

Building warmth and comfort: link-detached homes



About the author

Rob Benington first lived on Northover Road in 1986; he moved away from Bristol to study Town and Country Planning and Environmental Impact Assessment and to work with environmental consultancies and local authorities in a variety of policy and sustainability roles. In 2012, he moved back to Northover Road and used his interest and experience of home energy conservation to undertake many DIY improvements. He started as a surveyor with the CHEESE Project CIC in 2019 and has played a leading role in training new surveyors.

Rob is happy for you to contact him with feedback about anything in this document. It may be possible to publish an update as we learn more about what works to keep the link-detached homes in the area at a comfortable temperature while energy costs rise and the summers become hotter. All ideas, comments and experiences are welcome.

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Acknowledgements

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Special thanks go to Jon Lane for designing the cover, and to Christian Meylan for the great work on the curtain-performance graphics.

Disclaimer

Every building is unique. Before taking any action based on information in this report, expert advice should be sought.

Date of publication

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1. The Westover cluster

1.1 The cluster project



The project involves the link-detached homes on Westover Road, Westover Drive, Westover Rise and Westover Close in BS9 and was funded by Retrofit West's Community Group Retrofit Accelerator programme. In December 2024, at least one promotional leaflet was posted to all the eligible houses and some cold calling took place. Residents shared their thoughts about their surveys on local WhatsApp groups and this helped to promote the opportunity.

Thermal surveys carried out on a sample of 6 houses (10% of the link-detached homes) were analysed to identify the common causes of heat-loss. The results are presented in this report, which has been shared with all residents in the cluster.

The motivation for the project is primarily to reduce energy wastage and thereby tackle one of the causes of climate change- energy use in the home. As residents become more aware of how their homes are losing and gaining heat, they will be more able to take action to reduce both their winter fuel bills and improve comfort levels as our summers become hotter and hotter.



A fan is set into the door frame during the survey.

1.2 The CHEESE Project C.I.C.

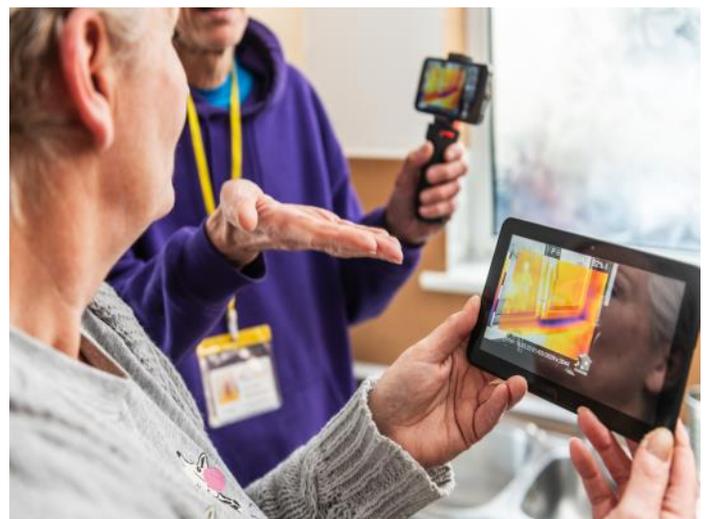


An internal thermal survey is the perfect starting point for retrofit because it identifies all the points at which heat is lost and gained through the 'thermal envelope' of the building. CHEESE (Cold Homes Energy Efficiency Survey Experts) is a multi-award-winning not-for-profit Community Interest Company (C.I.C) that has been combating fuel-poverty and reducing carbon footprints since 2014. CHEESE has delivered over 1,200 surveys in Bristol, Bath and South Gloucestershire.

Their powerful fans draw cold air in through all the gaps in the building. Using a bespoke Heatview® thermal camera with software designed by their own technical experts they examine air movement and see into the structure of the building to reveal where heat escapes when the fan is not there. Then, surveyors and residents discuss the findings and surveyors suggest options for the residents to consider.

For the Westover cluster project, CHEESE agreed to reduce their charges, meaning participants only had to pay a £25 booking fee for their thermal survey.

www.cheeseproject.co.uk



A CHEESE survey in progress.

1.3 Link-detached homes

The homes on Westover Road, Close, Rise and Drive were constructed before those along Northover Road, as part of the development named on the planning applications as the 'Henbury Hill Estate'. Construction is thought to have begun as early as 1960 and was completed around 1965. Houses on Westover Close were built by Stone and Sons, a local firm from Redland in Bristol.

This project refers to the Westover streets as 'The Westover Cluster'. There are more than one design of house in the cluster; this project focusses on those in the majority—the link-detached homes of which there are 68.

The aim is to identify how the houses lose heat in the winter and gain heat in the summer. Due to the similarity in design, materials and construction, there may be many similarities between them, despite the fact that over the years owners have made changes, particularly to the arrangement of the ground floor.

Some residents who were involved in the project were having difficulty keeping their home warm and complained about the cold, while others were reasonably comfortable but wanted to make simple improvements to improve comfort and reduce bills where possible.

When built in the 1960s, the homes would have featured metal, single-glazed windows probably from the manufacturer "Crittall" who are still making windows to this day. These have now all been replaced with double glazed units. The homes have a solid concrete ground floor which was not built with insulation in it as it would be today, meaning it is a good conductor of heat. The other notable similarity between the homes is that the walls are built with a narrow cavity. Some (but not all) homes have insulated cavities.

These features contribute to the relatively low scores the buildings achieve on their Energy Performance Certificates; the homes included in this study have an average score of 65 - slightly worse than the national average of 68 - and most get a 'D' grade. This report highlights ways to improve comfort and efficiency, but addressing the findings discussed will not necessarily improve the EPC score because of the way EPCs are calculated.

Q To what extent do houses that look the same share the same thermal characteristics?



A To find out, a sample of homes had thermal surveys carried out by the CHEESE Project CIC and the results are presented in this report.



The backs of 1-3 Westover Close, c.1960.

2. Summary of the thermal findings

Six homes from the 68 in-scope homes were surveyed.
The main findings are:

- Insulation in the concrete floors is not present in any of the surveyed homes;
- Where fireplaces are still present they are very draughty and let lots of heat escape;
- Every home has a draughty letterbox and cold air coming in around light fittings and light pendants;
- No home consistently uses energy efficient window coverings, with curtains usually being the wrong length;
- Holes in the ceilings and floors of the airing cupboard on the first floor are very common;
- Cavity wall insulation has been widely installed but it is not in every home;

Descriptor	Meaning
UNIVERSAL	Present in all (100%) of the homes surveyed
COMMON	Present in 50—99% of homes in the sample
OCCASIONAL	Present in less than half (50%) of the homes

- Where cavity wall insulation is missing, cold air is more likely to get into the floors around the joists;
 - Every house has radiator panels missing where they would be of benefit,
- and
- Hardly anyone knows how much energy they use.

Interpreting Heatview® thermal images

Mid-point (Vu) temp and range

Battery level and time remaining

Temperature at the midpoint of the view

The temperature scale. White (at the top) is hottest

Number of still photos (P) taken

Number of movies (M) in survey

Balance (B) between thermal and optical (Currently 100% thermal)

Survey code, room name, time, date, software version

Relatively cold



Relatively warm

The thermal images in this publication are generated by Heatview® software operating on thermal cameras custom-built for use by The CHEESE Project C.I.C. Other thermal cameras are available for purchase, hire and loan, but without an extractor fan to reveal hidden draughts, the results are unlikely to be as comprehensive. Trustpilot reviews show how much clients value a surveyor trained and experienced in interpreting the thermal images. www.trustpilot.com/review/cheeseproject.co.uk

Summary table

Not every thermal finding is listed below; some homes had unique features that are unlikely to be found elsewhere. Also, the findings below are those that provide opportunities for improvement. Some homes

have had works carried out to improve insulation and draughtproofing; these are not listed below but are referred to in the discussions about making improvements.

Feature	Frequency	Notes
Chapter 3: Loft and ceilings		
3.0 Cold loft hatch	COMMON	An important job that is often overlooked.
3.1 Thin or irregular loft insulation	COMMON	Loft insulation is rarely at the recommended depth.
3.2 Thin insulation in the eaves	COMMON	
3.3 Holes in ceilings	COMMON	Only small, but there are often many of them.
Chapter 4: uPVC Windows		
4.0 Window-frame draughts	OCCASIONAL	
4.1 Failed rubber seals	OCCASIONAL	Cause draughts that can lead to unnecessary window replacement.
4.3 Inefficient window coverings	UNIVERSAL	A huge opportunity for improvement in every house.
4.4 Trickle ventilators	COMMON	
Chapter 5: Doors		
5.0 Thin plastic doors	UNIVERSAL	
5.1 Draughty letterboxes	COMMON	
5.2 Cat flaps	OCCASIONAL	
Chapter 6: Pipework problems		
6.0 Draughty sink and toilet waste pipes	COMMON	Usually hidden away, often draughty.
6.1 Ventilation fans	COMMON	Includes cooker hoods and boiler flues.
6.2 Uninsulated hot-water pipes	COMMON	
Chapter 7: Floors		
7.0 Draughts under skirting boards	UNIVERSAL	
7.1 Uninsulated concrete floors	UNIVERSAL	Most residents are aware of their cold floors.
7.2 Gaps around joists	OCCASIONAL	
Chapter 8: Draughty fireplaces		
8.1 Draughty fireplaces	OCCASIONAL	
Chapter 9: Walls		
9.0 Walls vs windows	n/a	
9.1 Uninsulated cavity walls	COMMON	
9.2 Dot and dab	OCCASIONAL	

3. Lofts and ceilings

3.0 Cold loft hatches

COMMON

The thermal qualities of access hatches in the homes surveyed varied from reasonable to very poor; the thermal images show the effect of insufficient insulation and draughtproofing.

