INSULATION APPRAISAL

OF

13 YORK STREET

CLITHEROE

LANCASHIRE

BB7 2DH

07th October 2020

Job Reference Number: BS 1109

Glovers Project Services Ltd
The Old Tannery, Eastgate, Accrington,
Lancashire, BB5 6PW
Tel: 01254 398426
www.gloverspsl.com

1.0 INTRODUCTION

1.1 This appraisal is in connection with a listed building application at 13 York Street, Clitheroe with the application comprising of "Repairs and alterations including bathroom relocation, re-roofing, incorporation of insulation and new openings to outrigger".

1.2 As part of the listed building application new insulation is proposed to be introduced to parts of the building where no existed before. Some existing insulation is proposed to be upgraded.

1.3 The statement examines the potential impact of the proposed insulation upon the historic fabric of the building.

1.4 The technical assessment of the risks is based upon the STBA responsible retrofit guidance wheel report [Appendix 1] and Historic England 'Energy Efficiency and Historic Buildings' publications.

1.5 The building is effectively two independent structures; the main three storey building and the single storey rear outrigger which is a much later addition. New insulation is proposed to be introduced to the roof walls and floor of the outrigger whilst the main building is only to have the insulation within the roof void upgraded.

1.6 The listed building application does not seek to upgrade the entire dwelling to meet the insulation levels outlined under Approved Document Part L1B and it is recognised that the importance of the historic fabric and traditional methods of construction outweigh the need to insulate in line with modern requirements.

2.0 PROPOSED NEW INSULATION

2.1 Pitched Roof Insulation at Rafter Level [Outrigger]

The rear outrigger is a much later addition to the main building and does not have any special historical or architectural value. The outrigger is also in a damp and dilapidated condition. As such this part of the building alone is proposed to be refurbished in line with modern expectations in terms of insulation methods and techniques.
The proposal details the removal of the existing ceiling and ceiling joists together with new rafters to suit the roof windows and insulation between and under the rafters resulting in a new warm roof structure.

2.1.1 Possible Options

<u>Insulation above rafters</u>

This method was discounted as it would have raised the level of the shared duo pitched roof and would no longer have matched the opposite pitch belonging to the neighbouring property, the ridge line needs to remain as existing to maintain continuity to the external appearance.

<u>Between the rafters</u>

Due to the requirement to maintain the roofline as existing the rafters are of insufficient depth to insulate solely between the rafters and provide any meaningful improvement in insulation levels.

The main risk with this method is that if there are any air gaps between the insulation and rafters water vapour from the space below can form on the rafters and potentially cause wet rot timber decay through time.

<u>Below the rafters</u>

In order to maximise the space within the kitchen insulating solely below the rafters was discounted.

<u>Between and below the rafters (Combination Method)</u>

This method was selected as it means that the rafters do not need to be fully filled and allows for an air gap between the top of the insulation between the rafters and the underside of the roofing membrane. This mitigates against the risk of any condensation forming on the rafters. The insulated plasterboard to the underside of the rafters contains an integral vapour control layer to provide vapour resistance from within the kitchen.

By insulating between and under the rafters the potential risk of any future damage to the structure is negated.

2.2 Insulation to Cavity Walls [Outrigger]

The outrigger is a much later addition to the main building and does not have any special historical or architectural value. The outrigger is also in a damp and dilapidated condition. As such this area of the building alone is proposed to be refurbished in line with modern expectations in terms of insulation methods and techniques.
The proposal details dry-lining the external walls using insulated plasterboard upon a metal frame system.

2.2.1 Possible Options

External Insulation

Insulating the walls externally presents the fewest potential technical risks to the brickwork but has the greatest impact upon the appearance of the building. To add insulation externally would mean the outrigger would no longer match the neighbouring shared structure. There is also a difficulty in detailing the junction of the roof and the top of the wall once insulated as there is no existing fascia / soffit at the eaves to the existing structure. As such fitting insulation externally has been discounted.

Insulation within the Cavity

The existing cavity wall is believed to have a cavity width of approximately 50mm. This means that fully filling the cavity with an injected material is unlikely to have a noticeable benefit in terms of heat loss and it also increase the potential for dampness to bridge the cavity and as such has been discounted.

Internal Insulation

As the existing plaster to the walls is in poor condition and damp the proposal is to incorporate insulation as part of the dry lining for the new wall surface. Research has shown that where properties are insulated internally the resultant temperature drop within the cavity can cause cavities on north facing elevations to become permanently damp. However, the external walls in this instance are south west and west facing. Additionally, the existing cavity brickwork is proposed to be rendered as per the neighbouring adjoining property. This should prevent any dampness from soaking into the brickwork and remove the risk of a permanently damp cavity and potential risk of damage to the fabric.

2.3 Insulation to Solid Floor [Outrigger]

The outrigger is a much later addition to the main building and does not have any special historical or architectural value. The outrigger is also in a damp and dilapidated condition. As such this area of the building alone is proposed to be refurbished in line with modern expectations in terms of insulation methods and techniques.
The proposal details the removal of the existing asphalt floor structure with the reduction in ground levels, damp proof membrane, insulation and new floor slab.

The greatest technical risk to the fabric of a historic building with respect to insulating a new floor is to disrupt the permeable nature of the fabric and potentially creating new problems with dampness where none existed before.

Traditional construction allows for moist air to evaporate and be absorbed by the fabric of the building depending upon humidity levels. The new floor construction will comprise of impermeable materials which will prevent evaporation through the floor and potentially lead to increased levels of dampness in the surrounding walls instead. However, as the existing floor within the outrigger is already covered with an impermeable layer of asphalt, which has been insitu for many years, the new damp proof membrane and insulation will have no change upon the evaporation through the floor and therefore the risk to the fabric of the building is unchanged. Additionally, the adjoining floor and wall to the main building are of traditional construction and so any moisture present within the floor and the base of the walls will be able to evaporate.

3.0 PROPOSED UPGRADES TO EXISTING INSULATION

3.1 Pitched Roof Insulation at Ceiling Level

The main building is of traditional construction and as such no new insulation is proposed to the fabric where currently uninsulated. There is assumed to be a nominal layer of existing insulation laid above the second-floor ceiling.

