www.bre.co.uk

External Wall Insulation (EWI) Project guide

Procurement guide for EWI, tailored for Local Authorities and RSLs

Prepared for: **Welsh Government**

Date: 16 April 2018

Report Number: **P107357-1000** Issue 1

BRE Wales & South West
Ethos
Kings Road
Swansea Waterfront
SA1 8AS

Customer Services 0333 321 8811

From outside the UK:
T + 44 (0) 1792 630100
F + 44 (0) 1792 630101
E enquiries@bre.co.uk
www.bre.co.uk

Prepared for:
Welsh Government
Cathays Park
Cardiff
CF10 3NQ

Prepared by

Name Dr Caroline Weeks

Position Senior Consultant

Date 16 April 2018

Signature

Authorised by

Name Colin King

Position Director, BRE Wales

Date 16 April 2018

Signature

Table of Contents

1 Introduction

This publication was commissioned by Welsh Government to primarily help Local Authorities (LAs) and Registered Social Landlords (RSLs) understand the necessary considerations required to ensure a responsible, high quality building retrofit with external wall insulation (EWI). It will also likely be useful to private home owners considering such measures, but it has been written with a focus on housing stock owners who are likely to be undertaking area-based improvement schemes. The overall approach should also be relevant for those considering internally applied wall insulation (IWI) as a refurbishment measure, although it is acknowledged that such installations are not currently covered by all funding/ subsidy schemes.

The aim of this publication is to highlight potential risks and subsequent consequences that can arise when EWI installations do not follow best practice principles, while offering guidance on processes that can be implemented to reduce or eliminate such risks. It should help clients assemble an appropriate team of professionals to plan and deliver the EWI works and ensure that procurement specifications include the level of detail necessary for a robust design approach and quality installation.

1.1 Background

It is estimated that around 80% of the existing UK housing stock will still be in use in 2050[1]. Retrofitting buildings to improve their energy efficiency is therefore clearly an important step towards the UKs greenhouse gas reduction targets, while simultaneously managing people's spending on energy and addressing social issues associated with fuel poverty. Most of the 'easy/ cheaper' retrofit measures have already been tackled across the housing stock, such as installing cavity wall insulation, loft insulation and upgrading heating systems and controls. Attention must now turn to the harder to treat dwellings that typically offer the greatest scope for improvements and energy savings. These include:

- Solid wall (brick or stone) dwellings with no cavities
- Non-traditional 'system-built' properties (such as steel frame or panelised concrete)
- Properties with narrow cavities between walls where installing cavity fill insulation is deemed unsuitable due to the risk of damp ingress

In Wales, it is estimated that approximately 25% of dwellings are of solid wall construction, 4% non-traditional system build and 11% narrow cavity construction (assumed as cavities built before 1945)[a]. Improving the thermal performance of dwellings with these wall types is done by applying insulation to either the internal or external façade, which is a significantly more costly process than the more common improvement measures mentioned earlier. It can however considerably reduce energy bills and improve comfort in such dwellings.

Unfortunately, recent studies[2] have identified instances of undesirable side effects when homes have been retrospectively insulated, affecting both cavity and solid wall dwellings. This has resulted in increased condensation and mould growth in dwellings and subsequent damage to the building fabric. While the specific mechanisms of failure may be different depending on the type of construction, investigations have suggested common underlying causes that span procurement, installation and maintenance, including:

- Poor surveying standards
- Lack of a robust system design
- Selection of properties inappropriate for the chosen measures (based on property features, condition and/ or levels of weather exposure)
- Poor specifications/ details employed to address the levels of exposure and/ or the potential for thermal bridging
- Lack of onsite quality checking
- Lack of ongoing checking and maintenance following insulation works

The costs of rectifying problems that arise will often far exceed the initial cost of the measures, not to mention the adverse physical affects and inconvenience experienced by occupants. It is therefore imperative that stakeholders properly appraise and address the risks that may be associated with retrofit measures – particularly solid wall insulation – to ensure long lasting energy savings and healthy indoor conditions while protecting the longevity of the building fabric.

1.2 Existing reference sources

There appears to be little existing information available aimed specifically at clients looking to implement EWI. The UK Green Building Council retrofit task group carried out a high level search of literature sources related to domestic refurbishment, including EWI. While numerous technical standards exist covering some very specific aspects of

[a] From Living in Wales survey 2004, taking account of new house completions between 2004 and 2017 from StatsWales housing statistics.

installations (e.g. detailing of flue penetrations for external wall insulation), there are few documents offering fully rounded information of all aspects of such systems.

There are however a number of resources that could provide useful additional information and further reading on specific issues to supplement this document. These are set out below. While some offer information on enhanced detailing and measures to minimise risks, no guidance can fully capture all of the potential variations that may arise on any given building. This publication therefore recommends a robust approach suitably resourced with necessary technical expertise to react to any bespoke circumstances or site issues and thus ensure a high quality, durable EWI installation.

Manufacturer guidance and details

EWI system manufactures may produce their own guidance information, targeted towards their approved installers. They will provide a range of 'standard construction details' relating to the installation of their products, but these usually only cover the most common junctions and installation situations, since bespoke circumstances cannot be known. This product-specific information will usually form the basis of any guarantees that are applicable, with 'non-standard' details often being excluded from such guarantees.

Developer guidance and details

Some developers involved in large scale area-based EWI implementation schemes may produce their own guidance documentation beyond that provided by system manufacturers, to ensure a standardised approach across their different sub-contracting teams. By necessity, information is likely to be quite broad and may not cover all construction situations. However, they are more likely to cover detailing for situations that they have established will be common across their installation programme, including obstacles and fixings that may go beyond manufacturer's system-specific guidance, e.g. integration of fixing/ mounting points, etc. Such guidance is not very common and may not be widely available, instead only accessible by their chosen sub-contractors.

Industry-wide technical guidance and details

Some general guidance is available from industry trade associations, such as INCA (Insulated Render and Cladding Association), examples include:

- INCA, 'Best practice guide for external wall insulation' (2015)[3], which provides information about typical composition of EWI systems, types of products and 'an accepted minimum standard for all installations'. Much of the guidance is tailored towards installers, although it provides details of completion checks that would also be of relevance to clients (or clients' representatives). A selection of junction details are presented, however it is noted that some details may lead to cold bridging, issues of localised surface condensation and a reduction in the effectiveness of the applied insulation.

- Additional documents are available, including technical guidance on fire protection, wind loading and fixings for EWI. There is also an installation checklist and information about the safety of fuel burning appliances with EWI, plus a selection of common junction details ranked with a traffic light system according to their thermal bridging risk to meet basic requirements of PAS 2030 2017 for detailing. These documents and others, including the best practice guide mentioned above are available via: https://www.inca-ltd.org.uk/knowledge-hub/guidance/

Independent organisations have produced documents aiming to supplement industry-led guidance, inform about potential risks and encourage genuine best practice. Examples include:

- BRE Report FB61, 'Reducing thermal bridging at junctions when designing and installing solid wall insulation' (2013).[4] This quantifies the effects of thermal bridging at key junctions as a result of internal and external wall insulation and sets out concepts for improved detailing.

- BRE Report FB79, 'Designing out unintended consequences when applying solid wall insulation' (2016)[5], covers potential risks and undesirable effects that can arise with internal or external wall insulation and sets out considerations and processes to avoid these problems.

- BRE Report BR135, 'Fire performance of external thermal insulation for walls of multi-storey buildings' (2013)[6], is referenced in the Building Regulations and provides design methodologies to reduce the risk of fire spread across EWI systems, particularly in high-rise buildings.

- 'A Bristolian's Guide to solid wall insulation' (2015)[7], was developed for Bristol City Council's 'Warm Up Bristol' initiative by a team led by the Sustainable Traditional Buildings Alliance (STBA). The document offers general guidance on the overall implementation of EWI, particularly focussed on home owners. It provides good coverage of the considerations required to avoid risks in order to deliver high quality installations.

2 Typical risks and unintended consequences from EWI

Investigation of a number of EWI installations has revealed a range of consequences that have occurred in dwellings after the application of insulation. These are summarised briefly in Table 1 and can lead to premature failure or underperformance of the insulation system, or adverse effects on the occupants.

It may be concluded that the only way to avoid some of these unintended consequences (e.g. visual and aesthetic aspects, practical loss of space) may be to decide not to undertake the insulation measures at all. For others, common physical factors/ variables contribute to many of the problems, particularly **moisture, ventilation and thermal bridging**[b]. These issues are often linked, for example the presence of moisture is often exacerbated by inadequate ventilation. The control of these factors will ultimately determine whether adverse consequences are experienced. These physical factors are associated with the consequences as indicated in Table 1.

Risks can be managed by setting out adequate requirements within the specification of works for all parties/ professionals, to ensure:

- Sufficient and accurate detail is captured within surveys, as discussed in section 3
- All features of a system are specifically designed (and priced)
- Workmanship undergoes quality checking at regular, key stages, as set out in section 4.4
- There are robust handover processes with information for the occupants/ building managers to understand ongoing maintenance requirements

The risks and consequences are explored in more detail in BRE Report FB79, ‘Designing out unintended consequences when applying solid wall insulation’.[5] The subsequent sections of this document cover a strategic approach with the ultimate aim of eliminating or reducing the risk of these undesirable issues.

[b] A thermal bridge is a term given to any part of the building envelope where there is an increased heat flow compared with the adjacent parts. This creates areas of reduced temperature at internal surfaces since heat moves away from these areas more readily (hence the phenomenon is also often called ‘cold bridging’). If temperatures become too low, there is a risk of surface condensation and mould growth.

Table 1: Unintended consequences that may be experienced as a result of EWI installation

Consequence	Description	Physical contributing factors
Property value	The effect of solid wall insulation on property value is uncertain. While some value may be assigned to the reduced energy consumption that will result, the property value may be reduced if some aspects of the aesthetics are poor (see undesirable visual changes below) or if space is reduced.	N/A
Reduced daylight	Solid wall insulation can reduce internal daylight factors through increasing the depth of the window reveals and by adding additional insulation within the reveals (which should be a fundamental part of any installation). This may reduce daylight and solar gains to some extent and may lead to marginal increased energy use from lighting.	N/A
Reduced durability/ need for on-going repairs	Solid walls with no insulation applied are generally very robust, sturdy structures. The introduction of lightweight insulation materials at the exposed surfaces that are less resilient to impacts and potential damage may lead to the need for occasional repairs to maintain the integrity of the wall.	N/A
Disturbance to occupants during works	The installation of solid wall insulation has the potential for disturbing not only the occupants but also the surrounding vicinity, with the need for scaffolding, deliveries and other incidental activities. This could be a disincentive to some occupants to undertake such improvement works.	N/A
Potential elevated risk of fire spread in mid/ high-rise buildings	Externally applied insulation has the potential to offer a pathway for the spread of fire up the outside of buildings if not adequately controlled and designed. This is mainly only a concern in taller buildings (>18m) that may be out of reach of conventional fire-fighting techniques.	N/A
Overheating	This has been observed in buildings but it is also possible to forecast through simulation modelling. The addition of extra insulation can keep unwanted heat within buildings, particularly in warmer, summer months. Perversely, this may result in increased energy use from mechanical cooling, which would undermine savings made during the heating season.	Inadequate ventilation

