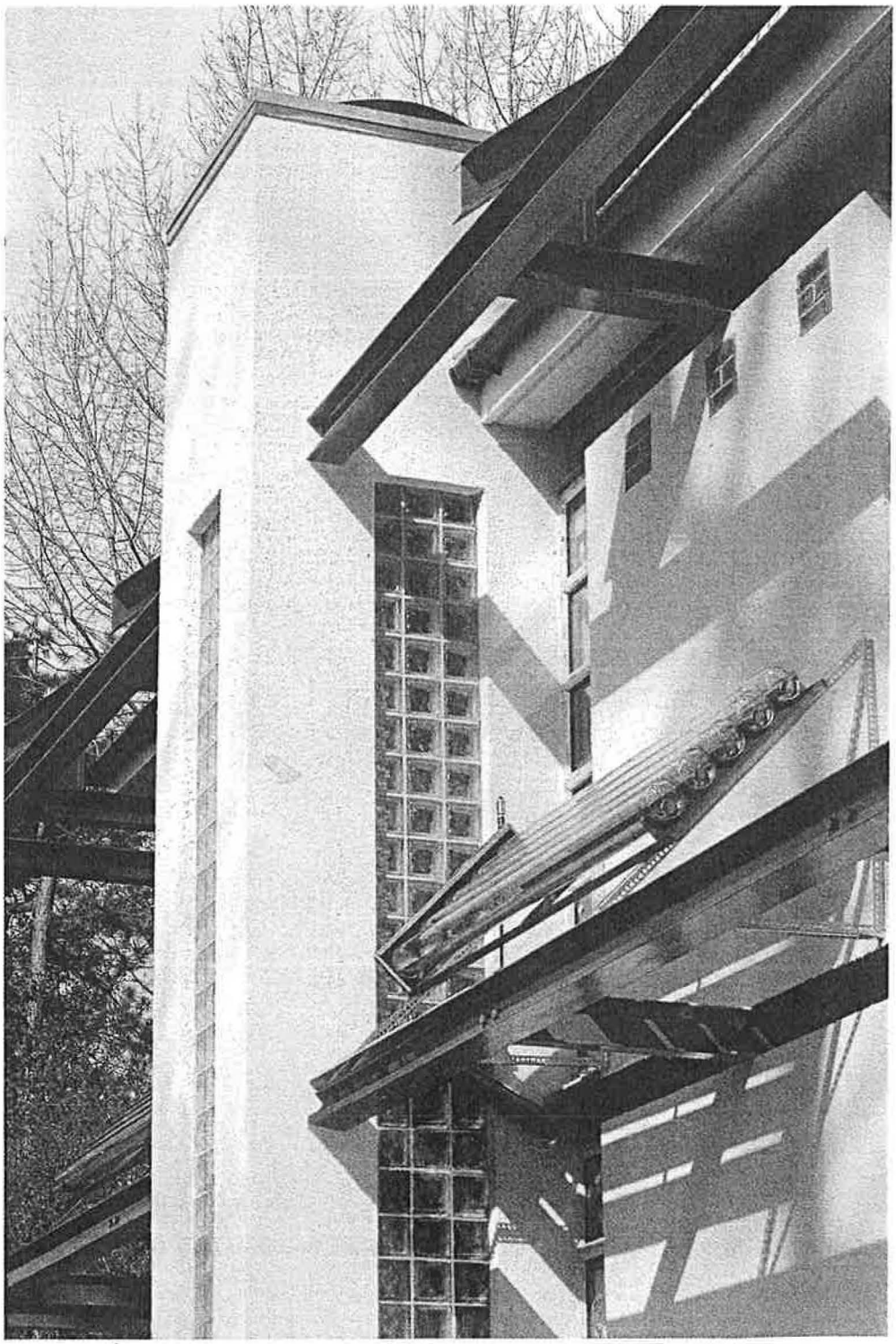
Housing benefits

There are a number of one-off examples of sustainable, energy efficient houses but how do you make them mainstream? This archetypal house may be the beginning.

