WELSH TRADITIONAL BUILDINGS FORUM
FFORWM ADEILADAU TRADDODIADOL CYMRU

Level 3 Award

Energy Efficiency Measures in Older and Traditional Buildings

Dyfarniad Lefel 3

Mesurau Effeithlonrwydd Ynni ar gyfer Adeiladau Hŷn a Thraddodiadol

ENERGY EFFICIENCY MEASURES FOR OLDER AND TRADITIONAL BUILDINGS

Energy Efficient Interventions to fabric: Design, Considerations and Risks

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HISTORIC BUILDING CONSULTANCY

ENERGY EFFICIENCY MEASURES FOR OLDER AND TRADITIONAL BUILDINGS

Options for improvements and ways in which energy efficiency improvements can affect performance of Traditional Buildings

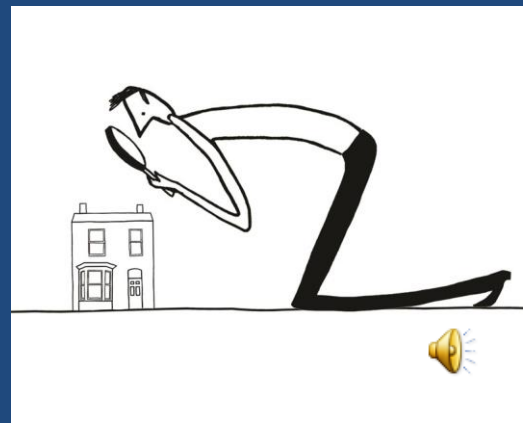
Insulation is not new!

Lime plaster on thick reed held with lath onto a brick wall behind

THE WHOLE BUILDING APPROACH

The best approach is to look at the whole building, its own environment, construction, condition and historic significance.

You need to know all the factors that affect energy use in order to devise an energy efficiency strategy for the building.



THE FOUR MOST IMPORTANT FACTORS ARE:

- **Building location and orientation**
  The performance of a building will be affected by local climate and its exposure to wind, rain and sun.
- **Building design and fabric**
  The form and design of the building, the construction materials and components and their condition also affect energy performance.
- **Services and equipment**
  Heating, cooling, lighting and ventilating a building all use energy. So does the equipment and appliances we use for cooking and entertainment.
- **People**
  We all use our buildings in different ways. The amount of energy we use varies too. The number of people in a house, the levels of comfort they expect, and the services and equipment they use all have a significant effect on how much energy a household consumes.

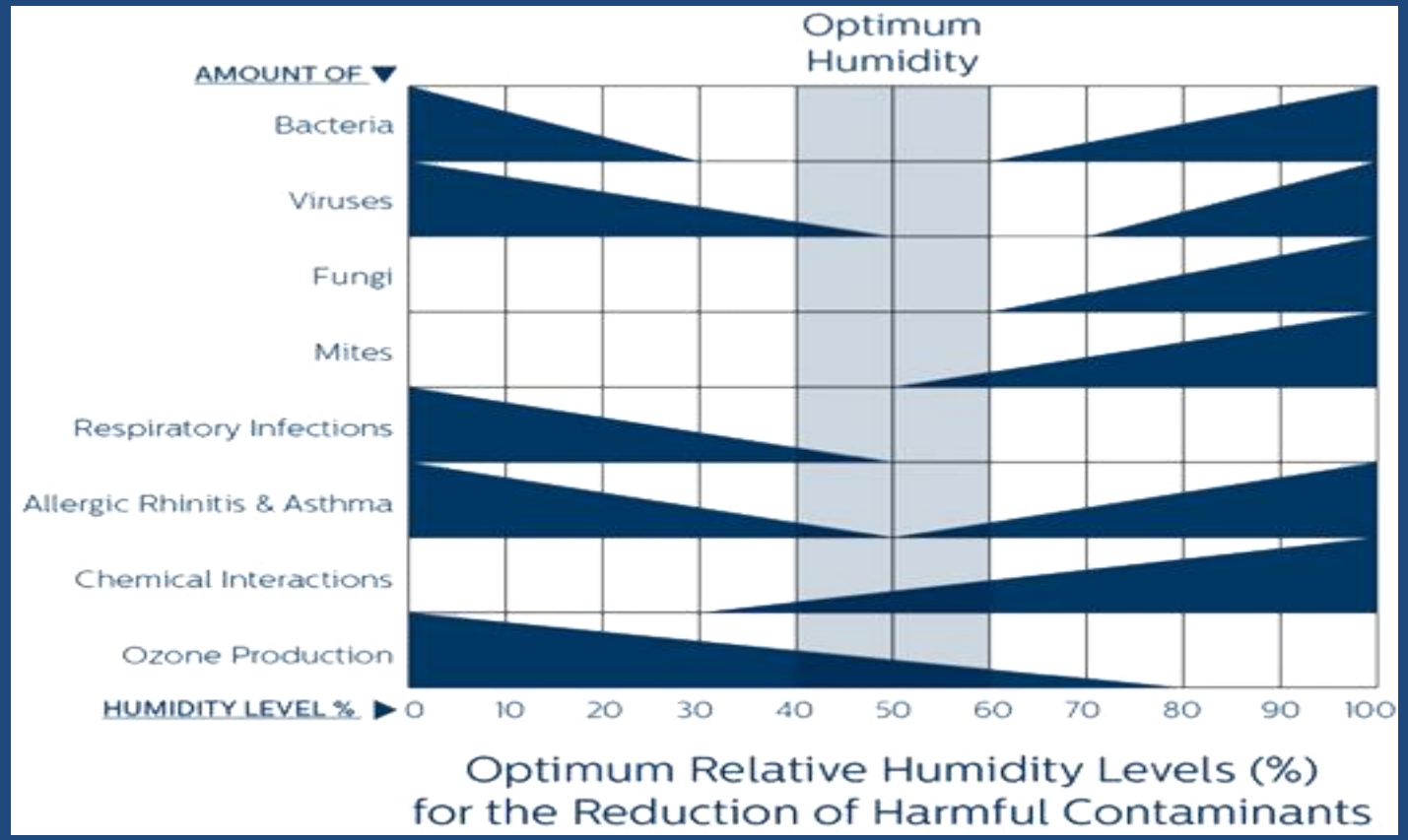
UNDERSTANDING THE BUILDING AND ITS CONTEXT

- The historic significance of the building and the potential harm from changes
- Its exposure to sun, wind and rain
- Its design, construction and condition
- The performance and behaviour of the building materials
- The design, condition and operation of services such as heating and hot water
- How the building is used
- Your / your clients requirements, aspirations and aims
- Budget and other resources, opportunities and constraints

THE WHOLE BUILDING APPROACH

- Make sure your building is dry & will stay dry
- Allow for controlled ventilation
- Control indoor humidity levels

THE WHOLE BUILDING APPROACH



ENERGY EFFICIENCY IMPROVEMENTS PRACTICAL SOLUTIONS

British Standard 7913

GUIDE TO THE CONSERVATION OF HISTORIC BUILDINGS

- The standard includes information such as walls can be 30% less energy efficient if damp and good repair provides greater energy efficiency. (Section 5.3.1)
- Impervious materials can be harmful including cement pointing and rendering and most types of impervious solid wall insulation and the Standard states that removal should be considered.
- Section 5.3.1 states 'some energy efficient measures can have an adverse effect on sustainability'.
- Section 7.4 on materials emphasises that 'the removal of historic fabric and patina should be avoided as far as possible to retain authenticity'.
- Section 0.1 highlights that British Standards that are applicable to newer buildings might be inappropriate.

HOW DO I INSULATE SOLID WALLS?

- Two main options
  - External wall insulation (EWI)
  - Internal wall insulation (IWI)

EXTERNAL WALL INSULATION

- maintains Thermal Mass
- additional Rain-Screen
- potentially less disruption
- physical adaption of the building, eaves, window sills, services
- planning, Listed Building Consent
- detailing of junctions crucial
- improved Acoustic Insulation

INTERNAL WALL INSULATION

- cools walls but rooms warm up quicker
- may lead to risk of Interstitial Condensation
- features such as skirting boards, door frames, coving, panelling and picture rails present a problem
- reduces room size

APPROPRIATE VS INAPPROPRIATE MATERIALS AND SYSTEMS

MATERIALS ARE NOT NECESSARILY EITHER GOOD OR BAD IT IS WHERE AND HOW THEY ARE USED THAT IS IMPORTANT UNDERSTANDING THE WHOLE BUILDING APPROACH

EXTERNAL RENDER FOR PROTECTION, KEEPING WALLS DRY AND LOW LEVELS OF INSULATION

IMPERMEABLE RENDERS	VAPOUR PERMEABLE RENDERS
OPC, Silicone, and Polymer renders	Non-hydraulic, Natural Hydraulic, Hydraulic & Formulated Lime renders
Sto, Weber, K-rend ….	Insulating systems include cork, hemp and perlite
Quality assured, often pre-mixed, test data sometimes lacking	Quality assured, often pre-mixed, test data sometimes lacking
Designed to be waterproof	Designed to be water shedding, vapour permeable
Lower porosity, capillarity, flexibility	Higher porosity, capillarity, flexibility *in general
Unsuitable for solid walled buildings and historic timber-framed buildings	Suitable for solid walled buildings and historic timber-framed buildings although not all products are equal

CASE STUDY

CEMENT RENDER, CEMENT POINTING

18TH CENTURY HOUSE & BARN

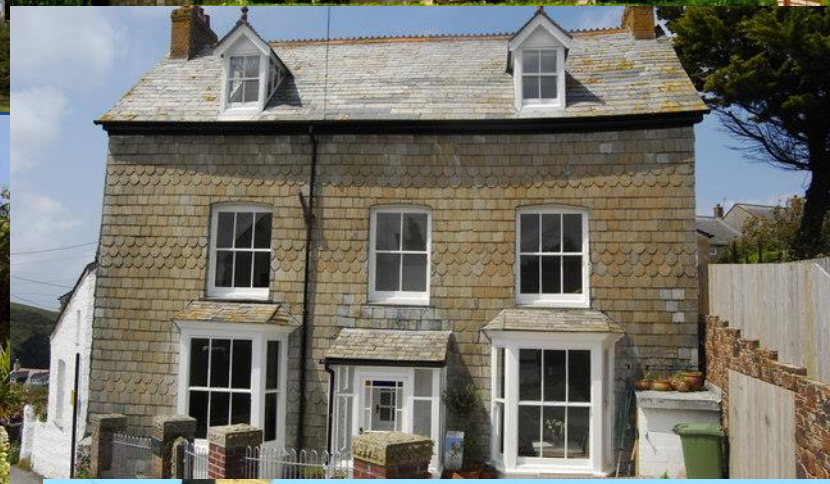
LIME RENDERS & INSULATING LIME RENDERS

External finishes to 'traditional' buildings include simple pointing, parging or 'bagging' , smooth render, stippled render, ashlar render, roughcast , slate or tile hanging, weatherboarding each is dependant on building physics, location, exposure, vernacular tradition , architectural style and status and each is designed to provide necessary protection from weather to keep the building dry and therefore warm

More recently in the last 20 years insulating lime-based renders have been introduced






CORK LIME INSULATING RENDER/PLASTER

- Made from cork bark aggregate blended with natural hydraulic lime – Formulated lime
- Can be applied in thicker coats than normal lime plasters – 20mm per coat up to 40mm thick – reduced shrinkage.
- Some thermal insulation value and good acoustic properties as well as being vapour permeable.
- Contributes to the air-tightness of the building

LIGHTWEIGHT INSULATING LIME RENDER/PLASTER

- Multiple brands using a variety of lightweight natural and recycled insulating aggregates
- Bauwer Light , Proofsheild & Telling Unilit 20 use perlite
- Cornerstone Insulating Render , Anglia Lime Thermalime and Adaptavate Breathaplasta don't disclose their insulating material
- All are formulated limes based on Natural Hydraulic Lime but often with other additives
- Roundtower have a new insulating lime render that is NHL2 and recycled aggregate.
- Some contractors will mix their own perlite fat lime plasters or Natural Hydraulic Lime Plasters

