Historic England

Energy Efficiency and Historic Buildings

Application of Part L of the Building Regulations to Historic and Traditionally Constructed Buildings

Summary

Historic England supports the Government's aims to improve the energy efficiency of existing buildings through Part L of the Building Regulations. Many improvements can be carried out, often at a relatively low cost, significantly enhancing the comfort of the building for its users, as well as providing savings on fuel bills and helping to meet greenhouse gas emission reduction targets. Improving energy and carbon performance may also give a welcome opportunity to protect and enhance a historic building and ensure that it remains viable into the future.

For historic buildings a balance needs to be achieved between improving energy efficiency and avoiding damage both to the significance of the building and its fabric. Taking a 'whole building approach' can achieve significant improvements in most cases, although not always to the standards recommended in the Regulations. Achieving an appropriate balance requires an understanding of the Regulations and the building, particularly the point at which alteration to the building's character and significance becomes unacceptable.

The Building Regulations Approved Documents for Part L make it clear that a reasonable compromise on the energy efficiency targets may be acceptable in order to preserve character and appearance and to avoid technical risks. They do this by specifically including some 'exemptions' and circumstances where 'special considerations' apply for historic buildings and those of traditional construction.

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Front cover:
Top left: Historic buildings need to be properly understood before thermal upgrading works are carried out.

Top right: This wall has had a cement render added which has failed and resulted in damp and a drastic reduction in its thermal performance.

Bottom left: Insulating a rafter level may be necessary if the habitable room is within the roof space.
© Oxley Conservation

Bottom right: Heat loss in windows due to draughts can be dramatically reduced by basic repairs and draught-proofing.
© Core Sash Windows

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Introduction

What is the purpose of this guidance?

The guidance has been produced to help prevent conflicts between energy efficiency requirements in Part L of the Building Regulations and the conservation of historic and traditionally constructed buildings. It also provides strategic advice on implementing measures, highlighting the various stages and issues that need to be considered when reducing energy use and thermally upgrading existing buildings.

The advice also acts as 'second tier' supporting guidance in the interpretation of the Building Regulations (referred to in paragraph 3.10 of the Approved Documents L1B and L2B) that should be taken into account when determining appropriate energy performance standards for works to historic buildings. Part L of the Buildings Regulations defines 'historic' as buildings that are listed, in conservation areas or are scheduled monuments. However, not all buildings falling into this category will necessarily be of traditional construction. Some historic buildings date from after the Second World War and have a quite different form of construction.

Who is this guidance for?

- **Building owners and occupiers** considering what action they need to take to improve energy performance, and to meet or surpass a range of statutory requirements.
- **Architects, surveyors and energy advisers** preparing proposals for work on traditional or historic buildings, and who need to make an appropriate professional response to requirements which can often be in conflict.
- **Building contractors, materials and component suppliers** needing to understand the implications of decisions they make in carrying out their work, or of the technical advice they give to their customers.
- Officials, such as **conservation and planning officers, building control surveyors, approved inspectors, environmental health officers and housing officers**, who will be experts in one area (for example building conservation, general legislation or energy performance), but may be less familiar with the balances that need to be struck in reaching reasonable solutions that suit all parties.

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What is Part L of the Building Regulations?

The Building Regulations set standards for how buildings must be constructed to achieve a minimum level of acceptable performance. They typically cover health, safety, energy performance and accessibility requirements for buildings. The Regulations apply mainly to new buildings and there is no general requirement for all existing buildings to be upgraded to meet these standards. However certain changes, such as a change in use of the building or renewal of parts of the building, can trigger the need for existing buildings to comply with the Building Regulations.

Part L of the Building Regulations covers the conservation of fuel and power. Although the Building Regulations themselves only state general requirements, they are supported by Approved Documents which set practical guidance as a response to these requirements. The Approved Document (Part L) for energy efficiency is in four sections:

- Conservation of fuel and power in new dwellings (L1A)
- Conservation of fuel and power in existing dwellings (L1B)
- Conservation of fuel and power in new buildings other than dwellings (L2A)
- Conservation of fuel and power in existing buildings other than dwellings (L2B)

The Approved Documents are not the regulations but are intended to provide guidance for complying with the more common forms of building construction. Applicants are under no obligation to adopt any particular solution from an Approved Document if they prefer to meet the relevant requirement in some other way. Approved Documents Parts L1B and L2B also make clear that the characteristics of historic and traditionally constructed buildings warrant some exemptions and special considerations in reaching appropriate solutions. These are covered in detail in Section 2 of this document.

Other approved documents

Since the physical factors controlling energy efficiency also affect other aspects of an individual building's environmental performance, the guidance contained in this document is also likely to be relevant to the interpretation of other Approved Documents when applied to historic and traditionally constructed buildings.

The most relevant of these are likely to be:

- Approved Document C: Site preparation and resistance to contaminants and moisture
- Approved Document F: Ventilation
- Approved Document J: Combustion appliances and fuel storage systems
- Approved Document to support Regulation 7: Materials and Workmanship

There are other Approved Documents that may also be applicable depending on the nature of the work being carried out.

1 Background to the Legislation

1.1 Energy and carbon in the built environment

For the past two centuries energy has been cheaper and more easily exploited than ever in the past and the world is now facing the consequences. One of the most worrying is a rapidly changing climate due to rising levels of greenhouse gases such as carbon dioxide in the atmosphere which are released when fossil fuels are burnt.

Many countries are now seeking to reduce their greenhouse gas emissions radically. The UK Government is legally committed to an 80% cut on 1990 levels by 2050 (Climate Change Act 2008), and is also looking to protect the environment from the inefficient use of resources and poor waste management. The building stock is inevitably coming under the spotlight, being the largest single user of energy and of many other resources.

Buildings are thought to offer better prospects for reductions than other sectors, particularly manufacturing and transport. In 2010, 45% of $C0_2$ emissions generated in the UK came from energy use for day-to-day building operation and powering electrical equipment in residential and non-residential buildings. Another 10% were associated with building work; collecting, processing and transporting raw materials, making building products and taking them to site, construction and maintaining the building over time. Of the residential buildings around 4 million or 20% were constructed before 1919. Almost a further 20% were constructed between 1920 and 1939.

The United Kingdom Housing Energy Fact File (2013) published by the Government estimated that of the total energy consumed by the average UK dwelling, 60% was used for heating 21% for hot water, 14% for electrical appliances, 3% for lighting and 3% for cooking. At the same time almost 50% of carbon emissions were associated with heating.

Given a particular site and context, the three most important influences on a building's energy use in operation are:

- Building Fabric
  The principal factor to be considered is how effective the building envelope is in providing a suitable indoor environment passively (including buffering of heat, humidity and solar gain; providing natural ventilation and lighting via daylight)

- Building Services and Equipment
  The equipment is the actual user of energy. This includes both the fixed building services (principally heating, cooling, ventilation, hot water and lighting) and other energy consuming equipment (for example computers and appliances used for business, cooking or entertainment)

- People
  Factors to consider include how the occupants maintain their buildings, the standards they consider appropriate for the internal environment; the technical services and equipment they bring in; and how they occupy the spaces

All these factors are highly interdependent, for example the effectiveness of a building envelope will critically depend on how well it is maintained and the operation of the technical systems. The complex system of fabric, equipment and people must be looked at holistically if the use of energy in the building is to be understood and reduced.

Basic principles of action

Given the range of influencing factors, there can be no 'one-size-fits-all' solution for making energy and carbon savings in older buildings. Nevertheless there are some general principles that can be applied across the board.

- **Understand context**
  Building's exposure to elements, construction, condition, occupancy, opportunities and constraints for changes
- **Engage building users**
  Involvement of owners, managers, occupiers in the plans for saving energy
- **Reduce demand on energy-using systems**
  Improve fabric performance, establish what comfort standards are needed
- **Increase efficiency**
  Building fabric, services and other equipment to be energy efficient as possible
- **Improve controls**
  Making control systems as efficient as possible
- **Avoid waste**
  Avoid leaving energy using systems on when not needed
- **Use lower carbon energy supplies**
  Using sources with lower emissions
- **Avoid unnecessary complication**
  Complication invariably is the enemy of good performance
- **Review**
  Assess how measures perform and any unintended consequences

The multiplier effect
Measures used in combination can have powerful multiplier effect. By halving demand and halving the carbon in the energy supply and doubling the efficiency of the equipment, carbon emissions would be cut by seven-eighths.

2 How does Part L affect Existing Buildings?

Although new building construction is well covered by the Building Regulations, existing buildings present a rather more complex picture. Current estimates suggest that of all the buildings expected to be in use in England in 2025 around 80% are already occupied. Moreover, at least 70% of the housing stock likely to exist in the England in 2050 has already been built and around 75% of these houses were constructed before 1975.

2.1 What triggers the Part L requirements?

The Approved Documents L1B and L2B (2010 edition, incorporating later amendments 2010, 2011 and 2013) published in March 2015 contain the requirements for conservation of fuel and power for existing domestic and non-domestic buildings respectively. What though, are the circumstances which trigger the need to take action to upgrade the thermal performance of existing buildings? For existing buildings energy conservation upgrading is generally only required for elements that are to be substantially replaced or renovated, or where there is a change of use. The requirements do not apply to normal maintenance and repair work.

The requirements apply in the following circumstances:

- **Renovation or replacement of thermal elements (Regulation 23)**
  A thermal element is a wall, floor or roof that separates internal space from the external environment. The requirement covers a major renovation, where more than 25% of the surface area of the building envelope undergoes renovation, or replacement/renovation of more than 50% of the thermal element's surface area.

