Repair and Maintenance in Sustainable Traditional Buildings

John Preston

STBA Heritage Chair; IHBC Green Panel Convenor
“Elements such as walls can be over a third less energy efficient if damp”

BS7913:2013: “Guide to the Conservation of Historic Buildings”

“10. Sustainability and energy efficiency

The most effective way of ensuring energy efficiency and sustainability is to keep historic buildings in good repair so that they last as long as possible, do not need replacement and do not suffer from avoidable decay that would require energy and carbon to rectify ...
“No maintenance, no building” (Stewart Brand)

Â “the root of all evil is water”

Â “rain is only the most obvious source of the problem”

Â “more pernicious now is internally generated water vapour”
The TC350 sustainability of construction works

BS EN 15978: 2011 defined the life (cycle) in multiple stages

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>CONSTRUCTION PROCESS</th>
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<th>END OF LIFE</th>
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<tbody>
<tr>
<td>A1</td>
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<td>A2</td>
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<td>A5</td>
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</table>

- Raw material supply
- Transport
- Manufacturing
- Construction-installation process
- Use
- Maintenance
- Repair
- Replacement
- Refurbishment
- Deconstruction
- Transport
- Waste processing
- Disposal

Embodied impacts
- Embodied impacts of refurbishment
- Operational energy use
- Operational water use

Slide by Alice Moncaster, Open University, TC350 sustainability of construction works
Modern buildings perform differently……

Modern

Modern construction sheds water
Impermeable outer surface
“vapour closed”

Traditional

traditional construction “breathes”
absorbing moisture then evaporating it
“vapour open”

Failure to understand the differences has led to countless problems……
Heritage / traditional - up to 35% of dwellings!

According to BRE’s own literature, published by DECC

“Heritage buildings represent approximately 35% of the existing dwellings in the UK as a whole and a large proportion of solid wall buildings.

Published on DECC website January 2015 (long before Bonfield Review was commissioned)
Building Regulations safeguards from 2002 introduced following lobbying by Heritage sector

Good principles established in Part L1B and L2B “Improve energy efficiency as far as reasonably practical”

Parts L1B and L2B paras 3.8-3.13

“Special considerations in making reasonable provision”

“3.8c buildings of traditional construction with permeable fabric that both absorbs and readily allows the evaporation of moisture”

“3.9 ..the aim should be to improve energy efficiency as far as is reasonably practicable. The work should not prejudice the character of the host building or increase the risk of long-term deterioration of the building fabric…”

……..but totally overlooked by DECC!!
Part L

• Applies to major renovation
• Or renovation of more than 50% of element’s surface area

• 5.6A Major renovation means the renovation of a building where more than 25% of the surface area of the building envelope undergoes renovation. When assessing whether the area proportion constitutes a major renovation of a building, the surface area of the whole of the external building envelope should be taken into account i.e. external walls, floor, roof, windows, doors, roof windows and roof lights.
Need for repair overlooked in Government Retrofit Schemes

Green Deal
ECO
Private Rented Sector

Rotten bay window – how to repair without damaging SWI?
# Green Deal and ECO Qualifying Measures - no mention of repairs!

<table>
<thead>
<tr>
<th>Green Deal Measures</th>
<th>In ECO (Affordable Warmth)?</th>
<th>In ECO (Carbon Reduction)?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measures/text in bold were added after the consultation</td>
<td>Low income and vulnerable households identified individually through benefits data (measures which reduce the cost of heating the home)</td>
<td>All households</td>
</tr>
</tbody>
</table>

