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Briefing Paper

Sustainable refurbishment of domestic buildings using BREEAM

A guide to BREEAM Domestic Refurbishment and how to incorporate sustainability through the refurbishment of existing homes.

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Summary

The purpose of this guide is to advise professionals on how to sustainably refurbish a domestic property. The guide covers the key aspects of the refurbishment process and outlines how sustainability issues can be considered through every step of the way. This includes issues to consider when planning the project, issues that may be specific to the site such as flood risk, as well as opportunities that should be considered for individual project types ranging from the extension of a property to re-roofing, installing new windows or electrical and water fittings.

This guide is arranged in such a way that the reader can choose to read only the sections that are relevant to them and the project that they are involved in. For example, a plumber may only want to refer to information about water and heating systems and may not need to know about electrical services. For each of these items, the guide highlights all of the sustainability opportunities that should be considered to maximise the sustainability opportunities in the project and that are covered by BREEAM Domestic Refurbishment.

It is intended that the guide will help professionals such as refurbishment project managers, BREEAM assessors, builders, architects, electricians, plumbers, joiners and others to identify how they can ensure that the aspects of a refurbishment relevant to them, are delivered in the most sustainable way. These could include the use of sustainable materials, avoidance and management of waste and energy efficiency measures. It also aims to identify how each individual aspect of a refurbishment project can impact upon each other to help all of those involved in a refurbishment project to work together in a more integrated and joined-up way.

The guide has been written to provide guidance on what is needed to achieve the sustainability standards set out in the BREEAM Domestic Refurbishment Scheme operated by BRE Global. Overall it aims to promote an integrated approach to refurbishment that delivers high quality, sustainable homes.

Background

Undertaking a refurbishment project on a domestic building can often be a daunting task. It is also an opportunity to significantly enhance the value of a home and improve the internal environment for an occupant.

The UK's housing stock is amongst the oldest in the world with 50% of the housing stock over 50 years old and much of it is in need of refurbishment in order to increase energy efficiency levels, enhance comfort and improve the health of occupants.

Low quality housing can create many problems for occupants including high utility bills and a wide variety of negative health impacts resulting from cold, damp and poorly ventilated homes. By refurbishing existing homes to a good standard of sustainable design, running costs will be lower, the internal environment more healthy and as a result it will be a more desirable place to live for the occupants, potentially increasing value.

When a property is being renovated, whether to bring it up to a modern liveable standard or to convert a large property into flats, it is a good time to consider what wider opportunities there are for improving the home and making it more economically, socially and environmentally sustainable.

It is not just the energy efficiency of the dwelling that can be improved during a refurbishment project. There are also opportunities for improving the water efficiency, minimising health impacts such as providing adequate ventilation and daylighting. It is also important to consider how the refurbishment process itself is managed, to ensure that the project runs effectively and with a low impact on neighbours and the wider environment.

An example of this would be a situation where a new kitchen is being installed. There are a number of opportunities to consider issues such as:

- Identifying and filling any gaps in walls behind the old kitchen units, around windows and doors to reduce heat loss.
- Providing new efficient and controllable ventilation.
- Sourcing new kitchen units from low impact and responsibly sourced materials including the use of FSC or PEFC certified timber.
- Specifying energy efficient white goods including dishwashers, washing machines and dryers where these are provided.
- Selecting water efficient taps, washing machines and dishwashers where provided.
- Using low impact paints and varnishes that minimise volatile organic compounds (VOCs) that are harmful to health.
- Providing space in the kitchen for the convenient storage of recyclable waste and composting.
- Where the property is in a flood risk zone, using kitchen units and construction materials that are more resilient and placing appliances, services and wiring above the flood level.

This Guide

The guide is intended to be used in the early stages when considering an assessment, during development of the specification and also as a reference as works are in progress. This guide has been prepared to provide an outline to the BREEAM Domestic Refurbishment method and its requirements aimed at the designer, the constructor and their client. It explains what needs to be considered in a typical domestic refurbishment project in terms of improving the sustainability of a refurbishment project, meeting BREEAM Domestic Refurbishment requirements plus also highlighting how to consider wider sustainability issues when undertaking a refurbishment.

Each section of this paper explains what needs to be considered for each aspect of the refurbishment process to meet best practice in BREEAM Domestic Refurbishment.

This guide provides essential information to those involved in domestic refurbishment projects undergoing a BREEAM Refurbishment assessment. This includes site trades such as general builders, plumbers, electricians, and plasterers as well as others involved in making decisions and influencing the project such as project managers, architects and surveyors. A high proportion of domestic refurbishment projects are small scale projects. One example of this is a shop being converted into a flat which was required to have a BREEAM Domestic Refurbishment assessment under a local authority's planning requirements. A project such as this may be managed by a single person who may not be familiar with BREEAM Domestic Refurbishment and what it entails.

BREEAM Domestic Refurbishment

BREEAM Domestic Refurbishment is an environmental certification scheme that is used to assess the sustainability of a refurbishment project and covers 33 issues within the following categories:

- Management
- Health and Wellbeing
- Energy
- Water
- Materials
- Waste
- Pollution
- Innovation

For more information about how to use BREEAM Domestic Refurbishment and how to get an assessment click here

Topics

This guide is structured in a way that people from different building professions can go straight to the section most relevant to them. The early sections look at the wider local area and the broad range of issues that need to be considered. These are then followed by more detailed sections that look at specific individual items within the dwelling in more detail.

This table provides an overview of the topics covered in this guide allowing you to go straight to the aspects that are most relevant to you by using the links below.

Planning for a refurbishment

To ensure a refurbishment project is successful an overall plan needs to be produced. This ensures that all of the aspects of the refurbishment are considered at the earliest opportunity making sure the refurbishment project will run smoothly. This includes considerations of project timescales, responsibilities, overall objectives and also ensuring that the refurbishment specification is planned and executed in the most effective way.

Project Planning

A refurbishment project is likely to be more successful where there are clear lines of responsibility and effective communication to ensure that the client's requirements are fulfilled in accordance with the specification across all trades and professions. There are a number of steps that can be taken to ensure the project's success, which are shown below. The level of complexity of these steps will vary with the complexity of the project but as principles they are always relevant and will assist in achieving the desired end results.

1. Appoint a project manager

Appointing a single individual as a project manager is an important step as they can take overall responsibility for the integrity of the project to make sure that all trades and other individuals involved in the project are fully aware of the project objectives and needs and of their individual and shared roles and responsibilities. The Project manager also needs to ensure that there is frequent and consistent communication across the project team.

2. Ensure the project runs on time and to budget

Running a project on time and on budget is important in many ways. It avoids 'fire fighting' decisions which run the risk of unforeseen negative impacts. It has the added benefit of giving the person delivering the project a good reputation and improving chances of repeat business.

It is also a good idea to assign tasks to individuals with a timescale of when they need to be completed. This will make sure the project is run on time and budget and ensuring the completed project meets the client's expectations.

Producing a timeframe for the project can help to ensure that the project gets completed on time and ensures that each person knows what they are doing and when they are doing it.

Keeping track of the budget of the project is also important to ensure that there is no overspend or need for last minute cost cutting.

3. Write a project implementation plan

One way of facilitating good project management is writing an implementation plan for the project. An implementation plan is a list of tasks that need to be carried out as part of the refurbishment process and when they need to be completed.

4. Hold an initiation meeting

An initiation meeting is also very useful as this can allow the project manager to introduce all of the members of the project team and to agree the contents of the implementation plan, to give team members responsibilities and identify when team members may need to work together or co-ordinate activities to ensure there are no conflicts.

5. Record keeping

As part of the BREEAM assessment process evidence such as manufacturer's literature and photographs need to be collected at the most appropriate time and submitted to the BREEAM Assessor. Whilst this evidence will come from a variety of sources and trades on a typical project, having someone in sole charge of gathering evidence makes sure there is less chance of evidence getting mislaid and that the correct evidence is collected. An obvious example would be the need to keeping copies of invoices and delivery notes but a less frequently followed one would be the collection of appropriate manufacturer's information. This can also help overall project management to keep a track of what is being done and for future reference.

6. Meeting legal obligations

Determining Building Status i.e. listed buildings and buildings in conservation areas

Approximately 440,000 buildings in the UK are 'Listed' in addition to 10,000 conservation areas containing many individual buildings. Listed buildings and conservation area status are there to protect the appearance of buildings and their surroundings and to maintain architectural, economic and social heritage. A building that is listed on the Statutory List of Buildings of Special Architectural or Historical Interest and/or is located in a conservation area is likely to have restrictions on what works can be done and how this can be carried out. For example, where a building is located in a conservation area, installation of solar panels (Photovoltaic or solar thermal) may not be allowed at all or may be restricted to certain parts of the roof which may have an impact on their functionality.

There are different grades of listed building which is based on the importance of the building in terms of the heritage. The higher the grade the more restrictions there will be on what works can be done.

In England and Wales, these grades are as follows:

- Grade I: buildings of exceptional interest.
- Grade II*: particularly important buildings of more than special interest.
- Grade II: buildings that are of special interest, warranting every effort to preserve them.

There was formerly a non-statutory Grade III, which was abolished in 1970. Additionally, Grades A, B and C were used mainly for Anglican churches in use – these correspond approximately to Grades I, II* and II. These grades were used mainly before 1977, although a few buildings are still listed using these grades.

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In Northern Ireland, these grades are as follows:

- Grade A: buildings of greatest importance including both outstanding architectural set-pieces and the least altered examples of each representative style, period and type.
- Grade B+:
  - Buildings which might have merited grade A status but for detracting features such as an incomplete design, lower quality additions or alterations.
  - Also included are buildings that because of exceptional features, interiors or environmental qualities are clearly above the general standard set by grade B buildings.
  - A building may merit listing as grade B+ where its historic importance is greater than a similar building listed as grade B.
- Grade B: "buildings of local importance and good examples of a particular period or style. A degree of alteration or imperfection of design may be acceptable.

In Scotland, these grades are as follows:

- Category A: buildings of national or international importance, either architectural or historic, or fine little-altered examples of some particular period, style or building type.
- Category B: buildings of regional or more than local importance, or major examples of some particular period, style or building type which may have been altered.
- Category C(S): buildings of local importance, lesser examples of any period, style, or building type, as originally constructed or moderately altered; and simple traditional buildings which group well with others in categories A and B.

It is vital to the success of a refurbishment project to determine at the earliest stage whether or not the building is in a conservation area or is listed and of which grade. This can be done by contacting the Local Planning Authority. Planning consent will not be given where these issues are not fully addressed in the application.

Building control notification

To make sure that the refurbishment work meets health, safety, energy efficiency and accessibility standards all work needs to be notified to and approved by Local Authority Building Control. Failure to do so may result in prosecution and fines of up to £5,000[1].

Before carrying out work, you need to determine whether or not building regulations apply to the building work being carried out. Generally speaking the following types of work will require building relations to be met.

- An extension or alteration to an existing building.
- The installation of services or fittings.

There are three routes to making sure building regulations are complied with which are described below.

Applying for approval though your local council

Before starting a project you need to apply for building regulations approval.

You can contact your local council's Building Control department to check whether approval is needed and apply if applicable by visiting this website: https://www.gov.uk/apply-building-regulation-approval-from-council and following instructions.

Applying for approval though a private approved inspector (England and Wales only)

If the dwelling is located in either England or Wales you may choose to use a private approved inspector instead of your local council. A list of approved inspectors is listed in a directory held by the Construction Industry Council and is available to view here: http://www.cic.org.uk/services/register.php

Appointing a Competent Person to carry out the work

A competent person is a building professional who is registered with a UK Government approved scheme which allows them to self-certify that their work complies with building regulations.

The type of work that can be carried out by a competent person is as follows:

- Installation of cavity wall insulation
- Installation of gas appliances
- Installation or replacement of hot water and heating systems connected to gas appliances
- Installation or replacement of oil-fired boilers, tanks and associated hot water and heating systems
- Installation or replacement of solid fuel burners and associated hot water and heating systems
- Installation of fixed air conditioning or mechanical ventilation systems
- Any electrical work in dwellings
- Electrical work only in association with other work (e.g. kitchen installations, boiler installations)
- Replacement windows, doors, roof windows, or roof lights in dwellings
- Installation of plumbing and water supply systems and bathrooms and sanitary ware
- Replacement of roof coverings on pitched and flat roofs (not including solar panels)
- Installation of microgeneration or renewable technologies

To find a competent person you can use the search function in the following website: http://www.competentperson.co.uk/

1 http://www.competentperson.co.uk/pdfs/buildingworkleaflet.pdf

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7. Getting the right professionals involved

There are certain aspects of a refurbishment project that would benefit from expert advice from relevant professionals.

Table 1 shows the professionals that may need to be considered, and how they fit into a domestic refurbishment project. Not all of the professionals listed below are required for all projects, but the more professionals that are appointed; the better the refurbishment project will be in terms of quality. A Domestic Energy Assessor or SAP assessor is required for all BREEAM Domestic Refurbishment Projects and a flood resilience expert may be required for exemplary projects.

Table 1 Professionals Required for a Refurbishment Project

Professional required	Why
Domestic Energy Assessor or SAP assessor	To provide the energy efficiency rating of the dwelling both before and after the refurbishment of the dwelling, showing how much the dwelling has improved.
Flood resilience expert	To provide specialist advice on how to minimise the amount damage flooding will cause to the dwelling.
Considerate constructors scheme auditor	To visit the refurbishment project when it is in progress to check people working on site are being considerate to the workforce, environment and the local community.
A crime prevention design advisor or police architectural liaison officer	To give advice on which doors and windows would be best to install in terms of security, making occupants feel more safe and secure.
Suitably qualified acoustician	To make sure only a reasonable amount of noise can travel to adjoining properties.
Accessibility expert	To make sure the dwelling can be accessed and used taking into account the changing needs of the occupants, for example old age and disability.
Microgeneration installer	To ensure that any renewable or low carbon technologies that are being installed are certified to the right standard.
Hydrologist	To give advice on the best solution to reduce surface water runoff from the dwelling and the external area.
Suitably qualified ecologist	To provide site specific advice on adding plants to the site
BREEAM Accredited Professional (AP)	To give advice on the best and most cost effective way to meet BREEAM Requirements
Professional to carry out a thermographic survey	To check the amount of heat loss through the dwelling fabric before and after refurbishment
Professional to carry out air-tightness testing	To check the amount air escaping through gaps in the dwelling fabric before and after refurbishment

BREEAM Accredited Professional (AP)

In BREEAM Domestic Refurbishment, one exemplary credit is given where 'Early Design Input' is gained from an expert in BREEAM Domestic Refurbishment. This can be achieved by appointing a BREEAM Accredited Professional (AP) or BREEAM Domestic Refurbishment Assessor for a small scale project at an early stage of the project. The design team will also benefit from this advice on how to comply with the requirements of BREEAM as well as being provided general advice on delivering the project to a higher standard of sustainability.

BREEAM requires the BREEAM AP or Domestic Refurbishment Assessor to be appointed no later than RIBA Stage 2 which is Concept Design if credits are to be awarded so that they can influence the design at the key decision stages.

What are RIBA Stages?

The Royal Institute of British Architects (RIBA) have a set of guidelines for project management called the "RIBA Plan of Work" which organises the process of briefing, designing, constructing, maintaining, operating and using building projects into a number of key stages[2]. There are 8 key stages of work labelled 0 through to 7.

What is a BREEAM Accredited Professional (AP)?

A BREEAM AP provides the design team with expert advice on how to undertake a sustainable domestic refurbishment. They facilitate the team's efforts to successfully schedule activities, set priorities and negotiate the trade-offs required to achieve a target BREEAM rating when the design is formally assessed.[3] In BREEAM a trade-off is a when easier and cheaper BREEAM requirements are targeted to gain credits as opposed to more expensive and difficult ones.

Thermographic and Airtightness Surveys

Before starting work on site it is also useful to conduct thermographic and airtightness surveys. More information on how to conduct these surveys and why you might want to consider this is covered in the Building Fabric section of this guide and available to view here .

2 http://www.architecture.com/Files/RIBAProfessionalServices/Practice/RIBAPlanofWork2013Overview.pdf

3 http://www.breeam.org/page.jsp?id=361

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Construction Site Management

Setting targets for Refurbishment Waste

In any domestic refurbishment project there will be waste created, for example old bathroom fixtures or material from a knocked-down wall, which will need to be taken away from the site. With space in landfill site space filling up and with all waste subject to being taxed up to £64 per tonne[4], it will be beneficial to both reduce the amount of waste from the refurbishment project as well as diverting as much waste as possible from landfill.

One consideration to take into account is the appointment of a waste contractor who will be able to help monitor the waste and give options for the reduction in waste to landfill. It is also good to work with contractors on site to set targets and actions for reducing waste which can also help to improve efficient use of resources on site.

The most beneficial thing to do in terms of cost and environmental impact is to prevent the amount of waste being produced in the first place. The least beneficial thing to do is to dispose of the waste to landfill or incineration. Table 2 shows the order in which questions should be asked to see the best option available to reduce waste

Table 2 The Waste Hierarchy

Question to ask	Description
1. Can the amount of waste be reduced?	Using less material in design and manufacture. Keeping products for longer; re-use. Using less hazardous materials
2. Can the waste created be re-used?	Checking, cleaning, repairing, refurbishing, whole items or spare parts
3. Can the waste created be recycled?	Turning waste into a new substance or product. Includes composting if it meets quality protocols
4. Can the waste created be recovered in any other way?	Includes anaerobic digestion, incineration with energy recovery, gasification and pyrolysis which produce energy (fuels, heat and power) and materials from waste; some backfilling
Disposal	Landfill and incineration without energy recovery

At the planning stage of the refurbishment it is a good idea to explore ways to reduce the amount of waste that will be produced and to find ways to either recycle or reuse the waste that cannot be avoided.

How to deal with waste

Separate skips

If there is enough accessible space available near the refurbishment site, a number of skips can be placed, one for each type of material for example, wood, metal and aggregate.

