Ongera Amata Project

Best Practice Rwandan Dairy Cattle Shed Guidelines

Best practice guidance to support the development of professional cattle housing designs in Rwanda for semi-commercial and commercial dairy farms



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Introduction

As dairy herds in Rwanda move towards zero grazing, with less reliance on extensive grazing, there is a requirement to provide up to date, cost effective guidance for dairy farmers on cow shed design, to ensure that housed animals are kept in comfortable, clean and dry conditions.

This guidance needs to be relevant to the specific conditions in Rwanda and take account of availability and cost of local construction materials.

Building a cow shed is a considerable investment and a professional design is crucial for cow comfort and health, optimal production and profitability of the enterprise.

This handbook is designed to provide comprehensive guidance on best practice cow shed design to allow cows to be housed throughout the year. However, due to the technical nature of shed design, implementation at farm level will need the assistance of experienced building contractors and engineers.

The handbook outlines modular cow shed designs, ranging from 10 – 30 mature cows plus young stock, based on the basic principles of good cow shed design in a Rwandan context. For each herd size scenario, a design has been included for cows to be housed in cubicles and in bedded yards, with designs in both steel and timber structures.

The designs address young calves < 6 months old and heifers between 6 – 24 months old.

Each module assumes that all heifer calves born will be reared, either to expand the herd, replace culled cows or sold as surplus stock.

Clicking on the hyperlinks in Table 1 will enable you to download a comprehensive set of plans, including:

- Floor Plans
- Sectional Drawings
- 3D Images
- Bill of Quantities

Table 1: Herd sizes and barn options

Herd Size	Material	Cubicle/Free Barn	Download
10 mature, 5 heifers & 5 calves	Timber	Cubicle	Download
10 mature, 5 heifers & 5 calves	Steel	Cubicle	Coming Soon
10 mature, 5 heifers & 5 calves	Timber	Free Barn	Coming Soon
10 mature, 5 heifers & 5 calves	Steel	Free Barn	Coming Soon
20 mature, 10 heifers & 10 calves	Timber	Cubicle	Coming Soon
20 mature, 10 heifers & 10 calves	Steel	Cubicle	Coming Soon
20 mature, 10 heifers & 10 calves	Timber	Free Barn	Coming Soon
20 mature, 10 heifers & 10 calves	Steel	Free Barn	Coming Soon
30 mature, 15 heifers & 15 calves	Timber	Cubicle	Coming Soon
30 mature, 15 heifers & 15 calves	Steel	Cubicle	Download
30 mature, 15 heifers & 15 calves	Timber	Free Barn	Coming Soon
30 mature, 15 heifers & 15 calves	Steel	Free Barn	Coming Soon

These designs address optimal cow comfort, cow hygiene and health, labour efficiency, flexibility and scalability (modular). The designs also need to be environmentally sound, simple to construct and cost effective.

The cow sheds are designed to be modular so it can be expanded as the herd size increases. Provided there is a thorough site plan with 'space to grow/expand', each module can be enlarged as needs require. The location and design of the milk facility needs to be considered as the cow housing buildings expand.

With both the cubicle design and the free barn design, the use of moveable gates within the building creates the flexibility to allow for cows to be grouped according to yield, sick cows to be isolated and calving areas created.

With the cubicle designs, for sick cows and calving cows, it is recommended to apply bedding material to the scrape passage to avoid cows lying on concrete.

Basic Principles of Good Cow Barn Design

1.1 Four Principles of Cow Barn Design

There are four key principles to good cow shed design, summarised below:

1. Cow comfort

- Provide adequate space for a cow to rest and move easily.
- Access to palatable, high-quality ad-lib feed and water.
- A clean, dry lying area where a cow can lie down and rise without risk of injury.
- The design should allow a cow to lie down for 12 – 14 hrs / day.
- The design should allow cows to walk around comfortably on a clean, non-slip floor surface.
- The shed must provide shelter from adverse weather, while allowing sufficient airflow and ventilation.

2. Flexible and expandable

The shed should be designed with straight lines to allow for good cow flow and the efficient removal of manure. The design should also allow easy expansion at minimum cost.

3. Simple, robust and economical

The construction should be simple and robust with structures that are durable, require minimum maintenance and offer a safe and comfortable environment for cows and working conditions for farm workers.

Consideration should be given to the type of building material and the advantages and disadvantages of each material type. Locally sourced un-treated timber may be cheaper in the short term but will have a shorter life expectancy than treated timer or steel, which is more expensive.

Estimates of construction cost in wood and steel are included within the handbook.

4. Optimisation of movements/flows and labour efficiency

- The shed design should allow easy flow of cattle food, whether for delivery of fresh food or removal of surplus food.
- Movement of manure and urine should be away from clean areas where cows lie down or are milked.

- Consideration should be given to whether cows are housed continually or require limited access to grazing areas.

1.2 Site Plan

To achieve the four basic principles outlined above - particularly expandability and the separation of clean and dirty flows - a thorough site survey and a clear site plan should be completed before construction begins.

This forms the basis for future expansion, whilst ensuring separation of clean and dirty flows (milk, feeds, manure). An example is given in Figure 1.

