This guidance note is one of a series which explain ways of improving the energy efficiency of roofs, walls and floors in historic buildings. The full range of guidance is available from the English Heritage website:

www.english-heritage.org.uk/partL
Introduction to the series

This guidance note is one of a series of thirteen documents providing advice on the principles, risks, materials and methods for improving the energy efficiency of various building elements such as roofs, walls and floors in older buildings. The complete series includes the following publications:

**ROOFS**
- Insulating pitched roofs at rafter level/warm roofs
- Insulating pitched roofs at ceiling level/cold roofs
- Insulating flat roofs
- Insulating thatched roofs
- Open fires, chimneys and flues
- Insulating dormer windows

**WALLS**
- Insulating timber framed walls
- Insulating solid walls
- Early cavity walls

**WINDOWS AND DOORS**
- Draught-proofing windows and doors
- Secondary glazing

**FLOORS**
- Insulation of suspended ground floors
- Insulating solid ground floors

All these documents can be downloaded free from:
www.english-heritage.org.uk/partL

This series of guidance documents provide more detailed information to support our principle publication:

*Energy Efficiency and Historic Buildings: Application of Part L of the Building Regulations to historic and traditionally constructed buildings*

This publication has been produced to help prevent conflicts between the energy efficiency requirements in Part L of the Building Regulations and the conservation of historic and traditionally constructed buildings. Much of the advice is also relevant where thermal upgrading is planned without the specific need to comply with these regulations.

The advice acts a ‘second tier’ supporting guidance in the interpretation of the Building Regulations that should be taken into account when determining appropriate energy performance standards for works to historic buildings.
CONSERVATION PLANNING

Before contemplating measures to enhance the thermal performance of a historic building it is important to assess the building and its users to understand:

- the heritage values (significance) of the building
- the construction and condition of the building fabric and building services
- the existing hygrothermal behaviour of the building
- the likely effectiveness and value for money of measures to improve energy performance
- the impact of the measures on heritage values
- the technical risks associated with the measures

This will help to identify the measures best suited to an individual building or household, taking behaviour into consideration as well as the building envelope and services.

TECHNICAL RISKS POSED BY THERMAL UPGRADING OF OLDER BUILDINGS

Altering the thermal performance of older buildings is not without risks. The most significant risk is that of creating condensation which can be on the surface of a building component or between layers of the building fabric, which is referred to as ‘interstitial condensation’. Condensation can give rise to health problems for occupants as it can lead to mould forming and it can also damage the building fabric through decay. Avoiding the risk of condensation can be complex as a wide range of variables come into play.

Where advice is given in this series of guidance notes on adding insulation into existing permeable construction we generally consider that insulation which has hygroscopic properties is used as this offers a beneficial ‘buffering’ effect during fluctuations in temperature and vapour pressure, thus reducing the risk of surface and interstitial condensation occurring. However, high levels of humidity can still pose problems even when the insulation is hygroscopic. Insulation materials with low permeability are not entirely incompatible with older construction but careful thought needs to be given to reducing levels of water vapour moving through such construction either by means of ventilated cavities or through vapour control layers.

The movement of water vapour through parts of the construction is a key issue when considering thermal upgrading but many other factors need to be considered to arrive at an optimum solution such as heating regimes and the orientation and exposure of the particular building.

More research is needed to help us fully understand the passage of moisture through buildings and how certain forms of construction and materials can mitigate these risks. For older buildings though there is no ‘one size fits all’ solution, each building needs to be considered and an optimum solution devised.

TECHNICAL ILLUSTRATIONS GENERALLY

The technical drawings included in this guidance document are diagrammatic only and are used to illustrate general principles. They are not intended to be used as drawings for purposes of construction.

Older buildings need to be evaluated individually to assess the most suitable form of construction based on a wide variety of possible variables.

English Heritage does not accept liability for loss or damage arising from the use of this information.
This guidance note provides advice on the principles, risks, materials and methods for insulating solid masonry walls. The insulation of early forms of cavity construction (early 19th century onwards) is covered by a separate guidance note.

