Solid Wall Insulation

DECISION MAKING PROTOCOL & CODE OF CONDUCT

Thursday 18 September 2014

NDM HEATH LTD
Sustainable Energy Services

NDM HEATH LTD

Sustainable Energy Services

- Independent, impartial services across technical, CO_2 & fuel poverty agendas
- Specialism in traditional, historic & other 'hard-to-treat' buildings

- *Sustainable Traditional Buildings Alliance* (*STBA*) – Steering Group
- *Institute for Historic Building Conservation* (*IHBC*) – Affiliate & Technical Panel
- SAP & BREEAM Domestic Refurbishment – licenced assessor

SERVICES

Energy, CO2 & cost analysis	Feasibility Studies	Financial Appraisals	Guides & Reporting
BREEAM and SAP	Research	Technical Support	Training

STROMA CERTIFIED

BREEAM LICENSED ASSESSOR COMPANY greenbooklive.com

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TRADITIONAL BUILDINGS

- Challenge: how to make *significant* improvements while retaining character & not causing unintended consequences
- 'Safeguards' are in place
    - How safe are they?

‘SAFEGUARDS’

<u>Building Regulations</u>

- *‘The work should not prejudice the character of the host building or increase the risk of long-term deterioration of the building fabric or fittings’*
- *‘Particular issues relating to work in historic buildings…include… enabling the fabric of historic buildings to ‘breathe’ to control moisture and potential long-term decay problems’*

‘SAFEGUARDS’

- *‘The adoption of any particular energy efficiency measure should not involve unacceptable technical risk of…excessive condensation’*

- *‘If you are the person (e.g. designer, builder, installer) carrying out building work to which any requirement of building regulations applies you have a responsibility to ensure that the work complies with any such requirement’*

‘SAFEGUARDS’

<u>Green Deal Code of Practice</u>

- *‘It is the responsibility of the Green Deal Provider to … –*
  a. *ensure that the energy performance of the products and the improved building will be broadly as anticipated by the savings estimate …*
  b. *minimise the risk of damage to the building fabric as a consequence of inconsistent or discontinuous insulation (thermal bridging); or inadequate ventilation or inadequate air tightness, particularly where the installed measures include internal or external solid wall insulation systems, cavity wall insulation or replacement or secondary glazing; and*
  c. *minimise any risks to the health and safety of occupiers’*

‘SAFEGUARDS’

- *‘The Green Deal Provider must ensure that…materials or systems…(including insulation or moisture and air control layers) do not increase the risk of interstitial condensation or moisture build-up to a point where fabric decay or risk to the health of occupants might be caused’*

'SAFEGUARDS'

- *'Where the … building is a vulnerable building, the Green Deal Provider must … take particular care to ensure that –*
    i. *the proposed improvements are appropriate for the building;*
    ii. *the finishes and fabric of the building are protected from damage resulting from installation of the improvements, by using appropriate materials, products and specifications'*

‘SAFEGUARDS’

- *‘The Green Deal Provider must also consider whether an architect or surveyor with specialist skills in respect of vulnerable buildings should be consulted’*
- *‘The Framework Regulations require a Green Deal Provider to agree in a Green Deal Plan to guarantee the functioning of the improvements and to repair damage to the property which is caused by the improvements’*

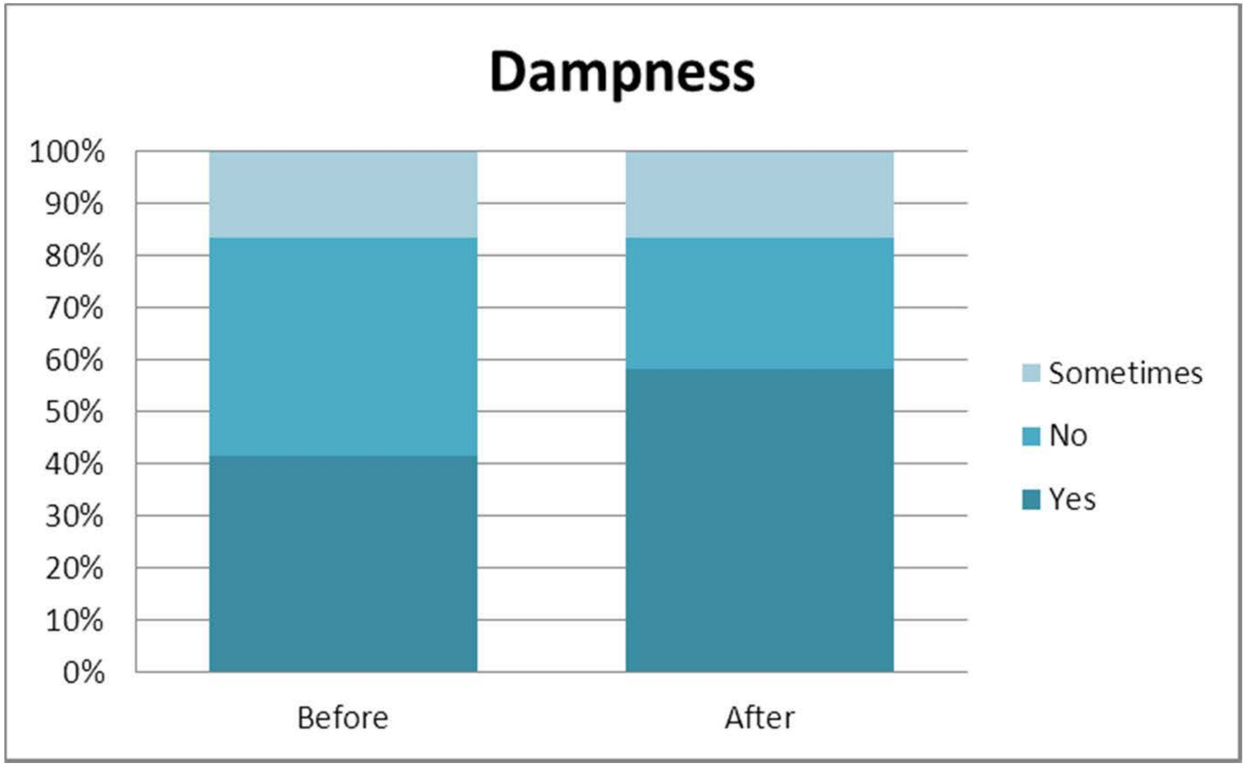
(Image source: STBA)

‘SAFEGUARDS’

- Safeguards may be written into official documents, but these safety nets are full of holes
- (Left: Actual examples of building failures within 2 years of installing solid wall insulation)
- Moisture + Heat + Organic Material = Compost

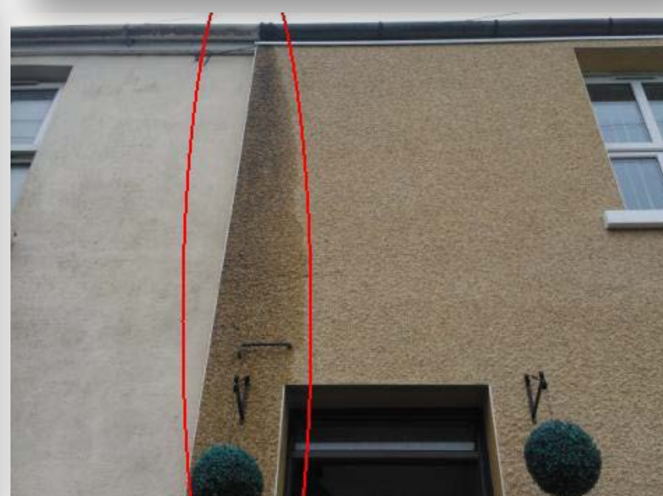
BRE study for DECC

- Unintended Consequences in Traditional Buildings
- Initially assessment of EWI
- >400 properties visited



(Image source: BRE)

Within two years…



(Image source: BRE)

DOING IT RIGHT

- How can we retrofit traditional buildings properly?
- Doing it properly means:
    1. Safely
    2. Significantly
    3. Affordably
    4. … and with occupants in situ

1. Safely = minimising technical risk
2. Significantly = making meaningful impacts (CO_2 / comfort / cost)
3. Affordably = replicably

1. SAFE RETROFIT

- A notoriously complex area
- Most technical risks for traditional buildings (solid-walled, permeable) = moisture risks
- Risks include
  - High humidity (mould, dust mites, health issues)
  - Condensation – both on surfaces and in cavities (decorative & fabric damage)
  - High moisture content in materials (rot, e.g. joist ends)
  - Frost damage (detached render, spalling brickwork)
  - + Cost/disruption of any remedial works
  - + Complaints!

