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

SAM HALE
HISTORIC BUILDING CONSULTANCY

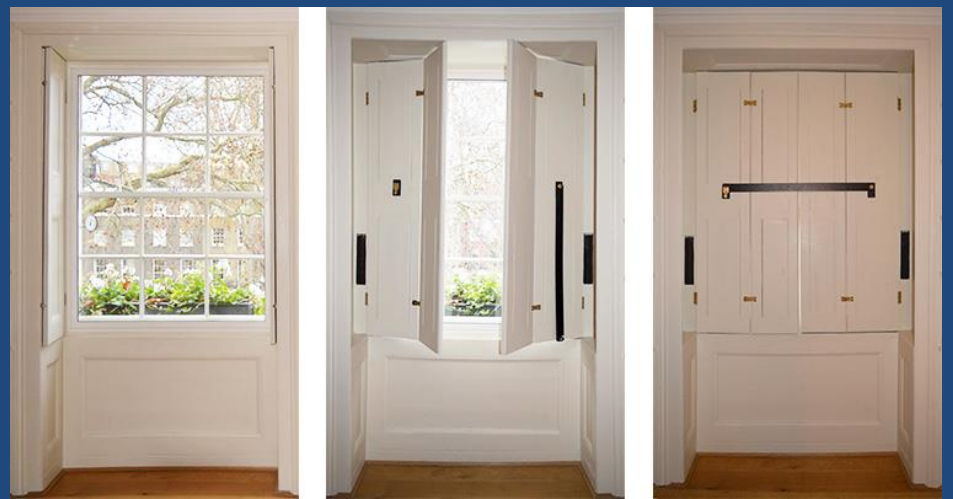
WINDOWS

WINDOWS

- Heat loss through windows and doors can be substantial but can often be over-stated. Reducing draughts and repairing ill-fitting windows and doors while maintaining necessary ventilation can often resolve many perceived issues of heat-loss
- Single glazed sash and case windows lead to less heat loss than you might think – less than 20% of the total heat loss in a traditional stone building.
- You can make your windows more energy efficient in a number of ways. Draught proofing is the most effective solution to keeping warmth inside and should be your first goal.
- Aim to keep windows in good repair in the first place – frames that have warped or no longer fit well will let in draughts. Close shutters and curtains at night to reduce heat loss. You can also consider adding secondary glazing, easily removable in warmer months.

WINDOWS

- Shutters are one of the best ways to reduce heat loss at night. Single glazing lets in more heat from the sun and shutters help to trap warmth inside overnight.
- Timber shutters reduce heat loss by 51%.
- Consider having ill-fitting shutters restored. If the original shutters have been removed, it's possible to have new shutters made.
- Heavy, lined curtains are a good alternative. These can reduce heat loss by 14%.