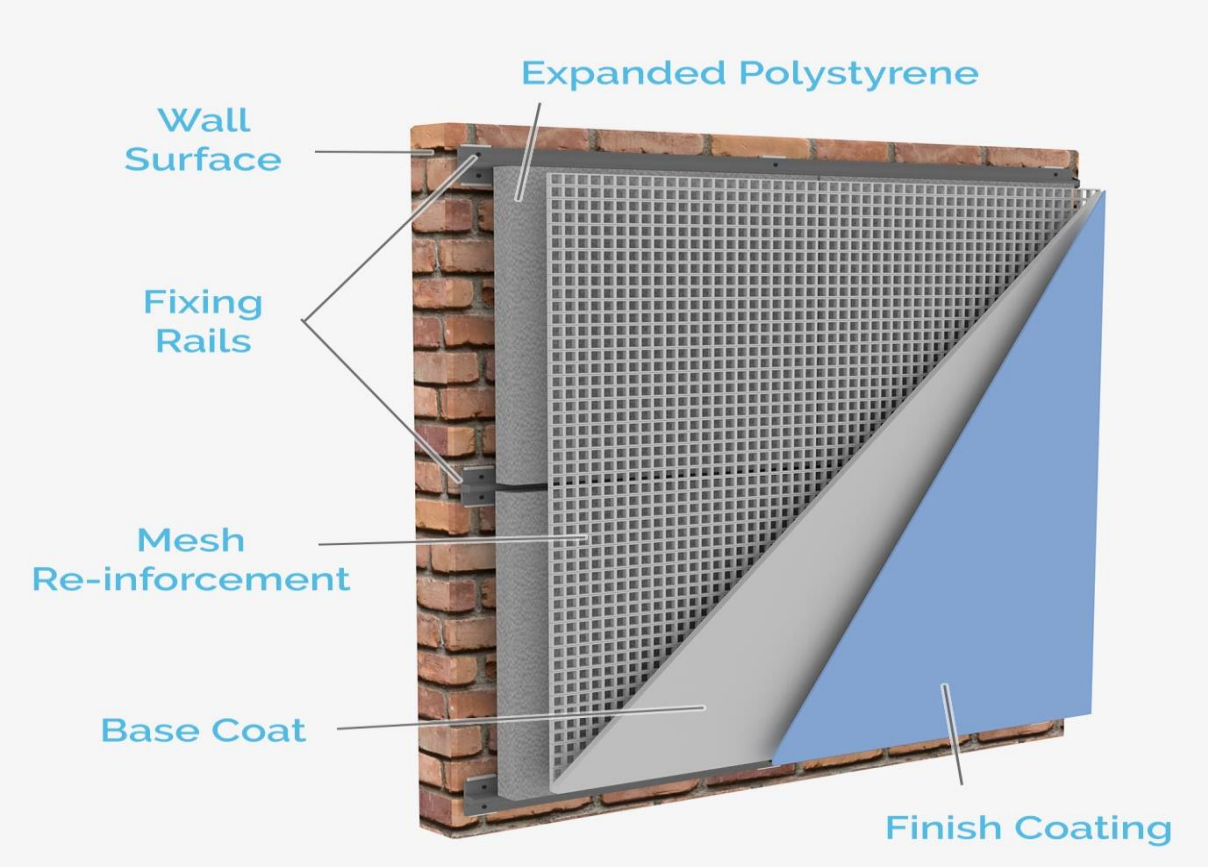
EXTERNAL WALL INSULATION

IMPERMEABLE INSULATION SYSTEMS	VAPOUR PERMEABLE INSULATION SYSTEMS
Expanded Polystyrene (EPS) ▪ Foamed glass ▪ Polyurethane ▪ Polyisocyanurate (PIR)	Wood fibre board ▪ Cork ▪ Mineral wool ▪ Glass fibre ▪ Aerogel ▪ Sheep's Wool
Celotex, Kingspan , Quinn therm….	
Increased risks of trapping moisture within walls, thermal bridging, interstitial condensation	Reduced risks of trapping moisture within walls, thermal bridging, interstitial condensation
Generally higher levels of insulation	Generally lower levels of insulation
Generally higher embodied energy	Generally lower embodied energy
Unsuitable for solid walled buildings and historic timber-framed buildings	On a case by case basis can be suitable for solid walled buildings and historic timber-framed buildings

CASE STUDY

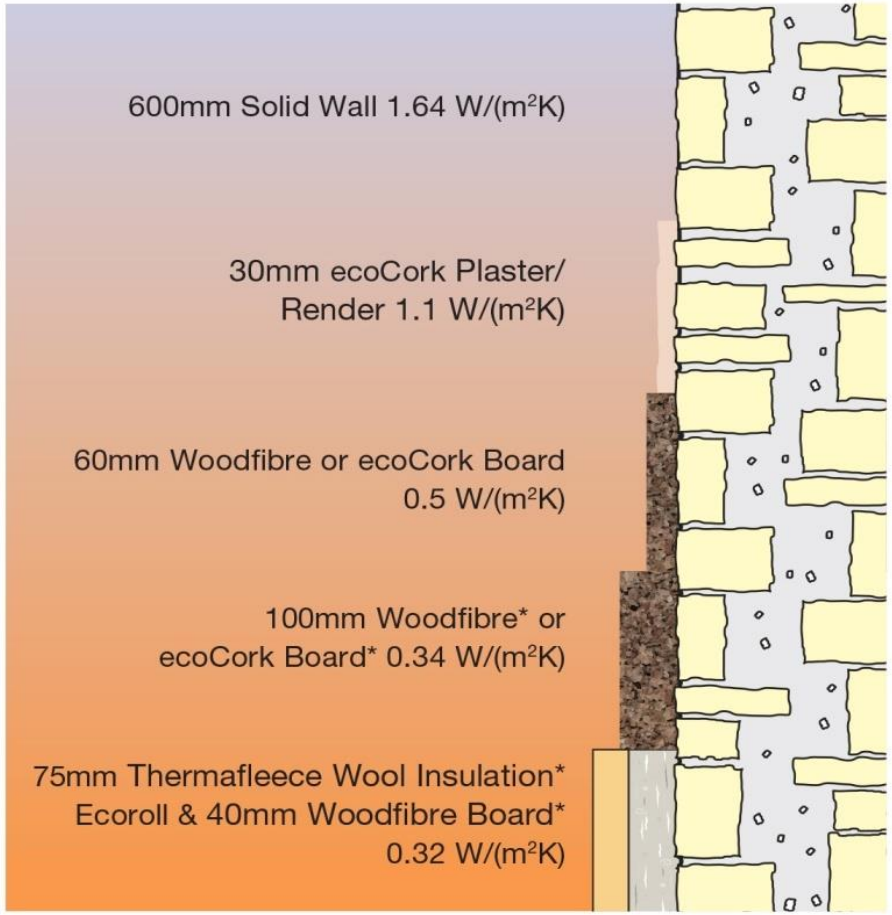
EXPANDED POLYSTYRENE INSULATION

19TH CENTURY HOUSE


Expanded Polystyrene
Wall Surface
Fixing Rails
Mesh Re-inforcement
Base Coat
Finish Coating

‘NATURAL’, VAPOUR PERMEABLE EXTERNAL INSULATION OPTIONS

EXTERNAL WALL INSULATION OPTIONS

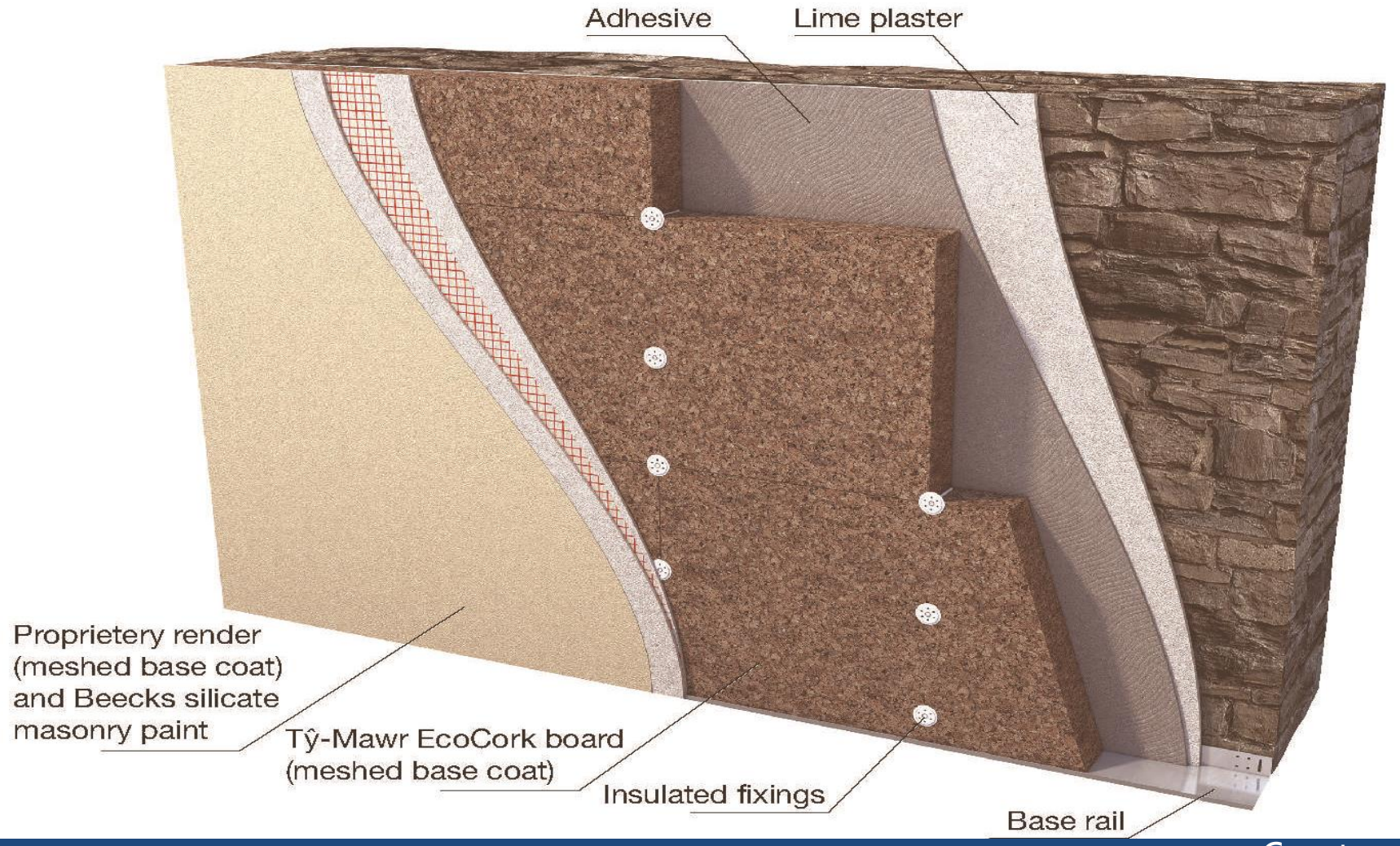


Courtesy Ty-Mawr Lime Ltd.