1. SAFE RETROFIT

- Many risk factors:
    - Materials
    - Ventilation
    - Coverage (thermal bridging)
    - Detailing
    - Workmanship (e.g. joints, seals)

1. SAFE RETROFIT

- Materials
  - Traditional buildings are made of permeable materials
  - Moisture in, moisture out
  - Many conservation bodies state preference for permeable materials to retain this feature
    - Often extends to avoiding vapour barriers
    - (N.B. Other views exist!)
  - Many modern materials are impermeable (esp. insulation)
    - If using impermeable materials, particular care required at detailing & application stages

(Image source: Conker Conservation Ltd / Old House Eco Handbook)

1. SAFE RETROFIT

- Materials
  - Challenges with using permeable materials include awareness, cost, depth of material, acceptance by installers etc.
  - Not appropriate in all situations (e.g. wet rooms)

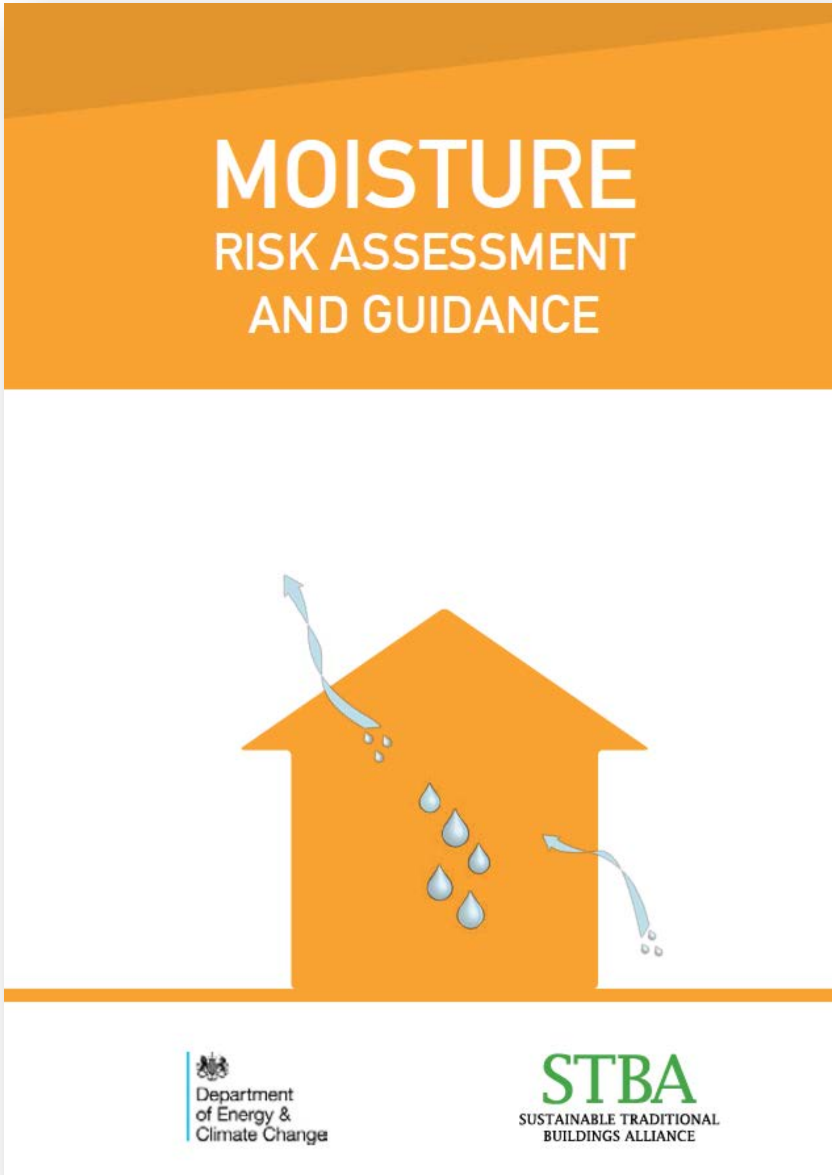
  - Wide range of materials, all with pros & cons
  - Different materials suited to different situations

1. SAFE RETROFIT

- Ventilation
  - Often not considered enough
  - Insulation changes internal building conditions (e.g. Relative humidity)
  - The greater the insulation levels, the more important ventilation becomes
  - Also becomes more important where using impermeable insulation systems

1. SAFE RETROFIT

- Important to distinguish between controlled (i.e. deliberate) & uncontrolled (i.e. infiltration) ventilation
  - Address excessive ventilation as well as insulation
  - Avoid over-sealing & moisture build-up
- Formal assessment mechanisms can present conflicting picture
  - SAP under-estimates impact of draughtproofing
  - Building Regulations recommend MV for >5 ACH
  - Insulation assessments misrepresent moisture risks



1. SAFE RETROFIT

- STBA for DECC (Draft 2014)
  - *‘There are many uncertainties and complexities in regard to moisture risk and management, and … the importance of learning cannot be understated. Learning refers not only to the understanding of moisture principles, but also … of buildings, their context and the way they are used’*
  - *‘The existing standard BS5250 and the standardised modelling method ISO 13788 [Glaser Method], which are the main guidance for moisture risk assessment in standards and regulations in the UK, are not sufficient, in many situations [e.g. old buildings], to deal with a proper moisture risk assessment’*

1. SAFE RETROFIT

- Current thinking among traditional building lobby:
  - Maintain natural ventilation
  - Maintain moisture movement
  - Insulation systems should generally be able to 'breathe' & transmit moisture
  - No vapour barriers
  - Breathable finishes

  - If doing other than above, particular care required

- (Other views exist!)

1. SAFE RETROFIT

- Coverage & thermal bridging
    - TB nearly unavoidable in retrofit
    - Common culprits:
        - Floor-wall junctions
        - Door & window surrounds
        - Complex windows (e.g. bay windows, mullions)
        - Poor insulation jointing
    - Risks both heat loss & condensation

1. SAFE RETROFIT

- Coverage & thermal bridging
  - Hard to avoid – but not always
  - Detailing & application are key
    - E.g. More tight jointing, less expanding foam
  - It will take longer
  - It will cost more
  - Implications of not addressing TB are potentially serious

1. SAFE RETROFIT

- Coverage & thermal bridging
    - Impacts can be considerable
    - Examples (STBA):
        - Scenario 1: 140mm IWI on walls, no insulation at reveals
        - Scenario 2: 20mm IWI on walls and reveals
        - Which is better?
        - Scenario 2 - Scenario 1 leads to 10% *more* heat loss

1. SAFE RETROFIT

- Coverage & thermal bridging
    - With internal wall insulation, TB heat loss increases where:
        - smaller amounts of external wall
        - larger windows, or more of them
        - thicker walls
    - Scenario: Terraced house, large windows, 500mm brick wall, reveals insulated
        - Increasing wall insulation from 20mm to 140mm reduces overall building fabric heat loss reduction by only 10%
        - (If house were detached & had small windows, this figure would be 28%)

1. SAFE RETROFIT

- Coverage & thermal bridging
  - Coverage can be more important than depth of insulation
    - (& there may therefore be an optimum insulation depth)
    - E.g. detached house, 500mm brick walls, small windows:
    - 60mm IWI + insulated reveals = 140mm IWI without insulated reveals
    - (Source: STBA research for DECC – *Heat Loss from Thermal Bridging in Internal Wall Insulation of Solid Buildings* (publication pending))

