Youngstock housing

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Contents

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Introduction

The first three months of a calf's life are critical as they will determine its future health, growth and performance. Whether you are rearing your future dairy herd, selling calves for rearing or rearing youngstock for beef, getting the housing right during this crucial time is vital.

Although there are a number of alternative housing systems available for calves, all must provide for the calf's needs, ensuring health is optimised, performance is maximised and welfare standards and regulations are complied with. The basic requirements for calf housing include that they are dry with excess moisture continually removed, draught free, clean and cleanable.

Calves are born with a poorly developed immune system. The quality of the environment the calf encounters in the first 10 days of life significantly impacts its future health and performance. Some of the key environmental considerations include temperature, social grouping, humidity and airspeed.

This booklet is intended to advise and guide you through a review of your youngstock housing requirements and design. Whether you are planning on building a new housing system or improving your existing housing, there is guidance to help you to design a system that works for both you and your calves.

This booklet is complimented by some online resources. You will find our system cost comparison useful in outlining the costs involved with each system, this can be used alongside our section on costs on page 28.

Farmer case studies are available online, each case study showcases different new build calf housing set-ups. Watch our interviews on each of the farms or read about how their systems work for them, including blueprints and what they would do differently next time.

Dr Jenny Gibbons
Senior Animal Health & Welfare Scientist

Find more useful resources online at ahdb.org.uk/knowledge-library/youngstock-housing

Legislation and market requirements

The legal definition of a calf is a bovine animal up to six months old. When updating, designing or building your youngstock housing, there are mandatory legal requirements to adhere to, as well as optional codes of practice and market guidelines to support you.

Background legislation

The legal requirements and regulations of youngstock housing are designed to assist the construction, design and management of compliant, optimal calf housing. However, these regulations should be considered a minimum standard and there are valuable reasons to seek to exceed these standards.

The Animal Welfare Act 2006 places a responsibility on all owners of animals to ensure that the welfare needs of animals in their care are met. These welfare needs are encompassed within the Farm Animal Welfare Committee's Five Freedoms:

- Freedom from hunger and thirst
- Freedom from discomfort
- Freedom from pain, injury or disease
- Freedom to express normal behaviour
- Freedom from fear and distress

The Welfare of Farmed Animals (England) Regulations 2007 (S.I. no 2078) is the Statutory Instrument that provides details of the standards under which farm animals must be kept. These regulations must be complied with when considering the design and management of calf housing.

The Code of Recommendations for the Welfare of Livestock: Cattle (2003) provides a practical interpretation of The Welfare of Farmed Animals (England) Regulations 2007. You should keep a printed copy of this code and ensure it is easily accessible to any person responsible for looking after your calves. The legislation requires that any person attending an animal must be acquainted with any relevant code of practice, have access to the code while attending the animal and have received instruction and guidance on the code.

Farm and milk buyers' assurance schemes, as well as the RSPCA's welfare standards, reinforce the legislation and codes, in addition to providing enhanced standards. Some of their enhanced standards are included within this booklet to help you consider potential areas for future proofing your design.

Schedule 1 of The Welfare of Farmed Animals (England) Regulations 2007 has several specific requirements relating to buildings and accommodation, which are relevant when considering accommodation for cattle of all ages. These requirements are broad statements, and the Code of Recommendations for the Welfare of Livestock: Cattle (2003) provides detailed information to help ensure compliance. While this publication primarily focuses on calf housing, we have included some brief information below on the requirements where calves are kept outdoors for completeness.

Where calves are not kept in buildings

Animals not kept in buildings must, where necessary and possible:

- Be given protection from adverse weather conditions
- Be protected from predators
- Be protected from risks to their health
- Have access to a well-drained lying area at all times
- Have access to water at all times
- Be inspected at least once a day to check their wellbeing
- Have access to shade
- Have access to shelter
- Be fenced securely and safely
- Be protected from biting insects

There must be a contingency plan in place for extreme weather where outwintering is used.

Building and accommodation

The following points must be adhered to when constructing buildings or accommodation for housing youngstock:

- Materials used for the construction of accommodation – and in particular, the construction of pens, stalls and equipment that the animals may come into contact with – must not be harmful to them and must be capable of being thoroughly cleaned and disinfected
- Accommodation and fittings for securing animals must be constructed and maintained so that there are no sharp edges or protrusions likely to cause injury
- Air circulation, dust levels, temperature, relative air humidity and gas concentrations must be kept within limits which are not harmful to the animals
- Animals kept in buildings must not be kept in permanent darkness
- Where the natural light available in a building is insufficient to meet the physiological or behavioural needs of the animals, appropriate artificial light must be provided
- Where animals are kept in a building, adequate lighting (whether fixed or portable) must be available to enable them to be thoroughly inspected at any time
- Animals kept in buildings must not be kept without an appropriate period of rest from artificial light

Schedule 6 of The Welfare of Farmed Animals (England) Regulations 2007 outlines further requirements which refer specifically to the keeping of calves. The requirements, given below, refer specifically to the design of the housing system.

Accommodation

When constructing your youngstock accommodation, it is important to allocate the correct minimum amount of space per calf to make sure that your housing complies with legal requirements.

Accommodation legal requirements

- No calf may be confined in an individual stall or pen after eight weeks of age unless a veterinary surgeon certifies that its health or behaviour requires it to be isolated in order to receive treatment
- The width of an individual pen must be at least equal to the height of the calf at the withers, and the length must be at least equal to the length of the calf (measured from the tip of the nose to the pin bones) multiplied by 1.1
- Individual pens (except for those isolating sick animals) must have perforated walls to allow calves direct visual and tactile contact
- For calves kept in groups, the unobstructed space allowance available to each calf must be:
  - At least 1.5 m^2 per calf with a liveweight of <150 kg
  - At least 2.0 m^2 per calf with a liveweight of 150–200 kg
  - At least 3.0 m^2 per calf with a liveweight of >200 kg
- Each calf must be able to stand up, lie down, turn around, rest and groom itself without hindrance
- Each calf on a holding on which two or more calves are kept must be able to see at least one other calf

Artificially lit buildings

Where calves are kept in an artificially lit building, artificial light must be provided for a period at least equivalent to the period of natural light normally available between 9:00am and 5:00pm.

Floors

Where calves are kept in a building, floors must be smooth but not slippery. They should be designed, constructed and maintained so as not to cause injury or suffering to calves standing or lying on them. Floors should be suitable for the size and weight of the calves and form a ridged, even and stable surface.

The Code of Recommendations for the Welfare of Livestock: Cattle (2003) adds that floors for cattle should not slope more than 10% as steeper slopes can cause leg problems, slipping and falling. In addition, you should not let slurry build up on concrete floors and passageways, as this will also make the floor slippery.

Bedding and lying area

All calves must be provided with appropriate bedding and be kept on, or have access to, a lying area which is clean, comfortable and adequately drained. This lying area must not adversely affect the calf.

All housed calves and calves kept in hutches or temporary structures must be kept on, or at all times have access to, a lying area which is well maintained with dry bedding.

Cleaning and disinfection

Housing, stalls, pens, equipment and utensils used for calves must be properly cleaned and disinfected as often as necessary to prevent cross-infection and build-up of disease-carrying organisms.

Faeces, urine and uneaten or spoilt food must always be removed to minimise smell and to avoid attracting flies or rodents.

Find best practice guidance on colostrum management, feeding and availability of drinking water in the AHDB Calf management guide.

Inspection

All housed calves must be inspected by the owner or other person responsible for the calves at least twice a day to check their wellbeing. Any animals which appear to be ill or injured must be cared for appropriately and without delay. Seek veterinary advice where appropriate.

Tethering and muzzling

Calves may not be tethered, with the exception of group-housed calves. Group-housed calves may be tethered for up to one hour when being fed milk or milk substitute.

Where tethers are used under this exception, the tether must not cause pain or injury to the calves and must be inspected regularly and adjusted as necessary to ensure a comfortable fit. Each tether must be designed to avoid the risk of strangulation, pain or injury and allow the calf to stand up, lie down, rest and groom itself without hinderance.

Calves must not be muzzled.

