Thermal comfort in older houses
Windows
Transition Cambridge

Jim Ross

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Jim Ross
BSc Dip Arch (RIBA II)

Building and Landscape Designer, Teacher, Community Architecture Facilitator

Trained in architecture, with a background in furniture-making and teaching, my interests lie in community lead design, practical sustainability, conservation and counter-urbanism.

As a director at Cambridge Architectural Research (CAR Ltd), I work with councils, charities, universities and private clients to find appropriate and engaging ways of making places and buildings work.

Cambridge Architectural Research Ltd
CAR is an independent research and design consultancy. Founded in 1987, CAR’s interdisciplinary team is at the forefront of new thinking in all aspects of the built environment.

Cambridge Architectural Research Ltd
Thermal comfort in older houses
Windows
Transition Cambridge

Why Insulate
Fabric First
Why Windows... Energy & Materials
Types of Windows
What to do with them...
Information and Advice
• Reduce Carbon Emissions
• Improve Comfort
• Rising fuel costs
• Long term savings
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Why Insulate

- Reduce Carbon Emissions
- Improve Comfort
- Rising fuel costs
- Long term savings

<table>
<thead>
<tr>
<th>Heating type</th>
<th>Percentage increase over five years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid fuel</td>
<td>42%</td>
</tr>
<tr>
<td>Electricity</td>
<td>26%</td>
</tr>
<tr>
<td>Mains Gas</td>
<td>48%</td>
</tr>
<tr>
<td>LPG/LPG Condensing</td>
<td>55%</td>
</tr>
<tr>
<td>Oil/oil condensing</td>
<td>29%</td>
</tr>
<tr>
<td>Wood pellets</td>
<td>5%</td>
</tr>
</tbody>
</table>
Key issues

• Reducing the amount of energy used from fossil fuels is the most important factor in promoting sustainability.

• Insulation has the greatest potential for reducing CO2 emissions, in buildings.

• Energy conserved, through improved insulation, in use far outweighs the energy used in its manufacture.

Source: GreenSpec
Behaviour - Fabric - Systems

1. Reduce the Average Temperature Difference. Hats and Thermostats
2. **Reduce the leakiness of the building.** Insulate and draft proof.
3. Increase efficacy of heating system 90% is good but we can do better.

Power use = Average temperature difference x Leakiness of the Building / efficiency of the heating system.

Before sending on improving heating or adding renewables sort out the building.

*Source: David MacKay*
Why Windows... Energy & Materials
### 8.2 RECOMMENDED RETROFIT MEASURES CHECKLIST

<table>
<thead>
<tr>
<th>Measures in order of carbon reduction and financial payback</th>
<th>□ □</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have you installed 300 mm loft insulation? (It needs to have high thermal lag characteristics under pitched and flat roofs.) – Jump to Chapter 7.</td>
<td>□</td>
</tr>
<tr>
<td>Have you specified draught-proofing, particularly around service switches, sockets and pipe penetrations, behind skirting boards, around windows and doors? – Jump to Chapter 7.</td>
<td>□</td>
</tr>
<tr>
<td>Dowing to high levels of airtightness, have you considered strategies for dealing with internal moisture and pollutants at the start of the project? This can be dealt with by either:</td>
<td>□</td>
</tr>
<tr>
<td>• Installing cost-effective masonry cavity wall insulation, if there is a 50 mm cavity (polystyrene beads or blown mineral wool are recommended; avoid urea formaldehyde spray foam because of internal air quality issues; needs to be combined with internal or external insulation to further reduce space heat demand), or:</td>
<td>□</td>
</tr>
<tr>
<td>• Insulating externally (reduce insulation around window reveals; specify new window sills and carefully detail roof overhang; verge and eaves extension gutters are available), or:</td>
<td>□</td>
</tr>
<tr>
<td>• Installing internal wall insulation, which is usually more disruptive (adapt services, windows doors, rooflights and their frames and architraves; refit skirting boards, floors and all electrical cabling: ideally replace ceilings and insulate below or above ceiling joists to avoid thermal bridging).</td>
<td>□</td>
</tr>
<tr>
<td>Assuming that the above fabric efficiencies are in place, have you installed new central heating thermostats or thermostatic radiator valves and smart controls?</td>
<td>□</td>
</tr>
<tr>
<td>Have you replaced the boiler with a smaller SEDBUK A-rated boiler and/or other monitoring and control technologies? – Jump to Chapter 12.</td>
<td>□</td>
</tr>
</tbody>
</table>

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Floor insulation is disruptive, but if there are suspended timber floors, have you considered lifting floorboards and placing insulation between floor joists, maintaining existing ventilation – but not blocking airbricks and sleeper walls? If this is not possible or if it's a concrete floor, have you considered insulating above, adapting and refitting skirting boards, and adapting door frames and architraves? (A new floor finish will be required.)