1. SAFE RETROFIT

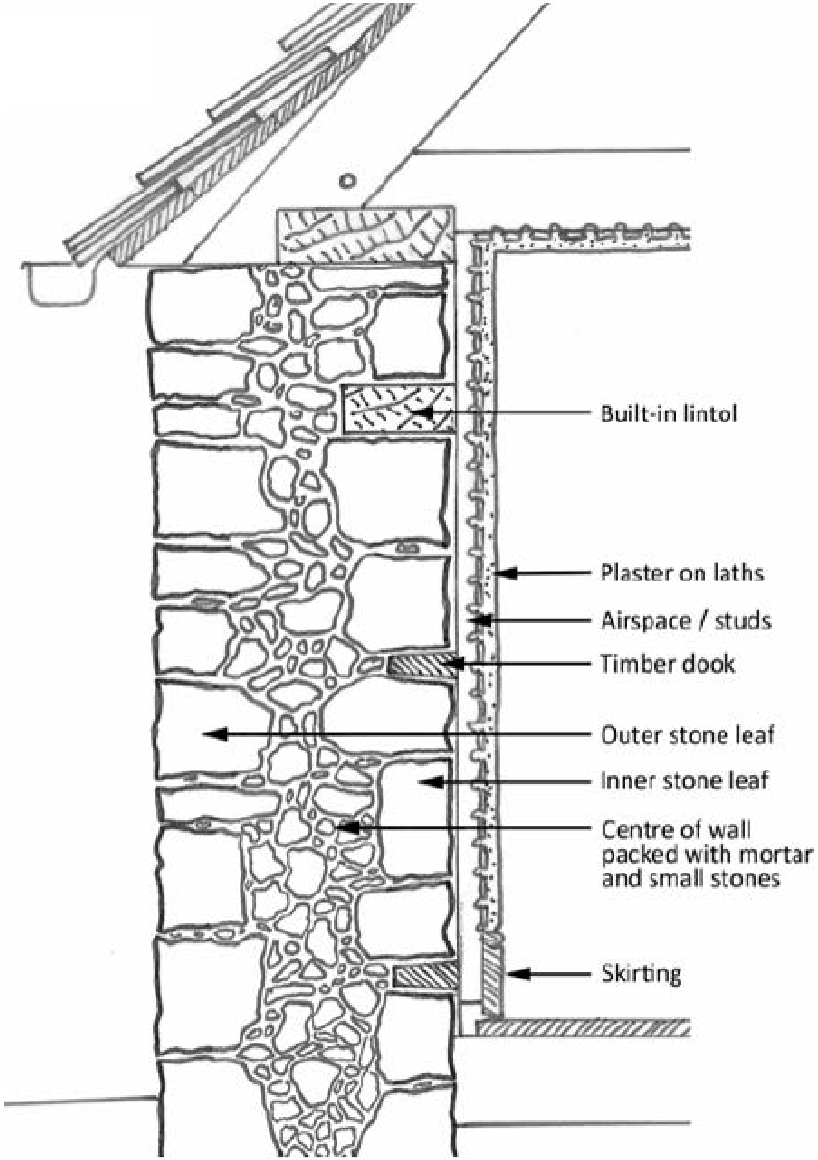
- Detailing & Workmanship
  - Issues at design stage & on site
  - Attention to detail is paramount in order to minimise risk
  - Includes use of appropriately experienced workforce & checks throughout project
  - *'The more complex the system of insulation, the more critical the workmanship becomes'* (Suhr, M. & Hunt, R., 2013)

1. SAFE RETROFIT

- Monitoring
    - Not often done for funding reasons
    - Important on many levels
        - Determining impact
        - Identifying performance gap
        - Allowing any potential problems (e.g. damp) to be found and dealt with

WALLS

- Internal or external?
- Both are complex, both carry technical risk
  - Still many unknowns
  - Many differing opinions!
- Nearly impossible to eliminate thermal bridging
- Attention to detail is essential to avoid (minimise) unintended consequences
  - In studio & on site



(Image © Historic Scotland)

WALLS

EXTERNAL WALL INSULATION

IN GENERAL:

- Best option where lots of wind-driven rain
- Relatively simple to install
- Minimises disruption
- Provides thorough coverage (?)
- Retains thermal mass benefits
- Easier to apply at scale …

BUT:

- Expensive
- Greater visual impact
- More knock-on works
- Complex for joined properties
- Complex re. site boundaries
- Hard to detail effectively around architectural features

WALLS: EXTERNAL

- *External Wall Insulation in Traditional Buildings: Case Studies of Three Large-scale Projects in the North of England* (English Heritage, 2014)
- NDM Heath Ltd, for English Heritage
- Findings:
  - Notion of EWI as the low-risk SWI option not necessarily true
  - Can be hard applying EWI comprehensively (& therefore minimising risks)
  - Clear & considerable gap between advice & practice
  - Knowledge gaps

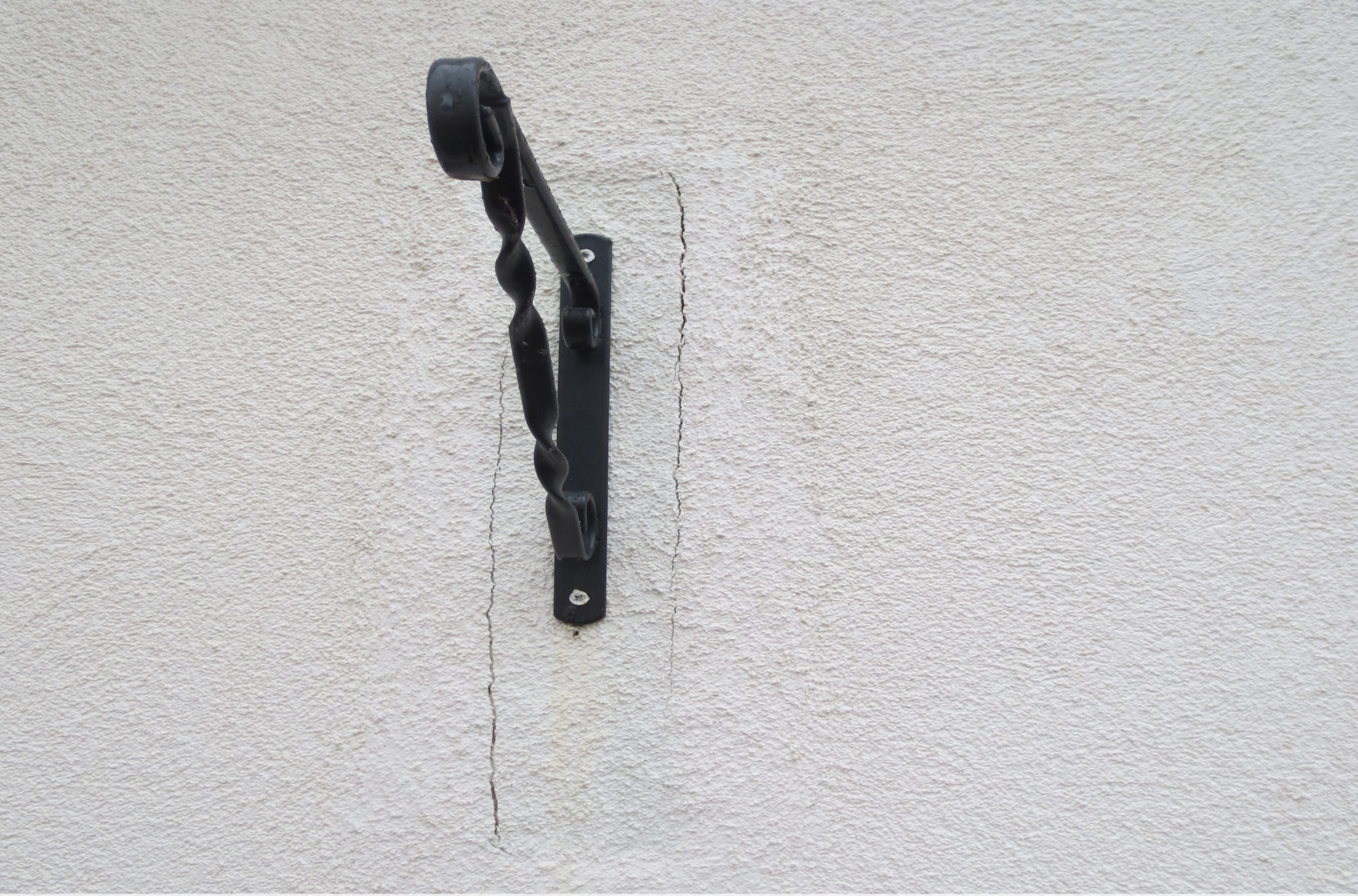
WALLS: EXTERNAL

- Findings (cont.)
    - Funding / time pressures
    - Ventilation issues not fully considered
    - Numerous reports of damp in all three projects assessed
    - Extensive thermal bridging
    - Complex areas avoided or worked around, rather than addressed properly
    - Impermeable systems throughout

