TESTING PROGRAMME

Rowner Research Project Phase One

March 2014

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The Rowner research project was undertaken in Gosport and spanned from 2009 - 2013.

The Project was funded by the Technology Strategy Board (TSB) as part of the Building Performance Evaluation programme (BPE), together with support from First Wessex, NHBC Foundation, LABC, Saint-Gobain, HCA and Taylor Wimpey.

The research project at Rowner investigated the design and delivery of 24 apartments, split equally over two blocks. The developments were part of Phase I of a multi-phased project, the Rowner Renewal project.

The first Block (B) was built to comply with the Code for Sustainable Homes (CSH) level 3 energy requirements, and Block C was built to achieve the Fabric Energy Efficiency Standard (FEES).[1]

This project provided the Hub with the opportunity to investigate the implementation of the FEES in built flats.

The two blocks had different tenancy agreements, with Block B being offered as shared ownership and Block C as simple tenancy.

1. The Fabric Energy Efficiency Standard (FEES) is the proposed maximum space heating and cooling energy demand for zero carbon homes from 2016.

The research project had three phases:

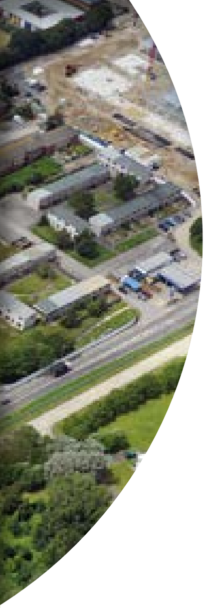
- Design and construction stage
- Post-occupancy evaluation
- And an overheating study

This series of five factsheets cover aspects of the first phase of the project.

This is the fourth factsheet in the series, covering the testing of the project.

Subsequent factsheets covering the other two phases of the project, and a case study report including all phases, will be produced by the Zero Carbon Hub in due course.

The factsheets can also be found online at: **www.zerocarbonhub.org**



Testing at Rowner research project

The Rowner research project was realised by a partnership of five members; First Wessex, Gosport Borough Council, Hampshire County Council, Home and Communities Agency (HCA) and Taylor Wimpey. During the project a complete set of building tests was undertaken. Through the different testing procedures potential weaknesses of the building's fabric were identified and a better understanding of the final product was achieved.

The testing tools in place were diagnostic and not prognostic in nature. The testing methodology in Rowner included a set of the most advanced testing tools for buildings. These are as follows:

Air permeability - Blower door test

The air permeability value of a building's fabric determined the rate at which air escapes through its exposed surfaces and can be a significant factor of the overall heat loss.

MVHR commissioning

The commissioning of the MVHR systems ensures that the systems are balanced and operate as they should. This check verifies that an adequate quantity of fresh air is supplied to the properties so that good indoor air quality levels (IAQ) can be maintained.

Co-heating test

The dwelling is heated to a constant temperature (of around 25˚C, so to get an average temperature difference between the inside and the outside of around 10˚C) using electric heaters. The required energy input into the dwelling, to maintain the internal temperature, is recorded as a measure of the rate of heat loss through the fabric in this instance.

U-value measurements

With the use of heat flux sensors the in situ u-values of various thermal elements are calculated.

Co-heating test equipment

Blower door test equipment

Air pressure testing - Blower door test

In Rowner air leakage tests were conducted on a ground floor, mid floor and top floor flat in both blocks.

In addition to the testing that took place to comply with Building Regulations, a set of air pressure tests was carried out on sample flats in the two blocks to understand how different stages of construction contribute towards achieving a target air permeability rate in buildings. These tests were performed at 3 stages:

1. First stage testing was intended to be post weathertightness; this can be interpreted as the end of the first fix stage, where the basic structure is in place, with doors and windows installed.

2. The second stage testing was conducted during the second fix stage – it was anticipated that this stage would highlight whether the areas identified in stage one had been suitably remedied.

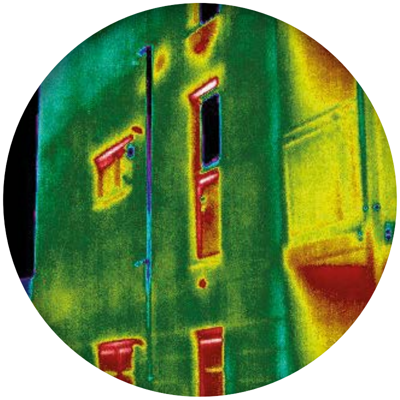
3. The final stage, when the flats were completed with the internal mastic applied and vinyl flooring laid throughout.

During the first two stages key areas where the fabric air-tightness was being compromised were identified and documented.

Another air-permeability test was carried out after the co-heating test to take into account any changes in the building fabric due to shrinkage and settling that may have resulted due to increased internal temperatures.

All final results complied with the requirement of $< 4\ m^3/m^2h$ as per the design target. Another set of testing was arranged for Phase 2 of the project.

Heat flux sensors



Thermographic image

MVHR commissioning

The extract rates of the MVHR system were designed to comply with the Approved Document F 2006 edition. The research team spot-checked the flow rates on a sample of the units and these were found to be lower than the design targets. This was highlighted as an issue and the need for them to be recommissioned was communicated to the developer. Confirmation records and certificates are yet to be produced.

Co-heating

The test was designed to be carried out during the heating period to increase external - internal temperature differentiation. The test at Rowner was conducted close to the Easter weekend in 2011 which was unseasonably warm with clear skies. It was therefore agreed that the opportunity for testing the built fabric should be undertaken but the results would be analysed and viewed with caution.

Co-heating results

The results were reviewed and analysed, and adjustments were made to the SAP calculations based on observations made through the construction process audit to reconcile the predicted and the measured values. These results were compared to measured consumption figures from Phase 2 of the research project and will be discussed in future documents.

