SAVING ENERGY IN TRADITIONAL NORTH EAST HOMES
Barbara Lantschner
John Gilbert Architects

A Deep Retrofit Case Study: Canongate Block 2
30th November 2021
1. JGA & Hab-Lab

**Conservation & Retrofit**
New ideas for old buildings, extending life, increasing use and improving performance

**Hab-Lab**
Building practice based research and knowledge on user needs, building performance and urban issues

**Strategy & Masterplans**
Development of large scale proposals, masterplanning and regeneration

**Sustainable Architecture**
Design and project management of beautiful, high performance, people-centric buildings

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John Gilbert Architects

Our Values:
- Work hard, have fun and change the world
- Creativity is based on knowledge
- Listen, share and collaborate
- Touch the earth lightly
- Be open and curious

HAB-LAB
1. JGA & Hab-Lab

Real world information & making POE accessible

- Energy monitoring
- Indoor environmental quality
- Building fabric measurements
- People
2. Case Study: Canongate Block 2

Canongate

- Built 1969
- Designed by Sir Basil Spence
- B-listed
- Significant for its location, architect, aesthetic and materiality
- Problems noted by all residents including energy use, mould and dampness problems

Key questions we were asked to answer:

- What is causing the current problems with the building fabric?
- How can we improve the building fabric without negatively impacting on the significance of the building?
2. Case Study: Canongate Block 2

Canongate

- Appointed by the owner’s group, the Canongate Development Owners Committee, supported by Edinburgh World Heritage who provided dedicated staff, advice and funding support to the project.

- Also being supported by funding from Scottish Government, Scottish Power and Edinburgh City Council.

- Working on block 2: 12 flats and 2 businesses.

- 32 persons involved including tenants and owners (incl. 2 vulnerable persons).

- 23 meetings prior to site start:
  - 1 initial general meeting
  - 4 pre-design phase
  - 12 during design phase
  - 5 during tender process / financial closing

JGA+EWH+Client’s meeting
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Canongate

- **Design Process**: (April 2018 – April 2019)
- **Match funding Process**: (January 2018 – November 2018)
- **Social and Technical Monitoring Process**: (February 2018 – March 2021)
- **Tender + F. closing**: (May – Nov. 2019 – March 2020)
- **Works**: (March – July – Dec. 2020)
2. Case Study: Canongate Block 2
2. Case Study: Canongate Block 2

Stage 1: Retrofit Assessment

• Assessment methodologies adopted include:
  • Archive analysis and previous research
  • Thermography
  • Air-tightness testing
  • IAQ and energy monitoring
  • Live U-value analysis
  • Dynamic thermal modelling
  • Ventilation modelling
  • Wufi calculations
  • Materials analysis
  • Acoustic surveys

In-situ tests conducted by JGA/Thermal Image UK
2. Case Study: Canongate Block 2

Stage 1: Retrofit Assessment

Design Team Inspections:

JGA site photos
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Stage 1: Retrofit Assessment

Materials Analysis:

- Mortar analysis
- Petrographic analysis
- Concrete analysis
- Render analysis

Plate 1. Image showing the condition of the sample, as received.

Plate 2. Image showing a close-up of the surface. The concrete is dense and the coarse aggregate a mixture of crushed gravel and rounded grains.

<table>
<thead>
<tr>
<th>PROCEDURE</th>
<th>OBSERVATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRELIMINARY VISUAL ANALYSIS OF SAMPLE</td>
<td>This sample is from a hard well compacted concrete. The sample is uncarbonated, but as there was no outer surface the impact of invasive carbonation cannot be determined.</td>
</tr>
<tr>
<td>EXAMINATION OF PREPARED SAMPLE BY BINOCULAR MICROSCOPE (X40 MAGNIFICATION)</td>
<td>Once dried the mortar was found to be 10YR 7/1 'light grey' when assessed against the Munsell Soil Colour Charts. The concrete is dense and the coarse aggregate a mixture of crushed gravel and rounded grains of various sizes.</td>
</tr>
</tbody>
</table>
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Stage 1: Retrofit Assessment

Paint Analysis:

- Book published by Fiona McLachlan alongside archive images from Canmore

Archives and Previous Research:

- Conservation Statement by Simpson and Brown
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Stage 1: Retrofit Assessment

Boroscope Surveys and Wall Tie Scanning:

• Understanding of existing cavity sizes
• And distribution of wall ties
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Stage 1: Retrofit Assessment

Thermography (conducted by IRT):

- poorly insulated, but its generally consistent and predictable
- primary issue is the structure of the building and the expressed concrete detailing
- some air leakage, typically at flue penetrations etc
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Stage 1: Retrofit Assessment