- Partial treatment of terraces

- Stepping insulation at ground level
  - Avoidable by treating terraces together as single units

- Architectural features deliberately exposed
  - Either on grounds of complexity or to retain visibility
  - Presents greater risk of heat loss / condensation / mould



- In practice, time / budget constraints mean existing features often left in place & worked around
  - Rainwater goods, drainage, rooflines, lampposts, gas pipes, burglar alarms etc.
  - Thermal bridging risks

- Incomplete coverage of window & door surrounds
  - Often hard to treat effectively without encroaching on opening
  - Exacerbated with paired openings

- Opening surrounds often left exposed to show off architectural features

- Complete coverage loses sight of original features, but arguably presents cleaner finish
- Sills & lintels often easier to treat than jambs
    - Full coverage unlikely to be achieved in many instances

- Depending on system it may be preferable to replace windows
    - Bringing forward reduces depth of reveal
- Replacing windows before EWI avoids difficulties later on

- Bay windows particularly hard to insulate thoroughly
  - Sills may be partially treated without complication; mullions rarely treated
  - Curved bays face added difficulties (flashing sometimes omitted)

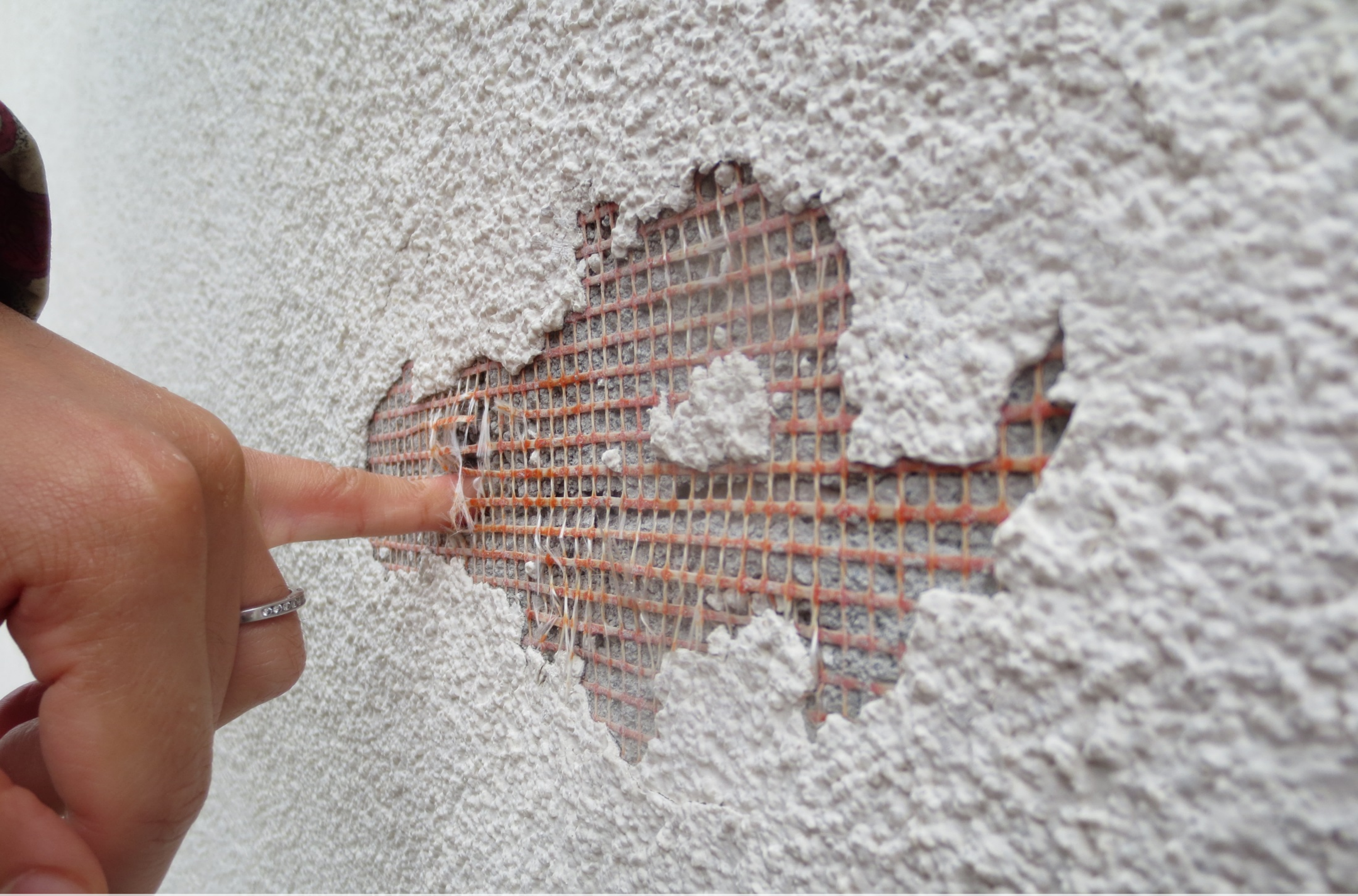
- Untreated bay windows represent considerable heat loss area
  - Better to treat windows instead / first?

- If boiler replaced as part of project, do this before EWI to avoid thermal bridging
- If flue cannot be replaced, ensure insulation is sealed effectively around perimeter

- Perimeter sealing very important
    - Inadequate / degrading seals risks rainwater ingress
    - Moisture cannot escape from impermeable system

- Eaves brickwork / boarding often left uninsulated
- Options: Run insulation up behind boards / remove & reinstate boarding / cut insulation to fit ornate brickwork
- N.B. Cutting insulation is time consuming & easier with some materials (e.g. EPS + hot wire cutter) than others

- Window heads in eaves – hard to avoid thermal bridging
  - Insulate reveal as much as possible



- Permeable render preferable, particularly where permeable insulation materials used
- Check weather conditions prior to applying
    - Can fall off in cold / wet weather

- Many other complex details
    - Porch roofs / side passages / unheated adjoining buildings / multiple roof configurations

- If many areas are left untreated, the merit of treating adjacent areas is questionable

Blackpool Council

DECISION MAKING PROTOCOL FOR SOLID WALL INSULATION PROJECTS

A Guide to Decision Making for Solid Wall Insulation Retrofit Projects on Traditional Buildings

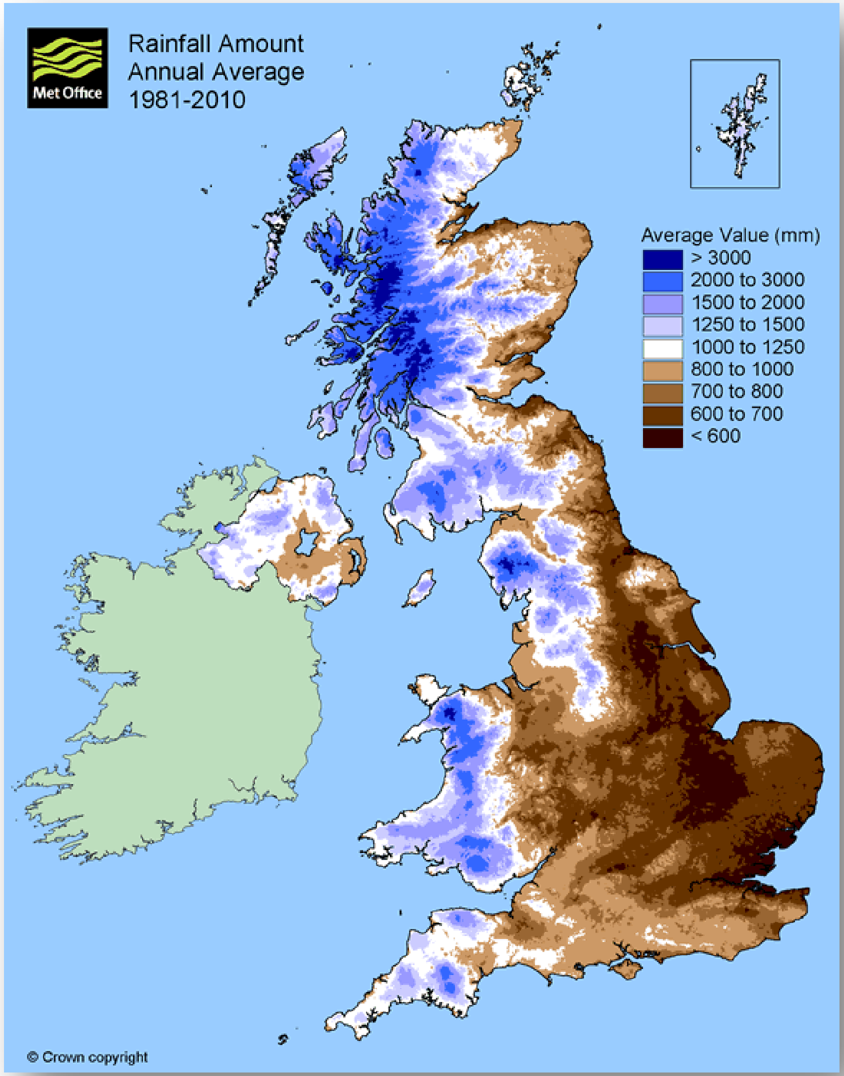
Prepared for Blackpool Council by NDM Heath Ltd and the STBA, July 2014

