LANCASTER WEST'S FIRST LOW-ENERGY HOME

VERITY CLOSE RETROFIT JOURNEY

ECD ARCHITECTS

LANCASTER WEST NEIGHBOURHOOD TEAM

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“We’re delighted to have refurbished a 3-bedroom home into Kensington and Chelsea’s first low energy council house. It is the first property on the estate to benefit from triple glazing, its own an air source heat pump, and mechanical ventilation with heat recovery.”

“This shows that it is possible to transform existing council homes into low-carbon high-quality places to live. We will use the learning from the project to benefit the wider estate, as we deliver our vision of making Lancaster West carbon neutral by 2030”

JAMES CASPELL
Neighbourhood Director, Lancaster West Neighbourhood Team


LANCASTER
ROAD, W.11.

INTRODUCTION

The Lancaster West Estate is in North Kensington, just south of the Westway.

Its buildings range from 1930s mansion blocks, through mid-rise 1960s flats, to the houses and flats of Verity Close completed in 1979.

The estate is to be retrofitted to become a model 21st Century, zero carbon estate. One of the houses in Verity Close was chosen as a pilot project, to help the council and residents understand methods to reduce energy and carbon use.

It is a 3 bedroom end of terrace, cavity wall property, with some existing cavity wall insulation.

Original windows had previously been replaced with double glazed units, and there was some existing loft insulation. However a solid uninsulated concrete floor, original vent openings in walls, poor window installation and the lack of a continuous line of insulation meant that the house was not very energy efficient.

It was heated by a gas boiler and energy modelling suggested that heating bills would have been around £1,436 per year.

Figure 1 - Completed new kitchen

Figure 2 - Post-retrofit, with new windows & photovoltaic panels

HISTORY

The site on which Verity Close now stands was, in the early 20th century, close to a meeting of several roads known as the Lancaster Circus.

Where today Lancaster Road becomes Silchester Road, curving past the new Kensington Aldridge Academy, formerly, these two roads met Walmer Road and Clarendon Road. This is illustrated on the adjacent map from 1935.

The circus stood close to several public houses and the former Kensington Public Baths. These baths were demolished in the late 1970s, along with a significant number of proximate streets. In 1978 works began to construct Verity Close on land cleared by demolition works.

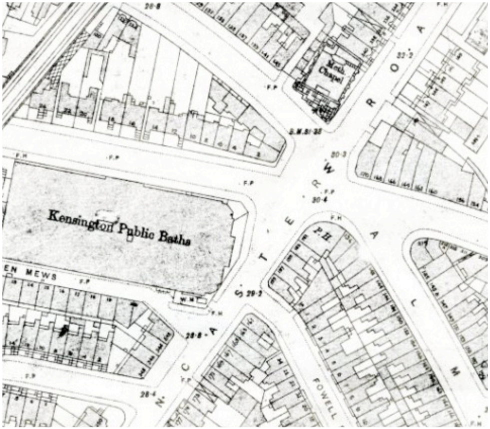

Figure 3 - A map of the area from 1935

Figure 4 - Notting Hill Methodist Church, pictured in the 1960s

Figure 5 - The Lancaster Pub, on the Lancaster Circus, pictured in the 1960s

DRIVERS FOR RETROFIT

Lancaster West Neighbourhood team (LWNT) understand that in order for the UK to meet its carbon reduction targets most existing buildings need to be deeply retrofitted and move away from the use of gas. They also understand that this deep retrofit will make homes more comfortable and cheaper to heat.

This unoccupied home was chosen as a place to try out methods of retrofit, to allow LWNT to learn lessons before retrofitting the estate more widely.

Works to the wider estate will be co-designed with residents, so having a completed retrofit to demonstrate effectiveness, technologies and comfort is a powerful tool to enhance everyone's understanding of the process and its benefits.

Grenfell Tower forms part of the Lancaster West Estate, so the use of non-combustible materials was a key driver in material choice, and in this instance meant avoiding the use of external insulation. The removal of gas from the property was also a key part of the brief.

