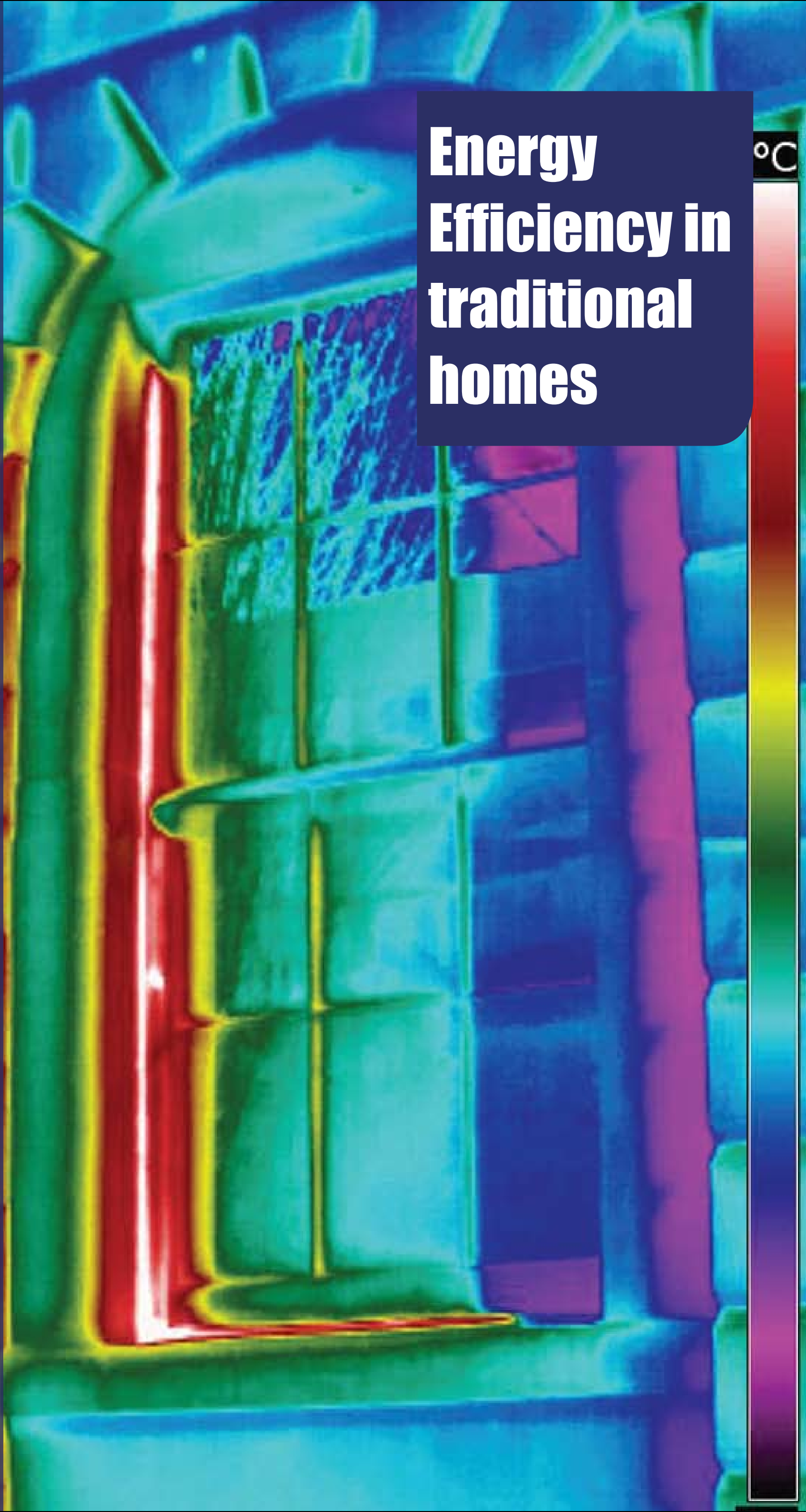
INFORM

INFORMATION FOR HISTORIC BUILDING OWNERS

Energy Efficiency in traditional homes



HISTORIC SCOTLAND

Introduction

As pressure grows to reduce CO2 emissions, so does the need for owners, designers, users and managers of traditionally built structures to improve energy efficiency and reduce fuel consumption. This INFORM guide provides background to the issues and some basic ways to improve the thermal performance of a traditional building and its associated elements.

While the advice in this leaflet is intended for domestic properties, it applies to any traditional building. If a building is listed or is in a conservation area any work that may affect its character should be discussed with the local authority Development Control or Conservation Officer.