Traditional solid wall construction is probably the most difficult, and in some cases the least cost effective building element to insulate. Whether applied externally or internally, work of this nature can have a significant impact on the appearance of the building. For listed buildings any form of wall insulation is likely to require listed building consent and for the majority of buildings external insulation will usually require planning permission. External insulation can be particularly difficult to incorporate into existing buildings as costly ancillary adaptations such as changes to the eaves and verges of roofs, rainwater goods, and window and door reveals are often required.

Wall insulation will alter the performance of the solid wall and can in some cases either exacerbate existing moisture-related problems or create new ones. It is strongly recommended that insulation is not applied to damp walls. Adding vapour barriers and materials that are highly resistant to the passage of water vapour are not normally appropriate for older buildings as they will tend to trap moisture and can increase the risk of decay to the fabric.

In some cases the technical risks of adding insulation to solid walls will be too great and alternative ways of providing a more cost effective long-term solution to improving energy efficiency may be more appropriate.
01 Issues to consider before adding insulation

Traditional solid walls have very different physical characteristics to modern cavity walls. The construction and performance of the walls need to be fully understood before adding insulation or there will be a significant risk of creating long term problems.

CONSTRUCTION

The first step should be to identify the external wall materials and their form of construction. Many older buildings may have three or four different types of wall construction, reflecting different stages of their development over many years. Construction can vary from single skin brick and stone walls of as narrow as 100 mm thick up to rubble-filled walls of a metre thickness or more. Wall materials can include brick of varying hardness and permeability, rammed earth, dressed stone blocks of varying types, rubble stone, flint and many more. Mortars can also be earth and/or lime based, also with wide variations in permeability and durability.

A single wall will often contain more than one material with quite different performance characteristics. For example, soft porous chalk and hard impervious flint have very different properties but are commonly found in the same wall.

The presence of voids, irregular bonding patterns and concealed timbers also add to the complexity of solid wall construction and performance.

Theoretical calculations are frequently used to understand and assess the movement of energy and moisture through solid walls often using quite sophisticated computer programmes. However data giving the thermal transmittance and moisture permeability of many traditional materials is simply not available and calculations at present are based upon idealised, homogenous walls. The actual variations within the wall and the influence of other variables such as the presence of salts that occur in reality can make such calculations very misleading when applied to many solid walled buildings. If ‘theoretical modelling’ is used as a basis for the design of thermal upgrading then performance should be closely monitored after installation in case any problems occur.
The first step should be to identify the external wall materials and their form of construction. Construction can vary from single skin brick and stone to rubble filled walls of a metre thickness or more. A single wall will often also contain more than one material with quite different performance characteristics.

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BREATHING PERFORMANCE

Traditional solid walled buildings are colloquially referred to as ‘breathing’ structures, meaning that they exchange moisture readily with the indoor and outdoor environment. Where insulation is introduced it is important that this breathing performance is taken fully into consideration.

It is important to recognise that moisture in solid walls comes from several possible sources:

- Water from rainfall. This obviously affects solid walls but not all internal damp is a result of penetrating rain. With the exception of extremely demanding locations such as on exposed coast or high ground, it is unusual for driving rain to pass through most solid walls in good condition. Normally it will only saturate the outer part of the wall, which will then dry out when the rain stops.
- Rising ground moisture can be present in any solid wall which does not have a physical damp proof course. In such situations the moisture level is generally controlled by the ‘breathability’ of the material, which limits total moisture by allowing the excess to evaporate harmlessly away.
- It is often underestimated how much moisture can be generated by people using a building internally, simply through breathing but also from cooking and washing. The ‘breathability’ of external solid walls also significantly helps to control excess moisture and condensation from these sources.

TRADITIONAL BREATHING PERFORMANCE

Most traditional buildings are made of permeable materials and do not incorporate the barriers to external moisture such as cavities, rain-screens, damp-proof courses, vapour barriers and membranes which are standard in modern construction. As a result, the permeable fabric in historic structures tends to absorb more moisture, which is then released by internal and external evaporation. When traditional buildings are working as they were designed to, the evaporation will keep dampness levels in the building fabric below the levels at which decay can start to develop. This is often referred to as a ‘breathing’ building.

