BOUNDARY CLOSE

Boundary Close is a small development of 8 dwellings at Boundary Close in York that were designed by Constructive Individuals for York Housing Association. The Housing Association were keen to reduce the living costs for the prospective tenants and reduce the likelihood of fuel poverty.

The dwellings comprise two identical terraced blocks of two end and two mid-terraced 2½ storey, 2 bedroom dwellings with a sleeping deck. They are designed to near PassivHaus standards, have a compact dwelling form and are expected to require little or no space heating. Consequently, no centralised space heating system has been installed. Instead, one 2kW direct electric panel convector heater, equipped with a thermostat and a timer, has been installed in the living room of each dwelling as backup. The dwellings are also designed to be very airtight by UK standards, with a target air permeability of 1m^3/($h.m^2$) @ 50Pa. This target is factor of ten lower than the air permeability target of 10 m^3/($h.m^2$) @ 50Pa that is contained within Approved Document Part L1A 2006 (ODPM, 2006). Ventilation is provided via a mechanical ventilation and heat recovery (MVHR) system which is linked to solar collectors mounted on the roof. The solar collectors are used to pre-heat the incoming air.

TYPE OF CONSTRUCTION

The dwellings have been constructed using a composite timber-frame joist panel for the external walls and roof, which is fully filed with Warmcel, and clad externally in timber (see photographs below). The external walls and roof slope are dry-lined internally with plasterboard on battens, creating an internal service void between the timber-frame and the plasterboard. The ground floor is a solid concrete slab with insulation placed above the slab, whilst the upper floors are constructed using timber-frame composite floor joists. Timber studwork has been used for the ground and first floor partition walls and the roof is of a tiled pitched design. The windows were double glazed, argon filled units with one low-e coating and a warm edge spacer. Although higher specification windows would have been preferred by the architect, these were the best windows available given the budget.

External walls clad in timber and the composite timber-frame roof panels being craned into position [Source: Constructive Individuals, 2008]

A summary of the nominal U-value and main construction details are contained within the table below.

Element	Nominal U-value (W/m^2K)	Construction Details
External Wall	0.10	Rough sawn softwood (ground floor) / larch or western red cedar boarding on 25 x 50mm battens, 300mm composite timber-frame joist panel faced internally and externally with OSB sheathing and fully filled with mineral wool, plasterboard dry-lining on 25 x 50mm battens creating an internal service void.

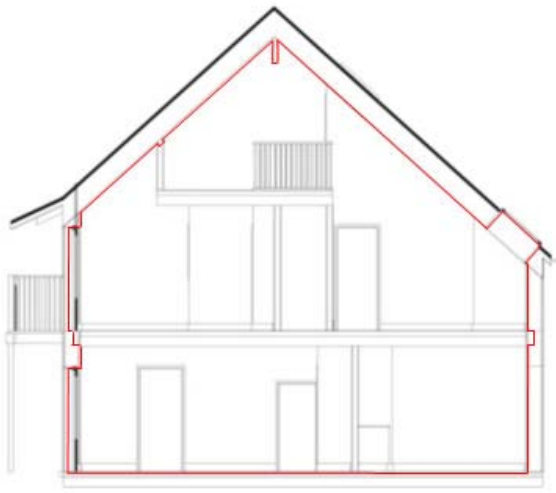
Ground Floor	0.12	100mm concrete slab on ground, 150mm (two layers 75mm) extruded polystyrene insulation, 22mm tongue and groove board (with all edges glued) floating floor.
Roof	0.08	Pitched roof comprising 407mm composite timber-frame joist panel (similar to walls) spanning wallplate to ridge purlin. Internal service void created using 25x50 battens and ceilings boarded with 12mm plasterboard.
Windows	1.7	Double glazed timber windows with low emissivity coating, 16mm argon fill.

Nominal U-values and main construction details of the dwelling

AIRTIGHTNESS STRATEGY

The strategy for achieving the airtightness target of 1m^3/h.m^2 @ 50Pa involved the following:
• A well thought through, properly designed and properly executed primary air barrier.
• Adoption of a formal well communicated airtightness target.
• Plans and details annotated to include information on airtightness.
• Inclusion of an airtightness testing strategy into the construction programme that enabled the dwelling to be pressure tested at various different stages of construction.
• Well communicated construction strategy and training programme for on-site personnel.

The location and continuity of the primary air barrier within the dwellings can be seen on the pen-on-section test shown below.



Pen-on-section test illustrating the location and continuity of the primary air barrier

A virtual tour of one of the dwellings (Plot 1) illustrating the use of properly designated materials for taping and sealing of the air barrier and the considerable efforts that have been undertaken to maintain continuity of the air barrier, can be accessed by clicking on the image below.

Air barrier incomplete

PRESSURISATION TEST RESULTS

A total of three dwellings were pressure tested at Boundary Close between March and June 2008. The calculated internal volume, floor area and envelope area for all of these dwellings was 254m^3, 88m^2 and 243m^2 respectively.