- Have you repaired or improved existing windows and shutters? Or added secondary windows? Or replaced windows and doors with triple glazing or double-glazed argon-filled BFRC A-rated windows? Have you insulated and sealed around windows and door frames?
- Have you installed MVHR for whole house ventilation if sufficiently airtight (≤3 m³/hr.m²)? Otherwise, have you used local MVHR for cooker hood and bathroom extracts? – Jump to Chapter 6.

Once fabric efficiency has been optimised, have you then considered any renewable energy system?

Source: Sofie Pelsmakers

Why Windows... Energy & Materials
Have you repaired or improved existing windows and shutters? Or added secondary windows? Or replaced windows and doors with triple glazing or double-glazed argon-filled BFRC A-rated windows? Have you insulated and sealed around windows and door frames?
Have you repaired or improved existing windows and shutters? Or added secondary windows? Or replaced windows and doors with triple glazing or double-glazed argon-filled BFRC A-rated windows? Have you insulated and sealed around windows and door frames?

Source: Sofie Pelsmakers

Why Windows... Energy & Materials
A typical house loses 10% of its heat through the windows.

The successful specification of energy efficient windows requires a sound understanding of the dynamics of thermal performance.

Overall energy balance = solar heat gain – heat loss

2/3 of the energy lost from a standard window is through radiation through the glazing.

Source: GreenSpec
The traditional method of measuring a window’s performance is through its U-value. In practice this can often be confusing since there are 3 types of u-value that can be quoted:

- The u-value measured through the centre of a glazing unit alone – ‘centre-pane’

- The u-value of the window frame alone.

- The overall u-value of the window including glazing unit and frame. – ‘overall’

(Note: it is common for window manufacturers to promote the ‘centre-pane’ u-value of a window rather than the more realistic ‘overall’ u-value.)

*Source: GreenSpec*
The u-value method of measuring a window’s performance has proven to been something of a blunt tool, ignoring, as it does, other factors such as a window’s capacity to transmit solar energy.

Though u-values are still often quoted, the BFRC rating system is gaining popularity through its citing by the Building Regulations in England and Wales

*Look For* BFRC rating system

*Source: GreenSpec*
Hard (eg Pilkington K glass): applied during the manufacturing process. Emissivity between 0.15 and 2.0

Soft (eg St Gobain Planitherm Total): applied after manufacture. Emissivity between 0.05 and 0.10. They produce a lower u value.

Soft coatings tend to degrade when exposed to air and moisture, are easily damaged, and have a limited shelf life.

Source: GreenSpec

Why Windows... Energy & Materials
Types of Window

- Double Sliding Sash
- Timber Casement
- Metal Casement
- Composite Windows
- Roof Lights
Types of Window

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Source: norgrove studios
Types of Window

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Double Glazing Film
Plastic shrink wrapped film stuck on with double sided tape....

- Cheap DIY
- Seasonal
- Effective

- Ugly?
- May damage paint work
- Can’t always open windows

Suitable for:
- Fixed Frame
- Casement
- Some Double Hung.

Not metal frames

What to do with them
Double Glazing Film
Storage
What to do with them
Draft Proofing
Draft Proofing
Sealing up the gaps...

Positives
• Cheap DIY or professional.
• One off
• Quite Effective

Negatives
• Can trap moisture if not fitted correctly
• Not for use with Secondary glassing

Suitable for:
• Fixed Frame
• Casement
• Some Double Hung.

Not for use with Secondary glassing
Secondary Glazing
A fully independent window system fitted to the room side of an existing window.