If properly maintained a ‘breathing’ building has definite advantages over a modern impermeable building. Permeable materials such as lime and/or earth based mortars, renders, plasters and limewash act as a buffer for environmental moisture, absorbing it from the air when humidity is high, and releasing it when the air is dry. Modern construction relies on mechanical extraction to remove water vapour formed by the activities of occupants.

As traditional buildings need to ‘breathe’ the use of vapour barriers and other impermeable materials commonly found in modern buildings must be avoided when making improvements to energy efficiency, as these materials can trap and hold moisture and create problems for the building. The use of modern materials, if essential, needs to be based upon an informed analysis of the full implications of their inclusion in order to minimise the risk of problems arising.

It is also important that buildings are well maintained, otherwise improvements made in energy efficiency will be cancelled out by the problems associated with water ingress and/or excessive draughts.
Materials used in repair and maintenance must be selected with care to preserve this breathing performance. Modern impermeable materials – not just vapour control layers but cement renders, plasters and pointing and many modern paints and coating will significantly impair the breathable performance and will therefore trap moisture. More often than not this will increase problems of damp and associated decay of the building fabric, and possibly also create health risks for the occupants.

02 Hard cement pointing has damaged these soft permeable bricks as moisture hasn’t been able to easily evaporate from the mortar joints. © Philip White

03 A cement render has been added to the stone wall of this church which has caused significant damp problems as the render has altered the breathing performance of the wall. © Robert Gowing

THERMAL MASS

Solid walled buildings, particularly those with thicker walls have comparatively high thermal capacities, which means they can absorb heat over time and release it relatively slowly as the surroundings cool down. This is the same principle as a storage heater, although on a larger scale and can have a significant stabilising effect on the internal environment. External insulation means little of this heat will be lost to the exterior. This allows a building to maintain a level of warmth over day-night heating and cooling cycles, improving human comfort and potentially reducing overall energy use. Internal insulation, whilst reducing short-term heat losses to the exterior will isolate the internal environment from the benefits of much of this thermal mass.

In summer, when strong sun can cause overheating, the thermal mass of the walls cools the interior by absorbing excess heat during the day and releasing it slowly during the night. This helps reduce the need for air conditioning or mechanical cooling.
ENVIRONMENTAL INFLUENCES
Location, aspect, and the differing exposure of individual elevations to direct sunlight and wind driven rain have important influences on a building’s condition and performance which need to be taken into account when making alterations.

Different parts of a building are affected by very different micro-climates. For example, north facing elevations can be subject to prolonged damp, as they do not receive the benefit of a drying sun and are usually sheltered from drying winds. However, they receive little driving rain from the prevailing south-westerly winds, so conditions are more stable over time. This often means that north-facing walls deteriorate less than south and south-west facing walls which tend to suffer from accelerated rates of decay caused by fluctuations in temperature and regular wetting and drying cycles.

Each building’s exposure to the elements is as much influenced by the proximity and position of surrounding buildings and its own projections and extensions as by the exposure of the site. For example, an apparently homogeneous terrace of houses can be affected by quite widely varying local levels of exposure and shelter. Such complex variations in microclimate would ideally need to be taken into account in the design of any insulation.

DAMP
If a wall suffers from prolonged damp then a number of problems can occur such as:

• decay in timbers in contact with the masonry
• deterioration of the external fabric of the wall due to freezing and thawing
• movement and crystallisation of salts
• movement of tars and other chemicals through the walls, causing staining at the surface
• growth of mould on the inside surfaces of walls
• corrosion of metallic compounds in contact with, or buried within, the wall

Before making any improvements, it is therefore important to understand how solid walled buildings ‘manage’ the movement of water, in both vapour and liquid form. This is not only complex in itself, but may also be affected by the presence of soluble salts (see below).