To improve warmth, the traditional loft hatch (usually just a board of ply or solid wood) needs to have a layer of insulation attached directly to it on the loft side. About half have some, but its often too thin to be making much difference. An easy and effective improvement is to glue PIR to the hatch (the deeper the better, 100mm is good) with PVA adhesive. Alternatives to PIR include polystyrene, wood-fibre products and rockwool insulation, but PIR is the most thermally resistant. Check skips for offcuts.

Loft ladders can restrict the depth of insulation that can be attached to parts of the hatch, but PIR is easy to cut to shape and there is often room for at least 50mm.

Draughtproofing loft hatches is very important. Cold air falls (it is denser than warm air) through any gaps and on downwards, cooling the house. When inside temperatures are high enough, hot air rises through any gaps and escapes, lowering the air pressure inside the house. This allows atmospheric pressure to force colder air in at the bottom of the house. This is called the Stack Effect. It makes houses operate like a chimney. Opening loft hatches in hot weather utilises this effect and helps cool the house down.

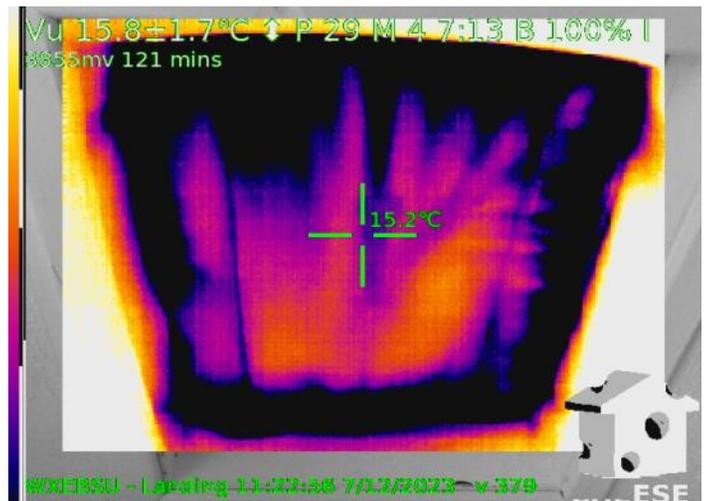
Many draughtproofing products are available to buy, but most rely on the weight of the hatch itself to compress them and block out the air. They work much better if a fastener (like the ones pictured which are also used on wooden sash windows) is used to clamp the hatch down, forcing the gaps closed and creating a tight seal. The fastener pictured has a screw fitting, so the tightness can be easily adjusted.

What is PIR?

PIR stands for Polyisocyanurate. It is a plastic widely used for thermal insulation and is sold under many brand names including Celotex, Kingspan, Ecotherm, Enertherm, etc. It is very warm, light and easy to cut to size, but when cut it creates small plastic particles that will not biodegrade. Alternatives include wool and wood-fibre products.



An ill-fitting and draughty hatch



A very draughty hatch with some insulation attached to it



Clamping hatches closed helps stop draughts



A well-insulated loft hatch with 100mm of Celotex PIR

3.1 Thin or irregular loft insulation

COMMON

The homes surveyed showed considerable variation in the depth and consistency of loft insulation - most did not have the recommended minimum depth. The minimum has steadily increased; installing it may be a fit-and-forget job and if done years ago to the standards of the time, adding more now may make an improvement.

And of course placing boxes on top of rockwool squashes it and reduces its usefulness. Boarding also limits the depth, but ways around both problems exist. 'Loft stilts' raise the floor to create space for insulation, and sometimes shelves can be added to the walls and used for storage. Rockwool is not the only insulator that can be used: better products do not have to be as deep to get the same benefit, but tend to be more expensive. Wood-fibre products or PIR may be good to use, possibly just where space is limited under boarding or in the eaves (for example) to keep costs down.

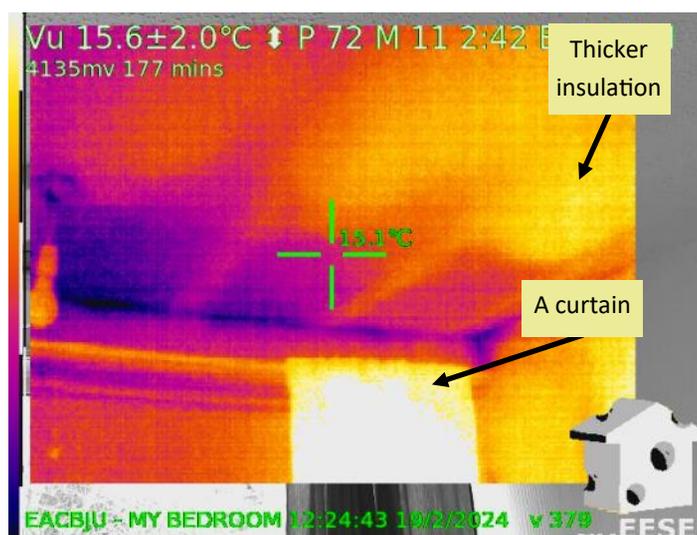
3.2 Thin insulation in the eaves

COMMON

In the eaves, the low height of the roof above the top-floor ceilings means it is difficult and unpleasant to work in these areas, and the insulation is often not as good as elsewhere. In some cases, the original thin glass-fibre insulation (the scratchy stuff that gave loft insulation a bad reputation) may be the only insulation present and over time this breaks down and doesn't work as well.

In the eaves, it is usually impossible to achieve the recommended minimum 270mm depth because the maximum depth of the space is, in places, just over the depth of the joists, which are around 100mm deep. Using an alternative material (such as PIR) can improve heat retention because it has double the thermal resistance of rockwool so only half as much is needed. Using expanding tape along the edges of the insulation board will allow a looser initial fit, while still achieving air-tight joints with the joists once the tape has expanded.

When insulating the eaves it is very important to maintain the air gap that allows fresh air to flow over the top of the insulation to keep the loft dry.



Patchy, inconsistent loft insulation



The minimum depth of rockwool loft insulation to meet current building regulations is 270mm or 10.5 inches



Cold eaves where the insulation is too thin

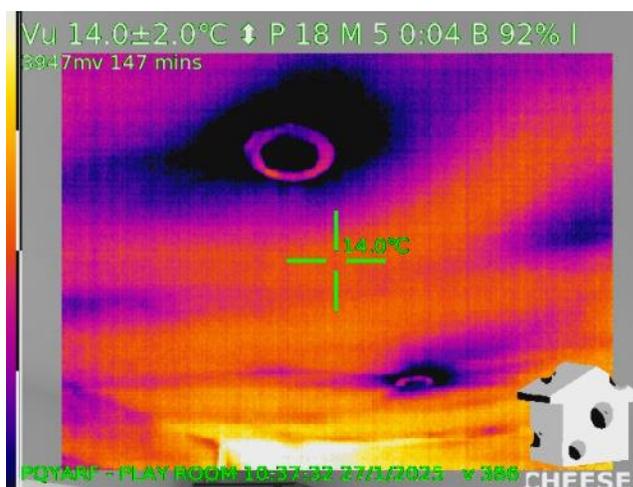
3.3 Holes in ceilings

COMMON

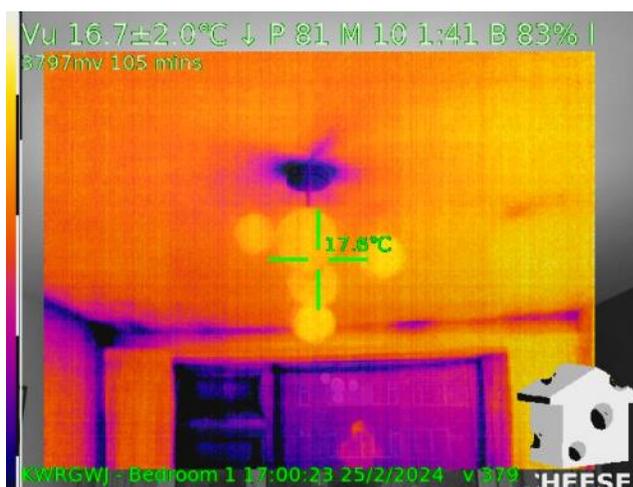
Most of the surveyed homes have holes in the ceilings, where heat escapes and cold air finds its way into the house from the loft. They are often hidden behind ceiling roses for light fittings and in cupboards where the ceilings are not usually visible. Routes for electric cables (light pendants and light switches), ventilation fans, downlighters and plumbing pipework all allow heat to escape around them if not draughtproofed.

Usually holes around the cables can be filled in, but care is needed around electrical cables which should not be thermally insulated. Powder fillers or electrical tape should be OK. On the top floor, filling and sealing holes can sometimes best be done from the loft.

