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The architecture of simplicity

Cork House, Eton, Berkshire
The home of Matthew Barnett Howland and Dido Milne

A research project has created an experimental house of great style and interest. It also presents a challenge to the architectural world, as John Goodall explains

Photographs by Will Pryce

ABOUT 200 yards from the towering medieval form of Eton College Chapel, there stands a handsome early 19th-century building, Tangier Mill House. It's accessible down a narrow lane from Eton High Street and occupies a small island, defined by the mill leat, on the River Thames. The property was in need of repair when it was bought in 2010 by two architects, Matthew Barnett Howland and Dido Milne, so they began to restore it. On the back of this ostensibly conventional project, however, there quickly developed a fascinating and radical architectural experiment.

The house shares its island with an industrial building, which effectively divides the garden into two sections. Placing a new building at the juncture of the two garden spaces promised both to link them together and also to screen this structure. In 2013, therefore, the owners began to develop plans for a freestanding annexe in the mill-house garden. Being interested themselves in sustainable building, and with grown-up children concerned about the environment, they also began to think about how the building might be constructed.

It's a dogma of Modernism that form follows function, so, with their colleague Oliver Wilton, they reformulated this idea and ➤

Fig 1: **The living area. There is an Arts-and-Crafts delight in materials and texture**

Fig 2 above: **The house, made of 1,268 blocks of specially cut cork, comprises five bays with pyramidal roofs.** *Fig 3 below:* **The interlocking blocks of cork look like rusticated masonry. The roof is clad in boards and the crowning rooflights deadweight the structure**

decided to design a building in which 'form follows lifecycle'. Or to put that another way: they determined not merely to create a house that could be constructed, occupied and demolished without leaving an environmental trace, but actually to express in its design the same fundamental demand.

To meet the challenge, the couple began to explore the potential of cork as a building material. Working in partnership with several institutions, including The Bartlett School of Architecture and the University of Bath, they secured part funding from both Innovate UK and the Engineering and Physical Sciences Research Council to pursue their investigation as a three-year research project. The resulting prototype structures—the Cork Casket of 2014 and Cork Cabin of 2017—still stand in the garden and serve, respectively, as a wood shed and a changing room for fair-weather swimming.

These relatively modest creations merely paved the way for Cork House, a building almost wholly constructed using blocks of expanded cork from Portugal. This single plant-based material simultaneously creates insulation, weathering and structure, functions usually served in modern buildings by distinct architectural elements.

The house was begun in the autumn of 2017 and completed in January 2019, since when it has garnered numerous awards. Beyond the technical achievement of what has been accomplished, the building is also unexpectedly satisfying, because its material simplicity speaks so perfectly to its architectural form. Simplicity, however, is always artful and such is the case here.

> 'The building's material simplicity speaks perfectly to its architectural form'

The cork oak is a native of the Mediterranean and its thick outer layer of bark is harvested about once every 10 years. It is a material long prized for its texture, easy working and lightness. These very qualities made it popular historically in the creation of architectural models, as is splendidly illustrated, for example, in the model room of the Sir John Soane's Museum, Lincoln's Inn Fields, WC2. Today, about 75% of cork is used by the wine industry. Bottle corks are made by boring through thick panels of bark, but this process leaves a large residue. In the recent past, this has been ground up and mixed with adhesives to form moulded 'composite' cork objects that serve as everything from lampshades to rocket cones.

Unlike this composite cork, the blocks of 'expanded' cork from which the house is built are made without any additives. Granulated cork is poured into a mould and heated up to 360°C. At this temperature, the natural resins within the cork are released and fuse together to form a block. As a result, the blocks have no harmful additives and could be returned directly to the environment without any treatment. The greater the density of the cork, the better it performs structurally, but the less thermally efficient it proves, so the precise

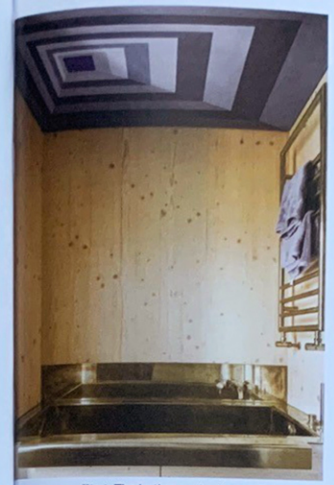

Fig 4: **The bathroom has brass fittings and a *trompe l'oeil* painting of a pyramidal roof**

make-up of these blocks is a compromise based on specific performance requirements.

The house comprises five identical bays, each one externally expressed by a stepped, pyramidal roof (***Fig 2***). This type of structure is widely paralleled in historic stone-built architecture around the world, from remote churches in Ireland to buildings in Peru. It allows for construction with a minimal of scaffolding because every course of the fabric is self-supporting as the building rises up. Crucially, it is also perfectly adapted to the qualities of cork as a building material.

In physical terms, the cork blocks are relatively strong under compression, but as with other natural materials, including timber or bamboo, a block of cork placed under sustained pressure can creep and distort over time. These are qualities that give additional challenges when considering its use in tall buildings, but make it appropriate for this low-built modular structure.