The main pitched roof is duo pitched and covered with natural slate over an impervious bitumen roofing underlay. At the front there is a lead lined stone gutter topping the wall and a lead lined stone trough at the rear. We consider it unlikely that there will be any specific ventilation pathway at the eaves with gaps between the slates historically providing sufficient ventilation to avoid condensation problems.

The introduction of an impervious, unsuitable bitumen roofing underlay at some point in the past is potentially harmful to the roof structure which is considered to be original in that it increases the likelihood of condensation occurring by preventing natural ventilation through the slates. As such the proposal for the main roof is to replace the bitumen roofing underlay with a modern breathable roofing underlay and to introduce additional mineral wool insulation together with provision for continuous ventilation at the eaves to the front and back via an eaves roll vent and a roof membrane support tray. Ventilation of the cold roof will be much improved and the risk of condensation negated through use of a more suitable fully breathable roofing underlay.

The main technical risk to the fabric of the building associated with insulation above an existing ceiling in a cold roof is by restricting the air flow through the roof void which can cause condensation to form on the roof timbers which through time can result in rotten timber. When the new roof membrane is fitted it will include for a continuous strip of ventilation by way of an eaves roll which cannot become blocked by the insulation therefore any moist air which passes through the lath and plaster ceilings will be able to evaporate from the roof void.

4.0 CONCLUSION

The building in question is Grade II listed and of value in terms of its originality internally and externally as well as in conjunction with the neighbouring properties forming the terrace as a whole.

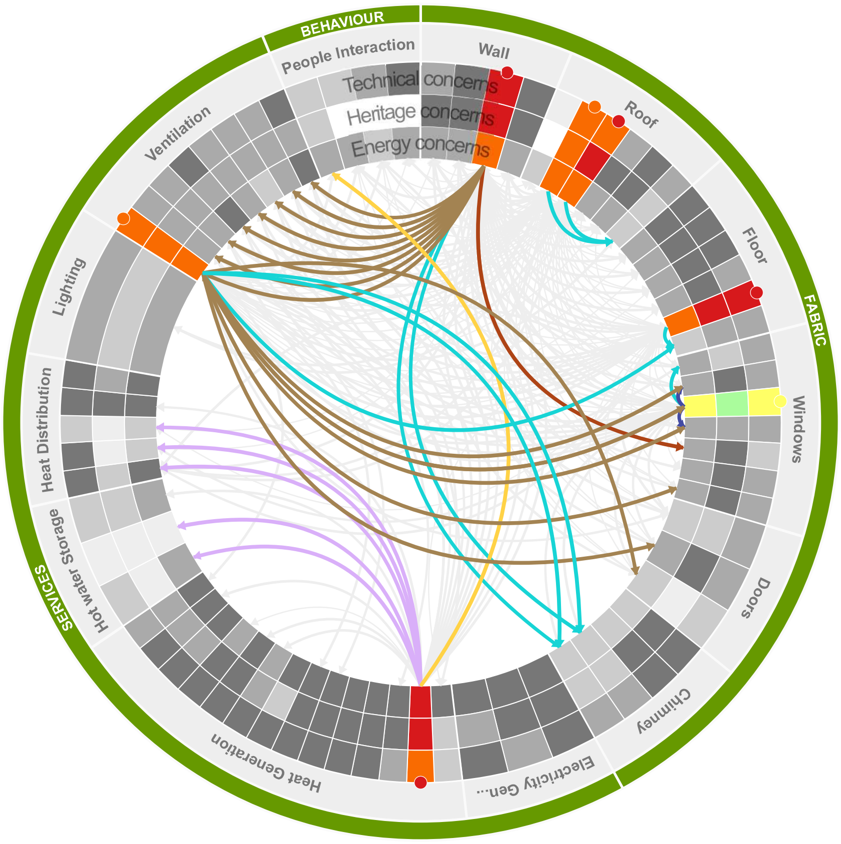
No changes are proposed to the insulation that would change the external appearance.

No changes are proposed to introduce new insulation within the main building whereby the over riding aim has been to repair and refurbish in order to maintain the character and originality as far as reasonably practicable. Whilst this means that the scope of Approved Document L1B cannot be adhered to this is deemed preferable than meeting energy efficiency requirements which would unacceptably alter the character and appearance by altering the traditional permeable construction.

Changes are proposed to the insulation to the existing rear outrigger. This part of the building is not original, being a much later addition and it is in a poor state of repair. In order to make the property habitable and to reach a reasonable level of thermal comfort new insulation is proposed to be installed. However, where new insulation is proposed the technical risk of damage to the structure has been considered together with the desire to ensure the general external form of the building is maintained. Insulation which is proposed is not deemed likely to be harmful to the fabric of the building

APPENDIX 1 – STBA RESPONSIBLE RETROFIT GUIDANCE WHEEL REPORT

Responsible Retrofit Guidance Wheel Report



Colour key

Concerns

Minor concern Medium concern High concern Major concern

Measure to measure linkages

Measure options Thermal coherence Airtightness Human Health/Fabric Health Heating issues People issues Monitoring and maintenance Hidden services Electricity issues

Context

Heritage: Listed - Important
Condition/State of repair: Poor
Exposure: Moderate
Energy User Type: Medium (Typical) Energy Use
User interest and involvement In Operation: Uninterested User
Number of exposed sides: Double or multiple

Chosen measures

Internal Wall insulation

Insulation material is fixed to the inside surface of external walls and new internal finishes applied or insulation is blown behind existing linings

Advantages

Reduce heat loss - improve comfort. Potential associated benefits of reduced energy cost and lower CO2 and depending on material and finishes improved internal moisture buffering

Technical concerns:

Trapped moisture (major) Interstitial Condensation (high) Thermal Bridges (high) Overheating (high) Personal capacity/Right opportunity (high) Building Control (medium) Rain and Drains (liquid moisture penetration) (medium) Monitoring and feedback required (medium)

Heritage concerns:
Use of sympathetic materials (major) Listed building consent (major) Original internal detail lost (high)

Energy concerns:
Installation quality (high) Actual U-value? (medium) Rebound effects (medium)

Loft insulation

Adding layers of insulation to a roof above the ceiling

Advantages
Reduces heat loss through roof and minimises risk of condensation or mould on underside of ceiling