- **When an extension or conservatory is to be added**
  Conservatories should be kept thermally separate from the main building. Extensions over a certain size on non-domestic buildings should be treated as new buildings.

- **When the building is to be subjected to a change of use or a change of energy status**
  A change in use or energy status occurs when a new dwelling is created or an existing dwelling is changed to certain other uses.

- **When changes are to be made to controlled fittings or services**
  Controlled fittings are windows, external doors, roof-lights and roof windows. Controlled services are space-heating and hot-water systems, mechanical ventilation and cooling, and fixed artificial lighting.

- **When consequential improvements are required**
  Consequential improvements are required when an existing building over 1000m^2 is extended, or its capacity for heating or cooling per m^2 is increased.

Note: This simplified list is included here primarily as a convenient introduction. For all projects reference should be made directly to the Approved Documents themselves where definitions of key terms will also be found. Several of these items are interdependent, and works to comply with one category can trigger the need to comply with another.

2.2 Part L statutory requirements

Regulation 2(1) of the Building Regulations defines the energy efficiency requirements as the requirements of regulations 23, 25A, 25B, 26, 28 and 40 and Part L of Schedule 1.

For existing dwellings the energy efficiency requirements are those in regulations 23, 28 and 40 and Part L of Schedule 1 to the Building Regulations.

Schedule 1 – Part L: conservation of fuel and power

L1: Reasonable provision shall be made for the conservation of fuel and power in buildings by:

(a) limiting heat gains and losses through thermal elements and other parts of the building fabric; from pipes, ducts and vessels used for space heating, space cooling and hot water services;

(b) providing fixed building services which are energy efficient;
have effective controls; and are commissioned by testing and adjusting as necessary to ensure they use no more fuel and power than is reasonable in the circumstances;

2.3 Ways of complying with Part L

The following actions are included in Approved Documents L1B and L2B as ways of demonstrating compliance with Part L for existing buildings.

Propose consequential improvements where required
This applies to all buildings. Consequential improvements may include improving the insulation of thermal elements, upgrading old services systems, or adding on-site zero-carbon energy-generating equipment. This requirement is, however, limited to those improvements that can demonstrate economic payback within a set number of years, and, in the case of extensions, to no more than a set percentage of the value of the principal works.

Ensure U-values and areas of openings comply
U-values of thermal elements and controlled fittings should meet the minimum required in the Approved Documents for any particular circumstance. For dwellings this is a basic but inflexible method of achieving compliance, but may be modified subject to certain criteria.

Show compliance using area-weighted U-value calculation
An area-weighted U-value allows the value for all elements of a particular type to be averaged, thus enhancing flexibility over basic U-value calculations. This can be used both for dwellings and other buildings, but absolute minimum values also apply.

Show compliance using an approved computer modelling process
This is potentially the most sophisticated and flexible way of achieving compliance. Dwellings should demonstrate compliance using the Standard Assessment Procedure (SAP). Other buildings should use the Simplified Building Energy Model (SBEM) or other approved software that conforms to the National Calculation Method (NCM). Note, however, that these methods do not at present make proper allowance for the specific requirements of historic buildings or traditional 'breathing' construction.

Confirm compliance of thermal bridges and minimise air leakage
This only applies where new thermal elements are provided. However, it is good practice that all upgraded insulating elements are checked to avoid cold bridges causing condensation, and all controlled fittings are checked to ensure they meet calculated standards of airtightness.

Justify reduced standards using set period payback criteria
This applies to upgraded or renovated existing thermal elements as part of a change of use, or a renovation, or when an existing internal element becomes part of the thermal envelope. Work which will only give an economic payback in excess of a set number of years need not be carried out. This is subject to other conditions, and to a particular calculation method.

Specify efficient boilers, pipe-work and controls; specify energy-efficient lighting
These provisions apply when new or upgraded services are being installed. Provisions for non-domestic buildings are more extensive and complicated than for dwellings.

Undertake duct leakage and fan performance testing
This applies to non-domestic services installations where appropriate.

Provide for energy metering
This only applies to new plant installations in non-domestic buildings, but includes differential monitoring between systems (dwellings are excluded as they are normally adequately metered).

Provide an instruction manual for heating, cooling, ventilation and lighting systems
To enable building users to realise the optimum levels of energy efficiency to which their buildings are designed.

Note: This simplified list is included here primarily as a convenient introduction. For all actual projects reference should be made directly to the Approved Documents themselves.

Although the recommended actions above are effective ways of complying with the Regulations, many of them will need to be applied with particular care in the case of historic buildings and those of traditional construction.

The two principal areas of risk when upgrading older buildings to meet the requirements are:

- causing unacceptable damage to the character and appearance of historic buildings
- causing damaging technical conflicts between the existing construction and changes to improve energy efficiency

To allow appropriate mitigation of both of the above risks, Approved Documents L1B and L2B contain some exemptions for historic buildings, as well as circumstances where special considerations should apply.

Top:
Listed buildings are exempted from Part L if compliance would unacceptably alter their character and appearance.

Bottom:
Buildings in conservation areas are exempt in so far as measures would unacceptably alter their character and appearance.

2.4 Buildings which are 'exempt' from the requirements

Certain classes of historic buildings are expressly exempted from the need to comply with the energy efficiency requirements of the Regulations where compliance would unacceptably alter their character and appearance. These are listed under paragraph 21(3) of the Regulations and paragraphs 3.6 and 3.7 of the Approved Documents L1B and L2B, and comprise buildings which are:

Listed Buildings at Grades I, II* and II

"Listed in accordance with section 1 of the Planning (Listed Buildings and Conservation Areas) Act 1990".

Listed buildings are those included on the National Heritage List for England. Controls apply and Listed Building Consent is required for any works of alteration or extension – both external and internal – which would affect a building's character and significance. Fixtures and curtilage buildings – any objects or structures which are attached to the building, or are within the curtilage (and have been so since before July 1948) – are treated as part of the listed building. The same controls apply whatever the grade of listing.

Buildings in conservation areas

"In a conservation area designated in accordance with section 69 of that Act".

Conservation areas are 'any areas of special architectural or historic interest, the character or appearance of which it is desirable to preserve or enhance'. Conservation area designation encourages authorities to implement conservation policies over these sensitive areas.

In a conservation area, the main emphasis is on external appearance. Surface materials (walls and roofs) and the details of windows, doors, and roof-lights are all extremely important. Changes to these may need planning permission, especially if they are subject to an Article 4 direction under the Town and Country Planning Acts. Consent is usually needed for the demolition of buildings in a conservation area. Planning permission is not needed for internal alterations to unlisted buildings.

While not all buildings in a conservation area will be of historic interest, many have original external features that contribute to the significance of the conservation area as a whole. Removing such features could therefore have an adverse impact on its overall character.

Scheduled monuments

"Included in the schedule of monuments maintained under section 1 of the Ancient Monuments and Archaeological Areas Act 1979".

Scheduling is the means by which nationally important monuments and archaeological remains in England are legally protected. Scheduled Monument Consent is required for any works that will affect a protected monument, whether above or below ground level.

Scheduled monuments are included in the exempt category in Part L.

2.5 Buildings where ‘special considerations’ apply

Paragraph 3.8 in both Approved Documents L1B and L2B lists three further classes of buildings where special considerations apply when making reasonable provision for the conservation of fuel or power:

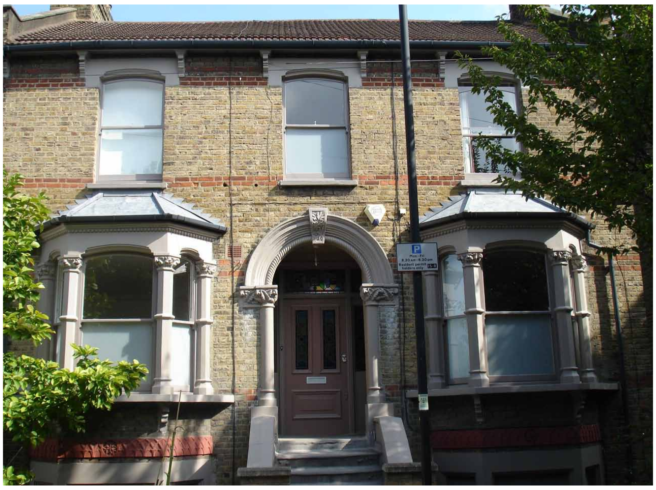
Locally listed buildings

“Buildings which are of architectural and historical interest and which are referred to as a material consideration in a local authority’s development plan or local development framework”.

This category includes historic buildings identified in a ‘local list’ or ‘supplementary list’ that has been included in a local authority’s unitary or local plan (known as the development plan). Inclusion within the plan means that any list of this kind has been subject to public consultation and is a material planning consideration in the determination of applications under the Town and Country Planning Acts.

Most buildings on these lists are good examples of a particular design or style of construction, for example buildings of the Arts and Crafts movement of the late 19th and early 20th centuries, the work of a noted local architect, or a building associated with a local historical figure. They could well become the listed buildings of the future.

These buildings have no statutory protection unless they are within a conservation area. Nonetheless, if they are to retain their significance it is often essential that original features and fabric are preserved in any schemes of alteration or extension.



Top:
Locally listed buildings are subject to ‘special considerations’.

Middle:
This barn conversion in the Peak District National Park would be subject to special considerations.

Bottom:
Buildings of traditional construction with permeable fabric are subject to special considerations.

Buildings in national parks and other historic areas

"Buildings which are of architectural and historical interest within national parks, areas of outstanding natural beauty, registered historic parks and gardens, registered battlefields, the curtilages of scheduled ancient monuments, and world heritage sites".

