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sustainability statement

introduction

bere:architect's

Founded by Justin Bere in 1994, bere:architects are widely recognised to be one of the UK's leading Passive House architects. The practice carries out PHPP analysis, thermal bridging analysis, fabric moisture analysis, building performance analysis and overall architectural design and project management. At the same time, we remain thoroughly design-led architects, using Passive House techniques to deliver healthy, comfortable buildings that perform efficiently and look beautiful.

From the beginning, the practice has advocated the principles of sustainable development, applying strict ecological, environmental, and sociological criteria to the projects that we undertake – including: the use of low impact sustainable materials, extremely high energy efficiency standards, and protection and enhancement of habitats.

environmental principles + objectives

The project has been designed using fabric-first Passive House techniques and aims to achieve Passive House certification. Energy efficiency and conservation are key to the Passive House approach to sustainability. The new home at 6 Camden Mews will have very high levels of insulation and airtightness combined with both natural ventilation and mechanical heat recovery ventilation to conserve energy and reduce the need for additional heating, while maintaining comfortable temperatures and high indoor air quality all year round.

The project also aims to install and test the additional performance benefits of insulated window shutters to further reduce energy use.

While creating a beautiful and unique home, the project has been design from the start to try and use straightforward construction materials and techniques currently available and/or in use in the UK construction industry. This is to help the project to demonstrate how the industry *can* be producing this kind of very low energy building *now*.

Passive House

The term 'Passive House' refers to an advanced low energy construction standard for buildings providing excellent health and comfort - both cool in summer and warm in winter - with minimal heating or cooling requirements.

Passive House buildings provide - for less than 10% of the energy consumption of a conventional building - a plentiful supply of fresh air, a stable internal temperature, low C02 levels, no drafts or condensation, and perfect air humidity for healthy conditions all year round. To achieve this, Passive House buildings use a combination of thermal bridge free super-insulation, draft-free construction, solar shading, natural and high-efficiency mechanical ventilation, and renewable energy systems.

This strategy is so effective, that Passive Houses can result in up to 90% annual cost savings to the occupier, on energy bills, compared to ordinary buildings. Furthermore, the very high standard of construction needed to build a certified Passive House means that common building faults are avoided, resulting in less maintenance.

Thermal insulation	Superior windows	Heat Recovery Ventilation	Airtightness	Thermal bridge free
All opaque elements of the exterior building envelope must be very well insulated. For most cool-temperate climates, this means a heat transfer coefficient **(U-value) of ≤ 0.15 W/ (m²K)**. Insulation must be installed carefully to avoid gaps and to be protected from moisture.	All exterior glazing must be high performance and airtight. For most cool-temperate climates this means **low-e triple glazing** filled with argon or krypton and **insulated frames** with a **U-value of ≤ 0.80 W/ (m²K)**. A light transmittance **(g-value) ≥ 50%** enables **good interior daylighting and solar gains**.	**Natural ventilation from openable windows**, coupled with an efficient MVHR (**mechanical ventilation system with heat recovery**), allowing for excellent indoor air quality and saving energy. The MVHR **recovers ≥ 75% of the heat from the exhaust air**, transferring it to the incoming fresh air. Continuously supplied fresh air, and filters on the ventilation system result in a very healthy interior environment.	Uncontrolled leakage of air through gaps in the exterior envelope have a significant effect on energy performance and so must be minimised. A **continuous airtightness barrier** (often a smart membrane) is carefully installed to prevent air leakage. The actual airtightness of the building is measured after completion.	All edges, corners, connections and penetrations must be planned and executed with great care, so that **thermal bridges are designed out** / avoided. Thermal bridges which cannot be avoided must be minimised as far as possible. And included in the energy model.

design overview

The newbuild three storey house is on an urban infill site on Camden Mews. The design fits in with the character of the historic mews, preserving the existing London stock brick front wall to the site with its existing gateway as the entrance to the property. The use of an open rather than gate provides views through the property to the back of the main house, maintaining this connection from Camden Mews to Camden Square. To the street, the ground and first floors are clad in vertical timber fins, creating privacy and a quiet, minimal yet tactile street frontage. The second floor is set back from the street hiding it from view from street level.

technical overview

The building is supported by a concrete frame. The concrete floor slabs are left exposed on the ceilings for thermal mass. The concrete columns are hidden within the walls. The frame is wrapped externally with a 270mm of mineral wool insulation, and wrapped internally with an airtightness membrane and 100mm of woodfibre insulation (forming a service cavity). The roofs are all insulated with high-performance PIR insulation and waterproofed with a multi-layer bituminous waterproofing system. Under the ground floor slab there is 400mm of XPS insulation.

All windows and doors are high-performance, airtight, and triple glazed.