NDM HEATH LTD
Sustainable Energy Services

STBA
SUSTAINABLE TRADITIONAL BUILDINGS ALLIANCE

KEY PRINCIPLES

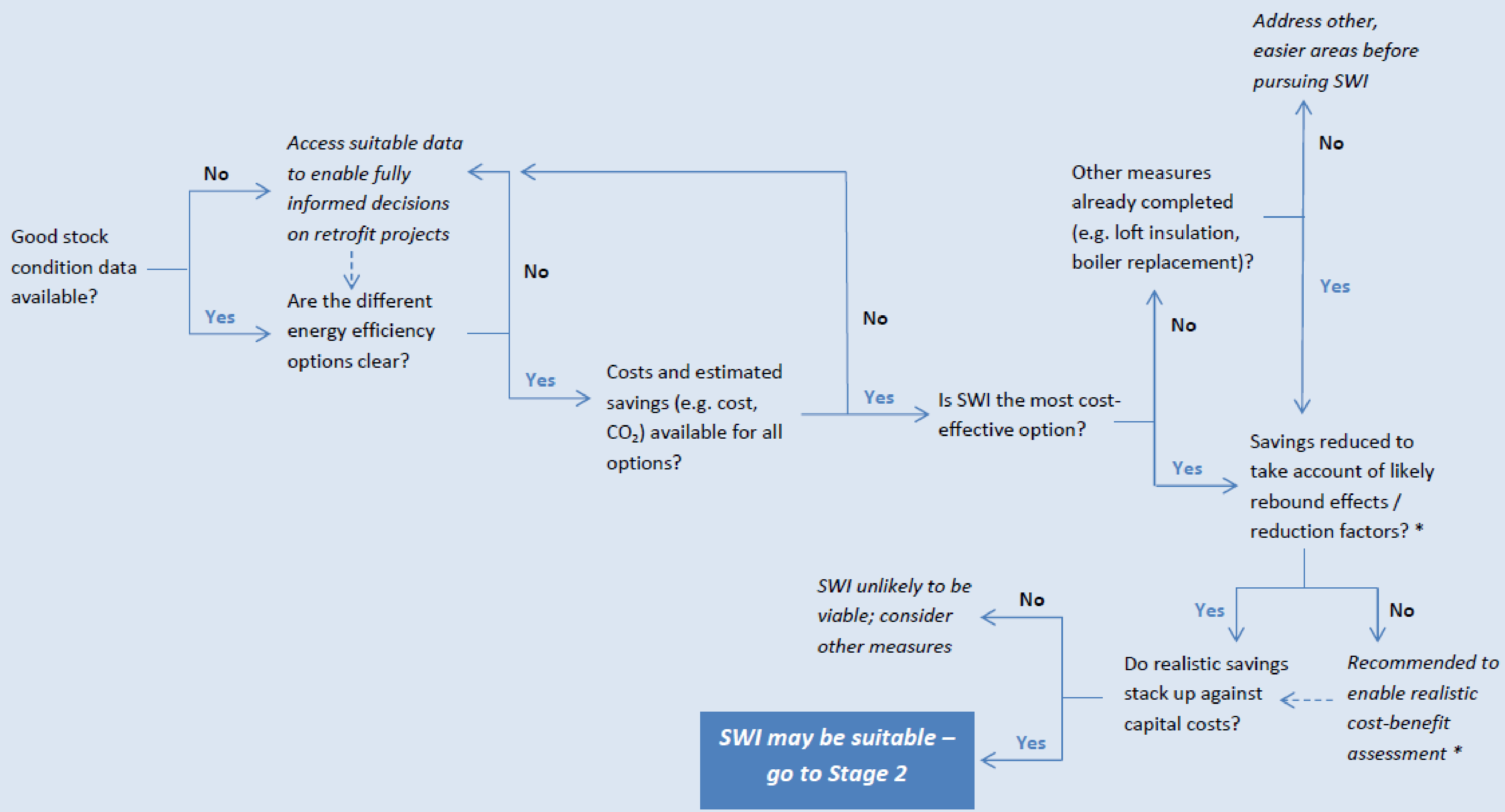
1. All treated buildings are in appropriately sound condition, free from defects and in particular damp
2. EWI is selected over IWI, unless there are specific reasons to choose IWI
3. Fully vapour-permeable insulation systems able to transfer moisture are used, including linings and finishes
4. Careful detailing is employed throughout, particularly around openings, junctions, eaves, seals and any areas of thermal bridging
5. Installation on site is properly managed by site personnel and independently monitored through a Clerk of Works of similar
6. Systems and detailing are consistent, both within individual projects and across multiple projects
7. Systems and detailing are in line with any relevant conservation considerations and requirements
8. SWI is approached holistically, as part of a whole-house retrofit programme
9. Occupants are involved in the process, and post-project advice is provided



LOCAL CONSIDERATIONS

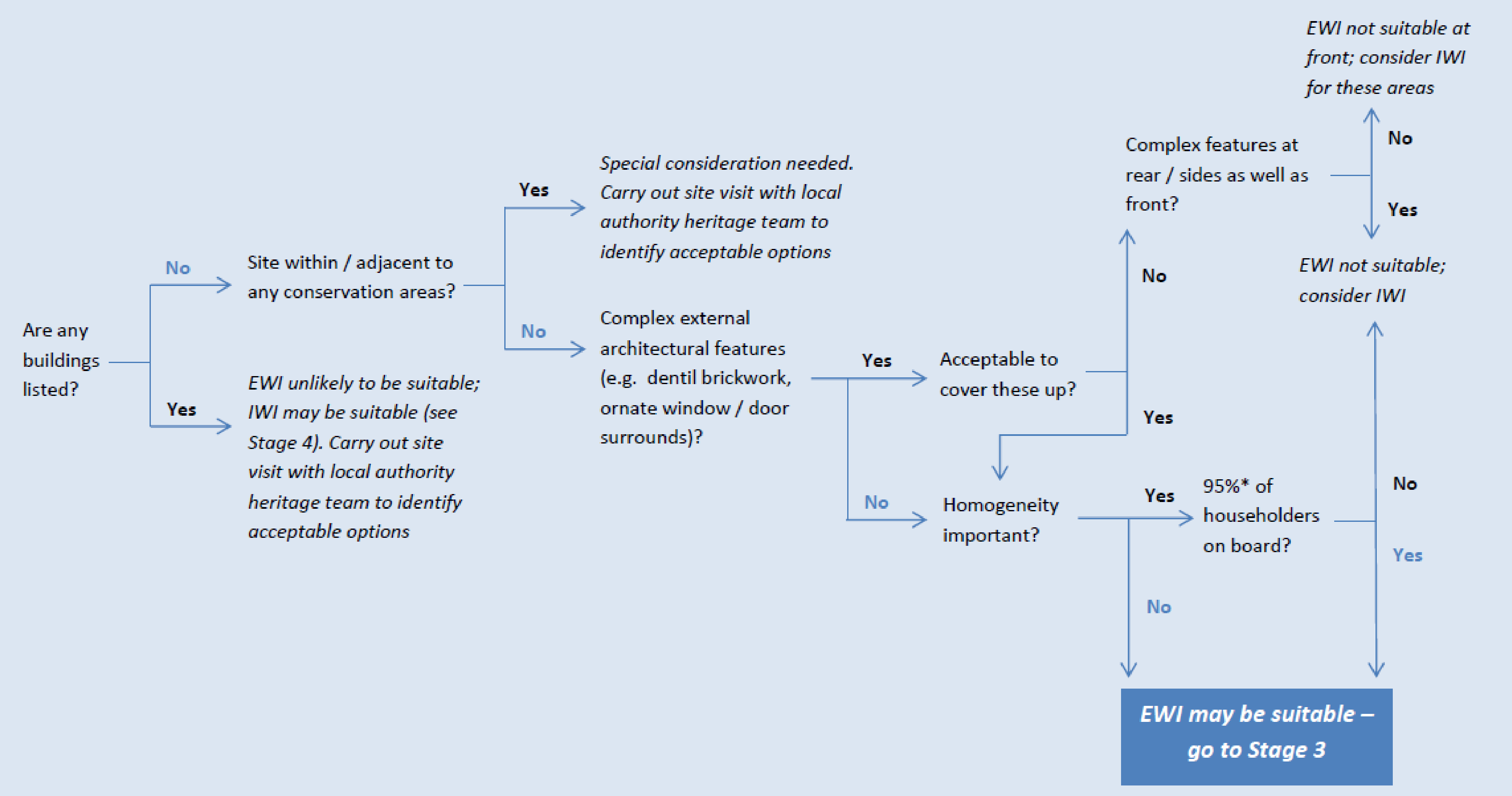
- ‘Severe’ levels of wind-driven rain
  - Influences system selection
  - Increases importance of adequate damp assessments
  - Increases importance of meticulous detailing & application
- Sand & sea spray
  - Weathering & cavity blocking
- Dependent on individual situations, e.g.
  - Location
  - Surroundings
  - Sheltering
  - Orientation
  - Materials