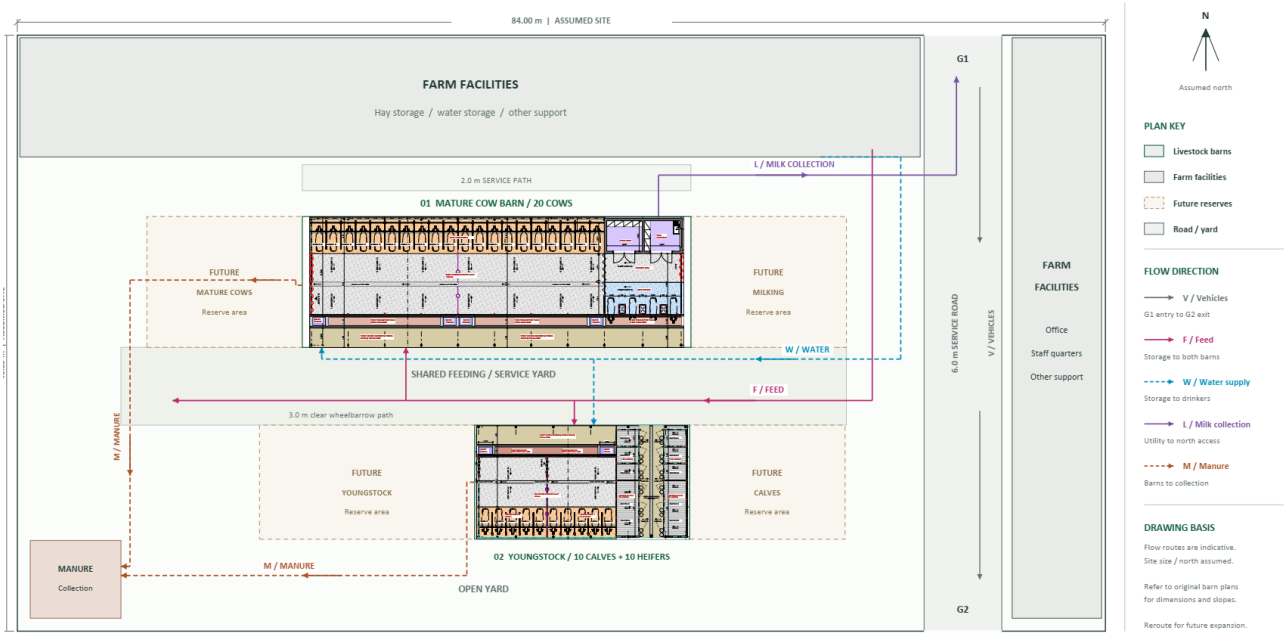


Figure 1- Example site plan

1.3 Specific Aspects for Rwandan Cow Shed Design

To achieve the four key principles of good shed design, a number of specific details need to be addressed:

- Ventilation
- Roofing
- Floor surfaces
- Lying areas (cubicles and bedded yards)
- Feed barrier
- Water provision
- Light
- Youngstock
- Milking
- Manure handling
- Rainwater harvesting

1.3.1 Ventilation

While temperatures below 0^0 Celsius are typically not seen in Rwanda, the shed design needs to allow for reliable air flow and protection from extremely high temperatures.

Air circulation, dust levels, temperature, humidity and noxious gas concentrations must be controlled within limits that are not harmful to people or cows.

As the humidity in a shed increases, the temperature at which cows suffer heat stress falls. This is described as the Temperature Humidity Index (THI) and is illustrated in Table 2.

Sheds should be designed to minimise the time the temperature / humidity combination identifies moderate or severe heat stress.

Table 2: Temperature Humidity Index (THI)

Temperature Humidity Index (THI)										
		Relative Humidity %								
Temperature °C		20	30	40	50	60	70	80	90	100
	22	66	66	67	68	69	69	70	71	72
	24	68	69	70	70	71	72	73	74	75
	26	70	71	72	73	74	75	77	78	79
	28	72	73	74	76	77	78	80	81	82
	30	74	75	77	78	80	81	83	84	86
	32	76	77	79	81	83	84	86	88	90
	34	78	80	82	84	85	87	89	91	93
	36	80	82	84	86	88	90	93	95	97
	38	82	84	86	89	91	93	96	98	100
	40	84	86	89	91	94	96	99	101	104

	No heat stress
	Moderate heat stress
	Severe heat stress
	Dead cows

It is as important to ensure that adequate building ventilation controls both temperature within a building and humidity.

To ensure natural ventilation, the shed should be designed to:

- Remove excess heat
- Remove excess water vapour
- Remove harmful microorganisms, dust and gases
- Provide a uniform distribution of air

Heat produced by cows naturally rises. If this hot air is unable to exhaust from the building at the highest point of the roof, the ridge, it will condense and remain within the building causing the humidity to increase.

However, if warm air is able to exhaust from the ridge of the building, this draws fresh, cool air into the shed through the side inlets. This is known as the stack effect (Figure 2).

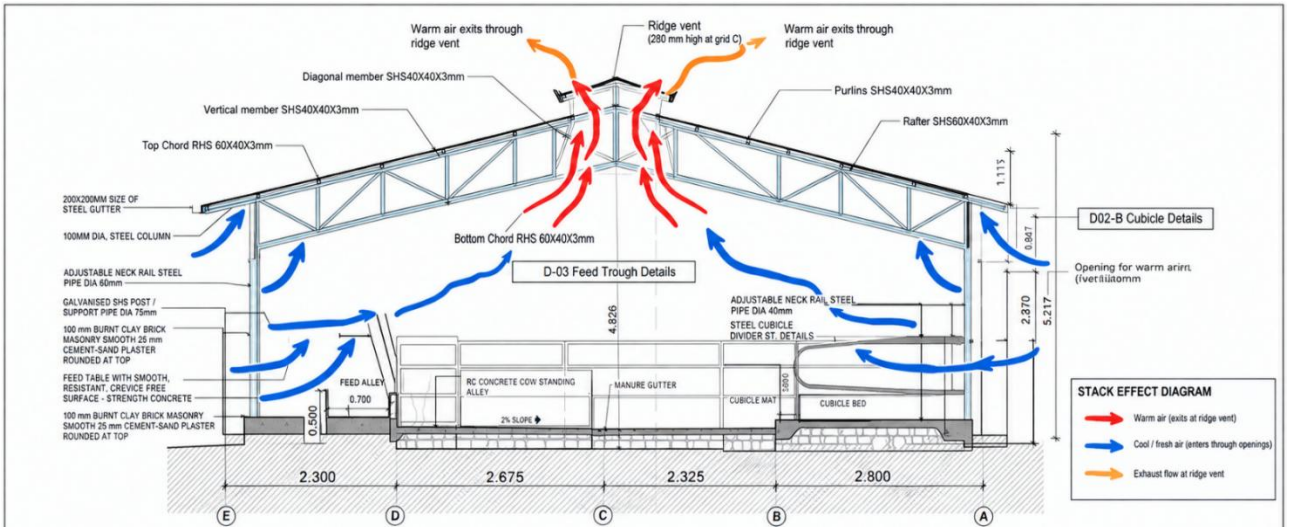


Figure 2 – The Stack Effect

A cow shed will naturally ventilate best when built at 90^0 to the prevailing wind. However, due to the open sides of the proposed cow sheds and despite the roof overhang, it is worth considering orientating the shed in line with the prevailing wind direction in Rwanda, particularly on exposed sites, to prevent rain blowing into the sheds during periods of intense rainfall.

