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Solid wall heat losses and the potential for energy saving

Consequences for consideration to maximise SWI benefits: A route-map for change

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Notes

This report is part of a collection of outputs from the DECC research project investigating the savings achieved with the installation of solid wall insulation. These will be made available on the project web site where a summary of the project can also be found (see http://www.bre.co.uk/swi).

The lead author for this report was Colin King of BRE.

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1 Introduction and rationale for solid wall insulation

1.1 Climate change and carbon reduction commitments

The Climate Change Act established a target for the UK to reduce its emissions by at least 80% from 1990 levels by 2050. Building Regulations are already pushing builders and developers to meet ever more demanding targets for carbon emissions for new houses but the realisation that about 80% of the building stock in use in 2050 is already built[1] has turned attention towards our existing houses.

Home owners and landlords are being encouraged and legislated upon to improve their properties and subsequently reduce the carbon emissions from the housing stock, ensuring that they play an important part in the fight against climate change and helping to alleviate fuel poverty. Some of the most difficult buildings to tackle are those considered as historic homes. The definition is not fixed but in reality this means the dwellings were probably constructed prior to 1930. These have the difficult challenge of balancing cost and environmental impact but there are additional considerations centred on the aesthetic and cultural significance of the building and place, its context as part of the built heritage and crucially the potentially negative impacts on the dwelling fabric of making changes to it.

1.2 Issues with improving solid wall older dwellings

To improve the thermal performance of older homes in the UK with solid wall construction, it is logical to consider the performance of these external walls. This can be achieved by introducing solid wall insulation applied either internally or externally. The most common form of solid wall insulation in the UK is applied externally, as it is less disruptive to the residents and technically less challenging when compared to internal wall insulation.

To enable DECC to consider changes to the methods of undertaking external wall insulation it is important to understand the context and complexity of the issues currently faced. A number of detailed reports on these issues have been produced by bodies such as BRE[2], EST[3], English Heritage[4], Historic Scotland,[5] STBA [6]and SPAB[7]. This document builds on these reports and offers a route map understanding the issues and risks that can affect the performance of solid wall insulation (particularly external wall insulation) more fully and safely. These include the assessment of the buildings (condition and exposure), selection of materials to be used (suitability), workmanship used to undertake the works,

[1] Energy Efficiency in new and existing buildings MacKenzie et al BRE Trust 2010

[2] SERS Report http://www.sersltd.co.uk/?page_id=3619

[3] http://www.energysavingtrust.org.uk/domestic/sites/default/files/reports/Solid%20wall%20-%20external%20wall%20insulation.pdf

[4] https://www.historicengland.org.uk/images-books/publications/external-wall-insulation-traditional-buildings/

[5] http://www.historic-scotland.gov.uk/publicationsresultsdetail.htm?id=47674

[6] http://www.spab.org.uk/downloads/STBA%20RESPONSIBLE-RETROFIT.pdf

[7] http://www.spab.org.uk/education-training/notes-from-courses

and the effect on the fabric of moisture. Further research into the whole approach to improving performance including moisture physics, modelling and material data forms a significant part of this.

An important factor affecting damp specifically in older buildings is the difference in building physics and construction between older and more modern buildings. Unfortunately a one size fits all solution to SWI is therefore not appropriate and can result in underperformance and/or premature failure of the system or building components. Additionally historical buildings may be at greater risk of disrepair which also complicates the installation of SWI.

More modern construction methods rely on the creation of a cavity or the use of cementitious or impervious materials to provide protection from moisture ingress whereas in older buildings in their original state moisture penetrated the structure and then that moisture was allowed to evaporate and vacate the building through the chimney and other openings (air bricks, infiltration etc.). To allow this process to continue it is important that improvements or interventions that may alter or restrict the passage of the moisture receive careful assessment and consideration.

1.3 Methodology

This report is an analysis of primary and secondary data analysis undertaken by BRE; either where problems have arisen after the installation of solid wall insulation, or where BRE was engaged to monitor the installation process from a Quality Assurance perspective. It is based on a desk-top review of specifications, interviews with scheme specifiers, surveyors and installers and site observations of the installation and handover process. The methodology included the following activities, with the sample size of properties being 1,800 properties in 27 locations across the whole of the UK.

- A review of the procurement process and tender specification compared with the actual works undertaken
- An analysis of the decision making process on site
- Categorisation and analysis of problems arising
- Use of thermographic camera
- Interviews with the residents of properties

2 Consequences for consideration to maximise the benefits of SWI

The observations made in this project combined with other on-going research and a review of published literature from other organisations has identified a total 126 unintended consequences of undertaking solid wall insulation to properties that should be taken into consideration when seeking to maximise the benefits of solid wall insulation. An initial grouping exercise compressed this number to 29 unintended consequences which are listed in Appendix A, and in Appendix B there are descriptions of a number of the observations made and highlighted as part of the literature review and secondary analysis of previous work undertaken by BRE. The 19 most commonly identified of these risks are indicated in Table 1.

Table 1 - Summary list of 19 common unintended consequences of installing SWI

Unintended consequence	Cause
Overheating (increases in temperature above 28° in the summer months)	Observed through both modelling and in the field. It is recognised that overheating can be a problem in all dwellings which have received solid wall insulation. This is particularly a problem for (but not restricted to) those that have been treated with internal wall insulation as a result of decoupling of thermal mass from the dwelling.
Increased relative humidity, and associated damp and mould growth	As a result of increasing air-tightness (not correctly alleviated e.g. through extract fans), increases in internal humidity can occur. This can lead to damp problems, and mould growth, with associated health problems for the occupants. The problem can be particularly associated with un-treated thermal bridges within dwellings.
Negative effect on neighbouring dwellings.	There is the potential for the installation of solid wall insulation on one property to affect neighbouring dwellings. This is because the relative temperatures of the walls of the dwellings will be adjusted. As a result, moisture can condense on a neighbouring property in a place where it did not previously causing damp, mould and other problems.
Shifting of thermal bridging to new points	The application of solid wall insulation can affect the internal condensation points. This can create new points which are incapable of withstanding exposure to condensation.
Increased risk of dry or wet rot to timbers.	The risk of dry rot developing increases with increased levels of humidity which can occur following the installation of solid wall insulation. An increase in wet rot can be caused by high levels of moisture or humidity in timbers due to poor detailing.
Increase risk of insect attack on timbers	Insect attack to timber structures is increased if the timbers are not kept dry. In older solid wall dwellings (where timbers are more prevalent) any increase in the relative humidity can lead to an increased risk of insect attack on timbers.