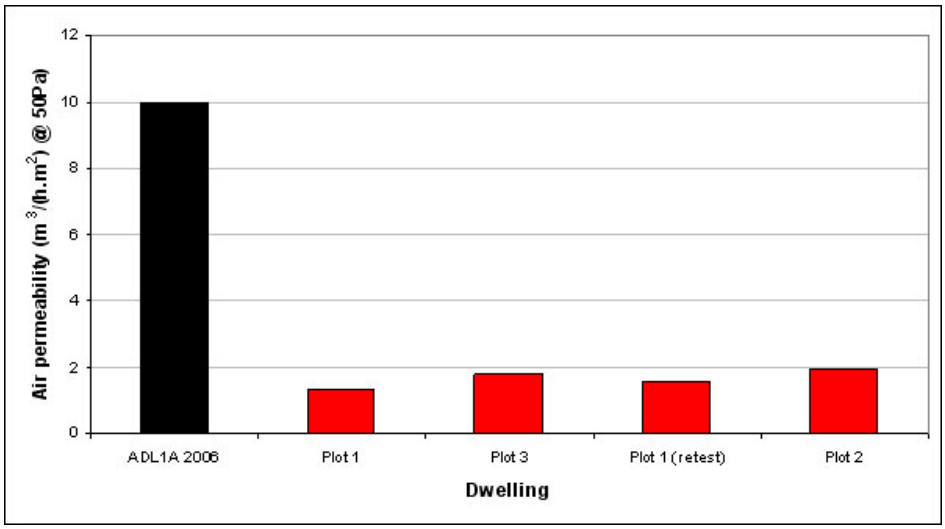
Two of the dwellings (Plots 1 and 3) were tested in March 2008 once the primary air barrier was complete, but prior to the installation of the floor insulation and floating floor. These tests were undertaken as part of a quality control check, to identify whether there were any significant areas of air leakage through the primary air barrier.

The original intention was to retest Plots 1 and 3 once the dwellings were complete. Unfortunately, it was only possible to retest Plot 1 in June 2008 (Plot 3 was not in a complete enough state to retest during the visit), so an additional mid-terraced dwelling (Plot 2) was

also tested. The results for pressurisation, depressurisation and the overall mean air permeability are detailed in the table and figure below.

Dwelling	Pressurisation Test		Depressurisation Test		Mean Air Permeability ($m^3/(h.m^2)$ @ 50Pa)
	Permeability (m3/(h.m2) @ 50Pa)	r^2 coefficient of determination	Permeability ($m^3/(h.m^2)$ @ 50Pa)	r^2 coefficient of determination	
Plot 1 (end terrace)	1.29	0.996	1.36	0.995	1.32
Plot 3 (mid terrace)	1.69	1.000	1.94	0.999	1.82
Plot 1 retest (end terrace)	1.63	0.996	1.53	0.994	1.58
Plot 2 (mid terrace)	1.94	1.000	1.93	0.994	1.94

Air permeability results



Air permeability of the tested dwellings

The calculated mean air permeability for the dwellings that were tested after the installation of the primary air barrier (Plots 1 and 3) was 1.32 and 1.82 $m^3/(h.m^2)$ @ 50 Pa respectively, indicating that the dwellings are extremely airtight by UK standards. These results were achieved despite that fact that these dwellings were far from being complete. Nevertheless, the figures do lie just outside the air permeability target of 1 $m^3/(h.m^2)$ @ 50 Pa. However, the air permeability results for both dwellings are significantly lower than Part L1A 2006 Building Regulations requirement of 10 $m^3/(h.m^2)$ @ 50 Pa.

The main air leakage points within Plots 1 and 3 were identified using a handheld smoke puffer and were as follows:
• At the external wall junction with the ground floor and sub floor walls.
• Around the window and door seals.

These leakage points can be viewed on the following tour by clicking on the image below.

Air barrier complete

The calculated mean air permeability for the dwellings that were tested once complete (Plots 1 and 2) was 1.58 and 1.94 $m^3/(h.m^2)$ @ 50 Pa. Although the figures obtained for these dwellings also lie just outside the air permeability target of 1 $m^3/(h.m^2)$ @ 50 Pa, they do indicate that these dwellings are still extremely tight by UK standards. Interestingly, the air permeability of Plot 1 has increased slightly by 0.5 $m^3/(h.m^2)$ @ 50 Pa. This increase is mainly felt to be attributable to additional leakage through the solar heat exchange unit, which was not installed when this dwelling was first tested in March 2008. Despite this, the air permeability results for both dwellings is still significantly lower than Part L1A 2006 Building Regulations requirement of 10 $m^3/(h.m^2)$ @ 50 Pa.

The main air leakage points identified within the tested dwellings were as follows:
• Around the window and door seals. A significant proportion of this leakage occurred at the corners of opening casements of the windows where the seal had merely been bent round the corner rather than being mitred. It is possible that this area of air leakage

could have been reduced if windows with mitred seals had been specified.
• Through the solar heat exchanger unit in the loft.

These air leakage points can be viewed by clicking on the image below.

Pressure testing

REFERENCES

CONSTRUCTIVE INDIVIDUALS (2008) Homepage. [Internet]. Available from: <http://www.constructiveindividuals.co.uk> [Accessed 15th July 2008].