The open sides to the shed are essential to achieve good airflows.

Nothing should block the air flow and the wind, so it is important to avoid building the shed surrounded by other structures.

- **Inlet ventilation**

The inlet ventilation, through the building sides, should be at least twice the outlet area and ideally four times the outlet area.

Eaves height of around 3.6 m will provide sufficient inlet ventilation.

- **Outlet ventilation**

There are a number of different outlet ventilation designs which allow sufficient outlet ventilation while ensuring heavy rain can't enter the shed and make the lying areas wet. An example of an Open Ridge vent is shown below (Figure 3):

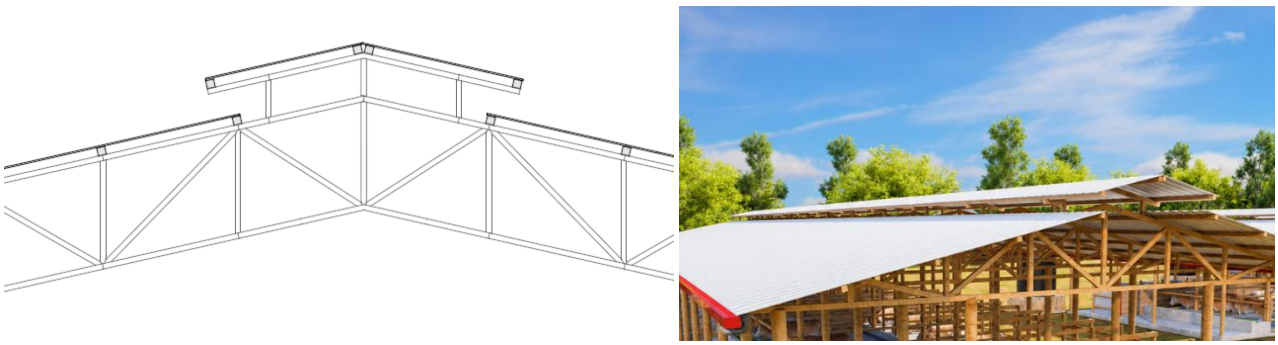


Figure 3- cross sectional drawing and 3D image of the protected open ridge outlet ventilation

Both falling and blowing precipitation is deflected from the building. Provide adequate clearance to prevent blockage of airflow.

The roof needs to have a slope (a minimum of 15^0), as flat roofs provide less ventilation and rainwater catchment is more difficult.

1.3.2 Roofing

The structure should be such that the lowest part (eaves) height is a minimum of 3.6 metres high, and the pitch (roof slope) is a minimum of 15^0. This allows for sufficient aeration and ventilation (Figure 4).

This design assumes manual feeding – if larger herds are to be fed with a tractor and feed wagon, this eaves height should be increased to 4.6m.

The gutter must be adequately sized and have sufficient fall to cope with periods of intense rainfall during the wet season.

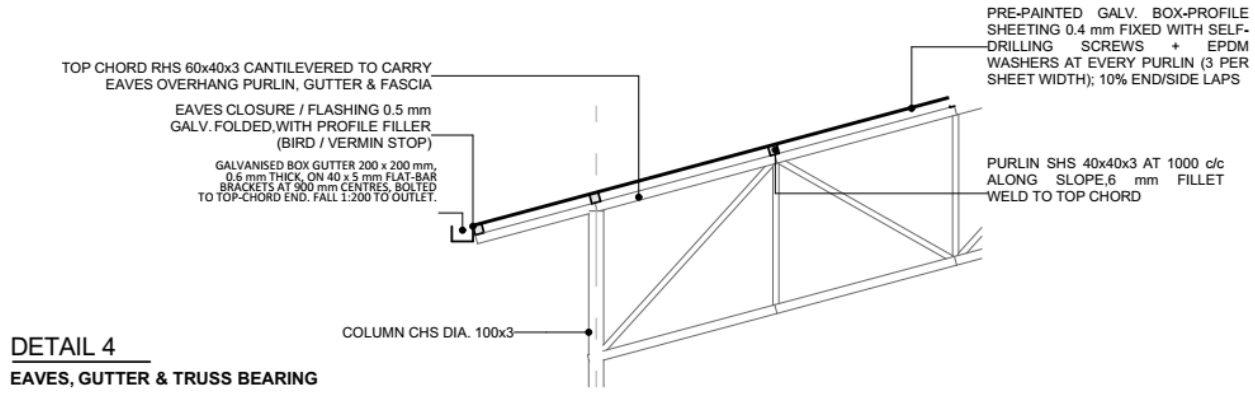


Figure 4: Roof detail designs (scale not accurate)

Roofing materials should be durable and cost effective. Selecting a light-coloured roof sheet will reduce the thermal gain and keep the shed cooler in hot weather. Avoid black roof sheets.

The roof should extend at least 1.0m beyond the outside wall to provide a degree of weather protection and prevent rain blowing into the building (Figure 5).



Figure 5: A 1-metre overhang of the roof

1.3.3 Floor surfaces

Providing a non-slip floor surface is critical. When floors are slippery there is a risk that cows will slip and be injured. Cows will move less confidently on a slippery floor surface and will be less likely to exhibit signs of oestrus (being on heat/bulling).

The construction of the floor is the same whether the shed is constructed from wood or steel.

The floor should be constructed of concrete in all walking, lying and feed alley areas. It is relatively inexpensive to install and provides a durable surface that is easy to maintain. Proper attention to the standard practices and procedures for constructing concrete can yield a concrete surface that will provide long-lasting, superior performance.

