Introduction

We have chosen a typical pre 1919 house as an example of what you might find when asked by a prospective client to advise on an appropriate retrofit to achieve an energy efficient and comfortable house. This fairly standard construction of this era could be of a terrace, semi or detached house and found in all UK regions. This example is not listed and of indeterminate architectural quality.

Foundations

The foundations are of brick or natural stone slabs, as typically the case, laid at a shallow depth compared with present day building regulations. There is no apparent subsidence; the soil at foundation level is a type of shale.

Walls

The walls are solid brick (225mm, or 'one brick' thick) laid using English Bond in a lime and sand mortar. A limited amount of spalling to the brickwork face can be seen, particularly on the west elevation. The west elevation is heavily shaded by trees and bushes. The house had been previously been repointed using a strong sand:cement mix. The internal finishes are a mixture of the original two-coat lime plaster with areas of modern gypsum plasters in areas - for example - around windows openings where the original plaster had been disturbed during window replacement.

An injection damp proof course has been installed at some point. On the ground floor the first 1.0 metre of plasterwork has been replaced with a hard sand:cement 'waterproofing' render - the householder's documentation suggests a product was used based on a pore-blocking, water inhibitor additive. This layer has been finished with lightweight, cement based, two-coat plaster. Skirting boards were replaced at the same time with non-preservative treated 175mm high softwood timber skirting.

Some rooms have a 65mm polystyrene-plasterboard laminate internal insulation system applied on battens over the original plaster and wallpaper walls.

Ground Floor

The original suspended timber floor has joists supported by brick sleeper walls, built into the external walls, tongue and groove floor boards, with a fitted carpet. The ground subfloor below is earth and the void has air bricks to at least 2 sides (these can be seen from outside the house) and it is assumed that this provides typical levels of cross ventilation. The floor boards are in poor condition due to careless removal in places during rewiring and plumbing works - the floor board tongues have been roughly broken and the boards insufficiently nailed back into place. In addition sheets of plastic have been laid across the floorboards under the carpet - presumably to cut out drafts and 'prevent the carpet getting damp'.

Intermediate Floor

The floor construction is of adequate timber joists built into the external walls with exposed tongue and groove timber floorboards, again in poor condition for the same rewiring and re-plumbing reasons as noted for the ground floor. The ceiling is the original lath and plaster, cracked and loose in places.

Roof

The roof is constructed at a 30 degree pitch with cold attic space. Renewal with the original natural slate and bituminous roofing felt was carried out some time ago. The ceiling has been renewed with modern (foil backed) plasterboard and
skim.

100mm of mineral wool has been laid between the timber ceiling joists. Disturbance has occurred during electrical and plumbing works. Solar thermal panels have been installed on the roof in a later development.

The chimney is in poor repair.

Multiple Choice questions

Rainwater System

The original cast iron rainwater gutter and downpipes have been replaced with budget UPVC plastic. The original cast iron gutter rafter brackets have been removed when the roof covering was renewed. The plastic guttering brackets have been screwed to the original timber fascia using steel wood screws.

Quiz question 1

Identify detrimental effects of broken downpipes (area d) and misaligned gutters (area e)?

1. Washed out pointing to brickwork
2. A wet/damp wall behind insulation leading to mould growth
3. Not an urgent issue as brickwork will dry out when not raining
4. Rot in timber fascias, soffits and rafter ends

Quiz question 2

A broken downpipe shoe (area g) can lead to:

1. A potential softening of ground under foundations leading to subsidence
2. Rotting of floor joist ends in wall when there is an effective damp proof course above the break (i)
3. There are no issues as the flower bed is sloping away from house

Walls

The bricks used have some imperfections - a result of variation in quality of the local clay used and an inconsistent firing process - and so are relatively rough and fissured in texture. However they appear have stood up to the exposed weather conditions reasonably well. Nonetheless there are areas of the brickwork surface that have spalled (area f).

Quiz question 3

Why might this have happened?

1. A broken down pipe has allowed rainwater to wash the face of the brick away
2. The harder cement repointing has led to bricks staying wetter for longer and the trapped water has frozen in cold weather, expanded and damaged the brick surface.

Discussion point: the spalling is worst on the west elevation - why?

Quiz question 4

It has become evident that there is a musty atmosphere in the rooms with the insulated wall boards installed. Which of these statements are likely to be true?

1. Rain driven moisture has entered the brickwork and wet the plaster and wallpaper promoting conditions for mould growth.
2. Inadequate ventilation of the rooms causes mould growth behind the lining boards which gives the musty smell.
3. Air from the interior of the house is moving behind the wallboard leading to condensation and mould growth forming on the cooler surfaces behind.
4. blocking the air movement described in 3. would remove all risks of mould forming on the old wallpaper.
5. Leaving the wallpaper in place gives ideal conditions for mould growth

Quiz question 5

The old plaster just above the junction between the 1m high damp proofing interior render has lost its adhesion to the brickwork behind and 'blown' (area m). Why might this be?