EXPANDED CORK BOARD

- From a sustainable source.
- Tree bark stripped every 7-9 years
- Utilises waste material - offcuts
- Internal or External
- Once processed is unaffected by prolonged moisture
- K-Value – 0.038 W/mK

CORK BOARD EXTERNALLY



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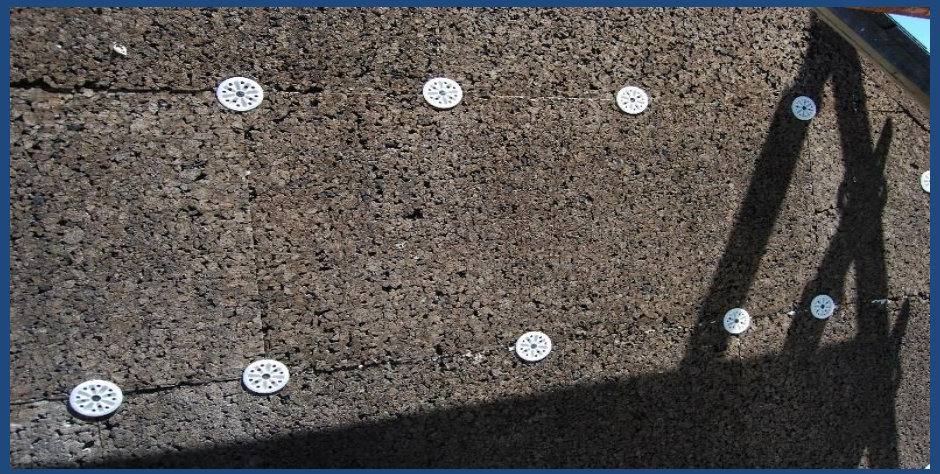
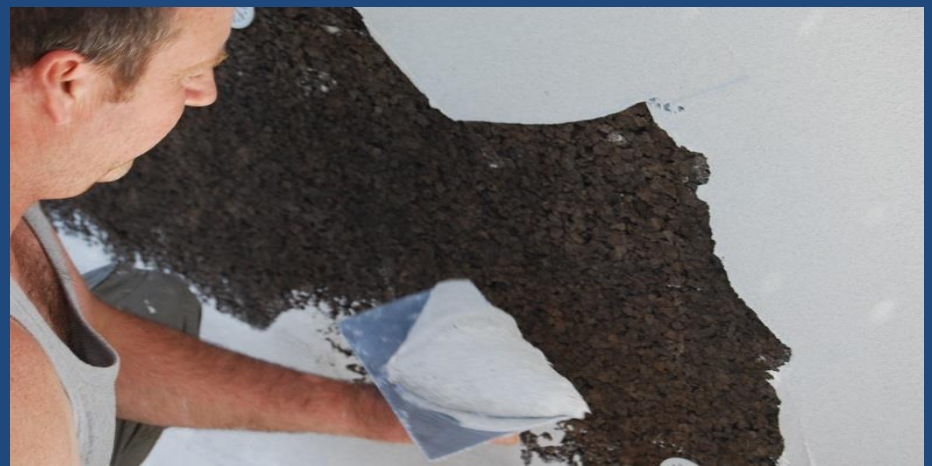
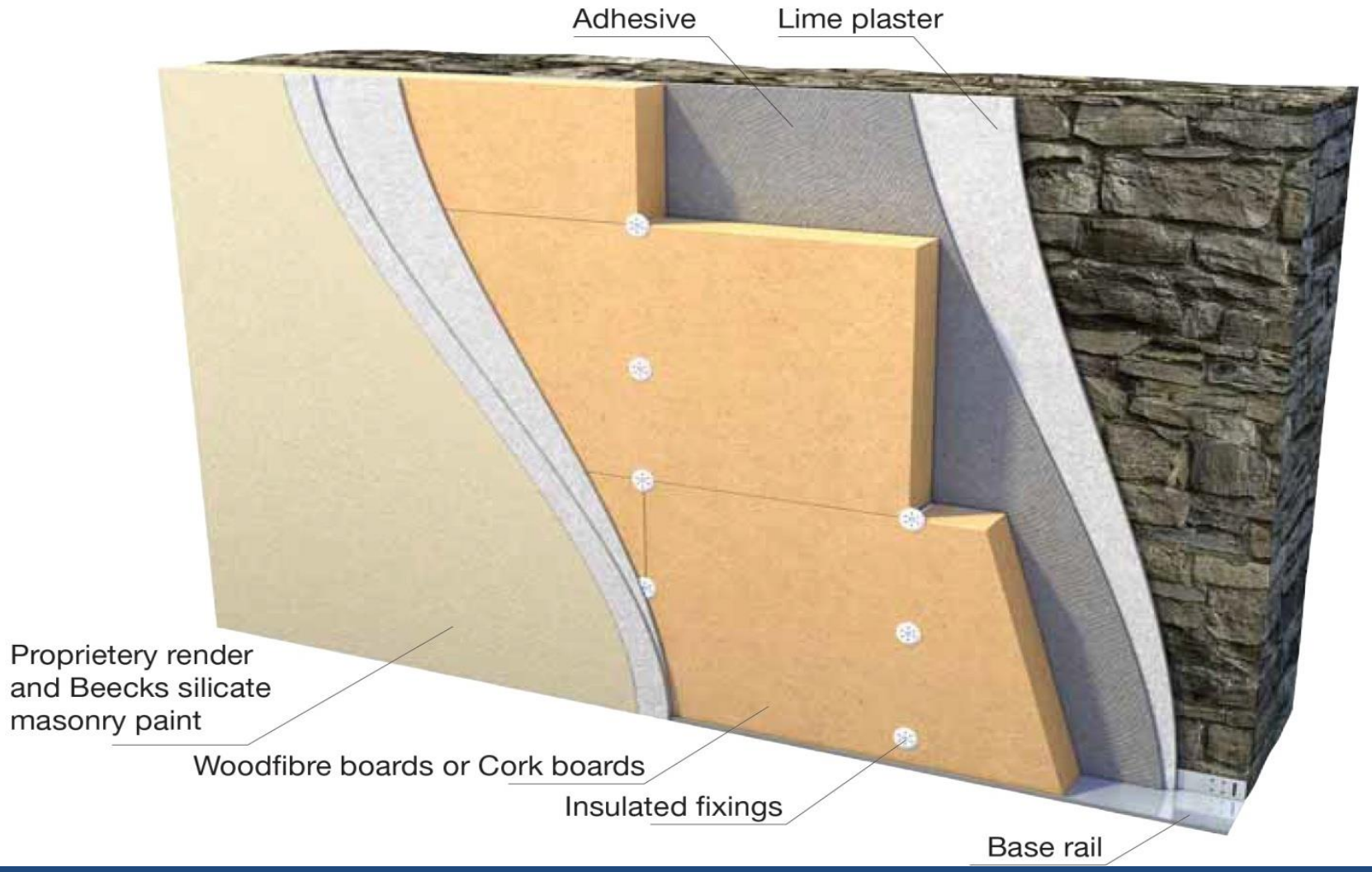




WOODFIBRE BOARD

- Multiple manufacturers including Gutex, Schneider, Steico, Pavatex, also sold as a system called Warmshell
- Heritage from the 1930s
- Raw materials from wood harvested and grown using sustainable forestry management practices.
- Untreated spruce and fir chips and shavings that are by-products produced by other timber manufacturing processes.
- Dry manufactured boards bound with heat and pressure
- Wet manufactured boards with glue lines
- K-Value – 0.038-0.044 W/mK

WOODFIBRE BOARD EXTERNALLY



Courtesy Ty-Mawr Lime Ltd.

STUD WITH WOODFIBRE & SHEEP'S WOOL

TRADITIONAL TIMBER-FRAME BUILDINGS

INFILL PANEL OPTIONS

- Built with wattle and daub the infill panels were lightweight and flexible moving with the timber through the seasons
- Damaged panels increasingly re-filled with brick from the Victorian period onwards
- Introducing insulation in the mid-late 20th century often involved Styrofoam/polystyrene or PIR boards covered with chicken wire/mesh and cement or lime rendered – the result was failures due to inflexibility and holding moisture against the timbers resulting in rot
- Solutions include replacement wattle and daub, hempcrete, cork boards, sheep's wool insulation with woodwool boards

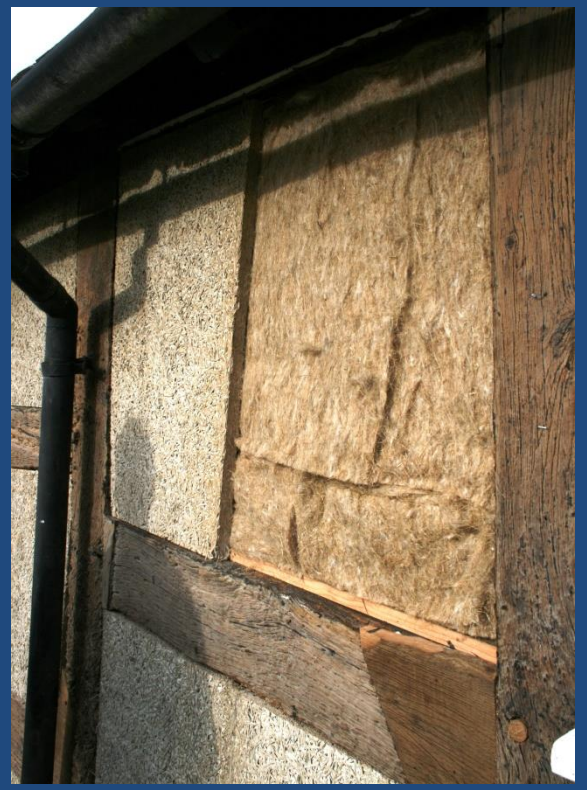
RESULTS OF CEMENT, FOAM AND METAL MESH

HEMP PLASTER

HEMPCRETE INFILL

EXPANDED CORK BOARD INFILL

FLEXIBLE SHEEP'S WOOL/HEMP WITH WOODWOOL BOARD



OVER-BOARDING TIMBER-FRAMES

- Over-boarding can be achieved with T& G Woodfibre boards that can then be battened and weather boarded or lime rendered

INTERNAL WALL INSULATION

INTERNAL WALL INSULATION

IMPERMEABLE INSULATION SYSTEMS	VAPOUR PERMEABLE INSULATION SYSTEMS
Expanded Polystyrene (EPS) ▪ Foamed glass ▪ Polyurethane ▪ Polyisocyanurate (PIR) ▪ Stud with mineral wool, plasterboard & skim	Wood fibre board ▪ Cork ▪ Calcium Silicate board Stud with Sheep's Wool/flexible hemp/flexible woodfibre/cellulose , woodwool/woodfibre board and lime plaster
Increased risks of trapping moisture within walls, thermal bridging, interstitial condensation	Reduced risks of trapping moisture within walls, thermal bridging, interstitial condensation
Generally higher levels of insulation	Generally lower levels of insulation
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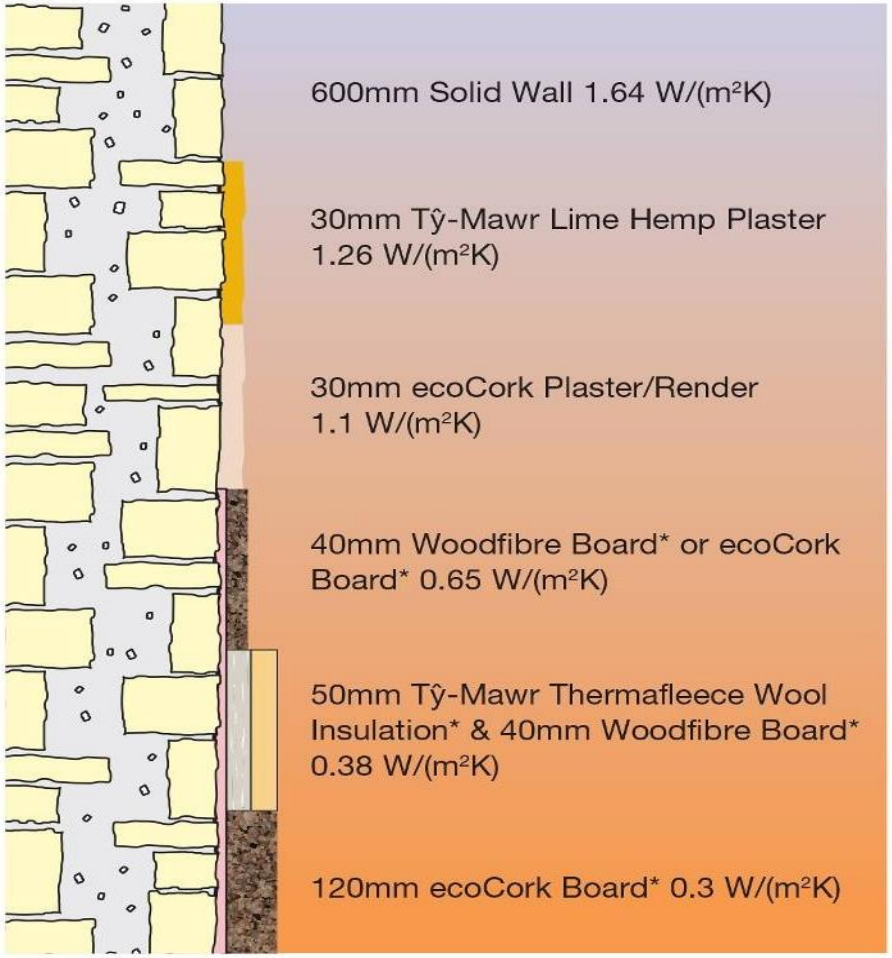
Unsuitable for solid walled buildings and historic timber-framed buildings	On a case by case basis can be suitable for solid walled buildings and historic timber-framed buildings

NATURAL & VAPOUR PERMEABLE INTERNAL INSULATION

INTERNAL WALL INSULATION OPTIONS



Courtesy Ty-Mawr Lime Ltd.