Passage between the cubicles and feed fence

The passage width from the rear of the cubicle to the feed fence should be a minimum of 5.0m wide. This allows cows to reverse out the cubicle without interfering with cows that are feeding, while allowing other cows to move freely around the area.

- The floor should be laid with high-quality concrete, resistant to erosion and able to withstand wear and tear.
- The floors should slope towards the direction of the manure store with a minimum of 1.0% and a maximum of 2.0% fall.
- Ensure the floor slopes to the gulley in the centre of the passage from both the back of the cubicles or free yard and the feed fence.
- The floor finish should be easy to clean but provide sufficient grip for the cows to move confidently.
- To provide sufficient grip for the cows, the concrete must not be polished. In most cases, grooving is necessary.
- Some shed designs suggest a brushed finish on the concrete. This is achieved by brushing fresh concrete with a stiff bristled brush. While it is a cost-effective solution, the brushed finish will quickly wear, and the floor will become slippery. Therefore, a brushed finish is not recommended.

Options for grooving

There are numerous options for grooving concrete to improve cow traction and reduce slippage.

Some examples are illustrated in Figure 6.

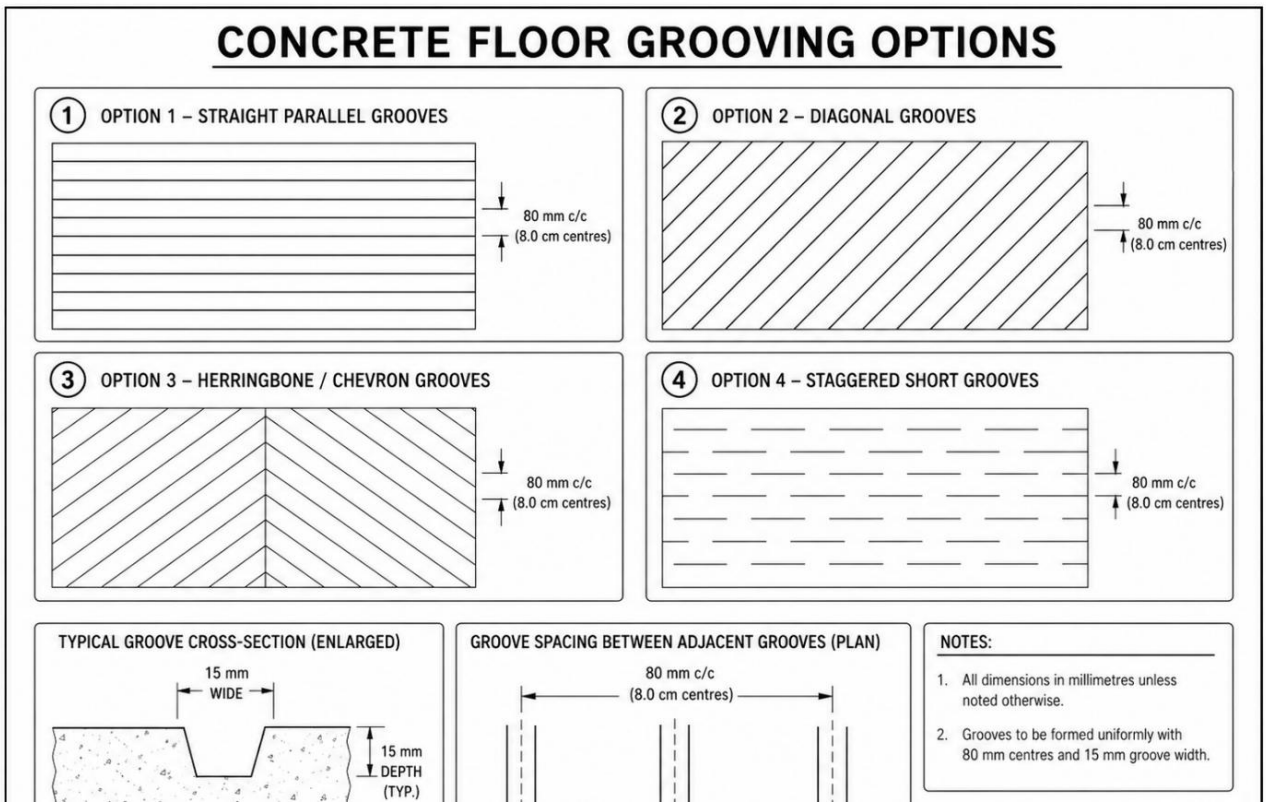


Figure 6

It is preferable to groove fresh concrete just as it starts to cure which generally involves either pulling a long-fingered rake through the concrete to generate long parallel grooves (Figures 7 and 8) or rolling a weighted, pre-formed template over the concrete (Figures 9 and 10).



Figure 7



Figure 8

The specially designed long fingered rake produces grooves of 15mm wide, 15mm deep with a distance of 80mm between the grooves.

Using a pre-shaped template pressed into the concrete before it sets can be very effective. Hexagonal shapes are very popular (Figures 9 and 10). The sides are typically 5.0cm long.



Figure 9



Figure 10

If it is not possible to groove the floors when the concrete is fresh, the grooves can be cut after the concrete has completely hardened, with a diamond concrete cutter. The best option is grooves of 15mm wide, 15 mm deep with 8.0 cm between grooves (Figure 6).

However, it is recommended to groove fresh concrete as it is being laid.

1.3.4 Cow lying area

Areas for cows to lie down should be clean, dry and comfortable. Cows should not lie on bare concrete without a layer of soft bedding material (chopped straw or sawdust or preferably a rubber mat covered in a light covering of bedding material).

As herd size increases, it will become difficult to keep cows clean and comfortable without providing a stall (cubicle) for each cow. The cubicle allows the cow to move freely around the building, eat and drink when she wishes, while having a separate lying area with a partition between other cows.

An alternative strategy is to separate a cow shed into a feeding area and a lying area where the cows lie on a bed of straw. Although this type of design may seem attractive from an initial construction perspective, the shed is considerably larger than a cubicle shed to house the same number of cows. Cost and availability of suitable bedding materials and the requirement to remove all soiled bedding material once a week and apply fresh bedding daily, means that this system has high running costs.