1. The chemical composition of the plaster and wallpaper glue has caused a reaction and expanded the plaster at the junction, leading to salt solutions damaging the plaster.

2. The paint and wallpaper used has not been of a correct specification to cope with the two types of plaster, breathable paint would have avoided this problem.
3. The injected damp proof course is ineffective, and rain is penetrating through the brickwork and at this junction strong evaporation leads to salts crystallising behind the old plaster.

Roof Void

Quiz question 6

There is evidence of damp in the roof void: sometimes when looking up from the loft hatch there are droplets of water evenly spread across the surface of the bituminous roofing felt and stains on the edges of the rafters close to the felt. Why might this be?

1. Wind blown rain is being driven under the slates and the roofing felt is degrading over time allowing water ingress.
2. Warm moist internal air is penetrating the first floor ceiling and condensing on the relatively cold surfaces.
3. There is inadequate ventilation in the roof void

Quiz question 7

What measures could rectify this situation?

1. Renew the roofing slates and bituminous felt.
2. Insert soffit vents in the eaves boxing and re-lay insulation at the eaves to allow free air movement through the roof void.
3. Inhibit air movement from the first floor by better sealing the attic hatch
4. Closing off gaps such as around recessed lights or 'hidden draught chimneys' where internal partition walls are built up into the attic joists.
5. Add a vapour control layer to the ceilings below.
6. Install adequate ventilation, particularly in bathrooms and kitchen.

Discussion points: the roof void is an area of the house that is often neglected due to awkward access. Ceiling insulation may have been laid with reasonable care at first but subsequent maintenance works such as rewiring or replacing a header tank (p and r) often disturbs the insulation, never to be repositioned correctly.

It could be argued that where insulation has been disturbed - for example as a result of a careless solar installation - additional heat losses incurred might result in more carbon emissions than those saved by the solar thermal or photovoltaic panels!

We are finding that the most important conditions for energy loss and discomfort in buildings is a lack of building fabric airtightness and hit & miss insulation. Please refer to the excellent AECB paper on Thermal Bypass by Mark Siddall
www.aecb.net/publications/the-impact-of-thermal-bypass/

Ground Floor

Quiz question 8

Suspended timber ground floors are often problematic, potentially failing due the proximity of their component timber elements to sources of ground moisture. In this example the space below the joists is very shallow and floor joists are decaying at critical load bearing points; where the joist ends bear in the external wall (k) and where they bear over the sleeper walls (j). What are the factors contributing to this situation?

1. position of damp proof course
2. Blocked vent (z)
3. A high water table and a bare earth subfloor
4. External paving (o) laid at a gradient toward the house
5. no DPC in the sleeper wall
6. a good quality but untreated timber was used for the joists
7. a broken shoe on the downpipe nearby
8. the plastic sheeting and carpet over the ground floor to cut out draughts

Quiz question 9

Looking forward to module 5 where we will be looking at how to improve all the elements of a building, which of the options below would likely to offer the *lowest risk, most reliable and easiest* strategy to improve the ground floor whilst incorporating good levels of insulation and airtightness, whilst minimising thermal bridging and thermal bypass?

1. Cut back rotting joist ends, bolt new timbers to side of joist inserting into newly formed holes in brickwork wrapping ends in damp proof plastic. Create access to floor space and insert insulation between joists by crawling beneath. Attach a wind proof vapour open membrane to the underside of joists tape butt joints and to the walls
2. Repair joist ends as above, render with a weak sand and cement parge coat on bare brickwork between joists and behind skirting. Take up all the floorboards and lay the wind tight vapour membrane up and over the joists taping the butt joints and to the parged wall. Lay mineral insulation between the joists and re-lay a glued or chipboard floor
3. Take out timber floor completely, raise ground level with hardcore, lay sand blinding, damp proof membrane, rigid insulation and pour concrete slab. Ensure a insulation upstand around the slab edge to minimise thermal bridge

Ventilation and Airtightness

Quiz question 10

When chimney flues through the house are no longer being used what might be sensible ways to both minimise problems *and* improve health and comfort?

1. Install a vent in the hearth to provide general house ventilation after sealing up an open fireplace.
2. Install vents to provide ventilation up the flue to inhibit moisture building up inside the masonry of the chimney stack.
3. reduce the chimney stack below insulated ceiling levels.
4. remove chimney and hearth structure altogether to increase room space.

Discussion points: where the builder has removed the chimney above ceiling level should they inject a DPC to the chimney base or remove the hearth structure entirely?

Quiz question 11

The area between the first floor joists in particular (below first floor floorboards and above ground floor ceiling) is a typical area for uncontrolled air leakage, either between the exterior and interior or to and from neighbouring properties). When repairing or maintaining intermediate floors what might be measures that can be taken to close these air paths when taking up the edge floorboards and skirting boards :

1. parging the exposed brickwork in these areas & taping the joists to the masonry.
2. fully filling the area with insulation materials such as mineral fibre, thick polystyrene or foam board.
3. fully adhering hygroscopic insulation boards between joists, against the masonry and taping joists to the board adhesive.