The Code of Recommendations for the Welfare of Livestock: Cattle (2003) adds some detail to help the design process and states that housed calves require an environment that is:

- Dry
- Well drained
- Well bedded
- Well ventilated
- Draught free

Where cows and their calves are group housed, calves should have a separate solid floor and bedded area which the cows are unable to access. Newborn or young calves should not be put on totally slatted floors.

Additional codes of practice and market guidelines

While The Welfare of Farmed Animals (England) Regulations 2007 provide overall minimum legal requirements which must be adhered to. Further practical recommendations and guidance are available to inform and support farmers in the design of optimal calf housing facilities to suit individual farm needs and enhance calf health and welfare.

Code of practice for design and construction of cattle buildings, BS5502-40:2005

Further guidance is provided by BS5502-40:2005. This is an advisory standard and not legislation, but it represents good practice. The code states that calves under 8 weeks old should be kept in groups of 12 or less, while calves from 8 weeks to 6 months should be kept in groups of no more than 20 animals. When calves are loose housed, the range of minimum bedded areas is shown in Table 1.

Table 1. Prescribed minimum dimensions of bedded areas

Calf weight (kg)	Minimum area per calf (m^2)
60	1.5
85	1.8
140	2.4

Additionally, BS5502-40:2005 introduces guidelines for minimum air space per calf (Table 2).

Table 2. Minimum air space per calf

Calf weight (kg)	Minimum air capacity per calf (m^3)
60	6
61–85	10
86–140	13
141–200	15

Red Tractor assurance schemes

The Red Tractor Dairy assurance scheme – Dairy Standards (October 2022) and the Red Tractor Beef & Lamb assurance scheme – Beef & Lamb Standards (October 2022) set out requirements for reared calves reared under its scheme. The Standards state that the recommendations set out in BS5502-40:2005 must be followed.

While The Welfare of Farmed Animals (England) Regulations 2007 state all calves shall be fed at least twice each day, the Red Tractor assurance schemes expands this requirement. It requires artificially reared beef and dairy calves be provided with at least 2 milk feeds a day until 28 days and not weaned before 5 weeks of age. To be given dry, fresh clean feed including forage from 14 days of age and sufficient access to clean fresh drinking water at all times from birth.

For dairy calves, since autumn 2021, there is an additional requirement under the Red Tractor Dairy assurance scheme – Dairy Standards to provide rearing facilities to cover the number of youngstock. This stipulates that you must provide calving pattern provision for 100% of expected births over a 10-day period. This does not mean the facilities have to be permanently set up.

However, the space must be allocated with a known number of pens or hutches for the herd size and appropriate calving pattern.

For example, a 440-cow herd with a tight calving pattern of 42 days will require space allocation for 105 calves. A 440-cow herd calving all year will require space allocation for 13 calves.

RSPCA welfare standards

The RSPCA welfare standards for beef cattle (February 2020) and RSPCA welfare standards for dairy cattle (June 2021) provide additional details and requirements to further enhance calf welfare when designing or updating your calf housing and for future proofing purposes.

These include:

- Provision of environmental enrichment for calves from 6 weeks of age onwards
- A thermal environment between 7–25°C with calf jackets applied in temperatures below 7°C
- Air speed to be taken into consideration when assessing thermal environment and ventilation
- Adequate fixed or portable lighting of 100–200 lux at calf level to enable calves to be inspected at all times

The RSPCA welfare standards describe specific requirements relating to calf hutches, which may be helpful to consider when upgrading or installing new accommodation.

Hutches must:

- Be made of a material which minimises heat stress and wide temperature fluctuations
- Have ventilation that's able to remove excess humidity and condensation while eliminating draughts but retaining constant air circulation
- Be placed on a free-draining base and be fixed to the ground to prevent movement in high winds
- Be located in a sheltered position, protected from prevailing weather
- Have sufficient bedding to exclude draughts
- Have dry bedding available for calves at all times
- Be of a size appropriate to the age and breed of the animal
- Be arranged so calves can see, hear and touch other calves in neighbouring hutches

Tethering of calves within the hutch is prohibited.

Where the health or behaviour of a calf has required them to be placed into an isolation pen then that pen must allow the calf to see, smell and hear other calves.

The RSPCA welfare standards also set out additional requirements for the feeding of calves. Where calves are fed by an ad-lib automated system or milk given via a trough, there must be sufficient space for all calves to drink at the same time.

Calves require enrichment from 6 weeks of age under the RSPCA welfare standards

This helps reduce competition between calves that may have result in feed intake limitations. Where a teat feeding system is used, teats must be positioned so that calves can drink in a natural position. Where calves are rationed by a transponder, feed stations must be designed to allow all calves to drink without hindrance. Where bucket fed, each calf should have an individual bucket and should be transferred to a teat feeding system if high levels of abnormal sucking behaviour are seen.

Other assurance schemes

Some of the milk buyers' farm assurance schemes stipulate that as well as young calves having sight and touch of other calves from birth, they should be moved into pairs or groups within three weeks of birth. One scheme requires calves to be accommodated in pairs from birth.

The quality of the environment is the most important determinant of success with calf housing. While it is essential that the regulations are complied with, the detail of the design and management included in these pages should guarantee success. A design that considers how staff will carry out routine tasks, maintenance and cleaning, and viewing the design from the animal's level will assist with animal movements around the building, reduce stress for animals and staff and provide labour-saving efficiency too.

Design questions to consider

Taking the time to understand your needs in the planning process of your youngstock housing will help make sure that the design chosen is right for your system. To help work through the design process, consider the eight questions below.

1. What will be the expected maximum number of calves on milk at any one time?

- Check your calving records
- Include a two-week post-weaning period
- Consider the need for empty pens for effective cleaning
- Allow for flexibility in the event that movements are restricted (e.g. adverse weather or Tuberculosis restrictions)

2. What are your future plans for the business?

- Is this a stop-gap or a 10-year investment?
- Will your cow numbers increase?
- Might the system need to adapt, e.g. to different calving systems?

3. What is the preferred feeding system?

- Is this individual buckets, trough feeders, automatic calf feeder, etc?

4. What is the likely pen size?

- Your pen size should fit your preferred feeding system and be dictated by your calf group size

5. What options do you have for pen layouts?

Consider:

- Space for some individual pens
- Group pens: number required so that effective cleaning is possible
- Isolation pen
- Central or side passage
- Feed preparation and wash area
- Storage requirements for milk powder, concentrates, forage and bedding
- Location of water and power sources

6. How will your pens be cleaned out?

Think about:

- Layout of the pens dictates the direction of floor slopes in each pen
- Floor slope dictates where drainage channels are required
- Equipment available for mucking out needs space for access
- Washing out: access to water and power sources

7. What is the optimum location of the new building?

Consider the following questions:

- How will calves be transported to the building?
- Where will the calves come from?
- From which direction will milk, bagged feed and straw arrive?
- What will provide ease of access for people?
- Where are the biggest risks to calf health?
- What will be the expected impact of the climate?

8. What are the wall cladding specifications and options?

- Are there specific restrictions to wind-driven airflow through the site? Is your site particularly exposed to the weather?

Once the size and orientation of the new calf house are brought into focus, the remainder of the design details can be decided. Choices are required for materials used internally and externally for pens and equipment. Details such as pen gates, divisions, feeders and racks, water drinkers, mechanical ventilation systems and lighting are all critical.

Temperature, humidity and ventilation

The calf's ability to maintain a steady body temperature develops during the first eight weeks of life. Regardless of the housing system, a newborn calf will feel cold when the temperature drops below 10–15°C. By the time it is four weeks old, a healthy calf can tolerate a wider range of ambient temperatures.

While absolute temperature is important, the role of humidity should not be underestimated. Humidity can directly impact calf physiology and create an attractive environment for bacteria and viruses. Control of humidity in calf housing requires a combination of good drainage and effective ventilation, so the design of building sidewalls is a critical aspect of good calf house design. Most systems require mechanical ventilation to provide clean air at all times.

Temperature

When a healthy calf is over 8 weeks old, it can thermoregulate reasonably well and maintain a constant body temperature of around 38°C.

The thermoneutral zone for a calf is the temperature range when the calf does not have to expend energy to maintain its normal body temperature. The lower critical temperature (LCT) is the temperature below which the calf must burn extra energy to keep warm, while at temperatures above the upper critical temperature (UCT) the calf must try and dispel the extra heat to avoid heat stress.