Technical concerns:
Hidden services (high) Interstitial Condensation (medium) Rain and Drains (liquid moisture penetration) (medium) Thermal Bridges (medium) Overheating (medium) Building Control (medium) Monitoring and feedback required (minor) Personal capacity/Right opportunity (minor)

Heritage concerns:
Listed building consent (high)

Energy concerns:
Installation quality (high) Rebound effects (medium)

Rafter insulation

Adding layers of insulation to a roof on the rafter (sloping) plane

Advantages
Reduces heat loss through roof and minimises risk of condensation or mould on underside of ceiling

Technical concerns:
Interstitial Condensation (high) Thermal Bridges (high) Rain and Drains (liquid moisture penetration) (medium) Overheating (medium) Building Control (medium) Monitoring and feedback required (medium) Personal capacity/Right opportunity (medium)

Heritage concerns:
Listed building consent (major) Use of sympathetic materials (major)

Energy concerns:
Installation quality (high) Rebound effects (medium)

Replacement of existing ground floor with new concrete insulated solid ground floor

Existing floor (timber or uninsulated concrete slab) is replaced with new insulated concrete floor.

Advantages
Space-heating energy saving and increased thermal comfort.

Technical concerns:
Hidden services (major) Personal capacity/Right opportunity (major) Trapped moisture (high) Rain and Drains (liquid moisture penetration) (high) Stair/Door/Skirting Adjustment (high) Structural loading changes (high) Party Wall (high) Complex installation (high) Thermal Bridges (medium) Building Control (medium) Overheating (minor)

Heritage concerns:
Listed building consent (major) Original internal detail lost (major) Use of sympathetic materials (major)

Energy concerns:
Installation quality (high) Rebound effects (medium) Actual U-value? (minor)

Window refurbishment

Repair of existing windows to make operational and tight fitting

Advantages
Good repair ensures that original window can be retained; some improvement in air-tightness may be achieved

Technical concerns:
Sufficient ventilation? (medium) Overheating (medium) Monitoring and feedback required (medium) Personal capacity/Right opportunity (medium)

Heritage concerns:
Detail retains character? (minor)

Energy concerns:
Rebound effects (medium)

High efficiency gas-fired condensing boilers

Installation of a gas condensing boiler (regular or combi)

Advantages

Significantly more efficient than non-condensing boiler

Technical concerns:

Condensing Plume location (high) Sufficient ventilation? (high) Personal capacity/Right opportunity (high) Relation to Building Thermal Performance (medium)

Heritage concerns:

Listed building consent (major) Detail for Access to services (medium) Detail retains character? (minor)

Energy concerns:

Installation quality (major) Commissioning quality (major) User understanding (high) Increased infiltration (medium)

Background ventilators and intermittent extract fans

Review natural ventilation strategy to ensure sufficient ventilation is provided. This strategy uses background ventilation devices (trickle vents) together with localised intermittent mechanical extract fans in wet rooms. Windows can be opened for rapid purge ventilation

Advantages

Simplicity; no energy in-use; low cost; low maintenance

Technical concerns:

Retention of air flow - door undercuts (high) Personal preference (high) Sufficient ventilation? (medium) Personal capacity/Right opportunity (minor)

Heritage concerns:

Listed building consent (high)

Energy concerns:

User understanding (high) Increased infiltration (medium)

Concerns

Major risks

Trapped moisture

Measures raising this concern: Internal Wall insulation, Replacement of existing ground floor with new concrete insulated solid ground floor

Moisture, both as a liquid and a vapour, becoming trapped and possibly accumulating within building fabric as a result of changing either fabric or ventilation conditions. For instance, where there is rising damp in a wall or high levels of moisture within a solid floor, the application of vapour closed materials or reduced whole house ventilation could result in moisture related problems (e.g. timber decay, mould growth)

Suggested actions (before)

Prior to refurbishment install moisture monitoring (e.g. through wall or other fabric element) to establish moisture profile of structure and cause of any existing problems. Check fabric for any water leaks. Ensure any existing dampness is resolved before proceeding with measure. Define specific site Exposure conditions for different orientations. Understand the properties of existing materials properties in relation to moisture (vapour permeability, hygroscopicity and capillarity).

Suggested actions (during)

Ensure the technical properties of any proposed new materials particularly in relation to moisture (vapour permeability, hygroscopicity and capillarity) and behaviour of these in relation to existing fabric are clearly understood. Choose appropriately breathable insulating materials. Develop robust details that avoid trapping moisture in instances of failure e.g. broken gutter, overflowing bath.

Suggested actions (after)

Monitore moisture at vulnerable locations and report findings

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RESEARCH Breathability: The Key to Building Performance (2005) May, N.

RESEARCH Drying of brick walls after impregnation (1996) Künzel H.M. and Kießl, K.

Use of sympathetic materials

Measures raising this concern: Internal Wall insulation, Rafter insulation, Replacement of existing ground floor with new concrete insulated solid ground floor

Are materials specified for a measure in sympathy with existing building either aesthetically, in terms of provenance (i.e. locally sourced materials for vernacular buildings) and/or technically in terms of similar fabric performance characteristics (e.g. vapour permeable construction)

Suggested actions (before)

Buildings rely on the use of materials that are sympathetic to their technical and/or aesthetic characteristics. Research the existing knowledge of the historic origins of materials and develop an understanding of the effect of repair, replacement and additions to these materials including appropriate methods of construction. Understand the performance of the existing materials within the construction with regards to heat and moisture. Understand how the existing fabric behaves in relationship with the general room conditions and how its performance may be altered by the addition of different materials. For example, a fabric element might rely upon a hygroscopic finish to allow evaporation of internally generated vapour and reduce vapour diffusion through the element.

Suggested actions (during)

Specify materials that retain the existing fabric conditions/qualities in relation with the room and external environment with regards to moisture behaviour.

Suggested actions (after)

Monitor any changes to fabric materials qualities. For higher risk levels, carry out continuous physical testing conditions within fabric and reporting of results is suggested. As a minimum, carry out occasional visual inspections to check for condensation/mould growth in risk areas. Develop a response and mitigation strategy in place if adverse conditions arise

References

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GUIDANCE A Short Paper on Internal Wall Insulation (2012) May N.

