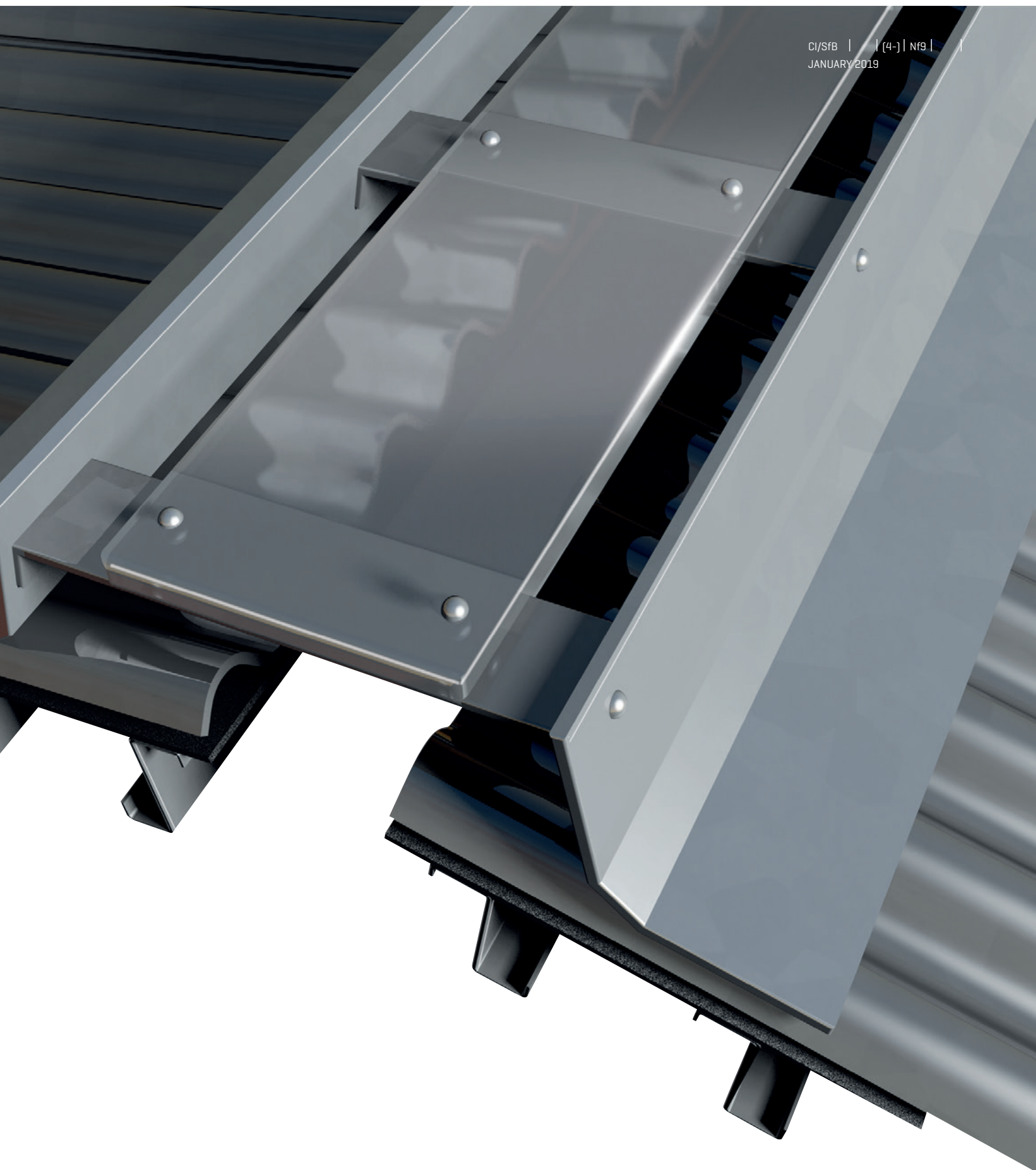


LIVESTOCK BUILDING DESIGN & MATERIAL GUIDE

for natural ventilation



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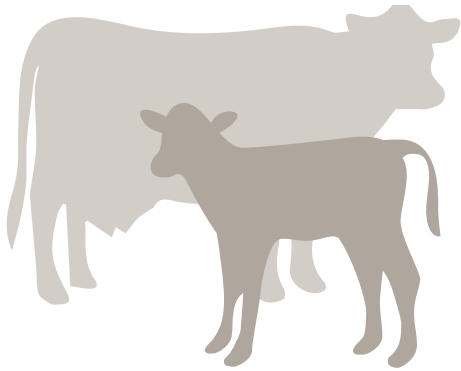




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In this guide, Eternit details best practices from leading research / by the Agriculture and Horticulture Development Board (AHDB) and industry experts.