The design of any calf housing system must take into account that a calf less than eight weeks of age has a reduced natural ability to regulate its body temperature. While a newborn calf must change its behaviour and burn extra energy below ambient temperatures of 10–15°C to maintain body temperature, a healthy calf at four weeks of age can comfortably cope with temperatures closer to freezing.

In some cases, the calf will lie with all four legs tucked under its body to reduce heat loss and will exhibit nesting behaviour when it tries to burrow into the bedding material

The temperature felt by a calf is a combination of the ambient air temperature, airspeed and relative humidity. The calf can lose heat through evaporation, radiation, conduction and convection, although this ability is relatively poorly developed in a calf less than eight weeks old.

It is strongly recommended to invest in a max-min thermometer (or a digital data logger if possible), placed at calf level, to monitor changes in temperature in the calf shed. This enables appropriate action to be taken where and when required.

Table 3. The temperature the calf feels is a combination of temperature, airspeed and humidity

Age (weight)	Lower critical temperature °C at air speeds of	
	0.2 m/s (draught-free)	2.0 m/s
Newborn (35 kg)	9	17
One month (50 kg)	0	9

Source: Webster, 1981

As well as reacting to the environment within the housing facility, a calf can attempt to thermoregulate by adjusting its behaviour. When a calf feels cold, it will spend more time lying down, which reduces the external body area exposed to the atmosphere.

Humidity

The impact of ambient temperature on calves is confounded by the level of relative humidity or how damp the environment is. The rate of energy loss from a body at a low set temperature will increase with higher humidity: cold plus damp 'feels' colder than cold plus dry because the rate of heat loss from a body is greater. The same is true with damp bedding, where the rate of energy loss from a calf to the environment is higher than on a dry bed.

The capacity of air to retain moisture reduces as the air temperature drops towards freezing point. This leads to high relative humidities at low air temperatures, typical of UK winter housing environments. High humidity and poor airflow in a building can result in pathogen build up and heat-stressed calves, even in cooler months.

The link between temperature and humidity is described as the temperature humidity Index (THI), which is normally used to describe warm and hot conditions (see Table 4).

Improved moisture management should be included in the design of any calf housing system. It is not uncommon to see 83–98% relative humidity in UK calf units.

Table 4. The effect of temperature and humidity on the temperature humidity index and heat stress in calves

Temperature (°C)	Relative humidity (%)								
	20	30	40	50	60	70	80	90	100
15	59	59	59	59	59	59	59	59	59
20	64	64	65	65	66	66	67	67	68
25	69	70	71	72	73	74	75	76	77
30	74	75	77	78	80	81	83	84	86
35	78	81	83	85	87	89	91	93	95

Temperature humidity index:
59–71% = Comfortable 72–78% = Heat stress 80–95% = Severe heat stress

Not only does humidity influence the temperature felt by the calves it can increase the survival rate of bacteria and viruses. For example:

- Cryptosporidium can survive in the environment for six months in damp conditions between 5–15°C
- Rotavirus can survive in a damp environment at around 20°C for months
- Mycoplasma species can survive for at least 30 days
- Salmonella species can survive for more than 50 days in damp conditions

Control of humidity in calf housing requires a combination of good drainage and effective ventilation.

Dust and gases

Dust and gases can adversely affect the health of a calf and some of these effects extend through to lactation. Dust from poor-quality bedding is especially damaging to the lungs. Airborne particles will contain very fine aerosols of bacteria and spores of moulds and fungi. These can penetrate the deepest parts of the lungs and have a significant biological impact.

Ammonia levels at 25 ppm will irritate mucous membranes and increase the animal's susceptibility to respiratory disease, while carbon dioxide (CO_2) and hydrogen sulphide (H_2S) can limit future development.

The information above highlights the importance of good ventilation in calf housing to remove humidity, dust and gases without causing the environment to become cold.

Ventilation

A constant supply of fresh air is essential in preventing respiratory diseases and infections. Good ventilation removes stale, humid air. Stagnant air contaminated with dust, moisture, ammonia and viruses, which can cause pneumonia, must be removed and replaced by fresh air. Cobwebs in buildings and condensation on the underside of roofing are signs of poor ventilation.

Movement of air within a calf shed can be visualised using smoke pellets. This helps to highlight stale pockets of air and demonstrates where air is moving. Airspeed can also be measured using an anemometer.

To ensure adequate ventilation, it is important the building is designed or adapted to:

- Remove excess heat
- Remove excess water vapour
- Remove microorganisms, dust and gases
- Provide a uniform distribution of air
- Provide correct airspeed for the stack effect

When designing a calf housing system, it can be challenging to balance the need for fresh air with the detrimental effects of draughts (see Table 5).

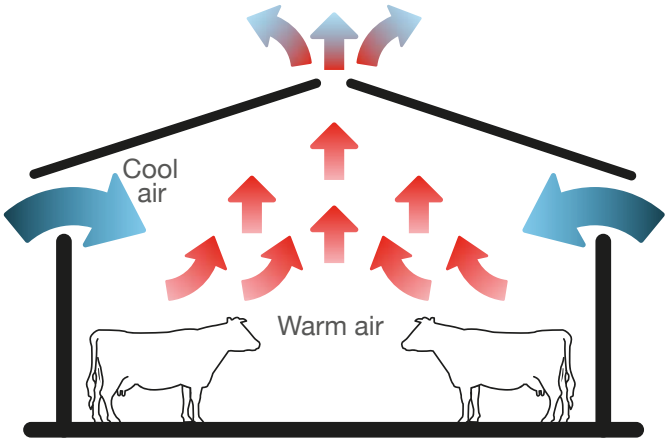
Table 5. Ideally, airspeeds at calf height should be around 0.25 m/sec. Any airspeed greater than this is considered a draught

Airspeed at calf level (metre/second)	Significance
0.15	Stale air – increases pathogen survival and reduces airway function, increasing the risk of pneumonia
0.2	Draught-free
0.3	Draught on calf – calf will become chilled

The stack effect and heat distribution

A common principle of ventilation in cattle buildings is the stack effect, which can come into effect when wind-driven ventilation is not present. The heat generated by cattle within the shed warms the stale air. This creates thermal buoyancy through the outlets in the roof, which creates a negative pressure when fresh cooler air is drawn into the building from the side inlets.

Unfortunately, young calves generate insufficient heat to initiate the stack effect. This can lead to poor natural movement of air within the building. This is common in buildings with insufficient exposure to the wind and is made worse during periods of low or no wind.



The stack effect provides air flow in sheds with larger cattle

Achieving good ventilation

There is an absolute requirement for clean air in animal housing and for the removal of stale air. Nearly all cattle and calf buildings are ventilated by the pressure from the wind, with clean air entering one sidewall and exiting the opposite wall, due to pressure differences. An ideal building will have equal amounts of openings in every wall so that it can manage the wind from any direction.

Common ventilation failures are described in the box opposite. Together they emphasise the importance of sidewall design in good calf housing.

Outlet areas on the roof are essential. Ventilation only works correctly if there is a balance of inlets and outlets. When buildings are located so that the wind has access on all four sides, wind-driven ventilation crosses the floor area from side to side or end to end. However, many locations will not provide wind access from all sides, and the design of an outlet in the roof has a major impact on assisting in the removal of stale air from a building.

The outlet area should be a minimum of 0.04 m^2 per calf and typically at least 1.5 m above any inlet. Inlet areas should be a minimum of 0.08 m^2 per calf (0.04 m^2 in each sidewall).

The optimum design of an outlet for calf housing is a covered open ridge. This provides an exhaust for the occasional periods when warm air accumulates in the building and is essential for providing a high-level outlet in the roof when mechanical ventilation is used.

A raised open ridge, though popular with some builders, does not provide a negative pressure to assist exhaust air at any time.

A covered open ridge is an optimum outlet

Lack of clean air delivery remains a critical weakness in many calf house systems. This occurs in all systems if:

- There is any compromise in wind-driven inlet areas in the sidewalls
- The wind stops blowing

Most systems require mechanical ventilation to provide clean air delivery at all times.

