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We're into month three of turning a leaky Edwardian house into a model of energy efficiency. Robert Prewett, the project architect, reports on the specification and installation of the front and rear windows

Making period homes highly energy efficient is one of the most challenging jobs facing the industry. Robert Prewett, partner at Prewett Bizley Architects, has taken on the task of refurbishing a terraced home in Balham, south-east London, to near Passivhaus standards. This means a leaky, 100-year-old, three-bedroom, solid-walled property will be heated with a single towel rail. To achieve this, the house has to be highly insulated and airtight: the team has a target of 1.0m3/hr/m2, which is 10 times better than the Building Regulations demand. Prewett is posting a fortnightly diary on progress at www.building.co.uk. What follows are excerpts from the third month on site.

Airtightness testing

When we left it last month, the house on 64 Midmoor Road had just undergone its second airtightness test. On the first attempt, we posted a respectable two air changes an hour - good for a conventional new build let alone a refurbishment project, but twice our target.

After the first attempt we took advantage of the fan that Paul Jennings of Air Leakage Detailing & Awareness Services left behind to identify leaks. It allowed the team to survey every inch of the house using fingertips to locate the slightest leak. Most of these were of the types we identified during test one - screw holes, damaged plywood, damaged taping and the like.

When we conducted the second test all the window openings were once again taped up, albeit fairly crudely. The good news is that we have finally made it to one air change per hour at 50Pa. We actually achieved 0.8 and are reasonably confident we can hold it at this figure, if not better. While this is still above the 0.6 for full Passivhaus compliance, it is good enough to satisfy EnerPHit, the Passivhaus standard for refurbishments that we hope will be ratified in the near future.

With the arrival of the windows, the building envelope is nearly complete. The windows have been made as replica timber sliding sashes, returning the front elevation to its original arrangement - an approach that contrasts with many of the neighbours, who have gone for PVCu versions.

The new sashes have a good overall U-value of 2W/m2K, mainly thanks to the double-glazed units that have a centre pane U-value of 1.5W/m2K despite their slim (12mm thick) construction. Crucially they have been carefully detailed to be virtually airtight when closed thanks to

compression gaskets at the top and bottom, and seals along the sliding edge. K&D Joinery, which manufactured the windows, worked with us in the design development for these details.

The windows were tested for airtightness when we conducted the site test last month. By covering each window with polythene, we were able to isolate the windows during the test and determine the airtightness for the building alone. Then by cutting the polythene and taking new readings, we were able to determine the leakage rate of the windows. This indicated a problem with the meeting rails and K&D replaced the brush seals with slightly thicker ones. On the second airtightness test, we were able to conclude that the windows were almost completely airtight.

Now, some of you may be wondering why we didn't pursue a lower U-value for these windows. Ideally, we would have done but we wanted to enhance the handsome front elevation and gain some favour with the planning authority to offset the more extreme work that we were proposing to the rear of the property.

The house is also situated within 100m of a conservation area, where double-glazed sashes are a bit of a no-no. We wanted to demonstrate that a high level of performance can be combined with the fine detailing similar to the original windows. If our project could convince the local conservationists, that would be a positive outcome at a local level.

Stricter approach to the rear
At the rear of the house, we have taken a much stricter approach to U-values. Here we have combined 280mm of expanded polystyrene external insulation with triple-glazed timber windows. This was especially important as the wall area and number of windows was much greater.

There are a number of triple-glazed window systems available in the UK. Our choice was based on a performance-to-cost rating and we chose the Eco-Passive range supplied by the Green Building Store.

The glazing units have a U-value of 0.6W/m2K, combined with low conductivity glazing bars and thermally broken frames, giving an overall U-value of 0.8-0.9W/m2K, which is much more in keeping with the Passivhaus norm.

The windows open inward, European-style, and use a tilt/turn mechanism that allows them to operate as a conventional hinged casement or be tilted inwards from their tops for night ventilation. The choice to go with inward-opening windows was partly driven by the options available from this manufacturer and partly by the superior thermal bridge detailing at the edge permitted by the inward-opening system.

The windows have been installed within plywood box linings fitted within the structural openings. This method has the following advantages:

- By fitting the plywood boxes first we were able to take accurate dimensions for the real window sizes

- From a sequencing point of view we were able to create the aperture within the room and therefore complete lining works to each room, but delay window installation and potential damage
- The inside edges of the boxes were taped into the plasterwork or on to the internal airtightness layer, extending our airtightness barrier to where the window will be fitted
- The plywood linings have allowed us to site the window just outside the original face of the wall in the same plane as the insulation, slightly reducing the thermal bridge at the window edge.

In line with Passivhaus detailing, we have also lapped the external insulation over the window frame to reduce thermal bridging further. We have also splayed this reveal to maximise daylight and sightlines. The insulation should be installed in the next couple of weeks.