RESEARCH Breathability: The Key to Building Performance (2005) May, N.

Listed building consent

Measures raising this concern: Internal Wall insulation, Loft insulation, Rafter insulation, Replacement of existing ground floor with new concrete insulated solid ground floor, High efficiency gas-fired condensing boilers, Background ventilators and intermittent extract fans

Submission of detailed proposals for approval by local planning authority conservation officer (and depending on listed status statutory body that protects built heritage e.g. English Heritage, CADW, Historic Scotland or Northern Ireland Environment Agency) needed for works placed on the Statutory List of Buildings of Special Architectural or Historic Interest.

Suggested actions (before)

Risk level 4 has been used for measures that need submission for approval and are more controversial or disruptive (e.g. EWI, IWI, Floor insulation, replacement glazing, new windows, installation of renewable energy generation technology e.g. P.V. panels, new heating system). Research the building's 'listing description' and any 'statement of significance'. Develop proposals that avoid changes to

Suggested actions (during)

Continue consultation with local authorty's conservation officer and heritage body during construction to confirm implementation of proposal as agreed.

References

GUIDANCE Energy Efficiency and Historic Buildings: How to Improve Energy Efficiency (2018) Historic England

GUIDANCE Bristolian's Guide to Solid Wall Insulation: A Guide to the Responsible Retrofit of Traditional Homes in Bristol (2015) STBA et al for Bristol City Council

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GUIDANCE Historic England Microgeneration series (2008-2019) Historic Englad

Hidden services

Measures raising this concern: Loft insulation, Replacement of existing ground floor with new concrete insulated solid ground floor

Concern with pipes or electric cables becoming hidden by insulation. Surface condensation on pipes or freezing of pipes may occur . Insulation around electrical wires may increase fire risk.

Suggested actions (before)

Review the danger that the application of insulation may bury electric cables resulting in overheating of cables with potential fire risk and/or water pipes with risk of condensation forming resulting in the excessive wetting of nearby material and/or the freezing of pipework on the cold side of insulation. This possibility is increased in older buildings with multiple phases of construction where service runs may already be obscure or forgotten. Prior to the design of an insulation strategy a thorough survey should be undertaken by a qualified surveyor (RICS) which should include a review of any existing plans detailing service runs and investigation into any voids or crawl spaces that maybe insulated, incorporating, if necessary, the use of a borescope or similar to investigate inaccessible places.

Suggested actions (during)

Redundant pipework should be removed and any pipe work on cold side of insulation should be separately insulated. Electrical circuits should be tested and cabling upgraded to prevent overheating prior to the application of any insulation. If possible services should remain accessible and electric cables should be laid clear of the insulation.

Suggested actions (after)

Check and report any instances where pipes are not insulated and the electric cabling positions are not suitable and organise for remediation.

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GUIDANCE Bristolian's Guide to Solid Wall Insulation: A Guide to the Responsible Retrofit of Traditional Homes in Bristol (2015) STBA et al for Bristol City Council

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Personal capacity/Right opportunity

Measures raising this concern: Internal Wall insulation, Loft insulation, Rafter insulation, Replacement of existing ground floor with new concrete insulated solid ground floor, Window refurbishment, High efficiency gas-fired condensing boilers, Background ventilators and intermittent extract fans

People need the right opportunity to make a change to their home - many factors involved and the capacity of the household to undertake the installation may be limited (by e.g. health, busy lives, job changes, etc., not just limited to available finance).

Suggested actions (before)

Engage users and understand their personal circumstances and what their interest is in the specific measures proposed. Consider whether there are any situations within the household that make the work inappropriate (e.g. health, change of employment) or better suited to another occasion (e.g. future plans for kitchen conversion) Discuss fully with users the impact of undertaking the changes will have in their building (what areas need access, what elements are dismantled, noise, dust, hours of work) and make sure they understand any disruption and complexity (e.g. boreholes for gshp, underfloor heating screeding) so that they can make informed choices. Consider carefully what the right time is to implement the various measures and make recommendations suited to the specific requirements of the customer.

Suggested actions (during)

Keep users informed throughout the building work of progress and any variation relating to duration, disruption or complexity.

Suggested actions (after)

Review the project and get feedback from users about their experience during the work carried out to feed into future projects.

References

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Original internal detail lost

Measures raising this concern: Internal Wall insulation, Replacement of existing ground floor with new concrete insulated solid ground floor

Temporary or permanent loss of original internal details that are linked to the character of the building e.g. cornices, dado or picture rails, historic plasterwork and wall linings, decorative finishes, alterations to room and door heights, window reveals and shutter boxes.

Suggested actions (before)

Check whether the building has protected heritage status. If the building is listed, it is unlikely that permission would be granted for the removal of original features. Adapt design to incorporate internal features or consider alternative installation method to prevent loss of details. Remember home users may have an emotional attachment to character features, especially wall detailing (if covered or altered) and windows.

Suggested actions (during)

Continue liaison with heritage body throughout installation to agree the installation methodology of measures affecting internal detail. Keep building user/owner informed regarding any amendments to building features during construction.

Suggested actions (after)

Inform the relevant heritage body of the reinstatement of any original internal features affected by the measure installation.

References

GUIDANCE Bristolian's Guide to Solid Wall Insulation: A Guide to the Responsible Retrofit of Traditional Homes in Bristol (2015) STBA et al for Bristol City Council

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Installation quality

Measures raising this concern: Internal Wall insulation, Loft insulation, Rafter insulation, Replacement of existing ground floor with new concrete insulated solid ground floor, High efficiency gas-fired condensing boilers

Product/material requires a standard of quality installation in order to operate as intended

Suggested actions (before)

Define installation quality requirements e.g : use only system trained and approved installers for measure and put in place on site quality checking procedures, monitoring and/or testing (e.g. thermographic survey of cavity wall infill). Ensure design and supply chain are aware of critical aspect of installation quality for success of measure. Provide information so that it can be understood by a range of people - from the well informed expert to the complete novice. Consider using a supply contract that guarantees quality and performance, which requires supplier to put right any failure due to poor installation. If quality of installation cannot be guaranteed consider alternative product.

Suggested actions (during)

Carry out on site checks to confirm quality of installation. Report any discrepancies with requirements and amend as necessary.