Airtightness Testing

- 71/6 Canongate – q50 = 5.12 m³/h/m²
- 2/3 Brown’s Close – q50 = 3.02 m³/h/m²
- 2/2 Brown’s Close – q50 = 5.36 m³/h/m²

Smoke test in the cavity space

- Overall, this test helped us to identify whether there was any evidence of convection ‘chimney effect.’
- During the test, strong air flows were visualised and recorded with smoke within the cavity, certainly at the locations where there were penetrations accessible externally that we could test.
- The existence of air flows within the cavity, limits the performance of internal or external wall insulation.
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Stage 1: Retrofit Assessment

Indoor Air Quality Monitoring:

- **ESP-r modelling:**
  - To test ventilation methods and condensation risk on internal surfaces

- **Dynamic thermal modelling:**
  - To test heat load, methods of heating, viability of renewables and more

- The accurate simulation models was also be compared to the Standard Assessment Procedure (SAP) results and the real world data, to assess on performance gap issues and achieve the full potential of the potential retrofit measures
2. Case Study: Canongate Block 2

Stage 1: Retrofit Assessment

Wufi Calculations:

- Analysis of different insulation types and their impact on the performance of the wall

<table>
<thead>
<tr>
<th>A. Render on brick + brick cavity wall</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
<th>Scenario 3</th>
<th>Scenario 4</th>
<th>Scenario 5</th>
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<td>As existing</td>
<td>EPS CWI only</td>
<td>Woodfibre IWI only</td>
<td>EPS CWI + Woodfibre IWI</td>
<td>Geoceli CWI + Woodfibre IWI</td>
<td></td>
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<td>Assessment 1: Internal surface condensation and consequent mould formation (within 80%)</td>
<td>No risk</td>
<td>No risk</td>
<td>Risk (not significant, between IWI layer and masonry)</td>
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</tr>
<tr>
<td>Assessment 2: Deterioration of insulation material</td>
<td>N/A</td>
<td>No risk</td>
<td>Risk</td>
<td>No risk</td>
<td>No risk</td>
</tr>
<tr>
<td>Assessment 3: Spalling damage</td>
<td>No risk</td>
<td>Risk (not significant)</td>
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<th>B. Sanstone + brick cavity wall</th>
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Wufi simulations findings

Wufi modelling results, conducted by Greengauge
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Stage 2: Retrofit Strategy

Retrofit Targets:

- All properties improved from an EPC D/E to an EPC B
- Reduction in energy bills
- Improvements in occupant health
- Eradication of mould and damp
- Key areas of building fabric repaired
- Original architectural intent of the building more clearly legible
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Stage 2: Retrofit Strategy

Key Strategies (in order of priority)

- Deal with structural issues
- Remediate external finishes and prevent staining
- Repair and repaint render
- Insulate walls without introducing unintended consequences
- Replace windows and improve airtightness
- Ventilate right!
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Stage 2: Retrofit Strategy

Evidence-based design example/ Wufi calcs:

• CWI alone does not present significant risks associated with moisture accumulation.

• The IWI strategy simulated present some risk of moisture accumulation at the interface between the wood fibre and the existing masonry which may lead to some mould growth.

• Where CWI is combined with IWI, the issues associated with the outer surface of the IWI are not present, because the CWI keeps everything in board of it warmer and therefore drier.

• Warmer indoor environmental conditions improved comfort but warm air can exacerbate mould and condensation issues at thermal bridges that have not been properly dealt with.
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Stage 3: Installation

Window replacement:

Non-original: Can be re-instated by painting
Non-original: Original component replaced
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Stage 3: Installation

Concrete repair:
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Stage 3: Installation

MVHR system:

• POE conducted by JGA and EWH: from December 2020 to May 2021

• Completion: January 2021

• Handover process: JGA & EWH, including Workshops with residents held on Zoom
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Tom Manley, Canongate Block 1

Tom Manley, Canongate Block 2 (post-retrofit works)
2. Case Study: Canongate Block 2

Tom Manley, Canongate Block 2 (post-retrofit works)

Tom Manley, Canongate Block 2 (post-retrofit works)
3. Conclusions

**Conclusions**

- Importance of implementing a WHR strategy (Enerphit, PAS 2035, etc) to ensure a holistic approach

- Overlaying the BS7913 approach with this retrofit methodology allowed us to balance our decisions against our understanding of the significance of the building throughout

- Applying an evidence-based design methodology allowed us to
  - understand the building and the way it performs,
  - test methods for repair and retrofit,
  - and to reach consensus amongst a client group that included 14 owners by showing a clear logic for the decisions we were making.

IEQ monitoring (SEEP funding req)
Thank you

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