+ Good noise insulation
+ Improved U-values
+ Seasonal, can be removable.
+ Retains Historic Fabric
+ Fits inside frame

- Can be Ugly?
- Expensive for best quality
- Storage can be an issue

Suitable for:
• Fixed Frame
• Casement
• Some Double Hung.
• Metal frames

Source: Magnatite
What to do with them
Secondary Glazing

Source: selectaglaze
<table>
<thead>
<tr>
<th>Environment</th>
<th>Sound Pressure Level (dBA)</th>
<th>Window Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jet Aircraft at 50m</td>
<td>140</td>
<td>A - Single Glazed opening window without seals</td>
</tr>
<tr>
<td></td>
<td>130</td>
<td>B - Single Glazed fixed window</td>
</tr>
<tr>
<td>Threshold of Pain</td>
<td>120</td>
<td>C - Well sealed primary window with 4-16-6 sealed unit (4mm - 16mm cavity - 6mm)</td>
</tr>
<tr>
<td>Pop Concert</td>
<td>100</td>
<td>D - Secondary window in combination with fixed single glazed primary window</td>
</tr>
<tr>
<td>Heavy Truck</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Street Traffic</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Normal Speech</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>Open Plan Office</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Living Room</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Bedroom At Night</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Broadcast Studio</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Rustling Leaves</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Threshold of Hearing</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

**Secondary glazing offers the best acoustic performance**

Source: selectaglaze
Replace Glazing with Thin Double Glazing

+ Minimises loss to historic fabric
+ Improves U-values 1.5-1.9W/m2K
+ Total thickness of units starting at 10mm
+ Low-E float glass inner pane
+ Gas filled cavity
+ Can have wobbly outer pane to look nice.
+ Can use Putty
+ Noise reduction if inner and outer pane varied -34dB

- Less air tight than replacement windows.

Suitable for
• Fixed Frame
• Casement
• Some Double Hung, will need rebalancing

Source: Histoglass
MARGERY THORN FARM
TYPICAL WINDOW SECTION FOR HISTOGLAS
5 AUGUST 2015 JIM ROSS
Drawing No A307

NO SILL LIME FILL ON BRICK
NO MASTIC!!!

JAMB

MULLION
What to do with them
Replace Windows
What to do with them
Replace Windows
Replace Windows

+ Best U-values
+ Can be adapted to work with internal or external insulation
+ Designed to meet the most rigorous specifications.

- Less air tight than replacement windows.
- Loss to historic fabric
- Pay back 15 Years cheapest double glazing 25 years for top end triple

Possible for
• All situations other than Listed

What to do with them
Replace Windows
Types of Window Storage

Source: Environmental Designers Pocket Book

NOTE:
1. Do not scale, if in doubt ask.
2. This drawing is to be read in conjunction with all relevant Architects drawings and details, the specification for the works, and any other specialist's drawings.
What to do with them
Double Glazing Film
Draft Proofing
Secondary Glazing
Replace Glazing with Thin Double Glazing
Replace Windows

But First
Insulate loft
Change heating Controls
Ventilate right
Insulate walls
Improve heating system
• Double Sliding Sash
• Timber Casement
• Metal Casement
• Composite Windows
• Roof Lights

Types of Window
English Heritage

Green Spec, Brian Murphy
http://www.greenspec.co.uk/

Sustainable energy without the hot air. David MacKay
http://www.withouthotair.com/

The Environmental Designers Pocket Book, Sofie Pelsmakers
http://www.environmentaldesignpocketbook.com/

The Building Regulations
http://www.planningportal.gov.uk/buildingregulations/

BFRC

FENCA
http://www.fensa.co.uk/
Steel Widow Association.
http://www.steel-window-association.co.uk

*Cambridge Clasics*
http://www.cambridgeclassics.co.uk/index.php

Selectaglaze
http://www.selectaglaze.co.uk/noise/reasonable_noise_levels.php

Eksalta
http://www.eksalta-sustainable.co.uk/contact-us.html
Sustainability is a powerful but slippery concept. Now that there is so much information (and some misinformation) in circulation, it can be difficult to know how to make sustainable decisions. CAR’s approach to sustainable buildings takes a broad and balanced view, based on technical knowledge and also practical experience.

A sustainable building should be designed, detailed and constructed to be:
• bright, well-ventilated and comfortable
• economical to run
• straightforward to maintain
• flexible in day-to-day use
• adaptable in the medium and long term, as well as having
• low energy, low emissions and low pollution.

These are practical objectives. Advanced or experimental technologies should only be used when they contribute to these objectives, never for their own sake.

There is no standard template for sustainable buildings. CAR works with clients to find solutions that fit their particular needs. By coupling good design skills with a solid technical foundation in Conservation, Structural Engineering, Building Physics and Whole-life Costing, CAR has the tools, skills and experience to deliver sustainable buildings that meet the needs of today and are prepared for tomorrow.

*If you have a Energy Retro Fit Project you need help with or are looking for Architectural Advice Please Contact:*

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