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Increased risk of dust mites, bed bugs, clothes moths 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 increased humidity which can follow the installation of solid wall insulation.
Increased Radon risk	In areas of the country prone to Radon (e.g. areas of South West England) increasing airtightness following the installation of solid wall insulation could potentially result in an increase in the risk of exposure to occupants.
Rot of internal floor and roof timbers	With internal insulation floor and roof joists can become significant thermal bridges unless particular care is taken. Due to increases in humidity, these thermal bridges can then rot as moisture condenses on them, causing significant structural problems.
Damage to the external wall structure, or failure of internal finishes, due to water fill and frost damage following internal insulation	The application of internal wall insulation can mean that an external wall is no longer dried by heating the interior of the dwelling. As a result, moisture is not driven out of the walls, which can cause structural damage and the failure and decoupling of the internal finishes (including the internal insulation itself). One mechanism for damage is 'frost damage' to the brick as the water in the wall freezes. It is important to understand the physics of how solid walls perform and deal with moisture transference based on their levels of humidity.
Increased interstitial condensation	An increase in humidity can result from the application of solid wall insulation, leading to condensation in interstitial spaces (such as in roof eaves etc.), or within the structure of the walls. In addition, moisture trapped in walls by closed cell insulation can result in moisture migration to the inner surfaces of the building, resulting in mould and premature decay of finishes and fittings.
Short-term reduction in air quality following installation of solid wall insulation (Formaldehyde and other VOCs)	There is a risk of increased levels of toxic volatile organic compounds (VOCs) including formaldehyde from the adhesives and other substances used in insulation products. These substances can have significant short and long-term effects on the health of occupants, with many being carcinogenic.
Long-term reduction in air quality following solid wall insulation (CO, CO_2 levels)	A reduction in air quality over the longer term as a result of reduced levels of ventilation following solid wall insulation may occur. This may lead to increases of Carbon Monoxide and Carbon Dioxide, both of which can have short and long term effects on physical and mental health of occupants.
Aesthetics	From a cultural or aesthetic point of view, the use of external wall insulation may have a significant impact on the character and vernacular of many towns and cities throughout the UK.

Property value	The effect of solid wall insulation on property value is uncertain. While some value can be assigned to the lower levels of energy consumption, lower values may result from any reduction in aesthetic appeal, or reduction in internal space resulting from the works.
Daylighting	Research undertaken by BRE indicates that the use of wall insulation can have a detrimental effect of internal day light factors. This has a counter factual outcome of providing insulation to reduced energy demand, with the potential for increased energy demand on lighting, and less benefit from solar gain.
Durability and maintenance and repair consequences	Solid walls with no insulation applied either internally or externally are very robust and sturdy structures. The introduction of materials that are effectively air traps and less resilient to impact could potentially have an unintended consequence of an increased demand for maintenance and repair, as a result of damage or even normal usage.
Disturbance	The installation of solid wall insulation has the potential for disturbing not only the occupiers but also the surrounding vicinity, with the erection of scaffolding, deliveries and other incidental activities. As a consequence, when residents understand the extent of disturbance, it may become a disincentive to having the improvement works undertaken.
Fire safety	Applying solid wall insulation internally or externally may introduce a potential for increased fire risk to buildings, unless this consequence is fully considered. There are potentially significant risks of creating a fire bridge between dwellings with external wall insulation systems over several dwellings (e.g. a block of flats).

Some of the on-site observations that these categories were developed from are presented in Appendix B which provides more detail and background into the causes. A secondary interrogation of these consequences indicated many common themes that would allow a further filtering and grouping exercise to be undertaken and resulted in 12 recommendations in a *Route Map for Change* presented in the next chapter that aims to minimise the likelihood of unintended consequences in SWI.

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3 A route map for change

To reduce the likelihood of these unintended consequences occurring 12 recommendations have been made and listed in Figure 1, which may be considered when undertaking thermal upgrades of older properties. These cover the jurisdictions from several external agencies, including the Department for Energy and Climate Change (DECC), the Department for Communities & Local Government (DCLG), Ofgem, British Standards Institute (BSI), British Board of Agreement (BBA), Manufacturers (CPA), Construction Industry Training Board (CITB) to name a few.

Avoiding consequences with SWI			
Research	Standards & Policy	Standards & Policy	Training & Behaviour
1. More in situ Testing Move away for reliance on unrealistic lab results	**4. Standards update** Updates to BS5250:2011 to account for performance gap	**7. Building Regs U-value update** Remove encouragement to achieve 0.3 in all instances	**10. Moisture professional** Training on in-situ assessment and correct methods of sign off at key stages to reduce risk
2. New materials data A database of materials used in construction for modelling performance	**5. Process control improvements** Review PAS 2030. On-site controls and sign off and increased inspection rates	**8. Update RdSAP thermal bridging** Creation of proven thermal bridging details and principles included in RdSAP	**11. Training of professionals** Review course content for professionals to cover the principles of condensation and moisture movement in structures
3. New weather data Weather data for modelling performance (wind driven rain included)	**6. Funding linked to performance** Ensure funding schemes are tied to best practice and require consideration of whole house and moisture issues	**9. Building Regs ventilation and moisture risk update** Part C and F reviewed and considered as part of thermal upgrades	**12. Encourage good occupant behaviour** Requirement for guidance on hand over to the occupants of improved properties

Figure 1 - Route map for change

A more detailed explanation of each of the main 12 recommendations in the route map is presented in Table 2.