Consequence	Description	Physical contributing factors
Increased relative humidity and associated damp and mould growth	The installation of solid wall insulation often improves the airtightness of a building as it seals a number of uncontrolled air leakage pathways. Although this has the positive effect of reducing heat loss, an increase in internal humidity can occur if there is inadequate ventilation provision in the building. This can lead to condensation problems and create the potential for mould growth. These factors can subsequently exacerbate health complaints, such as asthma.	Inadequate ventilation Excessive moisture
Reduction in indoor air quality	Improvements in the airtightness without associated consideration of the ventilation provision in the building can lead to reduced air quality for occupants, increases in CO_2 concentrations and other indoor pollutants.	Inadequate ventilation
Short term concentrations of VOCs	Improvement in the airtightness and reduction of uncontrolled air leakage can lead to increased concentrations of volatile organic compounds from solvents and adhesives likely to be used during the refurbishment. These can have both short and longer term effects on the health of the occupants.	Inadequate ventilation
Elevated radon concentrations in dwellings	In areas of the country prone to radon emissions from the ground, increased airtightness (without adequate ventilation) following the installation of solid wall insulation could increase the radon concentrations in a dwelling, which can lead to health problems. For maps of affected areas and general radon information see www.ukradon.org	Inadequate ventilation
Presence of dust mites and other insects within the home	A number of household pests including dust mites, bed bugs and clothes moths are more active and prevalent in higher humidity environments, which can arise following the installation of solid wall insulation without adequate ventilation.	Inadequate ventilation Excessive moisture
Negative influence on neighbouring property	In some circumstances, the installation of solid wall insulation on one property can affect uninsulated neighbouring dwellings, as the relative temperatures of the walls will be adjusted. New thermal bridging can result, which may cause increased condensation risk and potential for mould growth in places where there were previously no problems.	Thermal bridging Excessive moisture
Creation of new thermal bridging/ condensation points	Application of insulation can create new thermal bridging points in the structure. As well as undermining the anticipated thermal performance of the newly insulated wall, it can also lead to increased risk of condensation formation and mould growth at these points.	Thermal bridging Excessive moisture

Consequence	Description	Physical contributing factors
Rot and/ or insect attack on structural timbers	If structural timbers are not kept dry they become more prone to degradation from rot and/or insect attack, which can cause subsequent structural problems. Intermediate floor joists and roof timbers may be particularly susceptible to this where the insulation applied creates new thermal bridging, reducing the temperature at points within the timber, making it prone to condensation.	Thermal bridging Excessive moisture
Failure of internal surface finishes	If moisture is not removed from the dwelling and damp is trapped within the walls, it can cause delamination of internal finishes.	Excessive moisture Inadequate ventilation
Interstitial condensation	If moisture is not adequately controlled within the insulated wall, it is possible that it can migrate to parts of the wall that are sufficiently cold for it to condense. It may also be possible for water to directly penetrate behind the insulation if seals are inadequate or compromised by degradation over time. This can cause damage to the wall structure and potential mould growth out of sight, which could go unnoticed for a considerable time.	Moisture
Undesirable visual changes	The use of external wall insulation may have a significant impact on the appearance and character of buildings. Some detailing may be visually undesirable at difficult junctions if badly designed. Also, steps and staggers are often introduced when EWI installations are selectively ‘pepper potted’ across rows of dwellings rather than installed on all linked dwellings. As well as visual issues, these points typically also create areas of increased thermal bridging.	Thermal bridging

3 Property selection and regulatory considerations

3.1 Whole house approach

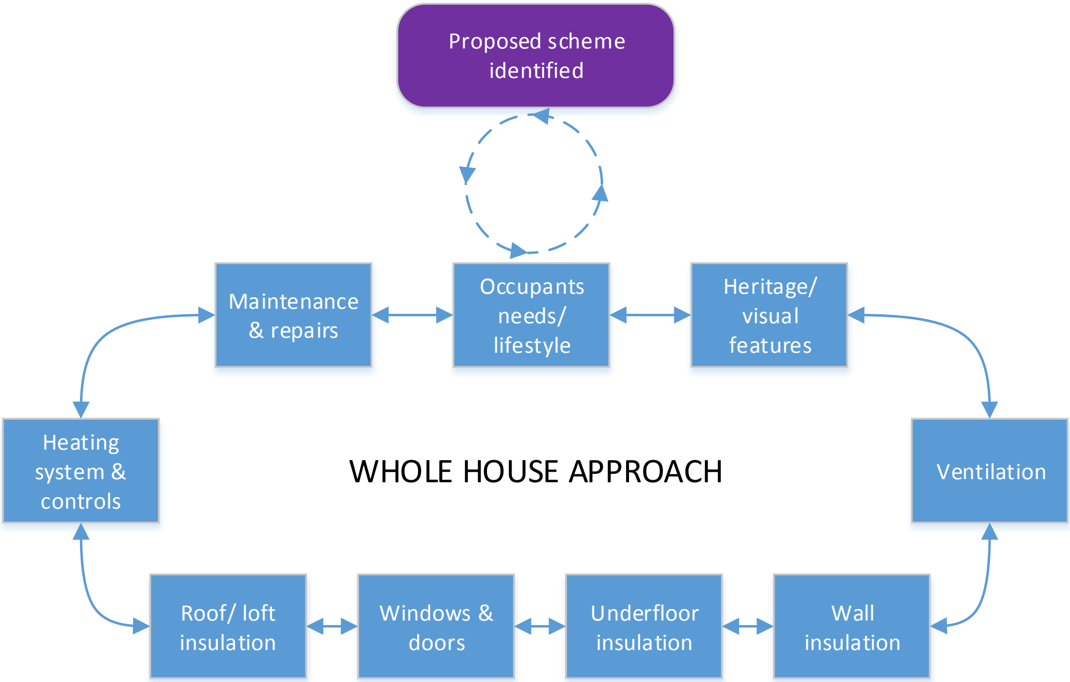
EWI should be considered as part of a 'whole house approach' for any given dwelling. The concept of the whole house approach is to ensure that potential retrofit options are considered in the context of the whole building, rather than simply as isolated measures. The operation of a building's services and the performance of its fabric are interrelated and actions in one area can have a knock-on effect in others. It is therefore important to consider these relationships to maximise the potential of the retrofit process and reduce the risk of undesirable consequences.

A whole house approach should consider multiple measures at the earliest stage to ensure the most cost effective approach overall is implemented (see Figure 1). This should consider interactions between building elements and with building services, practical installation issues, limitations and lifespan issues.

It is rarely possible to carry out all measures that may be desirable at once, but any stepped approach should not preclude any future improvements from subsequently being carried out and should not leave the building or its occupants at risk. A consequence of this is that in some cases it may be best to postpone a measure until it can be carried out alongside an appropriate complementary measure so it can fulfil its benefit without posing any risks.

This publication assumes that the whole house approach has been followed, which has led to EWI being considered as a potential option. This typically means that other low cost, low risk, high benefit measures have already been considered and actioned where possible, such as loft insulation, cavity wall insulation where applicable and viable, high efficiency heating systems and controls. The selection process that follows keeps the 'whole house' principle at its core and, in particular, a number of the recommended survey actions are intended to verify the suitability of EWI relative to other components of the property and highlight where complementary actions should be considered.

Figure 1: All aspects of a building should be considered through the whole house approach



3.2 Planning, Building Regulations and Highway Authority approvals

As a first 'gateway' in the property selection process, the likely planning requirements and/ or highways approvals should be considered. This could fundamentally influence whether EWI is possible or whether alternative measures should instead be sought. It is worth addressing this as a priority so effort is not wasted if these approvals cannot be granted.

The Welsh Government has introduced 'permitted development rights' for the installation of EWI on houses, where planning permission is not required, subject to certain conditions. For flats and commercial properties, planning permission may be required for the installation of EWI. Further details on whether planning permission is likely to be required are contained within 'External Solid Wall Insulation: A Planning Guide for Householders[8]. Local planning authority can also advise whether a proposal requires planning permission.

It will also be necessary to seek permission from the local Highways Department if the building fronts direct onto an adopted road or pavement. They will wish to ensure that the EWI would not result in unacceptable narrowing of a highway. A permit would also be required if it is necessary for temporary scaffolding to obstruct part of a highway.

Since the application of EWI will represent a change to a thermal element (i.e. external walls), it will generally be necessary (with some exceptions for minor works) to notify and submit an application to the preferred Building Control body prior to commencement of any work (i.e. Local Authority or private Approved Inspector). They will check the building work for compliance with the requirements of the Building Regulations and on satisfactory completion will issue a completion certificate. Alternatively, work can be completed by an installer registered with a Competent Person Scheme. These schemes, authorised by the Welsh Government for Wales and the Department for Communities and Local Government (DCLG) for England, give people who are competent in their field the ability to self-certify that their work complies with the building regulations without the need to notify and submit an application to a Building Control body, thus avoiding their associated fees. The Local Authority will be notified by the Competent Person Scheme on completion of the works. Installers registered with a Competent Person Scheme must follow certain rules and meet a range of minimum technical competency requirements.

A decision tree relating property selection to these regulatory processes is included in Figure 2.

3.3 Determining property suitability

There are numerous considerations when deciding if a property is likely to be suitable to receive EWI. Some may be determined quite quickly from a brief, **high level survey** and may represent another ‘pass/fail’ decision gateway. Other items will inevitably need a more **detailed survey** for thorough exploration of a building’s condition and characteristics. At this stage, a building may be deemed unsuitable to receive EWI or the survey will aim to capture sufficient detailed information to inform the system design process. After determining technical viability, a final consideration will be to **check practicality issues with occupants** by considering the occupants’ circumstances and whether they will cope with both the short and long term implications of the new insulation.

It is possible that these various steps may be done at different times (during an area-based feasibility assessment for instance) and will not necessarily be carried out by the same surveyor. However, it is important that personnel with an adequate level of knowledge required for each stage are employed and that the findings from each step are considered together and hence there is central oversight of the whole process.

A decision tree setting out the overall property suitability assessment is included in Figure 3. (The regulatory decision process would feed into the first step.) The subsequent steps are elaborated in the following sections. An example EWI feasibility survey template is also included in Appendix A.