Common ventilation failures to avoid include:

- No inlet in two or more walls; no clean air delivery to part of a building
- Big differences in inlet areas in each wall; this can lead to turbulent airflow within a building
- Inlets with wide openings (>25 mm) that create increased airspeed at calf height. Wide openings are not a problem when located so that they do not cause increased airspeed at calf height
- Unbalanced distribution of air inlets, leaving some areas inside a building exposed to increased airspeeds, and other parts with insufficient clean air
- Shared air space with older animals
- High-volume air space; while some believe this achieves good air quality in calf houses, it, in fact, has the opposite effect
- No roof-level outlet

Improving ventilation with building design

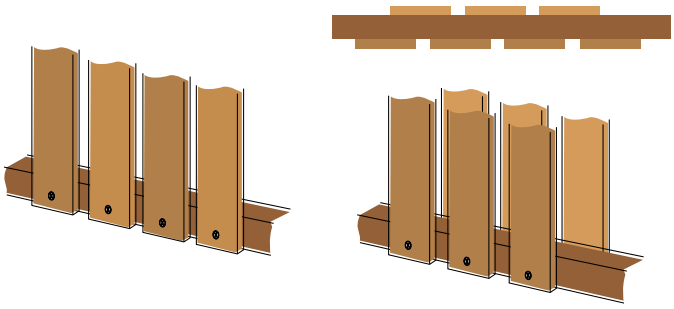
Modify sidewall cladding

Many buildings used to accommodate young calves can be improved by modifying the sidewall cladding (or inlet ventilation) to improve the natural airflow into the building. This, however, must achieve the difficult balance between airflow and draught.

Mesh cladding may reduce rain and wind entering the shed while allowing fresh air to circulate

Yorkshire boarding

Ventilated cladding or Yorkshire boarding on all aspects can help improve airflow. Conventional space boarding does not eliminate driving rain or higher wind speeds.



Space (left) and Yorkshire boarding (right)

Positive pressure tube ventilation (PPTV)

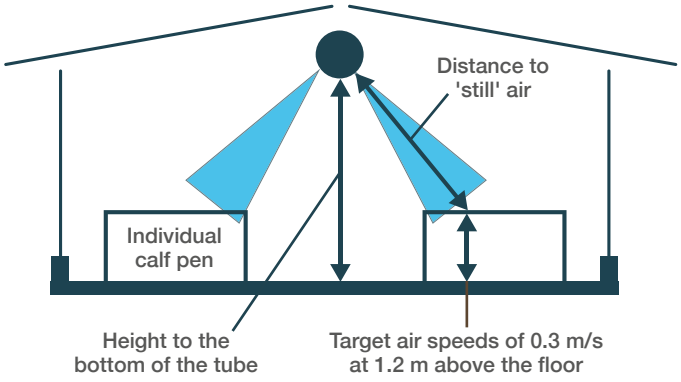
Where natural ventilation is not sufficient, the area will benefit from some type of mechanical ventilation. Well-designed positive pressure tube ventilation (PPTV) systems ensure that air flows at all times and have been associated with reduced levels of respiratory illness in calves. A fan fitted to one end or wall of a building blowing air over pens, without a tube, does not deliver fresh air. Fresh air may be delivered in the initial part of the air plume, but thereafter the air becomes increasingly dirty along the length of the plume. When the trajectory of the air plume ceases, between 6–10 m from the fan, the result is a concentration of stale air and an increased risk of disease transmission.

The fan capacity should be between 35–105 m^3/h per calf.

Fan controls must be such that the lower figure (35 m^3/calf) is always maintained, i.e. the fan must never be shut off. The upper figure is to provide adequate ventilation when calves have attained higher body weights and for summer ventilation. It is vital that there is contingency planning in the event of power outages, especially in hot weather to prevent heat stress.

The holes in the positive pressure ventilation tube are angled to ensure fresh air is delivered to the calves

The fan controller should be set up so that the minimum ventilation rate is always maintained. The requirement is to have the fan and tube designed so that fresh air is delivered into each pen at an airspeed of less than 0.3 m/s at around 1.2 m height. The target is to deliver clean air, whatever the external weather conditions (windspeed and temperature), with no draught at animal height.



The design of the system is dependent on the dimensions of the shed to ensure fresh air is delivered at 0.3 m/s at 1.2 m height

Fan performance (m^3/h) is provided by the manufacturers to guide selection of a suitable product. A common failure is to select fans based on stated performance against zero resistance (0 pascal), i.e. with no resistance created by the ducting, the tube or the prevailing wind.

The actual requirement is to use a fan with the required performance (m^3/h) at a resistance of 50 pascals. Fans also require an air straightener on the output side before the attachment to the tube. Standard tubes and fans generally only work in standard-sized and configured buildings.

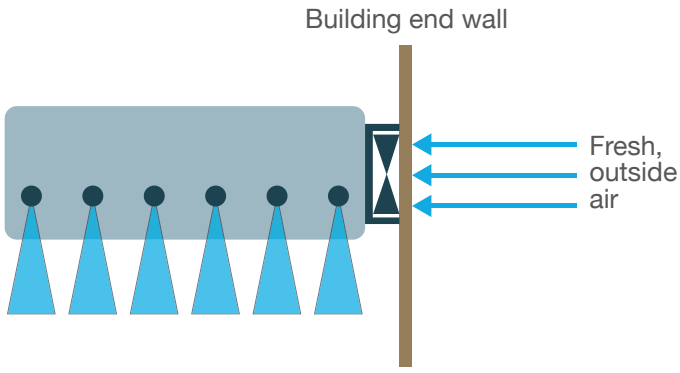
Fan size and tube configuration should be provided by someone who knows how to configure the size, number and location of holes in the tube to deliver clean air on target.

Fans in most sidewall locations benefit from an external cowl to protect the fan and provide more consistent operation

Information required to specify which PPTV system to choose:

- Length of area to be ventilated
- Width of area
- Eaves to ridge height
- Maximum number of calves housed
- Height of tube above pen floor area
- Horizontal location of tube across the width of building

The length of area to be ventilated and the width of area are easy to determine in a dedicated calf building. When compromises are needed, and the calf rearing area is part of a larger building space, you should consider targeting only the calf pen areas.



The fan attached to a PPTV tube draws the fresh outside air in and along the tube. Correctly positioned holes then provide fresh air in the correct location and at the correct speed

There are many reasons for a tube to be located at a specific height and horizontal location above the pens. Restrictions on fan placement or requirements during mucking out with large machinery often dictate the position of the tube. The design of the tube can accommodate a wide range of locations and still deliver clean air into the breathing zone of calves, if the correct information is given to the supplier.

Air space

Air space is as important as floor space, and BS5502-40:2005 outlines minimum air space for housed calves from birth to seven months old (Table 2, page 6).

However, it is essential to note that air quality directly influences animal health and performance, and that air volume per calf is not a measure of air quality. It can be especially difficult to provide consistent and effective ventilation that delivers good air quality in larger-volume calf buildings.

Housing layout and construction

Location

The optimum location for a calf building is upwind of growing and adult cattle, so that location will typically be west, southwest or south of the main buildings because of the direction of prevailing winds. The site should be exposed to natural fresh air delivery, and the building should be designed to reduce airspeeds within the building. Finding out meteorological data at a local level is straightforward and gives guidance about the amount of time different weather conditions should be expected and at what time of year. One good source is the Met Office's UK regional climates (**metoffice.gov.uk/research/climate/maps-and-data/regional-climates/index**).

Group housing

It is recommended that calves are group housed from three weeks of age. While individual pens help limit the spread of disease, they limit social interaction and learning. There is clear evidence that solid feed intake increases when calves are housed together or in groups.

Schedule 6 of The Welfare of Farmed Animals (England) Regulations 2007 states that no calf can be kept in an individual stall or pen after eight weeks of age unless a veterinary surgeon certifies that its health or behaviour requires it to be isolated.

Although the early placement of calves in single pens has a positive impact on their short-term health, there comes a point at which the benefits of shared space (social conditioning, reduced stress and improved intakes) become significant.

All movements of calves will create some short-term stress. When calves are moved from individual pens to group pens, they tend to be more aggressive and fearful and show reduced feed intake in the short term. Normal behaviour will gradually return between 5–15 days after group changes. Stress associated with group changes is reduced if calves are housed in pens with good visual and tactile contact between calves.

Minimum pen sizes are outlined in The Welfare of Farmed Animals (England) Regulations 2007 (box on page 5).