Table 2 - Detailed explanation supporting the route map

Issue	Cause	Risk & consequence	Guidance	Research needed	Timescale
Research					
1. Disconnect between performance of materials in testing and in use	Lab testing not reflective of real world conditions	Premature failure of organic materials (e.g. wood)	Move away from EN 13788 to a principles based approach so that analysis of how organic materials respond to condensation in traditional buildings is more robust	Review and production of protocols when using EN 15026 and undertake new testing	2 - 5 years
2. Materials data not UK specific	Wufi currently populated with mainland EU, American, or Oceanic data	Condensation risk based on incorrect parameters which could lead to mould & structural failures	Produce a database of materials used in the construction of older dwellings	Comparative study of materials in Wufi followed by laboratory analysis	< 2 years
3. Condensation calculations do not properly account for UK weather	Current models ignore location of the building as well as wind driven rain. EN 13788 does not require specific weather files	Internal or External SWI may be installed in regions/to buildings to which it should not have been	Creation of weather files	Analysis of files created using Meteonorm 7 and investigate accuracy of BS 8104	< 2 years
Standards and policy					
4. BS5250:2011 does not reflect real conditions observed in buildings	Standard does not account for a performance gap (poor installation / workmanship etc.)	Standards give no advice on problems occurring due to performance gaps	Rewrite BS5250:2011 and companion documents and standards including BR262	Research protocol for using EN 15026 and current working practices. Quantify effects of micro cavities, referenced against assumptions in BR443	2 - 5 years
5. Assessment and sign off of SWI installations is not sufficiently robust	Little evidence that good practice is required to achieve sign-off	Workmanship issues not being reported leading to increased risk of unintended consequences	Changes to PAS2030, increase inspection rates	Quantify prevalence of poor workmanship on inspected properties	1 - 2 years
6. Funding does not adequately incentivise good design & installation	Companies incentivised to install SWI while ignoring best practice	Poor quality and inappropriate installations increasing risk of unintended consequences	Change funding rules to only pay for suitable SWI installations and ensure good standards are met through post-installation inspections	Guidance on possible insulation types for different bridging risks	1 - 5 years
7. UK Building Regulations requirements increase likelihood of thermal bridging problems	Achieving upgrades to U-values of 0.3 makes walls more sensitive to thermal bridging	Failing to address cold bridging at low U-values reduces energy savings and increases risk of damage and decay	Relax U-value minimum targets and undertake bridging calculations	Proven principles of guidance, or target psi and U-values for older buildings methodology	2 - 5 years
8. Thermal bridging not adequately considered in RdSAP	Benefits of SWI overestimated if calculated using RdSAP	Payback times not being achieved	Update bridging assessment in SAP	Assess most appropriate way to incorporate bridging in SAP	2 - 5 years
9. Changes to ventilation rate not properly considered in SWI assessment	When undertaking thermal upgrades ventilation can be affected but may not be assessed	Impairing ventilation increases condensation, mould and respiratory problems	Require Part F assessments and link to funding Part F into installers training	Assess if Part F is sufficient for older properties and undertake air quality field tests post SWI	2 - 5 years
Training and behaviour					
10. Professionals not sufficiently aware of moisture issues related to the installation of SWI	Condition of property physics and weather often ignored	Inappropriate installation of SWI increasing risk of unintended consequences	Integration of a moisture professional into the design, survey, install and sign-off processes	Course on principles of As Built In Service conditions including CPD process	2 - 5 years
11. Professionals not sufficiently aware of other issues related to SWI installation	Standard protocols means workers miss critical problems with building condition and implications of not following designs	Insufficient attention paid to hard to treat properties increasing risk of unintended consequences	Increase uses of specialist SWI surveyors	Expand on current RICS requirements	2 - 5 years
12. Occupant behaviour can contribute to condensation problems	Ventilation and maintenance requirements are not explained to occupant at handover	Increased humidity and condensation, unintended damage caused by fixing items to SWI	Better hand over guidance “10 tips” for avoiding condensation	Establish best practice ways of communicating with occupants	5 + years

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These recommendations, put forward by BRE, are designed to address the fundamental and theoretical issues of SWI, however there are potential barriers to these actions being successful as set out below:

Table 3 - BRE recommendations to address the fundamental and theoretical issues of SWI

Recommendation	Responsibility	Barrier
That funding should only be made available to support schemes that address the risk posed by cold bridging and moisture, with demonstrable evidence of the process undertaken	Regulators / UK Government, devolved administrations and (potentially) local authorities	Current lack of guidance on acceptable approaches to risk management from moisture, and thermal details that are proven to work
A requirement to test materials to a standard that recognises the likely deterioration of the building fabric condition, to reflect likely conditions in service	Testing and Certification bodies (BBA etc.)	Additional cost to industry could be resisted
Provision of access to reliable weather data at an affordable cost, to enable a progressive move from calculating condensation risk from steady state (EN13788) to a more dynamic basis (EN15026)	UK Government / Met Office	Access to data is currently expensive and difficult to obtain from reliable sources outside the Met Office
That primary research be undertaken on the correct levels of ventilation required to maintain a healthy indoor air quality level post retrofit measures that effect infiltration rates	UK Government / Met Office / Research Institutes/ DCLG/ Ventilation Industry	Time scale for undertaking relevant primary research may not deliver the information quickly enough for short term improvements.
That a process of independent and impartial signing off of work is introduced, with a requirement for a substantial percentage of on-site checks at key stages in the solid wall insulation process.	System and Warranty providers	Resistance from industry on an added burden to delivery
An increased requirement for insulation manufacturers to certify and test their materials for likely As Built In Service (ABIS) conditions, which reflect that perfect conditions may not exist throughout the building's life.	Insulation manufacturers and system providers.	Additional cost to industry could be resisted
That training and guidance be produced to deliver an increase in awareness and knowledge on the risk of poor surveying, assessment and workmanship in solid wall insulation, with a specific approach to deal with moisture risk.	Training providers, Research Institutes, RIBA, RICS, CIBSE etc.	Time scale for undertaking relevant primary research may not deliver the information quickly enough for short term improvements

In summary, there are practical steps that could be made to minimise the likelihood of experiencing unintended consequences. The proposed route map touches on areas of policy and regulations, standards and technical understanding, workmanship and process control as well as the occupant handover. If the BRE route map is followed it is likely that fewer installations in general may be undertaken since those where problems might occur will be more properly identified. There may be cost implications that will also need to be considered though these can be balanced against fewer likely claims for disrepair around unintended consequences but also in a new policy and regulatory environment more innovative products may be developed.

4 Conclusion

The analysis shows that unintended consequences can and are introduced at all stages of the solid wall insulation process from specification, surveying, installation and in use. Many if not all of the unintended consequences can be designed out of the process if considered early enough and if the buildings are considered using a whole house approach, rather than singular elemental improvements, which tends to be the case currently. This "whole house approach" must include an assessment of the environmental factors, including weather and radon levels, to which the dwelling in question is exposed and devise solutions appropriate for these environmental factors.

Appendix A shows a summary of the major 29 unintended consequences that can be introduced during the application of solid wall insulation, either externally or internally. It is however not exhaustive or representative of all the unintended consequences that can occur.

Appendix B shows the categorisation of unintended consequences that were identified as part of the secondary analysis of previous projects that BRE was actively involved in, or subsequently engaged to identify the cause of problems that had arisen.