Most insulation systems are designed and developed solely to limit heat loss and to avoid interstitial condensation from water vapour generated internally. They do not take account of how they affect the movement of water and salts already in a traditional wall. So they can easily:

• exacerbate existing problems
• create new problems, such as the displacement of damp and salts and the decay of timbers in contact with the walls
• create health risks for the occupants, for example from mould growth
• be affected by the moisture, reducing their performance and sometimes failing entirely

Where walls have been damp for a long period of time it can take years for them to dry out. The selection and design of insulation must take account of the drying-out process, both before and after installation, and the presence of residual damp and salts.
SALTS

Buildings without a damp-proof course can be prone to damp and salt contamination, particularly at low level, where ground salts are carried in solution. Salts are also commonly found around fireplaces and chimney breasts where they originated as by-products of combustion. They can also originate from a previous use of a building such as from animal excrement and storage of fertilisers in agricultural buildings. Salts may also have been present in the original building materials (stone or aggregate extracted from marine environments) or from the use of chemicals such as caustic soda to remove paint. In some old buildings bricks were under-fired leaving a concentration of salts.

Many of these salts are ‘hygroscopic’, that is they have an affinity for water and so exacerbate the problems of damp by attracting moisture out of the air leading to the phenomenon of surfaces feeling ‘clammy’ to the touch. They may also re-crystallise at drying faces with changing moisture levels, and the related expansion within the pores can very effectively turn sound masonry into powder. The interface between existing walls and added insulation can be susceptible to cycles of evaporation, condensation and salt crystallisation. As such locations are hidden from view; major deterioration may have taken place before anybody becomes aware that there is a problem. Unfortunately salts are notoriously difficult to effectively remove from porous building materials such as brickwork, masonry and plasters.
02 Wall insulation generally-relevant issues

LOCATION OF INSULATION

Insulation may be added to existing solid walls either externally or internally, but the physical effects on both the building fabric and the internal environment can be very different. This is explored in more detail below.

COST-EFFECTIVENESS

The necessity to achieve good building detailing to perimeters and openings can significantly add to the initial base cost of both external and internal insulation and may significantly reduce its overall cost-effectiveness.

IMPERMEABLE MATERIALS

Practical experience of the repair and conservation of historic buildings shows that the introduction of materials and systems that do not maintain the traditional ‘breathing’ performance can seriously exacerbate existing problems and or create new ones. Examples of incompatible materials and systems which should be avoided include:

- closed cell and extruded plastic insulation
- plastic vapour barriers
- cement or acrylic based renders
- cement pointing
- plastic based external wall paints
- vinyl wallpaper and emulsion paint

Any of these used on the outside of the wall will trap moisture within the wall and lead to damp and decay, as well as making the walls feel cold and ‘clammy’. Installed on the inside, they may do less damage to the building fabric itself, but will negate its ability to buffer moisture levels in the internal air. Both of these can significantly reduce comfort for people using the building, who tend to try to compensate by turning the heating up, thus wasting energy.

Clearly, if the walls are already damp before installing insulation these effects will be exacerbated. Under these circumstances it is particularly important to allow walls to ‘breathe’ in order to dry to the outside as effectively as possible. Drying to the inside is significantly less effective, and may be extremely unpleasant for users of the building.
THERMAL BRIDGES

Whenever insulation is added to an existing building there is a danger of creating thermal bridges at critical details where full coverage may be interrupted. When insulation is added externally these weak points are typically at window and door reveals, but with internal insulation they may also be formed at the points where floors meet external walls.

Areas left with reduced or no insulation coverage will not only be colder because of the lack of protection from the outside environment, but will also attract relatively more condensation because the majority of other surfaces are warmer and can no longer share the load. The result can be severe local decay, particularly to timber and finishes. For example, the ends of floor joists embedded in the external walls are at increased risk of decay from condensation.

Great care needs to be taken to ensure adequate detailing around window and door openings to avoid potential thermal bridges, and this can significantly increase the overall cost of both design and installation. The necessary level of detailing can even be impossible to incorporate in certain circumstances, in which case, depending on the potential severity of the consequences, it may even be better not to install insulation at all.

FINANCIAL COST AND PAYBACK

As noted, the addition of external or internal insulation to solid walled buildings tends to be expensive, and financial payback times are potentially correspondingly long. It is important not to underestimate the costs associated with the necessary levels of care in detailing to avoid cold bridges. Full payback periods are typically 30 years or more, but they will inevitably vary greatly between individual instances.