Suggested actions (after)
Feedback any installation problems encountered to manufacturers, suppliers and specifiers
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Commissioning quality
Measures raising this concern: High efficiency gas-fired condensing boilers
Product/material requires a set of commissioning checks by specialists in order to check the operation parameters are correct and that the product can operate as intended
Suggested actions (before)
Define commissioning requirements e.g use only system trained and approved contractors for commissioning of measure and put in place checking procedure (commissioning checks). Plan for post installation monitoring of measure performance. Ensure design and supply chain are aware of critical aspect of commissioning quality for success of measure. Provide information in formats that can be understood by a range of people - from the well informed expert to the complete novice. Consider using a supply contract that guarantees quality and performance which requires supplier to put right any failure due to poor commissioning. If quality of commissioning cannot be guaranteed consider alternative product.
Suggested actions (during)
Carry out independent commissioning checks to confirm installation settings match design parameters.
Suggested actions (after)
Carry out monitoring of measure performance and check results against predicted performance and act on findings.
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High risks

Interstitial Condensation

Measures raising this concern: Internal Wall insulation, Loft insulation, Rafter insulation

The presence of liquid water within a building element due to condensing water vapour. This can lead to fabric decay and/or mould growth that are hidden. It can occur through vapour diffusion or air leakage into structure where warm moisture meets colder areas/surfaces. It can occur in walls, roofs or floors through incorrect installation of insulation systems, air leakage, thermal bridging and reduced ventilation.

Suggested actions (before)

Carry out a thorough assessment of context, moisture loads, fabric types and condition of building. Understand the restrictions imposed by the exposure for the different orientations of the building (e.g. internal insulation is not suitable in some orientations in certain locations). Consider that different solutions might apply for different orientations (i.e. a combination of insulation measures may need to be considered). Ensure mechanisms for managing moisture within existing fabric are thoroughly understood. Consider monitoring fabric elements (e.g walls) prior to refurbishment to establish interstitial hygrothermal (heat and moisture) behaviour, including monitoring conditions within voids before refurbishment in order to assess humidity levels and consequences of any temperature reduction. Carry out condensation risk calculations to EN15026 (WUFI, Delphin modelling) informed by the in situ interstitial hygrothermal monitoring. Modify design according to simulation and monitoring results to avoid material moisture contents in excess of 15% and/or RH above 80%. NOTE Meaningful interstitial hygrothermal modelling requires detailed modelling of wall construction components including the specific material properties for the exact construction materials, specific and detailed weather data and expert software operation. Undertake basic Glaser Analysis (BS 13788) to assess some risks posed by diffusion of internally generated water vapour. Avoid target U-values below 0.4 W/m2K. Use of Air Pressure Test to establish existing rate of air exchange.

Suggested actions (during)

Ensure the technical properties of any proposed new materials particularly in relation to moisture (vapour permeability, hygroscopicity and capillarity) and behaviour of these in relation to existing fabric are clearly understood. Choose design solutions that are coherent with the properties of the existing fabric. Avoid non breathable highly vapour resistant insulation materials and barriers.

Suggested actions (after)

Monitor fabric post refurbishment particularly at high risk areas, i.e. joist ends, consider inclusion of an alarm element to provide notification of extended periods of dewpoint within fabric and report on findings. On-going monitoring to assess condition of voids following refurbishment and to inform and necessary mitigation e.g. installation of mechanical ventilation. Regular visual inspection, if possible to check for signs of decay. Continuing monitoring and reporting to safeguard fabric

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Thermal Bridges

Measures raising this concern: Internal Wall insulation, Loft insulation, Rafter insulation, Replacement of existing ground floor with new concrete insulated solid ground floor

Thermal bridges occur when an area is less insulated than its surroundings. The higher thermal conductivity of the bridging element (or the multi-dimensional geometry of the detail) leads to increased heat loss and lower internal surface temperatures on the bridging area which can result in surface condensation and/or mould growth

Suggested actions (before)

Model vulnerable areas using heat transfer analysis software informed by in situ data.

Suggested actions (during)

Specify and clearly communicate details for key thermal bridges (e.g. windows, wall to floor junction, wall to roof junction) that minimise heat transfer at bridge position.

Suggested actions (after)

Continuous monitoring of conditions post re-furbishment and reporting of results.

References

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Overheating

Measures raising this concern: Internal Wall insulation, Loft insulation, Rafter insulation, Replacement of existing ground floor with new concrete insulated solid ground floor, Window refurbishment

High temperatures in buildings can cause discomfort and ill health. Fabric energy efficiency measures can exacerbate problems (e.g. by changing thermal mass, increasing thermal resistance and reducing ventilation). Services can also increase heat loads.

Suggested actions (before)

Carry out in situ tests to establish whole building performance (e.g. U-value measurement, room conditioning monitoring, air pressure test). Use these in situ measurements to inform whole building energy numerical modelling (i.e. IES, Energy Plus etc), making a thorough assessment of all factors contributing to year round internal temperatures. Consider strategy for building to deal with higher temperatures (e.g. shading, thermal mass, purge night ventilation, planting). Ensure effective ventilation is possible, i.e. cross ventilation, and check that existing window opening and shading opportunities are not compromised by additional measures. Beware that personal preference may override optimum settings for system. Decide on operation strategy and balance the need for good user understanding and automation of the system. Consider automation may be best for higher risk levels.

Suggested actions (during)

Communicate the strategy to minimise overheating to occupants clear and simply and check they understand it. Beware of personal preferences that may override optimum system settings.

Suggested actions (after)

Monitor and report temperature conditions experienced post refurbishment.

References

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Rain and Drains (liquid moisture penetration)

Measures raising this concern: Internal Wall insulation, Loft insulation, Rafter insulation, Replacement of existing ground floor with new concrete insulated solid ground floor

Excess liquid moisture in fabric caused by rain and poor fabric condition (e.g. poor pointing, porous masonry, cracks), defective rain water goods, high ground levels, high water table, poor detailing (e.g. around windows, external wall insulation) or reduced ability of the fabric element to dry (due to reduced vapour openness or reduction of heat reaching the fabric).