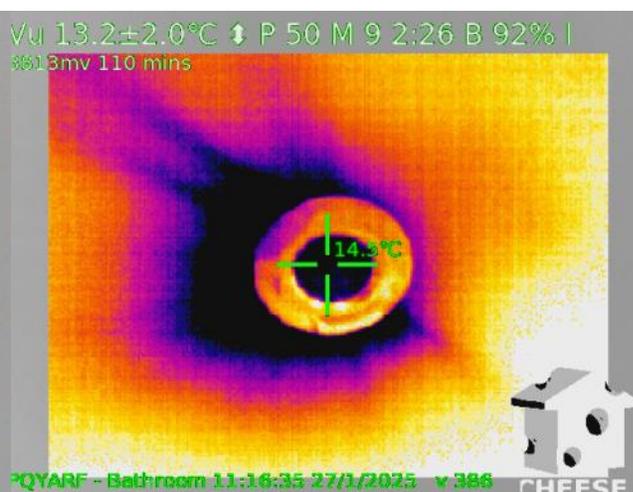
Downlighters (or spotlights) can be very draughty, with air coming both through the light around the bulb and from under the surround. There are many discussions online about how to solve the problem. Ingress Protection (IP) rated downlighters are usually much more efficient, and are required in wet areas for safety reasons. Some have an air-tight seal between the shroud and the bulb and a fitting that tightly clamps the spotlight to the plasterboard of the ceiling. Many different designs are available.



Heat escaping around downlighters on Westover Close



An example of a draughty light pendant



4. uPVC windows

4.0 Window-frame draughts

OCCASIONAL

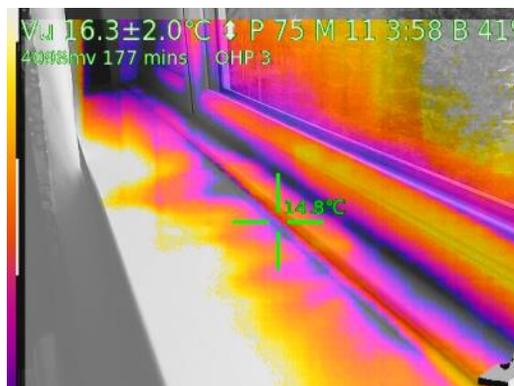
Strips of plastic called window trims, or “cloaking profiles”, are often used to tidy up the installation of uPVC windows. They make it quick and easy to hide cracks and holes between the window frame and the wall that were left when the frames were installed. They are usually held in place with double-sided adhesive tape or blobs of adhesive and are finished with silicone sealant, so are quite easy to remove. Removal exposes any holes that they are covering and allows them to be filled. Once any holes are filled and the wall painted they don't have to be replaced. It might be worth checking behind them if you are suspicious of cold spots and your windows are a few years old.

Alternatively, without removing the plastic, filling any gaps between the plastic trim and the wall with silicone sealant can prevent draughts.

Windows installed after 2022 should be compliant with the new building regulations. As well as making the glass panels and frames more energy efficient (meaning new windows should allow less heat-loss in winter and heat-gain in summer), the new regulations tighten-up on the approved method of installation, meaning fewer gaps between the frames and walls. But there will inevitably be some variation in the quality of workmanship.



Pulling back the window trim reveals the holes lurking beneath



Draughts around cloaking profiles



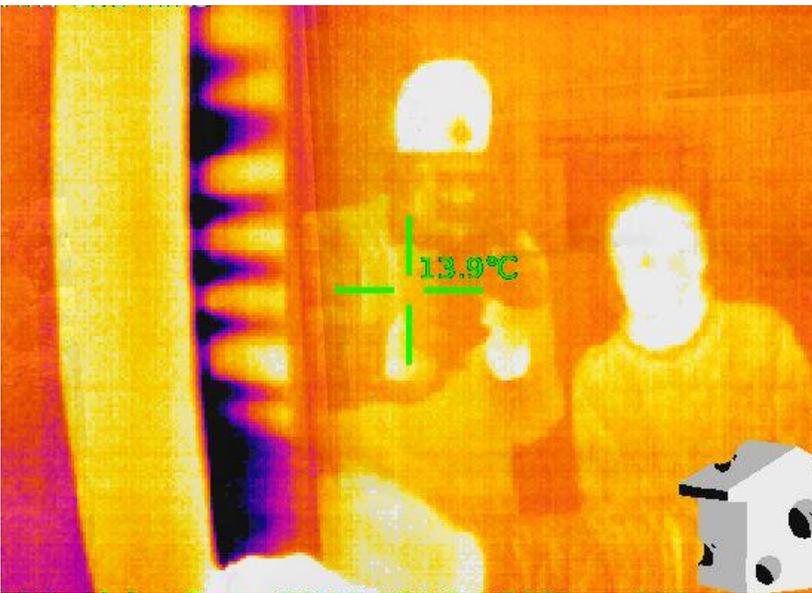
Gap between frame and masonry



Expanding foam is used to fill gaps

4.1 Failed rubber seals

OCCASIONAL



A failed bubble gasket creates the tell-tale draught pattern as surveyor and client watch on.



uPVC windows and doors use rubber seals, (also known as bubble-gaskets), to seal the gaps between opening windows and the frames. After 15 years or so, the rubber starts to deteriorate due to exposure to ultraviolet light and repeated heating and cooling. Eventually they lose their flexibility and windows and doors can become draughty. If gaskets don't feel soft and flexible anymore, or if the rubber is cracked or damaged, simply replacing the gasket may solve the problem.

Replacement is usually quite straightforward; YouTube has videos showing how. The design of the gasket can vary with the design of the frame, so it is best to get a sample pack from online retailers or local glazing companies. They are cheap and will help you to identify the gasket you need.

Adjustment of the hinges and fixings may also become necessary after years of opening and closing.

DIY triple-glazing

It is difficult to photograph double-glazing which has been triple-glazed using optically clear acrylic plastic sheet because it is more or less invisible. When fitted, acrylic sheet makes a real difference that you can feel to the touch, even with double-glazed windows.

Perspex is a familiar brand of acrylic plastic. The sheets are cut to the sizes you provide by many online retailers and when delivered, it can be attached to the frames of your double-glazing in a variety of different ways. Some people use magnetic tape, which works very well especially for small and medium-sized windows and means the acrylic can be taken down easily. It is also possible to fix with screws into the PVC frame, and some people make 'frames' using a wooden batten or plastic profile. A commercial product called Liteglaze®, matches white PVC frames perfectly. The base attaches to the frame with a self-adhesive strip and a locking strip is clicked in to hold the acrylic in place.



Liteglaze® glazing strip

Acrylic comes in a range of thicknesses and is easier to apply to larger windows if it is 3mm or more thick. However, its not the thickness of the plastic that gives the majority of the thermal benefit, but the layer of still-air that is trapped between the plastic and the glass. It is vital to get as air-tight a seal between the acrylic and the frame as possible and silicone sealant is sometimes used to help.

There are lots of videos on You Tube (search for combinations of: magnetic-strip, secondary glazing, acrylic) which will give you more information.

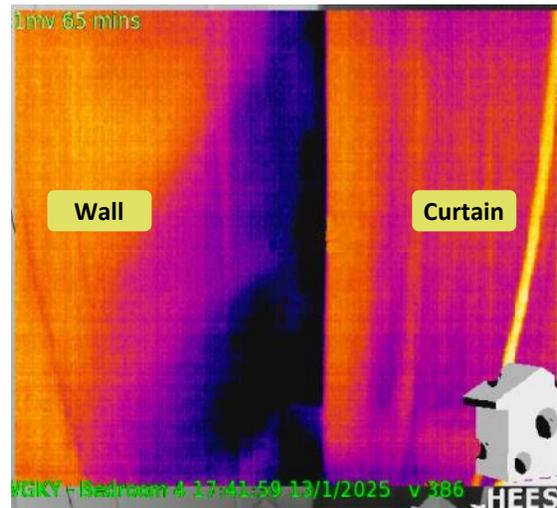
Not one surveyed home had thermally effective window coverings on all the windows - a huge lost opportunity. A thermally efficient window covering (be it a blind, curtain or shutter) will control both heat-loss in winter and heat gain in summer and will have:

1. Tight seals. Attaching them to the wall or window frame so air cannot pass around the sides, perhaps with Velcro or magnetic tape, can improve performance of double glazing by 19%, (Fitton, R. et al, (2017)). Curtains should rest firmly on the window cill or the floor to prevent cold air coming out underneath their lowest edge. Pelmet's stop warm air escaping down the back of curtains and cold draughts getting in over the top and are useful if it is impossible to get the curtain close enough to the ceiling.