BY STEPHEN KENNETT



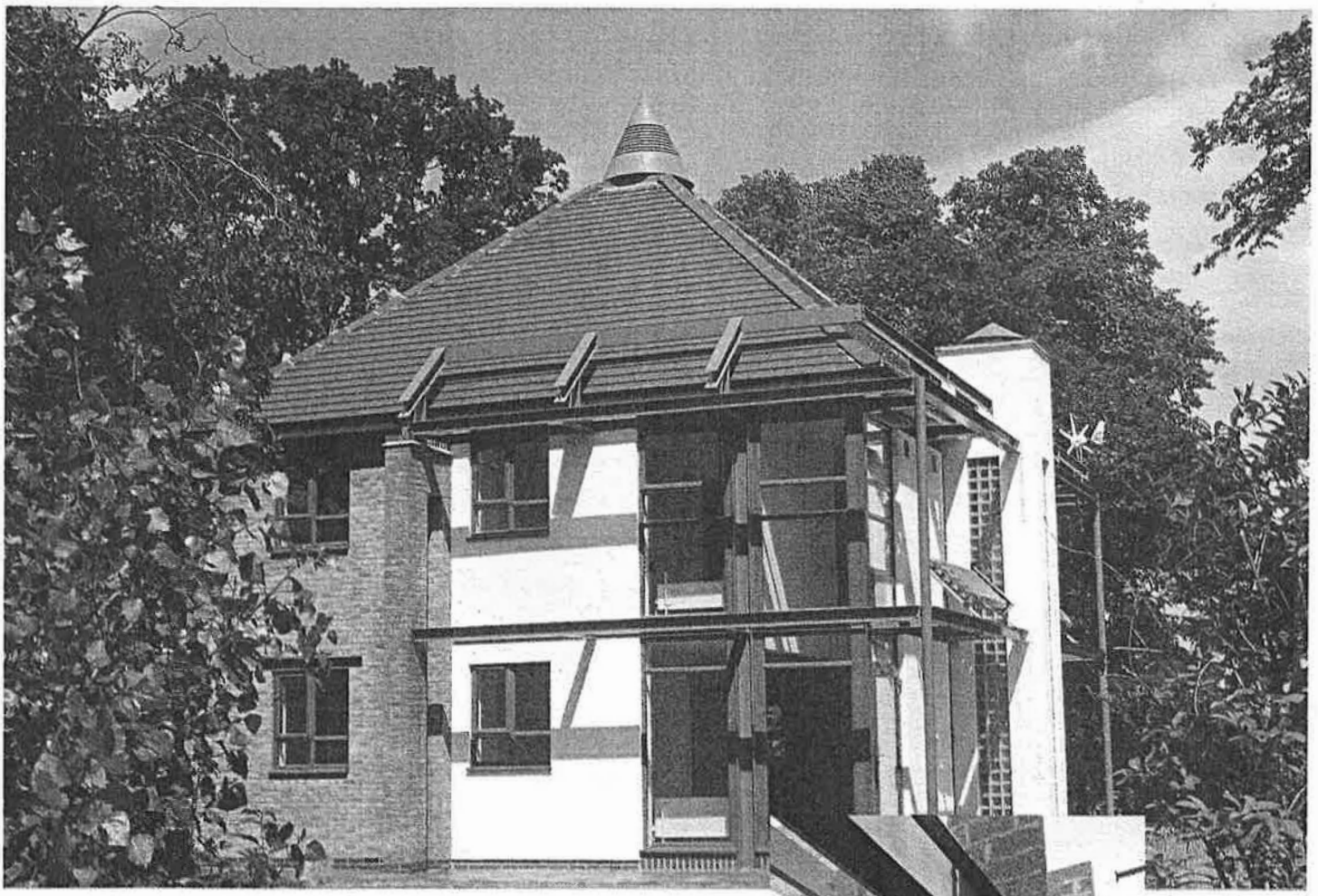
Take a look around the University of Nottingham's Park campus and you could be forgiven for thinking that its approach to student housing is a bit extreme. But accommodation isn't the primary role for the £200 000 four-bedroom house which has recently been completed within its grounds.