The embodied carbon

Most energy assessments of buildings are based on the consumption measured by your fuel tank, or gas or electricity meter. However, the embodied energy represented in the existing housing stock, in terms of carbon, has to be considered as well. This is the carbon that has been expended in putting the building up; it includes labour, construction materials, transport and other supply chain issues. The existing built environment contains significant amounts of such embodied energy and has been summarised in one report as "The embodied energy in the construction of a tenement is the equivalent of 1000 years of the energy requirement of its power and heating" (Edinburgh Standards for Sustainable Building). Keeping older properties in use is as important as some of the newer carbon reduction programmes. With appropriate modification, properly maintained traditionally built structures will last for hundreds of years and can play a full part in managing our carbon expenditure now and in the future.

Thermal Performance of traditionally built houses

Older structures perform differently from a thermal point of view to modern timber frame houses. They are described as being thermally heavy, or having thermal mass. This is the ability of a building to absorb heat over a period of higher temperatures, and release it when ambient temperatures fall, and has affected building design and orientation since the earliest times. This property is not considered in current energy assessment tools which rely on assessing the amount of insulation, or the insulation property of the building components. This is measured by what is called "U-Value", a number that expresses how quickly a certain amount of heat will pass through the material. Traditional buildings, due to their thermal mass, can stay cooler during periods of high temperatures.

Infra red photography is often used to assess energy performance. It can determine where heat is being lost in a building and can show very small differences in temperature. These images need to be interpreted with care, but when used correctly can show very clearly where heat is being lost.

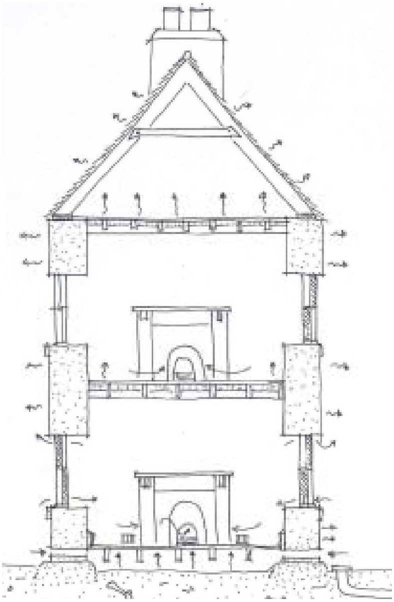


Fig 1. Airflow and moisture movement in a traditionally built house.

What you can do

Heating regimes and equipment.
Older structures need to be kept modestly warm over longer periods to prevent moisture absorbing materials from becoming damp. Where possible, keep the house at 10 – 12 Deg C if unoccupied, and 17 Deg C or so when in use.

There are many heating options available, and the age of your boiler will have a significant bearing on fuel costs. Electric heating, while non-invasive to the fabric, can be expensive. Underfloor heating from a heat pump is an economic way of heating an older structure, if the intervention in the floors is appropriate.

Roofs and attics

25% of heat is lost through a typical roof, so suitable levels of loft insulation must be the basic starting point; at least 270 mm of insulation is required to be effective. There are many types available, from natural materials such as hemp fibres or wool to recycled products made from newsprint, and others made from glass and more modern materials. In most circumstances natural materials are preferable in traditional buildings, as they are better able to disperse moisture and prevent condensation. Insulation of attics and the underside of roof slopes and dormers is often problematic but, with care, and the right material, can be addressed.

Fig 2. Insulation board can be cut to fit between rafters.

Fig 3. Mineral wool insulation can also be laid between rafters and joists, but with care not to inhibit air movement.

Fig 4. Fitting of natural insulation underneath a timber floor.

Floors

Where old floor boards are in good condition, there is no reason from an economic or aesthetic point of view to lift them. Insulation of timber floors is probably only worth it on the ground floor if there is a reasonable crawl space from which to work. Laying insulation board on top of a timber floor will inhibit water vapour movement, and may give rise to rot and other forms of timber decay.

Flagged floors should be left as they are, but there are considerable benefits in overlaying modern proprietary insulation sheets on a concrete floor. In tests carried out by Historic Scotland, the insulation value of the concrete floor was increased by a factor of 6.

Fig 5. Addition of floor insulation to a modern concrete floor. Lister Housing Co-operative.

External doors

External doors are generally thermally effective, as long as the door framework is around 45mm or so, but the boards in the panels are often thin, and their thermal performance can be improved. This can done by adding a layer of appropriate insulation material on the rear or indoor side. This maintains the character of the door from the outside, permitting modest intervention on the inside. Where possible, keep the finished insulation level flush with the door framework. Draught or weather stripping around the edge or the door and the letter box can also help. In the 19th century heavy curtains were mounted on rising rails to control draughts. Internal doors, unless there are significant heat differentials between rooms, should be left alone.