Costs associated to youngstock with pneumonia are £43 for dairy calves and £82 for beef calves – with significantly lower growth rates and increased treatment contributing the greatest costs shows research from Scarsdale Farm Vets.



Eternit has been backing British farming for more than 100 years with the only fibre cement profiled sheeting made in Britain. It's here to stay.

Poor animal welfare = lower productivity

Poor ventilation



Increased humidity and condensation



Higher levels of bacteria, lameness and illness



Respiratory disease increases, lower feed conversion, higher veterinary bills



Uncomfortable animals, decreased production

THE INTERNAL ENVIRONMENT IN LIVESTOCK BUILDINGS CANNOT BE IGNORED

As livestock producers work hard to manage antibiotic use by focusing on disease prevention, they must also maintain their moral responsibility to consumers and their animals by delivering products raised with high animal welfare standards.

The factors above drive the necessity to maximise production and increase profitability, one thing becomes clear – livestock producers are under immense pressure.

Whether it's an existing building undergoing refurbishment or a new build, design and materials for improved ventilation and internal barn environments will have a direct impact on animal productivity through the synergistic relationship between animal welfare and animal health.

Competent design is needed for air speed, air inlet and air outlet to work together for adequate ventilation to reduce humidity levels, bacteria and other pollutants which

significantly increase the chances of respiratory diseases such as pneumonia.

However, building design is only part of the equation

Building materials also come into play when maintaining a comfortable and healthy internal environment for livestock. And while some popular products may seem like the most economical decision, they can lead to heavy costs associated with decreased animal performance, increased veterinary costs and reduced material life span.

“50% of naturally ventilated buildings assessed are not competently ventilated.”

Jamie Robertson, Livestock health specialist and honorary research fellow at Aberdeen University

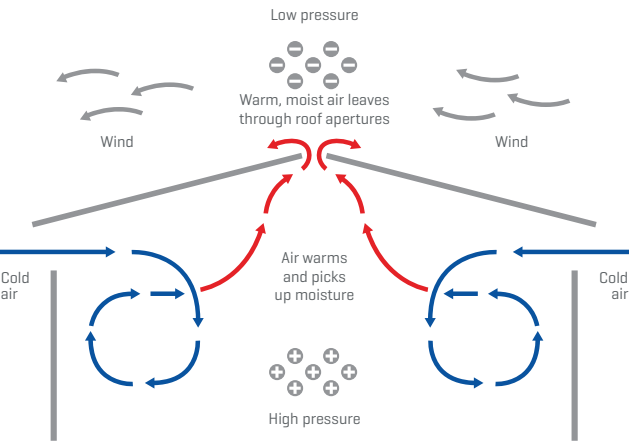


NATURAL VENTILATION REQUIRES THE STACK EFFECT



Stack effect ventilation for cattle

The stack effect provides effective and natural ventilation that works through the pressure differentials occurring between the inside and outside of the building.



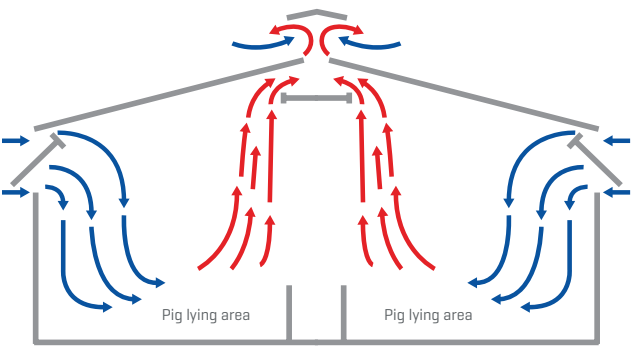
Unprotected open ridge



If you require ventilation advice and help on a live build project, simply email us at infouk@etexgroup.com and we will be happy to arrange for your regional specialist to contact you.