STAGE 1: PROJECT FEASIBILITY



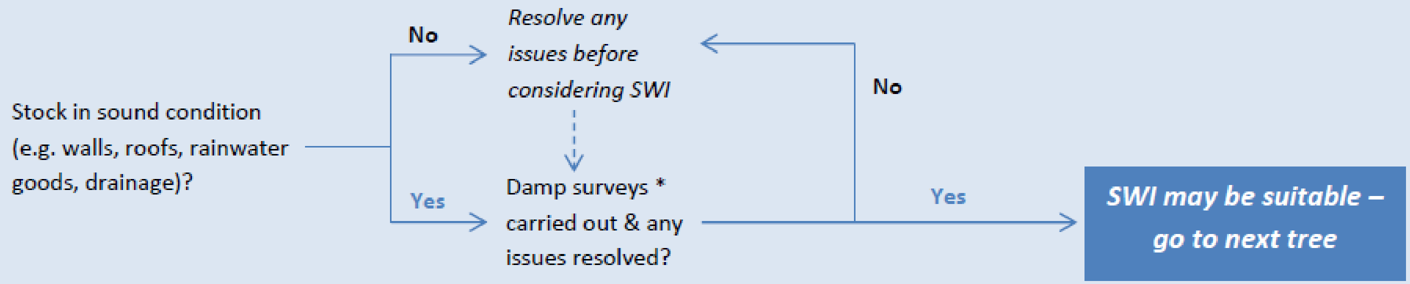
* *Revisions should also help counter some of the other potential causes of inaccurate estimates (e.g. inaccurate modelling tools, imperfect installations and so on). Obtaining suitable data will make revised estimates much more accurate, e.g. accurate U-values and energy consumption, as assumptions in these areas lead to misconceptions about actual impacts.*

STAGE 2: HERITAGE VALUE



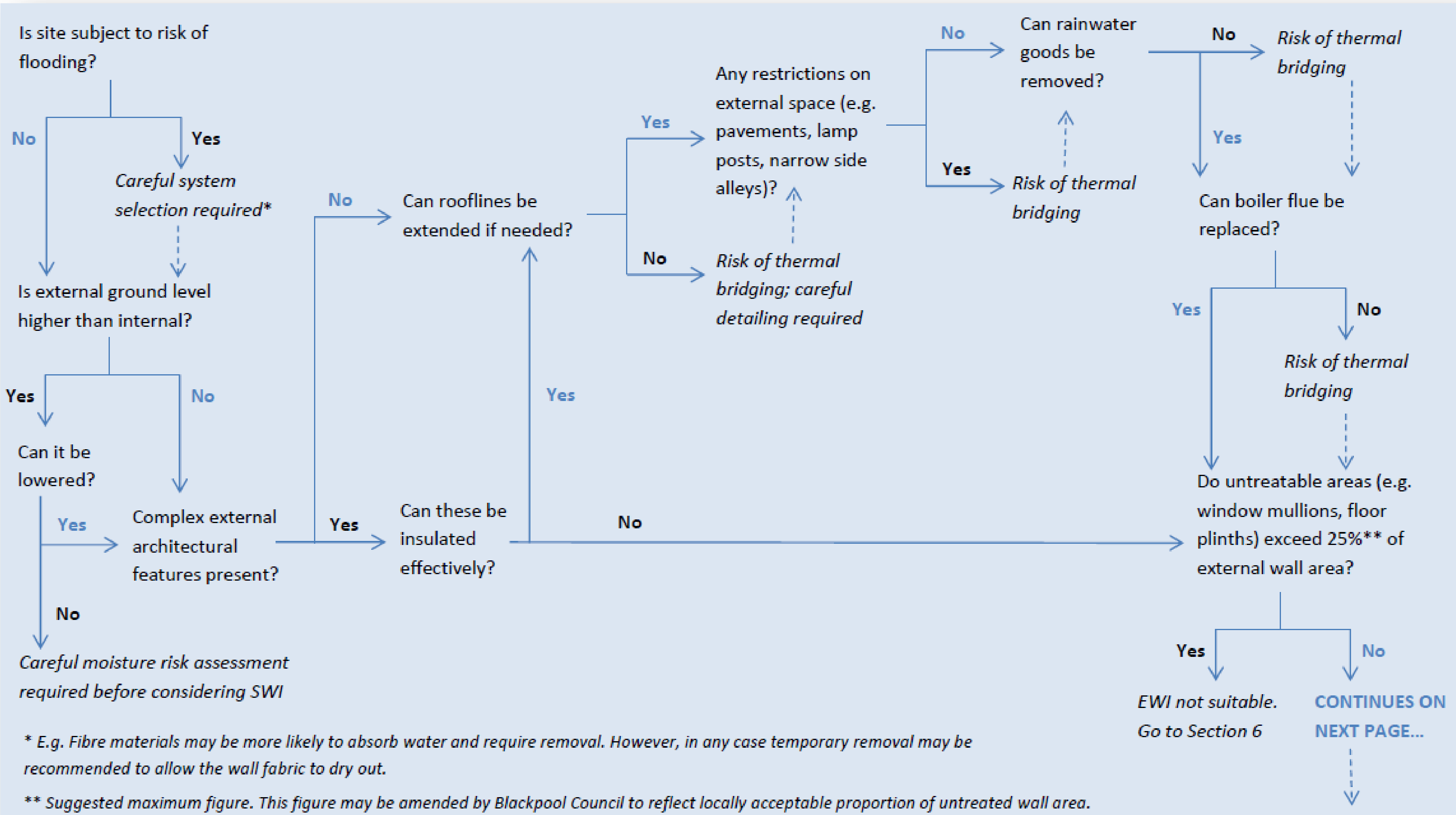
* Suggested minimum figure. This figure may be amended by Blackpool Council to reflect locally acceptable proportion of treated vs untreated properties.