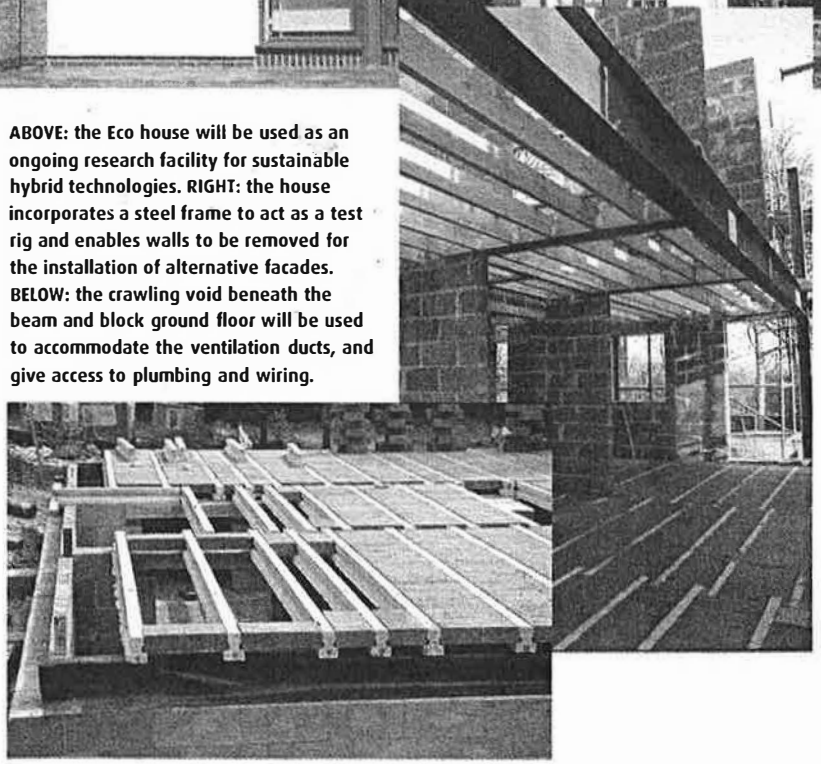
The Eco House, which has been funded and constructed by Midland's house builder David Wilson Homes, will be used to test, *in-situ*, sustainable technologies developed by the university's School of the Built Environment. As well as providing an ongoing research facility it will also be used to educate students and increase public awareness of the types of technologies available.

The house has been occupied since December by three of the school's researchers. Their role is to monitor performance and comfort levels, while at the same time creating the realistic occupancy conditions of a home – in exchange for rent-free accommodation of course.

Layout and technologies

The size and specification of the Eco House is typical of what most UK housebuilders employ. It uses brick and block construction, standard levels of insulation, double glazed upvc windows and fittings that are representative of