This suggests that in the majority of cases it would not be worth considering the insulation of external walls until the full range of easier and more immediately rewarding upgrades to traditionally-constructed buildings have been carried out. These would include actions such as repairing and draught-stripping windows and doors; insulating roofs and suspended ground floors, and possibly even installing condensing boilers. Significantly, most of these upgrades will also have considerably fewer detrimental effects on the character and cultural significance of historic buildings.
Most external insulation systems comprise an insulation layer fixed to the existing wall and a protective render or cladding installed on top to protect the insulation from the weather and mechanical damage (impact or abrasion).

**PHYSICAL ADAPTATION OF THE BUILDING**

The increased depth of an external render or insulation system will require adaptation to the roof and wall junctions, around window and door openings and the repositioning of rainwater downpipes. These alterations will require scaffolding access and possibly a temporary roof to reduce the risk of water penetration during the work.

**CHANGES IN THE APPEARANCE AND CHARACTER OF A BUILDING**

External insulation will radically alter a building's appearance, even if it is already rendered. Even then, decorative architectural features such as cornicing, string courses and window surrounds will be affected. Even where the elevations are quite plain, simple alterations such as the deepening of window and door reveals and the alteration of eaves lines can markedly alter a building's appearance.

In many cases it will be necessary to actually relocate windows and doors further forward in the overall wall thickness in order to minimise the danger of creating cold bridges at the reveals. This can reduce some of the visual impact, but will inevitably impact on the building's character.

Planning permission will be required for external insulation in the majority of instances, whether or not the building is listed; the local planning authority should be consulted before work commences. For listed buildings, consent will be needed, and will normally only be likely to be granted in very special circumstances.

**SOLID WALL: EXTERNAL INSULATION**

![Diagram of solid wall with external insulation]

05 This shows a permeable solution with an insulation such as hemp-lime or wood-fibre batts fixed to the masonry and finished with a ‘breathable’ lime render. Alternatively a non-breathable external insulation could be used such as expanded polystyrene (EPS) depending on the type of construction.
CHANGES IN MOISTURE MOVEMENT WITHIN THE WALL

It is important that the insulation and protective finish installed externally should have low vapour resistance in order to retain the necessary ‘breathability’, and allow moisture to evaporate away harmlessly. A useful rule of thumb is that all layers of an insulated solid wall should become progressively more permeable from the interior to the exterior. Whilst it is important to protect external insulation from rain, this should not be done in any way that will trap moisture from within the fabric or from the ground within the solid wall material.

MATERIALS

The need to prevent impermeable layers within the external insulation precludes the use of modern closed-cell foam and other plastic-based insulations, as well as the use of protective finishes which bar moisture vapour movement. As most suitable external insulations will also need to be protected from external rain and from mechanical damage, external insulation should normally be considered as a two-component system where all layers need to work together.

Useful materials for the external insulation itself include:

- Hemp-lime composites
- Mineral wool
- Wood fibre panels

All these insulation materials need to be protected from both the weather and mechanical damage, although to differing degrees. Suitable moisture-permeable finishes include:

- Lime renders
- Rain-screen cladding (tile hanging etc.) with lapped joints

Materials which can be used as a single coat are available, such as insulating lime renders containing expanded vermiculite, but these tend to give significantly lower insulating values. They can, however, sometimes be applied in circumstances where other types of external insulation would be detrimental to the character of a historic building.
Internal insulation is usually applied directly to the inner face of the relevant external wall, and then a finish is applied to the room side.

Rigid board insulations can often be fixed directly to the wall face itself, and then the finish applied to conceal them without any additional structure. In its most convenient form, plasterboard can be obtained with a factory-applied foam insulation backing which can be fixed to the inner face of the wall very easily, although such systems alone do not offer very great insulating performance overall.

For significant insulation thicknesses a non-rigid insulating material will often be installed between timber studs or battens erected internally to the wall, with the new internal finish applied to the timber structure. Occasionally, the structure and insulation may be erected as a separate inner leaf, with a cavity between the insulation and the original wall.

In all cases it is necessary to very carefully consider the control of vapour from the warm internal air entering and condensing within the insulation, or within vulnerable parts of the original solid wall.