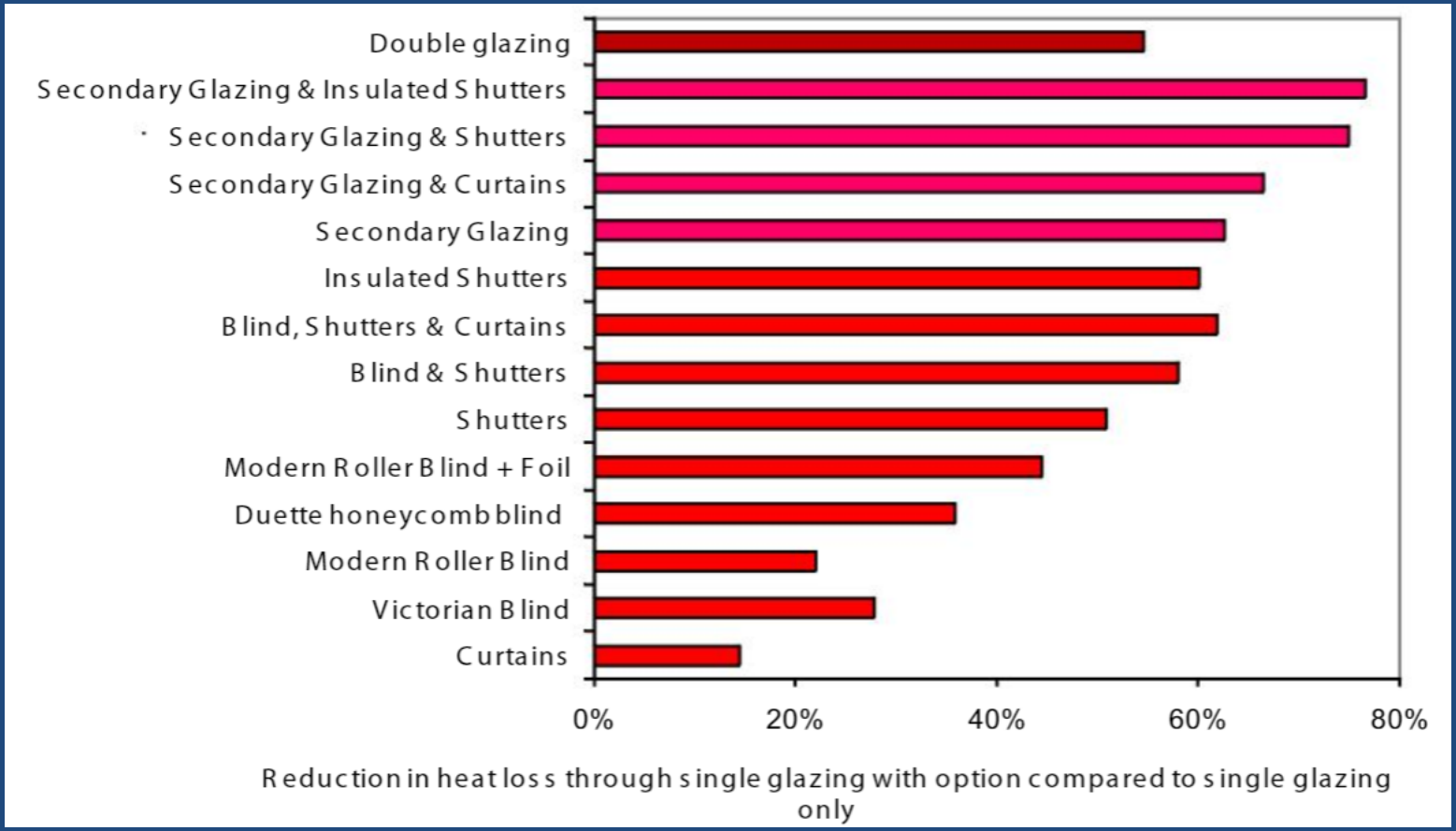
WINDOWS

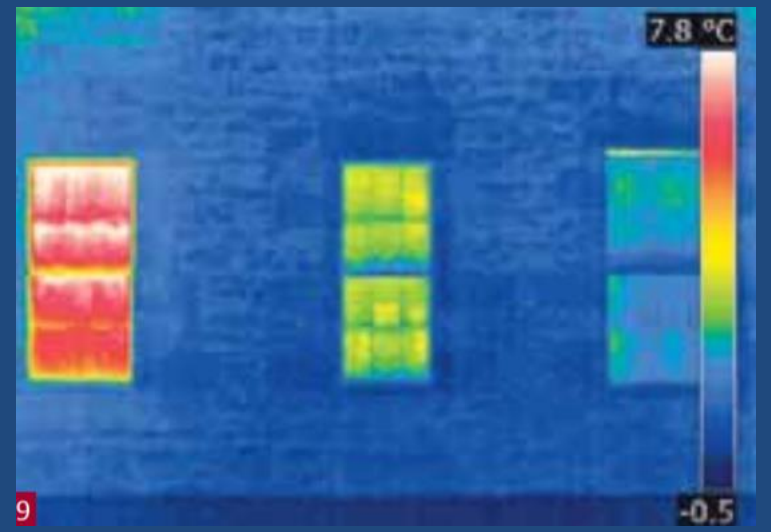
- Adding secondary glazing to sash and case windows can help to reduce heat lost through the glass and through draughts.
- Fitting secondary glazing involves attaching a second sheet of glass or acrylic to the inside of the window frame. Minimal changes are needed to the window fabric, and the glass panel can be easily removed. The character of the building from the outside is largely unaffected.

Secondary glazing:

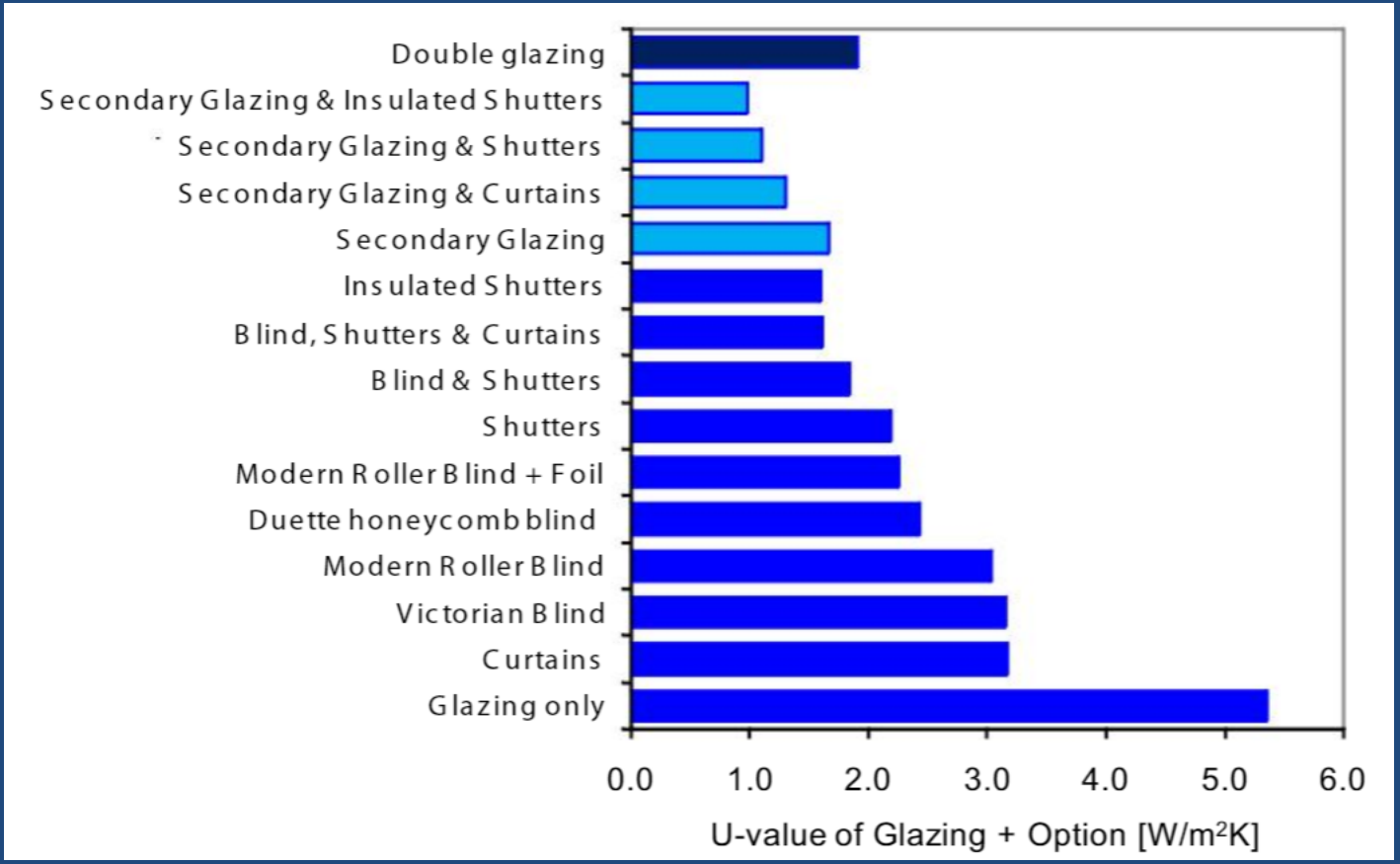
- reduces heat loss
- can filter out some outside noise
- is a cost-effective solution, generally cheaper than double glazing
- doesn't affect the look of sash windows
- Installing secondary glazing can reduce heat loss by 63%, making it one of the most effective ways to improve thermal performance. Heat loss can be reduced by more than 75% when secondary glazing is used with other methods like blinds and shutters.
- You can remove secondary glazing in the warmer months when it's not needed.