Windows

The use of thermally efficient glazing is probably the greatest area of conflict and opinion, yet there are many options for improvement. It has to be accepted that a single pane of glass has a low insulation value (the thickness of the glass makes little difference), with a U- value for most plate glass of about 5.2. Draft stripping the sashes can reduce air leakage by 80%, as well as getting full movement back into the window sashes, although it will not improve the U-value. Many companies provide this service, which combines the upgrading work with a general overhaul of the window and the sash cords. The table below, compiled from lab tests, gives a basic sequence of actions, and the consequent reduction in U-Value (from HS tests).

Action	U Value (W/m²K)
Single pane glass as existing (baseline)	5.2
Fitting a standard roller blind	3.2
Closing the shutters	2.2
Fitting heavy lined curtains	3.1
All 3 above	1.6
Fitting a modern honeycomb blind	2.8
Insulating the panels in the shutters	1.6
Fitting secondary glazing	1.6

The table shows that, the combination of blind, shutter and curtains gives the most significant improvement, with a U value down from 5.2 to 1.6. This combination does keep out natural light, but the period of lowest temperature, and therefore greatest heat loss, is at night. For more significant improvements, building fabric interventions are required, such as insulating the shutters, or fitting secondary glazing.

The fitting of secondary glazing is a very effective way of improving the thermal efficiency of traditional windows and retaining the original fabric. Fig 6 shows an approximate difference in surface temperature of 10 deg C, on windows in the same room.

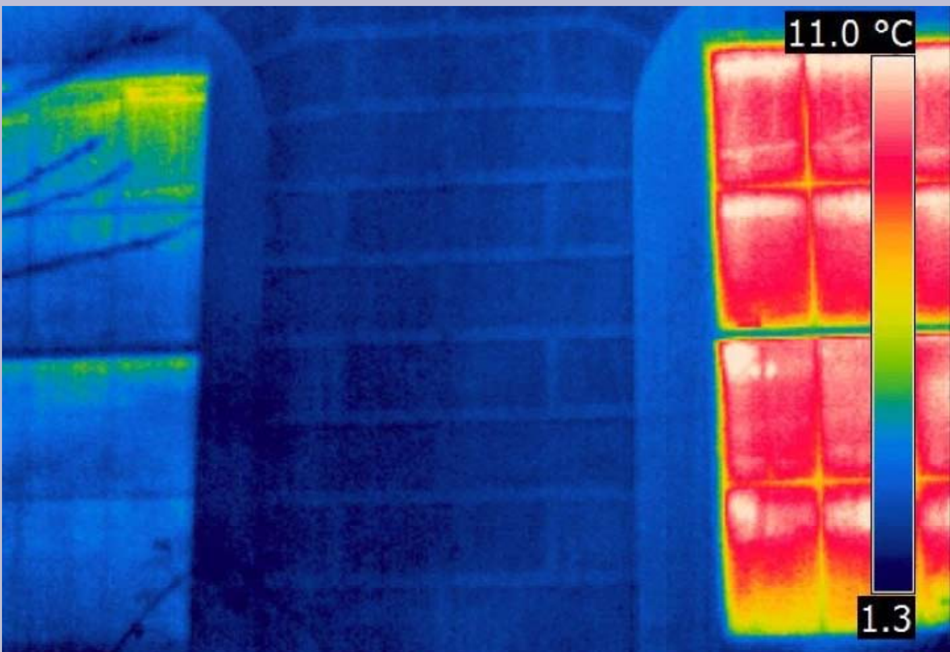


Fig 6. The difference made by secondary glazing. City of Edinburgh Council.

Fig 7. How does it look - Secondary glazing (seen in Fig 6) fitted on a sash window. Changeworks

Where shutters are fitted, they should be used. Fig 8 shows the significant benefits of closing shutters at night – In this photograph , the shutters on the right window have been closed, showing a significant saving of heat. However, many buildings may never have had shutters, or may have had them removed. As the thermal benefits can be considerable, consideration may be given to reinstatement.

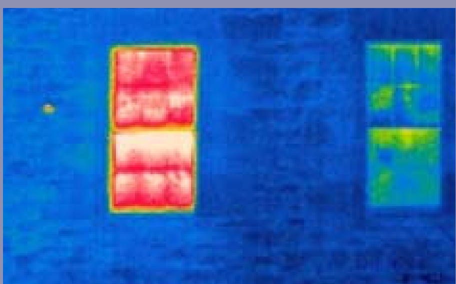


Fig 8. Heat difference from use of shutters. City of Edinburgh Council. The window on the left has been fitted with secondary glazing, showing a considerable improvement in thermal performance.