Buildings often help to create the townscape and landscape qualities that were among the original reasons for the designation of an area or site. They use local materials and highlight vernacular traditions; roofs, windows, roof-lights and doors that typify their period, age and style. Other buildings in these areas may be relatively modern or much altered, and may accommodate energy-saving upgrading more easily.

Traditionally constructed buildings

"Buildings of traditional construction with permeable fabric that both absorbs and readily allows the evaporation of moisture".

Most traditional buildings were designed and built before the development of reliable and cost-effective impermeable membranes or moisture barriers. They rely instead on their ability to allow moisture to evaporate rapidly away, and thus prevent the damaging build-up of damp and resulting physical decay. While the majority of historic buildings are 'traditional' in terms of their construction, there are many thousands of traditional buildings that are not legally protected.

This category includes nearly all buildings constructed prior to 1919, as well as a significant proportion of those built before 1945. It is essential that adaptations made to improve the energy efficiency of these structures should take into account the traditional technology and characteristic behaviour of the building fabric, otherwise damage can be caused. Well-meaning attempts to keep moisture out of these buildings using modern methods tend to have the effect of preventing the vital evaporation, thus causing or accelerating moisture-related decay to the fabric.

Paragraph 3.9 of the Approved Documents L1B and L2B goes on to state:

"When undertaking work on or in connection with a building that falls within one of the classes listed [in paragraph 3.8] above, the aim should be to improve energy efficiency as far as is reasonably practical. The work should not prejudice the character of the host building or increase the risk of long-term deterioration of the building fabric or fittings".

Although the wording is different, the provisions in this paragraph are very similar in their practical effects to the partial exemption accorded to listed buildings, buildings in conservation areas and scheduled ancient monuments. That is, the energy efficiency of the building should be improved as well as it can be, but not beyond the point where there is a risk that unacceptable damage to the character and appearance or the long-term durability of the physical fabric will occur.

Paragraph 3.10 of the Approved Documents L1B and L2B (as amended 2013) then states:

"In addition English Heritage (now Historic England) has produced detailed technical guidance on how to implement specific energy efficiency measures".

The 'guidance' mentioned in this paragraph comprises this document and the other supporting documents mentioned in the introduction.

2.6 New extensions to existing buildings

An extension will normally be able to accommodate a higher standard of thermal performance than the host building. An exception would be where the extension was designed to be a true facsimile of a previous structure or where certain planning requirements generated the need for elements to complement the historic building in terms of construction and detailing.

Sometimes an extension, such as a conservatory, can improve the thermal performance of the whole building, for example by reducing heat loss through the surface to which it is attached and enhancing solar gain. However, care needs to be taken in the design and integration of such structures. If they are unheated and isolated (for example, by doors which are usually kept closed in winter), a conservatory will normally be warmer than outside and reduce heat losses from the building to which it is attached. If heated or unheated but left open to the main building, the whole building's heating requirements could be significantly increased.

New extensions should comply with the standards set out in the Approved Documents unless there is a need to match the character of the extension with that of the host building.

Paragraph 3.11 of the Approved Document states:

"In general, new extensions to historic or traditional dwellings [or buildings in L2B] should comply with the standards of energy efficiency as set out in this Approved Document. The only exception would be where there is a particular need to match the external appearance or character of the extension to that of the host building".

Again, a newly constructed extension should comply fully with the energy efficiency requirements. However, the energy efficiency requirements should not be applied beyond the point at which they would unacceptably compromise the character and significance of the host building.

An example might be where windows need to match those in the host building and as a result might be single glazed. In these circumstances improved thermal performance could be met by draught-proofing or secondary glazing.

2.7 Issues that warrant sympathetic treatment

Paragraph 3.12 of the Approved Documents L1B and L2B also makes provision for 'special considerations' being applied as follows:

"Particular issues relating to work in historic buildings that warrant sympathetic treatment and where advice from others could therefore be beneficial include:

a) Restoring the historic character of a building that has been subject to previous inappropriate alteration, eg replacement windows, doors and roof-lights;

b) Rebuilding a former historic building (eg following a fire or filling a gap site in a terrace);

c) Making provisions enabling the fabric of historic buildings to 'breathe' to control moisture and potential long-term decay problems".

Left:
In this conservation area a PVC-u window has been replaced with a timber sash window to the original pattern. Such work would be subject to special considerations

Top right:
Historic buildings that have been subject to fire damage are subject to special considerations.

Bottom right:
Remedial work to allow permeable fabric to 'breathe' would be subject to special considerations.

This is clearly indicative and is not an exhaustive list. It should be noted that items 'a' and 'b' both make provision for reinstating key parts of a building which can enhance its character or significance which have been previously lost. Item 'c' is rather different in that this clause relates to maintaining the historic building's technical performance where this is of a traditional permeable construction.

Paragraph 3.13 of the Approved Documents goes on to advise that:

"In assessing reasonable provision for energy efficiency improvements for historic buildings of the sort described in [the above] paragraphs…, it is important that the BCB [Building Control Body] takes into account the advice of the local authority's conservation officer. The views of the conservation officer are particularly important where building work requires planning permission and/or listed building consent".

2.8 Places of worship

Paragraph 3.6 of Approved Document L2B also notes that special considerations apply to:

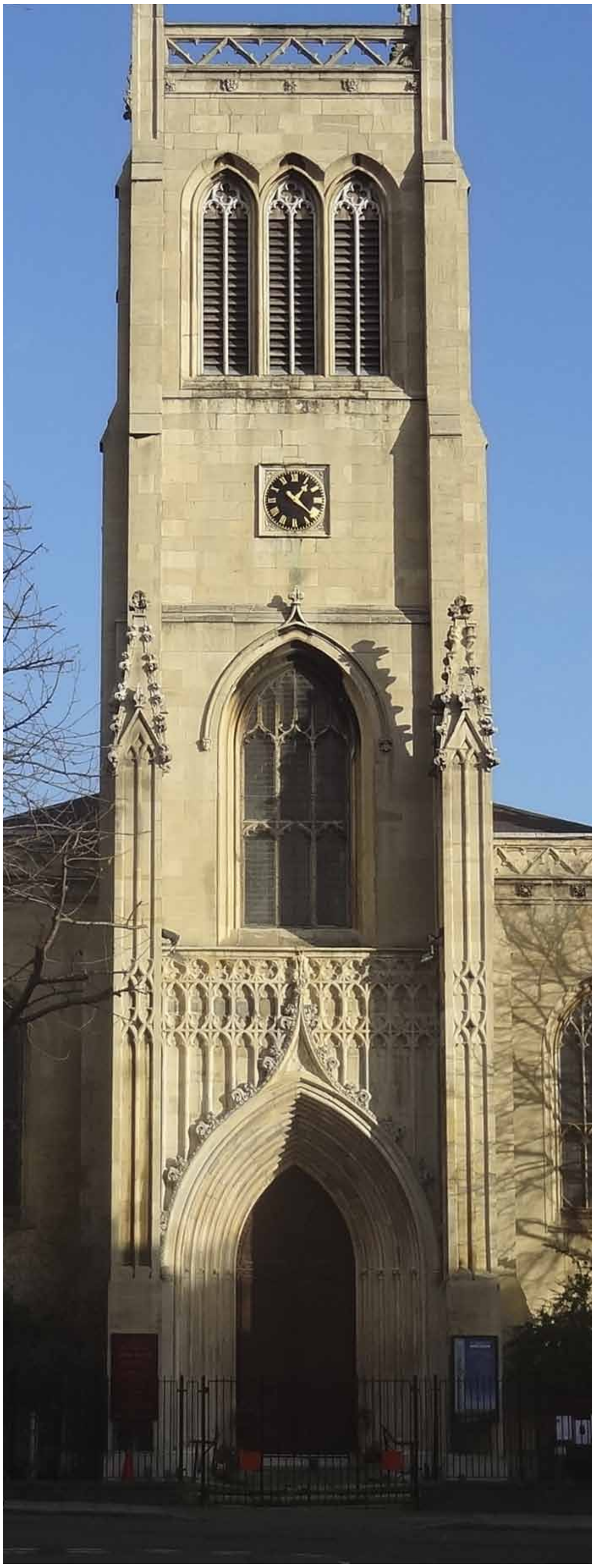
"Buildings used primarily or solely as places of worship".

This provision is further expanded in paragraph 3.14 as follows:

"For the purposes of the energy efficiency requirements, places of worship are taken to mean those buildings or parts of a building that are used for formal public worship, including adjoining spaces whose function is directly linked to that use. Such parts of buildings of this type often have traditional, religious or cultural constraints that mean that compliance with the energy efficiency requirements would not be possible. Other parts of the building that are designed to be used separately, such as offices, catering facilities, day centres and meeting halls are not exempt".

In the majority of cases these buildings will be designated and therefore covered by the exemptions, but this particular paragraph indicates that the definition of 'significance' can be drawn more widely when applied to places of worship, and may therefore include aspects of religious significance which are not specifically historic.

These special considerations also recognise that large internal volumes used only occasionally can never be heated efficiently, and that carrying out all the alterations necessary to achieve energy efficiency would be both disproportionately expensive and potentially damaging to their character and significance.



Places of worship are subject to special considerations, though many will be listed and therefore subject to possible exemption.

2.9 Exemptions and special considerations compared

Buildings which are exempt from the energy efficiency requirements are clearly defined in the Regulations, as is the extent to which their conditional exemption actually applies.

Regulation 21 states:

"….where compliance with the energy efficiency requirements would unacceptably alter their character or appearance".