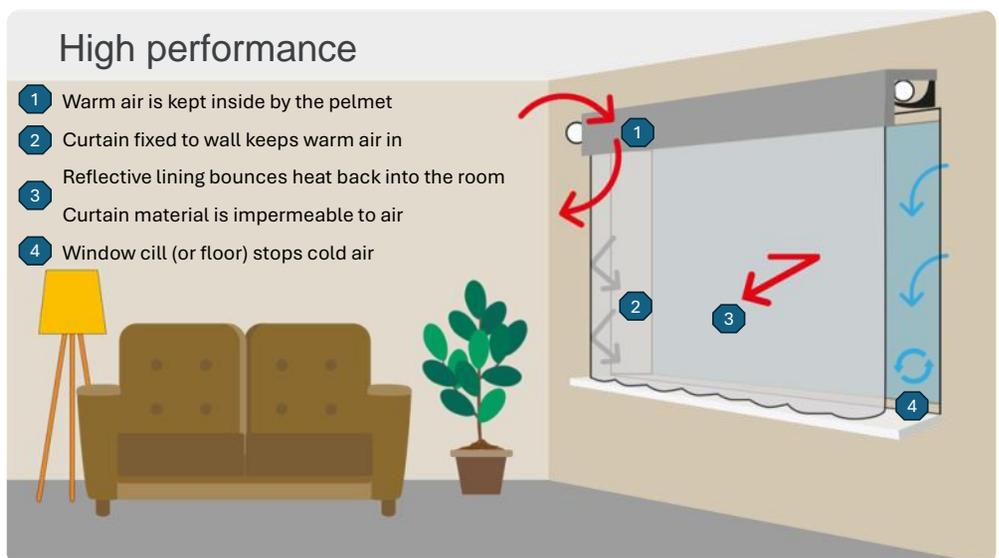
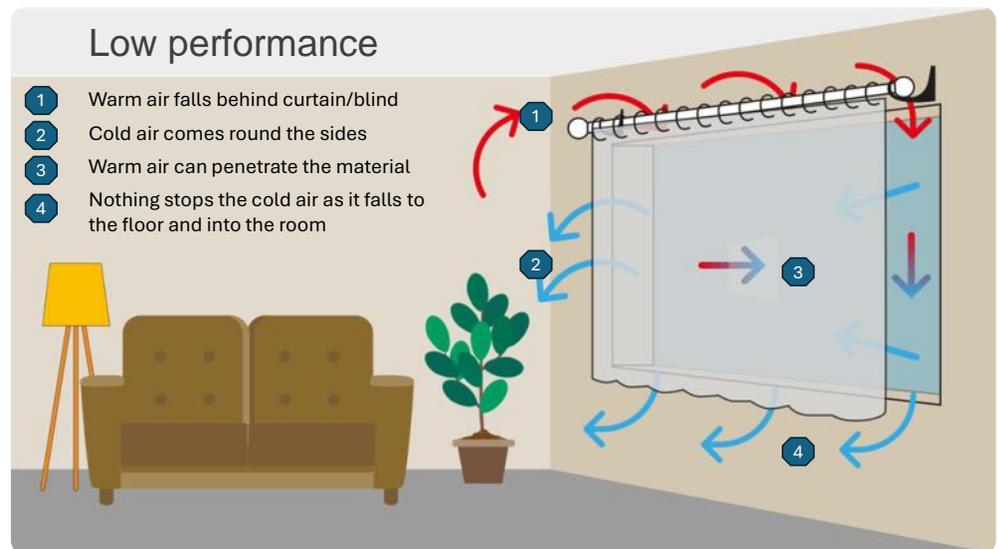
2. Pockets of air. Still-air is an insulator. Just like layers of clothes, multi-layered structures trap more air, so using inter-linings will improve heat retention. The folds in curtains trap air naturally - so make sure they are wide enough to create deep pleats. Some blinds have a honeycomb structure that creates this effect.

3. Resistance to air. Some shutter and venetian blinds are weak in this regard because of the gaps between the slats. If daylight is visible through the material, it is likely to be permeable to air. Material with a higher thread count (TPI) will be denser and so more resistant to air penetration. If the TPI of a material is not available, weight can be a useful proxy. This is measured in grams per square meter, (gsm). Aim for 300gsm or more.

4. Resistance to the movement of heat. Additional insulating layers or 'thermal liners' made from foam, polyester or fleece will improve warmth. Wool and velvet have better insulating properties due to their higher density.



A thermal image of cold air coming round the edge of a curtain



5. Reflective surfaces. Reflective thermal curtain linings are available which bounce heat back indoors. Some blinds can be highly reflective.

4.3 Trickle ventilators

COMMON

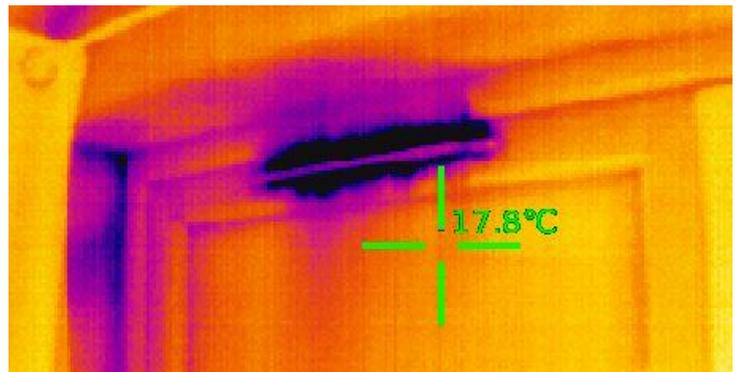
At least one trickle vent was present in 83% of the surveyed homes. A recent change to building regulations now requires ventilation to meet certain standards and not to be reduced when windows are replaced. Background or trickle ventilators in windows and doors are becoming more common, (See *Approved Document F: Ventilation*).

Unfortunately, most let in cold air, whether or not they are 'closed'. Some are more air tight, but air can come in along their edges where the ventilator meets the frame.

The regulations are there to maintain healthy indoor air quality; this is important and can be achieved in various ways. Demand for fresh air depends on occupancy levels and behaviour and many homes currently do not have or need trickle ventilators. Taping them closed may be an option in some cases, but care should be taken to maintain an adequate supply of fresh air from controllable sources of ventilation.



An example of a trickle or background ventilator



This trickle ventilator is closed, but the air is coming in around it, along its edges.

What's an EPC got to do with it?

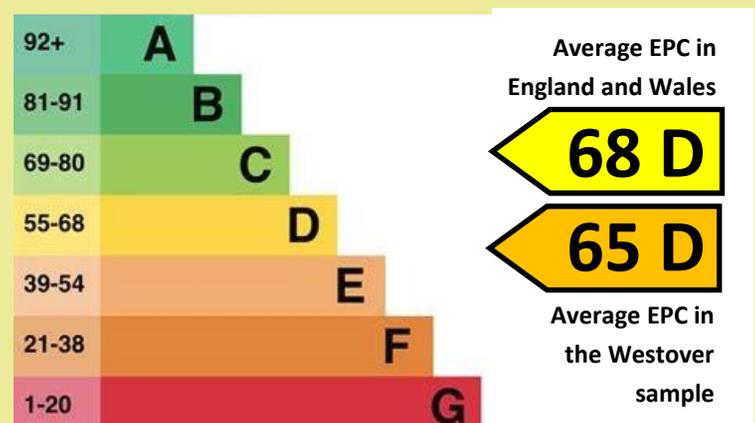
Energy Performance Certificates (EPCs) provide an indication of the energy efficiency of a property, typically issued upon construction, sale, or rental. EPCs inform homeowners, tenants and prospective buyers about energy performance and they have some useful information about how the house is built and include recommendations for improvements.

However, EPCs may not always provide homeowners with an accurate impression of their home's energy consumption because they:

- are based on standard assumptions about occupancy, heating patterns and usage, which may not reflect individual household behaviours or specific features of the property;
- rely on visual inspections rather than comprehensive energy audits, potentially overlooking nuances in building construction that can significantly impact energy performance, and
- except in new houses they do not thoroughly address draughts and air leakage, which can significantly affect energy consumption and comfort levels.

The average EPC for dwellings in England and Wales is 68—or 'D', (2023). The EPCs were available for all six homes in the sample producing an average of 65, slightly worse than the national average. But this is a small sample and some of the six EPCs are over 10 years old. The highest score achieved was 71 (2 properties) the lowest, 51.

YOU CAN TAKE A LOOK AT YOUR EPC AT:
WWW.GOV.UK/FIND-ENERGY-CERTIFICATE
(Scanning the QR code takes you to this page).





Do you use a lot of fuel?

Most people don't know how much energy they use each year. Many assume their annual kilowatt-hours (kWh) are on their bills or on an 'app', but then can't find them. The figures in the table include estimates obtained from [energy.comparethemarket.com](https://www.energy.comparethemarket.com) which provides consumption data for most homes in the UK.

Many factors affect fuel consumption and each household will use energy differently. The consumption of people living in the Westover cluster varies significantly .

Kilowatt hours per year	GAS (kWh)	ELECTRICITY (kWh)
Average per house	9023	3811
Highest consumption (house) (From estimated readings)	16212	7469 (electric car)
Lowest consumption (house)	3527	1209
Annual average per adult	4511	1905
Highest annual use per adult	8106	3734 (electric car)
Lowest annual use per adult	2752	580

Some commentators describe home energy as 'invisible'; we tend to focus on things we plug in or switch on, even though 'hidden' uses like water and space heating consume much more power. Not knowing how much energy is being used is a problem; it makes managing costs and consumption more difficult because the biggest uses may be hidden, especially where dual-fuel contracts obscure the split between gas and electricity use.