With this scenario the skips need to be clearly labelled and all people working on site will need to be educated about why it is important to separate the waste.

One Skip

If there is not enough space for many skips for different types of waste, one skip can be used and the waste contractor can separate the waste offsite instead. If this is the case it is important to ensure the waste contractor will do this and can report back to you on how the waste was dealt such as through a waste transfer note.

Related BREEAM Domestic Refurbishment Credit Was 02: Refurbishment Site Waste Management

BREEAM rewards projects that reduces the amount of waste produced and has a high amount of waste that is not sent to a landfill site.

Different criteria apply according to how much the project is worth, in terms of cost of materials and labour excluding VAT.

For more information please see Was 02 of the Technical Manual

4 http://customs.hmrc.gov.uk/channelsPortalWebApp/downloadFile?contentID=HMCE_CL_000509

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Considerate Construction Practices

Any building and refurbishing activity carried out on a site, if not managed well, can have a negative impact on the wider community as well as providing an unsafe environment for the workers on site and a poor reflection on the company carrying out the works. An example of this is excessive noise at an unsociable time of the day which will disturb neighbouring residents.

Table 3 shows five categories to consider when considering how to operate the site in a more considerate manner. These are taken from the Considerate Constructors Scheme more information of which can be found here www.ccscheme.org.uk

Table 3 Considerate Constructors Scheme Categories

Category	Example of what to think about
Enhancing the **Appearance**	Whether the site is clean and tidy
Respecting the **Community**	The impact of deliveries and parking e.g. routes, timings, unloading, public diversions, utility works
Protecting the **Environment**	Efforts made to minimise the impact of vibration and of air, light and noise pollution
Securing everyone's **Safety**	Systems being in place that care for the safety of the public, visitors and workforce
Caring for the **Workforce**	Are adequate facilities provided to the workforce for example Changing, drying, toilets, showers, lockers, canteen

Construction Site Impacts

Excessive use of energy and water during a refurbishment project will not only have a negative impact on the environment, but could put up the cost of the project. If you are using excessive energy and water, this can also mean that you are not viewed as a responsible company.

One effective way of reducing energy and water use in the refurbishment project is to nominate someone to record energy and water use and display it to rest of the site, for example on a chart in the site office. This can be done by taking meter readings before and after such as at the beginning and the end of the day.

A water use and energy use target should be set with the aim of making sure the use is below that target once the refurbishment project has finished. However, whilst monitoring is useful, if this only indicates that you use lots of energy and water and no action is taken to reduce this consumption, this could be a waste of time. Therefore it is also important to consider how to reduce energy and water use on site and below provides a few tips:

Tips for Saving Energy and Water on the Refurbishment Site

Energy

- Switch off equipment from the socket on the wall when not being used
- If using generators, make sure they are not producing too much power
- Use energy efficient temporary lights
- If there is a site office
  - Keep windows closed when heating is on
  - User timers and thermostats for the heating
  - Do not leave things on when they are not being used.

Water

- Report and fix any leaks found
- Use trigger guns on hoses. These control the use of water at the point of use.
- Don't leave taps running.

Materials

Use of materials has a direct impact on project costs and the type of materials selected can have a wide range of impacts on the environment. If a contractor has an Environmental Materials Policy, it is good for the image of the company and could reduce costs.

The following can help save money and identify ways of using lower impact materials as well as helping to improve your reputation as a responsible company. When selecting materials, try to source materials whilst considering the following:

- Use of local materials (where possible)
- Use of responsibly sourced materials
- Re use of materials
- Use of materials with a high recycled content
- Waste minimisation and recycling
- Use of non-toxic materials & refrigerants with a high global warming potential
- Use of materials with a low embodied impact
- Use of durable materials

Environmental Management System

An Environmental Management System is a set of procedures a company follows to ensure it meets legal environmental standards and goes beyond the standards by reducing their impact on the environment.

Having an Environmental Management System in place will increase the reputation of your company, help reduce your impact on the environment and help save you money. It is also becoming more common place that clients will seek contractors that have an Environmental Management System in place.

An EMS can be developed following guidance in the WRAP publication 'Your Guide to Environmental Management Systems', which can be downloaded from www.wrap.org.uk/content/your-guide-environmental-management-systems-ems

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Responsible Sourcing
Another way of considering more sustainable materials is through responsible sourcing which is a label that some products carry to show that they have been ethically sourced. Under BREEAM more than 80% of the site timber used in the refurbishment must be responsibly sourced. Please see the Responsible Sourcing for more details.

Handover and Aftercare

Checking whether or not a project is successful in terms of meeting the objectives and the needs of the client can provide a powerful learning opportunity. This will help improve the delivery of future projects and also provide good customer care.

The success of the project can be measured either on a social level by liaising with occupants of the dwelling to ask for their views, or on a scientific level by performing thermographic and airtightness surveys of the dwelling. These are described below.

Ensuring success for the occupant

The following tasks can be done to ensure that the occupants of the refurbished dwelling know how to use the features effectively.

- Arranging a handover meeting to explain how to operate any new systems such as heating controls
- Performing a site inspection to identify any defects
- Conducting post occupancy interviews with building occupants or a survey
- Providing longer term after care, for example a helpline or visiting 6 months after occupancy
- Providing a home users guide to explain key features of the home at handover

More information about how to go about providing the above can be found in the Man 06 section of the BREEAM Manual which is available here

Recognition is given in BREEAM for conducting a formal handover meeting with the building owner, which can be the Property Management Company or the occupant. There are a number of things that should be considered when conducting a handover meeting:

- Provide a copy of the home users guide and explain the contents
- Present the key information about how the building operates
- Being there to answer any questions about the home
- Demonstrate newly installed equipment and provide an insight into their advantages e.g. potential cost savings
- Present information in a clear manner and explain any technical terms

What is a Home Users Guide?

BREEAM provides an example of a Home Users Guide which should explain the following information about the dwelling.

- Information about BREEAM Domestic Refurbishment
- Energy Efficiency
- Water Use
- Transport Facilities
- Materials and Waste
- Emergency Information
- Local Amenities
- Recommendations on further improvements that can be made

Exclusions can apply where, for example, the dwelling is occupied by a resident who already knows the local amenities

More information about the contents list is shown here

Aftercare

When undertaking comprehensive refurbishment, it is also a good idea to provide aftercare to occupants. Aftercare is important to make sure the occupants are happy with their refurbished dwelling, pick up on any problems they have had, and review the advice given in the handover meeting. For example, a dwelling may have been completed in the UK summer when instructions for using the heating were given. By winter time, the occupants may have forgotten how to use the heating; therefore a follow up session can be useful. It can also be a good opportunity to see how the home is operating, review energy bills with the occupants (if available) and provide energy saving advice to occupants.

BREEAM provides recognition where aftercare is provided and requires that two of the three items have to take place to gain recognition for the 'Aftercare' Section of this issue:

- A site inspection within 3 months of occupation.
- Conduct post occupancy interviews with building occupants or a survey via phone or posted information within 3 months of occupation.
- Longer term after care e.g. a helpline, nominated individual or other appropriate system to support building users for at least the first 12 months of occupation.

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Surveying the Local Area

Crime rate

If your refurbishment project is located in an area with a high crime rate, particularly burglary, you may want to consider increasing the security of the doors and windows. You may already be considering changing windows and doors therefore this may be a good time to consider how secure the windows and doors you are selecting are. Having secure windows and doors can also help with reducing insurance premiums.

You can find out the crime statistics of your area by visiting http://www.police.uk/ and entering the postcode of the project location. More information about what can be done to improve the security of the property can be found under Windows and Doors

Flood risk

According to the Environment Agency, one in six properties in the UK is at risk from flooding. When planning a refurbishment it is important to consider any flooding that may occur due to the location of the dwelling. If the dwelling is in an area liable to flooding, resistance and resilience measures can be installed to reduce the impact a flooding event would have on the dwelling that could otherwise cause thousands of pounds in damage to the property.

Table 4 shows the number of properties at risk from flooding in the UK.

Table 4 Properties at Risk from Flooding

Country	Proportion of properties at risk of flooding
England and Wales	1 in 6 properties[5]
Scotland	1 in 22 properties[6]
Northern Ireland	1 in 18 properties[7]

Flood risk assessments

The flood risk of a dwelling can be determined by conducting a Flood Risk Assessment (FRA). An FRA is based on information such as

- The distance and height the dwelling is away from rivers, lakes and the sea
- The frequency of flooding events in the past
- How effective the drainage is around the dwelling

The above information can be obtained from the Environment Agency, the local authority, water companies and from speaking to local residents.

The assessment will conclude by showing the probability that the area around the dwelling will be flooded. If the dwelling is in a medium or high risk area then it is a good idea to consider adapting the dwelling to cope with the potential aftermath of a flood event. The assessment should be carried out by a Suitably Qualified Building Professional.

What is a Suitably Qualified Building Professional?

An individual with the appropriate training and relevant experience to be able to implement a full flood resilience strategy for a building. This could be a building surveyor, architect or a specialist contractor who should confirm that they have the necessary knowledge and experience to complete the task.

Making a home more flood resilient

There are some considerations that can be made to reduce the impact of flooding to the dwelling.

The area at highest risk is the ground floor of the property, where flood waters are likely to cause damage. Alterations can be made to aspects of the ground floor to help minimise the amount of damage flood water will cause.

The Department of Communities and Local Government have produced a document entitled 'Improving the flood performance of new buildings'[8] which gives guidance on what measures can be done to reduce the amount of damage done to a dwelling in the event of a flood i.e. make it more resilient. Although this is primarily for new dwellings, many of the same principles apply. More information can be found in the Part 3 of the document which is available here

BRE, the University of Manchester and Manchester Metropolitan University have produced a booklet for home owners on how to protect your property from flooding. This can be found at the following link:

http://www.bre.co.uk/filelibrary/pdf/projects/flooding/Property_owners_booklet_v2_web_(2).pdf

More information about how to protect the dwelling from flooding can be found here

5 http://www.publications.parliament.uk/pa/cm201314/cmselect/cmenvfru/330/330.pdf

6 http://www.sepa.org.uk/flooding/flood_risk_management/idoc.ashx?docid=cbbf7c88-b41e-4ba0-bbaf-c51d676ca36a&version=-1

7 http://www.cnccni.gov.uk/eaw_presentation_d_porter.ppt

8 Department of Communities and Local Government (2007)

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External Areas

Inspecting the site for plants and animals

The area outside of a dwelling that is being refurbished may contain plants and habitats for animals which may be protected by UK law. If protected species are disturbed by activities during the refurbishment process the people responsible may be liable for prosecution. It is important therefore to make sure that these areas are checked for any signs of any birds and bats to make sure these are not going to be disturbed.

Within the property

Loft spaces and dwellings which have been unoccupied for longer periods of time can become home to bats and birds, which may require protection during works. External spaces that are also within scope of the project may also have plants and animals that could be disturbed or damaged.

What to do if there are bats or birds present in the dwelling

If you find bats and birds in the property you would need to contact the appropriate Statutory Nature Conservation Organisation (SNCO) shown in Table 5 according to the country the refurbishment is taking place.

Table 5 SNCOs of different Countries

Country	SNCO	Website
England	Natural England	www.naturalengland.org.uk
Scotland	Scottish Natural Heritage	www.snh.gov.uk
Wales	Countryside Council for Wales	www.ccw.gov.uk
Northern Ireland	Environmental Heritage Service	www.doeni.gov.uk/niea

Outside the property

If you are planning to do work to the outside of the property, or you are extending it, you will need to check for any trees, plants and hedges or signs of a place an animal lives that are likely to be disturbed by the refurbishment works such as damage to tree roots.

A site survey can be done by any member of the project team to determine if there are any plants or roosting animals present on the site that will likely to be harmed by the refurbishment works that will take place.

Ecological features to protect

Features that you should consider in the site survey include:

- Trees which meet one or more of the following requirements:
  - over 100mm trunk diameter,
  - over 10 years old
  - of significant ecological value
- Mature hedgerows over 1m tall and 0.5m wide
- Natural areas (e.g. Flower-rich meadow/grassland and heathland which includes habitat/plants that thrive on acidic soils, such as heather and gorse)
- Watercourses (rivers, streams and canals)
- Wetlands (ponds, lakes, marshland, fenland)
- Protected Species
- Local Priority UK BAP species
- Roosting and/or nesting opportunities in buildings for bats and birds

If any particular plants or animals are likely to be affected by the refurbishment works a suitably qualified ecologist can be appointed to provide advice or alternatively contact your local authority or the Wildlife Trust. He or she would conduct a survey to give recommendations on how to protect any of the given plants or animals on the site during the refurbishment work being carried out.

What is a Suitably Qualified Ecologist?

An individual that has all of the following:

- Holds a degree or equivalent qualification (e.g. N/SVQ level 5) in ecology or a related subject.
- Is a practising ecologist, with a minimum of three years relevant experience (within the last five years)*
- Is covered by a professional code of conduct and subject to peer review.
- Full member of one of the following
  - Association of Wildlife Trust Consultancies (AWTC)
  - Chartered Institution of Water and Environmental Management (CIWEM)
  - Institute of Ecology and Environmental Management (IEEM)
  - Institute of Environmental Management and Assessment (IEMA)
  - Landscape Institute (LI)

*Such experience must clearly demonstrate a practical understanding of factors affecting ecology in relation to construction and the built environment; including acting in an advisory capacity to provide recommendations for ecological protection, enhancement and mitigation measures. Examples of relevant experience are: ecological impact assessments; Phase 1 and 2 habitat surveys; and habitat restoration.

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Related BREEAM Domestic Refurbishment Credit Man 05: Protection and enhancement of ecological features

More information about protection of ecological features can be found in the Man 05 section of the BREEAM Domestic Refurbishment Technical Manual where one credit can be gained where ecological features are protected during refurbishment works in accordance with an ecologist's advice

Landscaping works and adding plants to the site

When undertaking refurbishment, you may also be undertaking landscaping works. Plants and other features can be added to the site to enhance the appearance of the site and to enhance the ecology of the site. To consider this properly, advice needs to be taken from a suitably qualified ecologist about exactly what to plant and where.

Adjoining properties

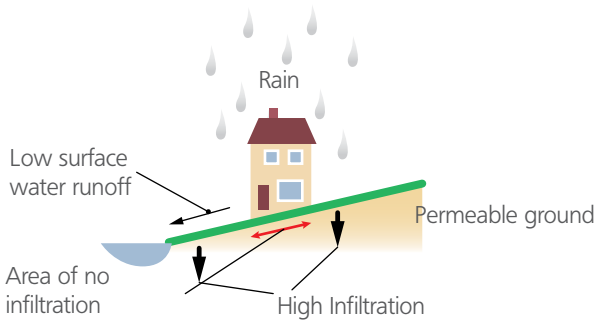
Noise from an occupied dwelling can travel to the properties within the same building envelope such as a block of flats very easily, particularly when the separating walls do not have acoustic insulation. Refurbishing a dwelling is a good opportunity to inspect and improve the sound insulation of the separating walls, floors and ceilings of the dwelling to ensure the impact of noise is reduced. More information about what can be done can be found here

Drainage

Ideally rainwater should infiltrate through the ground slowly to a nearby watercourse. Increasing the hard standing area by building an extension or patio for example will stop rainwater infiltrating through the ground. This then causes rainwater to flow quickly on the ground's surface causing potential for flash flooding and allowing pollutants to enter a watercourse.

Where the refurbishment does not increase the area of hard standing area (i.e. no new hard standing areas and the extension is not being constructed on an impermeable surface) there will be a neutral impact on surface water runoff. If you are doing any work that will result in an increase in hard standing area such as a patio or extension the following provides further guidance and figure 1 illustrates the principles of surface water runoff.

Dwelling without the Extension



Dwelling with the Extension

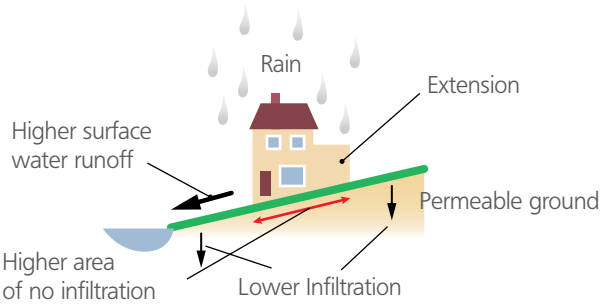


Figure 1 The impact of an extension on surface water runoff

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Figure 1 shows that the dwelling with the extension has higher surface area covering the ground, causing more surface runoff to occur, as a result of an increased roof area. The surface water runoff can be controlled by installing any number of measures. The most appropriate measure will depend on the design of each individual refurbishment project and also the geology of the land. Figures 2 and 3 illustrate some examples of what can be done to control the amount of surface water runoff.

A rainwater harvesting system diverts the rainwater into water tanks for use for internal use which can be used for the flushing of the toilets (WCs) or in washing machines. The rainwater harvesting tank can also be adapted with a tap or other means of drawing water for watering plants in the garden.

Another measure that can be installed is a soakaway. Figure 3 shows a highly permeable soakaway area is located at the upper end of the dwelling. This area is designed to hold the surface water for a period of time whilst it infiltrates through the ground instead running off to the watercourse, which can lead to flash flooding.

The most appropriate solution would need to be decided by a professional who is familiar with Sustainable Drainage Systems (SUDS) techniques. It is also important to consider these techniques to control surface water runoff at an early stage of the project to ensure the most appropriate and realistic technique is chosen and implemented.