Testing							
		Issue	**Type**	**Cause & Likelihood**	**Risk & Consequences**	**Guidance on reducing the risk**	**Recommendations**
1	General	**Testing of insulation materials in unrealistic laboratory environments not reflecting As Built In Service (ABIS) conditions of the buildings**	EWI, IWI	Limitations of current testing standards. Materials are not tested in a realistic environment, leading to the possible use of wrong insulation materials, and enhanced comfort of performance.	Insulation may become saturated and delivering less than anticipated energy savings. Can mean increased maintenance costs and cycles, can result in lower return on investment, or fuel poverty alleviation.	Clear guidance on the limitations of materials in certain conditions. Or changing the material testing protocols to reflect more accurate in-situ conditions in the UK	• Change to standards • Testing of materials
2	Air quality	**Increased Radon risk**	EWI, IWI	Increasing airtightness following the installation of external wall insulation. Could present a problem in high radon areas, little evidence of the effect of wall insulation on air infiltration rates.	Increasing airtightness and therefore reducing air infiltration following the installation of solid wall insulation could potentially result in an increase in the risk of exposure to occupants.	Existing properties difficult to deal with by using a ventilated sub floor only real option is to ventilate properly, no guidance exists on dealing with the possible increase in radon concentrations	• Additional research
3	Air quality	**Short-term impact on concentrations of Formaldehyde and other VOCs and potential long-term CO, CO_2 levels, resulting in a reduction of indoor air quality following installation of external wall**	EWI, IWI	Effect on indoor air quality, deterioration of internal finishes and associated health problems either introduced or if pre-existing being exacerbated by increased levels of VOCs.	There is a risk of increased levels of toxic volatile organic compounds (VOCs) including formaldehyde, without adequate consideration of ventilation and indoor air quality. In the long term, this may lead to increases of Carbon Monoxide and Carbon Dioxide, both of which can	Better testing and guidelines on ventilation requirements to maintain indoor air quality and required air changes.	• Testing • Changes to standards

		insulation			have long term effects on physical and mental health of occupants.		
4	Structure	**Failure of external finishes, due to increased moisture content of the wall, leading to freeze /thaw/frost damage.**	EWI	Moisture trapped or present in the walls can cause structural damage. One mechanism for damage is 'frost damage' to the brick as the water in the wall freezes	Early decay and deterioration of structural elements face damage to wall structure, increased risk of saturated buildings, moisture ingress and the build-up of toxic mould at the interface of the wall and the insulation.	It is important to understand the building physics of how solid walls of a breathable nature perform and deal with moisture transference, in both directions.	• Integration of a moisture professional into the design, survey, install, sign off process. • Training of professionals and site operatives • Testing of materials
5	Structure	**Internal moisture**	IWI	There is concern about too much internal insulation preventing heat flow into walls which may be needed to drive out latent moisture and thus prevent external surface or interstitial condensation	Lack of breathability, moisture trapped within the structure of the wall, interstitial condensation, frost damage, movement, premature decay. Surface condensation.	The presence of an un sealed Vapour Control layer (VCL) could lead to the movement of moisture from the exterior to the interior, and vice versa.	• Testing of materials • Integration of a moisture professional into the design, survey, install, sign off process. • Standards researched on ventilation requirements in post insulation works
6	Structure	**Cold-bridging**	EWI	The use of current standard industry details to deliver external wall insulation does little to address the issues of cold bridges being introduced into buildings.	Introduction of cold bridges, under performance of insulation, less reduction in fuel costs, accelerated damage to the property. Reduced efficiency of insulation, cold spots in the properties, mould and condensation forming.	There is a gap in understanding the effect of thermal bridging in existing traditional buildings, and of the consequences of retrofit. More testing is required.	• Testing of materials • Changes to standards • Requirement for greater emphasis on thermal bridging in RdSAP. Currently the effects of cold bridging are not dealt with in full when using RdSAP, a review of the effects on cold bridging needs to be undertaken to ensure that the energy loss for the buildings is accurately assessed at the survey stage,

7	Structure	**Pollution risk**	EWI	Poor selection of finishes to external wall insulation, failing to consider the extent of industry and air borne pollution that may be evident in the locality of the properties. Can be important in heavy industrial areas, properties close to busy major roads and chemical production areas, commuter routes etc.	Soot and nitrogen compounds form the main part of pollutants that are deposited on building surfaces. Reaction of atmospheric hydrocarbons with nitric oxide (NO) leads to the formation of ozone. Ozone reacts with nitric oxide and leads, in the end, to the formation of nitrogen dioxide (NO_2) and nitric acid (HNO_3).	Risk assessment for high risk areas of industrial and motor pollution	• Research • Training of professionals and on site operatives • Correct selection of finishes based on local context and exposure conditions and testing of materials to resist mould growth

Surveying

		Issue	Type	Cause & Likelihood	Risk & Consequences	Guidance on reducing the risk	Recommendations
8	General	**Premature failure of system due to incomplete assessment of actual building condition**	EWI	Failing to assess accurately the thickness of material, and thermal performance that will be needed to ensure that no cold bridges are introduced, resulting in steps and staggers at high level, and around other two dimensional junctions, this can be linked to the underestimation of the impact of this poor detailing or selection of solution.	High risk of introducing designed in failure to organic materials (timber). Can be important in high exposure areas.	Guidance on correct surveying and on-going measurement and observation principles to use when assessing for external wall insulation.	• Training of professional and on site operatives • Introduction of checking and verification for payment and sign off • Integration of a moisture professional into the design, survey, install, sign off process
9	General	**Performance issues caused by inadequate identification of construction form**	EWI	Lack of understanding of early construction techniques used in the UK, such as the use of snapped headers, rat-trap bond, leading to mis-diagnosis of construction form. Other issues on recognising the construction form might include: • doors jamming on insulation • uninsulated window reveals	Increased likelihood of thermal bypass effect, resulting in little or reduced energy savings when using external wall insulation. Warm air escaping into the roof void causing increased risk of moisture and condensation issues in the roof timbers.	More detailed training on identification of early brick construction properties, and wider understanding of early construction methods widespread in the UK.	• Training of professionals (creation of qualifications) • On-going training and development of those involved in the SWI industry
10	Structure	**Reduction in durability of the chosen insulation system**	EWI	Finish chosen may not be suitable for the level of exposure and wind driven rain in the area. Likely to happen if the local climatic conditions and exposure risk are not fully considered.	Accelerated weathering of finish coats can lead to less resilient layers being exposed allowing the ingress of wind driven rain. Can also lead to unsightly deterioration and mould, lichen growth on walls with less exposure to the sum and its drying affect.	Guidance on the durability of different finishes for different levels of exposure and weather.	• Testing of materials • Availability of weather and material data