Although both cubicles and a bedded yard are described in this handbook, cubicles are the recommended option.

- **Basics of cubicle design**

The cubicle should be wide enough to allow the cow to lie down comfortably but prevent her turning around.

A cubicle that is the correct length will allow a cow to rise comfortably without touching a wall or rail but will ensure that any dung is deposited into the scraping passage and not left on the free stall lying surface.

When a cow rises naturally, she will lunge forward by around 0.7 – 1.0m so any cubicle design needs to incorporate this natural activity. This is shown in Figure 11.

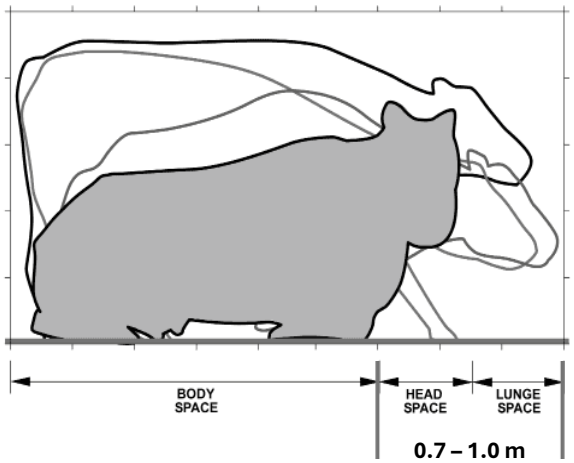


Figure 11: Space Demand for Rising

The cubicle divisions can be manufactured from steel or wood. Steel will cost more initially but will be more robust and have minimal maintenance while wooden divisions will require periodic maintenance.

The dimensions of a cubicle are dependent on the size of the cow. Larger cows require larger stalls.

Adjustable cantilever cubicles, suspended from horizontal rails, allow some adjustment of cubicle width to accommodate different cow sizes.

Larger cows require larger cubicles. If weigh scales are not available, weigh bands are a practical alternative (Figure 12).

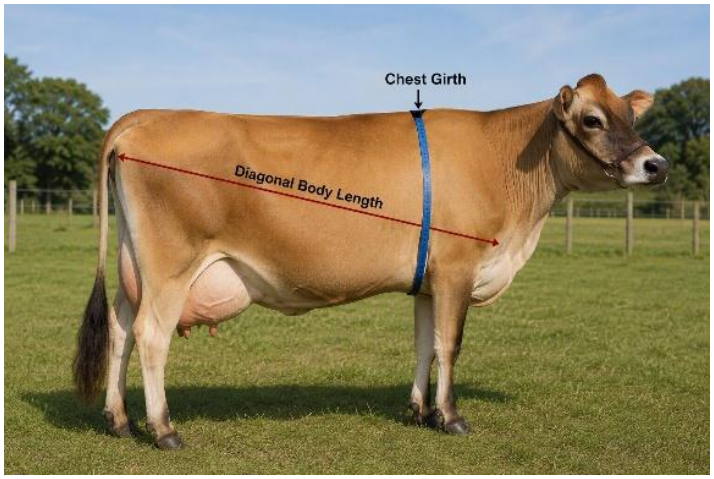


Figure 12

The measurements can be used to estimate cow body weight (Table 3).

Table 3

Chest girth (m)	Diagonal body length (m)	Cow body weight (kg)
1.68	1.36	375
1.75	1.41	425
1.81	1.46	475
1.87	1.50	525
1.93	1.54	575
1.98	1.58	625
2.04	1.62	675

2.09	1.65	725
2.14	1.68	775
2.18	1.72	825

The total length of a cubicle should allow space for the cow to lie down comfortably, space to hold her head comfortably and space to lunge forward when rising.

The cow is prevented from lying too far into the cubicle by the position of the neck rail and the brisket board.

A cubicle profile and key dimensions for different cow weights are illustrated in Figure 13 and Table 4.

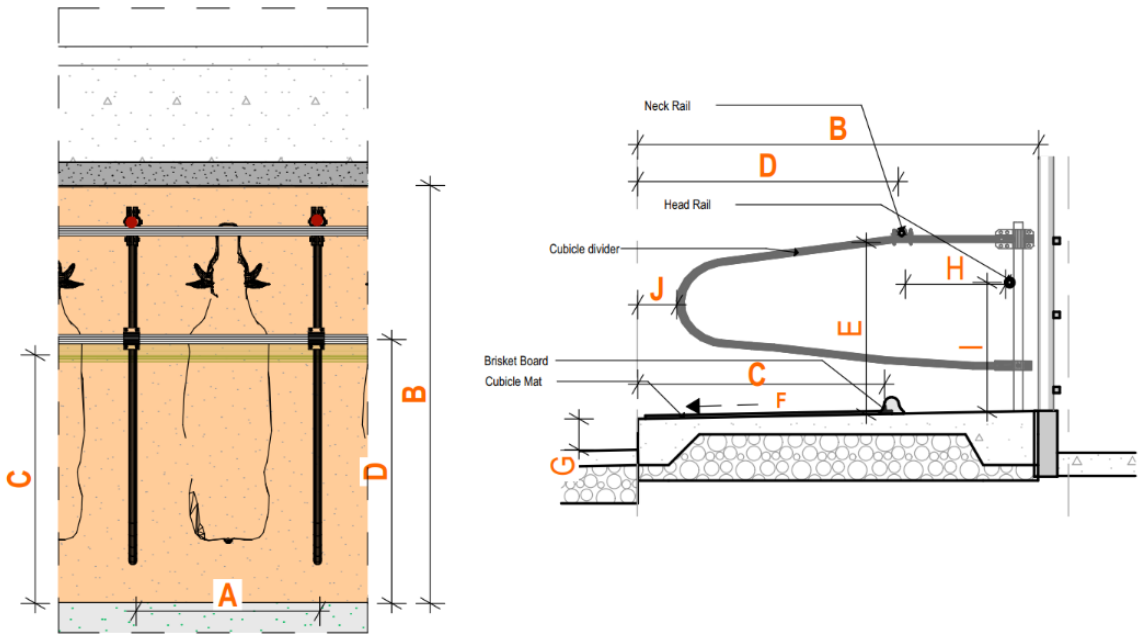


Figure 13

Table 4

	Specification	300 kg	400 kg	500 kg	600 kg
A	Width (m) (division centre to centre)	1.00	1.10	1.15	1.20
B	Cubicle length (m)	2.10	2.60	2.60	2.60
C	Brisket Board from kerb (m)	1.40	1.60	1.65	1.70
D	Neck rail from kerb (m)	1.50	1.70	1.76	1.8
E	Neck rail height above bed (m)	1.00	1.10	1.10	1.20
F	Slope of cubicle bed (%)	2.0	2.0	2.0	2.0
G	Bed height above passage (m)	0.15	0.20	0.20	0.20
H	Head space (m)	0.50	0.55	0.62	0.67
I	Head rail height (m)	0.61	0.65	0.72	0.77
J	Rear of divider to kerb (m)	0.23	0.23	0.23	0.23