Figure 2: Decision tree for EWI suitability within the regulatory context

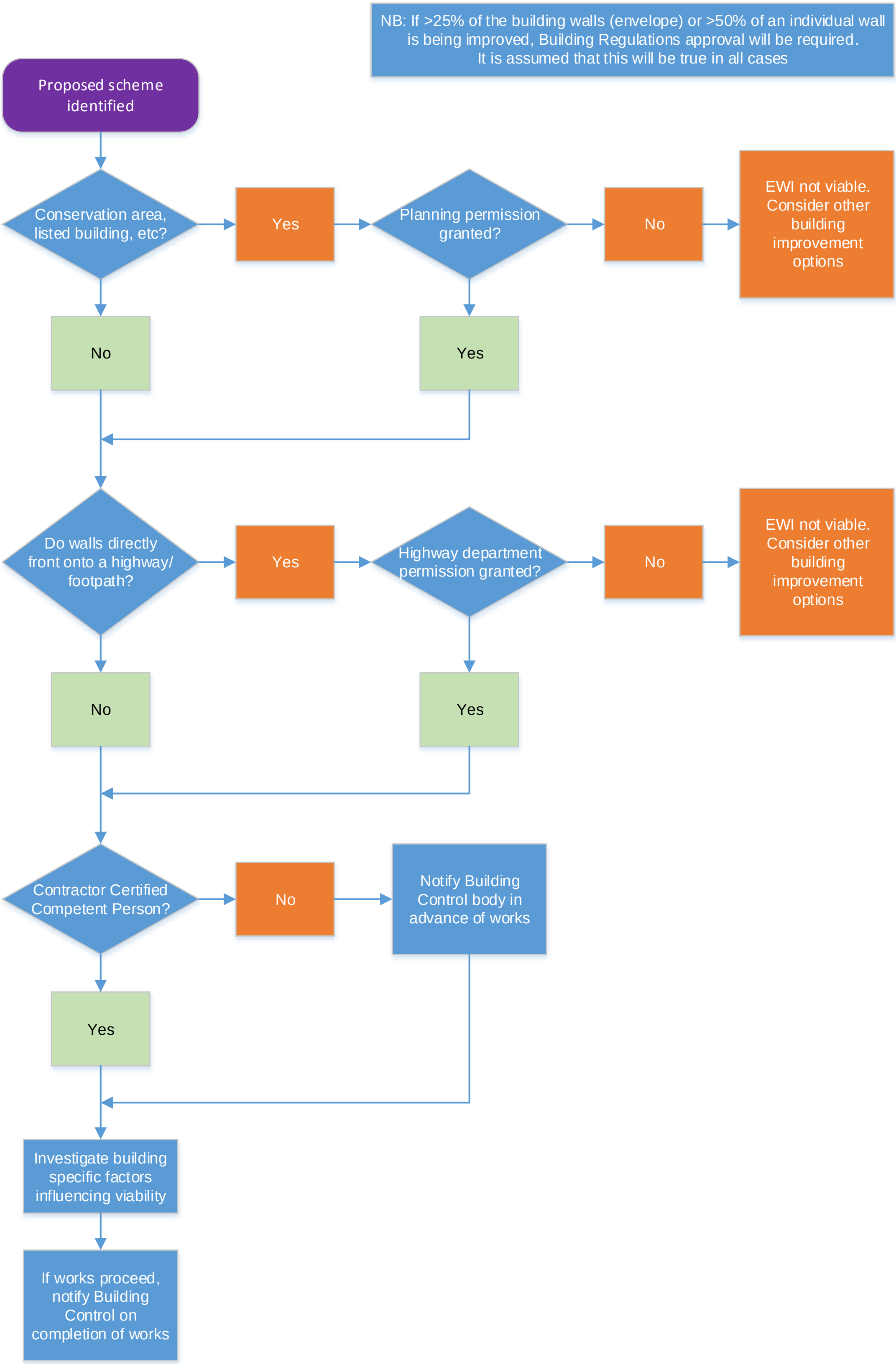
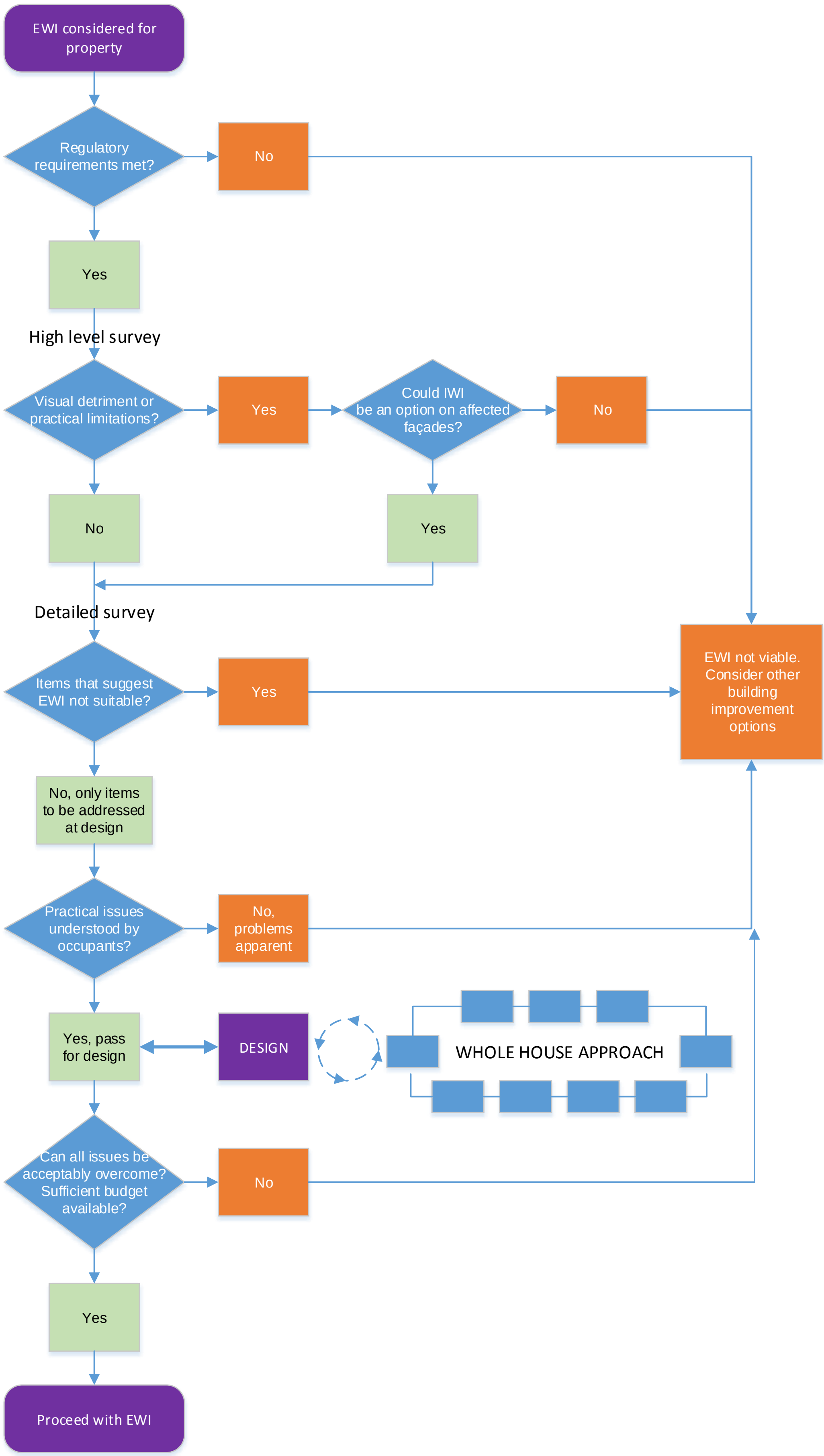


Figure 3: Decision tree for overall property suitability for EWI



3.3.1 High level survey considerations

In many cases, key issues can be established from a brief external survey of a dwelling. While many features can be determined in the first instance using modern online mapping/ street view tools, caution should be used with these since they only represent a snapshot in time and may not be representative of the current situation. A physical site visit should always be carried out to confirm findings.

Features to consider during the high level survey should include (as a minimum):

- Whether there are likely to be Planning issues or Highways approvals that could prevent the installation (changes in external appearance, walls fronting narrow roads or pavements).
- The fundamental construction type of the building, including whether there is any existing insulation. Experienced practitioners will often be able to readily determine the construction type from only an external assessment and whether there is evidence of retrospective cavity fill insulation (for relevant wall types)[c]. The thermal performance of the baseline construction will determine the savings and benefits that may be achievable and hence may influence viability.
- Visual detriment to aesthetics; if aesthetic features are to be preserved, typically the building will be unsuitable for EWI as it will inevitably affect the continuity of the insulation and undermine its performance. Even if features are not considered 'valuable' surveyors should give due consideration to the aesthetics and character of the immediate area and how EWI might impact this from a heritage perspective and also potentially effect property values.
- Practical limitations, i.e. whether there is physically space for access to install an EWI system. For example, in some cases it may not be possible to erect scaffolding to access some sections of wall. If they cannot be insulated, consideration must be given to the overall benefit to the dwelling of insulating other wall sections if high areas of heat loss will still remain; alternative measures may offer more benefit.
- Where a façade is deemed unsuitable for EWI due to the points above, internally applied wall insulation (IWI) may be considered as part of a 'hybrid' solution; IWI is applied where external features are an issue and EWI is applied on all

[c] EWI can theoretically be applied to any construction type, though it is most commonly applied to solid wall forms since they clearly cannot receive cavity fill. Some cavity wall dwellings may be considered for EWI if they have been deemed unsuitable for cavity fill due to exposure risks or cavity thickness. It is possible to externally over-clad a filled cavity, but there are diminishing returns in the benefit that may be achieved. In any case, construction condition (from detailed survey) will be imperative.

remaining façades. The viability for this would need to be assessed fully during the detailed survey stage.

3.3.2 Detailed survey considerations

If no issues arise from the high level survey that challenge the fundamental viability of EWI, a more thorough survey may progress. There is still a possibility that issues could be identified at this stage that may preclude the installation of EWI. However, if there are no major concerns, this survey will mostly seek to identify features that may require detailed consideration during the design stage of the EWI system. Further information on surveying considerations is provided in BRE Report FB79, 'Designing out unintended consequences when applying solid wall insulation'.[5] Key considerations include:

- Building condition, particularly the presence of moisture or structural damage. All would need to be rectified prior to EWI works since this could effectively seal and hide away problems.
- Specific construction composition, i.e. whether the building uses a 'vapour open or closed' strategy.
- Local exposure conditions, e.g. open aspects to prevailing weather conditions, overhangs, local obstacles (nearby buildings, trees, etc).
- Assessment of current ventilation provision. If ventilation bricks/ openings present in the walls, also determine if these are still required (i.e. if there is a combustion system still reliant upon them) or if they can now be closed up and/ or replaced by a more controlled ventilation system (e.g. mechanical vents).
- Consideration of adjacent obstacles, potential thermal bridging points and incoming services, pipes, ducts, cabling, etc that will require specific attention during design and installation.
- Condition of complementary building elements and whether wider measures are likely to be required in the short to medium term as part of the whole house approach (e.g. windows, roofs, etc). This should be considered since it would be ideal if works can be done at the same time to avoid disturbance of the EWI system in future. Also, the payback for grouped works when calculated together may compensate for individual interventions with longer paybacks.

Typical problems

Properties are often selected to receive EWI when they have fundamental characteristics that give rise to the risk of unintended consequences. If there are existing damp problems, these will be exacerbated with EWI, which will prevent the walls from drying by isolating them from external evaporative effects at warmer times of the year and also physically impeding the passage of moisture. The only route for moisture movement is then into the property, which is often poorly ventilated, giving rise to a number of the issues identified in Table 1.

There are many examples of EWI installations where the system has been inappropriately cut and finished around features that subsequently look unsightly and give rise to elevated thermal bridging. Some of the most unacceptable known examples include insulation cut around security alarms rather than removal and re-mounting, and gaps left in the insulated façade so a feature date-marked stone remained visible. Particularly relating to the latter, if there are features of the building that it is desirable to retain, they should not be considered for EWI as doing so will compromise the performance and integrity of the insulation. Instead, façades with such features may be considered for IWI as part of a 'hybrid' solution, allowing EWI to proceed on other walls with no such interruptions.