Designing naturally ventilated pig buildings

When designing naturally ventilated pig buildings, AHDB's Ventilating Pig Buildings manual recommends implementing the stack effect with automatically controlled natural ventilation (ACNV) in side-to-side buildings. In this combination of ventilation techniques, vent openings between the sidewall and roof on opposite sides of a building draw in fresh air from the outside while open ridges extract warm air out of the building like a chimney, allowing for more airflow when buildings run parallel to each other.



Protected open ridge

Air outlet for cattle buildings

According to AHDB's Better Cattle Housing Design, youngstock up to 100kg need 0.04m² outlet space per animal, increasing to 0.10m² outlet space per adult animal. An open ridge should be 0.2 to 0.3m wide and unrestricted, says AHDB's Dairy Housing Ventilation guide.

Air outlet for pig buildings

Calculations for air outlet can be determined by the following equation available in AHDB's Ventilating Pig Buildings Manual, which also outlines rate of sensible heat based on pig production type and weight:

$$A_2^{0.67} = \frac{V}{0.382 [H \times Q]^{0.33}}$$

A₂ = area of ridge outlet
V = total ventilation rate required in m³/second (for all pigs in the building)
H = height difference between the top of the outlet and the bottom of the inlet (m)
Q = rate of total sensible heat addition in kW
0.382 = a constant

In a scenario developed by AHDB, a building being used to house 1,035 pigs up to 110kg has dimensions of 61.1m x 15.2m. The height difference between the top of the outlet and bottom of inlet is 3m leading to 36.81m² outlet required.

Maintaining adequate ventilation comes down to two things: managing wind impact and the physics of the air inlet/air outlet cycle. As livestock expel warm air which may contain bacteria and viruses, it rises to the top of the building – making air inlets essential to support air movement in the absence of wind.

“Most wind effect designs will operate effectively at a wind speed over 1m/s and, in the UK, this is available for about 95% of the time.”

AHDB Controlled Environment for Livestock

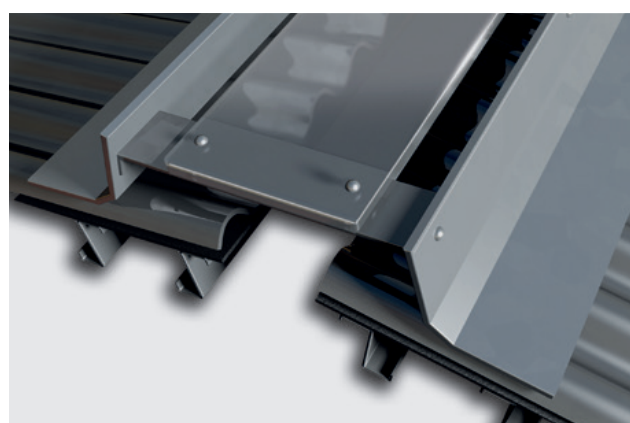
ETERNIT HAS PRODUCTS TO SUIT ANY AIR OUTLET REQUIREMENTS

For cattle and pig buildings, air outlet can be obtained from multiple products and designs, including open ridge upstands, breathing roofs and spaced roofs, which successfully improve ventilation while guarding against rain ingress.



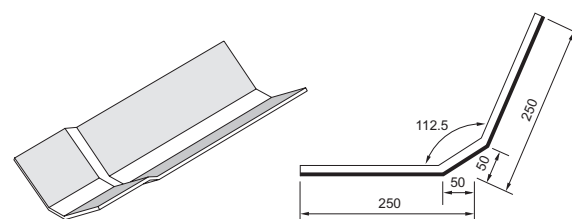
Unprotected open ridges

- Air moves up the slope of the roof and is deflected by the upstand, creating negative pressure at the ridge and enhancing the draw of air through the open vent
- Not only does this aid the ventilation of the internal space but physically blows rain away from the open ridge and stops it from entering the building

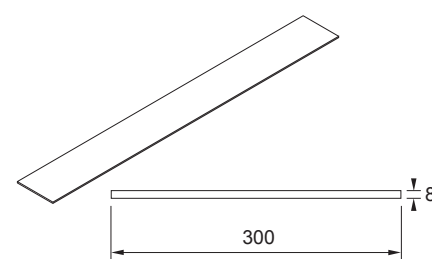


Protected open ridges

- In addition to the traditional fibre cement soffit strip, a polycarbonate soffit strip is available from Eternit to allow more natural light into buildings while avoiding 'hot spots' caused by low level glass reinforced plastic
- Has covering to prevent rain ingress
- Air gap width is configured by the barn's livestock capacity but must not exceed 300mm for HSG 33 requirements. Eternit can assist with design advice to obtain optimum air space for livestock while adhering to health and safety guidance