REDUCING HEAT LOSS THROUGH WINDOWS





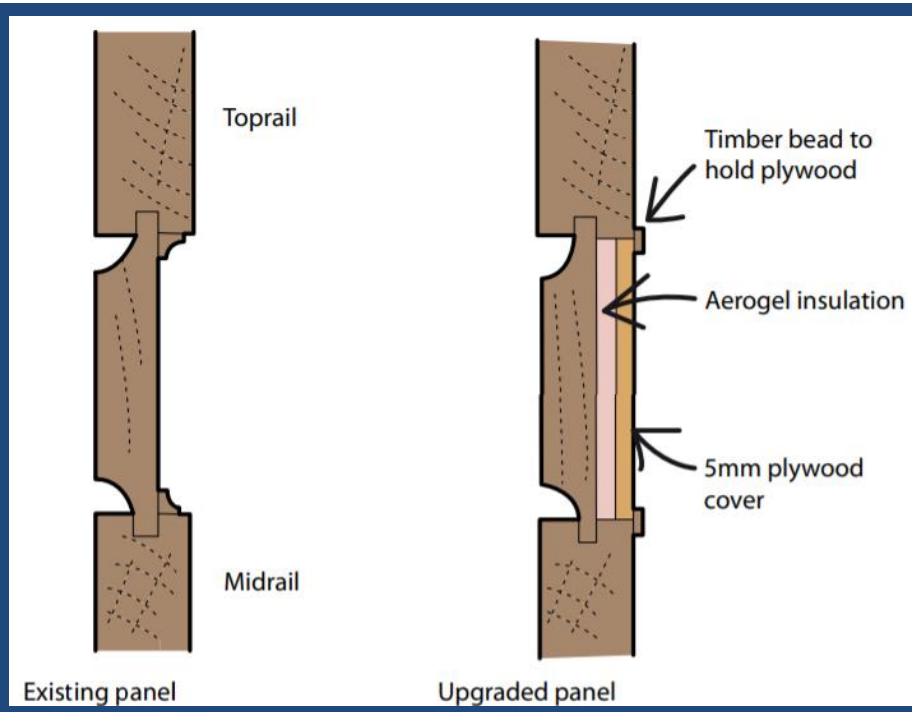
REDUCING HEAT LOSS THROUGH WINDOWS



DOORS

To reduce heat loss from an external door, you can:

- draught proof around the door edge
- draught proof around the letterbox
- insulate the door itself
- cover keyholes
- Internal doors don't usually need draught proofing, unless rooms vary a lot in temperature.
- Draught proofing may be unsuitable for fire doors or doors of special heritage value.



DOORS

- You can install insulation in the panels of a door, which are generally thinner than its main body. This helps to reduce heat loss through an otherwise sound door.
- A thin layer of a suitable insulation material should be added to the inside of the panels only. This avoids altering the building's external character.
- Thin insulation material is more expensive than other insulation products, because of its higher performance. The finished insulation should be flush with the door framework. New beads may be needed to finish the edge.
- Sometimes option to double board timber plank doors
- Porches and vestibules

TECHNICAL RISKS ASSOCIATED WITH THE ENERGY EFFICIENCY MEASURES

THERMAL BRIDGES (COLD BRIDGES)

- There are 2 types of thermal bridge: repeating and non-repeating
- A repeating thermal bridge is a bridge that occurs at regular intervals, e.g. timber joists between ceiling insulation
- A non-repeating thermal bridge occurs at junctions between building elements, e.g. wall junctions, wall-floor junctions, window surrounds. This form of thermal bridging is almost unavoidable in retrofit. The risks incurred include heat loss and condensation.