11	Structure	**Introduction of cold bridges**	EWI	Potential for introducing cold bridges such as fences, walls, satellite dishes, meter boxes, incoming service mains, proximity of telephone boxes, telegraph poles, external window sill, and other external obstructions. Failing to detail adequately at joints and junctions, around reveals, heads, gable ends, floors, the junction between insulated and un-insulated walls and other constructional joints.	Reduction in thermal performance delivered, high risk of condensation and mould growth, as well as the risk of shifting of condensation, mould, and cold spots to the adjoining property. Failure of timbers and other structural members, lintels etc. Expensive repairs, movement in the building, increased maintenance costs and cycles.	Improved standard and non-standard details and the requirement for detailed assessment of penetrations and service entry points in application for external wall insulation applications. Improve the ability of the insulation supplier and contractor to address thermal bridging issues. Improve the understanding on the part of the retrofitting supply/delivery chain to address thermal bridging risks.	• Adoption of moisture protocols (see appendix 2) • Training of professionals (creation of qualifications) • Integration of a moisture professional into the design, survey, install, sign off process • Training of site operatives • Requirement for greater emphasis on thermal bridging in RdSAP
12	Structure	**Introduction of cold bridges (2)**	IWI	Thermal bridges sometimes not eliminated, caused mainly by the difficulty in detailing in two dimensional junctions and the depth of window reveals and or thickness of wall structure. In areas where the architectural external features are kept to retain character, or in conservation areas, or client request.	Condensation risk shifted to junctions that cannot adequately deal with increased moisture, accelerated deterioration of internal finishes, in the event of timber windows or timber sub frames being present the premature failure of the material. Increased maintenance costs, premature replacement cycles for building elements. Mould and condensation formation with associated health risks if severe.	Guidance required on detailing for internal wall insulation.	• Adoption of moisture protocols • Testing • On-going training and development of those involved in the SWI industry • Building regulations

13	Moisture	**Increased relative humidity, and associated damp and mould growth due to lack of adequate and suitable ventilation**	EWI, IWI	Failing to assess for adequate ventilation in the original survey, operation or existence of trickle vents, and/ or mechanical ventilation, either interfered with by the resident or underperformance.	Increased mould growth, associated health problems, exacerbation of existing conditions, cosmetic damage to finish, early decay of timber elements. This can lead to damp problems, and mould growth, with associated health problems for the occupants.	Proper consideration of options for ventilation strategies during assessment	• Training of professionals • Integration of a moisture professional into the design, survey, install, sign off process • On-going training and development of those involved in the SWI industry
14	Moisture	**Rot of internal floor and roof timbers**	IWI, EWI	With internal insulation timber ground floors, intermediate floors and roof joists can become significant thermal bridges. Due to increases in humidity, these thermal bridges can then introduce rot into the timber as the temperature drops and moisture condenses.	Premature rotting of timbers, causing condensation in concealed spaces. Can lead to significant structural problems.	Particular care should be taken when considering the detailing around hidden spaces. Attention should be made on assessing timber moisture content and possible condensation or rot.	• Training of professionals • Testing of materials • Integration of a moisture professional into the design, survey, install, sign off process • Tightening funding rules to correct detailing and assessment
15	Other	**Overheating**	EWI, IWI	It is recognised that overheating can be a problem in all dwellings which have received solid wall insulation. This is particularly a problem for (but not restricted to) those that have been treated with internal wall insulation as a result of decoupling of thermal mass from the dwelling.	Reduced or no fuel savings from the introduction of insulation cooling load in the summer seasons. Uncomfortable conditions.	Guidance on assessing useful available thermal mass and additional guidance on behaviour change actions required to deal with change of the buildings effective thermal mass.	• Testing • Changes to standards

Workmanship							
		Issue	**Type**	**Cause & Likelihood**	**Risk & Consequences**	**Guidance on reducing the risk**	**Recommendations**
16	General	**Lack of quality controls on site leading to poor workmanship and works being undertaken in adverse weather conditions.**	EWI, IWI	Insufficient quality control processes on site: • poor workmanship not addressed, • inappropriate methods of tightening mechanical fixings • fail to fit insulation fixing caps • premature failure of silicone adhesion • rainwater goods not replaced properly • materials stored inappropriately on site	Inconsistent performance appears to be widespread in the EWI process leading to the premature failure of scheme.	Improve quality control on site by requiring professional and independent sign off of key stages during the works that considers moisture risk, competency and completeness of works.	• Training of professionals in the areas of moisture risk and poor detailing. There needs to be professional intervention on site to ensure that the work is undertaken correctly. Currently PAS 2030 relies heavily on self-certification. The sign off stage is crucial if the industry is to regain the confidence of the public, only by the creation of a professional process on moisture risk can this be resolved • Training of site operatives in the systems being installed, • Creation of specific details and key stages of checking to be undertaken on site • Introduction of checking and verification for payment and sign off
17	General	**Lack of specific insulation system knowledge leading to reduced performance and increased likelihood of failure**	EWI, IWI	Lack of specific system knowledge by the installers. Can be common in companies using multiple systems and new workforce with insufficient training, or tool box talks highlighting the differences in the systems.	Insufficient knowledge of system limitation leading to underperformance, • such as over tightening of mechanical fixings • failure to fit insulation fixing caps	Proper processes and procedures in place in all registered organisations undertaking external wall insulation, audited by third party.	• Training of professional • Training of site operatives • Introduction of specific technical checking and adherence to correct product specification prior to payment and sign off

18	Structure	**Introduction of micro cavities**	EWI	Poor abutment of insulation panels or/and under tightening of mechanical fittings. Common where insufficient training in correct techniques is not delivered. Common on sites with poor supervision and adequate checking procedures.	Introduction of micro cavities, extreme cases could cause damage by moisture being trapped behind the insulation on a cold surface. Increased risk of thermal bypass effect.	Awareness-raising on the reduction of effectiveness in thermal efficiency if these voids are introduced.	• Training of professional • Training of site operatives • Introduction of checking and verification for payment and sign off • Integration of a moisture professional into the design, survey, install, sign off process • On-going training and development of those involved in the SWI industry on improvements to materials to deal with this specific issue. Particular care is required when detailing areas where there is an elevated risk of water penetration at roof and eaves junctions.
19	Structure	**Introduction of modern materials in old buildings that if not carefully considered will fundamental alter the hygrothermal properties of the structure, which could lead to premature decay and trapped moisture.**	EWI	Introduction of modern materials affecting the breathability of the structure, creating an imbalance in hygrothermal performance which previously existed. Very common in work on buildings constructed prior to 1930's of a lime based mortar construction.	Lack of breathability, moisture trapped within the structure of the wall, interstitial condensation, frost damage, movement, premature decay of timber elements.	Clear guidance on appropriate preparation methodologies and site application of flexible sealants to ensure water tightness barrier is achieved.	• Testing of materials • Training of site operatives • Integration of a moisture professional into the design, survey, install, sign off process. For many years some of the moisture movement mechanisms have been either ignored or misunderstood, these include capillary conduction, vapour diffusion and surface diffusion and capillary flow. These are not taught in main stream construction and are key elements of knowledge for the moisture professional. •