**Green Cells** Always eligible

**Blue Cells** Eligible when delivered as part of a package hard to treat cavity wall insulation

**Red Cells** Never eligible

### Red Cells
- Air source heat pumps
- Biomass boilers
- Biomass room heaters (including with radiators)
- Cavity wall insulation
- Cavity wall insulation (HTT)
- Cylinder thermostats
- District heating (not GD)
- Draught proofing
- Duct insulation
- Hot water showers (efficient)
- Hot water systems (efficient)
- Hot water taps (efficient)
- External wall insulation systems
- Fan-assisted replacement storage heaters
- Flu gas heat recovery devices
- Ground source heat pumps
- Heating controls (for wet central heating system and warm air system)
- Heating ventilation and air-conditioning controls (including zoning controls)
- High performance external doors
- Hot water controls (including timers and temperature control)
- Hot water cylinder insulation
- Internal wall insulation (of external walls) systems
- Lighting systems, fittings and controls (including rooflights, lamps and luminaires)
- Loft or rafter insulation (including loft hatch insulation)
- Mechanical ventilation with heat recovery
- Micro combined heat and power
- Micro wind generation
- Pipe-work insulation
- Photovoltaics
- Chillers
- Gas-fired condensing boilers
- Replacement glazing
- Oil-fired condensing boilers
- Warm-air units
- Radiant heating
- Roof insulation
- Room in roof insulation
- Sealing improvements (including duct sealing)
- Secondary glazing
- Solar water heating
- Solar blinds, shutters and shading devices
- Transpired solar collectors
- Under-floor heating
- Under-floor insulation
- Variable speed drives for fans and pumps
- Waste water heat recovery devices attached to showers
- Water source heat pumps
s43 Where the Green Deal Provider considers that the building is a vulnerable building, the Green Deal Provider must:
(a) inform the improver and keep a written record that the building is a vulnerable building;
(b) 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; and
(c) advise the improver to enquire whether Listed Building Consent or any other approval is required before any work is carried out.

s44 Where the Green Deal Provider considers that the building is a vulnerable building, the Green Deal Provider must also consider whether an architect or surveyor with specialist skills in respect of vulnerable buildings should be consulted. If the Green Deal Provider is in any doubt about this, they must consult the local authority historic buildings or conservation officer.
Quality and Standards issues

PAS 2030:2012 Edition 2
Improving the energy efficiency of existing buildings
Specification for installation process, process management and service provision

Each Home Counts

Dr Peter Bedfield, CBE, FRIEng
Kit Pedler’s comparison of “Good” and Bad” materials
“The Quest for Gaia”, 1979

<table>
<thead>
<tr>
<th>GOOD</th>
<th>BAD</th>
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<tbody>
<tr>
<td>Low first cost</td>
<td>High first cost</td>
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<tr>
<td>Long Life</td>
<td>Short life</td>
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<tr>
<td>Low fabrication energy</td>
<td>High fabrication energy</td>
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<tr>
<td>Low entropic index</td>
<td>High entropic index</td>
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<tr>
<td>High renewability</td>
<td>Poor renewability</td>
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</table>
Different building elements have different life cycles

Over the lifetime of the building......

Maintenance

Repair

Replacement

Refurbishment

Diagram by Stewart Brand
Traditional buildings are sustainably built

Grundle House: On the Quantities of Timber in Certain East Anglian Buildings in Relation to Local Supplies Oliver Rackham Vernacular Architecture 3, 1972

Large c1500 house in Suffolk

330 trees, 80% oak 20% elm

40 large trees, rest less than 50 years old

6 years’ production from 50 acres of managed woodland

50 such houses per year from Suffolk woodland

ÅMinimal embodied energy

ÅRe-usable timber, tiles, clay

ÅMinimum disposal issues
Traditional construction and maintenance

**Water protection**
“Good hat and boots” –

Eaves, verges, jetties and reveals shed water and protect vulnerable areas

Brick or stone plinths protecting timber, cob etc

Layers of construction act as rainscreen

**Moisture management**
Pegged timber construction, lime mortar and lime plaster allow movement with changing humidity

**Maintenance**

Regular

Skills and materials sourced locally
Timber-framed construction

Peg-jointed – frame adjusts to changing heat and humidity

Traditional infill and lime / hair plaster also flexible
How things go wrong!

- Repair in incompatible materials / methods
- Lack of awareness and skills
- Loss of maintenance culture
  - the “maintenance-free” myth
Damage due to trapped moisture

Rotted timber frame and wattle and daub, due to cement render

Problems.....
Collapse due to trapped moisture
Cement pointing damage on Grade I College
long-lived material needlessly ruined by wrong repair
Cement render damage to brickwork
Planned maintenance??