The common causes are seen at:

- Floor-wall junctions
- Door & window surrounds
- Complex windows (e.g. bay windows, mullions)
- Poor insulation jointing
- Detailing & application are key - E.g. More tight jointing

COVERAGE &THERMAL BRIDGES

With internal wall insulation, Thermal Bridging heat loss increases where:

- Smaller amounts of external wall
- Larger windows, or more of them
- Thicker walls.

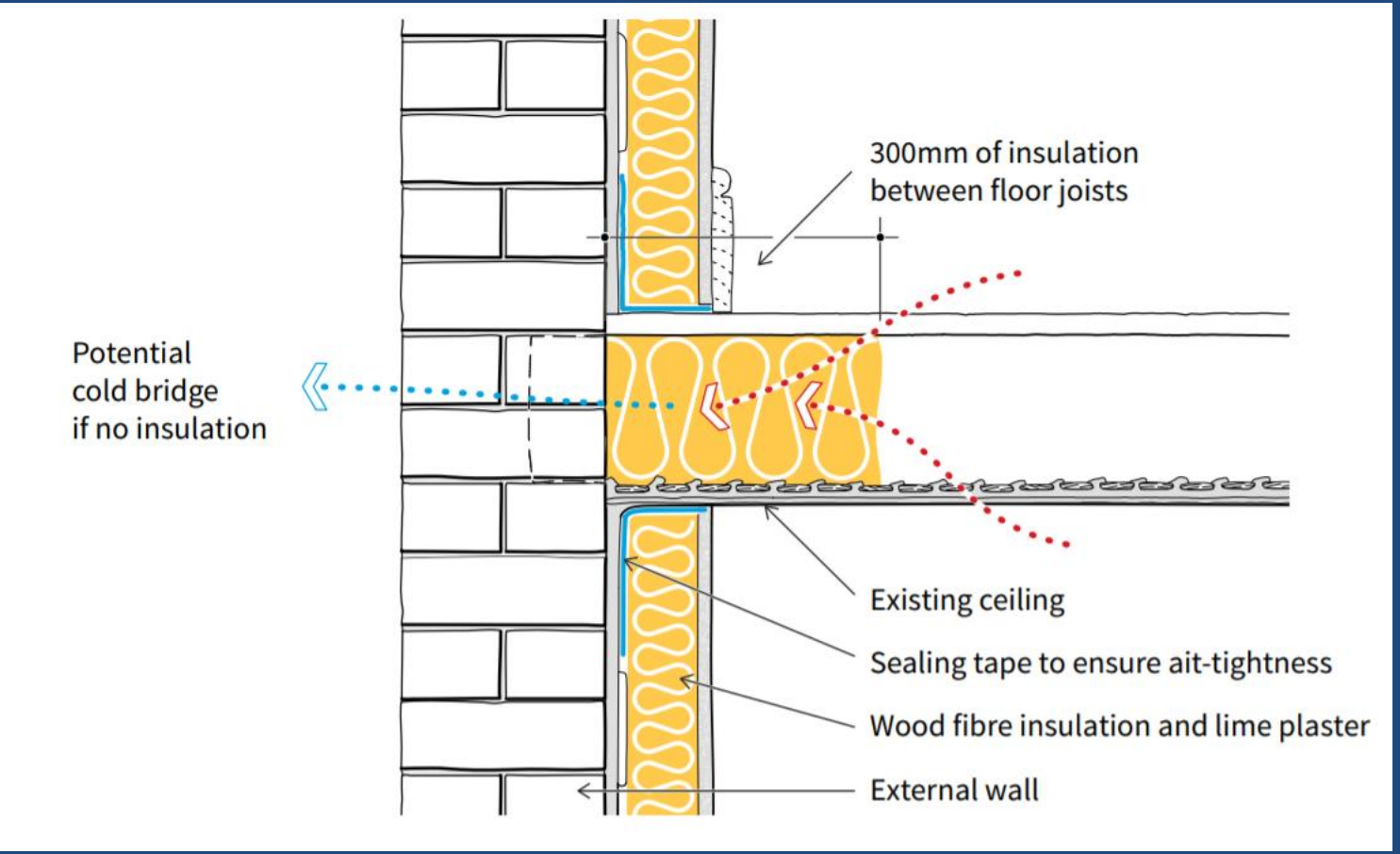
Scenario- Terraced house, large windows, 500mm brick wall, reveals insulated: Increasing wall insulation from 20mm to 140mm reduces overall building fabric heat loss reduction by only 10% (If house were detached & had small windows, this figure would be 28%)