When the calves move to group housing, BS5502-40:2005 suggest the minimum space per calf outlined in Table 6.

Table 6. Minimum space per calf in group housing

Calf weight (kg)	Area per calf (m^2)
60	1.5
85	1.8
140	2.4

Increased space allowance leads to higher growth rates on pre-weaned calves, and increased space per calf is associated with improved health scores.

Calves under eight weeks old should be kept to a maximum group size of 12 animals. Once they are weaned, this can increase to a maximum of 20 calves. Smaller group sizes mean it is easier to identify, isolate and treat any sick calves.

In practice, group sizes are often dictated by the feeding system. When calves are fed in groups, it is important to ensure that all calves receive the required amount of milk, dried food and forage. When calves are housed together, they exhibit increased feed intake and growth rates over calves kept singly; this is driven in part by the behaviour of youngstock to feed together.

Calf housing should recognise that all farms need to mix youngstock and should provide facilities that match pen sizes and building capacities to the number of calves flowing through the system at peak times. One attraction of the hutch/igloo calf housing system is the ability to accommodate small group sizes.

Pen design

Pen size needs to be related to group size and the feeding system. Some feeding systems require, for example, ample length of pen front to allow all calves to feed side-by-side at the same time. The feed fence sets the minimum pen width, the regulations set the minimum pen areas per calf, and thereby the minimum pen depth is defined. Pens should be sized to accommodate the maximum number of calves desired at their highest liveweight.

Group pens will have excess floor space per calf when calves are first placed in the pen. Some farmers place big bales within pens at the start of group housing to make use of the space, provide some protection from draughts and to reduce the time taken to bed pens later on.

Straw bales can provide protection from drafts and reduce excess space when calves are small

Constructing pens with much greater space per calf than the recommendations is not always a good idea. This will increase capital costs per calf and either increase straw costs or provide a significant area of exposed, dirty concrete floor that will act as a cold radiator throughout the winter period. Large pen areas per calf will increase building volumes per calf, which can make it more difficult to provide clean air throughout a building.

Conversely, there are minimum individual pen sizes per calf which are driven by the calf weight (box on page 5).

As the calf moves into a group situation, the area required per calf increases as the calf grows (Table 6, page 14).

Pen layout within buildings

The layout of facilities should take into account all the daily tasks of checking, feeding, watering, bedding and cleaning. Labour is a valuable resource, and if the labour component is included in the design process, there is potential to improve efficiency.

Some units will choose to retain an area of a calf housing system for individual or double pens. Their location should recognise the need for best environmental control, protection from draughts and mediation of cold temperatures, easy labour access, and ease of cleaning.

Group pens are frequently, but not necessarily, arranged to fit the bay size of a building. The focus should remain on keeping pen sizes in balance with the ability to fill each pen within a relatively short period (less than four weeks).

The required number of group pens within the building is determined by calculating group size, the maximum number of calves to be housed at any one time, and cleaning space. The arrangement of individual pens with either a centre or side passage will help to define a suitable building length.

The width of a calf building will reflect the layout of the pens and the required passage width for all routine daily tasks. Cleaning out pens is an essential but low-frequency task.

Isolation pens

Early intervention on individual animals showing signs of distress or poor health is a major success factor in health management. Isolation pens should be always available and easy to clean and use.

In group-housed systems, it may be practical to erect a double-fenced isolation pen in one front corner of the pen. This will make it easy to give individual help but minimise the negative impact of isolation. However, it is preferable for the isolation pen to be outside any shared pen. The ideal positioning of an isolation pen is downwind of the healthy calves, but upwind of adult cattle.

The isolation pen should give immediate access to water, a small quantity of fresh dry feed ad lib, and milk fed at the normal times. A heat lamp will be useful to counteract the effect of any reduced feed intake, so a suitably located power supply is useful in any design stage.

The isolation pen should be made of suitable materials and construction to make it easy to dismantle and remove from the building for cleaning. Positioning the drainage to remove all liquid away from the isolation pen and out of the shed without any contact with the healthy calves or other animals will reduce the transmission of disease.

Covered foot dips located immediately outside isolation and sick pens are strongly recommended. A cupboard for gloves and other supplies, e.g. syringes and easy access to a hand washing sink, are also helpful. Isolation pens should have dedicated equipment, e.g. stomach tubes that are clearly marked.

A boot wash is an alternative to a footbath

Building construction

Materials used in calf house construction should aim to mitigate and not add to any of the environmental pressures on the calf.

All materials and finishes used in the animal zone must not cause harm by mechanical damage, such as sharp edges or slippery floors.

Gaps at animal heights can be a trapping hazard for calves. Gaps at fixtures such as drinkers, feeders and gates should not be between 100–330 mm to avoid trapping calves by the head.

Concrete is the predominant material used for flooring and is frequently used for external walls. The thermal properties of materials used in construction influence the speed at which the building heats up or cools down when the weather changes. Buildings with high thermal mass will stay cooler and damper in UK winter weather conditions than buildings with low thermal mass. Plastics and tubular steel have lower thermal mass than concrete and solid steel. They, therefore, suck less energy from the air, making a building feel warmer.

The physical properties of roof cladding materials are relevant to calf health. Metal roof sheets have a low thermal mass and a higher conductivity than mineral fibre sheets. The air temperature under metal roof sheets will rise and fall quicker than under mineral fibre sheets and will rise higher than under other roof types. This can have a negative impact on calf health in autumn because a metal roof can increase the daily variation in air temperature under the roof.

Metal sheets, especially as a roofing material, will significantly increase the amount of condensation in a livestock building compared with mineral fibre or other materials that transfer less heat, such as plastic or insulated sheet. At low air temperatures, increasingly damp air (higher relative humidity) means that the effective temperature felt by an animal is lower compared with drier air (lower relative humidity) at the same air temperature.

General construction guidance for livestock buildings can be found in BS5502:2005 parts 20, 21, 23 and 40.

Lighting

Where the natural light available in a building is insufficient to meet the physiological or behavioural needs of the animals, appropriate artificial light must be provided. The Welfare of Farmed Animals (England) Regulations 2007 states that artificial light must be provided for a period at least equivalent to the period of natural light normally available between 9:00am–5:00pm.

BS5502-40:2005 recommends that calf housing should provide a minimum of 50 lux of artificial light. Natural lighting should be provided by 10% of the roof area. Natural lighting will need to be supplemented to increase the light levels to nearer 200 lux, which is required for the inspection of calves.

Roof lights are beneficial for reducing the need for artificial lighting, thus reducing lighting costs. However, they can increase heat in a building when fitted on the south-facing aspect. To avoid overheating, roof lights should be fitted to north-facing aspects of the building.

Animals in buildings must not be kept without an appropriate period of rest from artificial light.

Floors and drainage

The Code of Recommendations for the Welfare of Livestock: Cattle (2003) sets out requirements for flooring and drainage as set out on page 6. Concrete floors should have a minimum slope of 5% (1 in 20) under straw bedding or in areas with expected high moisture levels; this allows effective drainage of water and urine from under the straw.

A drainage channel at the front of and outside a pen will also help to remove water and urine so that the passage areas remain clean. A slatted area to the front of a pen, correctly designed, can be very useful in locations where bedding costs are high.

When calves are on automatic feeding systems, they will consume significant volumes of milk, so pen drainage is even more important to ensure the bed remains dry. The pen should be designed so that the calves can only feed when standing away from the straw-bedded area.

Floors, drains and ventilation are the key ingredients for managing moisture in calf houses. Moisture management within a pen should acknowledge the amount of moisture produced by the calves and provide a dry bedding surface. Most calves are housed on straw, and floor slopes will aid drainage and reduce straw costs.

Floors must provide a secure grip, non-slip surface, such as that provided by a heavy brush finish on newly laid concrete

Pens should slope from the back to the front, with a channel drain perpendicular to the slope, immediately outside the pen unless the drain is below the pen floor. Pens should be laid out to ensure that drainage from the feeding area is running away from the bedding. External drains must be easy to keep clean and accessible for that purpose.

Calf systems with lines of individual or double pens in a building should have simple channel drains immediately in front of each row to intercept the flow of liquid from the pens and keep the working area between the pens clean and dry. This reduces the negative impact of damp flooring on air temperatures and improves biosecurity. Drainage for rows of single or double pens can be provided by making a shallow depression, 75–100 mm wide, in the concrete floor slab during construction. A depression at the front of the pen installed during construction aids drainage. Drainage below the surface must be easy to flush out.