SOLID WALL: INTERNAL INSULATION

![Diagram of internal insulation](image)

06 A rigid non-permeable insulation is shown here fixed either with adhesive dabs or mechanically fixed. A vapour control layer is added to the room side face before plastering. Care needs to be taken to make sure this layer is not punctured by fittings or fixtures otherwise water vapour could find its way into the construction and condense on the cold side of the insulation.
PHYSICAL ADAPTATION OF THE BUILDING

As with external insulation, care needs to be taken with the design and installation of internal insulation at critical details in order to avoid cold bridging, particularly at the reveals of windows and doors and wall/floor junctions. It is also often necessary to relocate services (radiators and associated pipe runs, electric power points and light switches) as well as making adjustments to skirting boards and door architraves, fitted furniture etc.

(Thermal break at floor junction)

To avoid a thermal break at a floor junction insulation should be added within the perimeter of the floor zone. It is also important to seal insulation at junctions with the ceiling to maintain air-tightness.
The construction of a separate insulated inner leaf could include ventilation to the cavity. However, there is a risk that there will be insufficient air movement within the cavity and any vents could alter the character or appearance of the building. There is no point in ventilating such a cavity to the inside of the building, as the air movement will simply by-pass the insulation, rendering it ineffective.

**SOLID WALL: INTERNAL INSULATION WITH CAVITY**

08 The insulation here is kept entirely separate from the external wall by means of a cavity. If impermeable insulation is used then a vapour control layer would still be recommended as the air movement within the cavity might be quite minimal. With this arrangement the benefits of thermal mass of the wall are lost.

Thick, high-performing internal insulation installations will often significantly reduce the floor area of rooms and corridors, sometimes to the extent that they cannot be used as before.

**SOLID WALL: INTERNAL INSULATION WITH TIMBER BATTENS**

09 The use of timber battens can allow other types of insulation to be used other than rigid insulation. In some proprietary systems the battens have insulation bonded to them to minimise cold bridging through the timber. Quilt insulation can be held in place between the battens or materials such as cellulose can fill the cavity. A vapour control layer is shown in this detail as the insulation is non-breathable.
CHANGES IN THE APPEARANCE AND CHARACTER OF A BUILDING

Significant internal features such as plaster cornices and joinery components such as picture rails, skirting boards and door architraves may all be affected by internal wall insulation. They will inevitably be either concealed or disturbed to accommodate the insulation. Although it is normally possible to replicate such details on the inner face of the new insulation, the effect of revised room proportions on the design of adjacent wall finishes needs to be carefully considered at the design stage, as the side walls of an insulated room will become shorter.

The disturbance to the internal appearance can be compounded by the need to extend insulation back from the external wall onto party walls, other internal walls, floors and ceilings to reduce the risk of thermal bridging.

In listed buildings, consent will be required for any internal alterations that affect the appearance and character, including any materials, details and finishes of historic or architectural interest. In many cases this may simply make the installation of insulation unacceptable.

CHANGES IN MOISTURE MOVEMENT WITHIN THE WALL

As noted above, it is a useful rule of thumb that all layers of an insulated solid wall should become progressively more permeable from the interior to the exterior. In order to protect internal insulation from condensation occurring within its thickness it is generally necessary to separate it effectively from the warm, moisture-bearing air of the building’s interior. This will require either the use of impermeable closed-cell foam insulation or an effective vapour control layer. Alternatively a vapour permeable system such as wood fibre can be used.

SOLID WALL: INTERNAL INSULATION WITH SERVICES ZONE

13 An impermeable foil back rigid insulation board is shown here with battens fixed over. These provide a fixing for the plasterboard without puncturing the foil-face as well as providing a services zone.
Effective vapour control is, in practical terms, very difficult to achieve. Air and vapour control layers are positioned on the warm side of the behind the new finish. These membranes are easily damaged by building users nailing through walls or modifying electrical fitting etc. They can also be punctured during the construction process itself. All penetrations will allow moisture vapour through in very large quantities, which will condense either within or adjacent to the insulation, causing rot and decay in a hidden location. Closed-cell foams are inherently vapour-impermeable, but are vulnerable to vapour penetration at the joints.