In situ U-value measurements

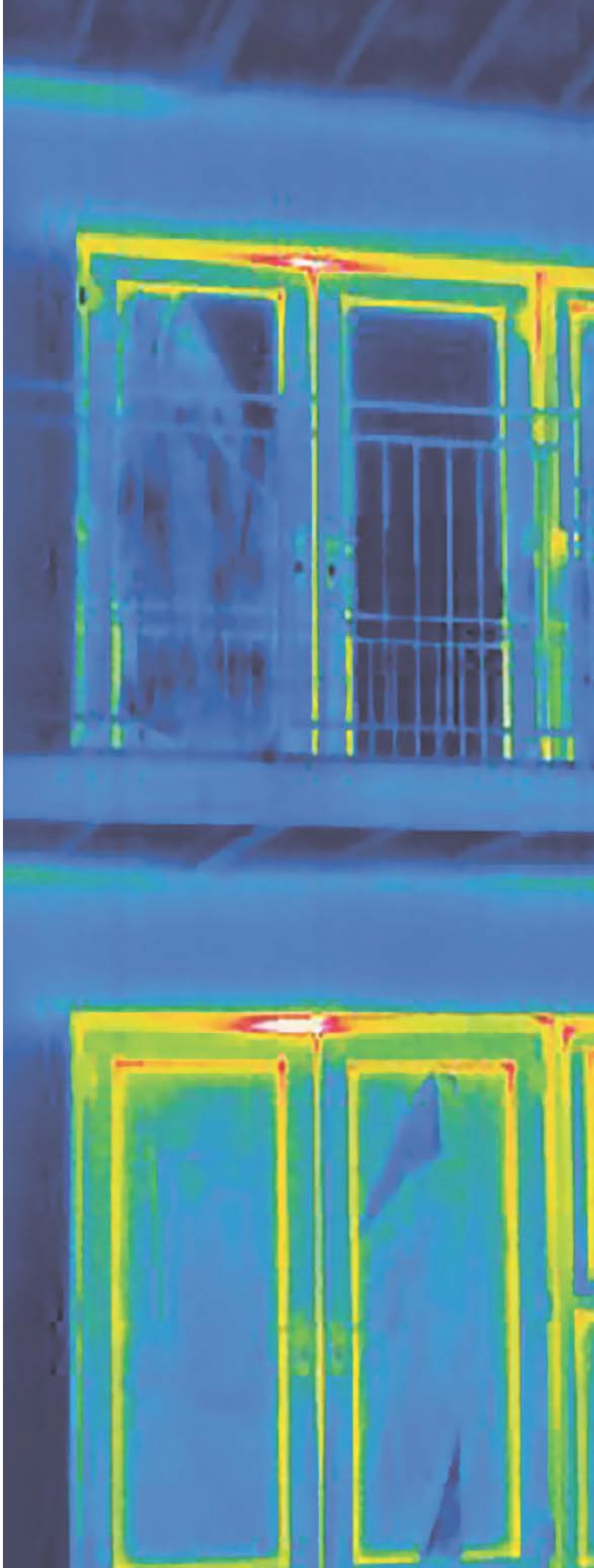
U-values were measured in situ using heat flux sensors during the co-heating test. These sensors measured the rate of heat transfer through the walls, an indication of the actual rate of heat loss. The values calculated were higher than the design values but within expected deviation.

Thermography

Thermal images of both blocks of flats were taken from the outside and the inside. Different areas of potential heat loss were identified and reviewed. The results were compared to the design intent and were used to inform the SAP calculations.

Observations

- The air-pressure testing, which was carried out during different stages of construction, allowed for areas of weakness to be identified and addressed at an effective stage. These observations were also helpful in informing future phases of construction.
- The most common areas where air permeability was compromised were where services penetrated the fabric. While it is expected that the impact of these penetrations would be limited after internal finishing had been completed, there may be other consequences such as circulation of cold air between the inner leaf of the construction and plasterboard lining which would have an impact on the space heating demand of the homes. Other areas where air permeability was compromised were around the fenestration and at some construction element junctions.
- The whole house heat loss coefficient test and other associated investigations, including heat flux tests and thermography, were carried out at the end of what would be typically considered as the winter heating season. Because of unusually warm weather, the test conditions were not ideal.
- The difference between the design Heat Loss Coefficient (HLC) and the measured Heat Loss Coefficient (as measured in the co-heating test) could be attributed to the lack of reliable data from the testing. Phase 2 analysis will explore the accuracy of this data further.
- The research team carried out checks on the ventilation system flow and extract rates, which were found to vary, and in some instances significantly, from the design rates.



Recommendations

- There must be a clear definition of the line in construction that will define the airtightness barrier. Ideally this will allow for effective diagnosis and remedial work if the target air-permeability rates are not met.
- It is recommended that the airtightness barrier is placed at the line of the fabric structure not the building finishes. This will ensure a robust solution that cannot be easily compromised.
- There must be clear consideration of testing conditions, equipment, protocol, data analysis and interpretation to be able to maximise learnings from any fabric testing of buildings.
- Procedures such as co-heating testing, heat flux measurements, and, to a degree, air-pressure testing are dependent on external weather conditions. While the research team may be able to correct data to account for the varying external conditions, it is important to view the accuracy of results within the context of test conditions.
- Guidance and procedures for the accurate commissioning of mechanical ventilation systems must be made more robust. One reason for variation in air flow rate measurements by different organisations may be due to incorrect calibration of the commissioning equipment.
- There must be clarity on information that is required to be submitted to Building Control bodies to demonstrate compliance with the Building Regulations. While the use of commissioning certificates for gas boiler systems are commonly produced and retained by occupants, similar information must be produced for mechanical ventilation systems as well.

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