Centenary Quay and One Brighton
Case Studies: Domestic Buildings
Building Performance Evaluation
BPE Aims and phases

- to measure the energy performance of new environmentally friendly dwellings.
- this information will help the developers, constructors and designers to understand how to build future environmentally friendly dwellings that are comfortable, efficient and healthy for the occupants
- gathered information will help occupants to understand how their home performs and how to use it to optimise levels of comfort whilst reducing energy use

Phase 1: Post construction and early occupation
- Fabric Testing
- Design and delivery team walkthrough
- Physical handover
- BUS survey
- Installation and commissioning

Phase 2: In-use performance and post occupancy evaluation
- Heating, electricity, and hot water were monitored to assess the real, physical performance of the occupied houses compared to the design intentions
- Internal conditions of relative humidity, temperature, and carbon dioxide levels were monitored to evaluate the thermal performance of the houses as well as the indoor air quality during occupied hours.
Centenary Quay (CQ)

First phase of the Centenary Quay development a large scale regeneration project.

Apart from offices, hotel, community facilities, library, supermarket, etc, the project contemplate 1,620 houses and apartments – homes for around 3,000
CQ findings / *Phase 1: Post construction and early occupation*

The results of customer interviews showed that:
- overall, the residents are satisfied with their new homes.
- In particular, they like the house design, room layouts, location and general levels of comfort.

![Winter Temperatures Graph](image.png)
There are a number of findings which highlighted the challenges and opportunities Crest took to improve internal processes, design and levels of customer satisfaction:

- Higher heat loss for external fabric of the tested home than predicted by SAP
- Measured wall u-values (0.35W/m$^2$k) were almost 70% higher than design values
- Thermal imaging identified pockets of thermal defects in the dwelling fabric
- There was found some differences between what was built on site and what was described in the construction specifications and drawings
CQ findings  

*Phase 2: In-use performance ad post occupancy evaluation*

- overheating risk in new build dwellings

<table>
<thead>
<tr>
<th>% of Hours above CIBSE Overheating Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>(based on temperature data from July, August and September 2013)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedroom 1 &gt;26°C (% year)</td>
<td>5.8</td>
<td>1.6</td>
<td>2.9</td>
</tr>
<tr>
<td>Bedroom 2 &gt;26°C (% year)</td>
<td>3.4</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Bedroom 3 &gt;26°C (% year)</td>
<td>5.5</td>
<td>2.4</td>
<td>2.7</td>
</tr>
<tr>
<td>Living Room &gt;28°C (% year)</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

- CIBSE Guide A overheating criteria: Less than 1% of annual ‘occupied hours’
- Figures presented are not adjusted for occupied hours; the table helps to compare relative performance of houses.
- The difference in overheating performance could be due to different ventilation strategies adopted by the users, use of curtains and the level of internal gains (occupancy & appliances).
CQ findings  Phase 2: In-use performance ad post occupancy evaluation

- performance of Mechanical Extract Ventilation (MEV) systems

<table>
<thead>
<tr>
<th>Plot No.</th>
<th>Design Trickle Flow (L/s)</th>
<th>Measured Trickle Flow (L/s)</th>
<th>Design Boost Flow (L/s)</th>
<th>Measured Boost Flow (L/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>30.4</td>
<td>11.7</td>
<td>35.0</td>
<td>34.9</td>
</tr>
<tr>
<td>B</td>
<td>30.4</td>
<td>12.2</td>
<td>35.0</td>
<td>30.2</td>
</tr>
<tr>
<td>C</td>
<td>30.4</td>
<td>2.2</td>
<td>35.0</td>
<td>24.1</td>
</tr>
</tbody>
</table>

MEV design and measured extract flow rates
CQ findings  

*Phase 2: In-use performance ad post occupancy evaluation*

- performance of district heating system

The performance of the system over the period October 2012 to July 2013 was disappointing with respect to three key parameters:

- overall energy centre efficiency,
- system power to heat ratio and
- heat distribution efficiency.
One Brighton (OB)

The One Brighton development was designed as mixed-use, with 172 dwellings, community space and commercial space. The homes at One Brighton are a mixture of studio, 1-bed, 2-bed and 3-bed apartments, with 30% being affordable.