There should be a slope on the cubicle lying surface from the front to the back of the bed of 2.0% to help the cow lie comfortably and ensure any milk or urine runs away from the lying animal.

Installing a brisket board to the cubicle bed will help to ensure the cow doesn't lie too far forward and dung on the back of the bed. Examples of brisket boards are shown in Figures 14 and 15.



Figure 14



Figure 15

Depending on cow size, the brisket board will typically be between 1.6 – 1.7m from the back of the cubicle. The board is typically 0.10m high. This prevents the cow creeping forward when she is laid down.

The board should be angled towards the front of the cubicle to allow for the natural shape of the cow's brisket.

The height of the board is important as the cow will often swing her leg forward before rising. It is felt that 0.10m is the maximum height the leg can be swung without risk of impact (Figure 16).



Figure 16

A neck rail located around 1.1 – 1.2 m above the cubicle bed provides strength and robustness to the divisions as well as positioning the cow when she stands in the cubicle before lying down.

The purpose of the neck rail is to position the cow when she enters the cubicle, before she lies down. The position of the head rail needs to be correct both horizontally and vertically. If it is too far forward on the partition, when the cow is standing with four feet on the cubicle, she can soil the back of the bed. If it is too close to the kerb, it will limit the occupancy of the cubicle and lead to cows perching (two feet on the cubicle and two feet in the passage).

The kerb of the cubicle bed should be 0.20 m higher than the surrounding concrete area to help keep the cow lying area clean and dry (Figure 17).

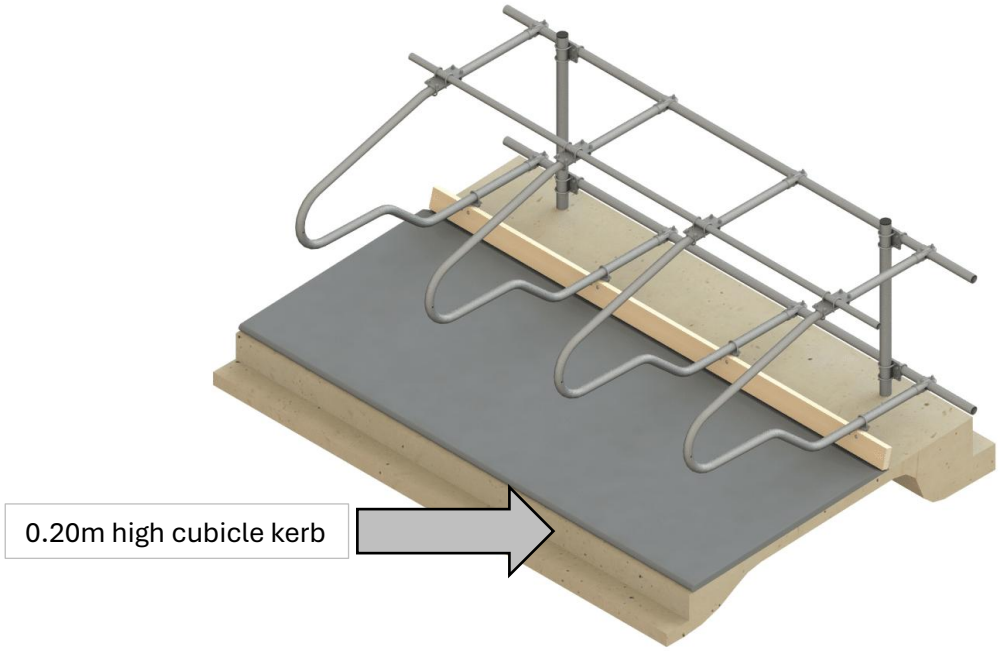


Figure 17

Figure 18 illustrates typical individual cow stalls in Rwanda, but this type of design doesn't provide a clear differentiation between the cow lying area and the cows traffic area.



Figure 18

The comfort of the lying surface is critical to ensure that cows are willing to use the facility.

Bare concrete is not acceptable and will lead to damage to the cow's legs and hocks. As a minimum, fresh, clean and dry straw or sawdust should be added each day. It is recommended a 30mm rubber mat is fitted to the cubicle which will increase the comfort and the amount of time a cow spends lying down.

Top Tip
The knee drop test can be very informative. If dropping from a standing position onto your knees is painful or uncomfortable, the bedding surface is **not** good enough for a cow.

- **Basics of Free Barn design**

While there may be good reasons for some farmers to consider a well-designed Free Barn cow shed, it is not a recommended option.

Ensuring adequate cow hygiene and low levels of mastitis requires the bedded area to be entirely cleaned out regularly (every two weeks) and fresh bedding material applied daily.

One of the first considerations with a Free Barn shed is to determine the shape of the bedded area. A rectangular bedded area is most suitable.

The distance from the bedded yard to the feed area should be as short and direct as possible.

The width of the bedded yard should not be greater than 10.0m.

The space allowance required for each cow will determine the number of cows that can be housed in the yard. The space allowance will be determined by the stage of lactation (lactating or dry) and the age of the animal.

The minimum space allowance is 6.0m^2 /cow. Beyond the 6.0m^2 minimum allowance, higher yielding cows require additional space. For every 1,000 litres of milk produced annually, a cow requires 1.25m^2. For example, a cow producing 9,000 litres per year requires 11.25m^2 bedded area.