20	Moisture	**Moisture trapped behind the insulation**	EWI	Insulation applied in less than ideal climatic conditions, or insufficient protection provided during the application process.	Moisture trapped behind the insulation causing issues with ingress. Insulation becoming saturated and ineffective.	Strict guidance on site working practices, a mandatory requirement to either stop work in poor weather or adequately protect the building when bad weather is anticipated.	• Integration of a moisture professional into the design, survey, install, sign off process • Training of professionals • Training of site operatives
21	Moisture	**Increased condensation risk in roof space**	EWI	Poorly detailed and placed external wall insulation blocking ventilations provision to the roof, or severely restricting ventilations to such an extent that condensation forms. Can be common where the roof line is not extended.	Condensation forming on timbers, premature rotting of timber members in locations not regularly observed or visited. Guidance on checking for ventilations continuity in roof spaces. Guidance on checking for ventilations continuity in roof spaces.	Guidance covering the importance of maintaining ventilation to roof spaces, when undertaking SWI	• Training of professionals • Training of site operatives • Integration of a moisture professional into the design, survey, install, sign off process
22	Other	**Underperformance of systems due to incorrect material storage, which results in warping and distortion of materials and potential for hydrophobic materials to become wet.**	EWI	Materials stored incorrectly on site, common on large schemes, not so prevalent on one off properties.	Warping and damage to the insulation systems, leading to poor installation, introduction of micro cavities through material warping.	Clear requirements and checking on site to ensure proper storage techniques.	• Training of site operatives

In Use							
		Issue	**Type**	**Cause & Likelihood**	**Risk & Consequences**	**Guidance on reducing the risk**	**Recommendations**
23	Structure	**Reduced floor area**	IWI	Internal insulation will reduce the floor area of any rooms in which it is applied (the thickness of the insulation is around 100mm.	Already small property made smaller leading to dissatisfaction	Consultations with residents before IWI installation	• Training of professionals undertaking the surveys to explain the impact on space to the residents or housing client. • On-going training and development of those involved in the SWI industry
24	Structure	**Reduced daylight quality**	IWI	Building façade refurbishment can significantly alter daylight quality in the interior spaces of the refurbished buildings, even when windows are not replaced, if the geometry of the aperture in which the window is inserted changes, such as reduction in the width of the aperture by insulating the reveals and heads.	Little risk attached unless being undertaken on a property with small windows or windows that are set back deep into the reveal.	Consultations with residents before IWI installation, effect on daylighting assessed as a principle when considering thermal upgrades.	• Tightening funding rules to correct detailing assessment to ensure that adequate daylighting is still available in the property, or not compromised • Training of professionals to understand that impacts on daylighting can result in an increased use of internal lighting, increasing energy use during daylight hours.
25	Structure	**Damage made by plants**	EWI	Roots can grow down to the base of the insulation and damage EWI. Aggressive rooting bottomland species are more likely to cause subsidence than slow growing upland species.	Ingress of moisture and reduction in efficiency of insulation.	Guidance to cover the removal of close proximity plants and shrubs to reduce the damage caused to EWI	• Training of professionals • Training of site operatives • Integration of a moisture professional into the design, survey, install sign off process • Occupant awareness of the importance of maintenance

26	Structure	**Hard to fix heavy items to walls**	EWI/ IWI	The introduction of internal wall insulation can lead to difficulties for the end user in fixing shelves, curtain rails, and other objects on certain walls.	Lack of knowledge by the resident on the limitations of weight bearing capacity of IWI could lead to damage and dissatisfaction.	Information included in any hand over documents on the limitations of the walls ability to hold heavy items.	• On-going training and development of those involved in the SWI industry, which demonstrates the importance of good detailing and appropriate fixings that do not rely heavily on flexible sealant

Aesthetic							
		Issue	**Type**	**Cause & Likelihood**	**Risk & Consequences**	**Guidance on reducing the risk**	**Recommendations**
27	Structure	**Significant impact on the character**	EWI	Applying external wall insulation externally changes the appearance of properties significantly. Introduction of multiple colours and finishes in one area, significantly changing the appearance of an area.	Reduction in character and acceptance of the principles of solid wall insulation	Residents need to be comfortable with any proposed changes.	• On-going training and development of those involved in the SWI industry on the impacts to place and aesthetics and the appropriate use of finishes and detailing. Creation of good detailing to allow a hybrid system to be used i.e internal IWI to front elevations, EWI to the remainder of the property to retain character.
28	Structure	**Stripping off finishes**	EWI	Stripping off or hiding of distinctive features before the installation of EWI can have a detrimental effect on the aesthetics of the property and area	Significant changes to the appearance of a property that may not have been fully appreciated by the resident or home owner when the work was agreed too	Guidance on the scope of information that needs to be handed to the resident and agreed to when detailing with internal wall insulation.	• On-going training and development of those involved in the SWI industry on the importance of place and character, and the benefits of using a hybrid approach to EWI, with IWI used on highly decorative front elevations and EWI on the remainder, with close attention to detail at junctions

29	Structure	**Vandalism**	EWI	EWI being used as a surface for graffiti, defacement and other anti-social behaviours due to the introduction of a smooth finish to properties walls that were not there before.	Resistance to changing external appearance of walls, increased maintenance costs for housing provider or owner.	Guidance on the use of textured finishes and other material finishes that hinder the chance of graffiti	• Training of professionals with specific focus on the type of finish to use in areas with high risk of graffiti and vandalism • Training of site operatives • On-going training and development of those involved in the SWI industry

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Appendix B Categorisation and description of specific problems observed

The secondary analysis of previous projects undertaken as part of this research programme indicates that, in general terms, issues can be categorised into five main areas. This Appendix presents these and describes some of the observations made in more detail. Primary evidence collected as part of this project will be included and categorised in a subsequent document.