Insulation cut around security alarm

3.3.3 Managing occupant expectations

It should be remembered that whether the occupants are the home-owners or tenants, it is important that they understand how the presence of EWI may affect them in the short and long term. They should be informed of:

Short term:

- Likely level of disruption during the actual installation (e.g. space required for scaffolding, access, material storage, etc). For some occupants, this could pose a real challenge and they may need to be relocated during at least part of the works if the disruption would be problematic
- Potential timeframes, with consideration of likely weather issues (e.g. delays during periods of rain or cold temperatures if external finishes cannot be applied)

Long term:

- The full visual impact on a property, particularly its detailing at junctions and obstacles
- Minor compromises on external space, particularly adjacent to pathways

- Considerations for future use (e.g. use of specific fixing points to avoid future damage to insulation)
- The importance of adequate ventilation to keep the home healthy (as described in section 5.4)
- Ongoing maintenance requirements (as discussed in section 6.2)

If occupants cannot accept the issues (visual effects are most likely to be contentious), EWI may not be advisable despite technical suitability.

4 Selection of professionals

To ensure a robust EWI implementation process, it is necessary for clients to employ the right level of specialist expertise to help guard against the risks and unintended consequences set out in section 2. The professions and key responsibilities that should be included in their scope of works are described here. The exclusion of any is likely to mean that certain tasks do not get the required attention to deliver a high quality installation.

4.1 Surveyor

Aside from using professionally qualified surveyors, there are no particular formal qualifications specific to surveying for EWI schemes. Surveyors may specialise in different aspects, e.g. construction identification and condition, building energy performance, historic buildings. However, some of the survey requirements for EWI reach beyond these typical situations to consider practical aspects specific to an EWI installation.

As such, it is important that **the survey requirements from section 3 are explicitly set out in a scope of works** so items uncommon to 'usual' surveys are not missed. It is also desirable that surveyors should have sufficient authority and independence to advise on all features that may appear unfavourable, such that a property may be rejected for EWI if need be. If installers' surveyors are used, independent sample checking should be carried out by another party (e.g. client, designer, independent checker).

As mentioned earlier, further guidance on EWI-specific survey requirements and their importance are set out in the BRE Report FB79, 'Designing out unintended consequences when applying solid wall insulation'.[5]

Typical problems

Typical energy surveys will not usually identify the condition of building elements or likely defects that will require attention, whereas general property condition surveys will often not cover details required for energy efficiency calculations. Both of these aspects need to be addressed for EWI, along with some things that neither survey would tend to cover, such as items that will require specific detailing considerations or ventilation provision, yet these are core considerations for the limitation of potential future risks with EWI.

Additionally, there may be limited handover between the surveyors and the EWI designers to ensure that when issues are identified they are specifically addressed and priced to avoid the need for installers to improvise on site.

4.2 Designer

Designers should be aware that there is rarely a one-size-fits-all solution when it comes to the installation of EWI. Manufacturer's system designers may be able to take responsibility for many of the design aspects mentioned here, but this makes a pre-assumption that their system is in fact suitable for the buildings in question. Hence ideally an independent designer should at least be involved with verifying property selection, system selection and the suitability of the external finish, which will take into account local effects such as wind-driven rain, traffic deposition or industrial activity. The following requirements for designers should be set out as a minimum in their scope of works:

- The designer should have sufficient knowledge, authority and independence to be able to identify if a building is unsuited to EWI for any reason. Where buildings are deemed suitable on the basis that certain issues are addressed or measures taken, these should be specifically identified in each building's design and project specification and priced accordingly.
- Designers should be responsible for choosing a suitable EWI system and its complementary components and should have direct dialogue with surveyors as necessary to fully understand any given building, its location, context and associated risks.
- Assess the state of moisture equilibrium of the building components based on survey findings, following the principles and hierarchical approach set out in the STBA guide, 'Moisture in buildings: an integrated approach to risk assessment and guidance'[9] and summarised in BRE Report FB79. This may influence property suitability and EWI system selection.
- Identifying suitable details or customisation of detailing to address *all* features and junctions identified by the survey, with the aim of ensuring longevity and eliminating thermal bridging (see box on thermal bridging).[10,11] Required products should be specified and priced so installers do not have to create ad-hoc solutions on site with insufficient resources. Particular attention should be paid to window reveals, ground floor plinth, obstacles and obstructions on the façade.
- Designs should address the risk of fire spread for mid- and high-rise buildings in line with the guidance in Building Regulations Approved Document B (Fire Safety) and BRE Report BR 135.[6]
- Specify a suitable ventilation system according to the findings of the survey. Ensure that extensions are available for existing vents to pass through the EWI or specify and price new vent provision to achieve this. Sequencing the ventilation installation is crucial; it is important that the insulation layer and airtightness details around these openings are carefully planned.
- Ensure detail is included (and information specifically expressed/ passed on to the installer) on whether any existing passive ventilation points are to be

maintained or blocked up depending on whether they are still needed for combustible heating systems. There may also be scope to install modern static vents to improve draught protection if ventilation points need to remain.

- Consider future maintenance issues and how detailing could be enhanced in difficult to access areas (high level) to offer better protection to the installation (i.e. roof overhang to protect the insulation rather than relying on silicone sealant that will need to be re-applied over time).
- Ensure if complementary works (e.g. windows, roof) are proposed to be completed over a longer timeframe they are carefully planned and sequenced so each stage can be carried out without detriment to the EWI installation and so as not to preclude any other future measures.

Typical problems

There is often no independent designer actually involved in the EWI implementation process, instead installers rely on standardised details from manufacturers. There is therefore no independent assessment of the fundamental suitability of the insulation system chosen. There is little or no customised design of solutions or details according to the particular situation or exposure conditions. Instead, installers must create ad-hoc (non-standard) solutions on site.

Thermal bridging

It is acknowledged that in many cases thermal bridging cannot be completely eliminated. However, the intent here is that steps should be taken to reduce the bridging effects so they do not undermine the overall performance of the EWI. To quantify this is difficult since construction situations can vary considerably. For indicative quantifications, BRE Report FB61[4] gives examples of 'best practice' thermal bridging values for a range of typical EWI junctions. This study indicated that heat loss from poorly detailed junctions can be nearly 50% of that from all the fabric elements.

In situations/ locations where it is determined that no measures are suitable (or affordable) to reduce the effects of thermal bridging, overall property suitability for EWI should be challenged. For example, where there is insufficient width at window reveals to accommodate insulation, windows could be replaced and re-profiled to accommodate this. If windows are not due for replacement, it may be pertinent to delay EWI installation until both measures can be done in tandem. Ultimately, decisions to proceed with EWI installation will lie with the client, but they should be aware that all compromises open them up to varying degrees of risk, as set out in section 2.

In any case, features should not be permitted on a dwelling that would create a risk of condensation and mould growth beyond the limits set in BRE IP 1/06[10], i.e. the temperature factor, f_{Rsi} should be greater than 0.75 for residential dwellings. Thermal modelling of details in accordance with the guidance set out in BRE Report BR 497[11] may be required to confirm this.

4.3 Installers

PAS 2030[12] is a workmanship standard for the installation of energy efficiency measures. Installers can be independently accredited to this standard and hence it is generally recommended that they should carry this certification to work on EWI installations. The most recent version of PAS 2030 makes reference to the requirement for a design and detailing with consideration for thermal bridging and ventilation provision, hence installers accredited to this standard will be expected to make these elements central to any installation activities, whereas they may not have been in the past. Installers may also be members of an appropriate competent person scheme, which gives them the ability to self-certify their work against building regulations. Compliance with PAS 2030 is now a requirement for competent person schemes.

Installers should follow all relevant guidance provided by system manufacturers and the scheme designer. No detailing should be improvised on site and work should not proceed unless details have been provided, customised as necessary for the building in question. Installers should be empowered to raise issues or concerns for direct resolution with the project designer.

Installers should be aware that it will be necessary to notify utility/ service providers (e.g. gas, electricity, telecoms) at the earliest opportunity if any of their equipment will need to be moved to ensure insulation continuity, since scheduling such works can require a long lead time. This should be considered when programming works.

It would be expected that regular checks are made on the installation in line with method statements and appropriate checklists, which clients may wish to request to see and approve prior to the commencement of any works. Although individuals may be PAS 2030 accredited and/ or a member of a competent person scheme, it is good practice for site supervisors to carry out such checks on colleagues' work for additional quality assurance.

Depending on the procedures in place and the decisions taken by the client, the installer may also be required to provide accumulated handover information developed by the delivery team (agreed by the client and incorporating the necessary elements as detailed in section 6.3) to the owners/ occupants.

Typical problems

There is often poor communication between system designers/ specifiers and installers to convey building-specific considerations and solutions that should be implemented on site. It is not common practice for installers to stop work and seek a design clarification when faced with a non-standard detailing situation, often because there is no designer in the project team to refer to for guidance anyway. This leads to improvisation on site, which can result in detailing that exaggerates thermal bridging effects and/ or may not be robust in the long term.

4.4 Independent quality control

Although installers may be self-certified under PAS 2030 and guarantee bodies and/ or manufacturers may carry out a limited number of spot checks on EWI installations (typically from 1 to 7% of completed installations), clients may wish to have greater assurances that their installations will be carried out to sufficiently high standards in practice.

It is recommended an ‘independent checker’ is appointed by the client for the duration of the project, a role which will provide them with a holistic review at each key project stage and ensure their aspirations are achieved in practice. So as to safeguard their interests, the independent checker may actually be a member of the client’s organisation, otherwise a third party should be appointed that is independent of the supply chain (i.e. not from the manufacturer, installer or designer organisation).

It is anticipated that there would be 3 key checking stages for each building, with work not progressing until the previous stage is signed off. Allowances should be made for this within delivery programmes.

- The first review should be at the end of the initial design stage prior to works commencing on a property. This will allow the checker to review that all information regarding each property has been properly considered and that the system has been suitably designed.
- The second check will be on site following the fixing of the external insulation, but prior to the application of an external mesh or render. This will allow the checker to assess the general quality of the core installation and look for instances of poor detailing and/ or gaps in the insulation and to check that suitable mechanical anchor points have been included to fix heavier items back to the main structure.
- The last review should be on completion of the installation, with particular focus on the joints, trims and seals suitable for long term durability. Consideration should be given to access, particularly at high level and hence it may be required for the final sign-off to take place in further sub-stages to take advantage of existing scaffolding before its removal, for example.

Typical problems

There is an over-reliance on installers to sign off their own work and generally insufficient quality assurance checks take place to quickly spot and rectify poor practices. Ideally checks should be carried out by an independent organisation so there is no conflict of interest. While some surveillance checks are done by guarantee bodies and manufacturers, the small percentage of spot-checks on installations allows significant scope for variation in quality to be missed. Clients are therefore advised to introduce their own independent checking regime.

5 Selection of systems/ materials/ products

5.1 Considerations when choosing an EWI system

There are a number of factors that may influence the EWI system chosen. Essentially, the EWI ‘system’ comprises the insulation material, plus the fixings, trims, finishing materials, etc. Some systems may include several options for these associated elements, depending on circumstances or preferences. The choice of system should take into account the following issues.