COVERAGE &THERMAL BRIDGES

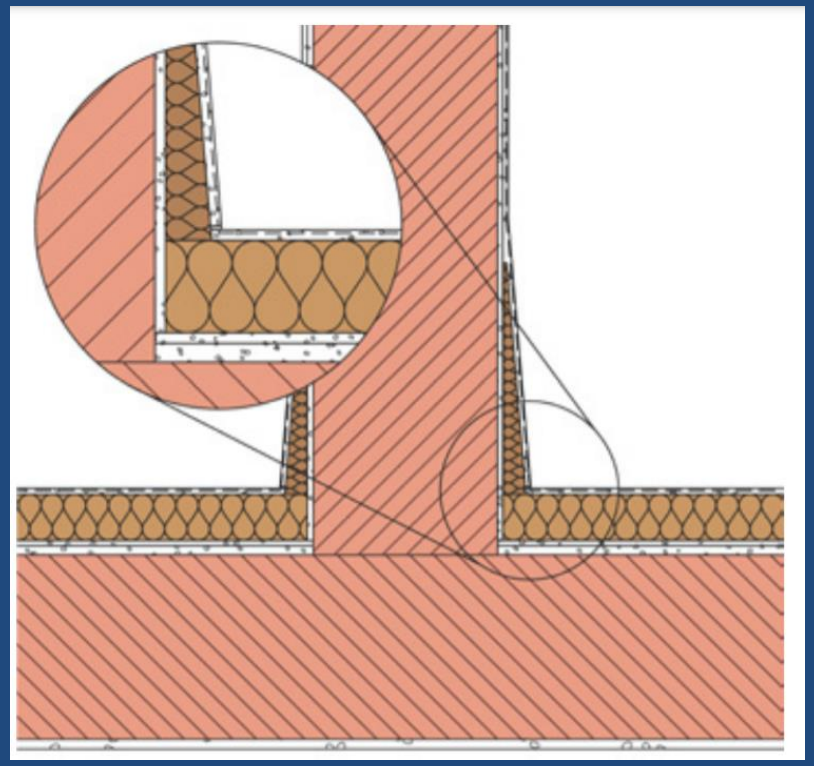
Detailing & Workmanship are key factors with Thermal bridging:

- Issues at design stage & on site.
- Attention to detail is paramount in order to minimise risk.
- Includes use of appropriately experienced workforce & checks throughout project.
- 'The more complex the system of insulation, the more critical the workmanship becomes'