All drainage should comply with BS5502-25:1991. The design should always keep clean rainwater, dirty water and slurry separate from each other. It is preferable to direct rainwater to clean water soakaways or for recycling within the building.

Young calves, particularly those less than four weeks old, should not be housed on totally slatted floors. The Code of Recommendations for the Welfare of Livestock: Cattle (2003) states: where slatted floors are used in calf housing, you should pay particular attention to the type of slats, to avoid slipperiness. The gaps between the slats should not be wide enough to cause foot injuries (for example, when claws get trapped).

You should only use slatted pens for the size of animals that they were designed for. It is advisable to check restrictions in quality assurance scheme specifications; non-slatted areas may be an essential requirement for all calves. Rubber-covered slats offer increased comfort compared with plastic or concrete slats.

Bedding

Calves show a clear preference for lying on dry bedding. Lying times reduce as the dry matter percentage (DM%) of the beds decreases. To aid in keeping bedded areas dry avoid locating water troughs and buckets over bedding. A calf should always have a clean, dry bed that's deep enough to allow the calf to nest in colder temperatures.

If the legs of the calf are fully covered in straw, there is sufficient straw to allow nesting

Calves choose to lie down 17–18 hours per day. Although there is little difference in lying times between individually housed and paired calves, when a calf is sick, it will spend more time lying down. This reinforces the importance of dry bedding, as sick calves often have an increased LCT as feed intakes drop and body temperature increases.

Poor-quality bedding materials have a considerable impact on calf health and performance in terms of thermal comfort and hygiene. While sand, sawdust or shavings are suitable bedding choices for the summer months, these are poorer choices for winter use because they do not provide the calf with any thermal protection. Straw is the ideal bedding for use in winter.

There is a strong relationship between the frequency of adding fresh bedding and the prevalence of diarrhoea, with well-bedded calf pens reporting fewer scours in young calves.

Hygiene

Effective hygiene is a basic design requirement for calf pens and calf buildings. All materials used within the area of the calf (i.e. floor, pen walls, drains) should be easy to clean and maintain. Broken and porous surfaces in this area are not supportive of animal health.

The internal area and fittings of a calf pen should be designed to be successfully cleaned even if there are other calves in the same building. It is not good practice to design pens that need to be scraped through passages between pens as it guarantees the sharing of pathogens. The choice of materials for pen walls should address longevity, cleanability and thermal comfort.

Pen size should take into account that the greater the age difference between calves in any one pen – and the wider the spread of ages within one air space – the greater the risk of disease spread. If buildings are not designed to be used on an 'all-in, all-out' basis, pen floors and drainage must permit effective cleaning of individual pens. Wheeled individual and double pens are available to make it easy to move pens outside a building.

Calf pens should be cleaned out as a minimum every 30 days. All wash water from individual pens should drain in such a way as to avoid contamination of other pens. Hygiene practices around the preparation and delivery of feed will be greatly affected by the provision of adequate facilities to clean, rinse and dry feeding components.

All surfaces and joints between surfaces up to 1.4 m in height should be easy to clean and preferably sealed. Maintenance of facilities on a regular basis makes this easier, safer and more effective. The choice of materials should reflect this.

A sealed concrete wall and metal gates are easy to clean between batches of calves

Emergencies and contingency planning

The Code of Recommendations for the Welfare of Livestock: Cattle (2003) recommends that plans should be put in place to deal with emergencies at your farm, such as fire, flood or disruption of supplies (for example, no electricity). The owner should make sure that all the staff are familiar with the appropriate emergency action. You will find more information in the Defra booklets, 'Emergencies on livestock farms' and 'Farm fires: advice on farm animal welfare'.

It is important that you get advice about design when you are building or modifying a building. You need to be able to release and evacuate livestock quickly if there is an emergency by, for example, having outward opening doors and gates. You should consider installing fire alarms that can be heard and responded to at any time of the day or night.

Your local fire prevention officers and the Fire Prevention Association can provide advice on all fire precautions.

Designing housing to feed calves with ease

Feeding is one of the main tasks of calf husbandry, and it requires a lot of money, time and effort. The preferred method of milk feeding for calf health and productivity is through a teat feeder. Group pens with teat feeders should permit easy access for the stockperson to help all calves in the group to access a teat. The choice of milk feed system should define the optimum group pen size for any particular farm.

Dry feed is best presented to individual calves in shallow bowls or buckets. This is so that quantities can be kept low, daily intakes are easy to see and spoilage is limited. A trough for dry feed should be located more than 2 m from a drinker to reduce the amount of feed that ends up in the drinking bowl.

The design of the feed fence has a significant impact on the amount of feed ingested by individual calves. Trough feeding milk to groups of calves is relatively simple and requires little intervention, and feeders are easy to clean. On the downside, this results in uneven milk feed intakes and subsequent uneven growth rates. Some systems use self-locking feed barriers to increase the control of individual milk intakes.

The feed fence – plus any other requirements, such as a water trough accessible from outside – will define the minimum width of the pen front. Group size can also be used to define the optimum pen size for the post-weaning rearing period. It is preferable to maintain groups through the growth period, as this reduces the short-term periods of stress that occur at mixing. This also reduces the frequency of contact with other potential sources of infection.

Automatic milk feeders

Automatic milk feeders (AMF) can significantly reduce the labour requirement per healthy calf while controlling and monitoring calf milk intakes. However, the automatic feeder is a significant factor in increasing the risk of disease transmission within groups of calves. There is also a requirement to provide sufficient labour to assist calves that do not take rapidly to the AMF.

Many AMFs will have frequent cleaning cycles of machine components. The teats and cleaning water should be directed to underfloor dirty water drainage within or immediately beside each pen. Floor design might incorporate a concrete plinth for automatic feed

The design of the automatic milk feeder may affect the labour required for training calves

A trough or rack feeder is required to provide long chopped straw for optimum rumen development

The working environment for tasks like cleaning buckets is enhanced by being inside and having hot water, a sink and good drainage

stations, with a slope towards a gutter or drain to facilitate regular cleaning. Local drainage will assist in managing the increase in urination close to the feeder and an increase in localised hygiene and cleaning required around the feeder. It may be beneficial to allow more floor area per calf than when using manual milk feed systems, to manage high liquid intakes.

In some pen designs, drainage of the floor area around an existing feed station can be improved by placing the feed station on a section of concrete pig slats sized for grower pigs.

The feed mixer and control station require water and a power supply with a local drain for dirty water from the wash cycles. Warm milk can be piped up to 5 m to a remote feed station, and all pipework and cables between the mixer and the feeders are best located in a 110 mm duct in the floor slab, with the duct protruding 200 mm above the floor slab at entry and exit points. Dirty water drains are typically 110 mm plastic waste pipes connected to an external sump for further export to the farm's dirty water system.

Calf kitchen and feed preparation

A calf system can be designed with a feed preparation and cleaning area as an integral part of the system. A calf kitchen is an obvious component to support calf health and growth. It should also serve to improve the effectiveness of labour and make a routine task more pleasant.

A feed preparation area might include:

- All items stored off the floor to facilitate cleaning
- A sealed floor sloping 1 in 60 (1.7%) to a drain
- Adequate racking and shelving for items for immediate use
- Shelves, racks and wall-mounted pegs to allow feed buckets and components to be dried off the floor
- A source of heated water with a volume suitable to provide all hot water requirements within a short period
- A water heater on a controlled timer so that water is available at the required volume and temperature at the right time
- An area for storage of bagged milk powder and dry feed immediately adjacent to the feed preparation surface, possibly on pallets
- Be wildlife proof
- A large-volume plastic sink or similar with hot and cold water supply for cleaning buckets, teats, troughs, etc.
- All sinks or similar to drain direct to waste dirty water system, not to floor

Moisture management in a building can be improved by ensuring bucket washing facilities are located separately from the housing or are provided with effective local drainage within the building.

Housing systems

There are many housing systems available for artificially reared youngstock, and it is important to understand which system will work best on your farm. In this section, we have identified seven of the main youngstock housing systems, although this is not an exhaustive list. Benefits, considerations and factors, including disease control, the quality of shelter that they provide and where they are best situated, are provided for each system.