5.1.1 Site exposure to wind-driven rain

The performance of any building will be influenced by the environmental conditions to which it is exposed, such as wind-driven rain that may cause elevated wetting. There may also be localised sheltering that can protect walls in otherwise relatively high exposure locations. Such factors may influence the insulation and/ or finishes that may be suitable for any given location.

Generalised exposure maps and guidance are given in BRE Report BR 262, ‘Thermal insulation – avoiding risks’[13], although this does not take account of the localised context. For areas suspected to be at elevated risk, buildings should be assessed according to BS 8104:1992, ‘Code of practice for assessing exposure of walls to wind-driven rain’.[14]

In more extreme exposure conditions, it may be pertinent for the designer to consider extra protection via the EWI detailing, such as extended eaves overhangs, wider gutters, splash protection, particular attention to the seals around windows, etc. in order to reduce the risks of moisture ingress. It should be noted that while BRE Report BR 262 suggests that EWI systems with external cladding are generally suitable in all exposure categories (1–4), it qualifies this by saying that reference should be made to manufacturer and third-party certification guidance on exposure suitability. This statement on suitability also assumes that the installation will be of high quality and, in practice, either any defects introduced through poor workmanship or the degradation of sealants over time may dramatically increase the exposure risk.

Typical problems

The acceptable exposure limit for which external finishing products are approved for use is not checked against the local exposure rating for wind-driven rain, meaning that unsuitable products could be used that increase the risk of water penetration into the EWI system.

5.1.2 Vapour open or vapour closed walls

Many older buildings used ‘breathable’ materials in their original construction, which allow some moisture to transfer in and out of a wall in natural seasonal cycles without causing damage to the wall structure. These are referred to as vapour open constructions and were typically built prior to 1919 using brick or stone with lime or earth mortar in the joints, finished with lime-based plasters, renders or paints. Conversely, the strategy in modern buildings is often to use impermeable materials to prevent moisture from being able to migrate into the structure at all. These are said to be vapour closed. After 1920, lime mortars were typically replaced by cement-based products, making walls vapour closed. This trend has continued with the use of impermeable insulation products, renders, finishes and vapour control layers across various different construction types. Risks can be introduced where these strategies are inappropriately combined – either trapping moisture in vapour open structures by preventing water from being able to evaporate out, or introducing breathable fabric elements to parts of a vapour closed structure that allow moisture to pass through and condense within the structure.

The vapour characteristics of the substrate wall should be determined during a detailed viability survey for a property (see section 3.3.2). The designer should then select a system that complements the moisture dynamics of the wall. It should be noted that although old buildings may have been vapour open when constructed, maintenance activities over the years may have introduced new materials that now effectively make the building vapour closed. If the vapour closed dynamic is now established and appears stable (i.e. no trapped moisture within the wall structure), it is likely to be more appropriate to adopt a vapour closed compatible system.

If IWI is being considered, the vapour characteristics of the substrate wall are particularly important, since the insulation will isolate the wall from internal heat sources, reducing its temperature significantly compared to the surface temperature in the room. If moisture is able to reach these colder areas, condensation will form out of sight and become trapped – the lack of heat reaching the wall means that it will be unable to dry out effectively. This is known as interstitial condensation.

For impermeable, vapour closed systems the strategy should be to ensure the wall is not wet prior to installation and the internal surface finish is well sealed using a vapour control layer (VCL) to prevent moisture migrating behind the insulation. For vapour open insulation systems, no VCL is used. Instead the insulation allows moisture to continue to pass in and out of the wall as necessary, acting as a buffer and preventing moisture from accumulating at detrimental levels at any point in the wall. Moisture is then released back out of the wall when the internal relative humidity drops. Although a partially saturated zone will exist within the wall during these times, the alkaline nature of the materials used do not create a favourable environment for the formation of mould. This will not be suitable in cases of rising damp or severe exposed weather conditions where the levels of moisture are likely to exceed the buffering capacity of the vapour open insulation. Ventilation provision within the property is also important to ensure internal humidity levels do not build up and prevent moisture from transferring back out of the wall.

Typical problems

Vapour control layers may be incomplete during installation, particularly at locations of complex detailing, or may be damaged over time, thus allowing moisture to access parts of the wall where it can condense and cause structural damage out of sight. Once present, it may be virtually impossible to dry the wall out without removing the insulation, since it will prevent heat from accessing the affected area.

Where vapour open insulants are used, there is a limit to their buffering ability that will be linked to the thickness of insulation (i.e. the extent to which it isolates heat from the wall behind). Ultimately, if the insulation is too thick there will be insufficient heat to evaporate the buffered moisture back out of the wall and the buffering layer may become saturated and ineffective. To reduce such risk it may be necessary to aim for a less stringent thermal performance target (U-value) for the insulated wall – the Building Regulations (Part L) allow for leniency against performance targets for refurbished walls where there may be technical risk. This must be discussed with the relevant Building Control body. Manufacturers of vapour open insulation products may be able to advise on appropriate limits, or hygrothermal modelling can be carried out to predict acceptable levels.

5.1.3 System accreditations

Systems will typically carry independent third party accreditations to confirm that they are fit for their declared purpose, such as BBA or BRE/UKAS certification. These accreditations are based on a range of criteria and assumptions and it should therefore be checked that they apply in the circumstances of intended use. For example:

- The system may be approved for use only with named proprietary trims or fixings. Typically accreditations will not extend to the removal or alternation of rainwater goods or other fixtures. Installer guarantees (section 6.1) may cover newly installed products but generally not adaptations to existing fixtures for which longevity cannot be assured.

- There may be limits to the environmental conditions in which finishes can be applied. It follows that when specifying external finishes, clients and designers may need to consider the time of year at which the installation will take place. Some external finishes will not apply well at low temperatures and may therefore fall outside their respective accreditation certificates. Consult with product suppliers about the suitability of different external finish options in light of the anticipated project timeframes.

- Finishes may only be approved for use in certain regions and/ or exposure conditions. As discussed in section 5.1.1, wind-driven rain exposure is ranked on a scale from 1 to 4 – sheltered to very severe – and while BR 262[13] states that external insulation systems are generally suitable in all exposure categories, some system finishes may not be accredited for use in the highest exposure levels. Building exposure should be verified and appropriate products and protective detailing features chosen accordingly.

- Most system accreditations make particular reference to certain detailing situations, however alternative details or situations for which there are no arrangement noted on the certificate are not typically covered by the accreditation. An example includes the application of insulation below the damp proof course (DPC) level – certificates will not cover this detail even though the DPC can be preserved and it considerably reduces thermal bridging compared to leaving the wall uninsulated below DPC level.

5.1.4 Maintenance requirements

The ongoing maintenance implications of any system should be assessed during the selection process in case it influences potential design decisions. Considerations include the likely ease of access for inspection and maintenance when selecting particular trims and details, the frequency with which seals may need to be renewed and the susceptibility of external finishes to accumulate dirt or biological debris that could make the building unsightly and hence require frequent cleaning. Maintenance is discussed further in section 6.2.

5.2 Properties of different types of insulation materials

EWI systems can use a range of different insulating materials. While all will achieve the primary function of resisting the passage of heat, other material characteristics may be favourable in certain circumstances. In particular, materials vary in their thermal performance, relative cost, resistance to moisture ingress, combustibility, embodied impact, etc. The most common types of insulation materials are set out in Table 2 along with key properties for consideration during product selection.

A selection of other insulation materials are available that more typically find use in IWI applications, though can also be used externally, including calcium silicate boards for use in vapour open solutions, or ultra-thin materials that will help reduce the loss of internal space. Examples of the latter include vacuum insulated panels (VIPs) comprising a micro-porous core that is evacuated and sealed within an airtight envelope, or aerogel products, which are based on silica materials derived from a gel to produce a very low thermal conductivity micro-porous structure. Both of these offer very high thermal performance relative to their thickness, allowing them to be used in locations where space is more critical. Aerogel products are sometimes adopted within trim elements of systems using more mainstream insulants to improve performance at notorious thermal bridging points, such as window reveals.

Table 2: Types of insulation materials and key properties

Type of insulation	Examples	Key properties/ benefits
Thermoset polymer	Polyisocyanurate (PIR) foam Phenolic foam	λ = approx. 0.020-0.028 W/mK Most thermally efficient mainstream insulation, hence thinner profiles for equivalent thermal performance
Thermoplastic polymer	Expanded polystyrene (EPS) Extruded polystyrene (XPS)	λ = approx. 0.030-0.038 W/mK Moisture resistant Typically the most cost effective material choice when considering performance vs cost XPS has relatively high compressive strength
Mineral fibre	Stone/ rock wool Glass wool	λ = approx. 0.034-0.040 W/mK Non-combustible
Natural fibre	Wood fibre Cellulose fibre	λ = approx. 0.035-0.060 W/mK Low embodied impact due to renewable material feedstock Some products vapour permeable

5.3 Associated system components

As mentioned above, in addition to the insulation, a system will generally comprise fixings, beads, trims, flashings, reinforcement mesh/ lath, renders, etc. The nature of the associated components can impact on the durability and performance of the overall system. Example considerations are given below.

5.3.1 Fixings

Often it is stated that EWI systems may be secured with mechanical or adhesive fixings, or a combination of both. A lot of focus is placed on the pull-out strength of mechanical fixings to secure the system to the building. However, there have been situations where the insulation has simply pulled away from the wall due to wind loading, leaving the fixings in the wall. It is therefore preferable to also use adhesive on the insulation boards in addition to mechanical fixings to prevent this suction effect and also the risk of a potential thermal bypass behind the boards. In any case, wind loading calculations should be carried out by a competent person in accordance with the standards set out by the relevant system accreditation body (e.g. BBA). See also Building Regulations Wales Circular WGC 015/2017 relating to wind loading calculations for cladding.[15]

While generally not classed as part of the EWI system itself, consideration should also be given to fixing/ mounting points for external items, such as aerials/ satellite dishes, etc that may carry a load that will need to be fixed back to the main structure. When items span the insulation layer in this way they effectively cause a thermal bridge, leading to higher heat loss and, in the worst cases, condensation or mould spots on the inside wall surface behind the fixing. It is relatively common for installers to simply install blocks of timber at these points to transfer load, however timber may degrade over time, particularly if moisture can access through the external finish. Proprietary fixings are available for many common installation situations that are thermally broken to minimise the potential thermal bridging effect while offering better longevity to the system.

5.3.2 Trims/ finishing elements

Metal trims (aluminium, stainless steel) are often used on EWI systems on the basis that they may provide a long lifespan. However, if they are not suitably thermally isolated they can introduce significant thermal bridging effects since they usually span the full width of the insulation to the outside, acting like a ‘fin’ for concentrating heat loss. For example, this is often the case with ground floor starter rails, where the thermal bridging effect as it runs around the entire perimeter of the property can actually be equivalent to leaving large sections of the wall uninsulated.

In contrast, PVC-based trims are less thermally conductive and will have a far reduced thermal impact. To illustrate, the thermal conductivity of PVC is approximately 0.17 W/mK, while that of aluminium is 160 W/mK – nearly 1000 times more conductive. Low conductivity products, such as PVC or fibreglass are therefore preferable to reduce potential thermal bridging effects. Choice may be limited when system manufacturers insist on specific trim products to complement their system and maintain their guarantee, which may ultimately be grounds for an alternative choice of system. To deliver the required level of overall thermal performance from the EWI system, in theory it would be necessary to increase the thickness of insulation to compensate for the additional heat loss through non-isolated, highly conductive trims or fixings.