INTERNAL LIME INSULATING PLASTERS

ECOCORK PLASTER

Courtesy Ty-Mawr Lime Ltd.

LIME HEMP PLASTER

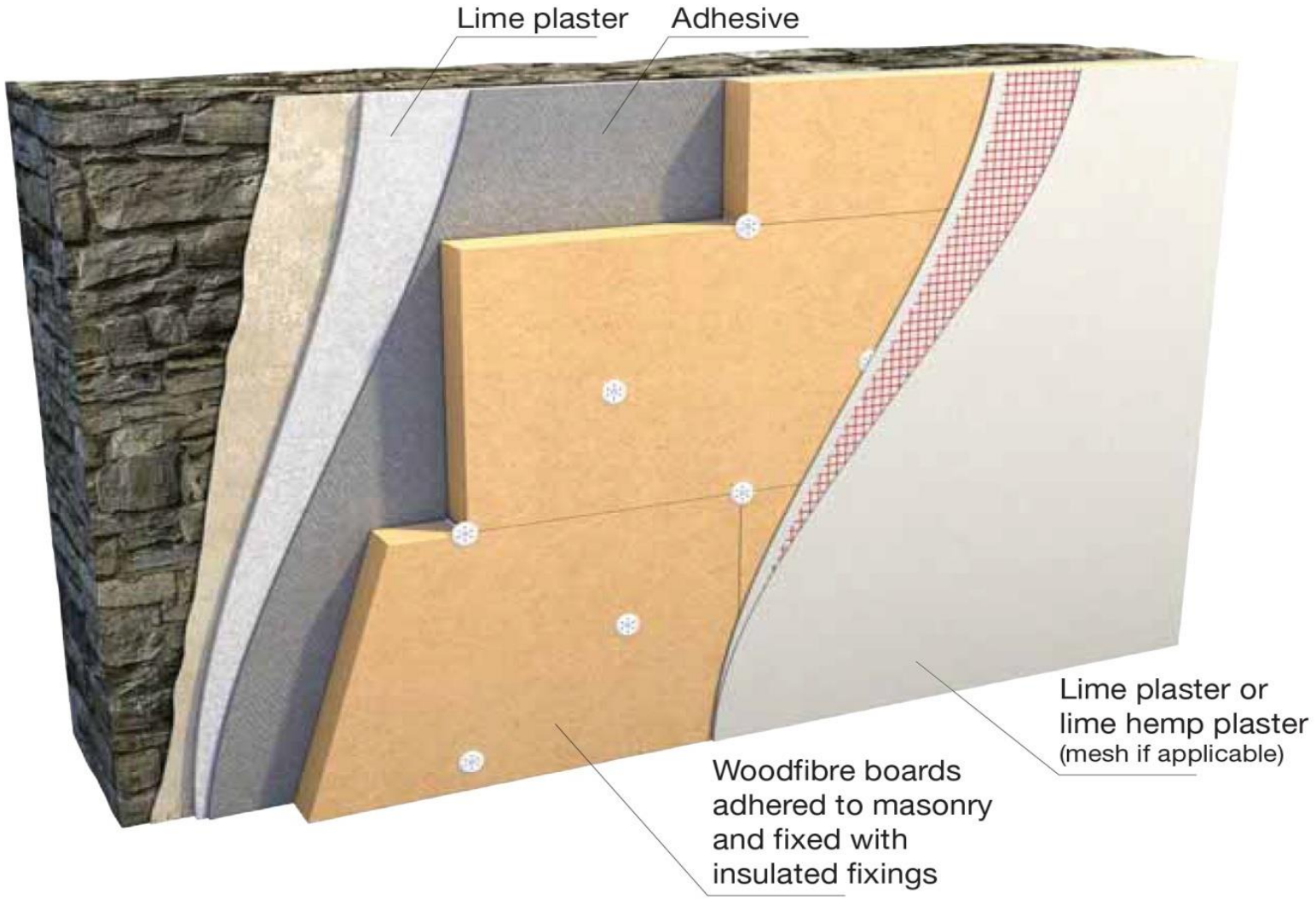
- Made from the chopped stems of hemp plant blended with lime putty – natural and renewable.
- Significantly lower CO_2 footprint
- Can be applied in thicker coats than normal lime plasters – 10-25mm with reduced shrinkage.
- Some thermal insulation value and good acoustic properties as well as being vapour permeable.
- Contributes to the air-tightness of the building

Courtesy Ty-Mawr Lime Ltd.

HEMPCRETE

- Shuttered lime hemp with a Natural Hydraulic Lime binder or Hydraulic lime binder
- combination of insulation and thermal mass (heat store) within the same material – means that the interior of hempcrete buildings remains at a near constant temperature
- Because of the lime binder which coats every particle of hemp in the hempcrete mixture, hempcrete achieves good ratings for fire-, rot-, and pest-resistance, without the need for additional treatment
- vapour permeable and *hygroscopic*: hempcrete walls and the lime plaster finishes will "buffer" the levels of humidity inside the home, absorbing moisture from the air into the wall during times of high relative humidity and releasing it again when humidity levels drop. Keeps internal humidity levels within the 40-60% range which inhibits the growth of viruses and bacteria.

WOODFIBRE INTERNALLY



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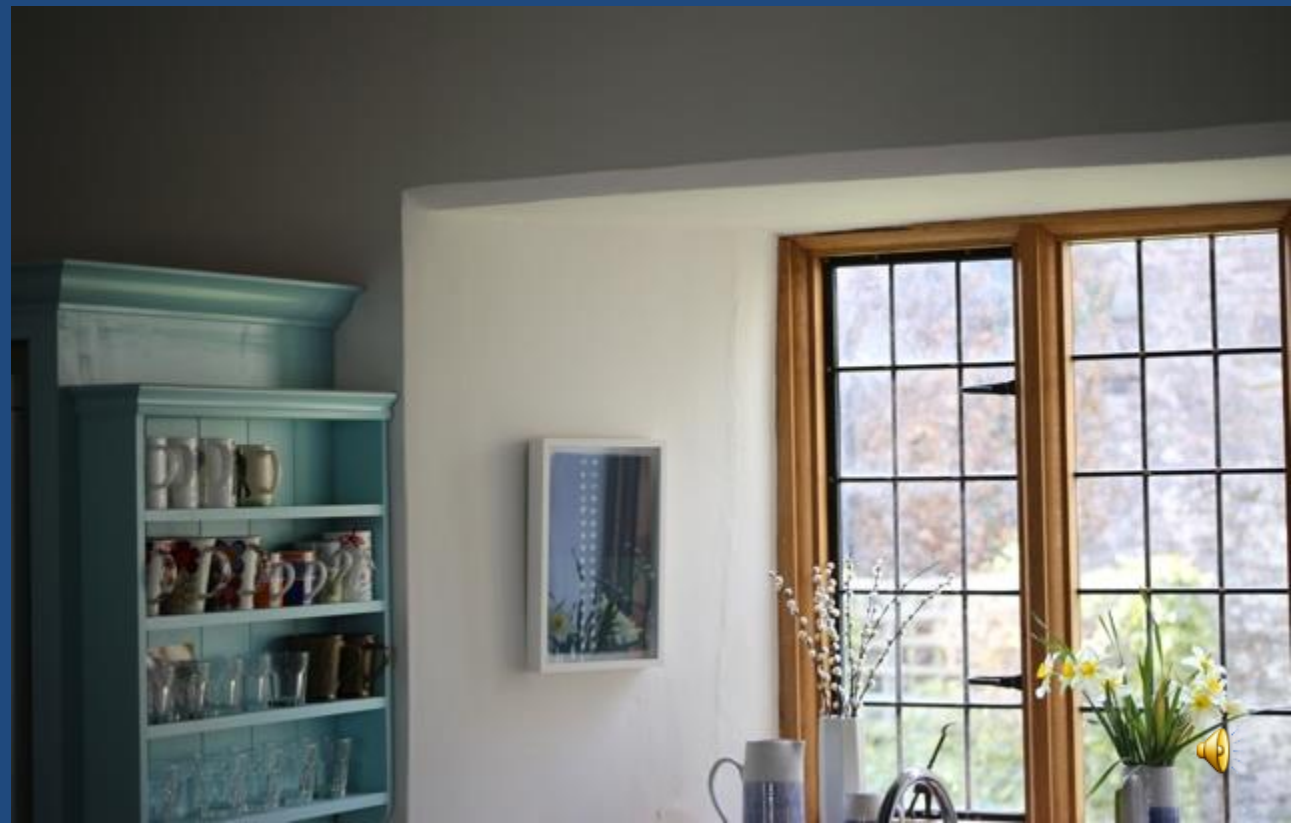
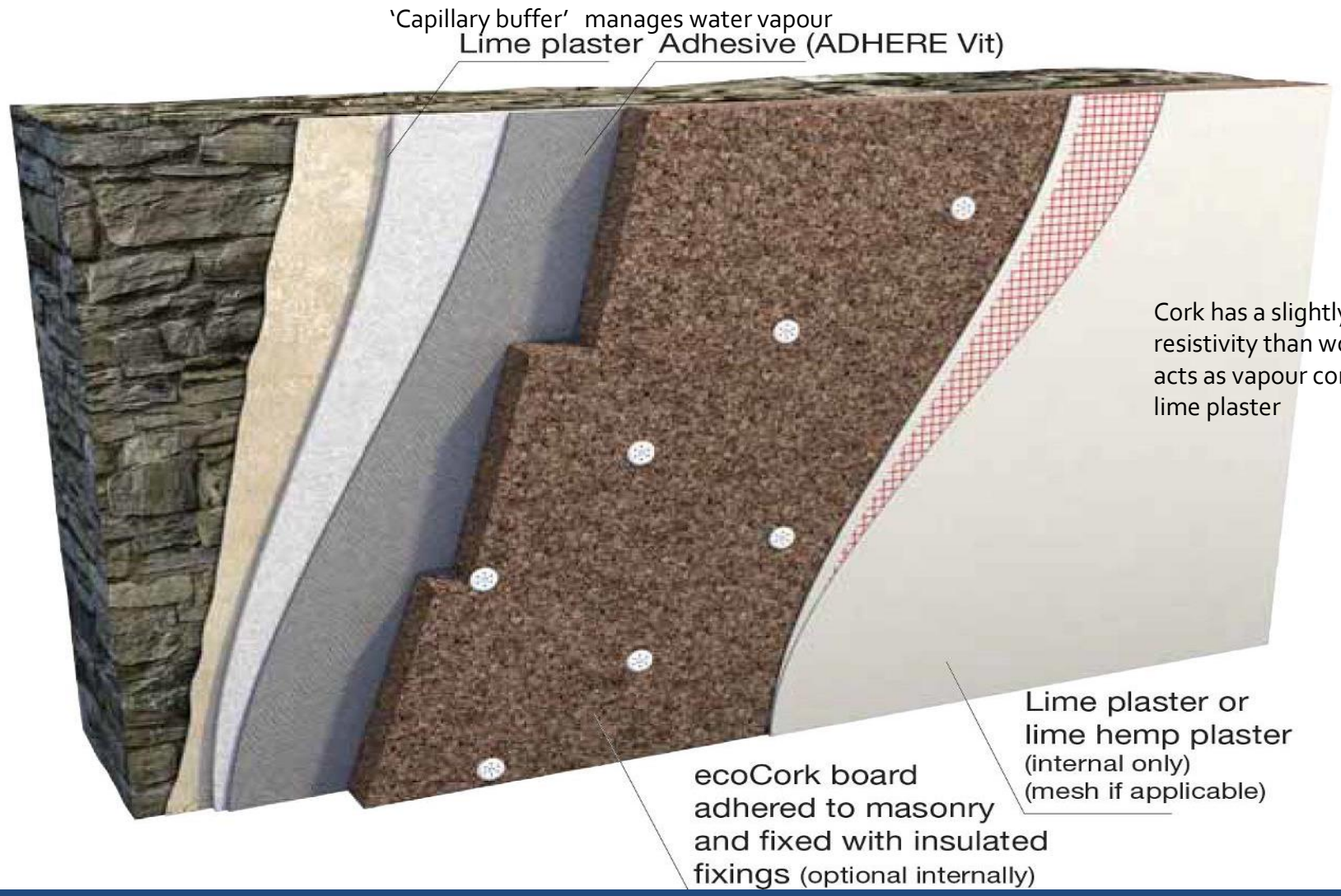