Any housing system based on straw yards must provide a separate concrete area for loafing and feeding (Figure 19). This helps promote some hoof wear and will prevent feet becoming over-grown.



Figure 19

The feeding passage should be 5.0m wide and it is important to ensure that there is ready access to the feeding area from the straw yard through multiple exits or, preferably, un-hindered access.

A 5.0m wide feed passage allows cows uninterrupted feeding at the manger, while animals are moving around behind them. The loafing area should be scraped at least twice each day to reduce faecal soiling of the feet.

The floor surface on the feed stance and loafing area should be well drained, easy to clean and non-slip.

A step should be provided between the feeding area and the lying area. This will help retain the bedding and prevent the ingress of faeces and urine into the beds, which can lead to contamination and soiling. A solid barrier also provides a straight edge to scrape against when cleaning out the loafing area. The height of the barrier will depend on the frequency in which the beds are cleaned out but it is likely to be around 0.20m.

Water troughs should be located so it is impossible for cows to drink when they are standing on the bedded area. This will either mean locating the trough in the feed fence (which can create problems with feed contaminating the trough) or on the edge of the bedded yard but protected by a block wall, or similar, so cows can only drink from the feed stance (Figure 20).



Figure 20

1.3.5 Feed barrier design

The design of the feed barrier is fundamental to the feeding system. The barrier is designed to separate the cow from high quality, palatable forages to maximise intakes whilst minimising rubs or callouses caused by incorrect barrier designs or excessive competition from other cows.

The amount of feed fence / animal will depend on the size of the animal.

If cows are expected to feed simultaneously (for example when a concentrate is fed), more feed fence is required than when cows can access the feed on an ad-lib (always available) basis. An indication of feed fence required / cow is shown in Table 5.

Table 5

Cow weight (kg)	Simultaneous feeding (m)	Ad-Lib feeding (m)
300	0.50	0.15
400	0.55	0.22
500	0.6	0.26

As well as providing sufficient feed face / cow to minimise competition, the design of the barrier is important to ensure comfortable eating.

The most cost-effective barrier type is a post and rail design. It can be designed and built to be adjustable. However, it does not prevent cows pushing other cows away from the feed fence and can encourage aggressive behaviour if there is not enough space for all cows to feed at the same time.

A cross section of a post and rail feed barrier is shown in Figure 21.

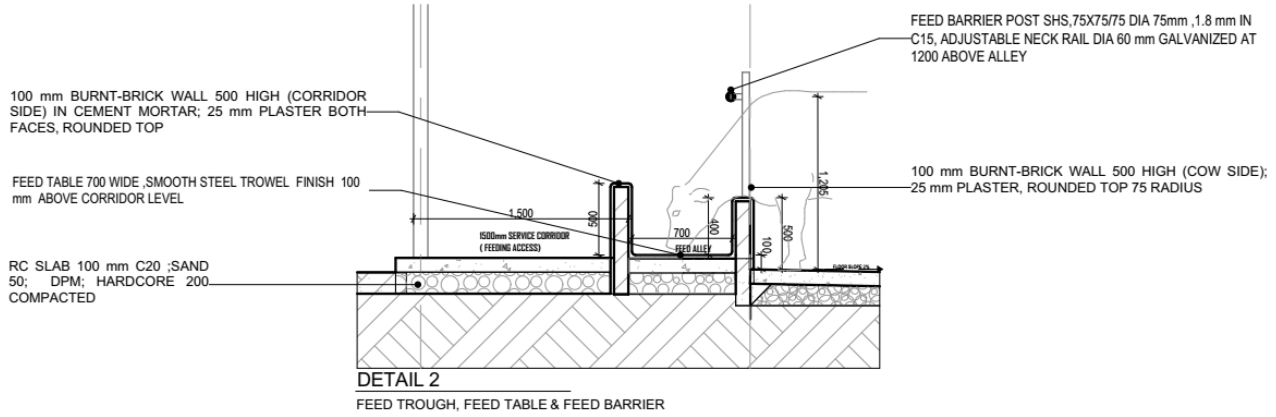


Figure 21

The **feed wall** on the cow side should be 500mm above the cow standing and rounded to avoid damaging the brisket of the cow.

The **neck rail** should be around 700mm above the feed wall (or 1.2m above the cow standing level) although this should be mounted to allow some adjustment to account for herds with smaller cows. An example is below in Figure 22.



Figure 22

The rail should be mounted on the feed side of the stanchion.

The feed table where feed is delivered (or the base of the feed trough) should be 100mm above the cow standing level. As the level of the feed table increases, the reach of the cow increases.

The base of the feed table (or base of the feed trough) should be very smooth concrete to allow the cow to eat easily and allow easy cleaning.

Delivering feed onto the floor of a feed table can be very labour efficient. When surplus feed is removed each day, it is easier to brush a level feed table than empty a feed trough. Examples of a feed table can be seen in Figure 23, while a feed trough can be seen in Figure 24.



Figure 23



Figure 24

However, as cows tend to throw food forward when eating, unless it is possible to push the food back in front of the cow five or six times each day, a feed manger is the recommended option.

Some farms may prefer a feed barrier with vertical divisions. This can reduce competition for feed while also providing a more effective barrier to contain the animals. An example of a vertical barrier is shown in Figure 24.

1.3.6 Water provision

Adequate provision of good quality, palatable water is essential for any dairy cow housing system. Any restriction in water supply will have an immediate impact on milk yield.

A dairy cow shed design must include ad-lib (always available) water.

The daily water requirement of a cow depends on many factors, including cow size, daily milk yield, dry matter content of the feed, stage of lactation and ambient temperature.

The total daily water requirement consists of water required to maintain bodily functions (maintenance) and water required to support milk production (production).

A cow typically requires 50 litres per day for maintenance and 4.0 litres of water for every litre of milk produced.

For example, a cow producing 20-litres of milk typically requires 130 litres of water per day while a cow yielding 30 litres will typically require 170 litres of water / day.