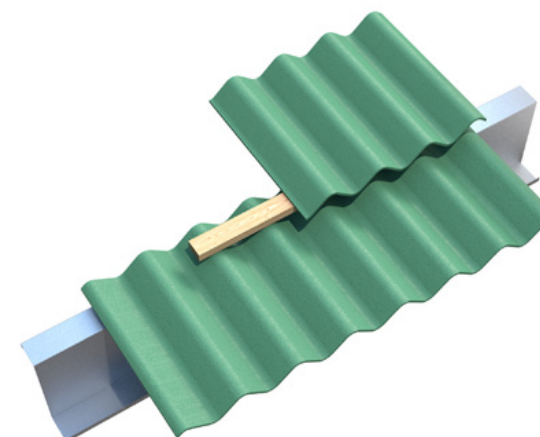
Protected open ridge flashing



Polycarbonate protected open ridge system
[2400mm cover length]

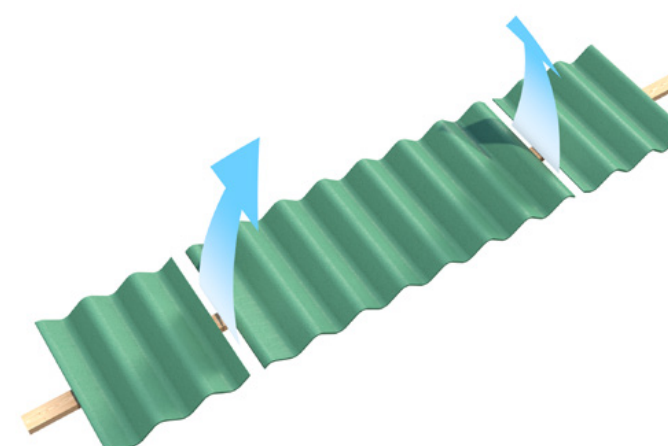
BREATHING AND SPACED ROOFS

While open ridges should be the main method of providing high level ventilation, spaced roofs or breathing roofs can be used in conjunction with open ridges when additional ventilation is required. Not only do these designs decrease condensation, but they also reduce or eliminate mitring of fibre cement sheets where it would normally be required due to overlaps.



Breathing roofs

- Made by inserting a preservative treated 15-25mm timber batten between the profiled sheets at the horizontal overlap of each course
- Small ventilation openings minimise weather penetration
- Reduces condensation on the underside of the roof
- Used in addition with protected open ridges when unable to provide enough high level ventilation for the size and stock level of the building



Spaced roofs*

- Achieve a high degree of ventilation and natural internal light
- Minimise internal condensation levels
- Should be fitted with a space around 10mm between each adjacent sheet
- Best achieved by using Profile 6 roof sheets trimmed to a width of 1,000mm
- Best suited for large agricultural buildings, especially those housing adult cattle during the summer
- Not advised for youngstock
- Will make a building unsuitable for anything other than livestock housing

* Please note that sheets fixed in this manner will be classed as a fragile roof covering.

“The average 650kg Holstein respire 10 litres of moisture per day, quickly turning a barn into a stagnant, humid environment without an outlet.”

Jamie Robertson, Livestock health specialist and honorary research fellow at Aberdeen University

“For optimum ventilation, roof pitch should be 17 to 22°. It's not uncommon to find buildings with a roof pitch at 12°, which reduces air flow and increases snow load.”

AHDB Better Cattle Housing Design

AIR INLETS PROVIDE CONSTANT AIR FLOW

Things such as pen walls, partitions and feeders can prohibit air movement in naturally ventilated livestock buildings and must be kept in consideration by livestock producers and building designers.

Air inlet for cattle buildings

According to AHDB, design for air inlet should consist of two evenly split sidewalls that are four times the size of the outlet area to maintain air flow throughout the building while reducing airspeed at animal height.