CORK BOARD INTERNALLY



Courtesy Ty-Mawr Lime Ltd.

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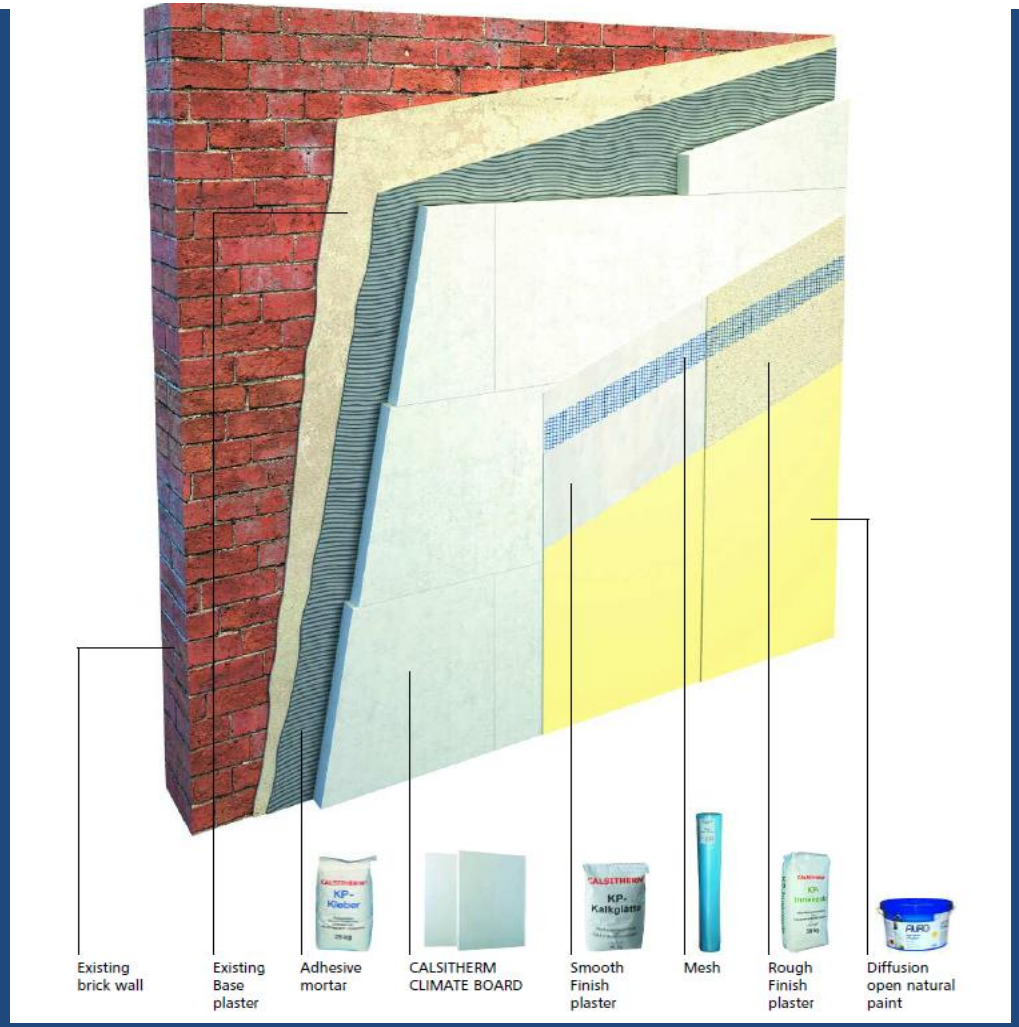
CALCIUM SILICATE BOARD



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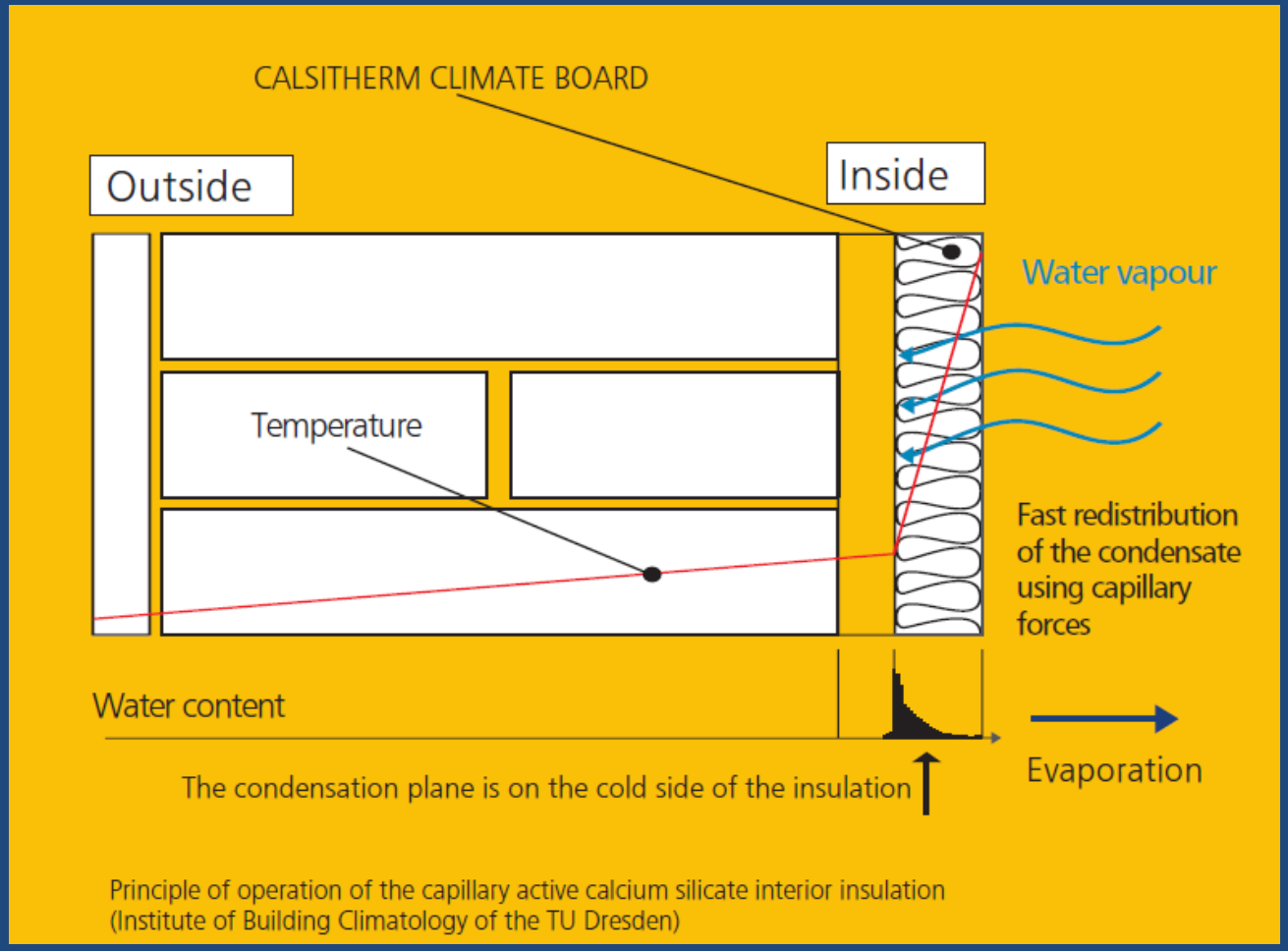
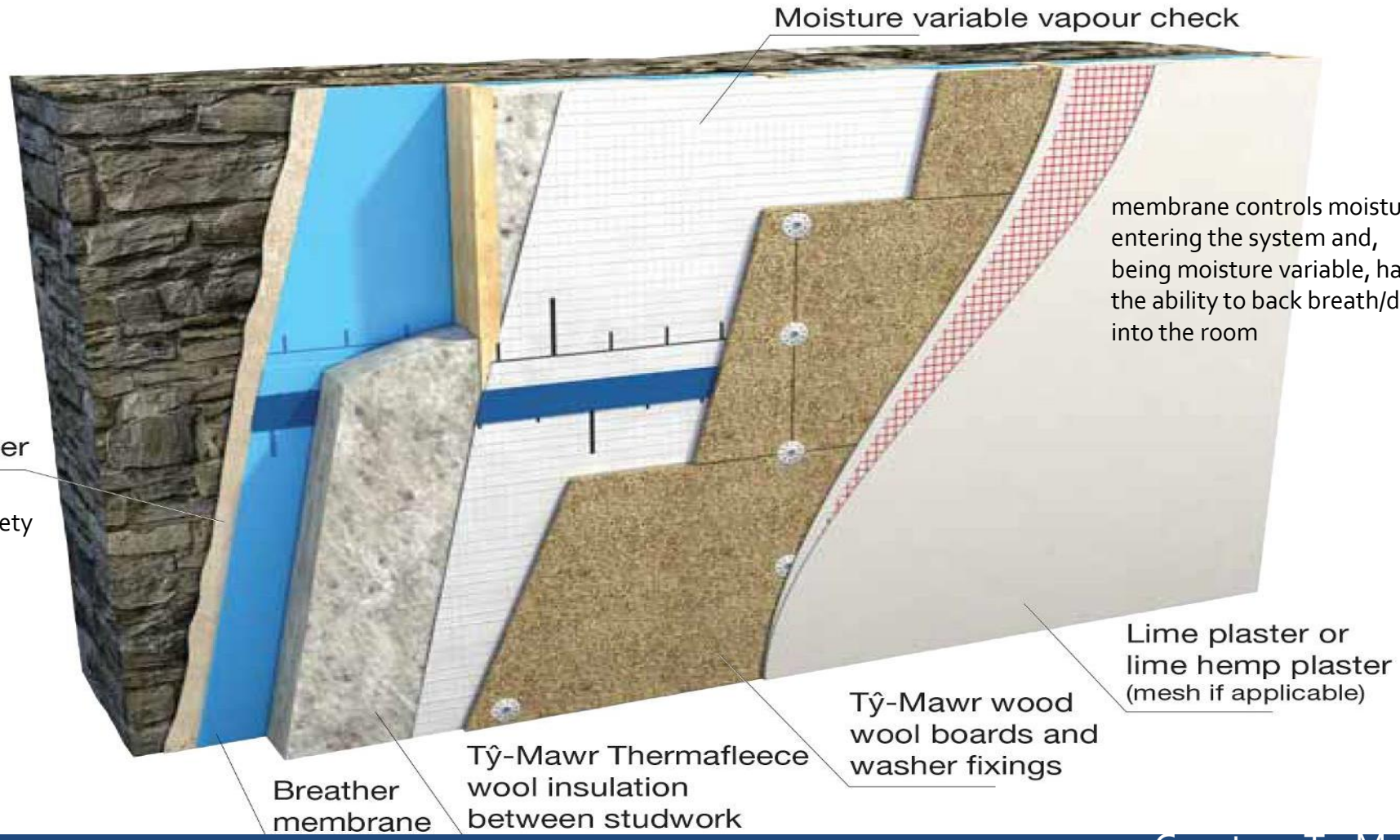