This conditional exemption therefore requires that these buildings should be upgraded in accordance with the energy efficiency requirements set out in Approved Documents L1B and L2B up to, but not necessarily beyond, the point at which the relevant alterations would become unacceptable. The definition of this point requires an understanding of what qualities of character and appearance are significant in each case, as well as an effective assessment of the degree to which alterations will be unacceptable.

Buildings for which 'special considerations' may apply, although identified in the Approved Documents, are not as clearly defined as 'exemptions'. The difference between historic buildings which are exempted from the energy efficiency requirements and those where special considerations may apply, reflects the degree of significance rather than any difference in the process or method which should be used to achieve compliance.

For all the designations, where consent is required, the local authority is required to assess proposals for any impacts on the significance of the heritage asset in accordance with the criteria set out in the National Planning Policy Framework (NPPF). Whilst Paragraph 94 of the NPPF advises planning authorities to adopt proactive strategies to mitigate and adapt to climate change, paragraphs 126–141 cover the protection of the historic environment.

Guidance on assessing proposals for impacts on significance is set out in the Historic England publication *Managing Significance in Decision-Taking in the Historic Environment Historic Environment Good Practice Advice in Planning: 2*.

3 Meeting the Requirements of Part L: Issues to Consider

When proposing any works to modify an existing building it is important that it should first be properly understood. This means understanding the nature of its construction, condition, context and the way it performs and how it is used. It also means understanding the building's character and significance.

If a building is properly understood, works can be targeted to the places where they are most needed or, in the case of major changes, the places where they will do least harm. Not only is such a targeted approach better for the building, it can also be more cost-effective.

The qualities that need to be understood in any historic building are those which make it special such as its windows, doors and joinery. However, a building's qualities is some cases are not always physical, but they will provide the underlying reasons why particular parts of a building or place are significant, and thus worthy of protection or designation.

Very few historic buildings or places survive as originally built. The majority will be made up of works from different periods, derived from and expressing different values. When simple modifications are proposed to individual building elements such as walls, windows and floors, the significance may well seem obvious and uncomplicated. This may well be so, but caution is still recommended as the full consequences of proposed changes may be more extensive and potentially damaging than first anticipated. There is also a danger that a range of small individual modifications, each of which may be quite tolerable in their own right, can together cause unacceptable damage.

3.1 Understanding the building and its significance

Historic buildings vary greatly in the extent to which they can accommodate change without loss of their significance. These considerations will influence the extent of change that is appropriate to improve energy efficiency.

When alterations for energy conservation are proposed, regard should be given to:

- ensuring that the building is well understood, including its significance to avoid damage
- understanding the impact of proposals on that significance
- avoiding, minimising and mitigating impact
- looking for opportunities to better reveal or enhance significance
- justifying harmful impacts in terms of the sustainable development objective of conserving significance and the need for change
- offsetting negative impacts on significance by enhancing others through recording, disseminating and archiving archaeological and historical interest of the important elements of the heritage assets affected

Significance is defined in the National Planning Policy Framework (NPPF) as:

"The value of a heritage asset to this and future generations because of its heritage interest. That interest may be archaeological, architectural, artistic or historic. Significance derives not only from a heritage asset's physical presence, but also from its setting".

Conservation Principles, Policies and Guidance (English Heritage 2008) lists four primary categories of heritage value:

Evidential value derives from the potential of a place to yield evidence about past human activity. Physical remains of past human activity are the primary source of evidence about the substance and evolution of places, and of the people and cultures that made them. This aspect is of particular relevance in places where there may be archaeological remains, but the archaeology within the structure of a building, while less familiar, may be every bit as important.

Historical value derives from the ways in which past people, events and aspects of life can be connected through a place to the present. This may be illustrative, by demonstrating important aspects of past lives and assisting the interpretation of the historic environment, or it may be associative, through being linked to a notable historical person or event.

Aesthetic value derives from the ways in which people draw sensory and intellectual stimulation from a place. This will include both the fortuitous qualities which have evolved naturally in a place over time, as well as the design values attached to a deliberately created building, group of buildings or landscape.

Communal value derives from the meanings of a place for the people who relate to it, or for whom it figures in their collective experience or memory. Communal values are closely bound up with historical (particularly associative) and aesthetic values, but tend to have additional and specific aspects. This can cover commemorative and symbolic values important to collective memory, social values which contribute to people's identification with particular places, or the spiritual values people associate with special buildings and places, whether attached to organised religions or not.

Assessment of significance

Being able to properly assess the nature, extent and importance of the significance of a heritage asset and the contribution of its setting early is a key task in the process of thermal upgrading. This should be carried out and documented prior to the design or preparation of any proposals, as close to the beginning of the process as possible.

Assessments of significance can vary considerably in scope and detail, from the large and complex to the quick and easy. The degree of understanding, and the care and complexity of the assessment required should be decided from the size, overall significance and complexity of the building or place in question. In each case, from the largest to the smallest, a suitably proportionate approach is encouraged.

The assessment needs to incorporate an understanding of:

- the nature of the significance
- the extent of that significance
- the level of significance

To accord with the NPPF, an applicant requiring a consent will need to undertake an assessment of significance to inform the application process to an extent necessary to understand the potential impact of the proposals and to a level of thoroughness proportionate to the relative importance of the asset whose fabric or setting is affected.

Where only local, small-scale changes are anticipated, such as the upgrading of an individual thermal element in a simple building such as a window, an assessment of significance can be adequately documented with no more than a photograph and a paragraph or two of text.

Components of a historic building might be significant because of the way in which they contributed to its original environmental performance. Among these will be chimneys and fireplaces, early heating and ventilation systems and remnants of other obsolete building services installations. Although now surplus to technical requirements, these will often be significant features to be recognised, understood and retained.

Further information on assessing significance can be found in the Historic England guidance: *Managing Significance in Decision-Taking in the Historic Environment Historic Environment Good Practice Advice in Planning: 2*.

3.2 Understanding the construction and condition of the building

Optimising original performance through maintenance and repair

Traditional buildings made from permeable materials work differently to modern buildings. It is therefore necessary to think carefully about how to optimise their performance in dealing with moisture and heat. Some traditional buildings have inevitably become damaged and worn over time so that they are cold, damp and draughty.

In addition, a large proportion of traditional buildings will also have been adapted or repaired over the years with the best of intentions, but using inappropriate materials, such as hard cement mortars and renders and synthetic waterproofing treatments. These reduce the building's permeability and give a detrimental impression of both its durability and its ability to provide a comfortable internal environment.

Removal of damaging alterations

While it is often beneficial to remove damaging later alterations which reduce the permeability of traditional buildings, this is not always practically possible. Certain materials, such as hard cement mortars, can adhere so strongly to traditional materials that all attempts to remove them will damage the older, softer substrate. Synthetic waterproofing treatments are inherently irreversible. Under such circumstances a mixture of technologies will have already been inflicted on the building, and the consequences, although undesirable, may simply have to be accepted.

If removing later materials is likely to cause serious damage it may be preferable to leave them in place. However, this will mean that the traditional construction cannot work as well as it once did, and that steps may need to be taken to mitigate the effects. These might include introducing membranes to protect vulnerable elements of the structure from trapped moisture, or finding alternative ways of allowing evaporation. The building's thermal performance is also likely to be reduced, although any techniques to compensate for this will need to be specified and installed with care.

Repairs

Repairing a building which has become worn and decayed through centuries of use can help to restore its original hygro-thermal performance. Fortunately, this is usually easier and less contentious than the removal of damaging alterations. The correct and sympathetic repair of a traditional building will bring its technical performance back to the optimum level and also provide a sound basis for the development of proposals for further upgrading. Carrying out repairs can also provide many cost effective opportunities for improving thermal performance.

Old windows and doors have a reputation for being draughty, but would originally have been made as accurately as the considerable skills of a traditional joiner would allow. Cracked joints and voids in masonry similarly allow liquid water to penetrate where sound mortar would once have effectively kept it out. Repair of such decay using materials which match the originals as closely as possible, particularly in their technical characteristics, will greatly enhance both the performance and the durability of the building.

Left:
This wall has had a cement render added which has resulted in damp and a drastic reduction in its thermal performance.

Right:
The first stage in any programme of thermal upgrading should be to carry out repairs so that all elements are working to their optimum performance.

The importance of maintenance

A basic principle of building conservation is that significant buildings should be maintained as well as possible in order to prevent decay damaging their fabric. Traditionally constructed buildings are generally capable of lasting indefinitely with moderate amounts of regular maintenance.

Basic maintenance should include regular inspections so that defects can be discovered while still small and easily fixed. This has the advantage of limiting the need for major works, which could trigger the need to comply with Part L when elements are largely or completely renewed, preserving historic fabric, as well as minimising cost and disruption to the building's owners and users.

Regular maintenance also helps the building to perform in the way that was originally intended. Damp and significant draughts are more often the result of inadequate maintenance or ill-considered changes, rather than original defects in the design and construction of the building.

Further information on maintenance and repair can be found on the Historic England website.

For historic buildings to perform well thermally they need to be kept in a good state of repair with regular maintenance.

3.3 Understanding the building as an environmental system

Before carrying out any thermal upgrading to a historic building it is not only important to understand the likely effects on the significance but also on the performance and long-term health of its fabric.