Suggested actions (before)

Ensure property is in good state of repair prior to refurbishment. Commission a professional building surveyor (RICS) to investigate condition of fabric. If necessary repair any features that may reduce effectiveness of measure e.g. re-point wall, mend/replace downpipes, reduce ground levels and add drainage to ground around property. Careful surveying and detailing required at design stage to provide clear information with full installation details (e.g. of VCL layer if applicable).

Suggested actions (during)

Ensure there is a robust delivery chain (design/supply/contractor/occupant) in place to be able to replicate the design details on site. Particularly necessary for insulation applications where mitigation of moisture risk may rely on intact VCL which should not be punctured i.e. by services, picture/shelf hanging or EWI where edge details maybe vulnerable to water penetration particularly in instances of rainwater goods failure. Ensure risks are understood by occupants. Provide targeted advice to occupants to keep a watchful eye on conditions (air quality, mould build up in bathrooms) and to seek advice if uncertain.

Suggested actions (after)

After refurbishment, watch for signs of deterioration (leaky pipes, mortar loss, damp) around the building. Remember that prompts may be needed for users to check the state of repair at regular intervals. For significant and/or vulnerable fabric an early warning monitoring system measuring moisture content/relative humidity should be installed to provide regular checks on the moisture condition of fabric including an alarm system for prolonged periods in excess of 15% moisture content or 80% RH. Report results to add to knowledge about refurbishment measures (e.g. monitor wall fabric condition (heat and moisture behaviour). Reporting of results of this monitoring to wider interest groups.

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Stair/Door/Skirting Adjustment

Measures raising this concern: Replacement of existing ground floor with new concrete insulated solid ground floor

Installing insulation on top of an existing floor decreases the floor to floor/ceiling height and requires the adjustment of stair risers, doors, skirtings and sometimes power sockets to compensate. This work may need to comply with building regulation requirements.

Suggested actions (before)

Detailed drawing required at design stage to assess impact of floor build-up. Consultation and agreement of detail with building control officer

Suggested actions (during)

Implementation of detail agreed with building control officer

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Structural loading changes

Measures raising this concern: Replacement of existing ground floor with new concrete insulated solid ground floor

Addition of structural weight to current structure

Suggested actions (before)

If a measure or measures are likely to result in changes to a building's structural load seek the advice and design expertise of a structural engineer. Any alterations to the structure should be designed by and signed off by a qualified engineer. Be aware that alterations of this nature may also require planning and/or listed building consent and/or building control/building warrant approval.

Suggested actions (during)

Agree structural solution with relevant planning, heritage and/or building control authority. If approvals are refused or design and alteration requirements are onerous consider alternative approaches or substitute measures. In high risk situations put in place a structural monitoring system with regular reporting intervals to ensure building remains safe and is performing as intended. Prepare a mitigation strategy in case of indications of failure.

Suggested actions (after)

Check the structural monitoring system at regular intervals. Carry out regular visual checks for signs of structural stress, if appropriate provide targeted advice to occupants to keep a watch for same.

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Party Wall

Measures raising this concern: Replacement of existing ground floor with new concrete insulated solid ground floor

Attaining Party wall agreement with neighbours for detail work proposals

Suggested actions (before)

Check relevant part of Party Wall Act 1996. Serve notice to neighbours for any work to be done to party wall structures and/or concerning excavation near a party wall. Notice needs to be served in advance to work being carried out within the timescale specified in the act. Neighbours consent in writing is needed or party wall surveyor(s) need to be appointed to draw an agreement (if neighbours don't respond to the notice within 14 days, a dispute is assumed)

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Complex installation

Measures raising this concern: Replacement of existing ground floor with new concrete insulated solid ground floor

A system or feature which is technically complicated requires specialist installation, understanding by installer and needs accurate commissioning in order to function correctly. Diagnosis and correction of problems can be more difficult than those of simpler installations.

Suggested actions (before)

Ensure implications of complexity of system (e.g. new heating technology, mechanical ventilation with heat recovery requiring new ducting, space allocation, wiring, controls) are understood through out supply chain e.g. from briefing and design through to installation, completion and on-going occupation. Consider alternative, less complex installations. Take into account the occupancy regime (e.g. tenanted properties with high turnover of occupants, home owner occupier).

Suggested actions (during)

Select appropriately qualified installer (e.g. MCS qualification for renewable technologies). Installers need to be professional and provide a good level of customer interaction. Prepare and provide record of specific installation to consumer in a simple format.

Suggested actions (after)

Check installation matches design requirements as specified and feedback any discrepancies to installers and manufacturers.

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User understanding

Measures raising this concern: High efficiency gas-fired condensing boilers, Background ventilators and intermittent extract fans

Lack of precise understanding by the user of the technologies and the controls installed in their homes. This can lead to an inefficient operation of the systems.

Suggested actions (before)

If possible, check occupants existing knowledge about their home and operation and identify any information gaps or misconceptions. Identify and compile clear and concise information to pass to the occupant about the implications of the measures installed (e.g. danger of compromising effectiveness of insulation installed and to allow moisture penetration by fixings on the wall; need to interact with various items of plant to adjust settings or carry out maintenance).

Suggested actions (during)

Provide a variety of information (in a range of media) that meets all occupants' needs. Consider that occupants can include users of different ages and abilities (children, elderly people, non technical, non English speakers, people with additional needs, etc.). Consider provision of information at different stages.

Suggested actions (after)

Carry out repeat or follow on visits to ensure understanding is embedded. Provide recourse to a help and advice service to provide guidance with maintenance and efficient operation of building on an on-going basis

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Condensing Plume location

Measures raising this concern: High efficiency gas-fired condensing boilers

The location of the exhaust water vapour plume of a condensing boiler needs careful consideration to avoid dampening surrounding fabric and prevent water vapour entering the loft via the eaves

Suggested actions (before)

Consider at design stage the position of the boiler exhaust and its surroundings, including the moisture handling properties of nearby materials.

Suggested actions (during)

Locate (or relocate if need be) the boiler exhaust in a position that avoids the condensing plume constantly hitting the surrounding fabric.

Suggested actions (after)

Monitor the conditions post-installation in proximity to the exhaust and carry out regular visual checks to look for signs of damage/decay. Relocate the boiler if continuous high moisture content recorded in surrounding materials or early signs of damage spotted.

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Sufficient ventilation?