Table B1 - Main categories

1.	**Systemic**	Built into the process of design, certification and testing of systems
2.	**Assessment**	Built into the process by surveys that do not capture or appreciate the important factors affecting the performance and durability of the systems
3.	**Workmanship**	Lack of controls on-site and deficiency in understanding of the requirements for installing EWI or IWI for a number of reasons, including lack of training, incorrect training and wilful neglect.
4.	**Design**	Weaknesses in design; particularly around geometrical obstructions, can lead to underperformance and increases in condensation and mould growth. Thermal modelling should be used to set standards.
5.	**Process**	Issues introduced at all stages of the SWI installation process, predominantly related to quality assurance procedures and practices

1. Systemic

Failure or underperformance of the post insulated building can be created by the current processes of decision making, both in the selection of the most appropriate materials to be used for thermal upgrades to a building, and the method and decision making process for deciding which elements of the building are suitable to be improved. Failing to undertake certain actions can result in this underperformance, for example,

- The omission of insulating reveals, heads, eaves and other penetrations for a variety of reasons such as increased costs associated with extending roof lines and gables,
- Isolating walls and fences to allow the placement of insulation behind their location and relocation/temporary removal of incoming services to provide thermal continuity,
- Technical issues such as insufficient space to insulate reveals using the same product as the main insulation material 2. Assessment (buildings and materials)

It is vital that thorough surveys of the buildings to be considered for thermal upgrades are undertaken, that consider, as a minimum:

- The condition of the building elements, ensuring that they are free from damp and mould growth. This must include the walls, floors, roofs, windows etc., with defects identified and rectified before or at the same time as work commences.
- The form of construction and original building materials (breathable or non-breathable), including the impact on aesthetics and character of the location.
- The location and exposure of the building to both wind driven rain and deposition from sources of pollution (e.g. industry, major road infrastructure), which should be considered when selecting the final finish of the systems being applied.

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- Ventilation provision in the property, including operation and suitability of provision (trickle vents clear and open), mechanical ventilation (installed, connected and operating to design output), with careful consideration of occupancy levels and lifestyle issues.
- Identification of geometrical issues that may restrict good design and workmanship, including the proximity of external obstructions such as telephone exchanges and trees, the presence of conservatories, bay window structures and utility meter boxes.

2. Assessment (materials and buildings)

Current methods of assessing durability and condensation risk are undertaken using unrealistic parameters for risk such as levels of high exposure to wind driven rain and high levels of internal and external relative humidity. These limited methods of testing can provide a level of comfort and assurance which in reality may not be delivered.

Hard to treat or traditional buildings are without doubt the most challenging to improve from a thermal performance perspective. Due to their use of natural materials (for example lime mortar) and porous constructions they are the most susceptible to the effects of moisture ingress and require accurate assessment and greater quality control when choosing an improvement option. The decision to insulate must be taken with the greatest of care. Attention must be paid to the existing condition of the property. The assessment should focus on fabric integrity and good watertightness and should include a thorough investigation of the likelihood of introducing cold bridges into the building and how these will be designed out in the installation process.

It is accepted that there is a limit to the changes that can be made to improve a building's thermal performance without a significant impact on its appearance and on its historic fabric so improving the sustainability of such buildings results in a tension between the competing demands for heritage preservation and the pressures to reduce the environmental impact of buildings in use. The option to do nothing is not viable in global terms and this report offers a route map for the changes that need to be considered to ensure that the methods, materials and workmanship used to improve the performance of the existing building stock are robust. Further down the line more specific guidance on dealing with unintended consequences and potential premature failure will need to be produced.

The problems caused by moisture in building structures are well known and there is a large body of literature addressing issues including rising and penetrating dampness and 'interstitial condensation'. For regulatory purposes the key document currently is the BS Code of Practice for condensation in buildings BS5250:2011, which is referenced in the three sets of Regulations in the UK. Besides a discussion of the principals of condensation risk, the main content of BS5250 is prescriptive guidance on how walls, roofs etc. should be designed and constructed to avoid problems. Many if not most designers will refer to this guidance and not carry out any more complex assessments.

If a more detailed analysis is necessary, BS5250 refers to a calculation procedure specified in ISO 13788, which uses a 'Glaser' procedure, taking account only of steady state vapour diffusion. While this may be adequate for some structures, such as flat roofs (and even here there are situations where it is inadequate), it does not represent the whole picture for constructions such as masonry walls where very large amounts of water are stored in the fabric. No account is taken of rain impacts and solar gain on the outside surface, liquid water movement and the effect of moisture on the thermal and moisture transport properties of materials. A further standard, EN 15026: *Numerical modelling protocols for condensation analysis*, was developed to address these issues and this is now becoming used in the UK through the German software WUFI (which can run calculations using EN15026), however there is no robust protocol for using this standard in the UK. Some advocates of WUFI suggest that it will solve all problems and should replace the old ISO 13788 methodology completely. However there are a number of difficulties with this approach at present:

- WUFI is a very complex programme that needs a good understanding of building physics to use successfully. It can be very easy to enter the wrong parameters to produce misleading or inaccurate results.
- Detailed data on the heat and moisture transport properties of the materials making up the structure is needed. There is a database, which contains mainly German materials, in WUFI. It is difficult to know whether these are relevant to UK constructions. Many of these properties are complicated and expensive to measure, and would no doubt raise objections from the insulation manufacturing companies.
- Detailed external weather data from the location of the building is needed to run WUFI. This would be very expensive (~£8,000) to acquire from the Met Office. It is possible to generate simulated climate data in WUFI format using software such as Meteonorm 7; however it is not clear how realistic this is of actual conditions, and many argue that the weather predicted by this method is often harsher than actual conditions. The weather files created in this manner uses triangulation from the nearest meteorological stations and extrapolates the results.
- EN 15026 describes and models only 1D movement of heat and moisture. The WUFI programme can be 2D but this is currently outside the range of EN15026, and there is no commercially available version of Wufi 2D. As many of the problems of moisture require a 2D approach there is currently also a disconnect between the standard and the current practice.
- WUFI does not model air movement in structures sufficiently accurately, and cannot deal with 2d junctions (eaves, reveals etc.)

Incorrect moisture predictions can lead to two types of failure:

- Predictions that problems may occur, when in fact the risk is negligible, which may limit the installation of insulation unnecessarily.
- Failure to predict real problems and take appropriate precautions which will lead to problems such as rot of timbers, frost attack to masonry, damp staining to interior finishes and bad indoor air quality (due to mould and damp).