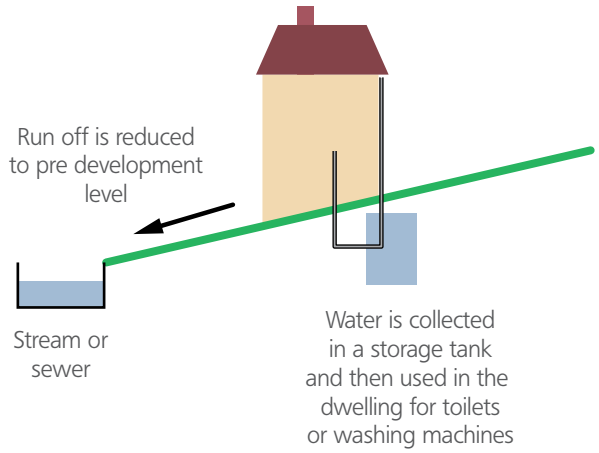

Figure 2 Rainwater Harvesting System

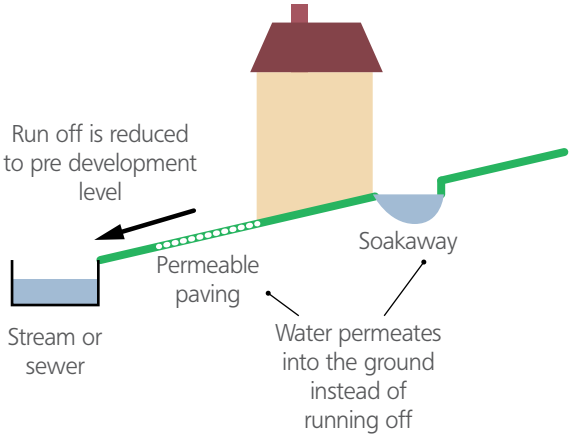

Figure 3 Example Soakaway

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Spatial Design

Daylight Levels

Good daylight has been shown to improve attitude, satisfaction and wellbeing of building occupants and in a recent RIBA study of homeowners[9], it was found that 20% viewed that poor daylighting was the main source of dissatisfaction with their home.

When considering daylighting, the first thing to consider is whether any works being undertaken will make the existing daylight levels any worse and if there is anything that can be done to minimise these impacts. An example of this is selecting windows that have a larger frame as this could reduce the levels of daylighting.

The other issue to consider is whether the minimum daylighting levels in a space can be provided such as increasing window areas.

Table 6 shows the requirements for daylighting under BREEAM Domestic Refurbishment.

Table 6 Daylighting Requirements

	Existing Spaces	New Spaces (e.g. extensions)
Maintaining Good Daylight Levels	Daylight levels in specified rooms* no worse than before the refurbishment	Daylight levels in new specified rooms* meet the minimum requirements Extensions do not significantly reduce daylight levels of specified rooms*
Minimum Daylighting Levels	Daylight levels in the specified rooms* meet the minimum requirements	

* Specified rooms are the following

- Kitchen
- Living Room
- Dining Room
- Study

Existing Spaces

How to assess whether a room has sufficient daylight
The amount of daylight a entering a room is measured by the daylight factor which is shown as a percentage. This is influenced by the following factors related to the design of the room.

The size of the window
A larger window will let more daylight into the room.

Whether the glazing is horizontal, sloping or vertical
It is assumed that vertical glazing will be easier to clean and so would gather less dirt than sloping or horizontal glazing. Vertical glazing will therefore let more daylight in.

The room surface area (ceiling, floor, walls and windows)
In a large room, there may be parts of the room far away from the window which will get a low amount of daylight. A small room with comparable window sizes will have a high amount of daylight.

The presence of outside obstructions
If there are obstructions such as other buildings close to a window, the amount of daylight entering will be reduced.

Consideration also needs to be made to neighbouring properties regarding the amount of daylight they receive. This is of particular importance if the refurbishment project includes an extension. More information about managing the impact of extensions on daylight can be found here

Examples of poor and good daylighting

Figures 4 and 5 show how the design of a room can affect the daylight level.

Figure 4 shows a room which has an obstruction close by and a small window. Both of these make the angle of visible sky small and therefore reduce the amount of daylight entering the room.

Figure 5 on the other hand has a larger window than that shown in figure 4 and the obstruction is further away. This increases the angle of visible sky and therefore increases the amount of daylight entering the room.

The angle of visible sky is how much sky can be seen between the top of the window to the top of the obstruction outside when up close to the window.

9 http://www.building.co.uk/the-daylight-factor/5053204.article

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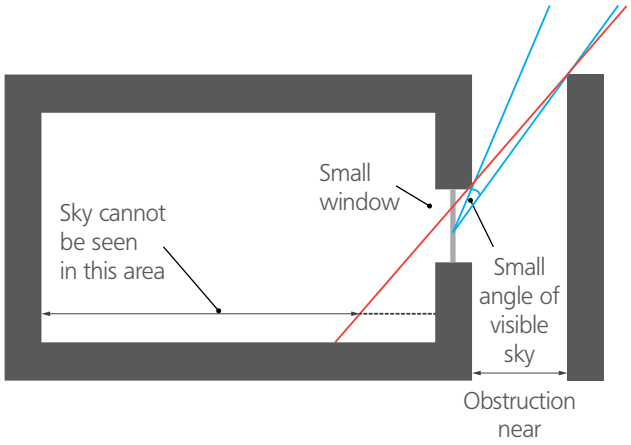

Figure 4 Poor Daylighting provision

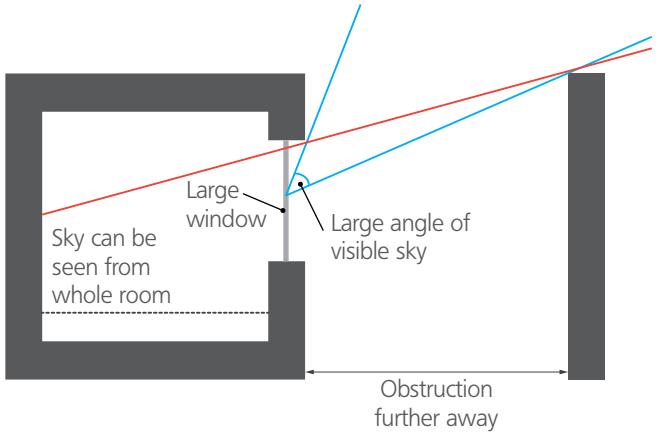

Figure 5 Reasonable Daylighting provision

Three more factors influence the daylight levels of the room which are as follows:

The colour of the wall

A light shade of colour on the walls, combined with the presence of a window, will increase the overall daylighting levels in the room. The colour of the wall is also referred to as the 'reflectance' which relates to the amount of light the surface reflects back into the room.

The type of glazing

Each type of glazing will allow a different amount of light to pass through the glass, which is referred to as the 'Transmission Factor', some examples of which are shown in the table below. The lower the transmission factor the lower the amount of light able to pass through the glass, therefore impacting on the daylighting levels.

Table 7 provides examples of transmission factors for different types of glazing.

Table 7 Transmission factors for glazing

Glazing Type	Transmission Factor
Single Glazing	0.9
Double Glazing	0.7
Double glazing with low-emissivity coating	0.6
Triple Glazing	0.6

Frame Factor

The frame factor is a percentage of the glazing area compared to the whole window. The higher the frame factor, more daylight can enter the dwelling.

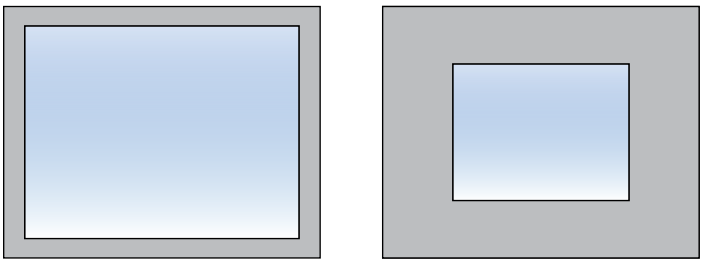

Figure 6 Example of low and high frame factors

New Spaces

When designing a new space, for example in an extension, it is important to consider the amount of daylighting to be provided. If a new space contains a Kitchen, Living Room, Dining Room or Study they will benefit most from good daylighting as these spaces will typically be used for tasks where good daylight is beneficial. It is therefore worth designing these spaces to meet minimum daylight levels, in order to maximise the opportunity for daylighting in the new space.

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Impact of Neighbouring Properties

If your refurbishment project includes an extension is also worth considering whether the daylight levels of any specified rooms in the neighbouring properties will be significantly reduced as a result of an extension being built.

For more information about how to make sure the extension does not have a significant impact on neighbouring properties click here

In summary you will need to think about:

- The size of the windows – larger windows provide increased daylighting
- Obstructions outside – may reduce daylighting
- Whether any extensions impact on neighbouring properties
- Colour of the walls – lighter colours increase reflectance
- Type of glazing
- Type of frame

BREEAM Domestic Refurbishment gives refurbishment project credits where is a neutral impact on daylight levels is achieved i.e. it is not made worse as a result of the refurbishment.

Recognition is also given if the daylighting levels are improved up to minimum levels as well as where creating an extension, the extension does not impact upon neighbouring properties and any new spaces also meet minimum daylighting requirements.

Related BREEAM Domestic Refurbishment issue Hea 01 – Daylighting.

Space Requirements

Cycle Storage

With the increased popularity of cycling as well as the benefits it has for health and reducing reliance on the car, it should also be considered whether space for cycle storage could be provided.

As part of the refurbishment project there may be the opportunity to provide space for the occupants to store bicycles either inside or outside the dwelling.

When designing the layout of the dwelling the following need to be considered to ensure that the cycle storage is suitable.

Inside

- Is the space suitable for use for bicycle storage?
- Is there a sufficiently sized space to store a bicycle?
- Can the bicycle be wheeled from the access door to the storage place easily?

Outside

- Will the cycles be secure?
- Is the storage weather proof?
- Is it within a convenient distance from the dwelling?

The number of storage spaces required depends on the number of bedrooms the dwelling has and whether or not the storage is communal. The more bedrooms there are in a dwelling, the higher the occupancy so therefore the higher number of potential cycle storage spaces may be required. It is also important to ensure that the space provided is practical, safe and secure.

The number of cycle spaces required

Based upon the guidance provided in BREEAM Domestic Refurbishment, the following provides guidelines which are based on the number of cycle spaces provided. This is based on the number of bedrooms the dwelling has and is shown in table 8.

Table 8 Number of Cycle Spaces Required

	Studios/ 1 bedroom	2-3 bedrooms	4 bedrooms
Basic Compliance	1 cycle storage spaces per two dwellings	1 cycle storage spaces per dwelling	2 cycle storage spaces per dwelling
Advanced Compliance	1 cycle storage spaces per dwelling	2 cycle storage spaces per dwelling	4 cycle storage spaces per dwelling

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Communal Cycle Storage Spaces

If there are many dwellings in one project, it may not be necessary to provide as many cycle storage spaces as outlined above, depending on the number of dwellings in the project. As a guide, the steps needed to calculate the number of spaces for a large site are shown below:

1. Calculate the number of spaces needed for example 120
2. The first 50 cycle spaces is 100% provision
   = 100% of 50 = 50 cycle spaces
3. The next 50 cycles spaces is 50% provision
   = 50% of 50 = 25 cycle spaces
4. An cycle spaces over 100 is 25% provision
   = 25% of 20 = 5 cycle spaces
5. Add up cycle spaces from steps 2, 3 and 4
   = 50 + 25 + 5 = 80 spaces

Indoor cycle storage

If there is no external space sufficient for cycle storage, BREEAM has specific requirements for internal cycle storage which provide common sense rules with regard to the access, the amount of storage and which rooms the storage space can be in.

When choosing the best location for the bicycle storage you should consider the following

- Is it safe for the bicycle to be wheeled from the access door to the storage place?
- Do the access routes avoid going through or being stored in any of the following rooms
  - Kitchen
  - Living Room
  - Dining Room
  - Bedroom
  - Bathroom
- Is there adequate room to allow a cycle of 1.1m in width and 2m in length to be wheeled through the house without causing damage?

Location of the cycle space – things to consider

Providing space inside the dwelling should be in a place such as a cupboard or place in a hallway that is sufficiently sized and also on the ground floor of the dwelling, to avoid having to carry a bicycle upstairs.

It is also important to consider the route from the access door to the cycle storage space within the house as this may be restricted by the widths of the doors and the rooms that need to be passed through. All corridors and doors between the point of access and the storage space need to be wide enough for a 1.1m bicycle to be passed through, which is the standard width of a bicycle. In terms of turning corners, there also needs to be enough space for a bike 2m long to turn corners without hitting any walls, as this is the standard length of a bike.

Figure 7 shows the hallway of a dwelling with an under stairs cupboard large enough for a bicycle to be stored and illustrates the importance of choosing the area of storage correctly in order to avoid potential damage to the dwelling as a result of the bicycle being pushed around tight corners. The scenario below shows that the bicycle needs to make two sharp turns within the route through the dwelling and would get quite close to the walls when doing so. In this situation, the solution may need to be reconsidered due to the tight turning spaces involved. For example is there an alternative space indoors or externally.

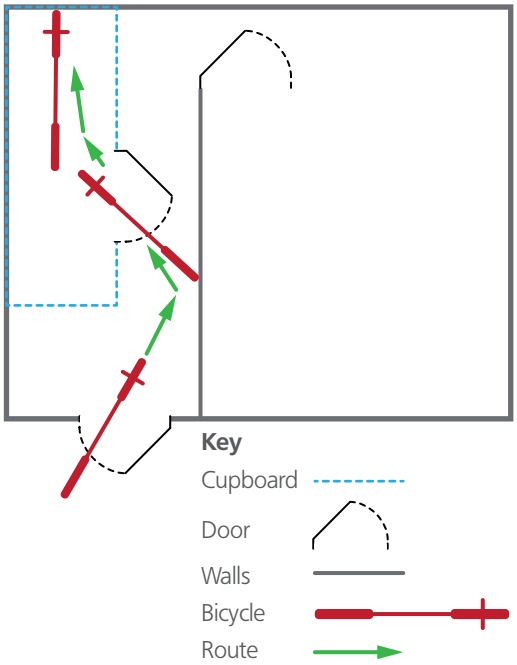

Figure 7 Example of a non-compliant internal cycle storage solution

The cycle storage space within the dwelling needs to be large enough to contain a bicycle that is 2m length by 1.1m width and have permanent fixings to allow it to be freestanding. A space for the bicycle to be propped up against a wall is not sufficient.

External Cycle Storage Space

Within a shed or garage

If you are considering storing a bicycle in a shed or garage you need to make sure there is enough space for tools (i.e. at least 1m^2 space) as well as anything else that is to be stored. The location of the cycle storage within the shed or garage would also need to be accessible with sufficient space for the number of bikes to be stored, of at least 2m length by 1.1 metres width per bike. If the cycle is to be stored in a garage a car or the number of cars the garage was designed for also needs to be accounted for. The space must also be able to be locked with a compliant fixing which allows the bike to be stored free-standing.

Within a dedicated storage facility

If the cycles are to be stored in a dedicated storage facility it needs a fixed to a permanent structure which is covered and has fixtures to allow bicycles to be locked.

In all cases the cycle storage should be within 100m of the dwellings main entrance for the space to be convenient enough for occupants. Where the access to the outside storage is through the dwelling, e.g. through a mid-terraced house, the route needs to comply with the requirements shown here

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If you are considering storing bicycles outside there needs to a means of securing the bicycles to a fixed point.

If a cycle storage facility is built on a previously permeable piece of land, this may affect the level of surface water runoff and what can be scored under the Surface Water Runoff issue of the assessment. More information can be found here

Recycling and Composting Facilities

It is common place now for homes to be provided with either a local authority or private recycling collection scheme. To encourage future occupants of the property to recycle their household waste separate internal waste bins can be provided to allow occupants to store their waste as they go. When designing the kitchen it is important to factor in the space needed to provide these waste bins within a cupboard.

When designing the kitchen, care needs to be made to make sure there is adequate storage available for recycling bins and kitchen waste containers for composting. As a guide, BREEAM Domestic Refurbishment requires there to be three internal bins provided in a dedicated place within a kitchen cupboard.

In terms of recycling, the number of bins required as well as their capacity depends on whether there is a compliant collection scheme (e.g. local authority or private collection scheme) in place and whether or not there is adequate external storage as shown in figure 8.

Useful definitions from BREEAM:

Adequate external storage
Room for three recycling containers with a combined minimum of 180 litres and space for a bin for non-recyclable waste.

Compliant collection scheme
A local authority scheme with a minimum of
- Fortnightly collection
- Three materials collected

In addition to the capacity of the bins they have to be within 10 metres of the kitchen.

Composting

In addition to space for recycling, it is also worth considering providing space for composting. Many local authority and private recycling schemes also collect composting waste, or alternatively the home could be provided with a composter.

As a guide, based upon the BREEAM Domestic Refurbishment requirements, an internal container of at least 7 litres must be available for the use of compostable material. If the dwelling has external space, a facility should be put within 30m of the dwellings entrance to ensure this is convenient. If the dwelling has not got external space an alternative would be to use a compost collection facility run by the local authority or local community project.

When designing the space in the kitchen it is worth thinking about the amount of space available for the recycling and composting containers.