Principle of operation of the capillary active calcium silicate interior insulation
(Institute of Building Climatology of the TU Dresden)

STUD, SHEEP'S WOOL AND WOODWOOL

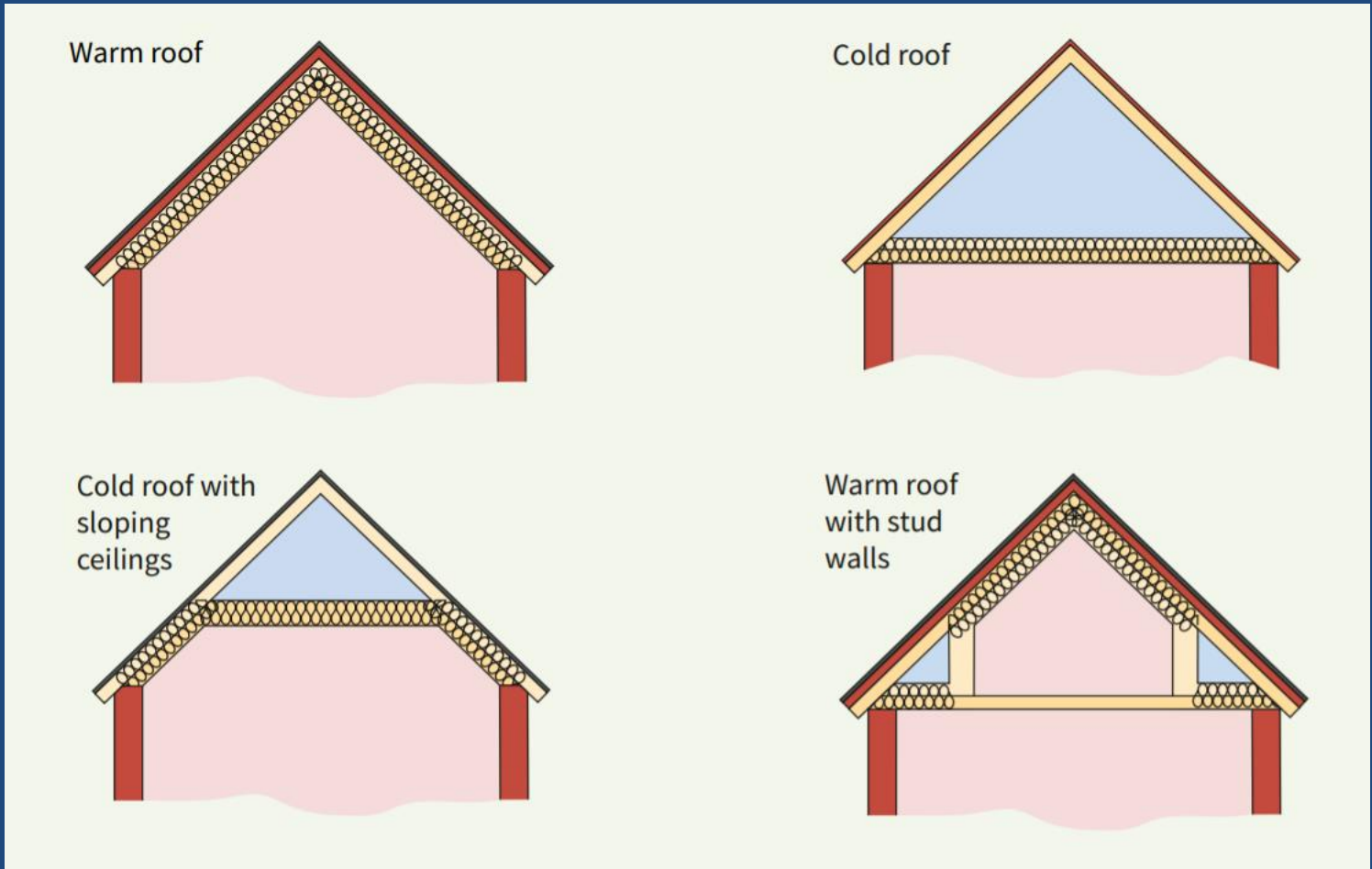


Courtesy Ty-Mawr Lime Ltd.

ROOF INSULATION

- COLD ROOF – Loft insulation laid crosswise, roof remains vented
- WARM ROOF – Insulation can be applied on top of rafters, between rafters and under rafters
- Essential to detail build-ups correctly to ensure warm air does not condense on any surface
- With impermeable insulations and roofing membranes air gaps (50mm) and ventilation are vital
- With vapour permeable insulations the whole build-up of materials needs to be compatible
- Do not mix systems
- *Breathable roofing membranes cannot be used where bats are present*

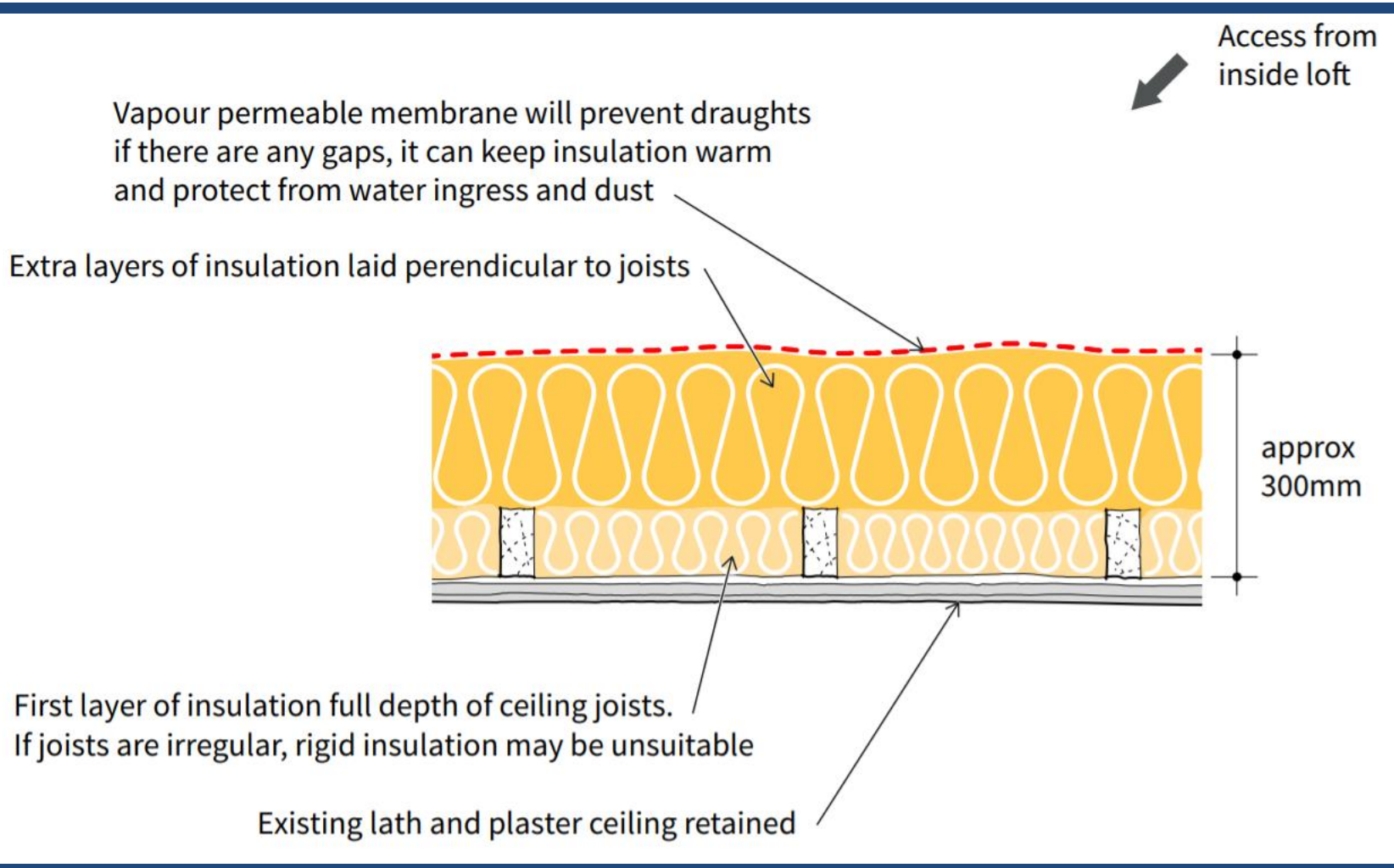
ROOF INSULATION



LOFT INSULATION

- Sheep's wool insulation (actively buffers moisture)
- Mineral wool insulation (health implications for installation or removal)
- Glassfibre insulation (health implications for installation or removal)
- Hemp batts
- Woodfibre batts
- Cellulose

LOFT INSULATION



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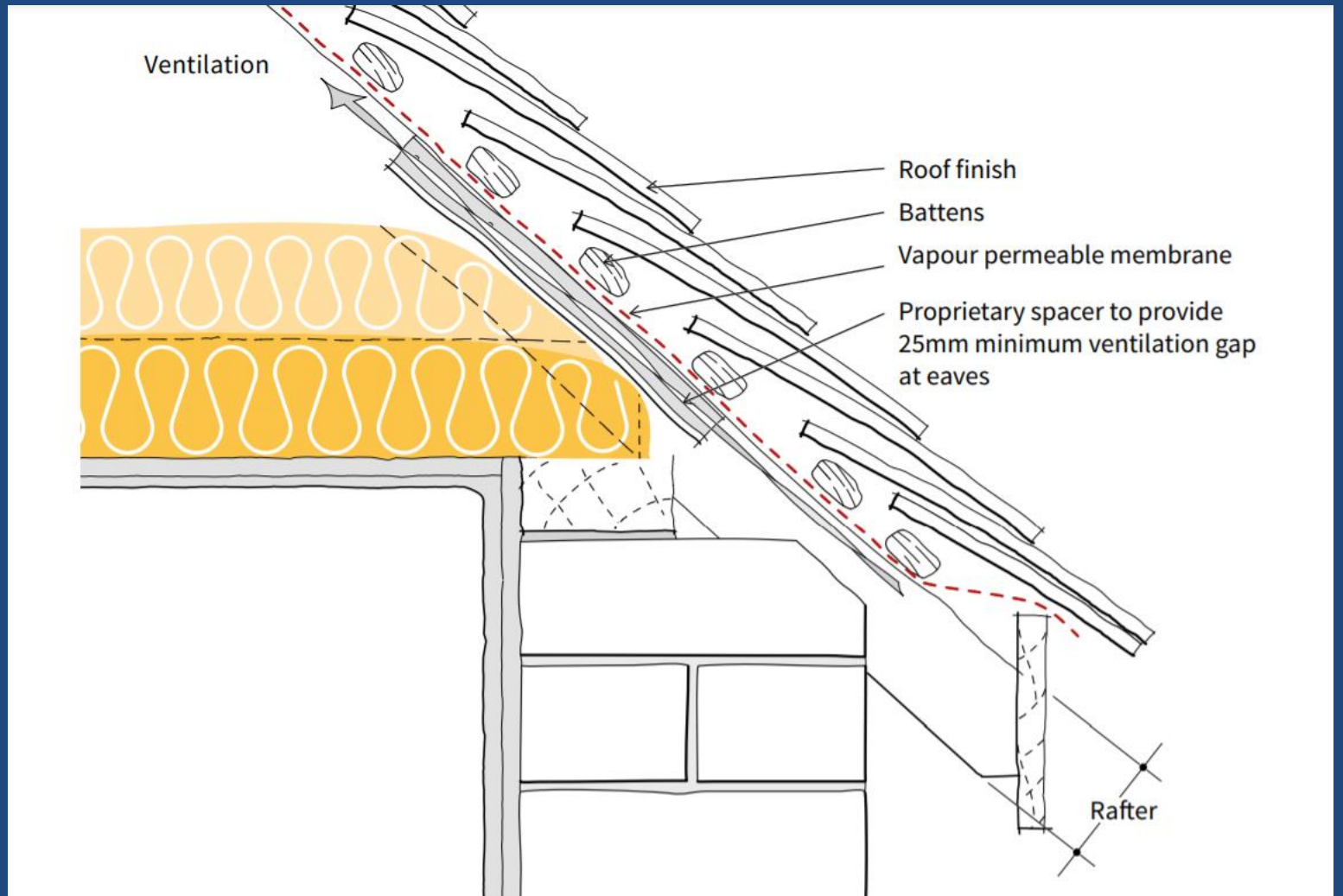