Figure 6 - Kitchen before works

Figure 7 - The home at Verity Close prior to retrofit

FEASIBILITY STUDY

A good understanding of the existing building's construction, performance and problems are essential before the start of any retrofit.

LWNT appointed ECD Architects and Greengauge Building Energy Consultants to carry out a feasibility study, examining the building and evaluating possible options.

This sets out how the existing building was losing heat and a range of methods for reducing heat loss. Each of these was explained in terms of spatial implications, pros and cons and energy bill reduction.

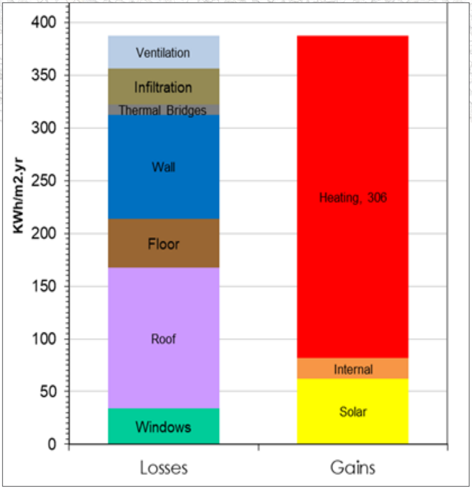

Figure 8 - Heat losses & gains prior to retrofit

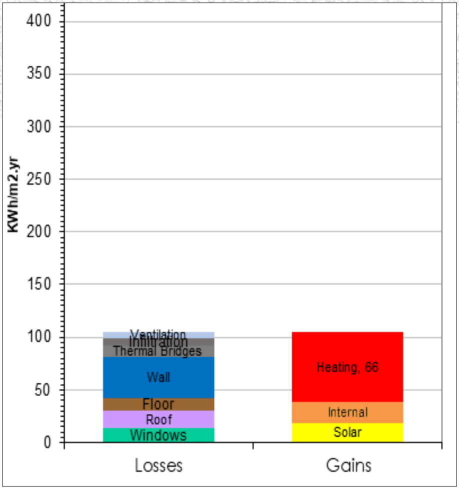

Figure 9 - Predicted heat losses & gains after retrofit

This allowed LWNT to make choices with a good understanding of the impacts of each item, while ensuring that whole house fabric improvements were prioritised, with renewable technologies implemented to support this.

This showed that space heating demand could be reduced from around 300 $kWh/m^2/year$ to 66 $kWh/m^2/year$.

Full building airtightness Design & install airtight layer around inside of house's insulation. Aiming for less than 1.5 air changes per hour		Warmed air is lost through gaps in existing building fabric, especially at window/door junctions & services penetrations	Dependent on insulation strategies adopted, but to include: Airtightness tapes around windows, doors & joist ends, grommets at service penetrations, Wet plaster to internal wall Airtight membrane in roof	Mec w (M M Ven requ ach

Figure 10 - Building Airtightness - example pros, cons & costs

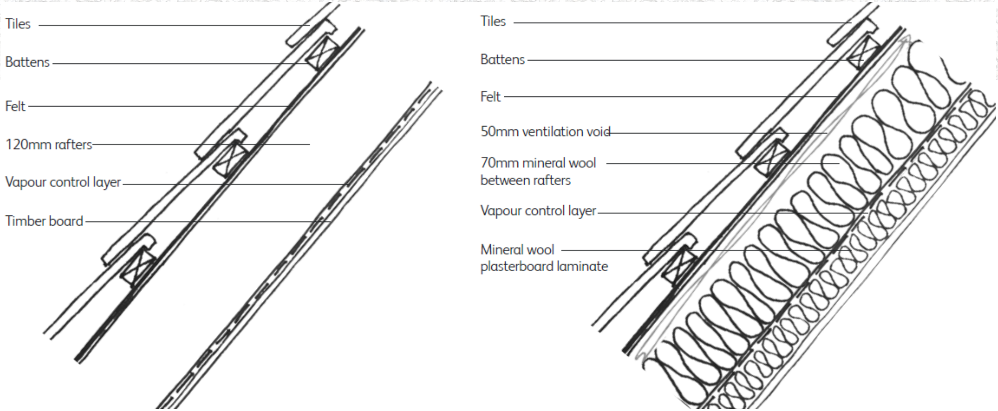

Figure 11 - Preliminary sketch sections through existing & proposed roof build up

