, sometimes when the cubicle bed is too wide and perhaps with flexible cubicles. In the latter case it may be necessary to train heifers with rigid cubicles.

2. Cows stand with the front legs in the cubicle but with the back legs on the passageway?

The distance from the neck rail to the kerb may be too short or the neck rail may be too low.

3. Cows turn right around in the cubicles?

This was a problem with old cubicles where the divisions were relatively low.

4. There is almost no dung pads on the cubicle beds.

If less than 10% of cubicle beds are soiled, it may indicate that the cubicles are too short or the brisket board is incorrectly placed. Cows vary in length so some soiling of cubicle beds is inevitable.

5. There is an excessive level of dung pads on the cubicle beds. This could be due to the absence or incorrect positioning of the brisket board or where animals are not lying straight (see also point 1).



Figure 17: Old cubicle houses can be improved, a wall in front of the cubicles has been removed (where red line is) and a looped neckrail installed. In this situation a band or an extra bar maybe needed to stop animals attempting to walk through the cubicle.

Cubicle Design for Young Stock

1.8 x 1m cubicles is typically recommended for spring born weanlings or in terms of width 5 cubicles per standard 4.8m bay (on one side). These animals are growing very rapidly so the cubicle needs to match their needs towards the end of the housing period. A mechanism to easily adjust the location of the brisket board would be in order. The 315 to 415 weight band represents replacements that are a year of age at housing (yearlings).

It is recommended to use the adult cubicle size for heifers in calf (approximately 500 kg at housing).

Suggested Passageway Widths

	<u>Weanlings</u>	<u>Yearlings</u>
1 - Space between 2 rows of cubicles	2.1	2.4
2 - Alongside a parallel feed barrier	3.0	3.3
3 - As per 2 but weanlings also backing onto the passageway	3.3	3.6

Parameter		Bodyweight (kg)	
		200 – 300	315 –415
A	Cubicle width	0.96-0.99	1.05
B	Cubicle length against a wall	2.03	2.24
C	Cubicle length (no wall in front)	1.84	2.03
D	Brisket board from rear kerb	1.24-1.39	1.39-1.51
E	Neck rail from rear kerb (measured horizontally, = D or D+ 0.1m)	1.34-1.49	1.49-1.61
F	Height of neck rail	1.0	1.1
G	Cubicle bed rise (slope)	75mm ¹	
H	Bed height above passage floor	150mm ²	
J	Head rail height	0.61m	0.65

Figure 12: Cubicle bed dimensions (parameters as per Figure 2) for replacement heifers

A cubicle width of 0.84m can be satisfactory for weanlings (200 to 300kg) if they are let out to pasture in early spring (February) but the Department of Agriculture, Food & the Marine (DAFM) Specification S123 stipulates that the minimum dimensions for cubicles for young stock be at least 80% of that for adult cubicles. This equates to a cubicle length of 1.92m against a wall and 1.68m otherwise and a cubicle width of 0.92m.

Notes

1. A rise of 75mm or 4.2% would be good.
2. Kerb height of 150mm (concrete, excluding the mat).
3. See also Teagasc YouTube video '**Cubicle Design's for Dairy Cows**'
<https://www.youtube.com/watch?v=ImFpGbZmJm0>

No endorsement of products or product suppliers is intended nor is any criticism implied of person(s) or companies or their products that are not included

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