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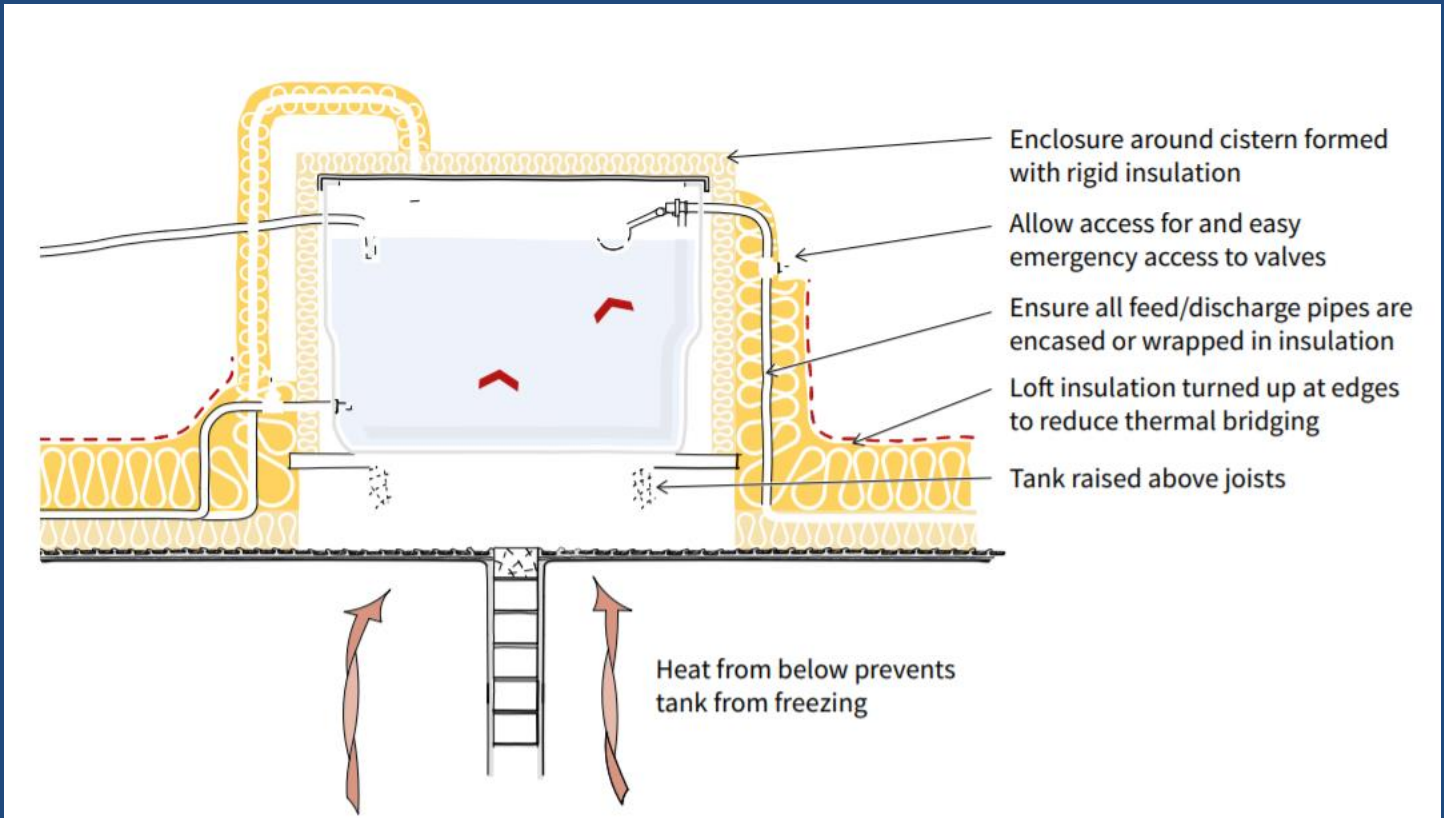
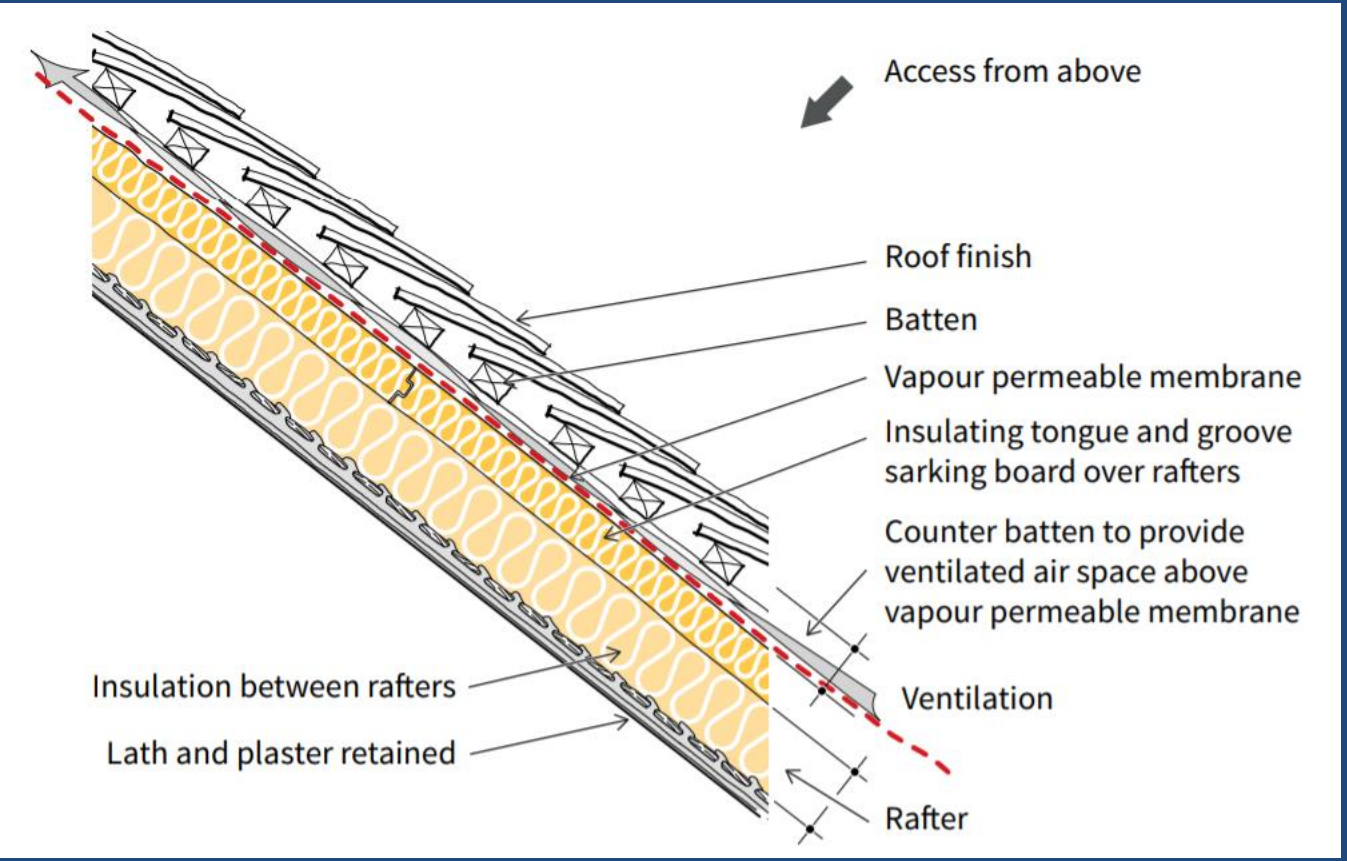


SHEEP'S WOOL INSULATION

240mm meets building regulations

WARM ROOF SYSTEM



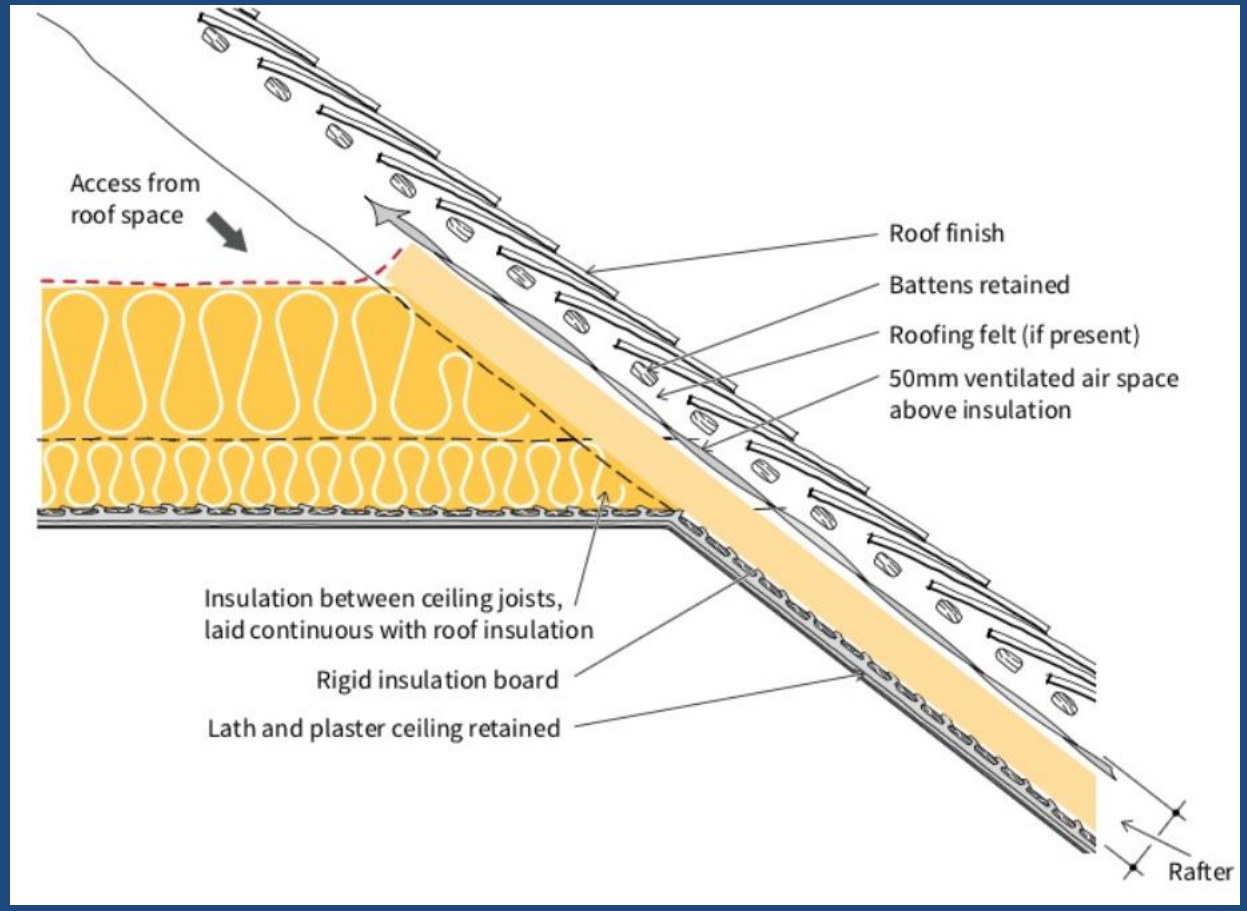
WARM ROOF SYSTEM

Courtesy Ty-Mawr Lime Ltd.