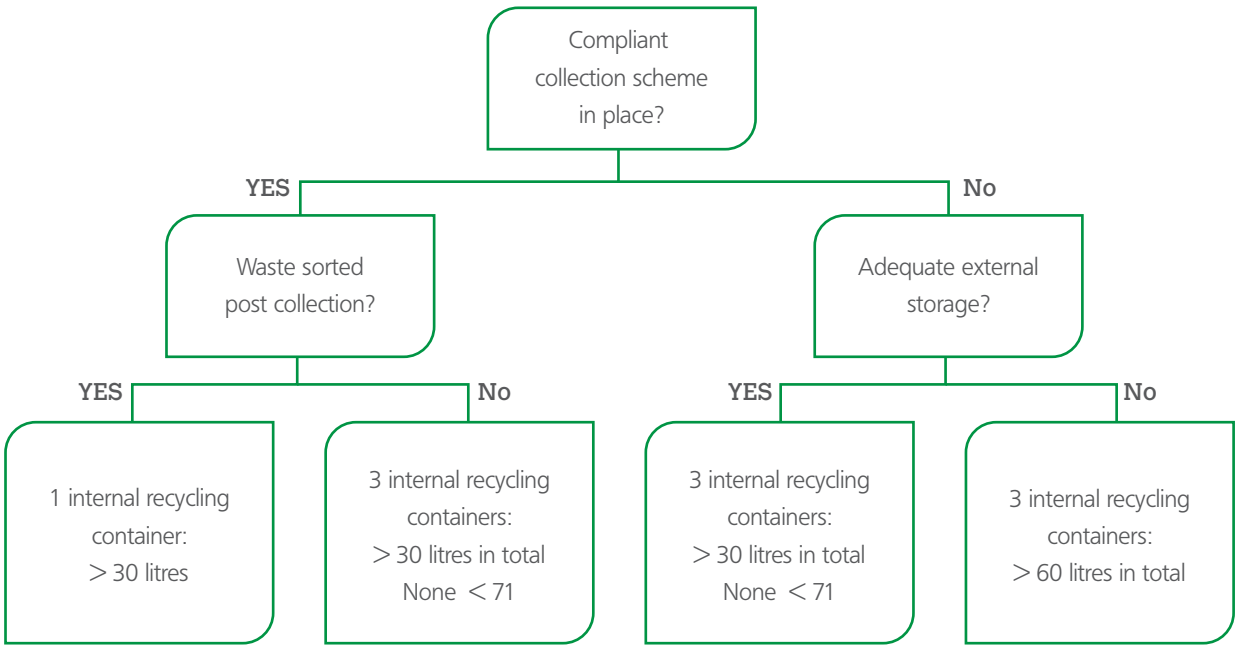

Figure 8 Compliant recycling facilities

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Space for an Energy Display Device

If an energy display device and/or water meter is to be provided to the occupants post refurbishment it is important to choose a suitable location for it. The location needs to be within sight of the occupants and therefore cannot be hidden away in a cupboard for example.

More information about the Energy Display Device itself can be found here

Space for clothes drying

Having a space within the dwelling or in an outside area that is suitable for the drying of clothes gives occupants of the dwelling an alternative to using a tumble dryer which can use a lot of energy.

A suitable room within the dwelling will

- Be a bathroom or utility room
- Have a form of heating
- Meet the Ventilation Requirements under Building Regulations Approved Document Part F
- Have a permanent fixing installed
- Have 4m or more of line if the dwelling has 1 to 2 bedrooms
- Have 6m or more of line if the dwelling has 3 or more bedrooms

An unheated outbuilding can also be used provided it has adequate ventilation.

Space can also be provided in external space as well, including a roof terrace of balcony and the length of line required is the same as what is quoted above.

Design of the home office

Occupants may wish to use a room in the home for working from home. The room that can be used for the home office depends on the number of rooms the dwelling has. Table 9 shows the rooms that cannot be used as a home office as these rooms are not deemed practical e.g. having your home office in the bathroom.

Table 9 Acceptable Rooms for a Home Office

Room	Studio, 1 or 2 bedrooms	3 bedrooms or more
Bathroom	No	No
Hallway	Yes	Yes
Kitchen	No	No
Living Room	No	No
Master Bedroom	Yes	No
Other Bedroom	No	No
Study	Yes	Yes

One point to consider is the amount of space available in the chosen room. As a guide, BREEAM requires there to be enough space for a desk, chair and filing cabinet/bookshelf with room to move around them as well as space for sufficient furniture for that rooms intended use. There is also a requirement that the wall length needs to be at least 1.8m in order for a desk to be put in.

Consideration also needs to be made with regard to the facilities available in the room chosen to be used as the home office. A double socket needs to be present in the room as well as a telephone point.

The window in the room needs to be more than 450mm either in width or height.

The following issues also need to be considered when designing a home office that is fit for purpose

- Ventilation
- Daylight Levels

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Designing for accessibility

Occupants of the refurbished dwelling may want to have the ability to stay living there for several years. During that time the needs of the occupants will likely to change, if and when they develop a disability, injury or have young children for example. A refurbishment project can be a good opportunity to adapt the dwelling to meet the needs of the occupant.

Adaptations can be made to the dwelling to suit the changing needs of the occupants, such as providing a ground floor WC or installing a ramp to the front door. This can be a great selling point for a property where the home is well adapted for those with reduced mobility such as pregnant mothers, those with injuries, disabled, the elderly and others with mobility restraints.

Using an accessibility statement

To consider this, you may want to write an access statement which is a brief survey/report which explores what can be done to adapt the home using a professional judgement.

BREEAM Domestic Refurbishment provides an accessibility statement template. This template lists all of the possible adaptations that can be made to existing dwellings and classifies them according to their difficulty. The more adaptations that are made to the property and the difficulty in doing them, the more BREEAM credits can be achieved. Tables 10 to 14 summarise the adaptations that need to be made to gain minimum, advanced and exemplary level design for accessibility and are split up into different types according to types of adaptation.

The level of accessibility is assessed on a progressive basis. This means, for example, to achieve an exemplary level of accessibility, all the requirements under 'minimum' and 'advanced' need to me met as well as the requirements in 'exemplary'. This is also assessed based upon whether reasonable provision can be made and where the existing home restricts certain criteria from being met. If seeking BREEAM certification, the assessors will be looking to see that alternative solutions have been considered.

There may be cases where there is no WC on the ground floor, or where there are steps up to the house, which cannot be practically altered. It is up to the project teams professional judgement (or the BREEAM assessors judgement where seeking a BREEAM rating) about what can and cannot be done to improve the accessibility of the dwelling. It may often be the case that alternative solutions can be considered such as providing hand rails where there are steps.

The following is an extract from the BREEAM Domestic Refurbishment Checklist A-8: Access Statement Template.

Table 10 Access to and within the dwelling

Accessibility Level	Requirements	
Minimum	An accessible threshold is provided into the entrance according to 'Accessible thresholds in new housing: guidance for house builders and designers'	All entrances should be illuminated have level access over the threshold have a covered main entrance
Advanced	The point of access to the dwelling should not have cross falls greater than 1 in 40	Access doors must have a minimum opening width of 775mm
	Meet minimum corridor and passageway widths in the entrance level (see Technical Manual)	In sloping plots where steps are cannot be avoided the steps need to be at least 900mm wide and have and have handrails on each side
Exemplary	The approach to all entrances should be level or gently sloping: distance of <5m = gradient of 1:12 distance of 5-10m = gradient of 1:15 distance of >10m = gradient of 1:20	
	The design should provide a reasonable route for a potential hoist from a main bedroom to the bathroom	The width of the doorways and hallways should meet the minimum requirements

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Table 11 Facilities on entrance storey of the dwelling

Accessibility Level	Requirements	
Minimum and Advanced	**WC provision in the entrance storey of the building** Door opens outwards Clear opening width (check what it is) Clear space for wheelchair users Basin does not impede access	
Exemplary	The living room should be at entrance level	There should be a space for turning a wheelchair in dining areas and living rooms and adequate circulation space for wheelchairs elsewhere
	In houses of two or more storeys, there should be space on the entrance level that could be used as a convenient bed-space	There should be a wheelchair accessible entrance level WC drainage provision enabling a shower to be fitted in the future

Table 12 Internal Walls

Accessibility Level	Requirements	
Minimum	Walls in bathrooms and toilets should be capable of taking adaptations such as handrails	Switches, sockets, ventilation and service controls should be at a height usable by all (i.e. between 450 and 1200mm from the floor)
Advanced		
Exemplary	Living room window glazing should begin at 800mm or lower and windows should be easy to open/operate	

Table 13 Lifts and Stairs

Accessibility Level	Requirements	
Minimum	No Requirements	
Advanced	Passenger lifts and common stairs in blocks of flats must meet requirements	
Exemplary	Minimum dimensions for communal stairs – Uniform rise not more than 170mm; – Uniform going not less than 250mm; – Handrails extend 300mm beyond top and bottom step; – Handrail height 900mm from each nosing;	Minimum dimensions for lifts – Clear landing entrances 1500mm x 1500mm; – Minimum internal dimensions 1100mm 3 1400mm; – Lift controls between 900 and 1200mm from the floor and 400mm from the lift's internal front wall;
	The design should incorporate; provision of a stair lift a suitably identified space for a through-the-floor lift from the ground to the first floor, for example to a bedroom next to a bathroom	

Table 14 Car Parking

Accessibility Level	Requirements	
Minimum	No Requirements	
Advanced	No Requirements	
Exemplary	Existing car parking space increased to 3300mm width, or provision for add the extra width at a later date.	The distance from the car parking space to the home should be kept to a minimum and should be level or gently sloping distance of <5m = gradient of 1:12 distance of 5-10m = gradient of 1:15 distance of >10m = gradient of 1:20

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Improving the Building Envelope

The amount of energy the dwelling will use when it is occupied largely depends on occupant lifestyles such as what temperature the thermostat is set to, however the main thing that will influence this is the performance of the fabric of the dwelling, the heating and hot water system and the performance of the electrical equipment. Each of these aspects can be improved or changed to improve the energy efficiency of the dwelling, making the home warmer and cheaper to heat. The energy efficiency rating is listed on Energy Performance Certificates for UK dwellings and is assessed using SAP (the Government's Standard Assessment Procedure). An EPC is required by law whenever a home is for sale or rent. The EPC is calculated using SAP based on features of the dwelling and produces a number between 1 and 100.

The strategy for what can be done to improve the energy efficiency of the dwelling depends on a number of factors such as the age of the dwelling, the type of construction (e.g. is it solid or cavity wall), what heating system is already there and what energy saving features are present. There is also the aspect of what the target EPC rating is and what budget has been set aside for the improvements. As a general rule the more the improvement needed, the more expensive it will be to achieve it however it is also important to consider the payback that can be achieved. The EPC report can be used as a helpful tool to highlight typical payback of the measures that are in scope for the home.

Thermal Performance

The walls, roof and floor are designed to keep the outdoor elements out as well as keep the occupants inside warm. As part of the refurbishment project, it may be necessary to ascertain and improve the performance of these fabric elements to reduce the amount of heat loss from the dwelling. Figure 9 shows the typical proportion of heat loss through an un-insulated dwelling

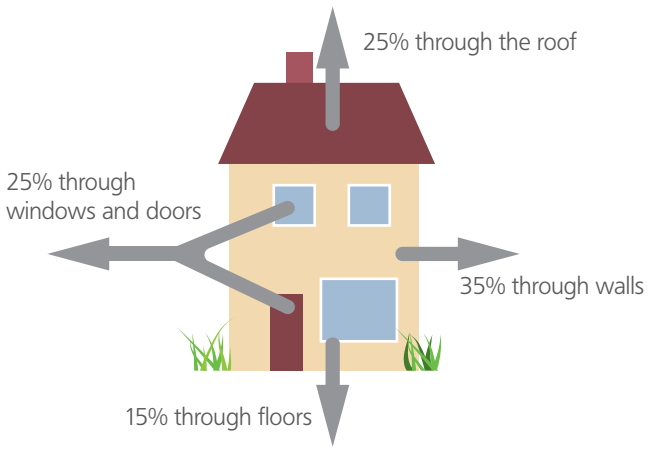

Figure 9 Typical heat losses through a dwelling

Making sure the building elements keep the home warm by being well insulated and is an important factor to consider when ensuring the occupants are comfortable and do not spend too much on their energy bills.

The heat travelling through the buildings external envelope is measured in U-values. The lower the U-value, the less heat is being allowed to pass through. When refurbishing the walls, floors and roof of a property it is important to use materials with low U-values.

Building regulations state that if more than 50% of the surface of an element or 25% of the total building envelope is being renovated, the U-values shown in table below must be met. The U-values shown in table 9 must be met.

Table 9 U-values for Upgrading Thermal Elements

Element	Threshold U-value (W/m^2-K)	Improved U-value (W/m^2-K)
Wall – Cavity insulation	0.70	0.55
Wall – external or internal insulation	0.70	0.30
Floor	0.70	0.25
Pitched roof – insulation at ceiling level	0.35	0.16
Pitched roof – insulation between rafters	0.35	0.18
Flat roof or roof with integral insulation	0.35	0.18

(Source: http://www.planningportal.gov.uk/uploads/br/BR_PDF_ADL1B_2010.pdf

What is meant by 'renovating'?

Building Regulations state what is meant by the renovation of a thermal element in paragraph 5.7 of Approved Document L1B.

The Roof

Insulating the loft space is a very popular option for reducing the amount of heat loss, especially where the property has easy access as it is fairly easy and inexpensive measure to install. There are two options available; insulating at joist level (referred to as a 'cold roof') is often the most straight forward option however if the loft space is also intended to be used for storage, you may need to extend the height of the joists in order to provide sufficient levels of insulation and then board over the joists as it is important to ensure that using the loft space for storage won't compress insulation, reducing its performance. Alternatively you may need to consider insulating between the joists and then installing rigid insulation above the joists and then board over the top of this.

The second option is insulating at rafter level (often referred to as a 'warm roof'). If major work is being carried out to the roof, or if the loft space is being converted into a room, insulation at rafter level would make more sense as it would create a warm space.

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One point of caution is that insulating between the rafters may cause condensation to form on the inside of the roof if the roof space is not adequately ventilated. This can be solved by installing vents in the eaves.

If the dwelling has a flat roof insulation options are limited as there is often no cavity within the roof itself. The preferred option is to install external insulation on top whilst replacing the roof covering.

The Energy Saving Trust has published guidance on insulating roofs when carrying out a loft conversion in their guidance CE120 Energy efficient loft conversions

Improving heating systems

If insulating the roof at the rafters, it is important to consider impacts on any heating system that may be located in the loft. The reason for this is that if insulation is added between the joists, the loft space will be colder and therefore there will be a higher the system being at risk from frost which could cause leaks. If major improvements are being made to the heating system, it is a good opportunity to move it all to another location in the dwelling, other than the loft to avoid this potential risk.

The Floors

The table 10 below summarises examples of what can be done to both suspended and solid floors.

Table 10 Work that can be done to solid floors

	Suspended Timber	Solid Concrete
Minor Works	To eliminate drafts, one large piece of hardboard can be fixed over the individual floorboards to cover the gaps. Where there are pipes and cables rising through the floor, gaps around these can be sealed too.	Add a layer of insulation and a chipboard or plywood floor above the concrete slab. Note: this has implications on the height of the doors and room heights
Major Works	Add layer of insulation below the floorboards which can be supported by nets. Note: take care with the depth of insulation to ensure sufficient gap is allowed below the insulation to allow for ventilation that is needed to remove moisture and prevent damp or dry rot.	Depending on the condition of the existing floor, it is possible to replace the existing concrete floor with a new floor, with insulation either above or below the concrete slab. A damp proof membrane should be provided below the insulation and also care should be taken to overlap floor insulation with wall insulation where provided.

The Walls

The options available for insulating a wall will depend on what type of wall it is. If the wall has an unfilled cavity then filing it with insulation will be the most cost effective option.

If the dwelling has solid walls, external wall insulation or internal wall insulation can be done.

External wall insulation is less invasive than internal wall insulation as it does not reduce the size of the rooms and can even enhance the appearance of the dwelling. One point of caution is making sure that the insulation is sealed correctly around windows and doors as well as the junction between the wall and the roof. If these are not done properly these will form what is known as a cold-bridge which is an area where heat can escape through the dwelling as described in more detail below.

Another point to consider is that items such as external lighting, satellite dishes, water pipes and guttering down pipes will need to be moved and refitted as well as having scaffolding up throughout the process. You may also need to extend window sills and the roof structure or select a proprietary system to extend the gutter and verge to provide sufficient protection from the elements, depending on the thickness of the external wall insulation.

If the dwelling is listed or in a conservation area, or of historic importance the appearance of the dwelling may not be allowed to be changed, therefore external wall insulation will have to be ruled out. An alternative to this is:

Internal Wall Insulation. Although this option may be cheaper, there are issues that may arise that will need consideration. These are as follows:

- **Loss of space in the rooms** Although the best practice thickness of 80mm to 120mm may not seem much, having it on the walls of a small room will make a big difference to the size.
- **Thermal Bridging.** Thermal bridges or cold bridges are where a conductive material (e.g. metal) passes through a layer of insulation, allowing heat to be transferred to the outside. These can occur at the joins between the floors, ceilings and windows if insulation is not installed properly. It is therefore important that internal wall insulation links to floor and roof insulation where possible to provide a continuous layer. At junctions with party walls and windows, it is also recommended that insulation should be overlapped with the window frame and returned along the party wall to avoid potential condensation and cold bridging.
- **Repositioning wall fittings.** Adding internal wall insulation will mean having to reposition plug sockets, light switches, radiators, pipe work, windowsills and skirting boards. It is therefore important to ensure that sufficient fixings to allow these fittings to be repositioned and that this is taken into account when installing internal wall insulation.

Working with other team members

If extensive work is being done to the heating system and the dwelling is to be rewired it is important to make sure it is done in liaison with the people installing the insulation so it the repositioning can be done effectively.

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– **Condensation.** If the material used for the internal wall insulation lets water vapour through, problems may occur with the build-up of condensation between the wall and insulation material, causing damp. The choice of material is an important consideration to make sure these problems do not occur and it is recommended that a continouse vapour control layer is provided between the plasterboard and insulation.

More information about what can be done to improve the building fabric of a building can be found in the following publications:

Solid Wall Insulation
"Reducing thermal bridging at junctions when designing and installing solid wall insulation" http://www.brebookshop.com/details.jsp?id=327287

"Insulating solid masonry walls" http://www.brebookshop.com/details.jsp?id=287475

U-values and R-values – what do they mean?

R-values represent the resistance to heat transfer through the material i.e. the higher the R-value, the better it is at keeping the warm in and the cold out of the dwelling.

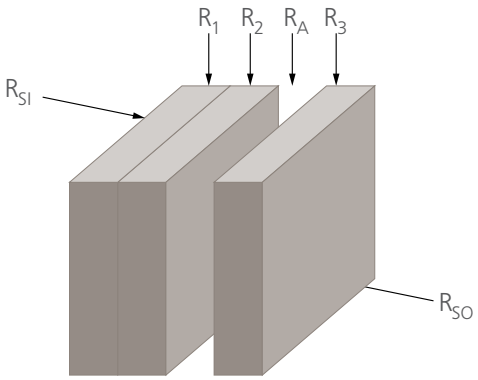

Figure 10 R-values of wall components

Each building component has an R-value which is the measure of the amount of heat that is stopped.