More generally, in some cases it may be necessary to identify systems that include approved options for thinner profile, higher performing insulation components for use in narrow spaces, such as at window reveals, to address thermal bridging at these points rather than simply leaving them uninsulated.

Proprietary sealed beading should be used to keep water away from the insulation and improve longevity of installations rather than heavy reliance on silicone sealant. This will also reduce subsequent maintenance requirements for the checking and re-application of silicone.

5.3.3 External finishes

As mentioned above, some external finishes will not apply well at low temperatures and although accelerants can be used, they may not work well with all renders (e.g. dark colours).[16] If carrying out installation works over winter it may prove beneficial to instead specify a finish that will definitely be applicable in cold conditions, (e.g. mineral versus silicon render) even though they may carry additional steps or different considerations for future maintenance.

Some finishes may pose elevated risk of discolouration or unsightly mould growth in certain climates or exposure conditions. Consideration will need to be given to how any finish will be maintained and cleaned where necessary. (See section 6.2.)

5.4 Ventilation as a core consideration of any system

In the specification for an EWI system, clients should ensure that ventilation is considered an integral part of the installation. Existing ventilation provision should be assessed during the detailed survey stage (see section 3.3.2) and reliance on window opening for ventilation should not be deemed adequate.

Part L of the Building Regulations sets requirements for the conservation of fuel and power and Approved Document L1B (existing buildings) advises that when considering the incorporation of energy efficiency measures in dwellings, attention should also be paid to interrelated issues, one of which is ventilation. It is generally expected that the air infiltration rate of a property receiving EWI will be decreased, thus reducing existing ventilation provision. Part F of the Building Regulations sets out requirements for ventilation. Approved Document F refers to the provision of trickle vents and where the size of the original ventilation openings are not known, a range of minimum opening sizes for background ventilation are provided depending on room type. However, this is considerably less than the overall ventilation provision for new buildings (likely due to the assumption that uncontrolled infiltration rates will be higher for older, existing buildings compared to modern airtightness standards) and there is also no requirement for additional intermittent extraction ventilation.

In lieu of specific guidance on suitable ventilation rates in refurbished buildings, it is recommended that Approved Document Part F guidance for new build construction should be used as a minimum backstop. The current occupancy and lifestyle of the building users should also be considered, which may suggest that the ventilation proposals may need to exceed the Part F guidance.

The exact measures to be implemented will depend on the existing state and provision within the dwelling. If extraction fans or another ventilation system is present, it should be verified that they work adequately (i.e. to the design performance rate). If not present or not working, it would be expected that they should be fixed or new ventilation units installed at least in the wet rooms (i.e. kitchen and bathroom) to deliver suitable ventilation rates throughout the building in conjunction with background ventilation through trickle vents or other means.

Occupants are often concerned that extract fans remove valuable heat from their home and the necessary benefits of good ventilation are not well understood. When installing new ventilation units, consideration should be given to specifying heat recovery fan units able to provide adequate ventilation while preserving heat in a dwelling. These are available as single room units, which can be installed in most situations where a regular extraction unit would be used. With the benefit of heat recovery, there is a greater likelihood that occupants will use the fans rather than switch them off, thus avoiding potential problems of moisture build up and condensation.

Typical problems

Historically, ventilation has not been considered in tandem with EWI, which has just been treated as an isolated improvement measure rather than considering the whole house approach and subsequent knock-on effects. The rate of background infiltration is typically reduced through the retrofit, meaning that if the ventilation appeared adequate prior to the measures (often this is not even the case) it may no longer be sufficient after EWI installation.

Moisture build up is the cause of numerous potential problems, as discussed earlier, with the most obvious to occupants being condensation forming on internal surfaces or mould growth. It should be noted that mould can begin to form at relative humidity levels as low as 65% and does not necessarily require condensation to first occur. The only way to safeguard against this is to ensure adequate ventilation rates to remove moisture from buildings. Otherwise, there is a high chance of mould complaints occurring in buildings that have not previously experienced any such problems.

6 Guarantees & Maintenance considerations

6.1 Guarantees

Guarantees are important to provide assurances that work is carried out to a high standard and to offer a route for rectification if problems were to arise. However, the guarantee market can be confusing, particularly relating to exactly what is and what is not covered and there is often low awareness of obligations on the client/ customer side that may invalidate a guarantee if not followed. Consumer protection across the energy efficiency and renewable energy sector was the area of focus for the recent independent report carried out for UK Government, 'Each Home Counts'.[17] This report proposes a 'single promise guarantee' for any type of energy/ efficiency measures or systems; a single guarantee for the consumer that covers the installation of the product, the materials and their manufacture. Progress on this aspirational future standard should be followed, but in the meantime clients will need to make their own decision on which guarantee is most suitable for their needs and should be mindful of the types of guarantee that may be required for works to meet particular funding requirements. For example, Ofgem maintains a list of guarantees that they have reviewed and consider meet their own criteria for an 'appropriate guarantee' for works under the Energy Company Obligation (ECO) scheme.[18]

Clients need to be aware of any limitations of proposed guarantees. Guarantees should be in place to cover all phases of the design, the system and its installation. It should be noted that often associated works may not carry the same level of guarantee as the main system, e.g. for associated pipework fittings, installers will often not cover extensions to original pipework (if not replaced with new), or silicone seals, which would be expected to be replaced periodically over the life of the system (i.e. classed as ongoing maintenance and beyond the scope of initial guarantee).

Items to check for guarantee cover include:

- All components of the insulation system, including any fixings and trims, plus any proprietary items that may fall outside the main 'system' but may offer improved durability solutions or reduced thermal bridging, e.g. fixing anchors, enhanced verge and eaves trims with integrated gutters, etc.
- All design details, including bespoke detailing required for a specific building situation beyond simply the standard manufacturer details and arrangements that are enhanced to reduce thermal bridging, such as insulation below DPC level to ground (while maintaining the DPC via a break-channel in the insulation).
- All pipework, ductwork, rainwater goods, etc that have had to be altered or extended to successfully install the EWI system.
- Any ventilation units that have been newly installed to complement the EWI installation.

- Installers workmanship relating to any of the above items.

For EWI the following types of guarantee may be offered:

6.1.1 Industry backed guarantee

These are independently backed guarantee schemes covering defects arising from the design, workmanship or materials of EWI systems (plus internal and hybrid systems where relevant). Works must be completed by installers registered under the relevant scheme using certified systems. The guarantee will remain in place even if the installer ceases to trade. It will also pass on with a change of ownership. The schemes include a level of surveillance and installation monitoring by the guaranteeing body and guarantees are valid for up to 25 years. Such guarantees are typically required for government-backed schemes and funding mechanisms, but are not mandatory on private schemes. However this level of guarantee would be recommended in all cases to offer the highest levels of consumer protection, which is usually a longer term than any product-specific or company-offered guarantees. Examples from the Ofgem list of appropriate guarantees include the Solid Wall Insulation Guarantee Agency (SWIGA) and the Kinnell ECO Guarantee.

6.1.2 System manufacturer product guarantee

System manufacturers offer product guarantee that will cover problems directly caused by an inherent defect in the basic system for periods of 10 to 25 years. Work should be carried out by an approved contractor and the manufacturer's specification and application procedures must have been followed. Suppliers will generally have to apply to the manufacturer for approval of any 'non-standard' detailing beyond the generic guidelines. These guarantees will not cover any installation issues, only problems directly caused by the materials themselves.

6.1.3 Company workmanship guarantee

Independent schemes may be offered to provide insurance protection in the event an installer ceases to trade and therefore is unable to meet their workmanship obligations. Cover may be in place for up to 10 years depending on the policy. An example from the Ofgem list of approved guarantees includes the GDGC Workmanship Guarantee Scheme.

Typical problems

Some guarantees may not cover all aspects of the required works and it may not be clear to building owners from the outset that some features may effectively carry enhanced risk by being omitted from a guarantee. Owners also often do not realise that guarantees may be void if the installation is deemed to have not been adequately maintained, or if it has been disturbed for any reason, such as seals around window reveals being broken during window replacement. Any proposed actions that may compromise the EWI should be consulted with the guarantee provider to establish an acceptable way forward.

6.2 Maintenance

A common cause of building damage and guarantee invalidation is if systems are not reasonably maintained, protected and repaired by the owner such that it jeopardises the installation. The importance of ongoing checking and maintenance should therefore not be overlooked. It is likely for managed properties that formal maintenance checks may only be carried out once a year at best, hence it is important to engage the building occupants and encourage them to be vigilant to potential issues that may arise and be detrimental to the EWI installation.

There may be areas of the installation that are not easily visible and hence not readily checked, such as seals and finishes at roof level, like the example shown in Figure 4. The implications of carrying out such checks should be considered at the start of the EWI decision process, as indicated in section 5.1.4. Choosing more expensive, better protected detailing at roof level during the design process may ultimately be preferable if it allows a reduced maintenance regime compared to the ongoing burden of checking less robust details more frequently.

Figure 4: Example of EWI system capped at roof gable level, not protected by an inherent roof overhang

Below are some key points for regular inspection that would require swift rectification. If checks are carried out at least annually with more obvious and substantial problems likely to be picked up by the occupants in the meantime, any potential damage should be limited and, particularly for moisture-related problems, should return to low risk conditions after the opportunity to dry out over a summer season.

- Silicone sealant used around windows and verges can degrade quite quickly. These areas should be checked regularly and are likely to need re-sealing every few years. If the seals are not maintained, moisture may enter behind the insulation layer and become trapped, causing damage to the insulation and building structure. This should be a particular consideration for details used at high level (upper floor windows, roof eaves, gable) where access will be difficult for checking and re-application.

- Any cracks in the external finish due to movement/ settling or other damage should be quickly rectified, again to prevent potential moisture ingress behind the insulation.
- Faulty rainwater systems and blocked gutters are a common cause of building damage, allowing excessive water to reach areas of the façade that should usually be protected. Gutters and drains should be inspected and cleaned regularly and any leaks or overspills addressed immediately. External finishes may not be rated for such elevated and consistent wetting, thus opening the system up to water damage.
- If the type of render finish is prone to discolouration through the build-up of organic particles, it may be necessary to carefully wash the surfaces periodically. This is not a structural risk but may be required for the system to be considered acceptable in the long term and not become unsightly. Care should be taken not to damage the render or insulation with too powerful a washer and the time of year for such activities should also be considered; preferably during the summer when it is dryer and additional wetting is less likely to increase the moisture risk of the building.

Typical problems

Handover between the installer/ supplier and the home owners or occupants is often inadequate and they are not informed of items that ideally require regular checks to ensure the EWI remains intact over its intended lifetime. The consequence is that guarantee may be found to be invalid if notable problems then arise.

6.3 Owner/ occupant handover pack

There may be some differences in the nature of a handover pack depending on whether the buildings are owner occupied or whether they are rented. For example, guarantee certificates are likely to be filed centrally by landlords, rather than being passed to tenants. The scope of guidance provided to occupants may also vary depending on the extent of works that they are permitted to do themselves and that which should be notified to the landlord. In any case, key information should be passed to the occupants to ensure the EWI system is effective and durable.