- For example, if a dairy building is 30 metres long and 20 metres wide containing 100 cows, then it needs a minimum of 10m² of hole space to get adequate airflow
- Inlet at gable ends should only be utilised when buildings exceed 25m in width or if inlet areas on the sides of buildings are restricted
- Should be above animal height

Air inlet for pig buildings

To prevent the airflow cycle around the outside of pig buildings from impacting airflow inside, a third of the first bay at each end of the building and a third of the ridge should be closed for ACNV side-to-side buildings with ridge outlets, says AHDB’s Ventilating Pig Buildings manual. Air inlet size will need to be approximately double that of outlet space.

“For ventilation to work well, you need adequate air inlets too. If the building is enclosed, the inlets need to be big enough to provide a constant flow of air, without being so large that they subject the animals to wind and rain.”

Jamie Robertson, Livestock health specialist and honorary research fellow at Aberdeen University

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Airspeed

Energy loss from livestock due to draughts can reduce feed conversion and immunity suppression, potentially leading to higher disease rates, says AHDB’s Better Cattle Housing Design guide.

Adult cattle are most resilient to airspeed, however youngstock’s low immunity and pigs not being ruminants, make them most sensitive.

- When wind speed rises from 0 to 15mph (6.8m/s) energy loss doubles
- 0.5m/s draught for youngstock
- 0.15m/s draught for pigs

Instead of sealing off walls, livestock producers should use cladding or windbreak material which act as precipitation barriers while allowing adequate movement for ventilation. While there are many options available on the market, there are many considerations outlined by AHDB.

- Openings should not exceed 25mm in width on windward side of building
- Windbreak material should be 50% permeable
- Minimum ratio of length to height of windbreak is 12:1

Cladding options

- Yorkshire boarding (150mm board with 20-50mm gap)
- Spaced boarding (100-150mm board with 20-25mm gap)
- Perforated metal sheeting
- Plastic or woven ventilation curtains

“The optimum temperature for a dairy cow is around 5°C, so this is critical to maximise production and welfare in the building. The cooler the cow, the more she lays down, and the more milk she will produce.”

Ivor Davey, CowPlan Dairy Housing and Design Consultant

Improved ventilation allows high yielding dairy cows to remain indoors all year round

Good ventilation and buying British were the key reasons for choosing spaced roof sheets from Eternit for a new dairy unit in West Dorset.

In 2012 the decision was made to invest in the farm, owned by the Cooper Dean Estate family partnership, near Beaminster. The buildings on the farm had not been invested in since the 1970s so plans were drawn up for a new cubicle house, collecting yard, feed passage and straw yard, increasing cow numbers from 150 to 300.

The proposed site for the new building was to be dug into the hill behind the existing unit, minimizing the visual impact. Farmscape Anthracite was chosen for the roof of the unit as the dark colour perfectly matched the roofs of the existing farm buildings adjacent to the new development.

“As well as being ‘down in a hole’ the site is also exposed to the prevailing wind from the South West, so getting enough fresh air in, whilst keeping the prevailing wind and rain out of the new build was something we spent a lot of time on,” said Ed Bowditch who runs the farm.

To address the ventilation concerns, local Agricultural Frame Manufacturer PH Hardwill Ltd., designed the building with spaced timber boarding on the wind-facing end and side, with the side where the building faces the embankment left fully open. To ensure enough

air circulation, the trimmed Eternit Farmscape sheets were installed with a 16mm gap and the building incorporated a protected open ridge to draw the stale air out of the building. The sheets nearest the eaves at either side of the building were left untrimmed to ensure that the air entering the building from either side flows over the cattle rather than exiting straight up and through the roof. “I’m really pleased with the design” says Ed. “The heat rising from the cows actually prevents the moisture entering through the gaps. Our high yielders are inside all year round and last summer these sheds were the coolest place on the farm.”

When planning the project, another consideration for Ed was sourcing British products wherever possible. “When PH Hardwill Ltd. recommended Eternit sheets I was happy to take their advice. They have a good reputation in the industry for producing high quality products and are a British company as well. We definitely made the right choice. The buildings work well and look right, most importantly our cows are content and performing well in their new environment.”



High animal welfare drives high performing pig unit

What started out as a small pig operation in a converted shed with 14 stables in 2013 grew to a 2,000-head pig unit within two years after investments were made to expand the growing pig enterprise.