The performance of all the building elements far exceed current building regulations in terms of both insulation U-values and airtightness. The walls achieve a U-Values of 0.091 - 0.145 W/m^{2}K. The roof achieves a U-Value of 0.138 - 0.093 W/m^{2}K. The ground-bearing floor construction achieves a U-Value of 0.11 W/m^{2}k. The tilt-and-turn Passive House certified windows have a Ug-Value of 0.6 W/m2k and achieve a Uw-Value of 0.8 W/m2k.

The building systems consist of a high efficiency air source heat pump and mechanical ventilation unit with heat recovery. Ductwork to the outdoors and all hot water supply pipework is very well insulated.

Through all phases of the design process, the building has been assessed using PHPP (Passivhaus Planning Package) energy modelling software. The design-stage PHPP energy model shows that the design meets the Passive House criteria. Detailed academic studies of a number of our previous buildings show that we have a track record in delivering buildings with no performance gap (ie: the finished building performs as well as or better than modelled).

energy

building envelope

The home is designed to be constructed using energy-efficient, cost-effective methods employing local skills wherever possible. The method proposed will result in thermal bridge free construction essential to Passive House buildings.

principles

Super-insulation – Super-insulated walls, floors and roofs keep winter warmth inside and summer heat out, creating an affordable, comfortable, healthy interior.

Thermal bridge free – Thermal bridging is designed out to prevent heat loss and condensation (common in conventional buildings). With care, a conventional heating system is sometimes eliminated completely.

Draught free construction – We assist contractors to rigorously apply advanced construction techniques and testing including the installation of a high-performance vapour control layer to, among other things, eliminate condensation and air leakage within the walls, which can lead to structural damage, reduced building life, and wasted money and energy.

Thermal mass – Thermal mass provides a passive energy storage within the building, making the interior environment even more stable, in particular during prolonged periods of hot weather. Combined with renewables and load-shifting, it can also optimise self-consumption by allowing the building to use excess energy from renewables on (eg on sunny or windy days) and store this in the building's thermal mass.

foundation + ground floor slab

Due to ground conditions, the building's ground floor slab is supported on piles. Due to the very low energy aspirations of the building, additional insulation has been added to the head of each pile, cost effectively reducing thermal bridging while maintaining structural continuity from pile-to-slab.

The entire underside of the ground floor slab is insulated with 400mm of XPS insulation, achieving a U-value of 0.11 W/m^2K. Insulating under the slab, rather than over it, has two advantages (1) the insulation runs, uninterrupted from under the slab to up the exterior face of the walls to meet the exterior wall insulation, and (2) the considerable thermal mass of the slab 300mm thick is kept within the thermal envelope.

structure + exterior walls

The building is supported by an in-situ reinforced concrete frame. The concrete floor slabs are left exposed on the ceilings for thermal mass. The concrete columns are hidden within the walls. The spaces between columns are infilled with very lightweight, non-structural blockwork.

The concrete frame and blockwork are continuously wrapped externally with 270mm of mineral wool insulation between timber I-joists. Internally they are wrapped with an intelligent, breathable airtightness membrane and 100mm of woodfibre insulation between horizontal timber battens (forming a service cavity). The walls achieve a U-Values of 0.091 - 0.145 W/m^2K.

The airtightness membrane has been carefully detailed, in combination with surrounding structure to provide a continuous – and easy to install and tape – line of airtightness around the whole building. The service void allows services to be run without puncturing the air barrier. It also protects the barrier from accidental damage once the building is in use.

Wood-fibre insulation is used inboard of the air barrier to maintaining the highest possible indoor air quality.

The in most locations, the walls are finished with high density gypsum wall boards. This type of board provides more thermal mass than a conventional plasterboard, helping to regulate internal temperatures.

roofs

The roofs are all insulated with high-performance PIR insulation and waterproofed with a multi-layer bituminous waterproofing system. The roof achieves a U-Value of 0.138 - 0.093 W/m^{2}K.

On the roofs of the ground and first floors the concrete slabs provide the airtight barrier. On the second floor roof, airtight OSB3 board (taped at all joints) are used to provide an airtight timber structural deck.

By putting the insulation externally to the structure, all roof parapets were able to be designed as cold-bridge free.

windows

All windows and doors are high-performance, airtight, and triple glazed. The tilt-and-turn Passive House certified windows have a Ug-Value of 0.6 W/m2k and achieve a Uw-Value of 0.8 W/m2k.

The design team has developed innovative shutters to further enhance performance. These automated, insulated, interior window shutters will close at night and during unoccupied periods in cold weather to further reduce the home's energy requirements.

building systems

ventilation

Operable windows – Generously sizes, fully openable windows in all habitable spaces provide natural ventilation during summer months. Wherever possible cross ventilation in encourage, either via windows located two or more sides of a space or via circulation spaces in single aspect spaces.