Â Too rarely done......
Out of sight, out of mind??
Valley gutter left blocked....
Sustainability depends on active use

Unused upper floors.
No maintenance.

Repairs only after fallen masonry endangered the public
Landlord or leaseholder responsibility?

Neglect leading to failure
Repair or replacement?
### The TC350 sustainability of construction works

BS EN 15978: 2011 defined the life (cycle) in multiple stages.

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<tr>
<td>A5</td>
<td>Construction-installation process</td>
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<td>Use</td>
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<td>Deconstruction</td>
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<td>C3</td>
<td>Waste Processing</td>
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**Embodied impacts**

- Embodied impacts of refurbishment
- Operational energy use
- Operational water use
- Operational impacts

**Beyond Life**

- Reuse
- Recovery
- Recycling
- Potential
Cement mortar prevents re-use and creates waste from 2006 survey cited by Dennis Rodwell:
• The UK construction industry uses 6 tonnes of building materials per head of population and creates 35 per cent of all wastes.
• 3.5 billion bricks are manufactured and 2.5 billion destroyed.

lime mortar would have enabled salvage and re-use of the bricks!!
“Salvage and make-up” allows fired materials to be re-used
Replacement issues

Loss of authenticity

Too much replacement
= loss of protection
Window replacement?

Long-life originals, short life replacements
Pressure-grown softwood replacing hardwood?

Substitute materials - manufacturing / disposal issues
“timber-look” PVC-U???

Short-life material, high embodied energy, disposal / pollution issues

Guarantee 10 years

Manufacturer claims  “almost maintenance-free”
  “Energy Saving Trust endorsement”
Advice & Guidance
Internal wall insulation:
Å needs any problems with penetrating or rising damp to be fixed first.

Moisture movement and ventilation:
Å In traditionally built properties with solid walls, it is recommended to use breathable (also known as vapour permeable) solid wall insulation materials as these allow continuous movement of air (vapour) and this helps reduce the possibility of moisture build up.
Å If you are planning on installing non-breathable (also known as vapour impermeable) solid wall insulation materials in a traditionally built property then we recommend you ask the installer what consideration needs to be given, if anything, to avoid the build-up of moisture in your home.
Advice – Energy Saving Trust

External wall insulation:
Å renews the appearance of outer walls
Å improves weatherproofing and sound resistance.
Å fills cracks and gaps in the brickwork, which will reduce draughts
Å increases the life of your walls by protecting the brickwork
Å reduces condensation on internal walls and can help prevent damp (but will not solve rising or penetration damp)
Å is not recommended if the outer walls are structurally unsound and cannot be repaired.
Good advice published, but......

“The Repair and Maintenance of Houses” Melville & Gordon  1973

Cement render will become cracked, allowing moisture to penetrate
Salt damage; freeze-thaw damage
..in bulky & costly books
Heritage bodies’ advice

Traditional Windows
Their Care, Repair and Upgrading

Energy Efficiency and Historic Buildings
Draught-proofing Windows and Doors
Historic Environment Scotland guidance

Building maintenance and repair is an important part of ensuring energy efficiency in traditional buildings.

Thermal performance of traditional buildings is reduced by:

- loose or defective pointing
- poorly maintained windows
- damp masonry

Reduced thermal performance leads to heat loss and higher energy bills.

Gaps around doors or windows let heat escape and cause draughts.

Building defects can cause masonry to become wet or stop water vapour escaping from the walls. A building with damp masonry will feel colder and its walls will also perform less well – heat moves more rapidly through wet material.

Maintenance must be carried out before insulating a building. Defects and water ingress can both stop insulation from performing at its best, and further problems may occur.

Welcome to the Responsible Retrofit Knowledge Centre. It presents information to assist decision making and increase learning about the responsible retrofit of traditional buildings. It is intended as a free resource to support a movement for responsible retrofit both at an individual and at a national level.

Knowledge Centre
Click below to view information on retrofit measures relating to:
- Walls
- Roofs
- Floors
- Windows
- Doors
- Chimneys

Guidance Wheel
Click below to explore and use the wheel on a specific building.