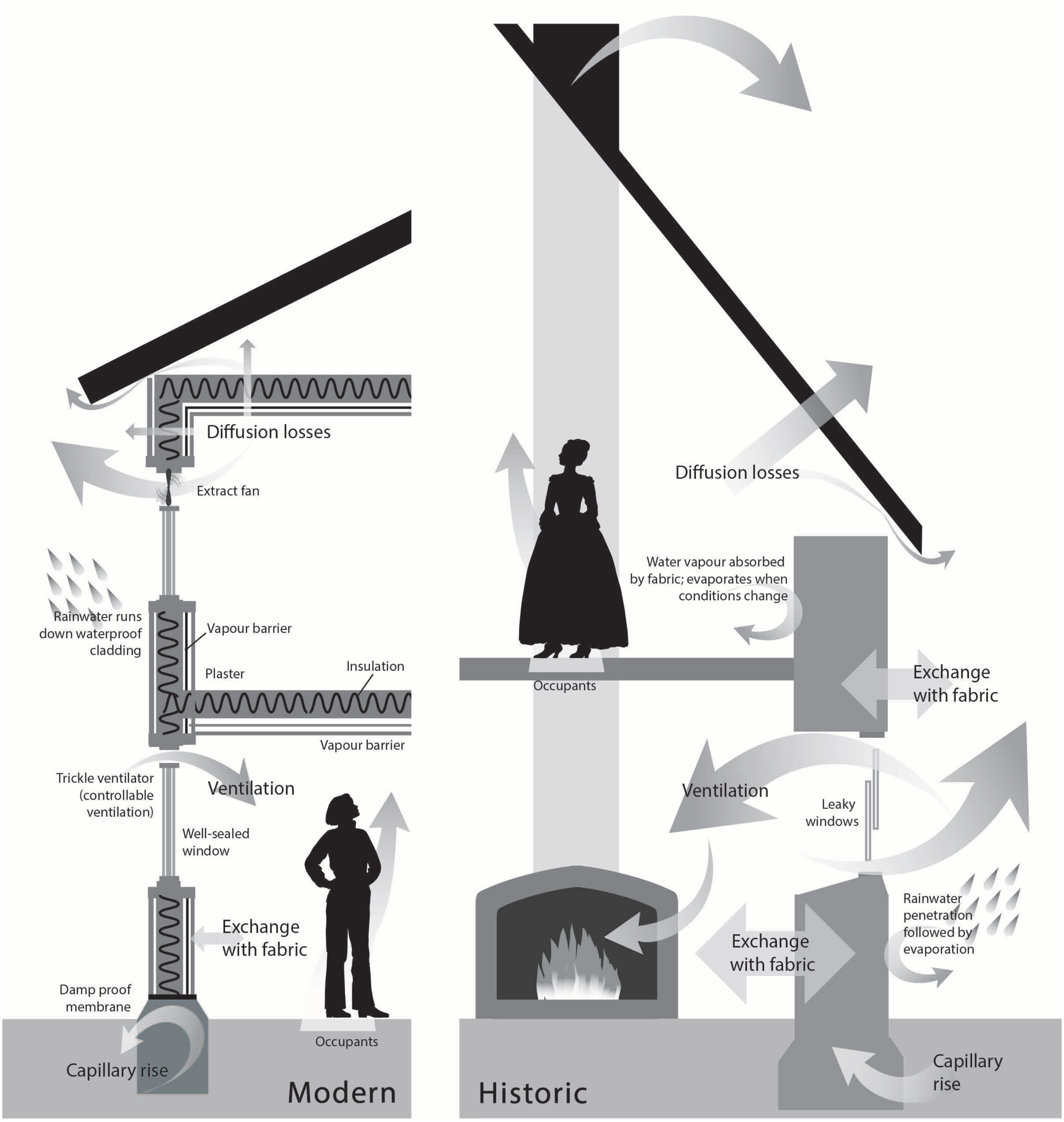
Buildings have always been designed to filter the extremes of the external environment and provide more benign internal conditions. This environmental filtration is provided in the first instance by the external envelope of walls, roofs, windows and doors. Together these keep out rain, snow and wind; retain warmth, and moderate the entry of light and air.

The internal environment of most traditionally constructed buildings is also moderated by internal features such as chimney stacks, cellular room plans and draught lobbies that together provide additional thermal mass, and limit heat loss through air infiltration.

While this environmental performance cannot compare with that available from modern materials and services, it nevertheless can be surprisingly effective and still make a valuable contribution to a building's future thermal performance. When planning improvements to the energy efficiency of a historic building it is useful to begin by working out how it was originally intended to perform. This will allow the development of upgrading proposals that will be as compatible as possible with the existing fabric.

This understanding needs to encompass:

- the large scale – the performance of the whole building in its context must be assessed with regard to heating, ventilation, insulation and energy efficiency
- the medium scale – it is important to understand how conditions vary from place to place around the building
- the smaller scale – consider key junctions between the existing construction and the types of insulation that may be used



Typical differences in the movement of moisture for a historic building and a modern building.

Buildings of traditional construction

Traditionally constructed buildings are characterised, and for the purposes of Part L defined, by the widespread use of permeable materials which allow moisture within the building fabric to evaporate freely away. This applies particularly to solid masonry external walls (whether of brick or stone), but is also relevant to earth buildings, infill panels in timber-framed construction, solid ground floors of stone or tile, plastering and rendering, internal and external decorative finishes.

Permeability may sound simple, but the actual behaviour of liquid water and water vapour, and their effects on other aspects of the performance of both the building envelope and the internal environment, can in reality be very complex.

Sources of moisture

There are four principal sources of moisture that are likely to affect a building of traditional construction:

- Rain
  Most traditionally constructed buildings are capable of resisting rain if they are kept in good order. Rain will normally be absorbed into the outer layers of permeable material, and then safely evaporate back out again when the weather changes. Problems may arise, however, if wall heads and other vulnerable areas are less well protected than was originally intended.

- Rising damp
  Traditionally constructed buildings can normally deal with rising damp surprisingly well. However, this depends on the balance between capillary water ingress and evaporation keeping overall moisture levels within tolerable limits. Problems tend to occur when circumstances change, particularly if ground levels are raised, impermeable materials such as cement renders are added, or a building is converted to a more intensive use.

- Internal moisture vapour
  The occupants of buildings can generate a considerable amount of moisture through breathing, cooking and washing. This is initially carried as vapour in the internal air, which itself is normally warmer than the external environment. This moisture can condense on cold surfaces or within the body of a permeable wall. This is not normally a problem if the water taken up by the wall is adequately balanced by suitable evaporation over time.

- Damaged services
  Water from damaged pipe-work is a self-evident problem which can and should be resolved by normal maintenance.

Hygro-thermal behaviour

The behaviour of water vapour is directly linked to temperature, because warm air can carry considerably more moisture than cold air. This is generally expressed as relative humidity (RH) – the amount of water vapour in air as a percentage of the total amount that could be carried at that particular temperature. This is an excellent practical indicator as it shows the potential for evaporation not just from building materials and surfaces, but also from the human body. For this reason RH affects not just the health of a building but the comfort of its occupants.

Pores and capillarity

Moisture is taken up into, and evaporated from the pores in permeable materials, but the pore sizes can be very variable. In larger pores the water is absorbed as in a sponge, and it can move out again relatively easily. However, water is absorbed into small pores by capillary action, which is a function of surface tension. Capillary action allows water to move from large pores into smaller ones, but not the other way. This means that water in the smallest pores can be surprisingly difficult to remove, usually requiring a considerable amount of energy.

Dynamic behaviour

The liquid water within permeable building materials is rarely static, but moves around in response to changing conditions, during both daily and seasonal cycles. For example, moisture levels can often vary through the thickness of a wall, ranging from relatively dry close to the surfaces, from where evaporation is relatively easy, to quite damp in the middle. This zone of dampness will often move inwards and outwards in response to changing internal and external environmental conditions.

This movement is often characterised by a process of constant evaporation and condensation in which movement is towards the side where condensation is greater than evaporation, and away from the side where the opposite applies.

Moisture vapour can contribute to this process by diffusing through the unfilled pores. However, it is important to understand that while the movement of moisture vapour is driven by differences in vapour pressure, liquid water movement is driven by differences in relative humidity. This can therefore result in the two kinds of moisture moving in different directions at the same time.

Within a healthy traditional building the moisture flows will generally maintain a balance between evaporation and condensation, which will in turn keep the overall level of moisture held in the material within tolerable and harmless limits.

Latent heat

The evaporation and condensation of water influences material temperature through the effects of latent heat. It takes around 540 times the amount of energy to evaporate a given amount of water as it does to raise the temperature of that water by 1°C. This energy must be obtained from somewhere, and is typically taken from the body of the permeable material the water is evaporating from, thus cooling it. Conversely, when that water then condenses on a surface, that latent energy is released back into the material. The energy transferred can be enough to have a significant effect on the temperature of both the fabric of a building and its internal environment.

Understanding permeability

The permeability of the external surfaces of traditional building materials is perhaps the most important aspect of this phenomenon and the one with which most people are familiar. It applies to traditional bricks, building stones (except slate and granite), traditional mortars, plasters and renders, unglazed tiles, cob, earth and early concretes. It also applies to timber, although the linear, cellular nature of wood makes its response directional: very permeable in the end grain, but less so to the sides. Reed and thatch tend to behave in a similar way to timber. Traditional lime washes, distempers and similar finishes are also permeable.

Permeability is a variable quality, not an absolute one. Many modern materials claim to be permeable, but their actual permeability is considerably less than that optimally required for the repair of traditional buildings. Traditional building materials can also vary considerably in their permeability, and this can also be modified in use, such as in the degree of finish which might be applied to a lime plaster or render.

When rain dampens permeable materials a proportion of the water soaks into the surface. The depth of penetration can vary considerably depending on the type of material and the degree exposure. However, experience built up over hundreds of years in different parts of the UK has allowed the development of effective techniques for dealing with prevailing local conditions and materials. When excessive damp penetration does occur, it is more often due to a lack of maintenance than faulty original construction.