The warmer, wetter winters and hotter, drier summers with the increased frequency of the intense weather events we are now experiencing are exactly what climate scientists predicted would result from failure to reduce greenhouse gas emissions. Powering homes accounts for c.13% of the UK's greenhouse gas emissions, (ONS, Mar 24) but potentially a larger proportion of our own personal liabilities. Improving draughtproofing and insulation is certainly one of the best ways for most homeowners to reduce their carbon pollution, given the extra comfort and financial benefits that will be achieved at the same time.



Draughts v ventilation



According to the Energy Savings Trust :

"Draught-proofing is one of the cheapest and most effective ways to save energy – and money – in any type of building. Controlled ventilation helps reduce condensation and damp, by letting fresh air in when needed. However, draughts are uncontrolled: they let in too much cold air and waste too much heat".

www.energysavingtrust.org.uk/advice/draught-proofing

All buildings need ventilation, but most have too much, or it's in the wrong places. The most modern and energy-efficient Passivhaus designs (passive houses) are effectively built within giant plastic bags, the idea being to cut out every draught. Great care is taken to make sure there is nowhere for air to leak inside. Some companies help make buildings more airtight by blowing a pressurised mist of plastic inside. As it finds its way to the outside, it sets hard, sealing small cracks and gaps and dramatically improving air tightness.

Draughts are neither healthy nor necessary. But controllable ventilation is essential.

Requirements are set out in *Building Regulation Approved Document 'F': Ventilation*.

Passive houses are so efficient they don't require any heating in addition to that derived directly from the sun and that produced by cooking, lighting and from body heat. Fresh air is introduced through an energy-efficient system of Mechanical Ventilation with Heat Recovery (MVHR) which warms the cooler, fresh air with the heat from the warm, moist air that is being expelled. While extractor fans are effective for removing moisture and odours, they don't recover heat, leading to unnecessary heat-loss and higher heating bills, especially in colder climates. Small MVHR fans are available and are designed to replace the old-fashioned extractor fans found in many of our kitchens and bathrooms.

Controllable ventilation is very important for all sorts of reasons, but most homes are just too draughty and let in more air than is necessary.

c. 15% of heat-loss is caused by draughts



A small MVHR extractor fan suitable for one room.

5. Doors

5.0 Thin, plastic doors

UNIVERSAL

Many homeowners said how cold the thin plastic-and-glass doors are. As well as having poor thermal resistance, any weaknesses in the adjustment of the hinges or quality of the gaskets will let in draughts. If the seals are not leaking, the easiest improvement is to line door-panels with acrylic sheet to create a warm pocket of air. Ideally, the door and frame would be replaced with what the Government refers to as a “thermally efficient door”.

Another option is to hang a heavy curtain in front of the door, which will help a lot.



Thin plastic door with draughty seals

5.1 Draughty letterboxes

COMMON

Every letterbox in the sample had brushes - sometimes two layers - but this makes posting things difficult and when deliveries are not pushed all the way through, the brushes are held open. Filling-in letter boxes and replacing them with externally mounted post-boxes or delivery boxes for parcels will reduce heat-loss. High quality cast iron boxes are available, but there are many different lower-cost designs. Letterboxes are optional in new doors and many people choose the more efficient external alternative.



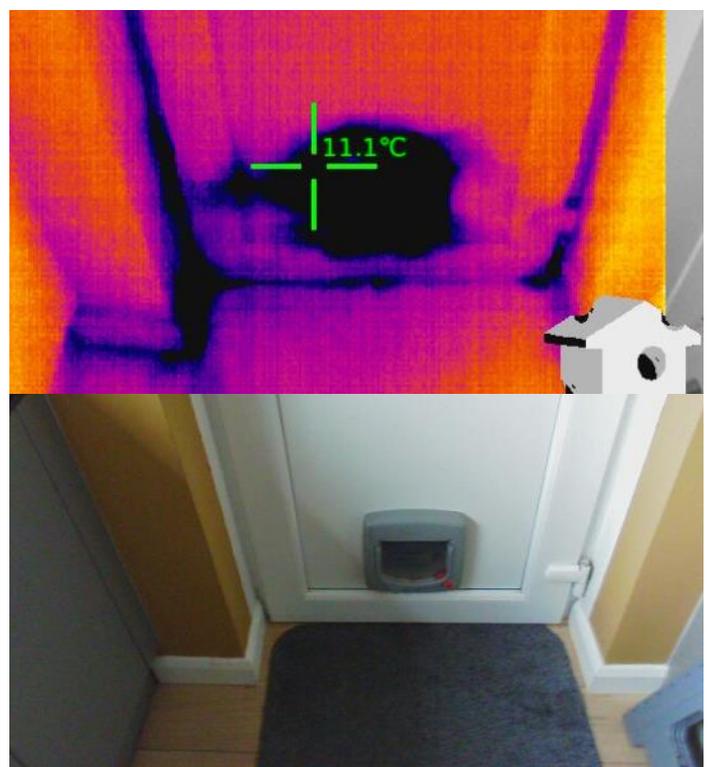
Draughty letterbox

5.2 Cat-flaps

OCCASIONAL

As with letterboxes, its almost impossible to draughtproof cat-flaps effectively and still have them working well. There are rumours of a double-glazed, draughtproofed cat-flap having been seen on the internet, but it was expensive! Draughts come in around the sides where the frame of the flap and the door meet -as well as through the opening itself - and some improvement may be achieved by sealing the edges.

Some owners will leave the cat-flap in place even after their cat has gone. The alternative is to remove it and cover the hole.



All cat flaps are cold

6. Pipework problems

6.0 Draughty waste pipes

COMMON



An unsealed waste pipe

Hole around a toilet waste

When pipework penetrates walls and is not sealed properly, or when time degrades the sealant that has been applied, cold air can enter the house around the pipework. Often, pipework is hidden behind boxing, under floorboards or behind cupboards and the cold air sometimes emerges a considerable distance from the pipe itself, making finding the source of the draughts more difficult – unless you know what to look for.

Air entering around the pipe may emerge around bath panels, under kitchen units, under skirting boards and through holes in floors and ceilings, so blocking one such source of air ingress can sort out many separate cold spots.

A visual check from outside is often the best way to see if this might be a problem that can be solved with mastic or silicone sealants. But if external access is difficult, or if it is difficult to see the tiny cracks in sealant that occur over time, the source of the cold can usually be reached and filled from indoors.

6.1 Uninsulated pipework

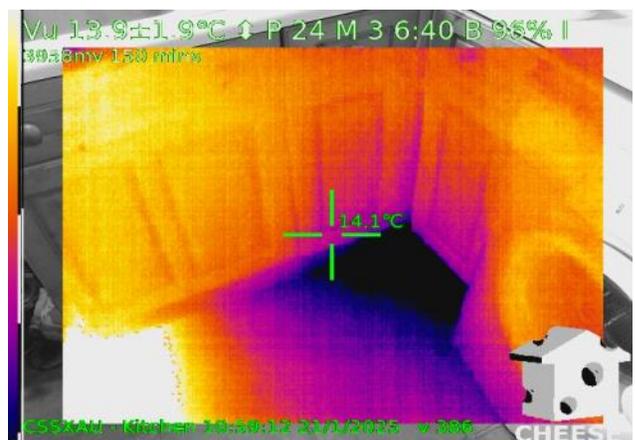
COMMON

Central heating and hot water pipes run through the floors and walls. Usually they are missing the pipe lagging that is used to keep the water hot and the heat-trails often show exactly where the plumbers have found it easiest to install the pipes. Not all the heat lost from uninsulated pipes is wasted because some stays in the building, just not where it is most wanted.

To insulate the pipes it is not always necessary to lift long lengths of floorboard. Wherever possible, pipes are laid so they don't have to be drilled through joists, meaning grey foam pipe insulation can sometimes be 'fed' onto pipes for some meters from a small point of access.



A poorly-sealed toilet-waste creates draughts



How waste pipe draughts appear in a kitchen



Expanding foam seals pipe holes and floor edges



Waste heat from uninsulated central heating pipes

Ventilation penetrations are another common source of air leakage. Typical examples include cooker hoods, extractor fans and boiler flues.

Cooker hoods

Cooker hoods work in one of two ways; some circulate air internally, trapping grease and other particles in a filter. Others have a fan blowing air out of the house through a hole in the wall and can be very draughty if there is nothing to stop backdraught when the fan is not working. The photos are both of hoods with a hole in the wall for the exhaust; one shows air pouring in and cooling the hob below. The other has a shutter that you can hear clunk shut when the hood is switched off. Hoods can often be changed from external extraction to internal filtration, in which case the hole in the wall can be filled, cutting out the draughts. Many homes have no cooker hood at all.

Extractor fans

Ventilation fans, whether in windows, walls or ceilings, also create air leakage if the devices intended to stop backdraught are not fitted, or are not working properly. Sometimes the louvres on the outside wall are missing entirely or have been replaced by grilles that are permanently open. Also, louvre stop working if they get blocked with leaves or moss, or lack lubrication and don't move freely enough to close tightly and stop draughts.