According to Anthony Robinson, pig production manager at Manor Farm in Sherrifhales, Shropshire, the fast-moving success is greatly attributed to prioritising animal welfare, which in return, has increased production.

The unit, which operates under contract, takes in 7kg weaners and finishes them at 110kg. The system operates under RSPCA and Red Tractor assurance schemes, as well as being Co-op and Waitrose assured.

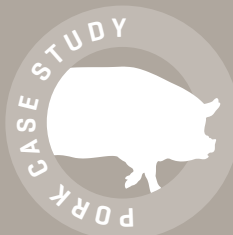
When the decision to expand was made in 2014, Anthony visited multiple pig sites to find which unit designs and building materials were the best to create an environment for improved animal welfare and performance.

Profile 6 fibre cement profiled sheeting from Eternit was used on the roof for its ability to absorb 25% of its own weight in moisture, greatly reducing high condensation levels that are often experienced with metal roofing materials.

Ventilation was another crucial component to achieving high animal welfare by ensuring a good flow of fresh air through the housing to reduce the build-up of dust and air borne bacteria. As such, a raised, protected open ridge from Eternit was installed to help draw in fresh air from the sides of the shed, forcing stale air up and out through the top of the building.

The new unit houses 930 pigs and employs modern technology to ensure optimum animal welfare and growth rates. This included the installation of automatic variable ventilation systems on the side of the building (linked to a computerised weather centre), automated feeders and metered water system.

Anthony’s focus on animal welfare and the strong production figures he achieved in the first two years with the new unit resulted in him being a runner up for the National Pig Association Young Pig Farmer of the Year Award.



ROOFING MATERIALS MAKE A DIFFERENCE

When selecting roofing material for livestock buildings, the overall production picture needs to be looked at with a focus of maintaining a stable building environment rather than choosing the cheapest option.



“Tin is the least appropriate material for animal house roofing because it increases the risk of condensation compared with most other roofing materials. Condensation is moisture that would have left the building if the ventilation specification and the roof materials were more appropriate.”

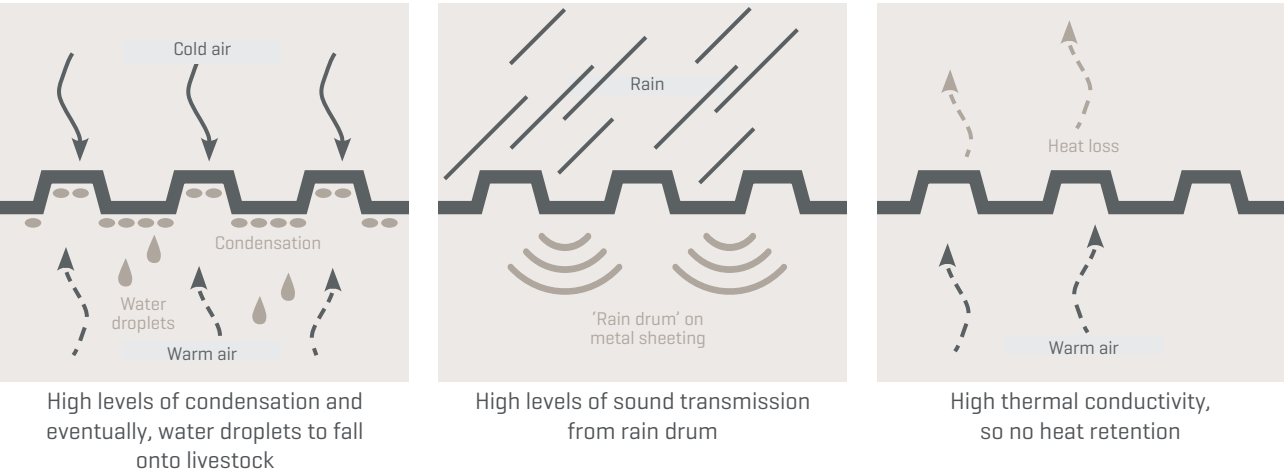
AHDB Better Cattle Housing Design

Metal Sheet disadvantages

For example, while metal sheet will cost less up front, it has several downsides that will end up costing livestock producers more long-term production decreases and short-lived longevity.