R_{SI} the amount of heat is stopped by the **inside** surface
R_{SO} the amount of heat is stopped by the **outside** surface
$R_{1\ etc.}$ the amount of heat is stopped by building components
R_A the amount of heat is stopped by air cavities

Each of the R-values shown in the wall cross-section above is described in the cross section of a wall above. The R-values of each component is added to each other to give to the total measure of the amount of heat stopped by the wall.

The U-value is the measure of heat going through the wall. The higher the R values of the building components as the whole wall, the lower the amount of heat going through the wall. Figure 11 shows two cross-sections of a wall, one with high R values and one with low R values.

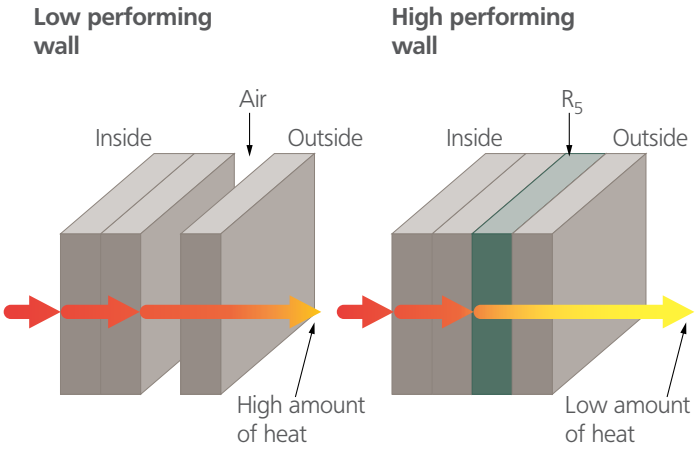

Figure 11 Low and High Performing Walls

The high performing wall has a layer of insulation where there was air. This decreases the amount of heat escaping from the dwelling to the outside.

The type of insulation chosen for a refurbishment will have an impact on the thermal performance of the wall which in turn contributes to the overall energy performance of the dwelling.

The u-values of materials are used as a measure of thermal performance, the lower the u-value the better the performance.

The Energy Saving Trust has published an Insulation Materials Chart within their publication CE71. This is available to download from here

Thermographic surveys

In most refurbishment projects, reducing energy bills is a major priority which can be most effectively achieved through reducing the amount of heat lost through the fabric of the dwelling.

A thermographic survey is an effective way of identifying areas of the dwelling that are causing the greatest levels of heat loss. This involves using an infrared camera to take photographs of the dwelling before and after the refurbishment whilst the dwelling is heated to a certain temperature.

The photographs taken before refurbishment are used to pinpoint areas of high heat loss and inform of which areas may benefit from improved insulation or through draft proofing measures.

The photographs taken after the refurbishment can then be used to confirm if the refurbishment measures have successfully reduced heat loss by comparing them to the photographs taken prior to refurbishment. This may confirm that the refurbishment has been successful in reducing heat loss, or it may indicate areas that remedial action is required.

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How are thermographic surveys undertaken?

Before the survey takes place the inside temperature needs to be of the same temperature throughout to mimic a typical scenario where the dwelling is occupied. The following outside conditions also need to be met in order to get meaningful results[10]

- A temperature difference between the inside and outside of a house of at least 5°C over a period of four or more hours, allowing the building mass to be heated. Because of this, best thermographic results are often (although not always) obtained in the heating season (October to March).
- Diffused light - i.e. minimal sunlight, again for a period of four or more hours, otherwise the solar temperature gain emitted from the surface of a structure could be interpreted as an energy loss.
- Dry conditions during the thermographic survey. This is not necessarily to protect the equipment, but because any rain on the surface of a building will cool the temperature, potentially leading to inaccurate interpretation of the thermal image during the thermographic survey.
- Low wind speeds (less than 6m/s or light to moderate breeze).

Airtightness surveys

Airtightness relates to any air leakage through gaps in the building fabric. A dwelling which is very 'leaky' would use more energy to heat up due to increased heat loss. Air leakage can often be detected through gaps around windows, doors, around skirting, floor boards and other junctions or gaps in the buildings fabric.

As with the thermographic survey, a test needs to be done before and after refurbishment. Airtightness testing prior to refurbishment can be used to pinpoint areas that would benefit from draft proofing. The pre-refurbishment test can also be used to define a particular target that needs to be achieved. Testing can then be conducted once refurbishment is completed to see if the project has been successful at improving airtightness levels or whether further remediation is necessary.

How are airtightness surveys carried out?

A survey is done by introducing a controlled source of air flow through the dwelling, with measuring equipment calculating the air flow. The Air Tightness Testing and Measurement Association (ATTMA) have produced the Air Tightness Standard for Dwellings[11] which gives information on what an Airtightness Survey involves. The ATTMA recommend the following should be done before an Airtightness Survey takes place:

- all internal doors should be fully opened and restrained.
- All areas of the dwelling to be tested should be connected by openings no smaller than a single leaf doorway (say 800mm x 2000mm).
- All drainage traps should be filled with water.
- All incoming service penetrations (e.g. power, telecoms) should be permanently sealed.
- All external doors and windows should be closed (but not additionally sealed). This includes door thresholds. The exception to this will be apertures to which test equipment is connected.
- Background trickle ventilators, passive ventilation systems and permanently open uncontrolled natural ventilation openings should be temporarily sealed.
- Mechanical ventilation and air conditioning systems should be turned off. These systems should be temporarily sealed to prevent air leakage through the systems during the test.

When the test results are produced from the survey, a target post refurbishment airtightness value needs to be made. A second survey needs to be done once the refurbishment is completed to make sure the target airtightness value is met. Having a target is important as it provides a means of measuring whether the project has been successful at improving airtightness. As a guide, an airtightness of around 5 $m^3/hr/m^2$ at 50 Pa is deemed as good practice, with 10 $m^3/hr/m^2$ being the level of airtightness required for Building Regulations Part L 2010. Where below 10 $m^3/hr/m^2$ it may be worth considering a form of whole house ventilation and heat recovery. For more information please see the Ventilation section.

BREEAM covers the use of effective project management on refurbishment schemes. More details on the requirements used to assess this are available in the Man 06 section of the Technical Manual.

10 http://www.airpressuretesting.net/seopages/faq_thermographic_survey.htm

11 http://www.attma.org/wp-content/uploads/2013/10/ATTMA-TSL1-Issue-1.pdf

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Sound Insulation

When refurbishing a dwelling it is a good opportunity to improve the sound insulation of separating walls between other dwellings, especially if the walls are to have thermal insulation installed as part of the refurbishment works, or where re-plastering or undertaking decorating works.

Noise travelling through separating walls and floors can make an uncomfortable living situation for the occupant, whether it is hearing conversations from an attached dwelling which is referred to as airborne sound or footsteps from the dwelling above which is referred to as impact sound.

There are two situations where sound insulation does not need to be considered which are as follows.

Detached dwellings

A detached dwelling will not have an impact on neighbouring dwellings; neither would neighbouring properties have an impact on the detached dwelling as they are not connected to each other.

Dwellings where the separating walls are only between non habitable rooms

A habitable room is any room where individuals will sit or lie down and require a reasonably quiet environment to concentrate or rest. Such rooms are bedrooms, living rooms, dining rooms, studies as well as kitchen-dining and kitchen-living rooms

Noise travelling between two non-habitable rooms (e.g. between two hallways) will have less of an impact on the occupants of the property than if one of the rooms were a habitable room such as a bedroom or living room. Where dwellings share a party wall for example a block of flats or a terraced house the amount of sound travelling from one dwelling to another should be considered.

There are two ways sound can travel between dwellings; via the vibration of the floor above a dwelling (impact) of by sound travelling through the wall or floor (airborne).

Figure 12 shows a dwelling which is in a block of flats with a dwelling above and a dwelling adjacent. Airborne sound impacts are illustrated by the blue arrows labelled "A", with impact sound impacts illustrated by the green arrows labelled "I".

If dwelling 1 is being refurbished the reduction of airborne sound from dwelling 2 would need to be considered as well as airborne and impact sound from dwelling 3. This can be done by adding in sound insulation to the wall and ceiling that separate them.

Design Considerations

The requirements for the design of walls and floors are shown in Section 4 of Approved Document E: Resistance to the Passage of Sound[12]

Care must be taken when designing new separating walls and floors, or refurbishing existing ones, to make sure it is adequately sound insulated. One important point to consider is that sound will not just travel directly through the wall or floor, but can travel through adjoining elements as well. This is known as 'flanking'.

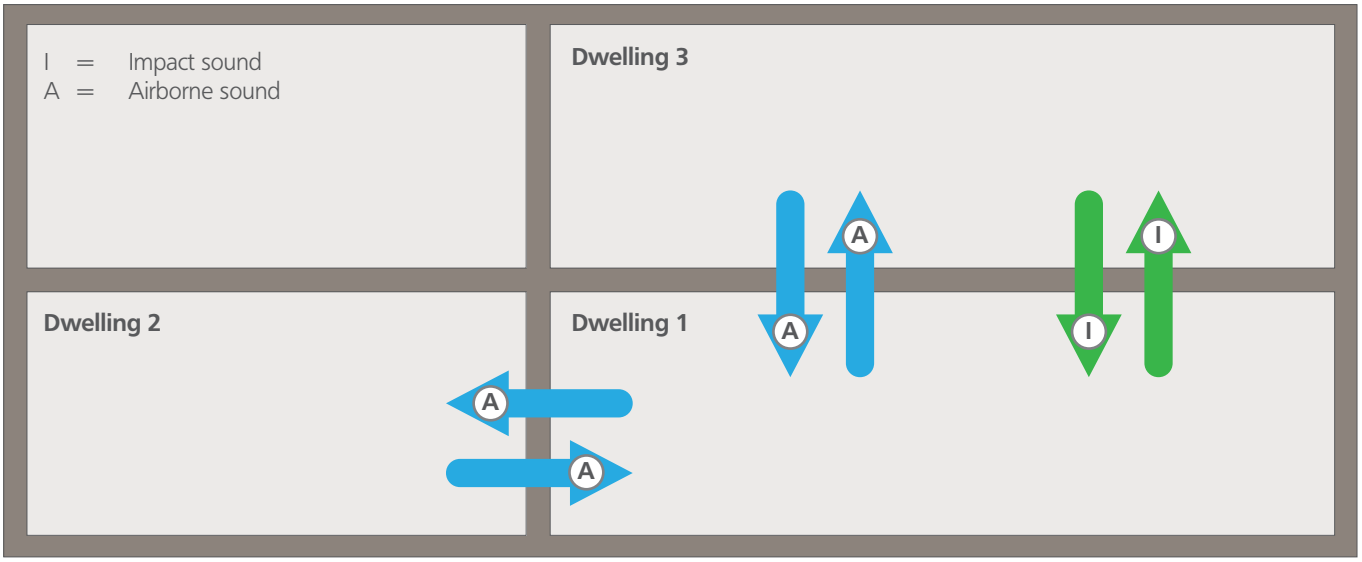

Figure 12 Sound insulation considerations in a block of flats

12 http://www.planningportal.gov.uk/uploads/br/BR_PDF_AD_E_2010.pdf

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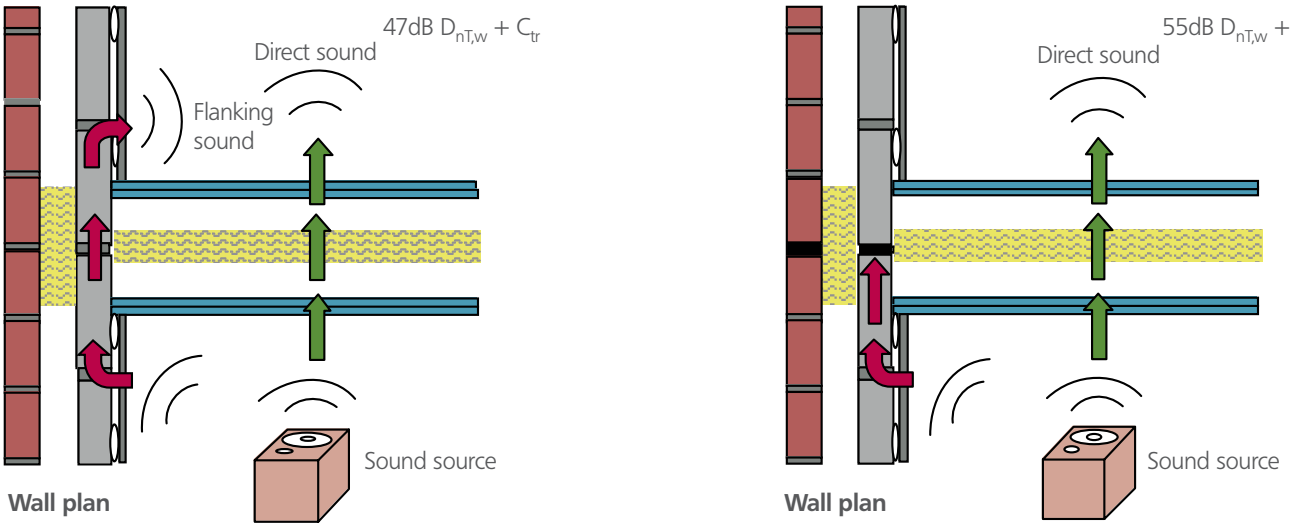

Figure 13 Flanking from Floors (Taken from NHBC[13])

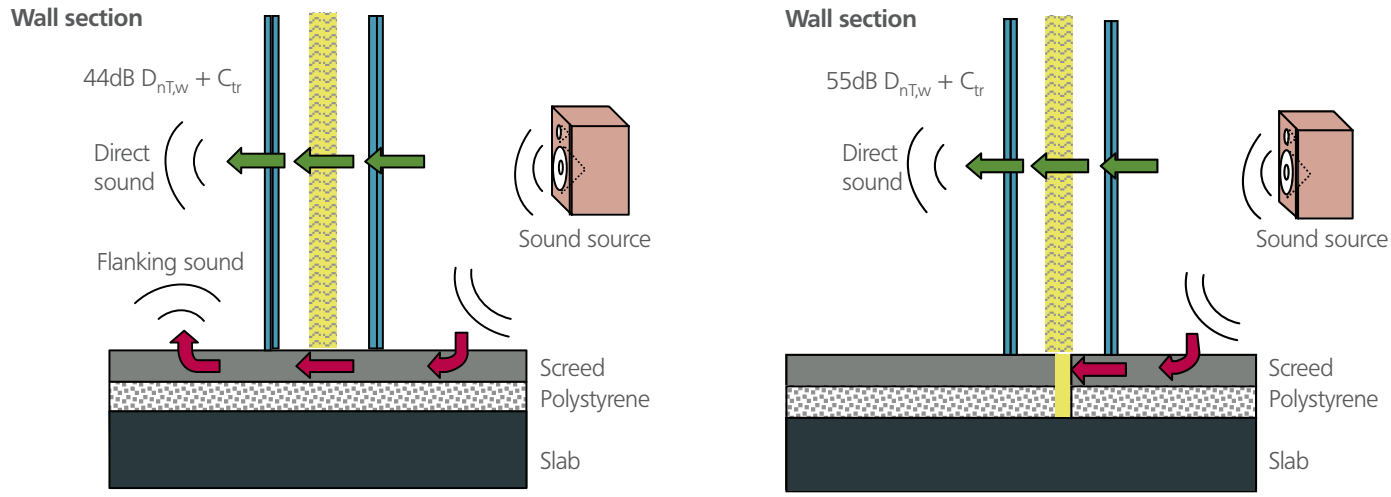

Figure 14 Flanking from Walls (Taken from NHBC[14])

The NHBC has produced a series of three case studies on this topic and have produced the following diagrams to show how flanking occurs and what can be done to reduce it. These are shown in figures 13 and 14.

Timing of sound insulation testing

If sound testing is planned as part of the refurbishment it is important to consider when to incorporate it into your programme. It is recommended to book an acoustician from a Compliant Test Body at the design stage of the project to ensure your project does not get held up.

What is a 'Compliant Test Body'?

According to BREEAM Domestic Refurbishment a compliant test body is defined as one of the following:

- Having UKAS accreditation to the appropriate scope, or who are accredited by a member of the International Accreditation Forum (IAF—iaf.nu) to the appropriate scope
- Organisations or individuals registered with the Association of Noise Consultants (ANC) Registration Scheme
- Who can provide evidence that they follow the relevant principles of BS EN ISO 17024 (Conformity assessment—General requirements for bodies operating certification of persons) in relation to BREEAM requirements

13 http://www.nhbc.co.uk/ProductsandServices/ConsultancyandTesting/Acousticservices/documents/filedownload,45069,en.pdf

14 http://www.nhbc.co.uk/ProductsandServices/ConsultancyandTesting/Acousticservices/documents/filedownload,44844,en.pdf

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It is also important to make sure the dwellings are adequately prepared before testing commences. The NHBC[15] have created a list of items that need to be done and checked in order for a sound test to be carried out which is as follows.

Site Readiness Checklist – Sound Insulation Testing

- All windows & external doors must be installed, glazed and closed.
- All trickle vents or other ventilation systems should be installed and closed.
- All internal doors should be hung.
- All walls/floors/ceilings must be completed.
- All skirting boards, electrical sockets and light switches should be fitted.
- In order to test separating floors for impact sound transmission, there must be no cosmetic floor coverings in the rooms to be tested (i.e. timber laminate/solid timber, carpet, vinyl, ceramics).
- Rooms in which tests are to be carried out must be empty and tidy.
- No trades should be working in the dwellings during the tests.
- Access is required to the properties either side of the separating structure(s) under test.
- There must be no noisy operations or work in or around the test properties during testing (e.g. drilling, cutting, groundwork).
- 240v 50Hz mains power to be available within the dwellings. 110v power supply may be accommodated if the testing body is told in advance.