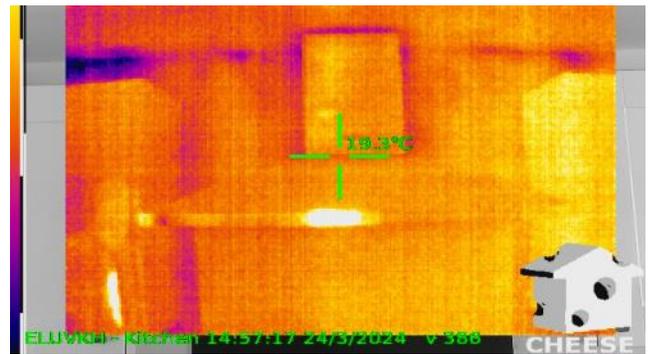
In-flue baffles can also work well.

Ventilation fans may have been required by building regulations, but they may no longer be needed if the number of people living in the house has reduced or if enough air is infiltrating from elsewhere. It may be possible to remove or cover them for greater warmth. To test, tape a plastic bag over the fan to see what effect any changes would have.

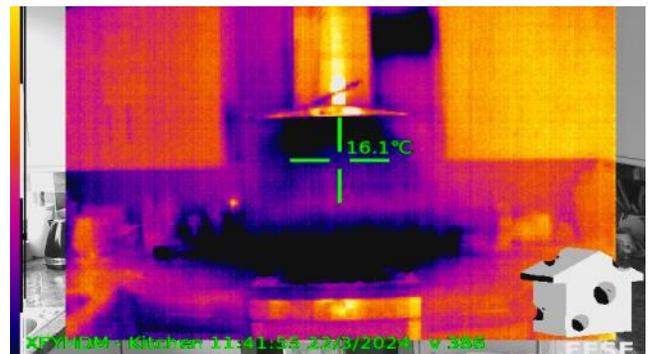
The most energy efficient ventilation fans include heat exchangers and they use the heat in the expelled air to warm the fresh air that is sucked into the house. Such MVHR fans are more expensive, but are more efficient.

Boiler flues

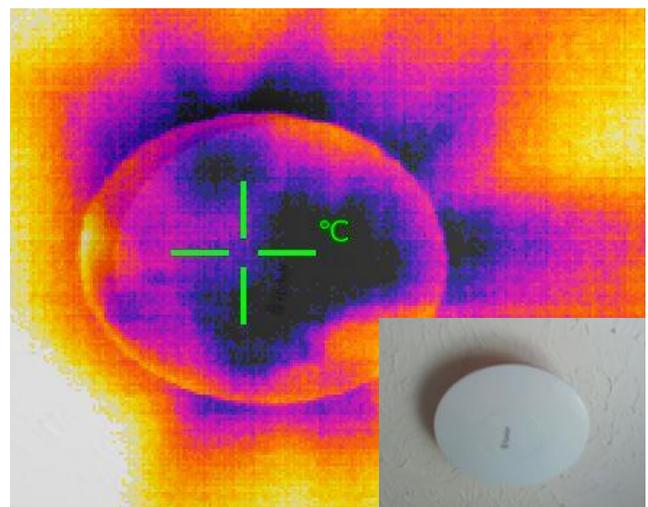
Gaps between boiler flues and the wall should be sealed with mortar (a mix of sand and cement) to prevent exhaust gases and cold air coming back into the house. There is usually a thin plastic shroud around the flue at the wall which hides the gap, but it is not designed to be airtight and is there mostly for appearances.



A hood with an effective closure in the flue



Ineffective closure lets in cold air, cooling the cooker



An extractor fan with poor backdraught prevention



The gap behind the white shroud on a boiler flue

7. Floors

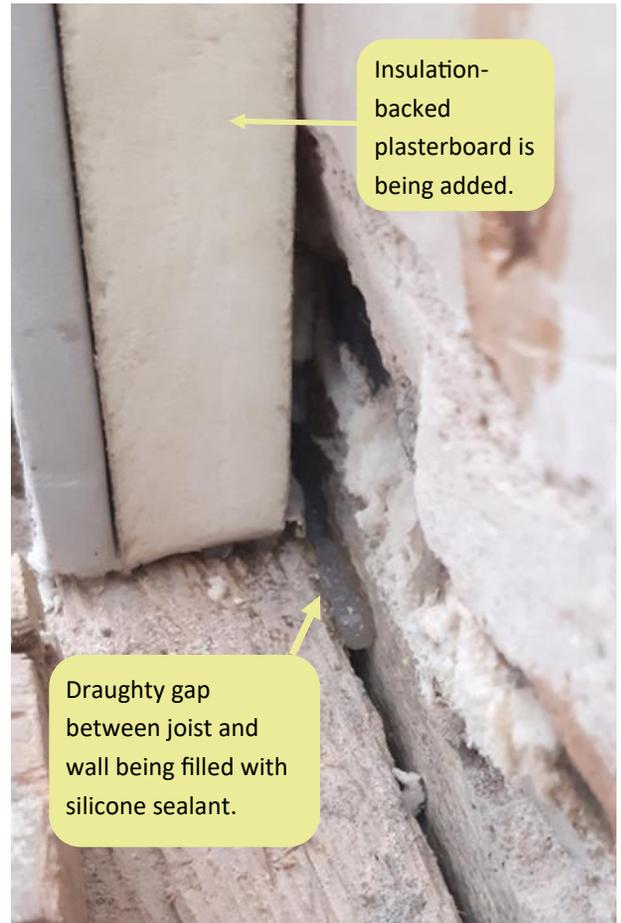
7.0 Skirting boards draughts

UNIVERSAL

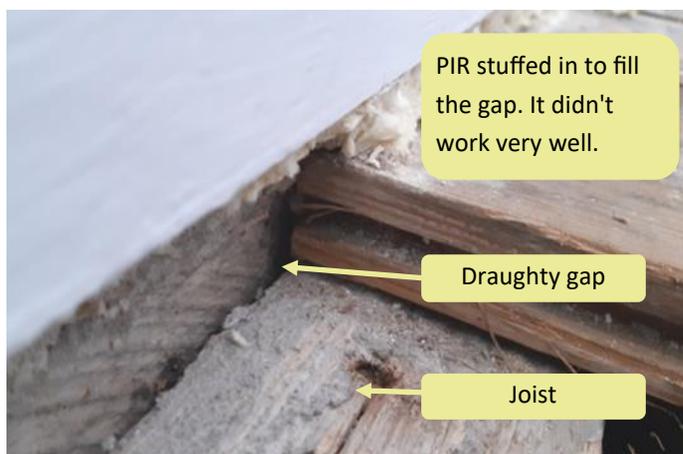
All the homes that were surveyed had cold air coming in underneath skirting boards, and the surveys showed that the strength of the draughts vary from house to house. Air can get into the upper floors around pipes that go through the walls, gaps in the mortar between the concrete blocks in the walls and around the joists where they are built into the inner-skin of cavity walls.

The photographs show top-floor floorboards resting on a wooden beam that is fixed to an outside wall. There is a gap between the beam and the wall which lets cold air in underneath the skirting board, (the skirting is not shown in the photos). The gap can be filled with mastic or silicone sealant. The photos also show internal wall insulation being fitted to insulate the wall.

Floorboards were originally tongue and groove; this helps block out draughts, but if they are ever lifted, gaps can open up. Carpet and underlay are useful insulators and draft-proofers.



A common skirting board draught pattern



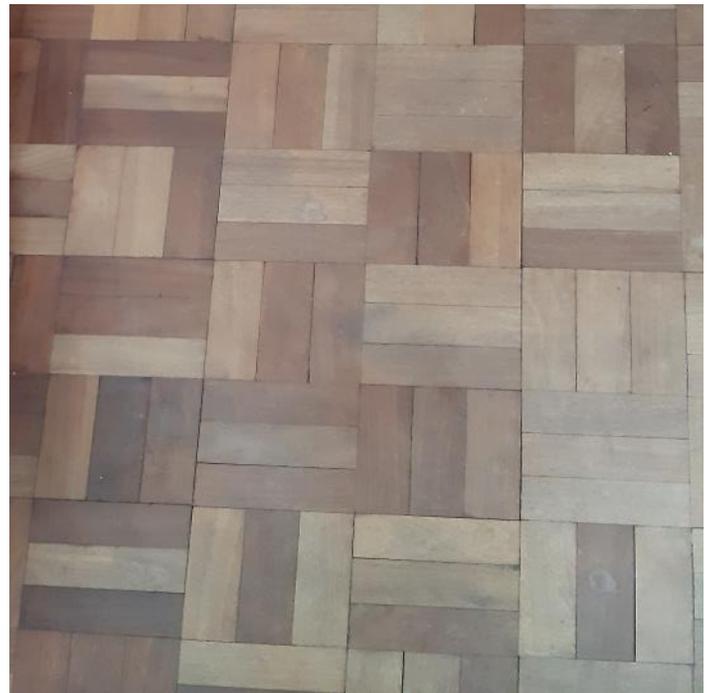
Join between floorboards and wall

7.1 Uninsulated concrete floor **UNIVERSAL**

None of the homes surveyed have the solid concrete floor insulated to modern standards. The construction, while common for the 1950s and 1960s, is now well out of date. Modern floors have at least 100mm of solid insulation, but the uninsulated concrete acts as a 'heat sink', pulling warmth out of the ground-floor rooms and making the floor feel relatively cold to the touch.