hanical ventilation ith heat recovery MVHR) or at least echanical Extract tilation (MEV) also uired if airtightness ieved. See section below	- Excellent reduction in heat loss - Excellent improvement in resident comfort - No draughts so more comfortable even at lower temperatures	- Must be combined with MVHR or MEV to avoid mould risk - Must be completely & carefully implemented to be effective	Specific energy demand reduction (kWh/m²/year) 24 Total energy demand reduction - (kWh/year) 2112 Annual cost saving £113

WHOLE HOUSE RETROFIT

Every element of the building needed to be improved to achieve a significant reduction in energy use and to avoid the risk of cold spots

It was important that the home's heating demand was reduced enough that it could be heated without the use of gas, but that bills would still be reduced. As gas is cheaper than electricity this required a really significant reduction in heat loss through the building's fabric.

Key to achieving this reduction in heating demand was creating a continuous line of insulation and of airtightness. The existing house's construction made this challenging in some areas, as did the need to insulate walls internally. Ecological Building Systems advised ECD on appropriate non-combustible, breathable insulation systems and airtightness products. Together with triple glazed windows, doors and rooflights these achieved the most continuous line of insulation and airtightness possible.

Figure 12 - The home as roof works were completed

INSULATION & AIRTIGHTNESS

Heat loss needed to be reduced by adding insulation to the walls, floor & roof. But also by stopping warm air leaking out of the house through gaps & cracks.

The existing concrete slab ground floor was covered with a thin layer of Aerogel insulation, bonded to a non-combustible board. The need to avoid changing the floor level too much meant that reduction in the floor's heat loss was limited, but this high performance insulation allowed the project team to ensure that the floor won't feel cold.

External walls were covered in Diathonite plaster. This is a breathable, airtight, insulating plaster made of lime, cork, clay and reinforcing fibres.

A thick layer to the inside of external walls, as well as a thinner covering to the party walls reduced heat loss through the walls by more than half. This was applied between floor joists to ensuring a continuous covering, reducing the possibility of cold spots and gaps in the building's airtightness.

Before this was applied airtightness 'paint' was used to cover the junction of joists and walls, as these could otherwise have been a weak spot in the airtightness line.

Energy reduction:
17864 kWh/year
Annual cost saving:
£953

Figure 13 - During works to the roof

Figure 14 - Walls with internal insulation freshly applied

LWNT wanted to replace the roof covering to ensure longevity, and together with the poor quality of the existing roof structure, this led to the decision to replace the roof almost entirely. The new roof is insulated with mineral wool and has an airtightness membrane to the inside of this, taped and sealed to the airtight plaster on the walls.

Figure 15 - Mineral wool insulation to go in the roof

TRIPLE GLAZED WINDOWS

Windows are a crucial feature of a home, but can lose a lot of heat from a building

Figure 16 - New windows being delivered to site

The existing windows were double glazed, but had been poorly installed, with visible gaps when opening panes where supposedly closed. This led to warmed air escaping from the home both at the junction of the window with the wall and around the opening panes of the windows.

The existing window frames were not very insulating, so heat was also lost by conduction through these. This all led to draughts and cold spots around windows.

Figure 17 - New windows, designed to open similarly to existing windows

Energy reduction: **1320 kWh/year**

Annual cost saving: **£70**

Figure 18 - Window frames are airtight and better insulated but still appear relatively 'light' externally

Triple glazed windows with airtight seals have been used throughout, and are designed to replicate the appearance of the existing windows, with openings in the same locations and similarly narrow frames. The wall insulation has been sealed to airtightness tape around the window frame, ensuring air no longer escapes at this junction.

DELIVERING FRESH AIR

Previously the air in the house was heated by radiators, keeping the residents warm. However, much of this heated air then escaped through gaps in construction. Cold air got in through the gaps and then this needed to be heated up too, wasting energy. Having this new line of airtightness around the building means that the heat energy that is put into the building stays in the building.