- While some manufacturers offer 25 year guarantees, some sheets may only last 10-15 years in the UK’s environment before needing to be replaced
- Noise levels in hail or heavy rain on metal sheeting are much higher than fibre cement, significantly increasing cow discomfort which leads to a reduction in productivity
- High thermal conductivity creates opportunity for rapid temperature swings within buildings, putting pigs and youngstock at greatest risk
- Contributes to high humidity levels due to the inability to absorb moisture, leading to increased condensation levels from warm, humid air coming into contact with the cool underside roof finish. Humid environments foster bacteria growth which increases the likelihood for disease

Metal sheet [‘tin roofing’] properties



Independent testing found semi-compressed fibre cement sheets only drip with condensation for 1% of the time during winter months, compared to almost 20% of the time for single skin steel.



Fibre Cement Profile Sheet advantages

While fibre cement profiled sheeting will cost more up front, it carries the greatest benefits in improving livestock productivity by contributing to animal welfare conditions. It can also outlast metal sheeting upwards of 25 years.

- Life expectancy of at least 50 years
- Absorbs sound, reducing rain reverberation
- Low thermal conductivity prevents temperature swings while creating mild internal building environment year-round
- Can absorb up to 25% of own weight in moisture which dissipates under warm and dry conditions, reducing humidity and mitigating condensation

NB: The market offers two types of profile sheet both made to the same standards which meet the same strength requirements.

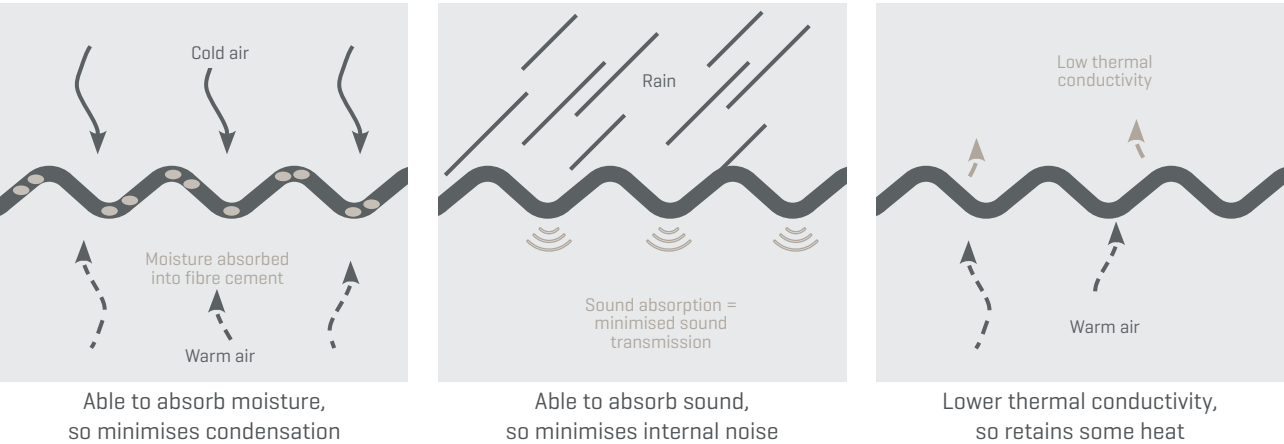
Eternit’s semi-compressed sheets are lighter sheets to install than fully compressed sheets and have the best absorbency rate of any Fibre Cement Sheet in the UK at 25% of its own weight. This minimises condensation beyond the ability of any other sheet in the market whether it is Metal or Fibre Cement, reducing the risk of condensation dripping from the roof onto the animals.

“Many livestock buildings in the UK are roofed with fibre cement profiled sheeting. This is a preferred material as it is durable, has limited absorbency of condensation, and produces a more stable internal temperature than steel roof sheeting.”

AHDB Better Cattle Housing Design

P6 | P3
PROFILED SHEETING

Fibre cement properties





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Eternit backs British farming

Eternit is the only UK manufacturer of P6 and P3 fibre cement profiled sheeting. British-made for British farmers, our wide range of products and ventilation systems are better for:

- animal health and welfare
- providing excellent noise and thermal insulation
- reducing condensation
- resisting the most extreme weather conditions

Eternit products for naturally ventilated buildings are also suitable for arable, equestrian, machinery and poultry buildings.

Further information

For more information on agricultural building design and to read our latest blog posts and case studies, please visit eternit.co.uk

Telephone 01283 501555
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