When sound testing is not possible and is required by Building Control

There may be instances where one or more of the items on the checklist above cannot be met, for example the neighbouring property is occupied so access cannot be made. If an instance like this occurs, and Building Control requires a sound test, you would need to make one of the following decisions:

- Identify whether the existing construction meets the applicable performance standards of Part E without the need for remedial work.
- Carry out remedial treatment in order to meet the applicable performance standards of Part E.

Under both scenarios, consultation with a Suitably Qualified Acoustician will be needed to fully determine whether the performance standards have been met.

Related BREEAM Domestic Refurbishment Credit Hea02: Sound Insulation

BREEAM Domestic Refurbishment gives credits to properties where sound insulation performance standards in compliance with or beyond compliance with Part E of Building Regulations as detailed in the tables below.

Table 11 Airborne sound insulation credit requirements

Credits	England & Wales	Scotland	Northern Ireland
Airborne sound insulation values			
2 Credit	Part E compliance	Section 5 compliance	Part G compliance
3 Credits	3dB higher than Part E	3dB higher than Section 5	3dB higher than Part G
4 Credits	5dB higher than Part E	5dB higher than Section 5	5dB higher than Part G

Table 12 Impact sound insulation credit requirements

Credits	England & Wales	Scotland	Northern Ireland
Impact sound insulation values			
2 Credit	Part E compliance	Section 5compliance	Part G compliance
3 Credits	3dB lower than Part E	3dB lower than Section 5	3dB lower than Part G
4 Credits	5dB lower than Part E	5dB lower than Section 5	5dB lower than Part G

15 http://www.nhbc.co.uk/ProductsandServices/ConsultancyandTesting/Acousticservices/documents/filedownload,46550,en.pdf

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Responsible Sourcing

There are a number of 'eco-labels' that product manufacturers provide for construction products used in refurbishment. One label more commonly found now is responsible sourcing scheme certificates.

When using new materials in the refurbishment it is important to consider where the material has come from and how the supply chain has been managed. There are a series of schemes which recognise companies who source and manage materials responsibly by assessing and certifying how the product was manufactured and extracted. These schemes look at how products are mined or harvested, how they are manufactured and processed and looks at social and environmental issue such as resource use, waste, pollution, ethical behaviour and other issues. When choosing materials for the refurbishment project it is important to locate the necessary paperwork from the manufacture to ensure the material is responsibly sourced.

There are many schemes available which certify products according to certain criteria. Perhaps the most well-known responsible souring scheme is Fair Trade, which certifies products from bananas to coffee based on the conditions the fruit pickers work in, making sure the workers get a fair price for their produce and what impact the product has on the environment. Similar certification schemes are available for construction products and by choosing construction materials that have been certified as being responsibly sourced gives your company the chance to show you are ethically minded and also helps promote responsible sourcing in the wider context.

The documentation that proves the journey of a product from the origin to the consumer is called the Chain of Custody. An example of this is Forestry Stewardship Council (FSC) certification. FSC is an international not-for-profit organisation which promotes the responsible management of forests. As part of this, they provide certified chain of custody to suppliers who source timber from responsible sources. The aim of which is for consumers to make an informed choice about where the timber is coming from. Suppliers who are FSC certified will have documentation, including a certificate, as evidence they are responsible.

Examples of responsible sourcing certification schemes include:

- BES 6001: responsible sourcing of construction products
- Canadian Standards Association (CSA) chain of custody scheme
- Forestry Stewardship Council (FSC)
- Programme for the Endorsement of Forest Certification (PEFC)
- Sustainable Forestry Initiative (SFI)

More information about how responsible sourcing of materials and how it relates to your project can be found in the Mat 02 section of the technical manual

Legal Sourcing of Timber

Although restrictions are in place to ensure that only legal timber comes into the UK, there is still a small amount of illegal timber available to purchase. By purchasing illegal timber, you will be breaking the law, so it is important to make sure that the timber you are purchasing is legal.

One way to do this is to check if it has been sourced in accordance with the UK Government's Timber Procurement Policy. This means that timber must be sourced from a forest where the following criteria are met:

- The forest owner/manager holds legal use rights to the forest
- There is compliance by both the forest management organisation and any contractors with local and national legal criteria including those relevant to:
  - Forest management
  - Environment
  - Labour and welfare
  - Health & safety
  - Other parties' tenure and use rights
- All relevant royalties and taxes are paid.
- There is compliance with the criteria of CITES

More information about legal and responsible sourcing can be found here http://sourcing.gftn.panda.org/

Selecting materials with a low Environmental Impact

What does this mean?

Throughout the life of a construction material from the extraction, manufacture, transport and use to its disposal, it will have an impact on the environment. A rating system called the Green Guide assesses the environmental impact of a material throughout its lifecycle and gives it a rating from A+(6) to E, A+(6) being the best.

Why should I consider it?

Construction materials have a major impact on the environment. By considering the environmental impact when choosing the materials used in the refurbishment, you will be helping reduce the environmental impact across the construction industry, whilst also maintaining the reputation of your company.

How?

All materials that form part of the roof, walls, floors and windows that have been assessed for the Green Guide will have a rating between A+(6) and E. Where seeking a BREEAM assessment, information about the material composition of the wall, for example, is then inputted into an online calculator by the BREEAM Assessor to give an overall Green Guide Rating.

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Example – a refurbished wall

When taking into account the environmental impact of the wall it is important to note that a higher green guide can be achieved if a wall is retained and refurbished, rather than demolished and rebuilt. Table 13 shows a hypothetical scenario where one where a new wall with an unfilled cavity is constructed. Table 14 shows a hypothetical scenario where an existing wall is retained and the cavity is filled.

As can be seen here, the newly constructed wall has a Green Guide D rating, whereas the retained wall that is refurbished as a Green Guide A+6 rating. This also shows that the 'embodied carbon' which is the amount of carbon that is produced as a result of the construction is only 9kg of CO_2 per m^2 for the refurbished wall compared to 62kg of CO_2 per m^2 for the new wall.

Table 13 New masonry wall with un-filled cavity

Layer	Element	Description	Green Guide Rating	Embodied Carbon ($kg/CO_2/m^2$)
1	Brickwork	Brickwork, External Leaf, 102.5mm, cement mortar	D	62.51
2	None	Cavity		
3	Blockwork	Brickwork Lightweight, Aircrete, 100mm, cement lime mortar		

Table 14 Existing masonry wall with filled cavity

Layer	Element	Description	Green Guide Rating	Embodied Carbon ($kg/CO_2/m^2$)
1	Brickwork	Retained/existing Brickwork, External Leaf, 102.5mm, cement mortar	A6+	9.82
2	Insulation	Cavity Wall, Partial Fill		
3	Blockwork	Retained/existing Brickwork Lightweight, Aircrete, 100mm, cement lime mortar		

Using low impact paints and varnishes

When working with paint and varnish, there is often a strong odour that is emitted while it is drying. These odours may contain what is known as Volatile Organic Compounds or VOCs which are a type of chemical gas which causes dizziness and drowsiness, headaches, irritation of the skin, eyes and respiration system and have also been linked in some studies to asthma. By limiting the use of VOCs in the refurbishment process the living environment for the occupants can be improved, reducing potential harm to health.

There are European Standards which relate to the levels of VOCs in certain products which can be used as a guide when choosing the finishing and fittings necessary in the refurbishment project. A list of all of the standards is shown in Table 15 of the BREEAM Domestic Refurbishment Manual found here.

Lead paint

Another issue to be careful of where doing work in an older property is that often lead paint may be present. Prior to the 1970s, lead was commonly added to paint, which means that many existing homes may have been painted with paint that contains lead pigments. It is important to establish whether lead is present in the paint and to take necessary precautions, prior to doing works to avoid effects that could be extremely harmful to health.

Further advice can be found on the Health and Safety Executive website as well as the Lead Paint Safety Association

- http://www.lipsa.org.uk/
- http://www.hse.gov.uk/lead/mostatrisk.htm

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Windows and Doors

When either improving or replacing doors or windows as part of the refurbishment process there are some considerations that need to made which can have a positive impact on the whole dwelling

Using low impact paints and varnishes

When working with paint and varnish, there is often a strong odour that is emitted while it is drying.

More information this and how to limit the odour can be found here

Ventilation

The amount by which a window can open and whether it has trickle vents can influence whether not good ventilation will be provided giving good indoor air quality.

Building regulations require that if windows are being replaced that the ventilation does not worsen.

Considerations such as the openable area of a window and whether the window has trickle vents will have an effect on meeting the requirements of BREEAM. More information can be found here

Accessibility

Issues such as the width of doorways and how easy it is to open a window should be considered. More information about the requirements can be found here

Daylighting

The size of the windows and doors will have an effect on the amount of daylight that enters the dwelling. Daylight is important for the health and wellbeing of the occupant as well as reducing the need for electric lighting. More information about what needs to be considered can be found here

Security

Windows and doors present in the dwelling may not be of good enough build quality to resist an attempted break-in.

If you are replacing old windows and doors for new ones it is a good opportunity to make sure that the security is improved as a result. If the windows and doors are to be retained, there are options available to make sure they are secure.

The design of the windows and doors are an important consideration when meeting the security requirements. The specification of new external doors and windows may not always be included within the scope of works. Where this is the case, external doors and accessible windows should be assessed to see if they meet the following.

Standards for existing external doors and accessible windows
External doors are of good quality with working key locks and a strong frame, where there is no sign of warping, splitting or rotting to the door or its frame. Where the door contains glazing this should be a minimum of double glazing. Putty or beading to glazed areas should be on the unexposed side of the door, in good condition, with no sign of degradation.

Accessible Windows should have a minimum of double glazing with working key locks. Putty or beading to glazed areas should be on the unexposed side of the window, in good condition, with no sign of degradation. The window frame should be strong with no sign of warping, splitting or rot.

Standards for New doors and windows
Where external doors and accessible windows do not meet the above, it is worth considering whether new doors and windows can be specified in accordance with security standards as detailed below.

External Door sets:

- PAS 24:2007 or
- LPS 1175 Issue 7 Security Rating 1 or equivalent

Windows are certified to:

- BS 7950:1997 (36)
- LPS 1175 Issue 7 Security Rating 1 or equivalent

To move onto more advanced security measures a crime prevention design advisor (CPDA) or police architectural liaison office (ALO) will need to be appointed to give advice on how to make the windows and doors meet Secured by Design Section 2.

Secured by Design is a set of standards which aims to 'design out crime' from products. For more information visit http://www.securedbydesign.com/. You can also contact your local constabulary for advice who may be able to provide access to a police architectural liaison office that can provide free impartial advice on security measures in the home.

Responsible Sourcing

When using new materials in the refurbishment it is important to consider where the material has come from and how the supply chain has been managed. There are a series of schemes which recognise companies who source and manage materials responsibly by assessing and certifying their products. When choosing materials for the refurbishment project it is important to locate the necessary paperwork from the manufacture to ensure the material is responsibly sourced. More information can be found here

Environmental Impact of windows

The environmental impact of windows will vary from one to another. It is worth considering the use of materials with a low environmental impact on your refurbishment project. More information can be found here

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Energy efficiency of Windows

Another consideration is the energy efficiency of doors and windows, in other words how much heat can pass through them.

Replacing single glazed windows with double or triple glazed windows will reduce the amount of heat escaping from the dwelling as well as keep the cold air out. The type of gas in the gap between the panes of glass also has an effect on how much heat can pass through. Also low emissivity or low-e glass, which has a layer of metal oxide, lets in heat and light, but reduces the amount of heat coming out.

Building Regulations Approved Document L1B 2010 states that replacement windows need to have a U-value of 1.8W/m^2.K or less.

Table 15 below shows the typical U values of windows filled with different gases and of a different gap between panes with the U values that meet building regulations highlighted.

Table 15 Typical U-values of different types of windows

	Gap between panes		
	6mm	**12mm**	**16mm or more**
Single glazing	4.8	4.8	4.8
Double glazing (air filled)	3.1	2.8	2.7
Double glazing (low E, εn = 0.2, air filled)	2.7	2.3	2.1
Double glazing (low E, εn = 0.15, air filled)	2.7	2.2	2.0
Double glazing (low E, εn = 0.1, air filled)	2.6	2.1	1.9
Double glazing (low E, εn = 0.05, air filled)	2.6	2.0	1.8
Double glazing (argon filled)	2.9	2.7	2.6
Double glazing (low E, εn = 0.2, argon filled)	2.5	2.1	2.0
Double glazing (low E, εn = 0.1, argon filled)	2.3	1.9	1.8
Double glazing (low E, εn = 0.05, argon filled)	2.3	1.8	1.7

εn is the measure of emissivity of the glass.

A typical pane of glass with no coating is assumed to have a εn of 0.89.

Installing the windows correctly

By insuring the windows are installed in the correct way, it will ensure that there will be no gap between the frame and the wall, causing less of a draught and reducing the likelihood of condensation forming.

The appropriate type of sealant should be used all around the edge of the installed window, ensuring there are no gaps. The Glass and Glazing Federation (GGF) have provided a good practice guide to installing windows which available to download here

Safety

The safety of the occupants needs to be considered when replacing windows both in terms of escaping from fire as well as protection from falling.

Approved Document K describes the requirements regarding protection from falling.

Approved Document B describes the requirements for means of escape from fire.

A summary of the building regulations related to replacement windows can be found here http://www.planningportal.gov.uk/permission/commonprojects/doorswindows/

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Flood Protection

Assessing the Flood Risk

Before considering flood protection measures, it is a good idea to determine whether or not the dwelling is in a high flood risk area. More information on how to determine the flood risk can be found here

Protection of Floors

Floors can be damaged by flood water in two ways

– by water seeping through from the ground

– by damage caused by standing water

The Royal Institute of Chartered Surveyors (RICS) have published a document called 'A Clear Guide to Flooding for Property Owners'[16]. This describes measures that can be done to existing dwellings to minimise the impact of flooding. RICS recommend replacing timber, tiled or flagged ground floors with solid or suspended concrete floors incorporating robust damp proof membranes (DPM's) to resist floodwater and rising groundwater. By making these improvements the floors will be also easier and quicker to clean and dry out after a flood.

Protection of Walls

When doing work to walls, for example adding or replacing layers such as insulation, it is important to consider whether or not the material will be suitable with regard to minimising flood damage.

The materials used to construct or refurbish a wall have an impact on how it acts when exposed to flood water. As part of the report 'Improving the flood performance of new buildings' different materials were tested in laboratory conditions to how they would react if they were to be subjected to flood waters.

Different materials were tested according to the following

– Water Penetration – leakage through the wall thickness

– Drying Ability – how easy it is to dry

– Retention of pre-flood dimensions – the change in appearance after the flood event.

Table 16 summarises the findings from the laboratory tests. This table gives an idea of which materials are best suited to use as wall materials.

Table 16 Flooding resilience of building materials

Material	Material Resilience characteristics*		
	Water Penetration	Drying Ability	Retention of pre-flood dimensions, integrity
External face			
Engineering bricks (Classes A and B)	Good	Good	Good
Facing bricks (pressed)	Medium	Medium	Good
Internal face			
Concrete blocks	Poor	Medium	Good
Aircrete	Medium	Poor	Good
Renders/Plaster			
Cement render – external	Good	Good	Good
Cement/lime render – external	Good	Good	Good
Gypsum Plasterboard	Poor	Not Assessed	Poor
Lime plaster (young)	Poor	Not Assessed	Poor
Cavity Insulation			
Mineral fibre	Poor	Poor	Poor
Blown-in expanded mica	Poor	Poor	Poor
Rigid PU foam	Medium	Medium	Good

* Resilience characteristics are related to the testing carried out and exclude aspects such as ability to withstand freeze/thaw cycles, cleanability and mould growth

16 http://www.rics.org/Global/Downloads/A_clear_guide_to_Flooding_for_property_owners.pdf

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Protection of Doors and windows

Doors should be raised as much as possible without compromising the accessibility requirements.

Hollow core timber internal doors should not be used and there should be an easy way to remove the doors from their hinges in case the occupant gets a flood warning with enough notice.

In the case of windows/patio door, the seals from window or door to the fabric of the house need to be water-tight enough. Extra care also needs to be made that windows, particularly patio doors are able to resist the pressure of excessive water that may build up outside the dwelling.

Fittings

The main aim is to use fittings, such as cupboards, that are easy to clean and to place fittings as high as possible off the floor so the chance of flood water reaching them is reduced.

Services

It is important to make sure boiler units, electric and gas meters wiring and sockets are to be installed above where the likely flood level will be. If there is any wiring for services such as telephone and internet which have to be in the ground floor it should be adequately protected by waterproof insulation to prevent damage.

When specifying materials for the walls in the dwelling, especially walls on the ground floor, it is important to consider the ability to withstand a flooding event. The table above summarises the characteristics of wall materials with regard to flood resilience.

Internal Fittings, Fixtures and Components

Water Fittings

If taps, baths, showers, WCs, washing machines or dishwashers are being replaced or installed in the dwelling it is important to take into account their water efficiency before purchasing them. This can reduce hot water usage, saving energy bills and for properties on a water meter, can also save water utility bills.

There are a wide range of water efficient products that can be found available that meet the above standards. One good way of finding products is to look out for the water label, which is the European label for water efficient products.