STAGE 3: TECHNICAL APPRAISAL



* *Robust damp surveys are of particular importance for stock in areas such as Blackpool; see Section 2 for more details.*

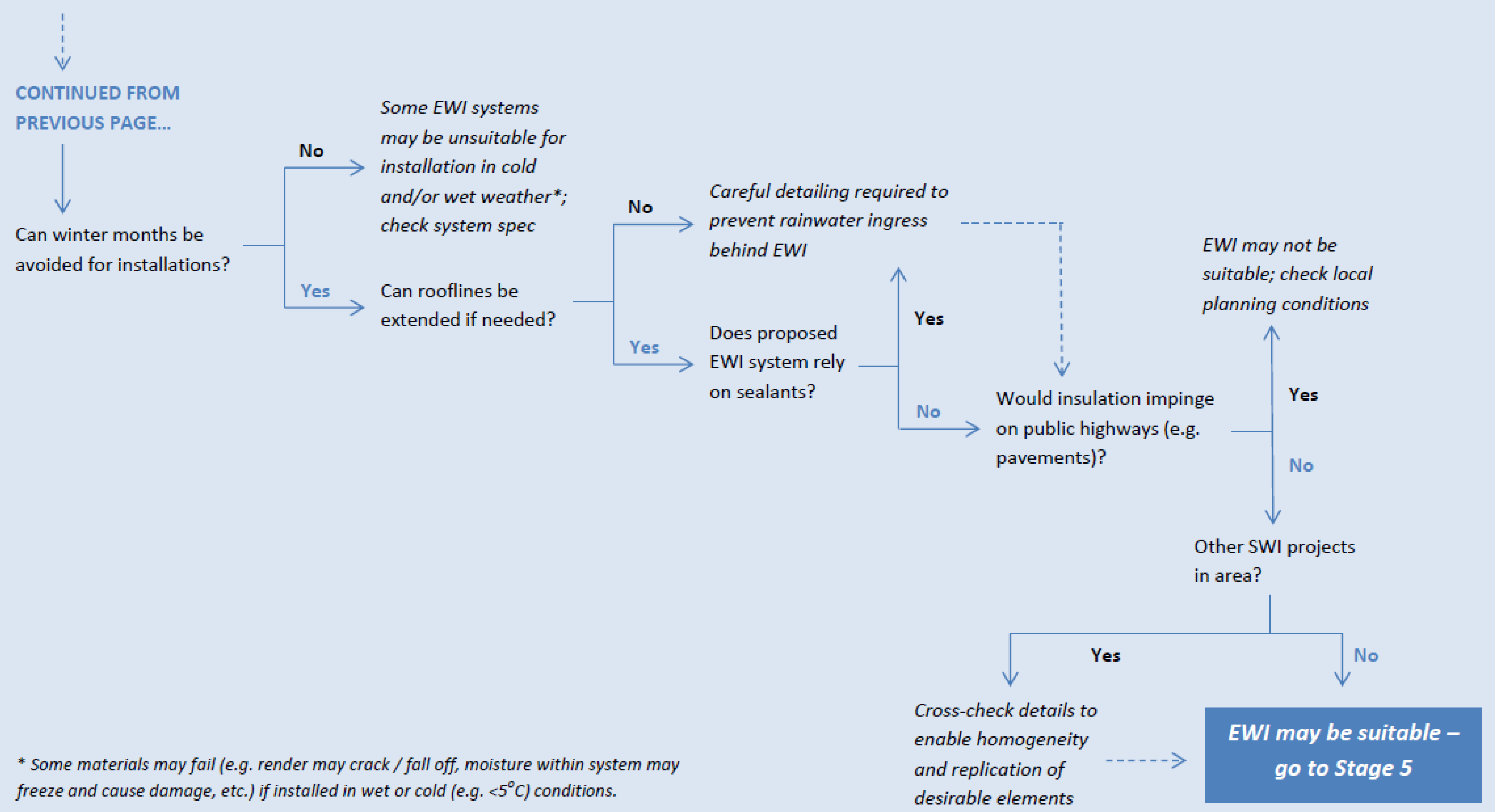
STAGE 3: TECHNICAL APPRAISAL



* E.g. Fibre materials may be more likely to absorb water and require removal. However, in any case temporary removal may be recommended to allow the wall fabric to dry out.

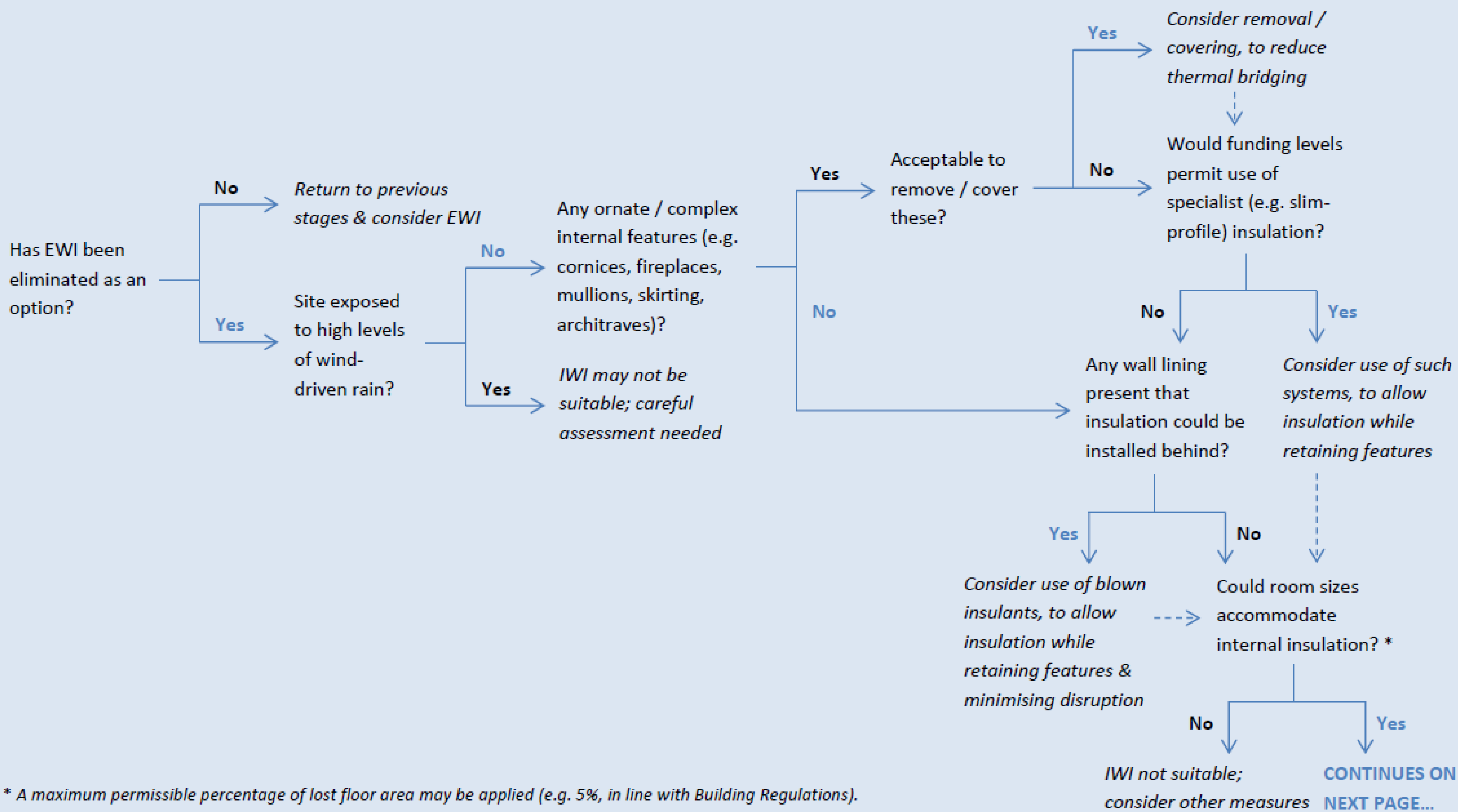
** Suggested maximum figure. This figure may be amended by Blackpool Council to reflect locally acceptable proportion of untreated wall area.