Cows are sociable animals and it is therefore important to plan for a minimum of 10% of the herd to drink at any one time. To ensure adequate access to water, allow 10cm of trough space / cow.

For example, a group of 30 mature cows requires a minimum total trough length of 300 cm. This will allow 3 cows to drink simultaneously.

When cows are drinking together, a cow can consume 20 litres of water / min. It is important the water supply can cope with this demand. As cows offered ad-lib water can drink up to seven times / day, there must be sufficient flow rate of water to the trough, as well as sufficient trough capacity to cope with the demand.

Ad lib water can only be provided using a float valve water trough system (Figures 25 and 26). The float valve must be protected to prevent damage caused by the cows (Figure 26).



Figure 25



Figure 26

The water trough should be located at the correct height for the cow. The edge of the water trough should be 500mm from the floor and the water level should be100mm below the edge of the trough to minimise splashing.

1.3.7 Light

The cow shed should have sufficient light, whether natural or artificial, to allow animals to be thoroughly inspected at any time of the day or night.

It is essential that animals are not housed in dark buildings as this will disrupt the production of natural hormones which can impact on both fertility and milk production.

There are minimum light levels required for general animal inspection and animal welfare. This level is usually achievable during daylight hours, but it is likely that supplementary light will be required for animal inspection during hours of darkness.

Natural light can be increased by fitting transparent roof sheets to a new roof (roof lights). However, these can lead to significant thermal gain during hot weather and are **not** recommended (Figure 27).

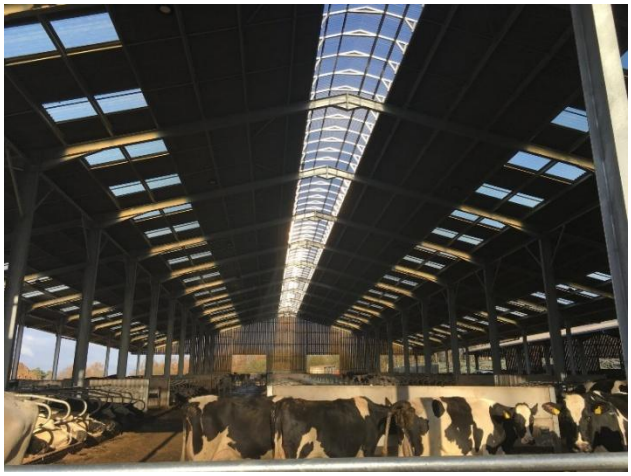


Figure 27

1.3.8 Youngstock

When calves are born, they are housed in individual pens bedded on straw and fed milk.

These pens need to be built with a 5.0% fall to allow urine to drain from the bedded area.

The design allows for calves to be moved from individual pens at around 3 months old into larger sociable groups where they will remain until they are 6 months old. After each calf leaves the individual pen, the pen should be cleaned thoroughly and disinfected.

The divisions between individual pens can be removed to form larger pens for multiple occupancy (Figure 28).



Figure 28

The calves are then moved into an adjoining pen with other calves of a similar age until they are 12 months old, when they will move into the cubicle training area.

The training cubicles for heifers will be smaller than those required for adult cattle (Table 7).

If cubicle widths are slightly larger than required, the width can be reduced by inserting pallets to the inside of the division.

Table 7

Liveweight (kg)	Cubicle length (m)	Cubicle width (centres) (m)
200	1.7	0.7
300	1.9	0.85
>300	2.0	0.9

As the heifers will be smaller than mature cows, the throat height for the feed manger should be reduced to 400mm and the adjustable neck rail should be set initially at 1100mm.

1.3.9 Milking

As herds increase in size, it is likely that cows will be milked in a designated milking area which is separated from the housing area.

This can either be in the form of a dedicated hand milking area where cows are brought, restrained, fed and then milked or this could be a purpose-built milking facility using a specialised milking machine.

It is essential that both systems can be easily cleaned and have nonslip floors. If cows are milked by hand, there needs to be a separate area where sanitised, dry milking containers can be stored between milkings.

There needs to be a facility where a milker can wash their hands with soap before milking.

This area will need to be cleaned after milking the cows, with manure and urine removed and the floors washed down with clean water. There should be a fall of 2.0% across the milking facility to ease the flow of urine and wash water away from the point the cows are milked.

If a milking facility (machine milking) is to be installed, specific design parameters need to be considered.

1.3.10 Manure removal

When dairy cows are kept in a shed where they can urinate and defecate, it is important that this material is removed at least twice a day.

A well-designed cow shed should help separate the cow's lying area from where she urinates and defecates. When the concrete floors are laid, there should be a consistent and even 1.0 - 2.0% fall away from the cubicle or bedded area to separate the lying cows from the foul material.

Adequate falls will ensure the urine is separated from the faecal material, and the faecal material can either be collected with a shovel and bucket or wheelbarrow or can be pushed with a handheld scraper.

As herd sizes increase, the handheld scraper will become more common (Figure 29).



Figure 29

There needs to be an easily accessible point that faecal material can be removed from the cow shed avoiding excessive distance.

The disposal point for the faecal material and urine should **not** be close to the milking facility.

1.3.11 Rainwater harvesting

A guaranteed supply of good quality water is essential to provide dairy cows with their daily water requirements. However, unless roof water is filtered and treated, it is not suitable for cow drinking.

It is advised that the farm has a high-quality piped water supply or a deep well or borehole.

Sufficient water storage should be provided in the event of an interruption to the water supply. It would be recommended to have sufficient water stored to provide all the water needs for the farm for three days.

1.3.12 Foot health

When cows are housed on concrete for extended periods of time, there is likely to be an increase in foot health issues, unless cows are regularly foot bathed.

Footbath Check List

- Footbaths should be
    - Long- 3.1 to 3.7 m
    - Base Width- 51 to 61 cm
    - Step-in height- 25cm
- Filled with solution to a depth of no more than 10 cm
- Filled with a suitable approved product

If a farm uses a spray race for spraying cows to treat parasites and ticks, a foot bath should also be installed, to improve cattle foot health.

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Royal Jersey Agricultural & Horticultural Society: https://www.royaljersey.co.uk/