Featured Additions
- **FEATURED MEASURE**
  - Frame infill insulation
  - Click here to view

- **FEATURED CONCERN**
  - Use of sympathetic materials
  - Click here to view

- **FEATURED REFERENCE**
  - Energy Efficiency In Historic Buildings - Secondary glazing for
  - Click here to view

- **FEATURED CASE STUDY**
  - Wells O Wearie Cottage
  - Click here to view
CONCERN & ACTION: Trapped/accumulated moisture

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 IMPLEMENTATION

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).

DURING IMPLEMENTATION

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.

AFTER IMPLEMENTATION

Monitore moisture at vulnerable locations and report findings
Third sector or self-help???

A SPAB advice line

A periodproperty.co.uk
Conservation officers

- Used to offer free advice to owners
- Some had resources for outreach
- Cited as contacts in Part L and Green Deal Code of Practice
- Linkages and scope diminished by outsourcing of Building Control etc
- Loss of knowledge and skills due to cuts

NOW AN ENDANGERED SPECIES!
Conservation officers under the axe

e.g. Cornwall  (new Unitary + “Each Home Counts” pilot)
12,664 listed buildings and 145 Conservation Areas
Â March 2009  11.4 conservation officer posts
Â Dec 2010  8.4
Â June 2011  7.4
Â June 2012  5.4
Â June 2014  4 (new) posts, only 2 appointed
Â August 2015  2, + 2 graduates
Â June 2017  4.6

Figures tell only half the story –
decades of local knowledge and expertise lost!
Caring for your home

A stitch in time...
— Makes good sense and saves money

It pays to look after your home. The value of the property reflects its state of repair and increases with its surviving character. Your enjoyment of the fabric is assured by regular maintenance and, in keeping a record of its care, you remain one step ahead. This guide takes the homeowner through the basic steps necessary to care for their home.

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No maintenance and repair, no sustainability!

“One day, son, all of this will be yours!”

from “Caring for your home”, IHBC
A stitch in time........

Â Maintain  “stave off decay by daily care”
Â Repair
Â Advice and guidance

Building maintenance and repair is an important part of ensuring energy efficiency in traditional buildings.
• Know your home
• Regular inspections

• Professionals and craftsmen
• Building elements
## Elements to be inspected

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<thead>
<tr>
<th>Roof coverings</th>
<th>Central heating &amp; hot water supply</th>
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<tbody>
<tr>
<td>Rainwater disposal system</td>
<td>Electrical installations</td>
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<tr>
<td>Walls</td>
<td>Sanitary facilities</td>
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<tr>
<td>External joinery and ironwork</td>
<td>Fire precautions</td>
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<tr>
<td>Ceilings and floors</td>
<td>External areas</td>
</tr>
<tr>
<td>Internal joinery</td>
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<tr>
<td><strong>DO’s</strong></td>
<td><strong>DON’Ts</strong></td>
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<tr>
<td>Regular inspection &amp; maintenance</td>
<td>Allow serious defects to remain</td>
</tr>
<tr>
<td>Get advice from suitably qualified professionals</td>
<td>Expect independent advice from someone who has something to sell you</td>
</tr>
<tr>
<td>Repair rather than restore or replace</td>
<td>Attempt to ‘improve’ by altering the appearance</td>
</tr>
<tr>
<td>Use only traditional materials and techniques</td>
<td>Rely on commercially-based claims for products or techniques, or use so-called “maintenance-free” products</td>
</tr>
<tr>
<td>Re-use material from the building</td>
<td>Waste re-usable materials</td>
</tr>
<tr>
<td>Remedy bad repairs</td>
<td>Bodge repairs</td>
</tr>
<tr>
<td>Adopt correct priorities for repairs</td>
<td>Replace windows or doors in non-original patterns or materials</td>
</tr>
<tr>
<td>Use reliable contractors / craftspeople</td>
<td>Employ anyone without references</td>
</tr>
</tbody>
</table>
Changing Culture & Opportunities?

Å Repair cafes

Å VAT (cf Sweden)?

Å Brexit opportunities

Å Brexit risks
Thank you

John Preston
Artist - Historic Environment Consultant - Lecturer
jpreston@phonecoop.coop