Information that should be included in a handover pack for an owner/ occupant includes:

- Guarantee information for the EWI system
- Basic guidance information to avoid damage to the EWI (i.e. that it is not solid like a typical wall and care should be taken to avoid impacts), particular areas to check the integrity/ condition of the system on an ongoing basis and, for rented accommodation, the required process/ contact information to notify of any suspected problems

- Suggested types of products or approaches that should be used if repairs are needed (e.g. new seals, render, etc)
- Information about anchor points that have been incorporated into the walls to fix heavier items (e.g. satellite dishes) and the types of fixings that would be suitable for other situations so as not to damage the installation
- The importance of maintaining adequate ventilation and the strategy that is used within the specific building, e.g. trickle vents, fans, etc, so occupants do not override or undermine any installed systems. It should be emphasised that any limited additional heat retention caused by blocking vents or switching off fans could come at a significant price to the integrity of the structure and the quality of the occupants' internal environment

Since the installer is the last point of contact for the occupants, they may be an obvious choice to pass on the necessary information. However, they may not have all the required knowledge, e.g. some guidance may be fed through from the initial design. It is important that clients decide how information will be passed through to occupants and by who. This may be aligned with in-house procedures/ teams for existing ongoing tenant support. If working on behalf of private owners (e.g. through area based support schemes) a specific process should be put in place for the handover of relevant information.

7 Case studies

The following three case studies demonstrate a number of best practice principles of EWI installation and embrace the approach set out in this publication.

7.1 Peulwys Estate, Llysfaen, Conwy

G Purchase for Cartrefi Conwy

Over 250 dwellings were retrofitted on the Peulys Estate, which were of a non-traditional construction form. The properties combined a steel frame structure with cavity walls of brick externally and gas concrete panels internally for gable and separating walls and timber infill panels to the front and rear façades. The complex nature of the construction meant they were not suitable to receive more conventional cavity wall insulation measures, hence EWI was installed along with other complementary measures including loft insulation, draught proofing and boiler upgrades. The majority of the properties were socially rented, with a small number privately owned.

Properties during EWI installation, including extended roof gable to cover insulation

Cartrefi Conwy sought independent advice from BRE on ways in which they could improve the energy efficiency of the dwellings while reducing potential risks and ensuring long term durability. Key features of note on this scheme include:

- Extending roof lines to ensure additional weather protection to the EWI system rather than relying on finishing trims and sealants
- Existing integral porches were removed and rebuilt with new thermally isolated units to avoid thermal bridging and allow continuity of the EWI
- Window reveals were insulated using higher performing insulation material compared to the main wall insulation so that thermal bridging could be addressed despite there being a limited window frame depth within the reveal

Window reveals insulated in front of frame to reduce thermal bridging effect at window junctions

- Other thermal bridging points were also addressed to allow continuity of the EWI, including cutting back adjoining fences at boundary edges
- Ventilation provision was assessed and new mechanical ventilation units provided in kitchens and/ or bathrooms where necessary
- Gravel soakaways were installed at ground level to prevent potential water build up adjacent to the EWI, particularly where there was previously soil banked up to the walls that may have been at a higher level than the damp proof course (DPC), thus a potential source of moisture leading to damp problems

Grass bank cut back and space for soakaway added so water cannot accumulate adjacent to the EWI

The transformation of the houses, both in terms of their energy costs and their visual appearance, along with other community-wide interventions, has led to a waiting list for houses on the estate, whereas previously there had been little demand for the housing in the area.

7.2 The Beaches Estate, Llandysul, Ceredigion

Wilmott Dixon Energy Services for Ceredigion County Council, Tai Ceredigion and Cantref Housing Association

A mix of 105 solid wall and hard-to-treat cavity wall homes off the mains gas network were retrofitted on the Beeches estate in Llandysul, receiving a mix of EWI, loft insulation, draught proofing, boiler upgrades and controls along with associated enabling works. The properties were 2-bed bungalows and 3-bed semi-detached dwellings, a third of which were privately owned, with the remainder socially rented.

Properties prior to EWI application

Properties after EWI application

The scheme has been widely credited as delivering high quality EWI installations embedding a range of best practice principles in their approach. Key features of note on this scheme include:

- Detailed technical assessments of each property to identify the most appropriate energy measures and inform detailed design and requirements for enabling works
- EWI system selected that could be installed at low temperatures so less risk of problems or disruption from poor weather, plus the finish was resistant to external biological growth to retain visual appeal and improve durability long term
- The system supplier developed a range of bespoke construction details to supplement standard details as necessary so there was no improvisation required onsite by installers
- Extended rooflines to ensure additional weather protection to the EWI system rather than relying only on finishing trims and sealants

Roof eaves being extended to provide an overhang beyond the insulation in order to provide better protection to the EWI system

- Window reveals insulated to address bridging. This was facilitated by the installation of new windows with different arrangements and thicker frames to allow space for the insulation. Other thermal bridging points were also addressed to reduce heat loss
- Concrete gutters (prone to leakage) were removed and replaced with new rainwater goods to reduce thermal bridging and risk of future leakage and water damage to the EWI system
- Ventilation provision was assessed and new mechanical ventilation units provided in kitchens and/ or bathrooms where necessary

- There was a specific focus on upskilling the local workforce in the particular EWI system to ensure high quality installation. Also the site management team, supported by the system designer, carried out site checks to ensure consistent quality
- Training on the maintenance requirements for the EWI system was provided to the RSLs to aid their ongoing maintenance programmes and ensure the longevity of the installations

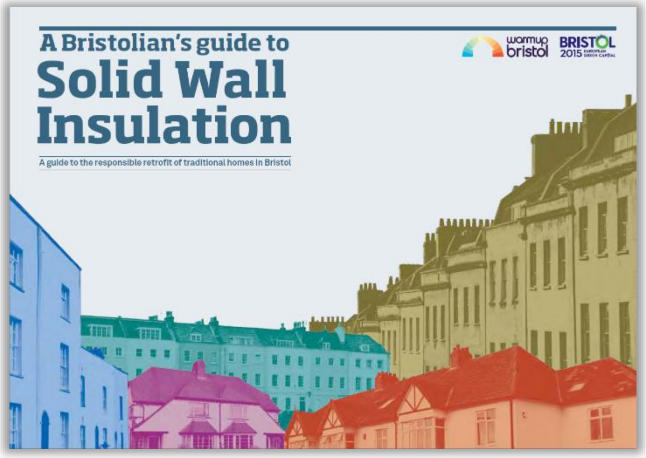
The contractor, Willmott Dixon Energy Services, have subsequently produced a detailed EWI installation guide for their installers with information about best practice installation techniques to ensure consistent quality and shared learning across all their installation contractors.

7.3 Warm up Bristol, guidance by STBA

Warm up Bristol is an initiative backed by Bristol City Council to promote energy efficiency retrofit measures across the city. The aim is to help save households money on their fuel bills, reduce the risk of fuel poverty and subsequently reduce carbon emissions. The scheme offered low interest loans to private home owners and in some cases offered grants to eligible applicants to allow them to make energy improvements to their home. Measures could include new heating systems, windows and doors, draught proofing and various insulation measures.

A key milestone under this initiative was the guidance provided to householders to help them fully consider the implications of potentially installing solid wall insulation on their homes. The guide was developed by a team of professionals led by the Sustainable Traditional Buildings Alliance (STBA) to promote responsible retrofit of Bristol's traditional buildings.

Private home owners typically do not have the resources and experience of larger housing stock managers and will often rely on suppliers to propose solutions to meet their needs. However, suppliers of particular measures will rarely be able to independently reflect on what may be most suitable for the property. Hence the guide provided information ranging from introductory through to detailed design, so users could engage with it to the extent they were most comfortable and understand their options and the implications of these.



The Bristolian's guide to Solid Wall Insulation embraced the whole house approach and provided detailed information about the importance of doing the right measures to the right properties to ensure a healthy building for the occupants. It recognised the need for an integrated team including surveyors, designers, installers and users to deliver an appropriate solution. It makes home owners aware of the fundamental differences between vapour open and vapour closed constructions, introduces complex issues such as thermal bridging, exposure risk and ventilation in an accessible way and raises awareness of how occupant behaviour can have a significant impact on various aspects of building performance.

The guide should ensure that any private home owners carrying out solid wall insulation measures under the Warm up Bristol scheme make an informed judgement on its suitability for their home and understand the best practice route they should follow to ensure a high quality installation.

8 Conclusion

The environmental and financial benefits of insulating the UK's older building stock are significant. However, if this is implemented badly, a number of unintended consequences could be introduced that could jeopardise the integrity of the building elements and the health and wellbeing of the occupants.

Many consequences can be avoided by:

- Careful selection of properties for EWI embracing the whole house approach and managing occupant expectations
- Creating a team to allow a joined up approach to the whole implementation process, including surveyors, designers, installers and onsite QA personnel (ideally separate to the installers)
- Allowing adequate time and budget for the whole process so all aspects may be fully considered and robust solutions implemented to prevent potential risks
- Thorough surveying to identify construction types, building condition, relevant obstacles and details that will need to be addressed
- Product specifications appropriate to the building in question and local exposure conditions
- Detailed design of systems, paying particular attention to junctions and interruptions to avoid thermal bridging
- Ensuring ventilation is a key consideration, with new ventilation units installed if existing provision is likely to be inadequate
- Carrying out ongoing checks on the installation throughout the process to ensure high quality and that detailing follows the design intentions and is not improvised on site
- Providing maintenance recommendations as part of handover packs to occupants/ building managers to ensure long term robustness and protection of the insulation system
- At handover (and longer term guidance in case of occupant changeover) ensuring occupants understand the importance of maintaining ventilation for a healthy indoor environment

Although this publication suggests positive steps towards the implementation of EWI and sets out a number of principles that can be followed to help reduce the risk of undesirable effects, it should be recognised that in some cases these effects may not be preventable. In these cases, the best course of action may simply be to refrain from applying solid wall insulation.

9 References

[1] MacKenzie F, Pout C, Shorrock L, Matthews A and Henderson J. *Energy efficiency in new and existing buildings: comparative costs and CO_2 savings.* BRE FB 26. Bracknell, IHS BRE Press, 2006.

[2] BRE on behalf of CEW. *Post installation performance of cavity wall & external wall insulation.* Constructing Excellence Wales, 2016

[3] INCA. *Best practice guide: External Wall Insulation.* Insulated Render and Cladding Association, 2015

[4] Weeks C, Ward T, King C. *Reducing thermal bridging at junctions when designing and installing solid wall insulation.* BRE FB 61. Bracknell, IHS BRE Press, 2013.

[5] King C, Weeks C. *Designing out unintended consequences when applying solid wall insulation.* BRE
FB 79. Bracknell, IHS BRE Press, 2016.

[6] Colwell S, Baker T. *Fire performance of external thermal insulation for walls of multistorey buildings. Third edition.* BRE BR 135. Bracknell, IHS BRE Press, 2013.