Cork is very light and the blocks have been proportioned so they can easily be lifted by one person. One disadvantage of this lightness, however, is that the building could simply blow away, so a rooflight on the top of each pyramid acts like a paperweight, holding the structures down.

Expanded cork is not strong in tension or shear, so the structure has been stiffened with an Accoya timber ringbeam connected to a number of cork and timber cross walls, which tie it together and absorb any lateral

Fig 5: **The cross walls lock the house together, with this one in the main bedroom opened out as a wardrobe. The floorboards, here and in the living room, are of American white oak**

strains. The timber cross walls have also been ingeniously opened out to serve as fixed wardrobes (***Fig 5***). The pyramidal roofs over each bay are also locked into place every few courses by Accoya ringbeams.

Lastly, cork may be worked easily. In this case, each block has been cut into shape by a robot and the whole collection of 1,268 blocks fit together like pieces in a Lego set. In the walls, the blocks are of a consistent size, but there are dozens of different shapes of block within the pyramids of each bay. Such precision also means that the whole structure has been completed without any 'wet' trades, such as lime mortar or render.

As a result, Mr Barnett Howland has—remarkably—been able to construct most of the building with his own hands in about 14 months. For the same reasons, the whole building—all structure, windows, fixtures and fittings—could be easily disassembled at the end of its life, whenever that may be.

Cork House stands on a series of steel piles that have been screwed into the ground, which could also be removed if it was ever demolished. These piles support an Accoya-timber base frame a few inches off the ground, into which the solid timber floor panels, insulated with cork underneath, have been dropped. The walls rise directly from this raised solid timber deck.

A particular problem has been water-proofing the structure. Cork, as does timber, will last for a long time, but only if it can be kept dry or has exposed surfaces that can dry out quickly. To combat rain, the inclined faces of the roof blocks have a protective cladding of western red cedar and all the rainwater goods are of copper, which blends well in colour with the cork (***Fig 3***).

The wall blocks are shaped so they discharge water outwards and to the ground, which also has the happy effect of giving the outward appearance of boldly detailed ➤

Fig 6: **The kitchen, with its built-in work surface of spruce and hardwearing brass fittings**

or rusticated masonry, and the blocks are interlocked in a way that prevents moisture being drawn inwards by capillary action.

The first—and southernmost—of the five pyramidal bays that makes up the house serves as a porch and gazebo, a covered space that connects the two parts of the garden on this awkward island site. All the rooms beyond it face north-west into the garden. The back of the house, which screens the industrial building, is almost completely blank. To lighten the interiors, the bespoke casement windows have been carefully designed to maximise the area of glass and the floorboards are made from American white oak, fixed to the substructure with exposed brass screws.

Accommodated within the second bay of the house is an entrance passage and a bathroom. The latter is compactly planned with solid brass fittings, a finish used throughout the building. Brass is hardwearing and creates reflective or patinated surfaces in keeping with the dark colour of the cork. For the benefit of those taking a bath, there is a painting executed across the ceiling of the room that imitates in *trompe l'oeil* the effect of the pyramids in the other rooms (***Fig 4***). An opening above the entrance passage gives access by ladder to a small loft bedroom above the bathroom, intimately arranged with two single beds set within the volume of one of the pyramidal roofs.

The third and fourth bays are internally integrated to create one room, a kitchen and a living area. The latter possesses a small stove, the only source of heating in the house (***Fig 1***). In summer, the skylights can be opened to regulate the temperature. Nearly all the furniture is built into the space and the kitchen is fitted with induction hobs and a brass work surface (***Fig 6***). Most of the furnishings are made from sourced spruce timber, creating an attractive contrast of colour and texture with the cork. The kitchen stools are made from storm-felled English oak, the sofa is upholstered in Harris tweed and a sliding door and flight of steps connect the room with the garden.

It would have been possible to lime plaster the interior, but that would have detracted from its simplicity and the natural tones that are a consistent theme of the house. These, in turn, have demanded that the services, including pipes and wiring, have been run beneath the floor and threaded up from it. Where that has not been possible, as with the fire sprinklers, for example, the copper piping has been made a feature of the room.

> ‘It illustrates with shocking clarity the scale of the challenge in the search for low-carbon architecture’

A bedroom occupies the final bay of the house and, in this space, the external structure of the design is perhaps most clearly realised. The view from the bed carries the eye up the steps of the pyramid to the skylight. It must, indeed, be a continuous temptation in every room of this building to sit staring upwards for long periods into the heavens. The smell of the cork, the soft acoustic it creates, as well as its yielding texture, all add to the sense of calm and repose.

Cork House is a remarkable experiment and, hopefully, there will be innovators who develop its ideas further. It is not, however, the stuff of commercial or industrial development, nor was it ever meant to be so. That said, it illustrates with shocking clarity the scale of the challenge that confronts the architectural profession in its search for low-carbon architecture.

For all the care that has been taken with Cork House, the embodied carbon emissions are only just below the levels proposed by the Royal Institute of British Architects as its future industry standard in 2030. Where, then, does that leave mainstream commercial development, in particular high-rise construction? Creating vast edifices of glass, steel and concrete consumes immense resources. Either the proposed standards are an absurdity that the profession has no serious intention of meeting or there are some very stark choices in store.