Having made the home airtight, residents still need fresh air. A Mechanical Ventilation with Heat Recovery (MVHR) unit brings in fresh air and pre-warms this with the heat from outgoing air. This fresh, warmed air is then distributed to living areas, while stale air is extracted from the kitchen and bathrooms. Windows can still be opened, but the building will still work even if windows are kept shut.

Figure 19 - Air supply fitting in ceiling

Energy reduction:

4136 kWh/year

Annual cost saving:

£221

Figure 20 - Fire-rated ductwork, prior to boxing-in

Figure 21 - MVHR unit in roof space

The mechanical ventilation with heat recovery unit has been installed in the attic space, with a pull down ladder into the attic allowing occasional access for filters to be changed. Fire rated ductwork carries the air around the home, and it comes out through supply terminals in the ceilings.

Filters within the units mean that the air is cleaned before being supplied to the home. In central London this makes a real improvement to the quality of air that residents are breathing in.

HEATING THE HOME

Without a gas fired boiler, an alternative way of heating water for hot water and heating was needed. As this was to be powered by electricity, it needed to be very efficient to avoid energy bills being high.

There is heat energy in cold, outdoor air. An Air Source Heat Pump (ASHP) takes this small amount of heat energy from lots of air and concentrates it, and transfers the energy to water, heating it up. This hot water is then used to heat your home and provide you with hot water from the taps. For every unit of electrical energy that goes into the heat pump, about 3 units of energy go into heating the water in the home.

The main ASHP unit sits in the garden and refrigerant carries the heat energy to the inside of the home where it warms the water. This water is then used as hot water in the home for showers, baths, washing up etc, as well as being distributed to the radiators in the usual way.

A hot water tank in a ground floor cupboard ensures that there is a sufficient supply of hot water for the residents to use.

Figure 23 - Hot water tank & pipework in under-stairs cupboard

Figure 22 - Air source heat pump external unit

ENERGY FROM THE SUN

Photovoltaic panels have been installed on the roof of the building to collect energy from sunlight and turn it into electrical energy for use in the home.

A small battery stores some of this so that it can be used when needed, and if necessary it can help to heat the hot water in the tank.

This free supply of electricity helps to reduce the residents' energy bills further, and this electricity does not create carbon emissions as it is made.

Not burning gas in a boiler in the house makes it safer, and also improves air quality. It also means the building can get closer to the goal of producing zero carbon emissions in its use.

As the electricity grid nationally becomes more reliant on renewable energy sources, the carbon emissions of the electricity input that the house does still require will go down and down.

The overall strategy for the house therefore relies on two key points – a huge reduction in energy demand for heating, and the change to really efficient, electrically powered heating.

Figure 24 - Photovoltaic panels to the east side of the roof

Figure 25 - ...and to the west side of the roof

NEW GARDEN & OTHER IMPROVEMENTS

To complete the change to a more sustainable home, the garden has been revamped, with planters encouraging residents to nurture plants, adding to an overall sense of wellbeing. A compost bin has been included, as has a rainwater butt. Both of these will support the growing of plants without using mains water or fertilizing products.

A washing line has been included to encourage clothes to be dried without resorting to the use of a tumble drier, which uses a lot of energy. Electric car charging is also catered for with a car charging point next to the parking space.

Figure 26 - Rear garden with washing line & planters

Figure 28 - Electric car charging point

Figure 27 - Planting to promote health & wellbeing

DESIGN AND CONSTRUCTION TEAM

Lancaster West Neighbourhood Team were a really dedicated client, committed to reducing the home's carbon emissions and bills, and were open to new ideas of how to achieve this.

ECD Architects worked with Greengauge Building Energy Consultants to evaluate the existing building and propose solutions. They then developed the architectural and services outline specification and drawings. Input from Ecological Building Systems was invaluable in developing the architectural specification and understanding some of the specialist products involved.

LWNT used one of their usual voids contractors to carry out the works. Many of the products were new to the contractor so ECD carried out a 'toolbox' talk on site, conveying the importance of airtightness and practicing using the paint, tapes and membranes needed to achieve this. Specialist installers were used to apply the wall insulation and install the MVHR and its ductwork.