Fig 9. Modern shutters fitted to a traditional window. Jonathan Gotelee Architects

If the sashes in a window are in good condition, and not glazed with historic glass, it is sometimes possible to remove the old glass and putty and fit a thin section double glazed unit within the existing astragals. However, the labour involved means that this is an expensive option and payback times should be considered against the lifetime of the sealed units.

Fig 10. Existing sashes re-glazed with DG units.

While most traditional windows are of seasoned timber that responds well to repair, it sometimes happens that new sashes are needed. Should sashes require replacement, new ones can be made, to matching dimensions, but fitted with thin double-glazed panes within the existing astragal (glazing bar) patterns. While these will perform well from a thermal point of view, with a U value of 2.1 (from tests), consideration must be given to cost and payback times, given the cheaper benefits of the options in the table above.

Walls

An estimated 25% of heating energy is lost through walls. Performance of mass walls has been underestimated and past advice was to clad and insulate within where possible. Recent measurements by Historic Scotland have shown that their thermal performance can be reasonable, and a dry lime bonded wall can have a U value as low as 0.9, whereas most modern assessments assume a value of 2.5 for a mass wall. These measurements can better inform the amount of linings required in refurbishment projects, reducing loss of old material and detailing, and reducing the amount of insulation required.

To ensure optimum performance, walls must be dry. Leaking downpipes, cement renders, incorrect paints inside and out can make a wall damp – and a damp wall will lose heat quicker than a dry one. Lath and plaster was generally used in the 18th-19th centuries, in preference to plastering direct onto the stone, showing that our predecessors understood the benefits given by wall linings. Lath and plaster, in good condition, will assist thermal performance. It may not fully reach modern standards, but its removal should be resisted, as cornice and other detailing can never really be replicated economically, and the replacement framing insulation and board itself has an embodied energy cost. Where no lath and plaster or cornice detailing remains, hemp board and other natural insulants may be used, as they transfer moisture better. Vapour barriers and waterproofing measures are not recommended as they will impair the performance of the walls, and act as condensation surfaces.

Insulation may be applied externally to walls but the combined thickness of the render layer and the insulation on it usually means that existing detail and surface texture are lost. It is not normally appropriate except in unusual situations such as once-mutual gables or on buildings with very flat facades and generous roof eaves.

Fig 11. External insulation applied to an unlisted tenement has dramatically changed its architectural character.

Building Standards

Some types of work to existing buildings require compliance with Building Standards. However, traditionally-built structures, accepted as working in a different way to modern buildings, are given a degree of latitude in the guidance documents. Compliance where possible is recommended. For more details see the publication *Conversion of Traditional Buildings: application of the Scottish Building Standards*, which is a guidance document for purpose of the building regulations published by Historic Scotland and Scottish Building Standards Division.

http://www.sbsa.gov.uk/tech_handbooks/traditional_Buildings.htm

More information

More information on energy efficiency and ongoing projects can be found on the climate change pages of Historic Scotland's website: www.historic-scotland.gov.uk

Changeworks, a charity based in Edinburgh, have also published a guide to energy efficiency in historic homes (Energy Heritage): www.changeworks.org.uk/content.php?linkid=373

English heritage have web and pdf information available: www.climatechangeandyourhome.org.uk/live/saving_energy.aspx

The Energy Saving Trust has also published guidance - Energy Efficient Historic Homes - Case Studies (CE138), see: www.energysavingtrust.org.uk/business/Business/Resources/Publications-and-Case-Studies

Energy Efficient Refurbishment of Existing Housing (CE83), see: www.energysavingtrust.org.uk/business/Business/Resources/Publications-and-Case-Studies

Useful contacts:

Historic Scotland Technical Conservation Group
Longmore House, Salisbury Place,
Edinburgh EH9 1SH

Tel 0131 668 8668
Email hs.technicalconservationgroup@scotland.gsi.gov.uk

Historic Scotland Investment and Projects Team
Historic Scotland, Longmore House, Salisbury Place, Edinburgh, EH9 1SH
Tel 0131 668 8801
Email hs.grants@scotland.gsi.gov

Historic Scotland Inspectorate
Historic Scotland, Longmore House,
Salisbury Place, Edinburgh, EH9 1SH
Tel 0131 668 8716

HISTORIC SCOTLAND

Principal author: Roger Curtis
Published by Technical Conservation Group, October 2008
Historic Scotland, Longmore House, Salisbury Place, Edinburgh EH91SH
Tel: 0131 668 8638 Fax: 0131 668 8669
www.historic-scotland.gov.uk email: hs.technicalconservationgroup@scotland.gsi.gov.uk

The House 7/08 Produced from sustainable material