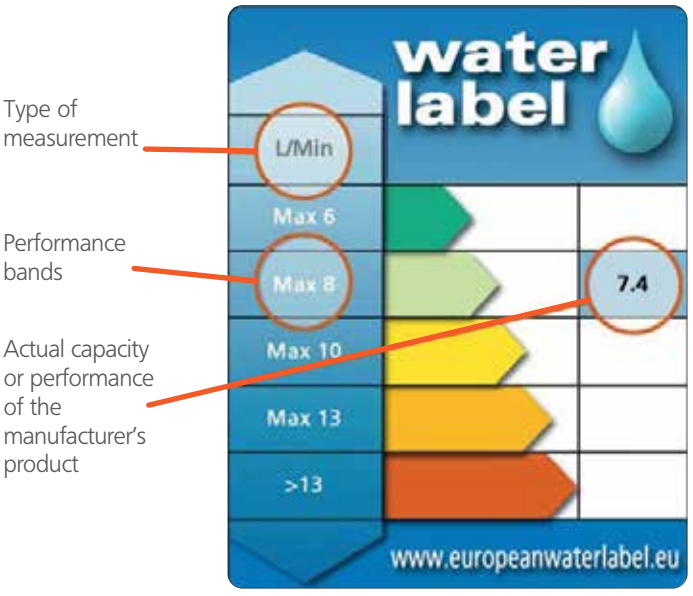

Figure 15 Sample Water Label

You may also want to consider what water efficiency options there are as highlighted in table 17

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Table 17 Water Efficiency Options

Fitting	Water efficient options
Showers	Fit a water efficient shower head Install an aerated shower Installing a flow restrictor for a mixer shower Select an electric shower
Taps	Spray taps Aerated taps Taps with a restricted flow
WCs	Dual flush WCs
Baths	Consider a bath with a lower capacity .e.g less than 140 litres
Washing machines	Compare water use of washing machines as listed on the energy or water label and aim to select the one with the lowest water use
Dishwashers	Compare water use of dishwashers as listed on the energy or water label and aim to select the one with the lowest water use

Where to find the information

The information about the flow rates and capacities will be available in the manufacturer's literature.

To see how water consumption relates to BREEAM Domestic Refurbishment see the Wat 01 section of the Technical Manual

External Water Use

If the dwelling has a private or communal garden, there may be an opportunity to install a rainwater collection system, such as a water butt, to ensure less mains water is used when watering the garden.

There are also of course instances where you may not be able to do this as follows:

- There is no individual or communal garden space or only have balconies provided
- There is no downpipe attached to the dwelling and it is not feasible to install one in an appropriate location
- The existing down pipe is not accessible and it is not feasible to relocate to an appropriate location
- If none of the instances above apply a water butt or similar system can be installed. What exactly is required depends on the following:
- Whether it is a patio or terrace
- Private or communal garden
- The size of the dwellings
- Whether the garden is completely covered by a hard surface

As a guide, Table 18 summarises the BREEAM Domestic Refurbishment requirements for the provision of a water butt based on the size of the dwelling.

Table 18 External Water Use Requirements

Space provided	Type of property		Capacity of water butt
Private Garden	1-2 bedroom dwelling	Not all outside space is of hard standing	≥150 litres
		all outside space is of hard standing	≥75 litres
	3 bedroom dwelling or more	Not all outside space is of hard standing	≥200 litres
		all outside space is of hard standing	≥100 litres
	Terraces or patios	≥100 litres	
Communal Garden	All	1 litre per m^2 of land with minimum of 200 litres per garden	
	More than 6 dwellings	Maximum of 30 litres per dwelling	

Water meters

Knowing how much water you consume by use of a meter and a visible display can be a good way of raising awareness of water use and identifying how much you can reduce water use in the home. If a water meter is to be installed it is important to make sure that the meter and display device is installed as the rest of the plumbing is being done. Where a meter is installed or being installed in the property, it is also important to consider if the device will provide a sufficient a separate visible display of water usage to the occupant in the same way the Energy Display Device is used to monitor energy use. Recognition is given in BREEAM Domestic Refurbishment where a water meter is provided with a visible display.

Working with other team members

When installing the downpipe to the outside of the dwelling it is worth finding out if any other work is to be done to the wall. For example if external insulation is to be fitted, the downpipe will need to be installed afterwards, which may seem obvious however this will need to be communicated with the appropriate trades.

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Electrical Appliances

The following electrical fittings need to be considered in terms of their energy efficiency rating whether they are being replaced or being kept. This is because appliances in the home account for a large proportion of energy use with fridges and freezers typically accounting for around 7% of domestic energy use alone.

- Fridges
- Freezers
- Fridge freezers
- Washing machines
- Tumble dryers
- Washer-dryers
- Dishwashers

The best way of determining whether any of the above appliances are energy efficient is by checking the energy label on the manufacture's literature. This energy label can either be an EU Energy Label. The definitions of these labels are shown below:

EU Energy Efficiency Labelling Scheme

BREEAM gives credits where all new white goods specified carry an EU Energy Efficiency Label which includes a rating from G (least efficient) to A+++ (most efficient) based on the energy consumption as well as product specific information such as noise level and water use.

If you are not providing new home appliances

If you are not providing any new home appliances to the dwelling, providing a leaflet explaining about the EU energy labelling scheme allows occupants to make an informed choice when choosing new appliances to make sure the appliances are of a high energy efficiency standard.

Link to Internal Water Use section

Dishwashers and washing machines that are energy efficient, also typically have a lower water use however it's important to compare different products to see if there are alternative that use less water. Dishwashers and washing machines are also assessed under the internal water use section of BREEAM Domestic Refurbishment. Please see the Internal Water Use section for more information.

Fire and Carbon Monoxide Detectors

Fire detectors and carbon monoxide detectors in a dwelling are an essential addition as they can help to save the occupants lives in the event of a fire. However you need to be careful about the choice of fittings you select as well as where they are located to ensure they operate correctly.

Where the fuel supply is mains gas or another fossil fuel a carbon monoxide detector will also help to save lives in the event of a fault with a boiler emitting carbon monoxide which can be fatal if breathed in.

Such as the importance of these fittings, it is mandatory to have them installed in dwellings if they are to be assessed under BREEAM

If a full rewire of the dwelling is being carried out as part of the refurbishment you need to make sure the detectors will be connected to a mains electrical connection.

It is also important to determine which systems are needed as well to help decide where best to place them.

- All dwellings need a fire detector and alarm system
- Only dwellings that are fuelled by fossil fuel need a carbon monoxide detector

Where to place fire detectors

Part B of Building Regulations 2006 (Fire Safety) describes the correct positioning of smoke and heat alarms in section 1, paragraphs 1.10 to 1.18 available here

In terms of the detector itself, it is important to make sure that it is the correct type and that it meets the relevant British Standards. The right British Standards depend on the size of the dwelling. This is described below.

Table 19 British Standards relating to Fire Detectors

Size of Dwelling	British Standard
2 storey with any storey exceeding 200m^2	BS 5839–6:2004 Grade B category LD3 standard
3 storeys or more with any storey exceeding 200m^2	BS5839–6:2004 Grade A Category A LD2 standard
Any other size	BS 5839–6:2004 Grade D Category LD3 standard

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Where to place Carbon Monoxide Detectors

It is advised by the Health and Safety Executive[17] that Carbon Monoxide (CO) detectors should be installed in the same room as where the fuel burning appliance is located and it can be either on the ceiling or on the wall. The following guidance is also given:

- If on the ceiling it should be at least 300mm from any wall
- If on the wall it should be at least 150mm from the ceiling
- In all cases it should be within a horizontal distance of between 1 and 3 metres.

BREEAM requires that the fire detectors and Carbon Monoxide detectors should meet certain standards, all of which are explained in the BREEAM Domestic Refurbishment Manual under Hea 06

Energy Display Devices

An energy display device and water meter displays information about current and historic energy and water use to the occupant with the aim of encouraging behaviour change.

In terms of the energy display device, the type of display required depends on the primary heating fuel, the type or types of fuel being measured and the amount of detail that is displayed to the occupant. The summary of the requirements for BREEAM is shown below.

If the primary heating fuel is from grid electricity

- Current Electricity Usage Data Displayed
- Current and Historic Electricity Usage Data Displayed

Increasing level of detail provided

If the primary heating fuel is from natural gas or other fossil fuel

- Current Electricity Usage Data Displayed
- Current Heating Fuel Usage Data Displayed
- Current Electricity and Heating Fuel Usage Data Displayed
- Current and Historic Electricity and Heating Fuel Usage Data Displayed

Increasing level of detail provided

A water meter that displays current and historic water consumption can also be installed. It is important to note that a water meter used by water companies for charging by the unit of water used would not meet the requirements for BREEAM.

Lighting

Providing energy efficient lighting ensures that the occupant saves energy in lighting costs, whilst enjoying a comfortable lifestyle.

Internal Lighting

Whilst providing energy efficient internal lighting is a good thing, there is a risk of providing too many fittings which will defeat the object of saving energy. The best way to judge whether or not the internal lighting in a dwelling is energy efficient is not by the output from the fittings in Watts, but the output per metre squared of floor space.

Types of Energy Efficient Lighting

Halogen

- Used as spotlights
- Use same technology as traditional bulbs
- Only slightly more efficient than traditional bulbs
- Often a lot of bulbs are needed to light a room, often requiring a lot of electricity to run

Compact Florescent Lamps (CFLs)

- Glass gas-filed tube charged with electricity when it is switched on
- Uses about 75% less electricity than equivalent traditional bulb

LEDs

- Can produce the same amount of light as a traditional light bulb of CFL with a fraction of the electricity
- Very energy efficient
- Very long life
- Can be problems with colour rendering for some lamp types

Link to airtightness: when installing recessed spot lights in the ceiling it is important to consider impacts on energy efficiency, as this can create additional air leakage especially where recessed into the loft space. This can be avoided by fitting the lighting in air-tight recess housing

External Lighting

It is not only the internal lighting that needs to be considered, external lighting can use a lot of electricity and by making sure they are energy efficient, the running cost of the dwelling on the occupant can be reduced.

It is not only the light fittings themselves that need to be energy efficient; the type of switch used for the external lights needs to be appropriate as well.

Lighting in areas such as the garage, car port, porches and patios are best controlled by a manual switch.

17 http://www.hseni.gov.uk/co_detector_advice.pdf

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Communal lighting in flats

If you are refurbishing a block of flats, there are likely to be communal areas with lighting. This electricity used for this lighting does not tend to get charged directly to the occupants of dwelling, therefore they have little or no incentive to turn them off when they are not needed. For this reason, manual switching is less effective and other options should be used.

In areas such as lobbies, main entrance halls and external steps, daylight sensors will be more appropriate. This means that this lighting will only be turned when it is too dark outside for people to see, lessening the number of hours the lighting is on for.

People do not tend to spend that much time in areas such as hallways, landings and stairwells; therefore the lighting only needs to be on for a short period of time. The most appropriate type of switch for these areas is either a push button switch with a timer or a motion detection control, which turns on the light with movement in the area.

People may spend a little bit of time in communal rooms such as laundries and cycle storage, therefore either occupant sensors or manual switching is appropriate.

Security lighting

As security lighting is only to come on at night time, there needs to be either a daylight sensor or timer switch to make sure it is on at the right time. An added switch can be a motion sensor which turns on the light as someone comes close to the building.

BREEAM recognises both internal and external lighting if they meet the energy efficiency requirements. More information about this is available in the Ene 07 section of the Domestic Refurbishment Manual

Other things to consider for lighting

The height of the plug sockets and switches may also need to be raised to help adapt the dwelling to future needs of occupant, i.e. making it easier for occupants to reach them. The raising of the plug sockets and switches also reduces the amount of damage that will occur to the property if it is at risk from flooding. Information on the requirements of the socket heights can be found here

Working with other team members

It is important to co-ordinate the work you plan to do with others to make sure that no negative impacts occur. For example, if you need to drill a hole into a wall that is due to be insulated, it is important to do this before the insulation is to be installed, as drilling into insulation material may damage it, resulting in poorer airtightness and increased heat loss.

Renewable Technologies

If a renewable energy technology has been specified for the project there may be some considerations to be taken into account depending on the type of technology.

Solar panels can either produce electricity in the case of photovoltaic (Solar PV) or can produce hot water (Solar Thermal). The best location to install solar panels is on a south-facing roof with no obstructions. The following questions need to be considered when installing solar panels

- Does the dwelling have a south-facing roof with no obstructions?
- Is the roof strong enough to hold the panels
- Solar PV - can it be easily wired in to the existing electrics?
- Solar Thermal – normally requires a new hot water tank so you need to consider if this can be easily incorporated into the heating and hot water system already there? Could the system be installed whilst the heating and hot water system is being replaced?

If photovoltaic (PV) or solar hot water panels are to be included as part of the refurbishment works, the roof needs to be strong enough to withstand the extra load due to the weight of the panels. Another consideration is the force imposed on the roof due to the lift caused by the wind. The forces in question are shown in figure 16.

A structural survey will need to be carried out to determine whether or not the roof is structurally sound or not and whether strengthening work needs to be done before the panels can be installed.

Building Regulations will normally apply to the roof. This means that the ability for the roof to carry the load of the panel will need to be checked and proven before work is to be carried out.

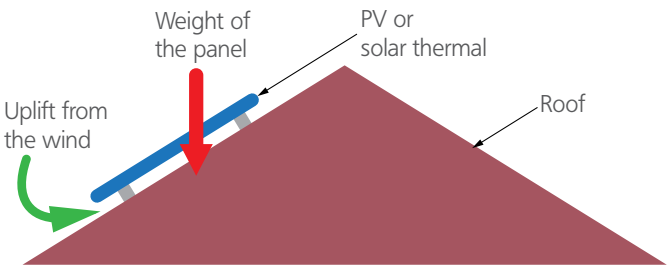

Figure 16 Forces upon a solar panel on a roof

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Heat Pumps

Heat pumps are a technology that uses electricity to take heat from either air (Air Source Heat Pump) or the ground (Ground Source Heat Pump) and converts it into heat for use in the dwelling. This can be used to heat air or water.

An air source heat pump works like a refrigerator in reverse. When a fridge or freezer is turned on the back of the fridge is warm. This is the heat that is taken from the inside of the fridge or freezer to make it cool. An air source heat pump uses the same principle by extracting hot air from outside and transferring it inside.

Ground source heat pumps work on the same principle, except they use a mixture of water and anti-freeze that is pumped via large boreholes or pipework in the ground.

The efficiency of an air or ground source heat pump is measured in Coefficient of Performance (CoP). This is the comparison of how much electricity is needed to run the heat pump to how much heat is produced. A heat pump will generally produce more energy than it consumes, making it an energy efficient way of heating a dwelling.

Ground source heat pumps use heat from the earth and require either a large borehole to be made with piping to go down into it, or for pipework to be laid horizontally, just below the surface. It is first important to know if the site's geology would allow the home to benefit from ground source heating and if there is enough land available and if it is practical to carry out such works.

One key consideration to make for both types of heat pump is what the performance is, in particular how much energy (normally measured in kWh/m^2) is produced compared to how much energy is used to run the pump. This will have an effect on the overall energy efficiency of the dwelling.

Another consideration to make is whether the proposed heating system is compatible with a heat pump. Air to water heat pumps for example typically performs best with either oversized radiators or under-floor heating in order to distribute the available heat effectively.

The Heating System

Installing a heating system that is cheap to run will be very beneficial to the occupants of the refurbished dwelling.

One way to make sure the cost to heat the home is as low as possible is to make sure the heating system is energy efficient, i.e. the amount of fuel used is low compared to the amount of heat produced.

The most popular way of providing heating and hot water in the UK is by central heating i.e. by a boiler and radiators. Boilers can run on oil, wood, coal or LPG but mains natural gas is the most popular fuel used in areas connected to the gas-grid as it is the cheapest fuel to use.

In areas where there is no gas-connection, dwellings are often heated by electric storage heaters. These charge up during the night time when electricity is cheaper, and then releases heat during the day. This method is very costly to the occupant and the timing of the heat being released is not ideal especially if the occupant is only the dwelling in the evenings.

An alternative to electric storage heaters could be the use of heat pumps. More information about these can be found here

When replacing a heating system in a dwelling, building regulations Part L1B state that the efficiency of the new system should not be significantly less than what is being replaced. A Domestic Building Services Compliance Guide has been published by the UK Government which has information about how to comply with Part L1. This is available here

Nitrogen Oxide

Nitrogen Oxide or NO_x is a gas that is emitted from the combustion of heating fuels including gas, coal, oil as well as biomass. For the purpose of BREEAM, it is measured in mg per kWh. It is important to consider NO_x as it can lead to the formation of nitric acid and ozone in this atmosphere leading to a number of health and environmental issues such as ozone which can cause respiratory health problems and nitric acid leading to the formation of acid rain. The amount of NO_x emitted depends on the performance of the heating system and the type of fuel that is being burned with systems ranging from less than 40mg of NO_x per kWh, up to more than 800mg of NO_x. Information on what an acceptable amount of NO_x is and how to find and calculate it can be found here

Working with other team members

When installing a heating system it is important to talk to others involved in the project to make sure that any work you do co-ordinates with the work of others. An example of this is talking to the builder to check that the plumber's installation of radiators does not conflict with any work being carried out to the walls before the radiators are installed.

Energy Display Devices

Occupants of the dwelling can monitor their energy use by using an energy display device, which reads data wirelessly from the electricity meter. This tends to be from a clip that attaches around the inlet or outlet wire to or from the electricity meter. It is important, therefore, to make sure there is enough available wire for the clip to be attached.

More information can be found here

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Indoor Air Quality

Ventilation

A dwelling with poor ventilation will more likely to have problems with moisture building up on the building fabric causing damp, condensation and mould problems due to humidity levels, especially in wet rooms such as bathrooms. It is important to make sure that the refurbished dwelling has enough ventilation to control the amount of humidity to prevent the build-up of damp and mould.

A dwelling with good ventilation also provides a healthy environment for occupants to live in.

When considering the options for ventilation a balance needs to be made to make sure that the increased ventilation does not result in excessive heat loss causing the energy efficiency of the dwelling to suffer.

There are three types of ventilation that can be used which are as follows.

Background ventilation

Background ventilation can be supplied by trickle ventilators which are small openings in a window frame to allow a little amount of air in and out of the dwelling.

Purge ventilation

Purge ventilation allows occupants to gain a higher level of ventilation in order to deal with odours such as in the kitchen and bathroom. This considers ability to open windows and the area that can be opened.

Extract

This is the mechanical ventilation that reduces the amount of water vapour and pollutants which are present in rooms such as in kitchens and bathrooms.