Some homes have the original parquet flooring which has lasted well. But most owners have installed a finish that makes a thermal improvement to the original, such as laminate flooring that includes a layer of insulation, or that is laid onto a warm underlay such as fibre board, foam roll, a felt underlay and / or foil products.

Overlays including cork tiles, carpet or carpet tiles also help keep feet feeling warmer. If carpets can't be fitted wall-to-wall, rugs and runners might be considered.



An original parquet floor covering the solid concrete ground floor

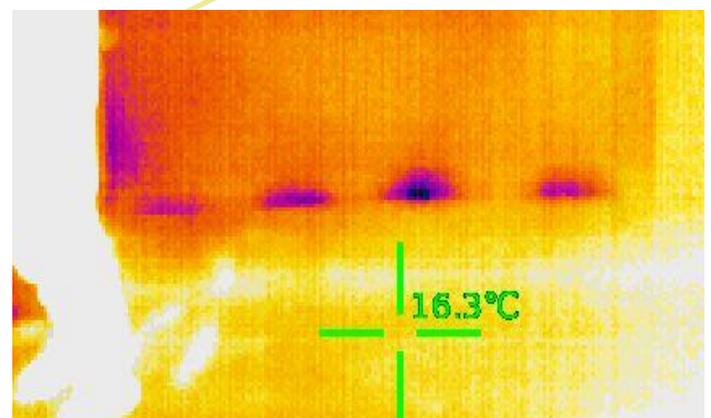
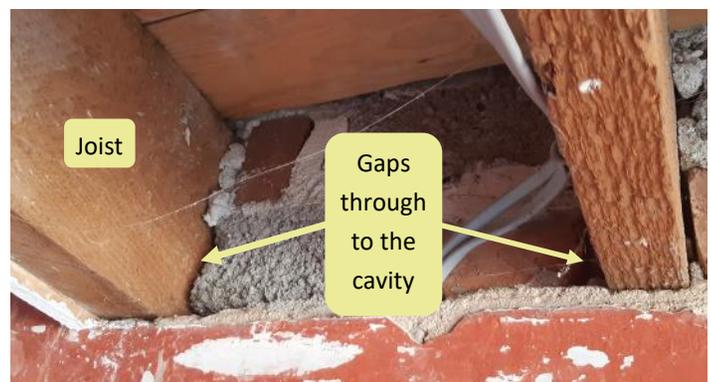
7.2 Gaps around joists **OCCASIONAL**

The homes in the area are built with walls that have a narrow cavity. The joists are set into the inner skin of the cavity wall for support. But the gaps around the joists are not sealed air-tight, so unheated air in the cavity finds its way around the joists and into the floor, cooling the area close to the skirting board and creating a distinctive pattern of regularly spaced cold patches. Heat will also find its way out into the cavity through any holes in the floors and ceilings such as around light fittings and unsealed pipework.

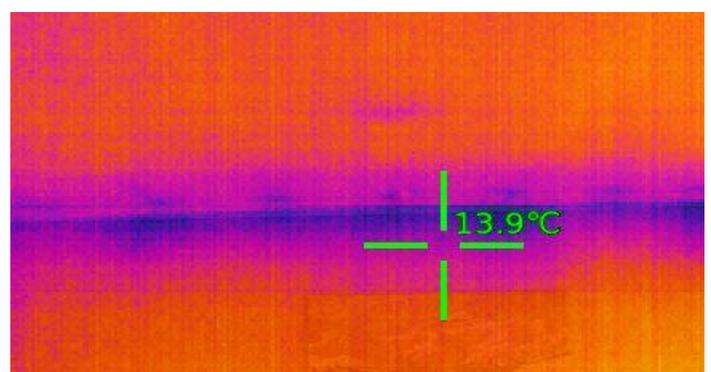
The thermal images of this effect are not as intense and distinct as for other features, but are signs of cooling over a wider area.

It is possible to fill the gaps around joists with mortar or expanding foam. Getting access to the joists in the top floor ceilings may be relatively straightforward from the loft because unless the loft is boarded, the joists should be visible. Access to other areas means lifting the couple of floorboards nearest the wall at the edges of rooms or removing plasterboard ceilings.

This issue was not seen in homes that have insulated cavities.



Above and below: the faint but distinctive pattern of cooling resulting from air ingress around the joists.



8. Draughty fireplaces

OCCASIONAL

All the link-detached homes would have had a fireplace when they were built, but now most have been covered over or filled in. Gas central heating usually removes the need for an additional heat source in the lounge, but sometimes the fireplaces (with or without a fire) remain. The original chimneys were brick-built like the chimneys for solid-fuel hearths that have been part of British housing for generations. And they work in a similar way, sucking warm air out of the house when the wind blows over the roof. This lowers the internal air pressure and causes cold air to be pressed into the building through all the gaps and holes that are described in this booklet.

Flueless gas fires provide an alternative to chimney-connected gas fires, but these have their own pros and cons.

To keep heat in, fireplaces can be covered with a “fireplace blanket” - a commercial product that attaches securely to the walls with Velcro.

The thermal image shows a fireplace that appears to have cold air leaking in around it from the chimney behind, and heat leaving the sitting room in the opposite direction. In this case, the heat-resistant sealant that is used to seal the flues of wood-burning stoves may help to reduce the airflow if applied around the edge of the fire surround.

In a well-insulated and draughtproofed house with a well-designed and maintained gas central-heating system, there should be no need for a secondary heat source, enabling the fire to be removed and the fireplace to be sealed up to help control air movement. An infra-red panel or other electric fire might provide a more modern alternative.

You are recommended to consult an engineer on the ‘Gassafe’ register when making any changes to gas heating appliances, or their ventilation.



Heat escapes around the fireplace towards the cold chimney behind it.



25%

of our home's heat is lost through the roof

86%

of home energy is from fossil fuels



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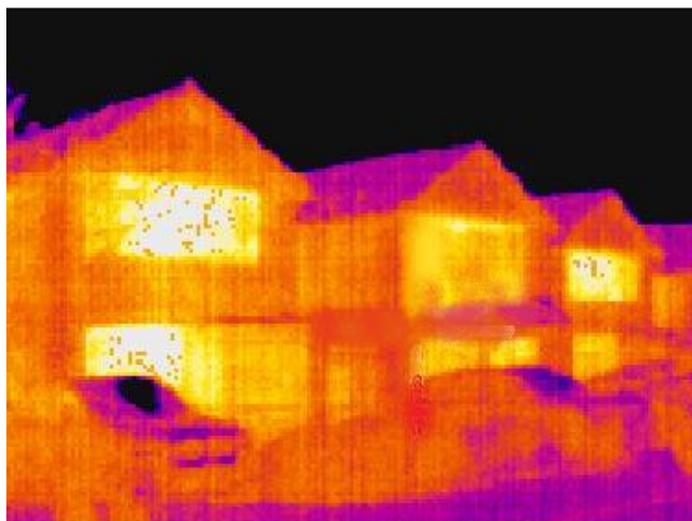
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9. Walls

9.0 Windows vs walls

Which loses more heat? Walls or windows? For those interested in cutting energy bills and feeling more comfortable, insulating the cavities in the walls is an obvious thing to consider. But glass loses heat more quickly, even than that lost through an uninsulated cavity wall. The effect this will have on particular rooms will depend on the areas of glass compared to the wall, the age and the quality of the glazing and whether or not the wall has been insulated. For example, in the bedrooms at the front, unless the window has been recently replaced and has good thermal curtains installed, it will be losing more heat than the walls and improving the curtains or adding acrylic or other secondary glazing might be the logical first step. But downstairs, the living room has a relatively large area of wall compared to glass, so it may make sense to prioritise the insulation of the wall, possibly by insulating the wall on the garage side.



An external thermal image of homes on Westover Rise showing contrasting heat-losses between walls and windows.

Energy transfer (in watts) = temperature difference (°C or °K) x area (m²) x the U-value.

U-values are a measure of how well a material conducts heat. A lower U-value means better insulation. Energy transfers (in watts) increase with the U-value, the surface area and the temperature difference on either side of the surface.

You can estimate if the windows or walls are a bigger problem in your house by measuring their areas, finding the correct U-values and using the formula in the box above. Making accurate calculations is very complicated, but this will give you a rough guide.

To calculate the U-value of the wall we need to know the materials used to build it. If we assume a medium weight concrete block, 102mm of medium weight brick, a 50mm ventilated cavity and 5mm of internal plaster, this produces a U-value of 1.29. The current maximum is 0.3, (the lower the better).

If the cavity is insulated with 50mm of polyurethane foam, this improves the U-value to 0.386.

These calculations use the tool at www.changeplan.co.uk/u_value_calculator.php so if you have more detailed information about the wall construction you can estimate U-values yourself.

Type of double glazing	U-value
Double-glazing (low-E, εn = 0.15, air filled) 16mm gap between panes	2.5
Triple-glazing (low-E, εn = 0.15), 16mm gap between panes	2.0
Triple-glazing (low-E, εn = 0.15, argon filled) 16mm gap between panes	1.8
2022 building regulations 'Notional Target', (NT) and the minimum 'Limiting Standard' (LS).	NT 1.2 LS 1.4
Passivhaus standard	0.8

Window U-values. Search SBSA Tables of U-values and thermal conductivity

	Old Windows (U-value >1.4)	New Windows (U-value < 1.4)
Insulated walls	Focus on windows	Focus on windows
Uninsulated walls	Focus on windows	Focus on walls

A suggestion - assuming the same area of wall and window.