3. Workmanship

The route to installing EWI can be undertaken through two main processes; by using pre-certified systems or processes from manufacturers or by adopting the PAS2030 process as the means of delivering an external wall insulation business. Both routes require checks in some form of another, normally undertaken by producing a number of checklists and guidance documents to help staff follow the adopted principles. However a review of a number of company practices does highlight inconsistency in the application of those standards and weakness in the skill sets of the staff involved in undertaking these checks and reviews. Below are set out the areas of weakness that have been observed, not only as part of the primary analysis in this project but on a considerable number of other schemes and properties; currently 63 schemes and approximately 2000 installations, in varying levels of detail, some from start to finish, some as a review of working practices and some as part of a reported issue for investigation of underperformance.

External insulation

Initial Preparatory Works

- Inconsistent identification/removal of areas of delaminated render (pre-installation)
- Limited assessment of characteristics of building and siting prior to specification

- Signs of movement in building ignored
- Parge coating essentially never undertaken, regardless of wall surface
- Detailed assessment of moisture content in the structure, evidence of condensation and mould ignored
- No assessment of ventilation provision in place, including the presence of trickle vents, working mechanical extraction, or delivered extraction rates, or availability of opening windows.
- Local climatic conditions not fully considered (wind driven rain, exposure etc.)

Inconsistent Workmanship

- Weep holes/channels of windows covered by overcills
- Gaps left between boards and void at bells
- Gaps between boards, at times up to 10-15mm
- Mesh not fully embedded
- Stress patches of inadequate size
- Bond pattern of boards not in line with spec (e.g. <200mm vertical edge to vertical edge between courses)
- Fixings: specified pattern not followed, over drilled, over sunk, etc.
- Adhesive (where specified) not applied consistently to board
- Inconsistency of pattress placement for hanging baskets, etc.
- Sills, verge trim, etc. not adequately sealed, or mistakenly left unsealed
- Capillary grooves on sills compromised
- System stops, base rail, trim etc. not firmly fitted
- Poor/no ground clearance, particularly around doorsteps, ramps, etc.
- Spill of verge cap and window sills often inconsistent (e.g. verge cap tilted in toward house)
- Top coat missing in small areas of wall (seen in two instances)
- No clearance left at gas shut-off valves
- Service penetrations not adequately sealed
- Inadvertent blocking of direct air vents for gas fires and back boilers
- Blocking of drains, poor routing of rainwater goods and wastes to drains (causing splashing or flooding)
- Penetrations of system (e.g. satellite dishes, hanging baskets, rainwater goods) insufficiently robust, may allow rain penetration over time
- Silicone sealant applied to dusty or unclean surfaces

Internal insulation

Initial preparatory Works

- Assessment of suitability of IWI for building is inadequate, no consideration of 'breathable' wall construction and specification of 'vapour permeable' IWI systems
- Wallpaper, wainscoting, organic material not removed prior to installation
- No inspection of exterior of wall to determine weather-tightness, rising damp, etc.
- No consideration of ventilated cavity behind insulation or vents through wall, even in areas of high exposure of likely interior damp, this principle may only be suitable in some locations and conditions.
- No assessment of a successful design when considering cold bridging, which when considering IWI is more crucial.
- No assessment of ventilation provision.
- Signs of condensation and mould ignored.
- Where floor-ceiling voids are not insulated, ceiling and floor penetrations are not sealed to reduce vapour transport
- Insulation applied when thermal bridging is not addressed to meet backstop value of $0.3 W/m^2K$. Latest research indicates that this approach will result in significant cold bridging, reduced returns in terms of energy savings and premature decay or organic materials and finishes.

Inconsistent Workmanship

- Poor butting of insulation boards
- Large gaps (10-150mm) left between boards and walls/ceilings/floors/sills – often coving is not removed and boards stop short of this height
- Window trickle vents covered by insulation
- Cupboards, meter boxes, in-built furniture etc. left in-situ and no insulation placed behind
- Joists not protected from condensation risk (particularly relevant where joist space is not insulated)
- Insulation not returned along partition walls (thermal bridge)
- Service penetrations not adequately sealed
- Inadequate fixings
- Pattresses not provided
- No communication with resident on the impacts of insulation – fixings being limited, damage to insulation, and impact on floor space.

4. Design Weakness

To ensure that any introduction of insulation is homogenous it is important to fully understand the impact of poor design. Most geometrical obstructions can with care be detailed to minimise the risk of mould growth and condensation risk. The use of thermal modelling can help to ensure that the risk is managed

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to an acceptable level, the principles of BR497 Conventions for Calculating Linear thermal transmittance and Temperature Factors and FB61, “Reducing thermal bridging at junctions when designing and installing solid wall insulation" should be used to set the standard.

The issues requiring attention have been identified as, but not limited to:

- Vapour control layer not installed when appropriate, or installed when not appropriate (in IWI)
- No insulation installed in floor/ceiling voids
- No insulation continuity between wall element and loft insulation for EWI and IWI
- Cheeks/reveals not insulated for EWI and IWI
- Window sills not insulated (including bow windows, etc.) for EWI and IWI
- Brick slips or high durability finishes not specified in high traffic areas
- Silicone render not specified over acrylic when climate conditions dictate
- Reveals and other two dimensional junctions not considered or included in the proposed scheme and then not insulated
- Meter boxes left in place, services boxed around rather than moved to outside of system
- Significant thermal bridging left at eaves – both with soffit and without. Heads of top-floor windows often left uninsulated if at roof level
- Thermal bridge at area over porch roofs, etc. (often >100mm left uninsulated to reduce rain splash-back dirtying render and saturation from snow)
- Flashing over conservatories, shed roofs, etc. not boarded over with insulation, instead insulation is left above level of flashing
- No insulation below DPC (often starts 50mm above)
- Gaps in insulation around services
- Fittings and fixtures not designed to be deconstructed, resulting in collateral damage on replacement or removal.
- Fences, gates and other abutments not isolated from the building to allow the insulation to be continuous.
- Introduction of conductive material (metal) into system designs, resulting in introduced cold bridges.
- Poor details produced at roof line and gable end, resulting in the use of mastic sealant to deliver the water resistance strategy.

5. Process

Other issues have been identified as part of this research into the causes of unintended consequences when introducing solid wall insulation. These are listed below, grouped as process issues

- Renders, insulation, timber and adhesives applied and/or stored in unsuitable weather conditions (cold, rain, heat)
- Insulation left outside in rain on installation day (wet insulation installed)

- Damaged insulation still fixed to properties
- Failure to follow manufacturer's installation process, or even good practice principles on fixing patterns and methods.
- QA processes where evidenced relegated to 'tick-box exercise'. Individual properties not adequately tracked and photographed at key stages of installation
- No commissioning or handover process

A number of the issues highlighted appear to refer back to a lack of understanding in the particular challenges that different construction forms can pose when being considered for SWI.

Report Ends