Purpose-built portal frame

Factor	Benefits	Consideration
Disease control	Advantageous if run on an all-in and all-out system. Walls and floors are easy to clean and disinfect. Adequate floor slopes and good drainage. Individual/double/small pens allow low disease transmission and can suit all-year-round calving.	Group housing can allow the spread of disease, particularly when stocked constantly. Construction costs tend to favour larger m^2, which significantly increases risk.
Ventilation	If suitably located, it can obtain maximum benefit from natural ventilation. Easy to fit positive pressure tube ventilation (PPTV).	Will not ventilate when wind speeds are low, particularly if a high-volume building. Will need mechanical ventilation to compensate for low wind speed days. If the building has large openings in gables or sidewalls, high wind speeds can cause turbulence at pen level, increasing wind chill.
Shelter	Provides excellent shelter, provided draughts are avoided without limiting access to fresh air.	The building can exaggerate weather conditions creating wind tunnels or no airflow. Some materials make cold temperatures colder and hot temperatures hotter.
Location	Good building design can accommodate most locations.	Choice of location based on, for example, available space or access for vehicles may create compromises on the effectiveness of investment. Some locations can increase biosecurity risk. Impaired natural ventilation. Consider labour requirements.
Hygiene	The choice of materials for pen walls and pen fittings has a long-term impact. Can achieve good hygiene levels if the building structure is well maintained and drainage is suitable.	Hygiene can be compromised if the drainage is poor, surfaces are badly maintained and hard to clean. Floor detail is essential as mistakes at installation are seldom repaired. The overall design may be compromised by using large field machinery for mucking out.
Cost	Calf handling and services for inspection, lighting and automation are readily available with a positive impact on variable costs. Efficient use of bedding with low or no ingress of rainwater.	Tempting to build a general purpose building that compromises on calf requirements. Relatively high capital cost.
Labour	Good logistics if well planned. Working inside during harsh weather. Consumables are available at hand.	Challenging to clean mechanically when not used as an all-in and all-out system.

Purpose-built mono pitch

Factor	Benefits	Consideration
Disease control	Advantageous if run on an all-in and all-out system. Walls and floors are easy to clean and disinfect. Adequate floor slopes and good drainage. Easy to create a series of smaller spaces to reduce disease transmission. Suitable for all year round calving with suitable protection.	Group housing can allow the spread of disease, particularly when stocked constantly. Construction costs tend to favour larger m^2, which significantly increases risk.
Ventilation	If suitably located, it can obtain maximum benefit from natural ventilation. Easy to fit positive pressure tube ventilation (PPTV).	Not suitable for an exposed site without protection to the front.
Shelter	Considerably better than outside housing.	Open-front designs will always be compromised by prevailing weather conditions, most commonly during the winter months.
Location	Suitable for most locations. Should be positioned with back to the prevailing wind. Small footprint gives flexibility.	Less suitable for very exposed sites.
Hygiene	The choice of materials for pen walls and pen fittings has a long-term impact. Can achieve good hygiene levels if the building structure is well maintained and drainage is suitable. The design allows for the best practice of mucking out/cleaning/disinfecting pens individually at the optimum time rather than having to clean out the whole shed from one end. Easy to run sections as all-in and all-out.	Floor design is critical; low-cost options are attractive but not sustainable.
Cost	Cheaper than a portal frame. Self-build kits available. Easy to start small and add capacity later.	Temptation to cut corners on self-builds that omits important details.
Labour	Similar to portal frame.	Similar to portal frame.

Individual/paired hutches

Factor	Benefits	Consideration
Disease control	Good for disease control with limited contact between calves. Relatively easy to clean out. Can be removed from facility for cleaning. Can be easily moved to a clean site.	Disease can spread if the hutches are not cleaned and disinfected between calves or the ground is poorly drained. Effort is required to inspect calves carefully. Calves not protected from wind/rain are at increased risk of immune suppression. Legal requirement to ensure visual and tactile contact between calves.
Ventilation	Some hutches have excellent ventilation.	Check roof outlet on some designs. Some are severely limited. Hutches under roofs or adjacent to buildings can have compromised ventilation. Need to pay attention to significant changes in wind direction.
Shelter	The inside area is dry and protected from the weather, and outside, the calf can get limited exercise and sunlight. The calf can choose its preferred environment depending on the weather. Good access to clean air.	External strawed area often uncovered and easily damp. Extra shade may be needed in the summer. Adjacent hutches can cause wind tunnels. Hutch can freeze in cold weather.
Location	Hutches can be oriented towards the sun or moved to locations that are most suitable according to the season. Can use small areas adjacent to existing facilities.	Wind chill can occur unless the hutches are protected from all directions. Hutches need to be fixed to avoid movement in high winds. Location needs to be free draining. Most sites require the replacement of the stone or hardcore base periodically to avoid silting up of drainage capacity. Not suitable for exposed sites.
Hygiene	Synthetic materials are easy to clean and disinfect. Hutches can be moved to clean ground.	Cleaning is labour-intensive, and cleaning porous bases presents a hygiene challenge. Can be prone to flies in the summer.
Cost	Cheaper than purpose-built sheds. Expansion can be modular. Modular design allows scale to be increased slowly. Purpose-built gates/feeders/drinkers/covers available.	Not cheap depending on the source of the hutch and when all set-up costs are considered. Variable costs high per calf. Straw costs per calf can be high.
Labour	Good work environment when weather is good.	Staff work outside in all weathers. Feed and water may need transporting some distance. High labour cost. Doesn't allow for automatic feeding.

Group hutches/igloos

Factor	Benefits	Consideration
Disease control	Good for disease control with limited contact between small groups of calves. Small groups are better than large groups. Typically, good access to clean air. Easy to run each igloo and hutch as all-in and all-out. Can be removed for cleaning.	Disease can spread if igloos are not cleaned and disinfected thoroughly and the bases are not free draining. Drainage is a huge consideration. Group housing can lead to the spread of disease. Effort is required to inspect calves carefully.
Ventilation	Dependent on natural ventilation and adjustments to vents. Typical igloo systems work well. Area outside the igloos often under a separate roof cover.	Some designs of group hutches restrict ventilation.
Shelter	The inside area is dry and protected from the weather, and outside, the calves can get limited exercise and sunlight. The calves can choose their preferred environment depending on the weather. With igloos holding 4–15 calves, there is an opportunity for social interaction with other calves.	Outside exercise areas can become very damp. Some designs have a wide tall-door area that increases the risk of wind chill inside. Outside areas can be a poor-quality environment.
Location	Hutches can be oriented towards the sun or moved to locations that are most suitable according to the season.	Poor location can expose calves to high wind speeds. Igloos need fixing to the ground. Location needs to be free draining. Not suitable for exposed sites.
Hygiene	Synthetic materials are easy to clean and disinfect. Hutches can be moved to clean ground.	Cleaning is labour-intensive, and cleaning porous bases presents a hygiene challenge. Drainage is a major weakness. Prone to flies in the summer.
Cost	Some systems are cheaper than a purpose-built facility. Expansion can be staged. Variety of sizes to choose from.	Many systems are similar costs-per-calf compared with fixed buildings. Running costs can be high due to labour and bedding. High labour cost.
Labour	Suited for group feeding system. Better working environment than being totally outside.	Staff work outdoors in all weather. High labour cost.

General purpose building

Factor	Benefits	Consideration
Disease control	Suitable for all-in and all-out.	A standard flat floor can be a major disadvantage for calf rearing by creating poor drainage. Building size can lead to the temptation to have mixed ages of animals, which greatly increases the risk of disease. Increased risk of cold stress in large-volume concrete and steel structures.
Ventilation	Ventilation can easily be improved with the addition of PPTV, which can be removed later.	Often too much air volume for young calves with high eaves height. Draughts, cold zones and poor ventilation is common.
Shelter	Provides excellent shelter, provided draughts are avoided without limiting access to fresh air.	Modifications may be required to reduce drafts.
Location	Can provide flexibility with building use for block-calving herds.	
Hygiene	The choice of materials for pen walls and pen fittings has a long-term impact. Can achieve good hygiene levels if the building structure is well-maintained and drainage is suitable. Good logistics if well planned.	Hygiene can be compromised if the drainage is poor, surfaces are badly maintained and hard to clean. Floor slopes and drains finish is vital. The overall design may be compromised by using large field machinery for mucking out. Cleaning individual pens is a problem. Unlikely to have channels or drains suited for single and double pens.
Cost	Initial capital cost can be high.	Low ongoing maintenance cost. Can be used for other purposes and may suit block-calving herds.
Labour	Working inside during harsh weather. Consumables are available at hand.	Challenging to clean mechanically when not used as an all-in and all-out system. Design can lead to mechanical cleaning across pens.