Both forms of vapour control are vulnerable at the perimeter, particularly in a traditional permeable structure, where moisture can by-pass the physical vapour barrier through adjoining walls and floors.

However, many of these problems can be overcome by using insulation systems that are hygroscopic and vapour permeable (eg wood-fibre).
Almost any insulation material available can be used internally, subject to proper control of vapour and careful isolation from sources of dampness. The full range of possible internal finishes can also be applied, either to copy the original or to introduce a new design.

New insulation products are continually being developed, particularly those that have a very minimal thickness (around 10mm). The benefits of such products to reduce overall energy consumption will be small and they can be relatively expensive. What they will do however is to make a room feel more comfortable by raising the surface temperature of the walls and possibly reducing the risk of condensation occurring on the decorated surface.

In all cases, however, it is vital to understand the likely effects of proposals at the design stage in order to avoid damage to both new and valuable historic building fabric.

**INTERNAL SOLID WALL INSULATION**

(With no vapour control layer)

15 This shows a fully permeable insulation system using wood-fibre board and lime plaster. A new lime plaster may need to be added to the existing wall to provide an even surface if the existing plaster surface is particularly uneven.
Permeable insulation such as this wood-fibre board are compatible with the 'breathable' nature of traditional construction. © EH/David Pickles

Closed cell insulation bonded to plasterboard. © EH/David Pickles
Further information

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</tbody>
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# English Heritage Local Offices

## NORTH EAST
English Heritage  
Bessie Surtees House  
41 - 44 Sandhill  
Newcastle upon Tyne  
NE1 3JF  
Tel: 0191 269 1200  
E-mail: northeast@english-heritage.org.uk

## EAST OF ENGLAND
English Heritage  
Brooklands  
24 Brooklands Avenue  
Cambridge  
CB2 8BU  
Tel: 01223 582700  
E-mail: eastofengland@english-heritage.org.uk

## NORTH WEST
English Heritage  
3rd floor Canada House  
3 Chepstow Street  
Manchester  
M1 5FW  
Tel: 0161 242 1400  
E-mail: northwest@english-heritage.org.uk

## LONDON
English Heritage  
1 Waterhouse Square  
138 - 142 Holborn  
London  
EC1N 2ST  
Tel: 020 7973 3000  
E-mail: london@english-heritage.org.uk

## YORKSHIRE AND THE HUMBER
English Heritage  
37 Tanner Row  
York  
YO1 6WP  
Tel: 01904 601901  
E-mail: yorkshire@english-heritage.org.uk

## SOUTH WEST
English Heritage  
29 Queen Square  
Bristol  
BS1 4ND  
Tel: 0117 975 0700  
E-mail: southwest@english-heritage.org.uk

## WEST MIDLANDS
English Heritage  
The Axis  
10 Holliday Street  
Birmingham  
B1 1TG  
Tel: 0121 625 6820  
E-mail: westmidlands@english-heritage.org.uk

## SOUTH EAST
English Heritage  
Eastgate Court  
195-205 High Street  
Guildford  
GU1 3EH  
Tel: 01483 252000  
E-mail: southeast@english-heritage.org.uk

## EAST MIDLANDS
English Heritage  
44 Derngate  
Northampton  
NN1 1UH  
Tel: 01604 735400  
E-mail: eastmidlands@english-heritage.org.uk

## CONSERVATION DEPARTMENT
English Heritage  
The Engine House  
Fire Fly Avenue  
Swindon  
SN2 2EH  
Tel: 01793 414963  
E-mail: conservation@english-heritage.org.uk
English Heritage is the Government’s statutory adviser on the historic environment. English Heritage provides expert advice to the Government about all matters relating to the historic environment and its conservation.

The Conservation Department promotes standards, provides specialist technical services and strategic leadership on all aspects of the repair, maintenance and management of the historic environment and its landscape.

This guidance has been prepared on behalf of English Heritage by Oxley Conservation under the direction of Phil Ogley and has been edited by David Pickles, Ian Brocklebank and Chris Wood

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Telephone: 0870 333 1181
Fax: 01793 414926
Textphone: 01793 414878

E-mail: customers@english-heritage.org.uk