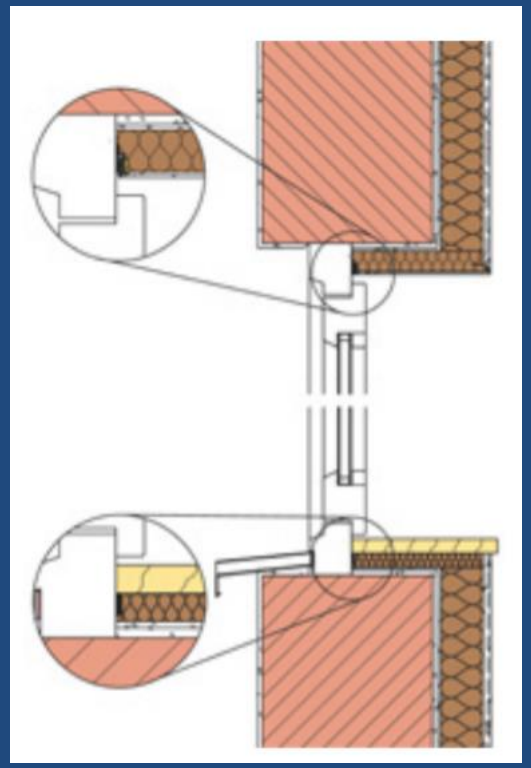
COVERAGE &THERMAL BRIDGES



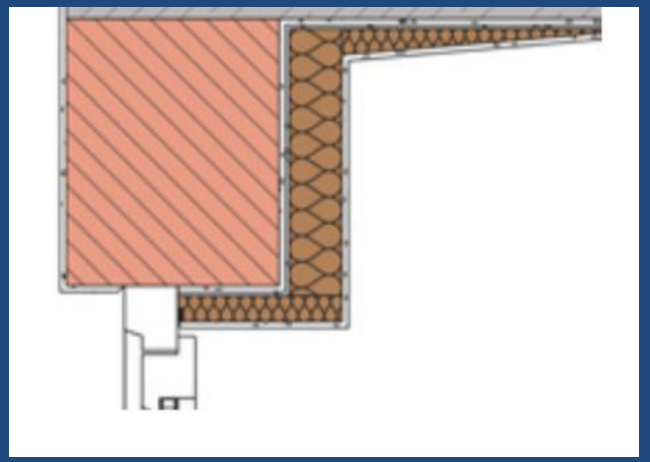
COVERAGE &THERMAL BRIDGES



Insulation at least 600mm onto uninsulated walls



Insulation to window reveals, heads and sills



Insulation from window head to wall to ceiling

VENTILATION

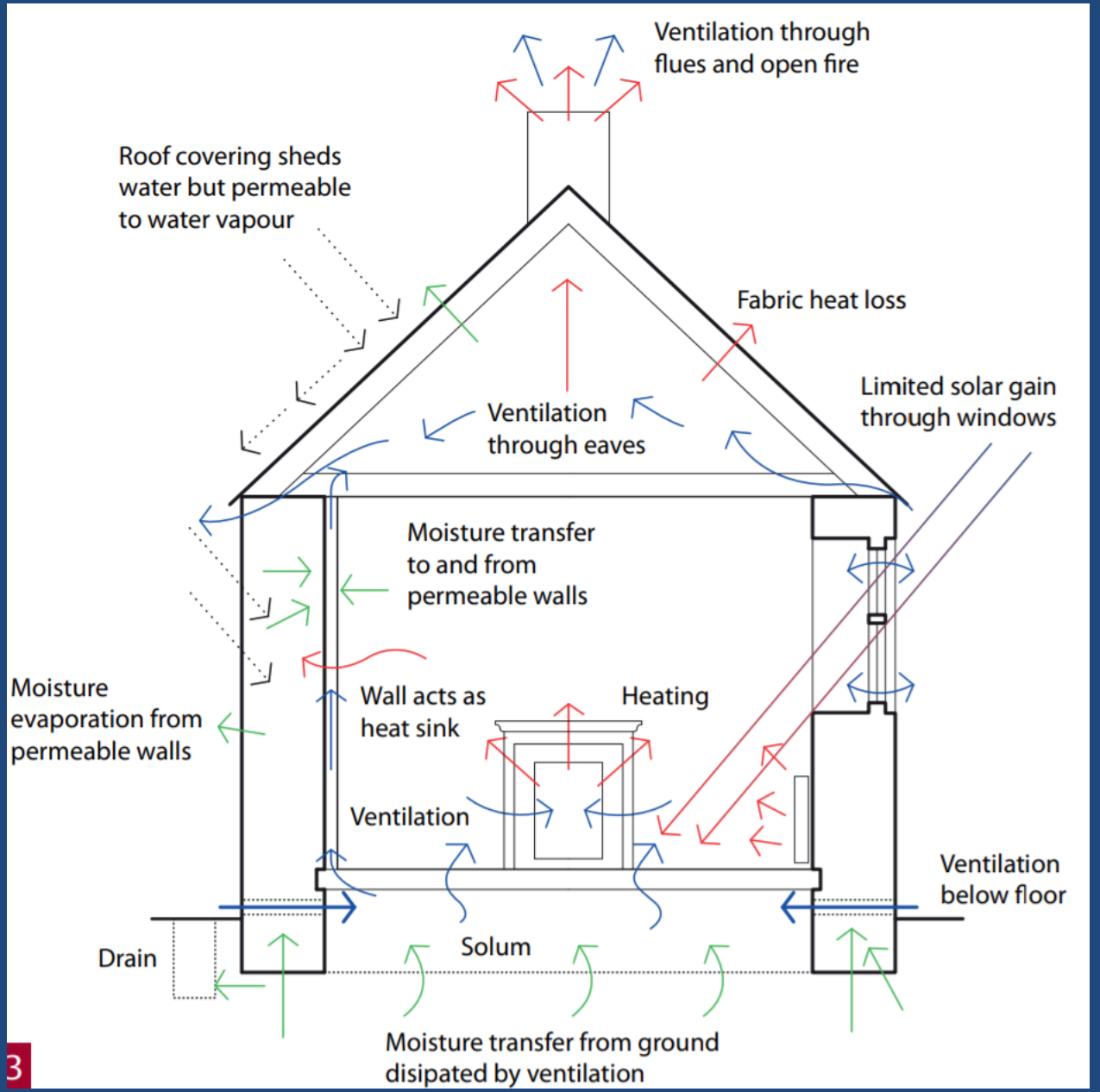
Solid walled constructed buildings require good ventilation.

In the past ventilation was often supplied by loose-fitting doors and windows. In addition, open fires created generous rates of exhaust ventilation through chimneys at times, in the winter, when condensation risk could be high.

If ventilation of a solid walled building is reduced too much, condensation, mould and fungal growth may occur, leading to deterioration of the fabric and contents, and possibly health problems for occupants.

In modern homes it's recommended that 40 per cent of the total volume of air within the building is replaced every hour, in other words around 0.4 air changes per hour (ac/h). In a solid-walled traditional building up to 0.8 ac/h may be required because of the extra moisture present in the structure. In a damp building the ventilation might need to be increased even further to maintain acceptable levels of RH.

It is important to distinguish between controlled (i.e. deliberate) and uncontrolled (i.e. infiltration) ventilation. A balance is required between the two issues - if in doubt, seek specialist guidance.


Ventilation through flues and open fire
Roof covering sheds water but permeable to water vapour
Fabric heat loss
Limited solar gain through windows
Ventilation through eaves
Moisture transfer to and from permeable walls
Moisture evaporation from permeable walls
Wall acts as heat sink
Heating
Ventilation
Ventilation below floor
Drain
Solum
Moisture transfer from ground disipated by ventilation

VENTILATION

Addressing excessive ventilation as well as insulation

- Two types of heat loss – fabric heat loss & ventilation heat loss
- Older traditional buildings often suffer from excessive natural ventilation
- Insulating without addressing airtightness reduces benefit of insulation
- (Benefits / impact of draught proofing older buildings are often under-recognised by energy modelling software).

Avoiding over-sealing and moisture build-up

- Buildings need some ventilation, and insulating older buildings can lead to over-sealing
- This risk is exacerbated where impermeable materials are used
- Adding insulation without considering ventilation can lead to risk of damp.

VENTILATION

When Existing Ventilation may not seem enough:

- Insulation changes internal building conditions (e.g. Relative humidity)
- The greater the insulation levels, the more important ventilation becomes
- Also becomes more important where using impermeable insulation systems.

It is important to distinguish between controlled (i.e. deliberate) & uncontrolled (i.e. infiltration) ventilation

- SAP under-estimates impact of draught proofing
- Insulation assessments misrepresent moisture risks.

THERMAL BYPASS

"Closed loop" convection can result in significant failures in thermal performance. In principle this is driven by stack effect. A range of studies have shown that even narrow air gaps between the (internal) air barrier and the insulation and small gaps in the joints between insulation have been shown to result in significant heat loss.