[7] Bristol City Council. *A Bristolian's guide to solid wall insulation.* 2015. Available at: www.fourwalls-uk.com/wp-content/uploads/2016/10/SME522_Bristol-wall-insulation_v9-SP-low-res.pdf

[8] Welsh Government, 'External solid wall insulation: A planning guide for households'. October 2013. Available at: http://gov.wales/docs/desh/publications/131001external-solid-wall-insultation-guide-en.pdf

[9] May N, Sanders C. *Moisture in buildings: an integrated approach to risk assessment and guidance.* London, BSI, 2017

[10] Ward T. *Assessing the effects of thermal bridging at junctions and around openings.* BRE IP 1-06. Bracknell, IHS BRE Press, 2006

[11] Ward T, Hannah G, Sanders C. *Conventions for calculating linear thermal transmittance and temperature factors.* BRE BR 497. Bracknell, IHS BRE Press, 2016 edition.

[12] BSI. *Specification for the installation of energy efficiency measures (EEM) in existing buildings*. PAS 2030:2017. BSI. 2017.

[13] Stirling C. *Thermal insulation – avoiding risks*. BRE BR 262. Bracknell, IHS BRE Press, 2002 edition.

[14] BSI. *Code of practice for assessing exposure of walls to wind-driven rain.* BS 8104:1992. BSI. 1992

[15] Welsh Government, Building Regulations Wales Circular, WGC 015/2017, 'Wind-loading calculation for cladding'. September 2017. Available at: http://gov.wales/topics/planning/buildingregs/circulars/building-regulation-circular-wgc015-2017

[16] Be Constructive Ltd. *Can frost damage my silicone render?* Blog article by EWI installer. January 2017. Available at: www.beconstructiveltd.com/can-frost-damage-my-silicone-render/

[17] Bonfield P. *Each Home Counts. An independent review of consumer advice, protection, standards and enforcement for energy efficiency and renewable energy.* DCLG & DBEIS, 2016

[18] Ofgem. *Guidance on appropriate guarantees*. Feb 2017 issue referenced, though periodically updated. Available at: www.ofgem.gov.uk/environmental-programmes/eco/contacts-guidance-and-resources/eco-guidance

10 Appendix A: Example EWI property viability survey

EWI property viability survey

This survey form is intended to be used to identify whether a property is likely to be suitable to receive EWI. It is not intended to replace an energy assessment/ EPC survey or an installer's measured survey. Listed items are not exhaustive and surveyors should consider any and all aspects that may interfere with the optimal installation of EWI.

Part 1 – High level survey: Properties identified as having problematic features would not be expected to progress to the Part 2 – detailed survey.

Part 2 – Detailed survey: Provides a more in depth analysis of EWI suitability and, if found to be feasible, identifies areas that will need to be specifically addressed at the system design stage.

PROPERTY DETAILS	
Client name:	Surveyor name:
Property address:	Date of survey:
Postcode:	
Ref No:	

DIMENSIONED PLAN AND SITE NOTES

PART 1: HIGH LEVEL SURVEY CONSIDERATIONS FOR EWI	
Number of storeys	
Height of building to eaves	m
Does property front directly onto a footpath or public highway?	Y/N
Will EWI application result in a significant change in external appearance?	Y/N
Will EWI application result in compromised access (i.e. main access paths likely to become less than 900mm wide)	Y/N
Is there sufficient space (approx. 800mm) adjacent to all walls for scaffolding?	Y/N
If no, note which walls are affected, describe reasons and/ or give relevant limiting dimensions	

Type(s) of wall construction		
Main dwelling	Construction type	Solid brick ☐ Stone: granite or whinstone ☐ Stone: sandstone ☐ Cavity ☐ Timber frame ☐ System ☐
	Insulation type	External ☐ Filled cavity ☐ Internal ☐ As built ☐ Unknown ☐
Extension 1	Construction type	Solid brick ☐ Stone: granite or whinstone ☐ Stone: sandstone ☐ Cavity ☐ Timber frame ☐ System ☐
	Insulation type	External ☐ Filled cavity ☐ Internal ☐ As built ☐ Unknown ☐
Extension 2	Construction type	Solid brick ☐ Stone: granite or whinstone ☐ Stone: sandstone ☐ Cavity ☐ Timber frame ☐ System ☐
	Insulation type	External ☐ Filled cavity ☐ Internal ☐ As built ☐ Unknown ☐
Alternative wall (if applicable)	Area (m^2)	
	Part of	Main ☐ Extension ☐ + note extension number if more than one ___
	Construction type	Stone: granite or whinstone ☐ Stone: sandstone ☐ Solid brick ☐ Cavity ☐ Timber frame ☐ System built ☐
	Insulation type	External ☐ Filled cavity ☐ Internal ☐ As built ☐ Unknown ☐
Provide as much detail as possible about any system built constructions:		

Current building finish and number of exposed walls where present (i.e. x/y walls)	
Render – pebbledash	/
Render – smooth	/
Weatherboarding/ cladding (detail: PVCu/ timber/ other)	/
Random stonework	/
Facing brickwork	/
Are there aesthetic features likely to be desirable to retain?	
Decorative brickwork/ stonework	Y/N
Built-in gutters, i.e. finlock gutter	Y/N
Decorative window/ door surrounds	Y/N
Feature/ date stones or similar	Y/N
Other (give detail below)	Y/N

PART 2: DETAILED SURVEY CONSIDERATIONS FOR EWI	
Condition of elements	
External walls	
Render damaged/ spalled?	Y/N
Cracking surface/ structural?	Y/N
Degraded mortar beds?	Y/N
If cavity wall, cracking due to wall tie failure?	Y/N
Subsidence?	Y/N
Roof	
Roof bowing deflection?	Y/N
Damaged tile covering?	Y/N
Signs of internal water penetration?	Y/N
Need for repair?	Y/N
Roof ventilation present?	Y/N
If yes, are ventilation points open/ uninterrupted?	Y/N
Floor	
Type of floor, e.g. solid floor on grade, suspended solid floor, suspended timber, other (please state)	
Underfloor insulation points present?	Y/N
If yes, are ventilation points open/ uninterrupted?	Y/N
Doors (indicate numbers)	
Fault present?	Y/N
Renew	Y/N
Repair/rehang	Y/N
Windows/ frames	
Do any windows have single glazing? If yes, give number (i.e. x/y windows)	Y/N /
Faults?	Y/N
Wet rot/ Significant disrepair?	Y/N
Other faults/ more detail on any of the above elements:	

	Living room	Bathroom	Kitchen	Bedroom(s)	Circulation
Damp/ condensation					
Rising (ground level) damp	Y/N	Y/N	Y/N	Y/N	Y/N
Penetrating (higher level) damp	Y/N	Y/N	Y/N	Y/N	Y/N
Moderate condensation	Y/N	Y/N	Y/N	Y/N	Y/N
Serious condensation/ mould growth	Y/N	Y/N	Y/N	Y/N	Y/N
Inadequate room ventilation	Y/N	Y/N	Y/N	Y/N	Y/N
Inadequate appliance ventilation	Y/N	Y/N	Y/N	Y/N	Y/N

Do any walls have a ‘vapour open’ moisture dynamic? (‘breathable walls’)	Y/N
Evidence of vapour open or closed nature:	

Relative exposure conditions	
Most relevant description of the surrounding land (choose only one category)	
1. No effective shelter, close to the coast or a large estuary (within 8km)	
2. No effective shelter, greater than 8km from coast/ estuary. E.g. open countryside, or land that falls away in the direction of the prevailing weather such that buildings or trees offer little protection	
3. Frequent low level obstructions, e.g. walls, hedges, single storey buildings	
4. Closely spaced obstructions, built up areas, forests. e.g. buildings, trees. Obstructions offer a substantial degree of wind shelter	
Horizontal distance to nearby obstructions within line-of-sight of walls. Consider the case at the highest point of each wall: (If greater than 100m, assume ∞) (Note: For larger distances, establish approximate proximity at site then determine distance from maps later if necessary)	
Obstructions North (NE-NW)	metres
Obstructions East (NE-SE)	metres
Obstructions South (SE-SW)	metres
Obstructions West (SW-NW)	metres
Depth of eaves/ gable overhangs (Delete as appropriate. If depth varies over façade, report smallest)	
Overhang North (NE-NW) Eave / Gable	metres
Overhang East (NE-SE) Eave / Gable	metres
Overhang South (SE-SW) Eave / Gable	metres
Overhang West (SW-NW) Eave / Gable	metres
Internal items	
Heating system	
Heating fuel of main system, i.e. mains gas, economy 7 electricity, direct electricity, heating oil, biomass, LPG, other (give details)	
Is current heating system in full working order?	Y/N
If no, is heating system serviceable? (i.e. < 20 years old)	Y/N
Is replacement heating system recommended?	Y/N
Ventilation	
Is there mechanical ventilation in ALL wet rooms? (kitchen, bathroom, utility) If no, provide further detail (which rooms) below	Y/N
If so, are these working?	Y/N
Are trickle vents present on windows?	Y/N
Are there ventilation bricks/ openings for combustion systems present?	Y/N
If so, are these still required? (i.e. does heating system still rely on them, or has the system been replaced and they are no longer needed)	Y/N
Is there any other form of passive or active ventilation present in dwelling?	Y/N
Please provide further details of alternative systems, whether heat recovery present, or any areas lacking in ventilation provision:	

Potential obstructions to continuity of EWI			
Building features that could interfere with installation of EWI			
Likely to want to retain decorative brickwork or stone façade/ features?	Y/N		
Is kitchen and/ or bathroom present on reverse of decorative feature walls that may interfere with internal insulation if pursued	No	Yes: Kitchen	Yes: Bathroom
If Yes, are kitchen and/ or bathroom due to be replaced soon?	Y/N Estimated date:		
Utility box(es) present	Y/N		
Bay windows present	Y/N		
Space between openable window casements and window reveals	mm		
Do any doors open outwards	Y/N		
Undercroft or enclosed passageway present	Y/N		
Internal or adjacent unheated garage or utility room present	Y/N		
Lean-to/ conservatory or other connected unheated structure	Y/N		
Items within close proximity of walls (within 0.5m):			
Perimeter/ Boundary wall	Y/N		
Fences or gates	Y/N		
Growth of trees/ bushes	Y/N		
Road signs	Y/N		
Telegraph pole	Y/N		
Street light	Y/N		
Items that may need to be re-fixed or re-worked:			
Telephone/ TV/ Sat cables	Y/N		
Satellite dish/ ariel fixing	Y/N		
Water pipes (hot/ cold)	Y/N		
Gas pipes	Y/N		
Drain pipes, i.e. S&VP, waste outlets, rainwater goods	Y/N		
Overflows	Y/N		
Central heating drainage	Y/N		
Central heating flue	Y/N		
Room ventilators/ extractor fan outlets	Y/N		
Security alarm and/ or external lighting	Y/N		
Clothes line fixtures or other external fixings	Y/N		
Window sills – determine sill type (stone/brick, built in sill, separate sill cap)			
Window sills – is a drip present?	Y/N		
If drip present, what is the overhang?	mm		
Any other obstacles or issues? (Give details below)	Y/N		
Access issues:			
Adequate space to erect scaffold around dwelling (note any restrictions of scaffold design under 'further details')?	Y/N		
Adequate space for scissor lift if required?	Y/N		
Will access be required to neighbouring property for works?	Y/N		
Rights of way – notification to neighbours required?	Y/N		

Further details relating to access

FINAL CHECKS	
Has the plan diagram been completed showing location(s) of any notable details?	Y/N
Have photographs of dwelling and important features been taken?	Y/N