WOODFIBRE, SHEEP'S WOOL & WOODWOOL

SLOPING CEILINGS

- Sloping ceilings/roof spaces should be effectively insulated while maintaining ventilation throughout the roof space. There should be a gap of at least 50mm between the top of the insulation and the underside of sarking boards/ roofing felt.



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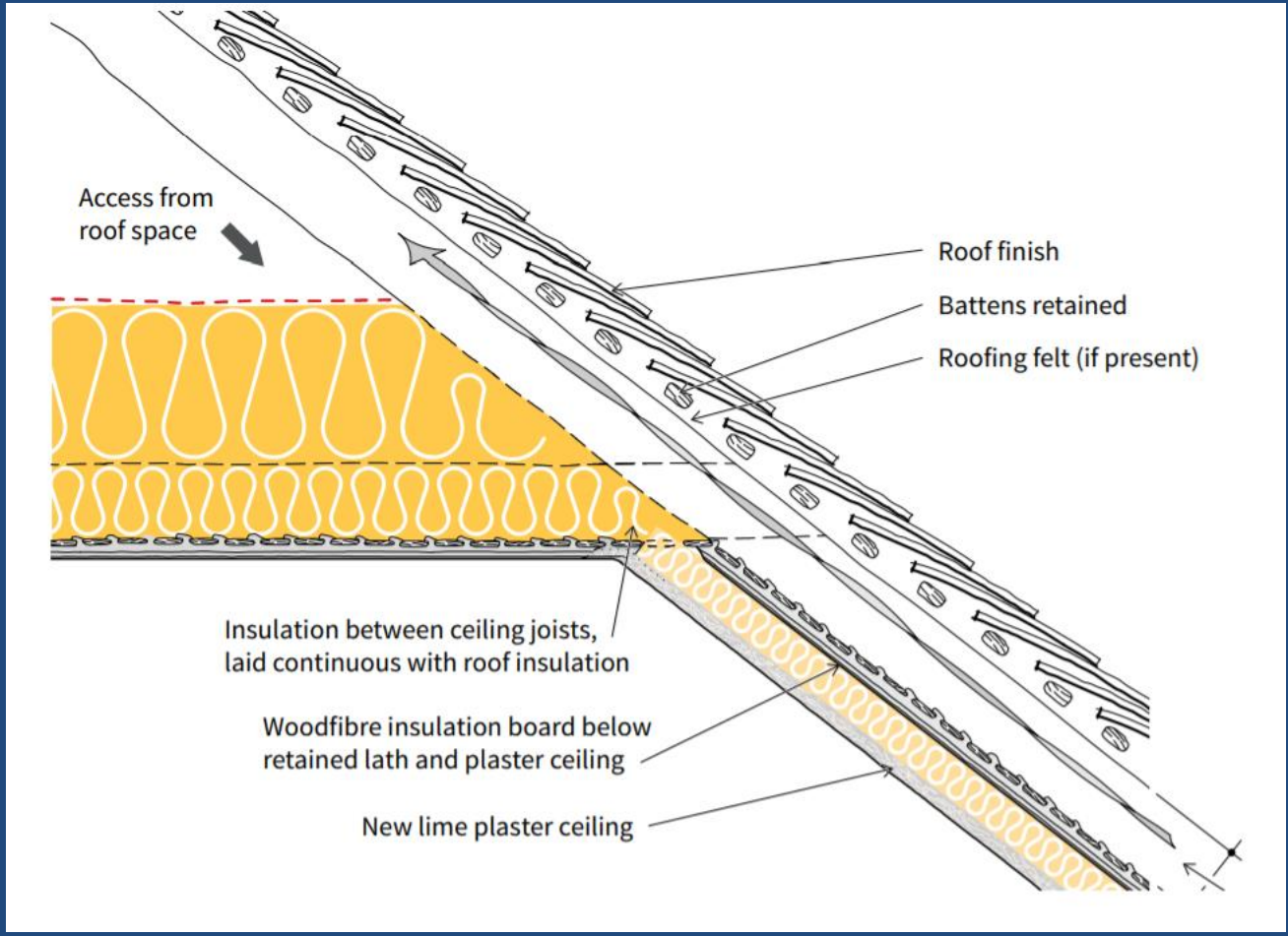
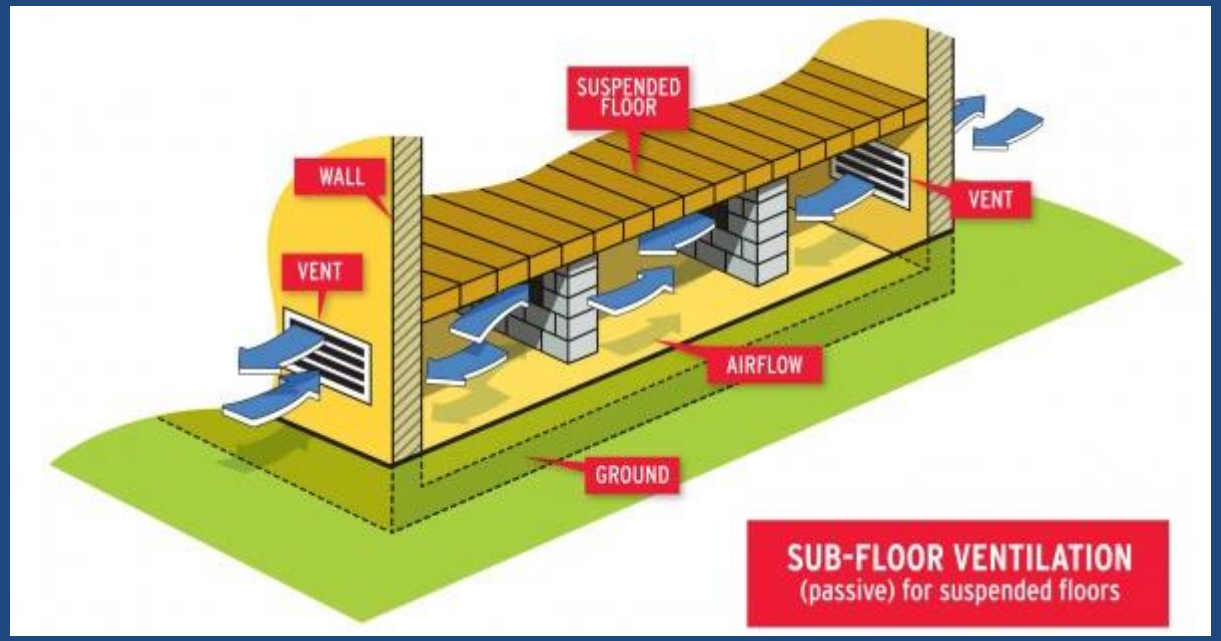


FLOORS

- SOLID GROUND FLOORS – can be insulated within the floor-build up or retrofitted on top of a dry floor slab

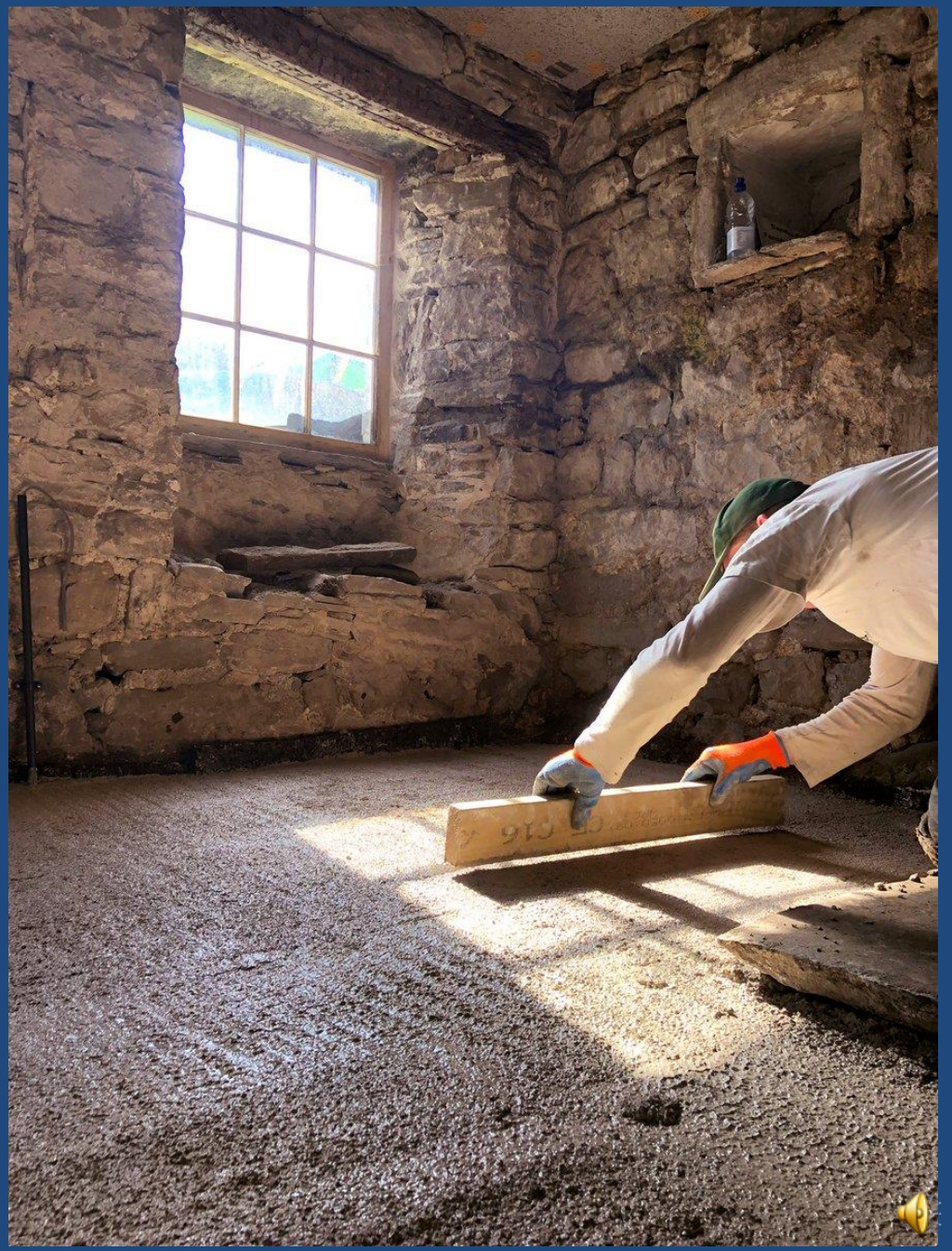
- SUSPENDED TIMBER FLOORS – can be insulated under floorboards between joists providing that air flow is maintained

SUSPENDED TIMBER FLOORS



LIMECRETE FLOOR

Courtesy Ty-Mawr Lime Ltd.



RETROFIT ON A DRY FLOOR SLAB