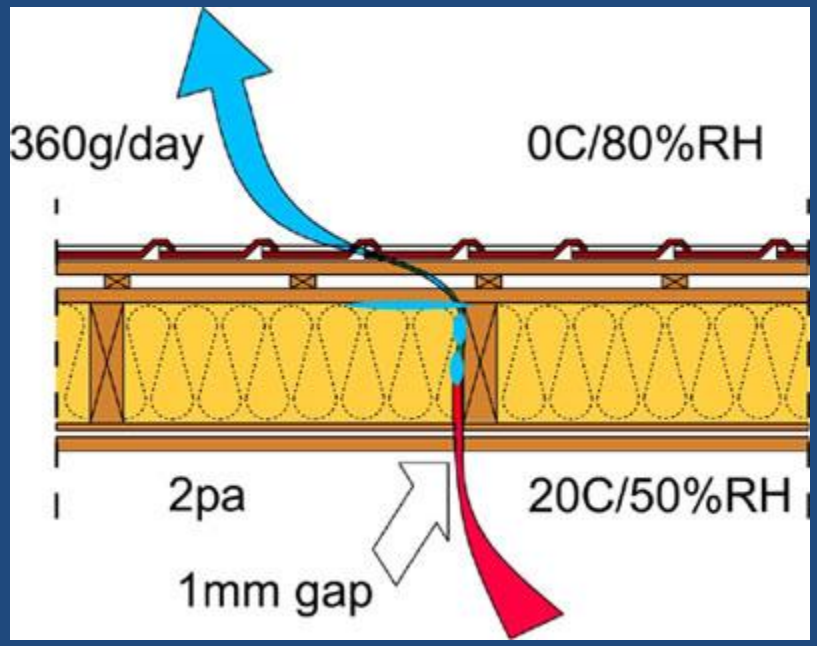
The proportionate impact of the convection increases as the U-value is improved. An increase in heat loss of about 160% greater than the calculated U-value is not uncommon when air gaps exist behind the insulation.

"Open loop" convection this is driven by the wind penetrating the thermal envelope. This form of heat loss can be addressed by air tightness and wind tightness.

Airtightness may be defined as "the property of preventing air from penetrating through the shell" and wind tightness as "the property preventing air from penetrating into the shell so that the thermal insulation property of the insulation material is not reduced."

In reality it is often found that both Open and Closed loop bypass can occur at the same time.

The air flow through a 1 mm wide one meter long joint, transports approximately 360 g water per day when there is a pressure difference of just 2 Pa, the stack effect occurring over two storeys. In the winter across the section of an insulated wall the temperature gradient falls towards the outside.



In the example given above, where there is poor airtightness and the temperature falls below the dew point, substantial condensation will occur which can lead to mould growth and the damage of timber. In contrast the quantity of water vapour transported via diffusion is very small. Assuming suitable attention is given to vapour diffusion the greatest risk to moisture performance is poor airtightness.

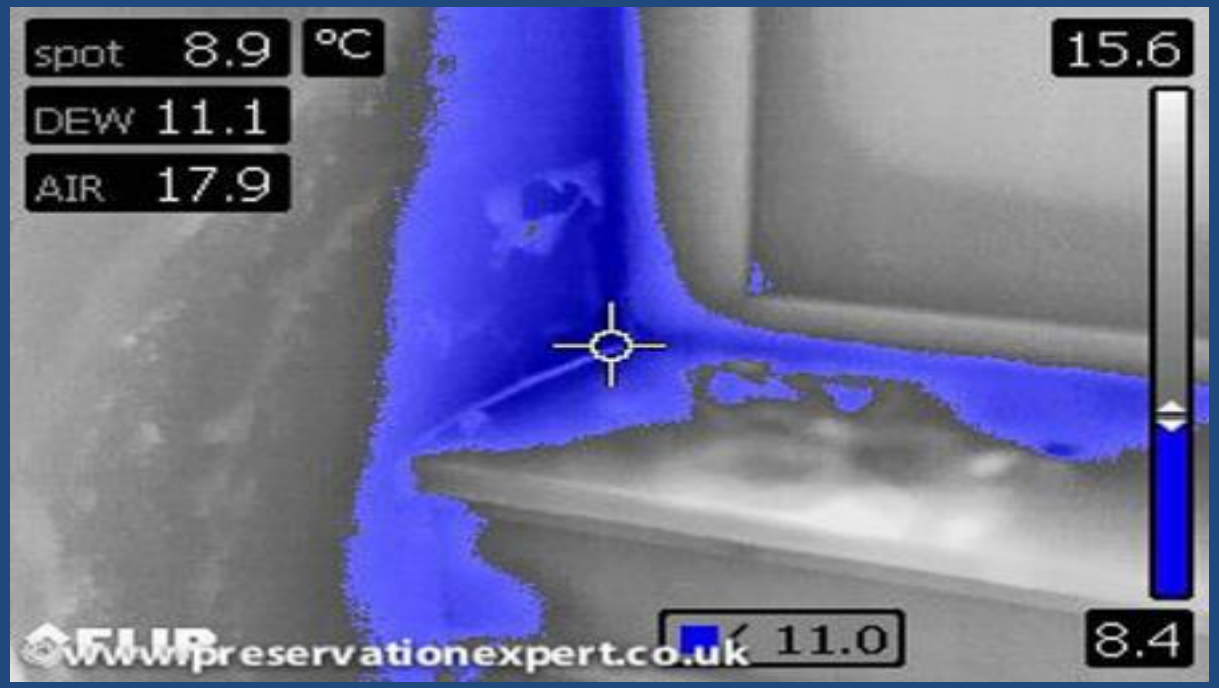
CONDENSATION

Condensation occurs when water vapour comes into contact with cold surfaces: it then returns to a liquid. Interstitial Condensation occurs as a result of large differences in the temperature between internal and external walls. The dew point represents the position within in the wall at which point the ambient vapour in the air will condense. Examples of Interstitial condensation can be seen in cupboards built on external walls or in the corners of a room. It is very often accompanied by green and black moulds.