Measures raising this concern: Window refurbishment, High efficiency gas-fired condensing boilers, Background ventilators and intermittent extract fans

Adequate ventilation is needed for the occupants in a building and for the protection of the building fabric in normal circumstances. Some measures can reduce the existing air permeability and make necessary additional ventilation. In addition, Certain activities (e.g. cooking, showering/bathing, drying clothes) create high moisture loads. Appropriate active ventilation system are needed to remove this excess moisture. Otherwise significant localised moisture problems can occur.

Suggested actions (before)

Monitor and measure existing room and fabric moisture conditions pre refurbishment. Carry out airtightness test (include open flues) to assess infiltration levels in existing building. Assess existing ventilation provision and weigh up ventilation strategy options post refurbishment to address proposed increased airtightness. Take into consideration household size and occupancy pattern. Establish ventilation strategy to provide adequate ventilation in line with AD Part F, including air provision for occupants in the building and adequate ventilation at points of moisture generation within building (bathroom, kitchen, utility and other wet rooms). Beware of personal preferences that may override optimum system settings Decide on operation strategy and balance the need for good user understanding and automation of the ventilation system. Consider automation may be best for higher risk levels. Consider moisture buffering internal finishes and controls triggered by humidity sensors.

Suggested actions (during)

Physically test the installed ventilation system capacity to confirm design criteria given in AD part F is met. Communicate the ventilation strategy to occupants clear and simply and check they understand it. Beware of personal preferences that may override optimum system settings.

Suggested actions (after)

Monitor indoor air quality post refurbishment and report results. Monitor room and fabric moisture conditions and report findings. Carry out regular visual checks for damp patches and mould growth in vulnerable areas (kitchen, bathrooms)

References

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Retention of air flow - door undercuts

Measures raising this concern: Background ventilators and intermittent extract fans

Door undercuts of at least 10mm are needed to keep air floor between rooms with the door closed.

Suggested actions (before)

Check existing doors have at least a 10mm high undercut and specify any new doors to finish 10mm above floor finish (10mm undercut) to allow for air flow between rooms even with door closed.

Suggested actions (during)

Check all doors finish 10mm above floor finish (10mm undercut).

Suggested actions (after)

Explain to users the need for this undercut to retain appropriate air movement between rooms so that it is not blocked when draughts are felt under internal doors.

References

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Personal preference

Measures raising this concern: Background ventilators and intermittent extract fans

People have habitual practices, e.g.. sleeping with the window open, airing the house in the morning, drying clothes on radiators etc. that may not be energy efficient or may affect technical performance (e.g. ventilation). Note that within a single building there may be conflicting preferences between users.

Suggested actions (before)

Engage users and understand their personal patterns of use of the house (rooms use, cooking mode, heating settings, ventilation routines). Discuss with them the implications and/or restrictions the new measures will have in their personal routines and amend as necessary if restrictions prove too impractical. Choose controls with user and get them to interact with the options before choosing.

Suggested actions (during)

Provide guidance in various formats but only of those items specific to their homes. Keep guidance simple, concise and straightforward. Demonstrate user interfaces and controls at handover of their house or soon after moving in. Provide variety of ways of communication for the different ages, needs and abilities. Make it easy for them to ask questions.

Suggested actions (after)

Come back and check whether there is any teething problems and understand what changes have they made to their lives.

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Medium risks

Building Control

Measures raising this concern: Internal Wall insulation, Loft insulation, Rafter insulation, Replacement of existing ground floor with new concrete insulated solid ground floor

Submissions of technical details for approval to approved building inspector

Suggested actions (before)

Contact local authority building control to establish whether approval or warrant for work is required. Establish the part(s) of the current building code relevant for your proposal. Consider any additional implications of your measure (e.g. insulation may imply improving air tightness and affect ventilation; work to floors may allow for the inclusion of Radon barrier in risk areas). Decide, in consultation with building control, whether a full plans submission or building notice is most suitable approach (some parts of the work may be carried out by self certified competent persons scheme). Prepare details and information to submit to local authority or approved inspector as necessary for approval. Negotiate and alter design details in response to the inspector

Suggested actions (during)

Establish programme of building inspector visits to site during works. On completion, obtain completion certificate from building inspector or certificate by competent installer.

References

GUIDANCE Energy Efficiency and Historic Buildings: How to Improve Energy Efficiency (2018) Historic England

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Monitoring and feedback required

Measures raising this concern: Internal Wall insulation, Loft insulation, Rafter insulation, Window refurbishment

Due to complexity and uncertainty of certain measures, monitoring and feedback is needed to provide information about their effectiveness and to reduce long term risks. Checks and processes are needed to ensure that measures are installed correctly and are working properly and not creating any adverse results (e.g. excess energy use, mould growth). They can include visual checks, meter readings, probes, thermographic survey or more detailed investigations.

Suggested actions (before)

Establish on going requirements (e.g. regular checks such as visual checks, spot moisture readings, thermographic survey check) and who is going to carry them (specialist or occupant).

Suggested actions (during)

Provide targeted advice to occupants to keep a watchful eye on conditions (air quality, mould build up in bathrooms) and to seek advice if uncertain. Prepare a response plan for possible outcomes of the monitoring.

Suggested actions (after)

Report results to add to knowledge about refurbishment measures.

References

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Actual U-value?

Measures raising this concern: Internal Wall insulation, Replacement of existing ground floor with new concrete insulated solid ground floor

Performance gap between the modelled U value for any building element and its actual thermal performance can be considerable. Inaccurate modelling can lead to incorrect specification of measures and unexpected energy use outcomes.

Suggested actions (before)

Compare calculated U-value with measured data for similar fabric elements (e.g. walls, floors, roofs, windows, doors) . If possible carry out physical measurement of existing and feedback measured data to add to knowledge of buildings elements performance

Suggested actions (after)
Consider another measurement post-insulation to assess effect. Feedback measured data to add to knowledge of building elements performance.

References

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Rebound effects

Measures raising this concern: Internal Wall insulation, Loft insulation, Rafter insulation, Replacement of existing ground floor with new concrete insulated solid ground floor, Window refurbishment

Rebound effects occur when the full energy saving of a measure is not achieved due a number of factors, including comfort take back, change in occupation or building use pattern, use of savings to fund our energy consuming activities.