9.1 Uninsulated cavity walls

COMMON

Semi-detached houses are exposed on three sides. Compared to terraced homes, this is a thermal disadvantage and many homes have had the cavities filled. They are more comfortable as a result because heat-loss through the walls and draughts around the joists are reduced.

The majority have no problems with their cavity fill. But in the early days of cavity wall insulation, and still on occasion now, people have bad experiences, particularly on West-facing walls where wind-driven rain sometimes penetrates the insulation and crosses the cavity, making the inner skin of the wall damp. Such issues led to the creation of the **Cavity Insulation Guarantee Agency** in 1995. You can read about their independent 25 year guarantee at ciga.co.uk. This covers defects in materials and workmanship for their registered installers.

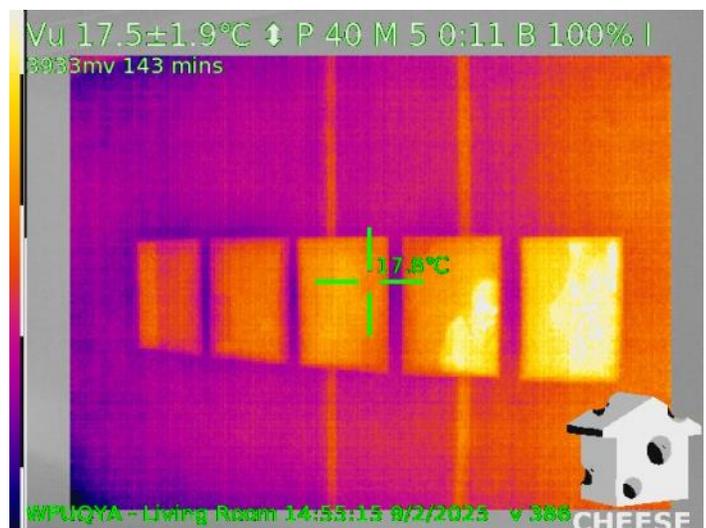
The exposure of the three walls is mitigated to some extent by the garages which provide shelter to part of the external wall. And benefit may be gained by putting insulation against the wall of the hall and stairs on the garage side, rather than inside in the main living areas of the house. In the garage, the loss of space (due to the thickness of the insulation) and the finished appearance may not be as important. Insulating the wall in the garage is also an easier job.

Internal cladding is preferred by some people who have used wooden panelling to create a gap of still-air between the wood and the wall. Usually this is done for cosmetic reasons, but it will make the wall slightly warmer, especially if a reflective insulating material is put in place behind the cladding.

The movement of moisture through walls needs to be considered carefully when adding insulation and expert advice should always be sought to minimise the risks.



Looking into the narrow empty cavity of a first floor wall under a window, (sill removed). Expanding foam has been used to fill the gap under the window frame and some has fallen into the cavity.



Glass picture frames reflect heat and look relatively warm. The vertical lines are probably metal safety strips covering electrical cables that have been cut into the wall.



Using PIR insulation to improve an internal garage wall (on Northover Road).

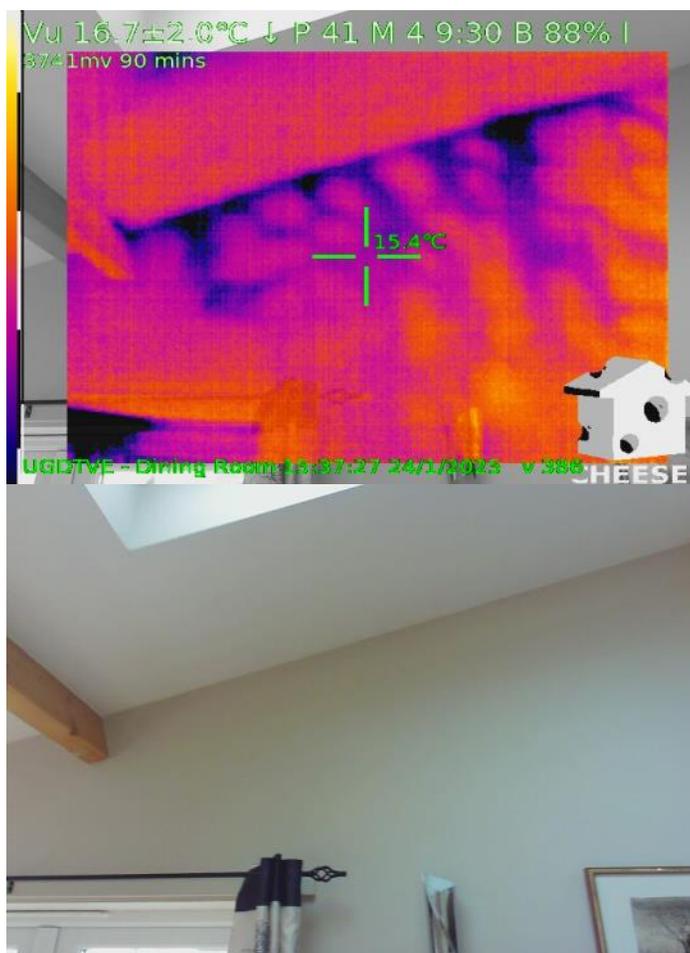
9.2 Dot and dab

OCCASIONAL

“Dot and dab” is a method of fixing plasterboard to concrete-block walls with blobs of adhesive. Builders are recommended to use a continuous bead of adhesive around the edge of the plasterboard to prevent cold air running down behind it, but this takes longer and uses more adhesive, so the ‘fish-scale’, mottled pattern of warm adhesive and colder air can often be seen in new-build properties and kitchen extensions, including those in some of Westover’s homes.

Remedies are not simple unless all the cold behind the plasterboard is coming from the roofline, in which case removing a narrow strip of plasterboard along the top edge and replacing with wet plaster will fill the gap and stop the air ingress. If gaps in the mortar between the concrete blocks of the wall are letting in air elsewhere, this will only partly solve the problem.

Where dot and dab is cooling the wall, heat will be lost and draughts can occur through electrical plug sockets and light switches, so it’s a good idea to keep plugs in the sockets until a thermal survey can rule out dot and dab as a possible cause of heat-loss.



A colder patch of wall resulting from dot and dab

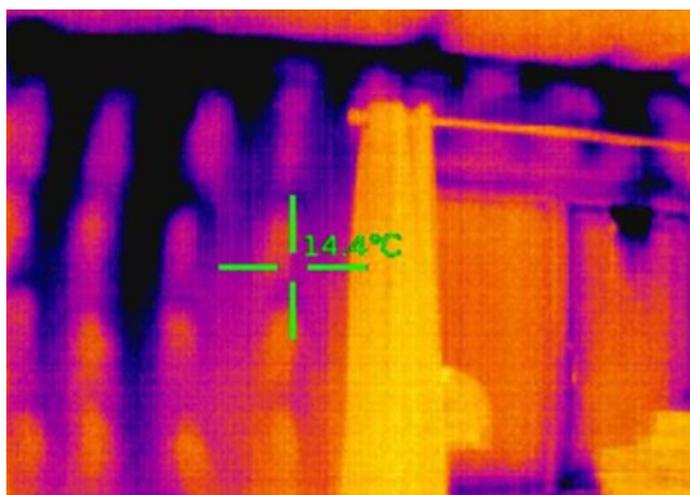


image credit: Getty Images

Top Tips

Every thermal survey revealed areas of heat-loss that homeowners were unaware of, even in some cases after 30 years of residency. Surveys are a very helpful way to draw up the (usually long!) list of opportunities to improve comfort levels, including simple jobs that will only take minutes, to bigger jobs that will take longer. Having the list helps most homeowners to plan and prioritise.

The information in this report should make it possible for most owners of link-detached houses on the Henbury Hill estate to make some improvements without having a survey carried out, based on the common thermal characteristics of the buildings. A visual check for common findings will probably identify many simple actions that will make a difference. It is important to attend to the small jobs—which on their own may seem insignificant— because the cumulative effect of lots of small improvements will equate to filling a sizeable 'hole'.

The following tips are drawn from the findings of the sample surveys. You can find many other lists of generic energy-saving tips on the internet, for example the Centre for Sustainable Energy's fact sheets about insulation and ventilation: www.cse.org.uk/resource/home-energy-fact-sheets



- Find out how many kWhs of energy you are using
- Make sure the loft hatch is properly insulated and draft proofed
- Check rockwool loft insulation is at the recommended minimum depth of 270mm and top-up if necessary
- Check your window seals and/or get windows serviced
- Fit a heavy curtain in front of thin external doors to cut out draughts and keep in heat
- Fill-in letterboxes and replace with an external, wall-mounted, lockable box
- Check that backdraught prevention on ventilation fans is present and working
- Find out if your wall-cavities have been filled, and if not, investigate having this done
- Consider the thermal qualities of your curtains and how well they isolate the colder glass of the window from the room



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www.makeitwild.co.uk