It was designed and built (2008-10) considering the One Planet Living principles and to be Zero Carbon through a combination of good thermal design and on- and off-site renewable generation technologies.

Source: http://www.goodhomes.org.uk/projects/onebrighton
OB findings  *Phase 2: In-use performance ad post occupancy evaluation*

- **BUS survey**
  
  - In general the **building meets the occupants needs**
    
    (A huge range of factors was mentioned that work well including: layout, allotments, bike storage, location, bins, the green caretaker, insulation and transport links. Examples of things which do not work included: noise insulation, lack of car parking, intercom system and the heating/ventilation system)

- Overall occupants are **comfortable** at OB but issues remain.
  
  (Winter: negative comments relating to the heating system ranging from poor reliability and control to lack of temperature and poor distribution.

  Summer: negative comments excessive dust, poor control and poor flow design. Many occupants report the necessity to open windows to keep cool)
**OB findings**  *Phase 2: In-use performance ad post occupancy evaluation*

- Energy consumption

Normalised electricity use was **42.8 kWh/m²/annum**, while Design target **75 kWh/m²/annum** (BioRegional Quintain Ltd. 2006)

Normalised heat use was **30.2 kWh/m²/annum**, while Design target **45 kWh/m²/annum** (BioRegional Quintain Ltd. 2006)
OB findings  Phase 2: In-use performance ad post occupancy evaluation

• Summer overheating risk

One Brighton does not have an active cooling air conditioning system. The system is mixed mode mechanical ventilation & natural ventilation.

The residents’ manual states that “keeping windows closed in summer will allow your (MVHR) unit to provide free cooling by letting in cooler air from outside and extracting warmer air from inside your home”.

Percentage Time above CIBSE Overheating Threshold in bedrooms and Living Rooms by Month
OB findings  *Phase 2: In-use performance and post occupancy evaluation*

- performance communal heating system

The measured efficiency of the gas boiler was very good, with an overall efficiency of 86.1% over the monitoring period.

The efficiency for the communal biomass boiler used in the as built SAP calculation was 85%, which is much higher than the measured 69.6%.

It was found that the plant output was actually dominated by heat provided by the gas backup boiler, with heat from Biomass only accounting for 27.8% of total heat output over the monitoring period. The design and regulatory expectation was that 100% of heat should have been provided by the biomass boiler, with the gas backup only being used for shutdowns due to maintenance or equipment faults.

The results from One Brighton show that actual carbon emissions for delivered communal heat at 0.5 kgCO2/kWh were ten times that predicted, and twice that which would have been expected had the development used individual gas boilers to heat the apartments.
BPE Wider lessons

- **Sap calculation:** evidence from both project show that there can be several errors in SAP inputs, inaccuracies in U-values calculations.

- **Commissioning of mechanical ventilation systems (MVHR and MEV):** The main issues with ventilation systems seem to be related to poor installation practice and inadequate commissioning processes, which could greatly impact energy consumption, indoor air quality, condensation and mould growth.

- **Designing for overheating:** The risk of overheating is likely to increase in the future if there is an increase in seasonal atmospheric temperature.

- **Carbon emission from community heating:** The underperformance of community heating schemes (if not addressed) could seriously compromise the CO₂ emissions targets set out by the UK Government in the construction sector.
MSc EDE Dissertations


Chatzinota Maria (2013) Evaluating the In-use performance of a combined heat and power district heating energy system: the Centenary Quay case study


Bainbridge Jamie. (2011) Do buildings that are built according to sustainability principles and to a high environmental standard deliver a sustainable living solution to their occupants? – A Case Study One: Brighton, MSc Dissertation, Bartlett School of Graduate Studies, UCL, London.
Acknowledgements

The Team:
Robert Lowe, Lai Fong Chiu, Hector Altamirano Medina, Jez Wingfield, Esfandiar Burman, Sam Stamp, Carrie Behar, Zhihui Ye, Ian Ridley, Henrietta Lynch, Jamie Bainbridge

Funders and partners:
GHA, TSB, Crest Nicholson, Bioregional Quintain
(Nick James, Chris Eaton, Tom Kordell and Julia Plaskett)