Suggested actions (before)
Record actual energy use by users (from meter readings) before implementation of measures and compare (where possible) with national benchmarks. Record default settings for heating used prior to refurbishment and assess comfort conditions.

Suggested actions (during)
Give clear information to users about appropriate default settings. Consider choice of the user interface for temperature control to steer users to acceptable temperature settings.

Suggested actions (after)
Remind users about appropriate default settings for energy efficiency and make sure they know how to adjust temperature controls. Assess and report results with regards energy use and comfort, comparing them with national benchmarks. Feedback results to occupants and wider building energy performance interest groups.

References

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Detail for Access to services

Measures raising this concern: High efficiency gas-fired condensing boilers

When installing hidden ducts, services and other fittings, future access requirements for maintenance and repairs, need to be considered.

Suggested actions (before)

Consider access required for maintenance (e.g. access to replace filters of ventilation units) post-refurbishment and/or position items that require regular checks and maintenance within easy reach. Review design and detailed drawings to accommodate any changes.

Suggested actions (during)

Ensure during site work to see that access/controls are installed in planned locations and that their positions still make sense.

References

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Increased infiltration

Measures raising this concern: High efficiency gas-fired condensing boilers, Background ventilators and intermittent extract fans

Unintended increase of air permeability caused by the installation of a new technology/alterations that require penetration of the building envelope (such as a new boiler flue, solar hot water or photovoltaic panel installation, relocation of kitchen sink waste pipe etc.). This can lead to unintended higher energy use and interstitial moisture problems.

Suggested actions (before)

Ensure all services installers are aware of the buildings air tightness levels and the impact of service penetrations on reductions to air tightness.

Suggested actions (during)

Require all penetrations through walls, roofs and floors to be sealed back to retain the same level of air permeability.

References

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Relation to Building Thermal Performance

Measures raising this concern: High efficiency gas-fired condensing boilers

Need for an accurate understanding of the heating demand in order to correctly specify the energy system. Incorrect understanding can lead to wasteful or inadequate system specification.

Suggested actions (before)

Consider undertaking a whole building energy modelling (i.e. IES, Energy Plus etc.) assessment at design stage to determine the building heat demand. Be aware that default U-values may not be accurate for solid wall constructions -seek measured data to override input. Improve fabric thermal performance and airtightness before installation of any low temperature heating system.

Suggested actions (during)

Match the design heat demand to the proposed heating system rating. Avoid oversizing of heating system to maximise efficiency and coefficient of performance of system.

Suggested actions (after)

Monitor building performance in operation and feedback results to add to knowledge of actual performance in use.

References

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Minor risks

Detail retains character?

Measures raising this concern: Window refurbishment, High efficiency gas-fired condensing boilers

Where a particular feature is changed or covered (e.g. window, radiator type, ceiling), does the new detail preserve or enhance the original character of the building?

Suggested actions (before)

For any building elements that are new, specially if building is listed or in conservation area, design them to match the character of the original features (e.g. windows retaining original operation, frame design and glass pane division).

References

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Related measures that should also be considered

These are measures that should also be considered due to interactions with the measures you have chosen. For further details please refer to the digital wheel.

Measure options

Energy efficient glazing INTENSE INTERACTION, Secondary glazing INTENSE INTERACTION, Loft Hatch insulation, Flue gas heat recovery devices, Solar water heating, Micro combined heat and power, Cavity Wall Insulation, External Wall insulation, Frame infill insulation, Flat roof insulation, Room in roof insulation, Window Shutters Refurbishment, Waste water heat recovery devices for showers

Thermal coherence

Window Shutters Refurbishment INTENSE INTERACTION, Flat roof insulation, Room in roof insulation, Floor insulation between/under floor joists, Floor Insulation on top of existing floor finish , Floor void filled with insulation, Exposed soffits to upper floors: Insulation in between joists or under soffit, Energy efficient glazing, Secondary glazing, Window Replacement, High performance doors, Cavity Wall Insulation, External Wall insulation, Frame infill insulation, Loft Hatch insulation

Airtightness

Chimney blocking INTENSE INTERACTION, Reduced air flow INTENSE INTERACTION, Loft hatch and ceiling airtightness INTENSE INTERACTION, Increased Floor airtightness INTENSE INTERACTION, Window draughtproofing INTENSE INTERACTION, Door draughtproofing, Door refurbishment, Cavity Wall Insulation, External Wall insulation, Frame infill insulation, Flat roof insulation, Room in roof insulation, Floor insulation between/under floor joists, Floor Insulation on top of existing floor finish , Floor void filled with insulation, Exposed soffits to upper floors: Insulation in between joists or under soffit

Human Health/Fabric Health

Passive stack ventilation INTENSE INTERACTION, Continuous mechanical extract ventilation INTENSE INTERACTION, Continuous mechanical supply and extract ventilation with heat recovery INTENSE INTERACTION, Passive stack ventilation with heat recovery INTENSE INTERACTION, Passive stack ventilation with demand control ventilation INTENSE INTERACTION, Continuous mechanical extract ventilation with demand control ventilation INTENSE INTERACTION, Continuous mechanical supply and extract ventilation with heat recovery and with demand control ventilation INTENSE INTERACTION, Energy efficient glazing INTENSE INTERACTION, Secondary glazing INTENSE INTERACTION, Window Replacement INTENSE INTERACTION, High performance doors INTENSE INTERACTION, Door refurbishment INTENSE INTERACTION, Window External Shading, Window draughtproofing, Door draughtproofing, Oil-fired condensing boilers, Biomass boilers, High efficiency replacement warm-air units

Heating issues

Cylinder thermostats INTENSE INTERACTION, Hot water cylinder insulation INTENSE INTERACTION, Heating controls (for wet and warm air systems) INTENSE INTERACTION, Heating Distribution Refurbishment INTENSE INTERACTION, Pipe insulation INTENSE INTERACTION, New cylinder, Wet Under-floor heating, Heating system Refurbishment, Biomass stove with back boiler

People issues

User interfaces for usability INTENSE INTERACTION, Provision of simple and clear information, Improving User interest and involvement

Monitoring and maintenance

Maintenance

Hidden services

Lighting system upgrade, Heating Distribution Refurbishment, Pipe insulation, Heating system Refurbishment