LWNT oversaw the works on site, with regular site visits, photographing the work as it progressed. The majority of the works were carried out under Covid-19 restrictions, so the successful completion of the works is even more impressive.

Figure 29 - Practicing airtightness taping on a small scale

Figure 30 - Window & door installed with airtightness tape sealing them to the walls

WHOLE LIFE CARBON STUDY

ECD carried out a study of the home's whole life carbon.

Before it was even first occupied in 1979, a lot of energy had been used in its construction and the bricks and concrete and other materials that went into it. This translates to a lot of 'embodied' carbon before the first residents even moved in.

The heating and other energy use in the building meant that further energy was used and carbon emitted each year through the building's operation.

As small improvements were made to the building this 'operational' energy use went down slightly, but each improvement also added to the embodied carbon, as new materials were used, each of which to energy to produce.

The retrofit has further added to the home's embodied carbon, as a lot of new materials have been added into the house, and some old ones disposed of. It has also led to a huge reduction in the home's carbon emissions in operation, so overall it will reduce the home's whole life carbon emissions over the rest of its life.

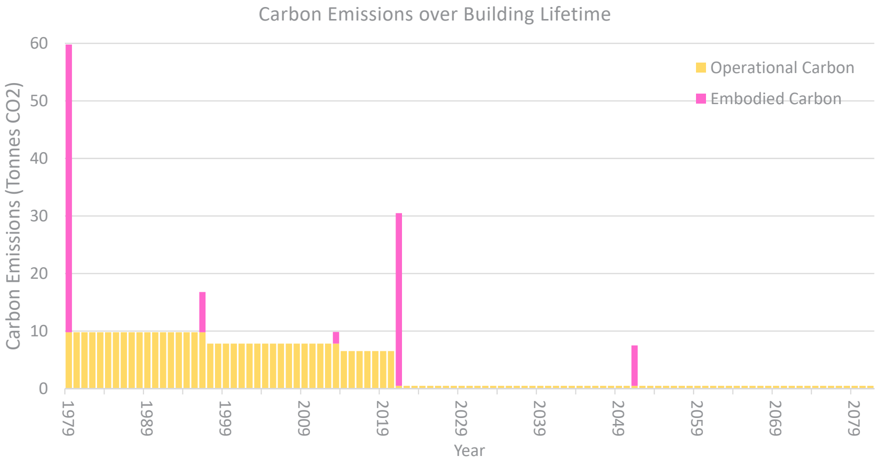

Figure 31 - Carbon emissions over the building's lifetime, from start on site to 60 years post-retrofit

LESSONS LEARNED

One of the motivations for creating an eco-home at Verity Close was to learn some lessons ahead of retrofitting the rest of the estate.

Key lessons learnt are:

- Ensure a full understanding of the building before starting work
- Create a plan for the whole house before starting work
- Close oversight of works is crucial to ensure that details that will later be hidden are built properly. This is particularly important where airtightness is concerned.
- Using non-combustible products limits the available systems, potentially adding cost.
- Internal wall insulation can be very invasive – while acceptable in a vacant property this won't be the right solution everywhere.
- Non-combustible ductwork is larger and less flexible than other ductwork, so it takes up more space and may be slower to install.
- A deep retrofit will take longer than a standard refurbishment, and using products that are new to the team may take even longer.

Figure 33 - Internal insulation can be messy & take up space

Figure 34 - Insulation creates a thicker wall

Figure 32 - Completed first floor bedroom

ESTATE-WIDE RETROFIT

LWNT have employed several design teams to help them to retrofit the many buildings across the estate so that the estate as a whole is an exemplar of 21st Century living and is zero carbon in operations. These design teams are working with the residents to co-design practical solutions that achieve these goals.

Carrying out so many works at once, on homes of different tenures, with residents with varied needs is an enormous challenge.

Having a proven example of what is possible, together with the learnings from this project is an important part of ensuring that this challenge is met, and residents across the estate have healthy, comfortable, affordable and low-carbon homes.


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Figure 35 - Images of the newly refurbished home

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