Heat recovery ventilation – Complimenting the natural ventilation, is a high-efficiency heat recovery ventilation system (MVHR) is provided for the coldest times of year – when most buildings close their windows and are often stuffy or damp, or open the windows which wastes heat. The system supplies fresh air to living rooms and bedrooms, tempered by the air exhaled from kitchens and bathrooms.

Typically, a high-quality heat recovery ventilation unit saves 10 times more energy than it uses – reclaiming 80-90% of the heat in outgoing air, while running on only 15 watts of power on supply, and 15 watts of power on extract.

Ductwork runs are kept to a minimum and supply ducts to the outside are insulated to minimise heat loss.

heating

The building has been designed, using Passive House techniques as so requires very little heating energy (less than 15kWh/sqm per year). On this project, the core Passive House techniques have been used in combination with insulated shutters on the windows, to not require any mechanical heating system at all (typically a Passive House has a very small heating device with a heat output similar to a hair dryer). The building will be heated by 'solar gains' (thermal energy from the sun entering through the windows) and 'internal gains' (thermal energy from the occupants' body heat, electronic devices, lighting, and appliances).

hot water

A high efficiency air source heat pump (ASHP) will be installed to provide hot water for the house.

lighting + electrical

High efficiency LED fixtures are used for the lighting throughout. Spaces are designed to provide a good level of daylight and a high quality of light to improve occupant comfort as well as reducing the use of electric lighting. The lighting is also designed to be simple and minimal, to help promote a lower lumens-per-capita use of lighting.

energy provision + renewable energy

A Passive House building first and foremost derives a large proportion of its energy requirements passively – from solar and internal heat gains. In addition, because the energy requirements are so small, a significant proportion can be derived from on-site renewable energy systems, like solar panels.

On this building, a significant proportion of the home's very low energy requirements will be supplied by a 27m^2 photovoltaic array on the second floor roof.

The home will be all electric, thereby avoiding the use of any fossil fuel on site and being ready for the future all-renewable national electrical grid.

appliances

All the appliances are specified as highly energy efficient (A rated of above under the EU Energy Efficiency Labelling Scheme) with the majority being A+++ or A++ models.

All appliances are electric, eliminating the need for fossil fuel use on-site.

materials

responsible sourcing

All timber and timber products is specified to be from FSC or PEFC accredited sustainable sources.

regional sourcing

Where possible we have specified UK or EU manufactured products to reduce the environmental impact associated with material transportation and help ensure we support more ethical production practices. These include: plumbing products, ventilation and heating equipment, tiles, structural timber, timber boards products, timber cladding.

embodied energy

GGBS cement has been specified for all the in-situ concrete. GGBS is 'ground granulated blast-furnace slag', a processed waste product from steel production. It can be used to replace some of the cement content in concrete, reducing the CO2, NOX, and SO2 emissions of the concrete by around 70%. As a waste material, it also reduces the embodied energy of the concrete by 40%.

As in many of our buildings, we extensively use UK and EU sourced timber as a rapidly renewable, low-embodied energy material that is also provides a natural store of CO2. On this project timber is used in structural framing elements, insulation, exterior cladding, and interior finishes.

healthy materials

In addition to healthy ventilation year-round, our buildings improve indoor air quality by using non-polluting, natural materials and finishes. Zero-VOC finishes have been specified throughout. Paints will be from Earthborn's VOC-free, organic paint range.

Timber products containing glues and resins (such as plywood and OSB) have been specified as zero-added-formaldehyde.

durability and usable life

The building has been designed to be highly durable while also allowing for straightforward adaptation to the evolving needs of users.

The concrete and blockwork frame provides a robust, long-lasting structure that is also rodent and fire resistant.

The design also incorporates a modern interpretation of a traditional dado rail and panelling arrangement. As well as the general 100mm service cavity throughout, up to dado rail level, the interior walls of most spaces are made up of demountable timber panels, allowing increase services to be easily adjusted or added without redecorating.

end of life

Wherever possible, constructions are designed to allow for decommissioning and disassembly, avoiding irreversibly glued constructions. Materials are chosen with consideration for recycling or reuse at end of life.

ecology

wood-fibre breathable exterior sheathing

Larch cladding is fitted on battens creating a ventilated facade to the upper floors. Behind the cladding, the floor are protected breathable wood-fibre board. This board is used instead of a synthetic 'breather membrane' to reduce the use of petroleum-derived products and to avoid bats from getting trapped in a membrane (bats are known to roost behind rain screen cladding and can get their claws trapped in loose membranes).

biodiversity + green roofs

Native plantings are integrated into the design, providing habitats attractive to birds, bees, and butterflies. Plants are chosen to provide flowers over the course of the year to better support biodiversity.