The permeability of the outer surface of these materials allows the moisture absorbed in poor weather to rapidly evaporate once the rain stops. This two-way flow is vital for the health of the building, because it ensures that the overall moisture load never reaches a high enough level to cause damage to the building fabric. However, not all materials have equal permeability; brick and stone rely heavily on more permeable lime mortars to increase the overall amount of evaporation. In addition, the greater the evaporative area available, the drier any particular part of a building will tend to be.

For many years it was assumed that permeable walling and other surfaces should be sealed to prevent water getting in. However, such treatments, including cement rendering, silicone (and other) sealants and plastic paints should be avoided. In most cases some water will be absorbed through the finish into the permeable material behind, often through cracks or decayed patches (these treatments often have limited lives). Once inside it will be unable to freely evaporate out again. The result is a build-up of moisture in the wall thickness which is detrimental both the health of the building and its thermal performance.

The absorbency of the permeable materials has the beneficial side effect of reducing run-off from the face of the building during rain. This significantly reduces the wetting of lower parts of the building, including details and flashings. Treating an area of permeable walling to make it impervious can often trigger rapid erosion and failure of other parts of the building which were never intended to carry this degree of run-off.

Permeability within the construction is also extremely important to the overall health of traditional buildings. The use of highly permeable materials allows moisture to disperse through a mixed construction both by diffusion and capillary action. The effect is to spread water widely and evenly through the structure, avoiding any damaging concentrations.

It is this ability, more than any other, that allows timber and masonry to co-exist safely without separating membranes in traditional buildings. Joist ends and bonding timbers built into brick walls, although theoretically vulnerable, can survive happily for hundreds of years if the permeable masonry around them is properly maintained. However, old timber-framed buildings can be very rapidly damaged by concentrated and trapped damp if their masonry infill panels are replaced or rendered over with hard cement.

The permeability of internal surfaces has less marked effect on the physical health of traditional buildings, but can still be important because of the way they can also absorb quite large quantities of moisture from the internal environment, and to store it for release later.

This process of 'moisture buffering' can be extremely beneficial in the control of internal humidity. It becomes very important when the rate of air change with the exterior is significantly reduced (as may be the case when a traditional building is draught-proofed). This is because the resulting build-up of internal moisture can cause considerable discomfort for people living and working in the building. Many will respond by turning the heating up (as this will allow the internal air to carry more moisture), but this will immediately increase the rate of heat loss through the external envelope. On the other hand, if internal humidity is adequately buffered, an interior can be comfortable for the occupants at a cooler temperature.

It is important to recognise, however, that very little of this moisture will disperse itself right through even a highly permeable wall. In reality, the moisture tends to be taken a certain distance into the surface of the wall whilst humidity is high, and the greater part then re-evaporates back into the room when it is no longer being used. It can then dissipate safely through natural ventilation.

Moisture barriers

Because the movement and evaporation of moisture is so important to the performance of traditionally constructed buildings, any intervention in this process, however well meaning, can have significantly detrimental effects on the building fabric. It is for this reason that great care must be taken when considering adding modern, impermeable materials to traditional construction such as insulation.

- External moisture barriers

  The danger of applying impervious treatments to the outside face of permeable construction has already been mentioned. Rainwater that would otherwise be partially absorbed and then evaporate harmlessly away can be trapped in large quantities behind such treatments. The impervious treatment tends to exaggerate the absorption through cracks because of the water pressure caused by the surface run-off. Fully saturated walls can easily result.

  This will be highly detrimental to the health of the fabric. Not only will it cause rot in built-in timbers but it will also allow water to be held in places where it can mobilise soluble salts and freeze. In addition, dampness in walls causes increased heat loss through the fabric, and prevents moisture buffering in internal spaces, making buildings feel cold and clammy. The normal (and entirely understandable) human response is to turn up the heating, thus seriously compromising the energy efficiency of the building.

  External moisture barriers also effectively trap condensation from the internal environment within the building envelope. While the majority of internal condensation is buffered and released back to internal spaces later, a proportion can build up within the fabric over time to damaging levels. Allowing a proportion of this moisture to evaporate away from the external face can be very helpful in preserving both the building fabric and its performance.

- Internal moisture barriers

  Internal moisture barriers are commonly used in an effort to prevent water vapour from the internal environment condensing within the building fabric. These typically take the form of foil-backed insulation added to the internal face of solid walls. Known as vapour barriers, vapour checks or vapour control layers, these can under the right circumstances be very effective.

  To remain effective, vapour barriers need to be completely imperforate, as even small holes will allow water vapour through. This can seriously reduce the effectiveness of any added insulation, as well as causing rot and other damage to the structure of the building.

  Retrofitting vapour barriers into existing buildings is particularly difficult because of the existing structural connections, such as where floor joists are bedded into internal walls. Where such junctions already exist it will be impossible to seal them adequately, and the gaps in the vapour barriers will be at the most vulnerable point in the construction.

  The installation of vapour barriers into existing buildings of traditional construction is therefore rarely effective, and can actually cause increased damage by concentrating the moisture rather than dispersing it. Vapour barriers also restrict the advantages which might otherwise be gained from moisture buffering in the inner face of permeable construction and the transfer of moisture in the external wall to the inside where it can evaporate.

  Internal tanking for waterproofing, or to control rising damp, is often applied to traditional buildings which are perceived to have problems. Very often, this will simply direct the moisture in unpredictable ways to alternative places where it can then evaporate away. This might be at a higher level within the building, even an upper storey, or to a connected internal wall.

Whenever possible, instances of damp like this are far better dealt with by removing the moisture at source, and reinstating the original external surfaces to full health, before considering any kind of impervious intervention.

- **Moisture barriers within the fabric**
  Moisture barriers within the construction, such as damp-proof membranes (DPMs), damp-proof courses (DPCs) and localised separating membranes are also commonplace both in modern construction and in converted traditional buildings. However, these also need to be treated with care.

  Traditional breathable solid ground floors have often been replaced with modern concrete constructions that include a damp-proof membrane. While this is effective in producing a dry floor, the moisture that previously evaporated harmlessly from the old floor can be driven to the perimeter and in turn rise up the walls, causing significantly increased concentrations of dampness.

  Rising damp can be restricted by installing a damp proof course within the wall but it must be continuous so that damp is not concentrated in any gaps. Physical DPCs are difficult to insert and can be damaging to fabric. Injected DPCs tend to have a short service live and in most cases are ineffective.

  It is worth remembering that most traditional buildings were deliberately constructed to be healthy and durable. If there is a problem with damp it is very often a result of the situation of the building having changed through time – for example as result of raised ground levels, subsequent construction of an adjacent building or road surface, or revised patterns of land drainage. Restoring the building's original circumstances as well as possible will often contain the moisture at source.

  The provision of local moisture barriers around built-in timbers or against otherwise vulnerable components is also commonplace in repairs to traditional buildings. These are often added as a way of 'playing safe' in case the moisture diffusion within traditional materials is ineffective. The reason these rarely cause problems is because they are small components within a much larger mass of permeable material. Their effect on moisture flows is therefore minimal, and it is thus important not to over-specify in such situations.

Thermal bridging

If the thermal performance of one element is improved by adding insulation while an adjacent area is not insulated, a local cold spot – known as a thermal or cold bridge – is created. For example, it may be possible to place insulation over a ceiling but not at the head of the adjacent wall at the eaves, which will remain cold. Elsewhere, a wall may be internally lined but not the window reveal – so here the exposed edge of the newly insulated wall actually becomes colder, and at greater risk of condensation.

Cold bridging becomes more severe when the insulation value of the main body of a construction element is high. This means that adding more and more insulation, although apparently desirable, can increase the risk of localised damp and construction failures in less-insulated components which bridge this layer. The same effect applies wherever the insulation thickness is reduced, such as at window and door reveals, and comparable construction details. If such weak spots cannot be successfully detailed, then added insulation may have to be reduced or omitted, or the amount of heating and ventilation may need to be increased to help avoid mould growth or condensation.

Material compatibility

Paragraph 3.9 in the Approved Documents also includes a requirement that work should not:

"……….increase the risk of long-term deterioration to the building fabric or fittings"

In addition, Approved Document 7 'Material and Workmanship' covering Regulation 7 of the Building Regulations states:

"Building work shall be carried out … with adequate and proper materials which … are appropriate for the circumstances in which they are used".

All changes to upgrade the energy efficiency of historic buildings need to be technically compatible with the existing building fabric. It is a fundamental objective of the Building Regulations to ensure that technical risks are not introduced. It is also accepted best practice to use materials that match the original fabric as closely as possible. This will guarantee visual harmony, both in the short term and as the building weathers over time, but it also ensures that no detrimental technical problems are introduced into the permeable fabric.

Many historic buildings include soft, weak or permeable materials; for example, mortars, plasters and renders. These cause the fabric to respond in different ways to air, moisture and structural movement from the hard, strong, impervious materials and membranes widely used in modern construction. Before any work is carried out, it is important to understand a building's form of construction and how this might have changed over time – and that alterations are compatible.

To use modern substitutes and to introduce impermeable materials or membranes into permeable traditional construction is usually not good practice and can lead to problems. Obvious examples include the use of cement-based mixes for plasters, renders and pointing where, for example, incompatibilities in flexural strength, permeability and porosity can lead to salt migration and damage.

Many manufacturers now quote permeability figures in their literature, and this is to be encouraged. However, there is a shortage of corresponding data for traditional materials already in buildings. This is because it is difficult to test materials outside a laboratory, and there has generally been no economic reason to do so. For the moment simple human judgement and experience remain the principal tools for assessing the matter. For this reason caution is recommended. It is probably better to err on the side of extra permeability.