To make sure the ventilation levels are of an adequate level the requirements are shown in Section 7 of Building Regulations Approved Document Part F.

To achieve advanced ventilation Section 5 of Building Regulations Approved Part F would need to be met. This section relates to the requirements for new build dwellings which need to achieve a higher standard than that of existing dwellings, across the whole house.

Ventilation Standards

Part F of Building Regulations sets out the ventilation levels for both New Dwellings (Section 5) and Existing Dwellings (Section 7). Table 20 shows good practice and best practice ventilation requirements for background, extract and purge requirements.

Table 20 Good and Best Practice Ventilation

Type of Ventilation	Good Practice	Best Practice
Background	Section 7: Existing Buildings	Section 5: New Buildings
Extract	Section 5: New Buildings	Section 5: New Buildings
Purge	Section 7: Existing Buildings	Section 5: New Buildings

More information about ventilation requirements can be found in Part F of Building Regulations

Using low impact finishes and fittings

Please see Using low impact paints and varnishes in this guide for information about this topic.

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Extensions

Introduction

This section describes the issues that need to be considered if your refurbishment project includes an extension, whether you are extending the footprint of the property to the side of the dwelling, underneath the dwelling (e.g. a basement extension) or on top of the dwelling (e.g. a loft conversion).

Issues affecting all types of extension

Planning Permission

When planning an extension it is important to seek advice with your Local Planning Authority about whether you would need planning permission and to gain the necessary permission prior to construction. When undertaking an extension, if the extension is being undertaken in a more sustainable way, this may also be looked upon more favourably. A list of Local Planning Authorities can be found here

Managing impacts on Daylight for Neighbouring Dwellings

It is important to consider whether the extension will impact upon daylighting in neighbouring properties

The windows of neighbouring properties only need to be considered if they are the following rooms:

- Kitchen
- Dining Room
- Living Room
- Study

The impact of an extension on the daylight level of a neighbouring property is measured by working out whether the centre of the window for the neighbouring property is within both the 45 degree lines from the section and the plan.

Figure 17 shows that the centre of the door to the left of the extension is within the 45° angle of both the section and the plan. This would significantly reduce the daylight level of that room. If this were to be a room on the specified list, BREEAM would consider that this extension will not comply with the daylight requirements.

In the example below the living room window of dwelling 1 is being assessed to see whether the new extension on dwelling 2 has a significant impact on it. As the extension has a sloping roof, the 45 degree angle is taken at the half way point.

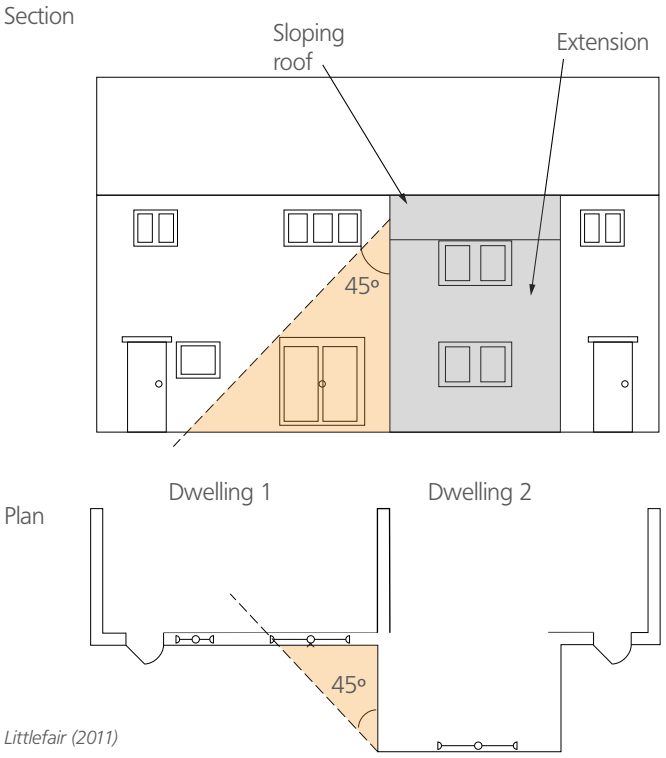

Figure 17 Assessing the impact of an extension on neighbouring properties – example 1

It is evident from the assessment shown above that the centre of the window is within both the 45 degree angles and therefore the daylight level will be significantly reduced as a result of building the extension.

If the extension is opposite the property, the visible sky component is taken into account. This is the percentage of the visible sky that can be seen from the centre of the lowest window of the neighbouring property after the extension is built. The figure below shows an example of where a dwelling has a roof extension making it taller and thus blocking daylight to the dwelling opposite.

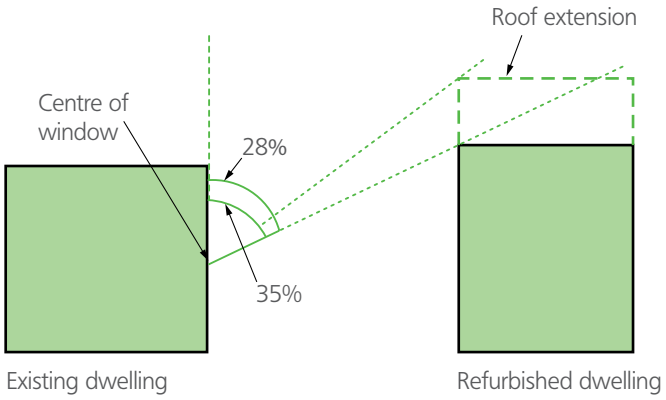

Figure 18 Assessing the impact of an extension on neighbouring properties – example 2

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Daylight within the Extension

It is important to consider the levels of natural light coming into the new spaces to ensure it is a pleasant place to be for the occupants with less reliance on electrical lighting. More information on how to consider daylighting in new spaces can be found here

Nuisance to neighbouring properties and site impacts

Excavating, in the case of subterranean extensions, and extending a building can have a significant impact on occupants of neighbouring properties such as noise, dust and additional traffic. More information on how to manage these impacts can be found here

Ventilation

New spaces require there to be adequate ventilation in order to provide a good indoor environment for the occupant. More information on how to provide adequate levels of ventilation can be found here

Heating System

The heating system will also need to be looked at. It will need to be considered whether the system will be able to cope with the extra heating demand from the new space, how practical it will be to extend the plumbing to the space and also whether there are opportunities to improve the existing heating system to save on heating costs.

Services

When providing a new space to the dwelling it is important to think about what is to be provided in the room in terms of heating, water and electrical fittings. What would need to be provided would depend on what the room will be used for.

Disturbing plants and animals

When planning an extension it is important to assess whether any plants and animals will be disturbed during the building process. More information on what to look for and what to do if there are plants in the way can be found here

Additional issues regarding increasing the footprint

When extending the footprint of the property, this may affect the refurbishment project as a whole if some considerations are not taken into account such as impacts on drainage, daylighting, plants, trees and animals as well as construction site impacts on neighbouring properties. More information about what to do can be found here

Impacts on drainage

Extending a property over permeable surfaces essentially makes it waterproof, causing rainwater to take a more direct route over the land, potentially causing flash flooding in heavy rainfall events. This is known as surface water runoff. This can impact on the property itself as well as other properties that are downstream.

There are a number of solutions that can be looked at to reduce surface water runoff which are described here

Issues affecting subterranean extension

Daylight

When providing a new space underneath a dwelling, one of the biggest challenges is ensuring there is sufficient natural daylight provided for the new space.

An advanced way to provide daylight to a basement can be to install a light tube from the floors above. This can be an invasive and expensive solution and may not be possible in your refurbishment however there may be other options depending on the site.

More information on required daylighting levels can be found here

Flooding

If the dwelling is in a high flood risk zone, the planning authority may not permit a subterranean extension.

In the event of prolonged heavy rain the subterranean extension, being the lowest part of the dwelling, will be the first part to get flooded. It is important therefore to consider flood resistance and resilience measures. More information about how to make the extension as flood resilient as possible can be found here

If the basement is to be below the flood level, it may not be practical to use the space due to the high risk. If the dwelling is in a high flood risk area, your Local Planning Authority may reject the planning application. For more information contact your Local Planning Authority.

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Damp proofing

Excavating the ground to create a basement can cause problems with damp seeping through into the dwelling. It is important to make sure the materials used for the walls and floor are waterproof to ensure that water from the surrounding soil does not cause damage to the dwelling through damp.

It is important to prevent damp coming into the basement as it can be very expensive and time consuming to correct.

There are two methods of damp proofing that can be done and are described below:

Chemical Damp Proofing
This is where a chemical is injected into the wall of the basement to stop rising damp coming up from the ground.

Waterproof Rendering
This is where a waterproof lining is installed on the floor and walls of the basement to stop moisture coming through to the basement.

Potential structural damage to properties above

Consideration needs to be made with regard to the building above to make sure no damage is being done to the foundations which will affect the structure of the building above and other buildings attached to the development. It is advisable to write a Construction Method Statement which looks at the construction techniques, details of the hydrology and geology of the ground as well as the impact of the development to neighbouring properties.

Issues affecting building into the loft and above

To help decide whether a loft conversion is possible it is important to do an inspection to check there is enough space for the furniture needed for the proposed room as well as room for the occupant to move around. As a general rule a height of 2.3 metres would be needed to allow an occupant to stand up in the space. This is also to take account of the depth of space required to insulate the loft space at the rafters, which will be required in order to gain building control approval.

Disturbing plants and animals

When planning the loft conversion it is necessary to check for any bats or birds roosting or nesting in the loft space or on the roof itself. Information on what to do if any birds or bats are found is available here

Building Envelope

Another consideration to make is the addition of insulation in the rafters of the roof to create a warm environment for the occupant and reduce heat loss from the property. Consideration should also be made of the window specification to help minimise heat loss. More information about heat loss from the roof can be found here

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What is BREEAM Domestic Refurbishment?

BREEAM Domestic Refurbishment is an environmental certification scheme that is used to assess the sustainability of a refurbishment project.

The scheme provides an assessment methodology, software tool and certification scheme for those responsible for the delivery of sustainable domestic refurbishment projects. It can be used for a range of project scopes including:

- situations where a variety of alterations are being made to an existing dwelling, e.g. window replacement and new insulation
- domestic conversions and change of use projects, e.g. the conversion of a large dwelling into smaller ones, or an office building into dwellings
- refurbishment and regeneration schemes covering a large number of existing and retained dwellings.

Why undertake an assessment?

The scheme is useful as it allows the building professional to demonstrate to their clients that they are delivering a higher quality and more sustainable refurbishment, as it provides third party certification, which is provided through a network of independent assessors. BREEAM Domestic Refurbishment is designed to be used when developing refurbishment package and specifications, and to:

- demonstrate environmental credentials to clients, and to funding and planning authorities
- guide refurbishment designs by identifying the sustainability issues that should be taken into account
- reduce utility bills for occupants
- reduce risks from flooding, fire and security issues
- support initiatives to enhance the health and wellbeing of occupants.

BREEAM Domestic Refurbishment is used by a number of planning authorities in the UK as a condition of planning permission for domestic refurbishment projects, particularly where undertaking a change of use project (e.g. changing an office to residential) and also for major extension projects such as basement conversions.

How does it work?

BREEAM Domestic Refurbishment looks at a range of aspects to do with the sustainability of the refurbishment project both in terms of the performance of the building and the refurbishment process itself. The assessment method is separated into 33 issues which are within the eight categories shown in table 21

Table 21 BREEAM Domestic Refurbishment Categories

Category	What it covers
Management	Management of the overall process
Health and Wellbeing	Measures to improve occupant health
Energy	Improvements to the homes energy efficiency
Water	Installation of fittings to reduce and monitor water use
Materials	Use of sustainable materials
Waste	Reducing, reuse and recycling of materials
Pollution	Avoidance of pollution
Innovation	Exemplary and innovative approaches followed

For each issue there are a number of credits that are awarded according to how many of the requirements are met. The credits are then combined to give an overall rating for the refurbishment project: the more credits awarded the higher the rating achieved. The ratings in order of achievement is shown in table 22

Table 22 BREEAM Domestic Refurbishment Ratings

Rating	Required score
Pass	≥30%
Good	≥45%
Very Good	≥55%
Excellent	≥70%
Outstanding	≥85%

The technical manual which sets out the detailed criteria and assessment procedures is a public document and is available from here: www.breeam.com/domrefurbmanual

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How to use BREEAM Domestic Refurbishment

To get the most out of a BREEAM assessment, the following tasks should be followed in this order.

Step 1: Review the technical guidance document

Reviewing the guidance at an early stage of the refurbishment project gives an overview of the range of issues that need to be addressed in order for it to be sustainable. This guide should also be followed in order to help consider how the projects will be delivered on site and through the refurbishment specification

Step 2: Contact an assessor

BREEAM Domestic Refurbishment Assessments are carried out by qualified and licensed BREEAM Domestic Refurbishment assessors who are independent of the refurbishment project and is normally appointed by the refurbishment project manager or client. There are a wide range of assessors available and all licensed assessors are listed on www.greenbooklive.com.

Step 3: Get a Pre-Assessment Estimation

The pre-assessment estimator is an informal assessment that can be used to give an indication of what rating can be achieved, prior to conducting a formal assessment. The pre-assessment estimator is available for free and can be found at http://www.breeam.org/login.jsp via a registration page. It is normally best to use this with a licensed assessor, who will know the requirements of the scheme in much greater detail.

Step 4: Carry out a formal assessment

There are two types of assessment available; Design Stage and Post Refurbishment Stage. Certification can be gained at each stage, with design stage leading to an 'interim' certificate, which is an option stage. The Post Refurbishment stage leads to a 'Final' certificate. All projects are then listed on www.greenbooklive.com.

1. Design Stage Assessment
This is done at the design stage of the project and is used to make sure that the refurbishment design specifications meet the criteria. It is recommended that a design stage assessment is carried out in order to guide the refurbishment process.

2. Post Refurbishment Stage Assessment
The post refurbishment stage is done at the end of the refurbishment to confirm the final 'as-refurbished' performance of the project. This post refurbishment stage assessment confirms that the design stage specification have been implemented on site. This can be done after the design stage assessment or the refurbishment can be assessed only at Post Refurbishment stage without doing a Design Stage Assessment.

Step 5: Gain certification

Once a design stage or post refurbishment stage assessment has been conducted the assessor will write a report using the evidence you have supplied. This report will then be issued to BRE Global who, as a UKAS accredited certification body, is responsible for issuing certification and conducting Quality Assurance (QA) of the assessors report.

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Further Reading

Below is a list of publications that supplement this guide.

General Guidance

BREEAM Domestic Refurbishment 2012 Technical Manual http://www.breeam.org/domrefurbmanual/

Construction Products Association, 'An Introduction to Low Carbon Domestic Refurbishment' http://www.constructionproducts.org.uk/fileadmin/client/cpa/documents/Sustainability/Domestic_Refurbishment_Revised_low_res_.pdf

Energy Saving Trust, CE309, Sustainable Refurbishment http://www.energysavingtrust.org.uk/Publications2/Housing-professionals/Refurbishment/Sustainable-Refurbishment-2010-edition

Institute for Sustainability, Retrofit Guides, http://bob.instituteforsustainability.org.uk/knowledgebank/retrofitguides/guide-6/Pages/6.1--Introduction.aspx

Planning for Refurbishment

Building Control Notification http://www.competentperson.co.uk/pdfs/buildingworkleaflet.pdf

A Simple Guide to Site Waste Management Plans, Environment Agency, http://www.environment-agency.gov.uk/static/documents/NetRegs/SWMP_Simple_Guide_Feb_2011.pdf

Considerate Constructors Scheme www.ccscheme.org.uk

Surveying the Local Area

How to protect your property from flooding (BRE, the University of Manchester and Manchester Metropolitan University) http://www.bre.co.uk/filelibrary/pdf/projects/flooding/Property_owners_booklet_v2_web_(2).pdf

Improving the Building Envelope

Good Practice Guide for Installing Windows and Doors http://www.ggf.org.uk/assets/W&D_Good_Practice_Guide-4ec42d0c5aa21.pdf

Site Readiness Checklist for Sound Testing and Airtightness http://www.nhbc.co.uk/ProductsandServices/ConsultancyandTesting/Acousticservices/documents/filedownload,46550,en.pdf

Approved Document Part E (Resistance to Sound) http://www.planningportal.gov.uk/buildingregulations/approveddocuments/parte/

Legal and Responsible Sourcing, WWF http://sourcing.gftn.panda.org/

Secured by Design http://www.securedbydesign.com

Approved Document K (Protection from Falling) – protection from falling from windows http://www.planningportal.gov.uk/uploads/br/BR_PDF_AD_K_2013.pdf

Approved Document B (Fire Safety) – escape from fire via windows http://www.planningportal.gov.uk/uploads/br/BR_PDF_AD_K_2013.pdf

A clear guide to flooding for property owners, RICS http://www.rics.org/Global/Downloads/A_clear_guide_to_Flooding_for_property_owners.pdf

Approved Document Part L (Conservation of fuel and power) http://www.planningportal.gov.uk/buildingregulations/approveddocuments/partl/

Energy Saving Trust, CE120 Energy efficient loft conversions, http://www.energysavingtrust.org.uk/content/download/2615/61590/version/1/file/CE120+-+energy+efficient+loft+extensions.pdf

Fittings Fixtures and Components

Building Services Compliance Guide for Dwellings http://www.planningportal.gov.uk/uploads/br/domestic_building_services_compliance_guide.pdf

Approved Document B – where to locate smoke and heat detectors http://www.planningportal.gov.uk/uploads/br/BR_PDF_AD_B1_2013.pdf

Advice on Carbon Monoxide Detectors http://www.hseni.gov.uk/co_detector_advice.pdf

Indoor Air Quality

Approved Document Part F http://www.planningportal.gov.uk/buildingregulations/approveddocuments/partf/approved

Lead Paint Safety Association http://www.lipsa.org.uk/

Health and Safety Executive – Lead – When are you most at risk? http://www.hse.gov.uk/lead/mostatrisk.htm

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