STAGE 3: TECHNICAL APPRAISAL



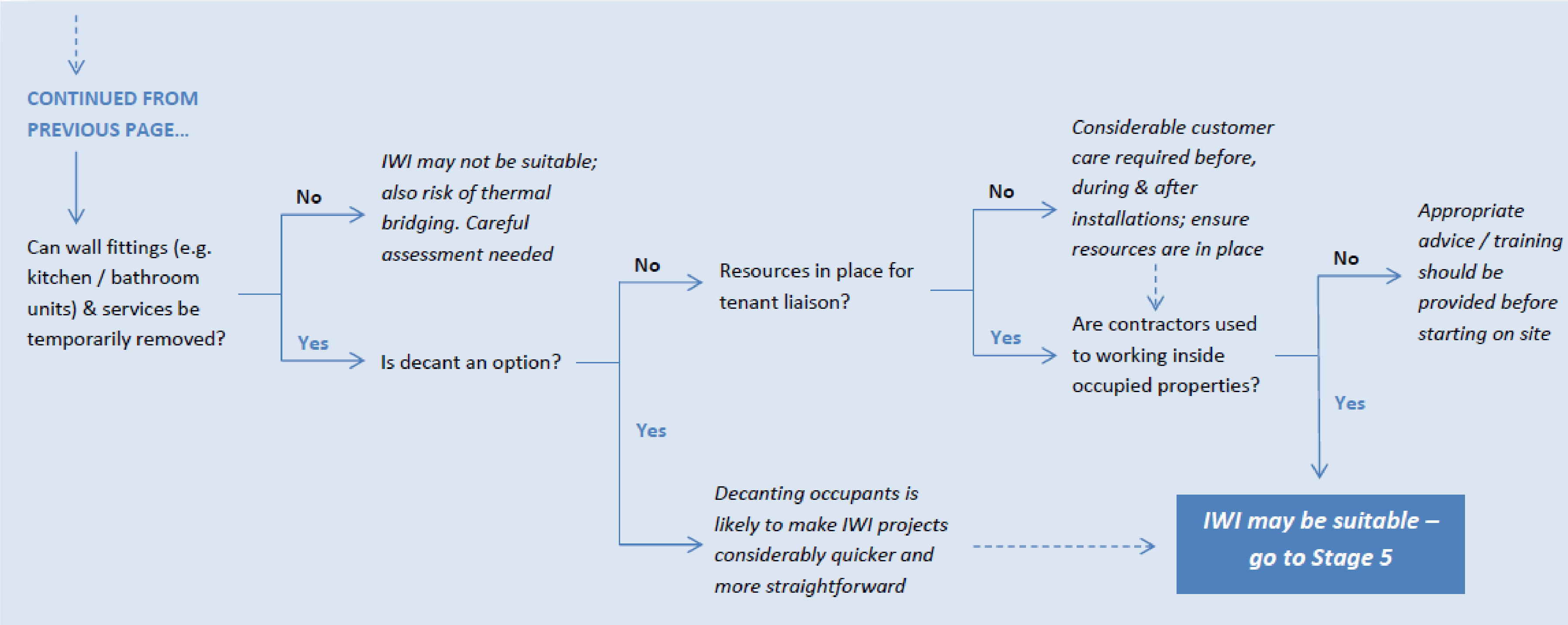
** Some materials may fail (e.g. render may crack / fall off, moisture within system may freeze and cause damage, etc.) if installed in wet or cold (e.g. <5°C) conditions.*

STAGE 4: INTERNAL WALL INSULATION



** A maximum permissible percentage of lost floor area may be applied (e.g. 5%, in line with Building Regulations).*

STAGE 4: INTERNAL WALL INSULATION



STAGE 5: ASSOCIATED MEASURES

CONSIDERATION	ISSUE
Are all Key Principles (see Section 1) being followed?	Following these principles should naturally lead to consideration of most of these associated measures; not adhering to them is likely to increase risks
Have related works been carried out in advance?	While this may not always be possible, completing relevant upgrade works (e.g. repairing / replacing windows, repairing rainwater goods) before installing SWI should reduce the likelihood of related problems occurring in the future
Has overheating risk been assessed & retrofit strategy amended accordingly?	SWI can change indoor climate (e.g. temperature, relative humidity, air quality). In some cases this may be considerable, and it can lead to risks of overheating and moisture-related issues. Assessment of these risks allows associated measures (e.g. ventilation system, heating controls / programming, occupant education) to be identified and implemented where necessary
Is any monitoring possible?	While funding does not always permit monitoring, it is likely to provide valuable data on the impacts and overall effectiveness of SWI. Monitoring can cover numerous levels of detail ranging from qualitative occupant surveys to quantitative scientific testing (of e.g. temperature, energy consumption, relative humidity, interstitial moisture,), and can be carried out before, during and after installations. All such data can be invaluable, particularly where doubts exist about pre-existing moisture issues, estimated values (running costs, U-values) and so on

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SUSTAINABLE TRADITIONAL BUILDINGS ALLIANCE

PRE-QUALIFICATION REQUIREMENTS

PRE-QUALIFICATION REQUIREMENTS
▪ Business and Financial Standing
▪ CRB Checks
▪ Health and Safety
▪ Protecting the Environment
▪ Insurance
▪ Processes, Management of Installation Works and Records of Work Undertaken
▪ Quality Management Systems
▪ Competence and Supervision
▪ Guarantees
▪ Complaints Handing and Management
▪ Subcontractors
▪ Financial Advice

MEMBERSHIP REQUIREMENTS

MEMBERSHIP REQUIREMENTS
▪ Supporting Blackpool Council in the Market
▪ Compliance and Breaches of Membership
▪ Disciplinary Proceedings
▪ Fair Trading Practice
▪ Honesty and Integrity
▪ Consumer Credit Licence
▪ Continuing Development
▪ People, Equal Opportunity and Diversity
▪ Dealing with Vulnerable Customers
▪ Respecting Other Members and the Blackpool Council Tender Process
▪ Advertising / Marketing / Communication / Branding
▪ Impartial Advice
▪ Sales Techniques
▪ Taking on the Work of Other Companies
▪ Customer Service
▪ Commercial Considerations with Customers
▪ Commercial Considerations between Blackpool Council and Members
▪ Collaborative Working on Site
▪ Processes and Management of Work
▪ Competence and Supervision
▪ Quality Management Systems

METHOD STATEMENT

‘BEFORE WORK:

‘Method statements must be produced for all works. These can be generic statements for similar works, but as a minimum the key risks must be assessed for each site.

‘The MS should include details of design and detailing specifications agreed with Blackpool Council. This is important to ensure homogenous and appropriate installations in line with Blackpool Council’s design requirements, particularly in relation to traditional and conservation-grade stock. This will extend into the During Work requirements.

‘The MS should make explicit mention of how the proposed design and installation will address any points of weakness where either water ingress and/or thermal bridging are most likely, noting how such risks will be mitigated. This may be agreed with Blackpool Council at the time of agreeing the design and detailing. The MS should be in a condition to be submitted to the building owner for 100% transparency’

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NEXT STEPS

- Test it out
- Refine & develop over time
- Bring in good practice principles over time as they become feasible
  - Cost
  - Availability
  - Market awareness
  - Contractor willingness
- Monitor
  - Identifies real impacts
  - Identifies performance gap
  - Identifies any technical issues

RESEARCH & RESOURCES

Resources

- BRE
  - *Unintended Consequences of Traditional Buildings* (pending, 2014)

- Changeworks
  - *Energy Heritage – A Guide to Improving Energy Efficiency in Traditional and Historic Homes* (2008)
  - *Solid Wall Insulation in Scotland* (report & conference presentations, 2012)
  - *Guide to insulating Hard-To-Treat Cavities* (2013)
    - http://consultancy.changeworks.org.uk/

- English Heritage
  - *Energy Efficiency and Historic Buildings* (series of 14 guides, 2012)
    - http://www.english-heritage.org.uk/professional/advice/advice-by-topic/climate-change/energy-efficiency/
  - *External Wall Insulation in Traditional Buildings – Case Studies of Three Large-scale Projects in the North of England* (2014)
    - http://www.english-heritage.org.uk/publications/external-wall-insulation-traditional-buildings

Resources

- Historic Scotland
  - *Short Guide 1: Fabric Improvements for Energy Efficiency in Traditional buildings* (2012)
  - Technical Papers 1-22 (2008 – present)
  - Refurbishment Case Studies 1-13 (2012 – present)
    - http://conservation.historic-scotland.gov.uk/home/publications.htm

- SPAB
  - *The SPAB Research Report 1: U-value Report* (revised 2012)
  - *The SPAB Research Report 2: The SPAB Building Performance Survey: Interim Reports* (2011 / 2012 / 2013)
  - *The SPAB Research Report 3: Hygrothermal Modelling: Interim Report* (2012)
  - http://www.spab.org.uk/advice/energy-efficiency/

- STBA
  - *Responsible Retrofit of Traditional Buildings* (2012)
  - *Conventions and Standards for the Refurbishment of Traditional Buildings* (2012)
  - *Moisture Risk Assessment and Guidance* (Draft for DECC, 2014)
  - STBA Knowledge Centre & Retrofit Guidance Wheel (2014)
    - http://stbauk.org/resources/stba-guidance-and-research-papers

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