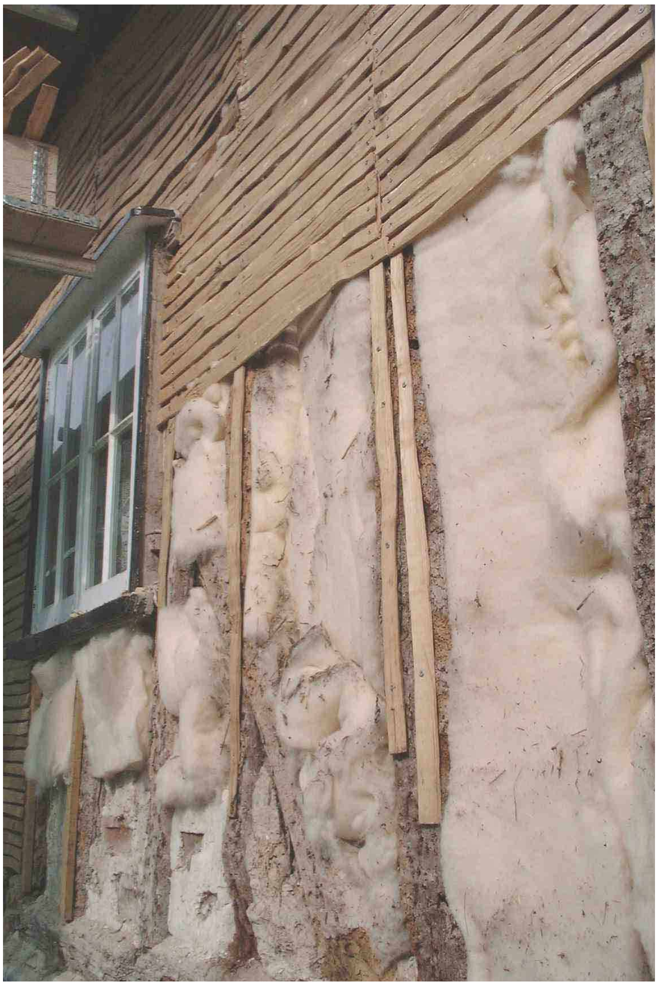
As a general rule it is also preferable to increase permeability progressively from the interior of a traditional building to its exterior. This may seem counter-intuitive, but for a traditional building in good order, in the English climate, the water vapour generated internally has more difficulty evaporating from the fabric than rain falling on the external surfaces. It is only in areas of exceptionally high exposure, and often only on the sides of buildings facing severe prevailing weather, that this rule will not normally apply. Damp problems caused by external moisture are most usually a result of poor maintenance, such as damaged or blocked gutters and drainpipes, missing flashings or raised external ground levels.

Insulation materials based on natural fibres can be very effective when adding insulation to traditional buildings. Typical among these are wool, hemp, flax and recycled newspaper (cellulose). These materials not only allow transpiration of moisture through their air spaces, but the fibres themselves are able to absorb and then release moisture by evaporation. Synthetic insulation materials do not have these attributes.

These natural insulation materials allow moisture vapour to balance itself across the insulation layer, allowing any condensation to evaporate away. However, they can take up and disperse moisture from vulnerable materials in which they are in contact, such as when installed between timber frame components. This means that a given amount of water condensing in a space is no longer forced into the timber alone, but is dispersed through both the timber and the insulation, allowing local relative humidity levels to remain low, and easing the evaporation when conditions change.

Buildings of modern construction

After the First World War, construction methods gradually changed. The cavity wall started to replace solid walls particularly for domestic properties and cement-based mortars superseded lime mortars. Concrete often replaced timber for elements such as lintels and floors. This form of construction relies on keeping moisture out by the use of damp proof membranes and wall cavities.



Top:
Materials used in the thermal upgrade of historic buildings need to be technically compatible with the existing building fabric.

Bottom:
After the First World War construction methods began to change from permeable construction to a form of construction that relied on keeping moisture out.

4 Implementing Measures

The previous section has focused on the need to understand both the significance of the building and the way the building fabric behaves and its condition before undertaking thermal upgrading works. This section describes the 'whole building approach' and looks at the process of energy planning that underpins it.

4.1 What is a 'whole building approach'?

A true 'whole building approach' is one that seeks to save energy, sustain heritage significance, and maintain a healthy indoor environment through understanding the building in its context. Most of all, it deals with specific situations as opposed to generalities. Opportunities and constraints can vary widely depending on context, and the optimum solution in one case might be quite different in another, even if buildings appear similar. Therefore, a site-specific approach in needed - one that considers the interrelationship between building fabric, engineering services, and people. A whole building approach also takes into account the significance of the building, along with wider environmental, cultural, community and economic issues, including energy supply.

The whole building approach ensures improvements are suitable, proportionate, timely, well integrated, properly coordinated, effective and sustainable. It also helps to highlight and resolve uncertainties, reconcile conflicting aims, and manage the risks of unintended consequences.

4.2 Planning energy efficiency measures

The whole building approach depends on a logical and systematic process in which an informed understanding develops by continually questioning what is required and why, and whether it is achievable.

The key stages in this process are:

- Assessment - understanding the context
- Setting objectives and planning improvements
- Detailed design and specification
- Installation
- Use and evaluation
- Maintenance

4.3 'Whole building approach' in practice

This section looks in more detail at the issues that need to be considered at each stage of the process.

In principle, managing a programme of energy efficiency improvements is no different to managing any other kind of building project. Success depends on several key factors: the availability of adequate financial and human resources (knowledge, skills and experience); a realistic timescale for carrying out the project; the commitment, enthusiasm and open-mindedness of the client and project team.

A whole building approach should always be proportionate in scope to the significance and sensitivity of the building in question, and the complexity of the envisaged proposals. Often, the range of knowledge and skills required will not be available from a single source. Individual specialists might be needed to perform the tasks of assessment, design and installation. This is especially true with larger, more complicated projects. For example, it may be necessary to obtain professional advice if a building is listed or in a conservation area. For obvious reasons, assessments or inspections carried out free of charge by companies with a product or treatment to sell should be treated with caution.

Good communication between all members of the project team (assessor; designer; supplier/installers) and client is important throughout the process and will help ensure the project is adequately coordinated. Decisions and actions taken at every stage of the process have a bearing on the quality of the works eventually carried out.

Stage 1: Assessment
Understanding the building and its context

A good assessment will consider the context and current situation of the building and then identify potential opportunities for improvements, and constraints. This is done by gathering information about the building and the behaviours and needs of its occupants, as well as current modes and levels of energy consumption, and factors affecting the feasibility of improvements.

- Character and significance of the building
- Local climate, orientation and exposure
- Energy performance of the building envelope
- Hygrothermal behaviour of building fabric
- The condition of the building
- Energy performance of building services
- Levels of energy use related to occupancy and human behaviour

Assessments can range from a simple 'walk-through' to a highly detailed analysis that might include computer simulations. The scope and depth of investigation and documentation should be proportionate to the size and sensitivity of the building and the scale and complexity of the envisaged improvements. Although householders can carry out useful do-it-yourself appraisals, suitably qualified, experienced and independent practitioners will provide more thorough assessments.

A comprehensive assessment allows informed decisions to be made about energy-saving strategies that protect heritage values and occupant health. It also provides baseline data against which the impact, effectiveness and cost-efficiency of improvements can be measured. Furthermore, it lowers risk of unintended consequences from measures that might, for example, cause the building envelope to deteriorate by trapping moisture, or harm the health of the occupants by lowering indoor air quality.

Stage 2: Setting objectives and planning improvements

After all necessary information has been gathered in the assessment stage, the next stage is to devise a preliminary energy plan. This will set out both short and long term objectives for the project and identify the measures likely to be appropriate and practicable in the specific context. It will also help to ensure that measures are properly integrated and technically compatible.

User requirements, aspirations and aims

People may have different reasons for wanting an energy retrofit for their building. For some, the aim will be to save money on fuel bills. Others might want to reduce greenhouse gas emissions or make a building more comfortable.

Opportunities, constraints, and resources

Opportunities and constraints vary widely depending on context. For example, when a building is being repaired, altered or extended, the installation of fabric improvements, such as internal wall insulation, will be relatively easy and economical. But in an occupied building, the level of disruption and relative costs may be unacceptably high.

Identifying areas for improvement

A whole building energy plan should cover building use, engineering services and equipment, building fabric, and energy supply. These four areas offer opportunities for saving energy and reducing greenhouse gas emissions:

- Building use and occupation
  Changing behaviour; adjusting the way the building, engineering services and equipment are used and managed to minimise energy demands and avoid waste.

- Engineering services and equipment
  Increasing efficiency of building services and equipment and improving controls to reduce the amount of energy used.

- Building fabric
  Improving the thermal performance of the building envelope.

- Energy supply
  Changing fuels or using renewable systems to reduce carbon emissions.

Quick wins

Opportunities for simple cost-effective improvements should be identified at the outset. Changes in behaviour, remedying poorly adjusted, faulty or inappropriate controls and badly maintained or malfunctioning systems and equipment can all have a positive effect. So can straightforward low-cost fabric-related measures, such as repairing or reinstating window shutters and awnings, draught-proofing and installing loft insulation.

Appraising the options

Measures should be appraised to evaluate their efficiency, cost-effectiveness and suitability. Their impact on the character and significance of the building should also be assessed, along with technical risks and the likelihood they pose of unintended consequences.

Determining priorities

Work may be carried out in stages to enable specific measures to be incorporated in future planned maintenance or improvements or to spread costs. Where works are phased, it is important to consider the interactions between the measures at every stage and ensure they are properly integrated (for example, providing for adequate ventilation when draught seals are installed).