Lightweight structures

Factor	Benefits	Consideration
Disease control	Can provide discrete-housed conditions for small groups of animals. Variable sizes mean suited for all-in and all-out requirements.	Floor conditions are critical. Respiratory health is sometimes an increased risk. Very dependent on the internal layout.
Ventilation	Simple structure to manage.	Not suitable for exposed sites without additional protection from the wind.
Shelter	Can be good, and a low-profile building means that the structure can sit low in the environment.	Outside exercise areas can become very damp. Some designs have a wide tall-door area that increases the risk of wind chill inside. Outside areas can be a poor-quality environment.
Location	Fairly flexible. The type and design of passive ventilation in the structure can be maximised by consideration of the predominant wind direction.	Must be sited in dry, well-drained areas. Solar radiation can lead to a temperature increase within the structure. Care is required with the selection of cladding colour.
Hygiene	Structure size can be made highly appropriate to group sizes to run all-in and all-out. A suitable structure for batch-calving herds.	Depending on the materials used in construction, it can be hard to clean and disinfect. A deep clean protocol is needed for non-concrete floors.
Cost	Lower initial capital cost.	The costs associated with concrete flooring, pens and fittings, water and power supply must be considered. Be realistic about maintenance and repair costs and durability.
Labour	Good shelter from inclement weather for staff.	Higher labour requirements for managing fittings and more manual handling than buildings with machine access.

Low-cost or temporary calf structures

Factor	Benefits	Consideration
Disease control	A small building or structure can naturally limit group size. Can be single use. Can be used for rapid interventions when, for example, biosecurity issues arise. Can be used to facilitate deep cleaning of main calf house facilities.	Can be more challenging due to nature of installation. Should be disposable or of a material that can be completely cleaned before reuse.
Ventilation	Can use natural ventilation when located outdoors. PPTV can be used in temporary structures and reused elsewhere.	In some existing buildings, ventilation may require improvement. Can be difficult to ventilate naturally without draughts.
Shelter	Basic structures can be easy to manage.	Layouts can be inflexible. Can be exposed to extreme weather. Need to be realistic about losses to environmental factors.
Location	Flexibility on the location.	Not suited to exposed sites.
Hygiene	Can be located on clean ground promptly. Straw bales make good temporary pen dividers but should be changed between batches of calves.	Less likely to have cleanable surfaces. Drainage unlikely to be suitable. Stone walls will need rendering. May prove difficult to clean out mechanically. If bales are used, they should be changed between batches of calves.
Cost	Minimal initial financial outlay.	Be cautious about the additional costs required in time and feed efficiency.
Labour	Variable	Labour intensive on daily routines. Labour is required to keep all the various parts of the structures working effectively and to clean and disinfect thoroughly.

Cost considerations

Cost is a key factor, but the business approach is to consider the money required to build a new building as an investment. The importance for the farm business is the value of any expenditure, not the size. A self-locking feed fence for a group of eight calves will always have a higher cost than a simple trough behind a rail and a board, but the self-locking feed fence will have value in producing more even batches of calves and leaves fewer calves at risk from poor performance.

Not only are there different calf housing system types, but the quality and functionality of examples available within any one type is extremely variable. Further complicating the range of options is the method of construction: whether this is DIY, project-managed or turnkey.

Calf systems can be attractive as a DIY self-build operation. The individual components are generally not large, construction can mostly take place using on-farm equipment, and the project timeline can be fitted around periods of available labour. There are, however, several pitfalls to avoid when considering a self-build project, such as:

- Underestimation of hours involved
- Undervaluation of staff hours involved
- No estimation of the alternative value of staff hours involved (alternative costs)
- No consideration of the value and suitability of the final product compared with a professional build
- Underestimation of the full cost of items involved
- Unintended consequences from overlooked aspect within design planning

Not fully appreciating some of these pitfalls can fundamentally affect the final product.

As a rule, final build costs can be in the region of twice the component costs. The quality of components can also suffer when control of cost is the main driver.

For example, mineral fibre roof sheets and fixings might cost £30/m^2 and stressed corrugated galvanised steel sheeting £26/m^2 (prices correct at time of printing). On a small four-bay building, the difference in cost is in the region of £1,000. While a potential saving of £1,000 is certainly significant, the thermal properties of steel sheets are completely different compared to mineral fibre. In the summer, galvanised steel sheeting can conduct heat, leading to an exceptionally hot rearing facility, and in the winter, galvanised steel sheeting can be cold and lead to significant problems with condensation and high relative humidity (RH).

The return on investment will depend on how many calves are housed per year, whether batch calving, all-year-round calving, or calf rearing all in, all out. Some components within systems will have a shorter expected life span than others. An example of this is polytunnel covers, which will come with a 5-year or 10-year guarantee dependent on quality, which will be reflected in the price/m^2.

Total costs

Calculation of the cost to provide a complete calf housing system is not a straightforward exercise. Much will depend on the availability of resources, especially time, on the requirement (or not) for groundworks, and the quality of concrete flooring.

A self-locking feed fence can improve the even-ness of a batch

There is also a wide range of fittings that are necessary and can add considerably to the total cost. This means that basic items such as a standard steel portal frame may be available from local suppliers and contractors at competitive prices, but the requirements for all penning, gates, drinkers, feeders, suitable cladding, and suitable pipework will significantly add to the cost of the completed calf system.

Further variation in costs comes from the availability and quality of the added components to a system. Some of the hutch and group hutch/igloo systems have a range of products that provide a complete calf housing system and require very little time input to get to the finished product. The same is true for some of the mono-pitch and lightweight structure systems; some items are offered as almost complete packages with only the base and the services as additional costs, while others will require the addition of gates, drinkers, feeders and more.

The base of any calf system makes a significant contribution to its success or failure and to sustainability. Having no base to a system is cheaper, but this puts negative pressure on hygiene, consumable costs, and problems from diffuse pollution. While no base and no roof protection is advantageous when taking a short-term or urgent reaction to circumstances, the inclusion of a drained hardcore or concrete base adds significant value to a calf housing system.

Variable costs, labour requirements and the working environment all have a considerable impact on the success of calf rearing. It is crucial that you consider the value (and not just the cost) of capital items, such as drainage, solid floors, roofing, windbreaks and ad-lib water supply. The presence, or absence, of these items, can make a real difference day-to-day.

A concrete base adds value to a system as it is easy to clean

Further information

Case studies

ahdb.org.uk/knowledge-library/youngstock-housing-case-study-eldon-farm

ahdb.org.uk/knowledge-library/youngstock-housing-case-study-cobblers-farm

ahdb.org.uk/knowledge-library/youngstock-housing-case-study-holly-green-farm

System cost comparison

ahdb.org.uk/knowledge-library/youngstock-housing-system-cost-comparisons

AHDB publications

- Calf management guide
- Dairy beef production systems manual
- Calf health scorecard
- Calf notebook

Online resources

- Healthy calf rearing system checklist

ahdb.org.uk/knowledge-library/healthy-calf-rearing-system-checklist

References

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The Welfare of Farmed Animals (England) Regulations 2007

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BS5502:2005 Building and structures for agriculture

Code of practice for general design considerations BS 5502-20:1990

Code of practice for selection and use of construction materials BS5502-21:1990

Fire precautions. Code of practice BS5502-23:2004

Code of practice for design and installation of services and facilities BS 5502-25:1991

Code of practice for design and construction of cattle buildings, BS5502-40:2005

Red Tractor assurance schemes standards

redtractorassurance.org.uk/wp-content/uploads/2023/06/RTStandards_Dairy_Streamlined-1.pdf

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RSPCA welfare standards

science.rspca.org.uk/sciencegroup/farmanimals/standards

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