Where flat roofs on the building are not paved/decked terraces, plantings are incorporated. On the second floor roof, a 100-150mm thick extensive green roof will be installed, over the roofing membrane, and planted as a wild flower meadow. On the first and second floor terraces, 900mm deep planters will be installed allowing large plants to be

A mixture of shrubs, ground hugging plants, and grasses will be planted in ground floor beds around the paved areas.

biophilia

Biophilic design, in the form of natural material finishes, has been used throughout to increase occupant wellbeing.

water

storm water attenuation

Storm water is increasingly an issue as our cities become denser. The building is designed to attenuate storm water by absorbing water in green roofs, slowly discharging water from roofs using reservoir boards and small outlets, and permeable paving.

water use

All fittings in the house have been specified with very low flow restrictors. All toilets have very low flow dual flush cisterns. The result is very low overall water consumption (well beyond what is required by building regulations), including hot water, which has the knock-on benefit of reducing energy used for heating hot water.

use

summer comfort & shading

The building has been designed to minimise the risk of summer overheating (a common problem in many contemporary buildings). Sometimes dedicated exterior shading devices can be used as part of this strategy. However, this building has been designed not to require exterior shades for preventing summer overheating. This has been achieved through thermal mass, low-e glazing, effective natural ventilation, careful sizing and positioning of windows, and avoiding very large areas of glazing.

Operable windows in all habitable spaces provide natural ventilation for summer cooling.

The concrete structure, exposed on the ceilings, provides thermal mass to help maintain stable interior temperature. The secure tilt-and-turn windows can be left ajar overnight to provide purge cooling of this thermal mass, further improving summer comfort.

air quality

UK towns and cities have very high levels of air pollutants, consistently in breach of EU air quality regulations. The health problems associated with this pollution are serious, even indoors.

Passive House homes provide a significant degree of protection against these outdoor pollutants. Studies on a number of our buildings have found consistently high indoor air quality, especially in the winter months when windows are mostly closed. This is achieved through the following:

Low-level, mechanical 'hygiene ventilation' providing a healthy supply of air, year-round. Evening in the winter when building occupants don't want to use natural ventilation.

High-quality filters on the mechanical ventilation intake ducts prevent insects, pollutants, allergens, and other fine particulates entering the building or the ventilation system. The ventilation system also reduces dust. There are filters on the exhaust air ducts to capture dust and keep it out of the ventilation system.

MVHR unit is designed to be assessed easily to encourage regular filter cleaning/changing.

clothes drying

The garden provides a private, external recreation space which can be used for clothes drying. When clothes do need to be dried inside, the warm and stable interior environment means drying is fast. This reduces the need for tumble dryer use and its associated energy consumption.

recycling + waste

Amble, exterior bin storage will be provided for recycling, compost, and general/landfill waste. Spacious, segregated, internal waste bins will be provided in the kitchen to encourage building users to better sort waste and recycle.

secure bike storage

Secure and covered bike storage loops will be provided for bikes within the entrance passageway.

maintenance access

We have found that ease of access and maintenance is key to helping ensure that building systems are properly maintained. As such, the heat recovery ventilation system is located in the ground floor cloakroom for ease of maintenance and filter replacement. The air source heat pump is located on the ground floor for.

accessibility

Accessibility is important to design for not and/or in the future with minimal interventions required.

The ground floor had been designed as a standalone accessible studio flat.

The route from the street to the front door is all smooth/level and at least 900mm wide to allow for wheel chair access. The floors within the building are level and the threshold between the building and front path are level, providing level access into the house.

All light switches will be positioned 1000mm - 1200mm above floor level. Door handles at 1000mm above floor level. Sockets above 450mm from the floor level.

Stairs are designed with consideration to Life Time Homes guidance.

review

commissioning

The building and its systems will be carefully commissioned both at completion of construction and re-inspected and re-tuned one year one after completion. This will be combined with explaining how the building and building systems work to the occupiers to help ensure the building operates as intended.

monitoring + post occupancy evaluation

Based on best practice compiled from our previous projects, we will be carefully monitoring the building to assess its performance against our design-stage energy modelling and benchmark values for comfortable, healthy interior environments. This monitoring will be done with a set of electrical submeters and a range of sensors measuring temperature, humidity, CO2, and airborne particulates. Based on our previous low-energy projects we expect to find no performance gap (very rare in the UK construction industry) and exceptionally clean and healthy interior air.

We will also carry out post occupancy evaluation, interviewing the occupants to understand their level of satisfaction with the building and gain any insights as to what could be improved on future projects.

This process of detailed review and learning is often not done on construction project or done very weakly. However, it is critical to enable design teams to improve the performance of the buildings they deliver in the future.