Stage 3: Detailed design and specification

In this stage the preliminary energy plan is developed in detail. Depending on the size and complexity of the project, detailed design drawings and the specifications will be required to enable the necessary consents to be obtained and the works procured. Documentation should be detailed, clear and unambiguous. For example, where insulation is to be added to roofs, walls or floors, details showing how the junctions between each of the elements are to be formed will be needed to avoid solutions having to be improvised on site. Specifications should be explicit about products and material to ensure that lower quality alternatives are not substituted.

Consents for energy improvements

Applications to the local planning authority for planning permission and/or listed building consent may be required for certain energy efficiency measures.

However as Section 2 has outlined, listed buildings and buildings in conservation areas are exempted from the need to comply with the energy efficiency requirements of Part L of the Building Regulations where compliance would unacceptably alter their character or appearance. In addition, 'special considerations' apply to buildings that are locally listed, in national parks or other designated historic areas. Special considerations also apply to buildings of traditional construction. Early consultation with the building control body (either the local authority inspector or an approved inspector) can help to ensure that performance of the building is not adversely affected through compliance with the energy efficiency requirements.

Top:
Insulating at rafter level may be necessary if the habitable room is within the roof space.

Bottom:
Insulating a ceiling level will usually be the simplest and cheapest form of roof insulation.

Stage 4: Installation

Installers should have sufficient training, expertise and interest in the whole building approach. An experienced installer will be able to contribute valuable specialist practical knowledge to a project. Therefore, maintaining good communications between installer, and the designer, assessor and client is a key factor in ensuring the outcome of the project is successful. Also, it is important that the project is priced on the basis of a whole building approach and allows for adequate levels of supervision, checks, testing and feedback as the work proceeds.

Before starting installation works, make sure that all necessary permissions have been obtained and any conditions complied with. If something unexpected is found as the work proceeds or a design detail does not work, this should be reported back to the assessor and designer so that suitable modifications can be made. Good levels of site supervision will help to ensure that works are carried out to the required standards. On larger or more complex projects, a clerk of works should be appointed to monitor the quality and progress of the works on the client's behalf. Where fabric improvements have been carried out, the quality of completed work should be checked using thermal imaging and air pressurisation tests.

Stage 5: Use, review and maintenance

Handover should be managed in a way that ensures that building engineering services are properly commissioned, and that building users/ managers understand what has been done, how it is intended to work, and what they need to do to maintain it. Advice should also be given on the importance of ventilation in reducing the risks of condensation and maintaining good indoor air quality. Projects where user manuals, maintenance schedules, verbal briefings and follow up visits have been provided prove to be significantly more successful than those where little or no information was offered.

After handover, energy efficiency improvements should be checked and reviewed to make sure everything is working as planned. Energy bills can be used to compare levels of energy use before and after improvements. And where fabric improvements have been carried out, (e.g. added insulation to roof, walls and floors), inspections should be made annually to check for signs of condensation, mould or decay. In larger, more complicated projects a full Post Occupancy Evaluation (POE) may be carried out. Normally, a proportionate step-wise approach is preferable, with more advanced investigations being done only if needed. Findings should be used to adjust the energy plan, if necessary.

Information gathered in reviews, and the steps taken to remedy any problems, should be documented and made available to the building users and managers. They should also be passed on when a building changes hands. The energy strategy should be reviewed and adjusted whenever a building is altered, or if its use or occupancy changes.

Heat loss due to draughts can be dramatically reduced by basic repairs and draught-proofing using a broad range of products.

5 Glossary

The conservation officer
For listed buildings and those in conservation areas the local planning authority will need to be satisfied that the proposals for thermal upgrading are designed and implemented in such a way that the character and significance of the building is adequately respected in accordance with planning law.

At the outset of any project, the conservation officer will be able to give advice about the appropriate level of understanding and assessment which may be required, and whether specialist advice will be needed. To ensure that optimum upgrading can be achieved without causing 'unacceptable' damage, the conservation officer may also be able to give guidance on achieving an appropriate balance between protecting the building's significance, and complying with the energy efficiency requirements of the regulations.

Historic buildings
For the purposes of the interpretation of the energy efficiency requirements of the Building Regulations, Approved Documents L1B and L2B, and this series of documents, 'historic buildings' are defined as those which meet at least one of the following criteria:

- Listed in accordance with section 1 of the Planning (Listed Buildings and Conservation Areas) Act 1990 at Grades I, II* or II
- In a conservation area designated in accordance with section 69 of that Act
- Included in the schedule of monuments maintained under section 1 of the Ancient Monuments and Archaeological Areas Act 1979
- Buildings which are of architectural and historical interest and which are referred to as a material consideration in a local authority's development plan or local development framework
- Buildings which are of architectural and historical interest within national parks, areas of outstanding natural beauty, registered historic parks and gardens, registered battlefields, the curtilages of scheduled ancient monuments, and world heritage sites

All these categories of historic buildings are recognised and designated as such in order to protect either their own inherent significance or their contribution to the wider significance of a place. It is this significance and its expression in the physical fabric of these buildings which the specific legal designation is intended to protect.

While the vast majority of historic buildings within the UK are also of traditional construction, certain buildings, particularly from the 20th century, are designated as historic because of their significance even though they are built using modern methods without permeable materials. Such buildings are therefore 'historic' but not 'traditional'.

Traditional buildings

For the purposes of the interpretation of the energy efficiency requirements of the Regulations, Approved Documents L1B and L2B, and this series of documents, 'traditional buildings' are defined in Paragraph 3.8 of both Approved Documents L1B and L2B as "buildings of traditional construction with permeable fabric that both absorbs and readily allows the evaporation of moisture".

This quality is often colloquially referred to as 'breathability'. For simplicity these may also be referred to as 'traditional buildings'.

U-values

U-values describe the thermal transmittance of materials. This is measured by how much heat will pass through one square metre of a structure when the air temperatures on either side differ by one degree. U values are expressed in units of Watts per square metre per degree of temperature difference (W/m^2 deg K).

6 Where to Get Advice

6.1 Historic England guidance

Energy Efficiency and Historic Buildings series

This series of guidance provides good practice advice on adaptation to reduce energy use and the application and likely impact of carbon legislation on older buildings The latest versions can be downloaded from: HistoricEngland.org.uk/energyefficiency

This series of thirteen guidance documents provides advice on the principles, risks, materials and methods for improving the energy efficiency of roofs, walls, and floors, and includes the following topics.

- Roofs
  Insulating roofs at rafter level
  Insulating at ceiling level
  Insulating flat roofs
  Insulating thatched roofs
  Open fires chimneys and flues

- Windows and doors
  Insulating dormer windows
  Draught-proofing windows and doors
  Secondary glazing for windows

- Walls
  Insulating timber-framed walls
  Insulating solid walls
  Insulating early cavity walls

- Floors
  Insulating suspended timber floors
  Insulating solid ground floors

This guidance note provides detail on the type of information included in an EPC, how it is calculated and its limitations as an assessment method when applied to older buildings. The guidance also covers the issues to be taken into account when commissioning an EPC and considering its recommendations.
Energy Performance Certificates

Other Historic England guidance

Conservation Principles, Policies and Guidance for the Sustainable Management of the Historic Environment. (2008)

Practical Building Conservation series
This series of fully illustrated books published by Routledge provide detailed guidance on understanding, deterioration, assessment and care and repair. More information is available on HistoricEngland.org.uk/PBC.

Basics (2013)
Building Environment (2014)
Concrete (2013)
Earth, Brick & Terracotta (2015)
Glass & Glazing (2012)
Metals (2012)
Mortars, Renders & Plasters (2012)
Roofing (2013)
Stone (2012)
Timber (2012)

Historic Environment Good Practice Advice in Planning: 2 Managing Significance in Decision-Taking in the Historic Environment (2015)

Managing Changes to Heritage Assets, Historic England Advice Note 2 (2016)

Traditional windows, their care, repair and upgrading (2017)

6.2 Historic England conservation research

Research into the Thermal Performance of Traditional Windows: Timber Sash Windows (2009)

Research into the Thermal Performance of Traditional Brick Walls (2013)

Retrofit of a Victorian terrace house in New Bolsover: a whole house thermal performance assessment (2015)

Improving the thermal performance of traditional windows: metal framed windows (2017)

Thermal performance of energy efficiency improvements to timber windows (2017)

6.3 Other publications

CIBSE (2002), *Guide to Building Services in Historic Buildings*. London: Chartered Institution of Building Services Engineers (www.cibse.org/publications)

HM Government, Building Regulations 2000 (2010 editions with later amendments 2011/2012/2013/2016) Published 2016
Approved Document L1B: Conservation of Fuel and Power in Existing Dwellings
Approved Document L2B: Conservation of Fuel and Power in Existing Buildings other than Dwellings
(www.gov.uk/government/publications)

Historic Scotland (2012) *Fabric Improvements for Energy Efficiency in Traditional Buildings* (shop.historic-scotland.gov.uk)

Hughes, P (1986). *The Need for Old Buildings to 'Breathe'.* Information Sheet 4. London: Society for the Protection of Ancient Buildings (www.spab.org.uk)

Stirling, C (2002). *Thermal Insulation: Avoiding Risks* (3rd edition). London: Building Research Establishment (www.bre.co.uk/bookshop)

Sustainable Traditional Buildings Alliance (2012) *Responsible Retrofit of Traditional Buildings* (www.stbauk.org)

Sustainable Traditional Buildings Alliance (2015) *Planning Responsible Retrofit of Traditional Buildings* (www.stbauk.org)

6.4 Contact Historic England

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7 Acknowledgements

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