The limit of the amount of humidity air can hold depends on temperature, warm air can hold more humidity than cold air

- Air saturated with water vapour has a relative air humidity of 100%. If air is cooled down, the relative humidity increases
- When relative humidity reaches 100 % this leads to condensation.


CONDENSATION


spot 8.9 °C
DEW 11.1
AIR 17.9
15.6
8.4
11.0
www.preservationexpert.co.uk

INTERSTITIAL CONDENSATION

Occurs when warm moist air penetrates into a building element and condenses when it reaches dew point. The dew point will move depending on conditions

- This occurs where the wall is warm on one side and below dew point on the other
- If the diffusion of the vapour is restricted on the cold side the consequences of interstitial condensation are likely to be worse as in the use of impermeable external insulation
- In traditional buildings it will be almost impossible to avoid moisture entering the fabric
- Timber lintels and joist ends vulnerable to interstitial condensation if it becomes concentrated. Most historic buildings are of traditional (solid-walled, permeable) construction and risks include:
- High humidity (mould, dust mites, health issues)
- Condensation – both on surfaces and in cavities (decorative & fabric damage)
- High moisture content in materials (rot, e.g. joist ends)
- Frost damage (detached render, spalling brickwork).

RETROFIT STUD & GLASSFIBRE INSULATION WITH PLASTERBOARD

CASE STUDY EWI 1880S SOLID BRICK HOUSE

DETAILING!

THE RESULT INSIDE

DETAILS

Using vapour permeable insulation systems can still fail and cause damage to buildings through trapping moisture and resulting in interstitial condensation if not correctly installed.

It is important to remember:

- Some buildings will not suit wall insulation
- Understanding the structure is key
- Following best practice guidance and observing detail is essential

External wall insulation with Woodfibre laid over a cement render that is holding moisture within the wall. The gable is roughcast and therefore there are air pockets between the board and the wall

Courtesy Ty-Mawr Lime Ltd.

External Wall Insulation

Woodfibre

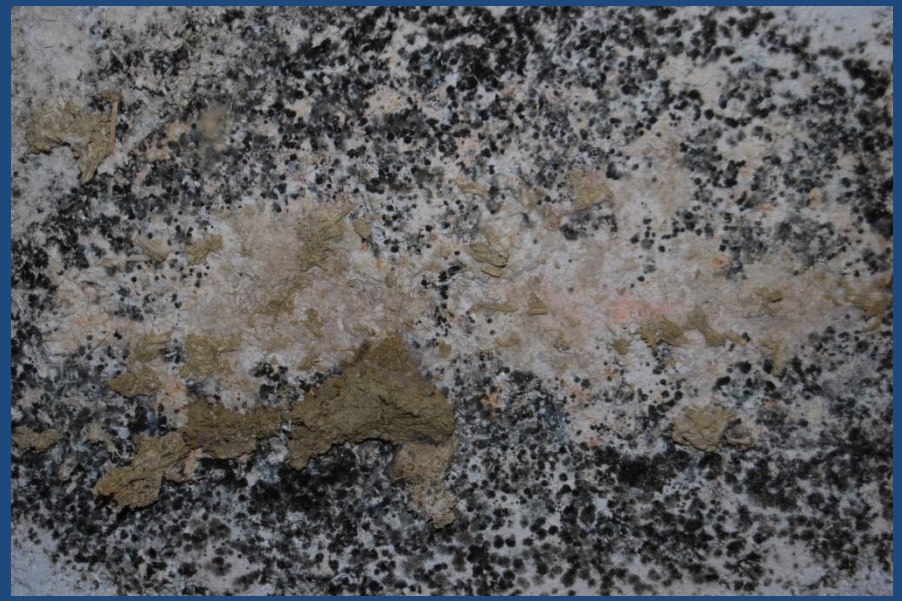
Before and After

How long before there are issues?

Courtesy Ty-Mawr Lime Ltd.

Telegraphing of woodfibre joints through render of insufficient depth

Courtesy Ty-Mawr Lime Ltd.



Surface mould on hemp plaster due to cold wall caused by moisture ingress

Staining coming through cork plaster due to wall behind being fed with moisture

Moisture ingress and condensation resulting in water staining and mould growth on hemp plaster

Don’t cover up problems cure moisture ingress

WELSH TRADITIONAL BUILDINGS FORUM

FFORWM ADEILADAU TRADDODIADOL CYMRU

The Welsh Traditional Buildings Forum promotes the development of traditional building skills and sustainability issues relating to all old buildings across Wales.

Thank you to the CITB for funding the Heritage Construction in Wales project, and the Wales Cultural Recovery Fund for funding the final stages of the project. This funding enabled this information to be made available to all those wishing to learn about the appropriate energy efficiency measures for older and traditional buildings.

For further information contact:

https://www.wtbf.co.uk/

Mae Fforwm Adeiladau Traddodiadol Cymru yn hyrwyddo datblygiad sgiliau adeiladu traddodiadol a materion cynaliadwyedd sy'n ymwneud â phob hen adeilad ledled Cymru.

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Am wybodaeth bellach cysylltwch â:

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