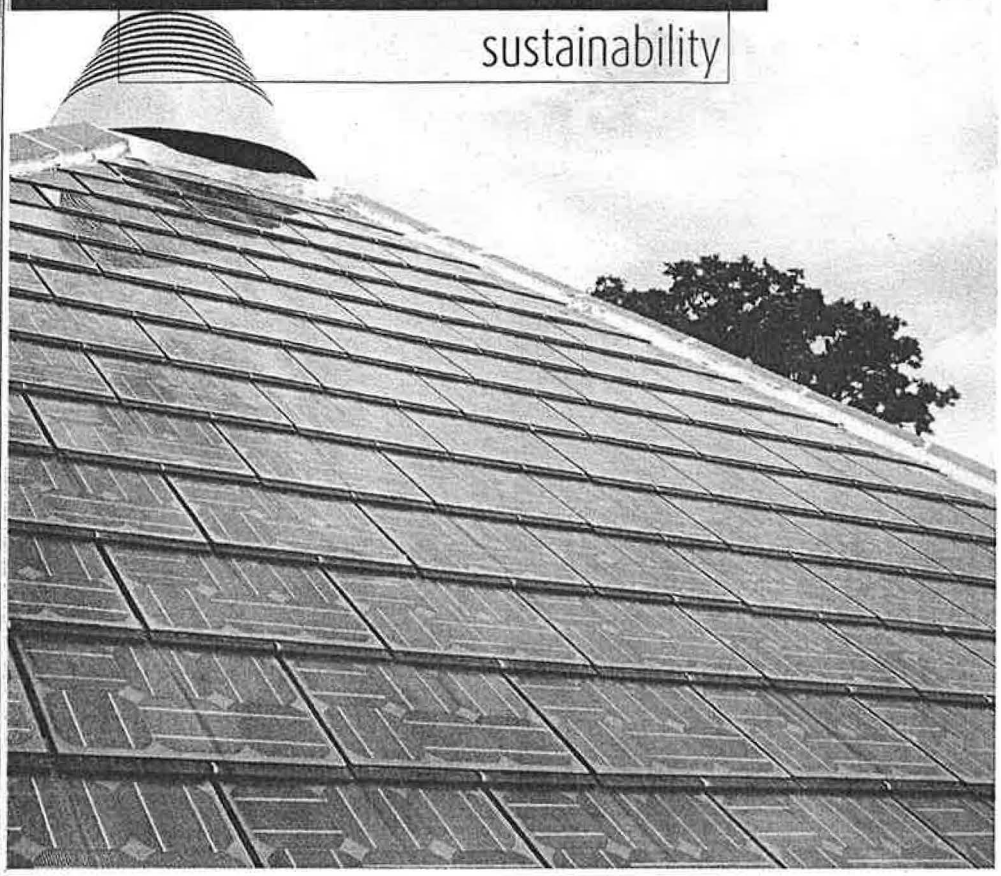


ABOVE: the Eco house will be used as an ongoing research facility for sustainable hybrid technologies. RIGHT: the house incorporates a steel frame to act as a test rig and enables walls to be removed for the installation of alternative facades. BELOW: the crawling void beneath the beam and block ground floor will be used to accommodate the ventilation ducts, and give access to plumbing and wiring.

those in other David Wilson homes.

However this isn't a standard house. The university dictated the layout to accommodate its research requirements. The south facing facade incorporates an exposed steel frame that extends two thirds of the way along both of the flanking walls. The purpose of the frame is two-fold, one to act as a rig for mounting experiments, second it enables wall sections to be easily removed. This will allow say, for improvements to be made to the levels of insulation or the installation of different facade systems for testing.

A solar chimney has been incorporated into the south wall to help with heating and cooling. Constructed from concrete blocks, it has glass block infills on the three external sides as well as the internal face. On an overcast day the temperature difference between top and bottom is typically between 3° to 8°C. In the winter the damper at the top will be closed and the ground floor and first floor hatches opened so that heat collected in the fabric of the chimney warms the air creating a convection loop. During the summer the damper will be opened and the



"15·9 m² of photovoltaic roof tiles produce 1250 kWh of electricity per year, approximately 30% of the dwellings total demand"

LEFT: any surplus electricity generated by the photovoltaic roof tiles will be exported to the grid. BELOW LEFT: the double height space in the living and dining area is a consequence of the solar chimney.

first floor hatch closed thereby drawing fresh air into the building. The glass blocks currently used are partly for aesthetic reasons, but the aim is to try out different materials to enhance the chimneys thermal storage capacity, such as phase-change materials.

The south facing roof pitch incorporates 15·9 m² of monocrystalline photovoltaic roof tiles, designed to produce 1250 kWh of electricity per year, approximately 30% of the dwellings total demand. These are inclined at 52° and supply a peak power of 1580 W. The photovoltaic system is being monitored as part of a two-year joint research programme with the Department of Trade and Industry/ETSU, to evaluate the integration of photovoltaic systems in buildings. In conjunction with this there are two self-operated sun-tracking photovoltaic arrays that are installed alongside the house. These will result in approximately 75% of the buildings electricity demand being satisfied by photovoltaics.

A 3 m x 1 m solar collector has been mounted on the south facing portion of the frame. This will provide hot water during the summer and pre-heat water in the winter. A digital sensor on the panel compares the temperature of the water in the array with that in the water cylinder. When the panel fluid is 4°C warmer the a pump is activated to fill the water cylinder.

A 4 kW ground source heat pump has been installed to provide heating and cooling for the house. Approximately 250 m of coiled pvc pipe have been laid on three sides of the house at a depth of 2-3m where the ground temperature is at a constant 12-13°C.

The system isn't up and running yet but it will eventually replace the condensing boiler.

A rainwater collection system will provide approximately 60-70% of the building's water demand. Water from the 90 m² roof will be collected in a 3000 litre storage tank. The water is not used for drinking but is suitable for washing, bathing and flushing toilets.

The conical WindCatcher on the roof provides enhanced ventilation to the landing area while a SunPipe is used to supply natural light to the enclosed groundfloor toilet.

The internal layout is relatively conventional with the kitchen, living room and a toilet on the ground floor, with the bathroom and four bedrooms on the first floor. The main variation is the creation of a double height space parallel to the south end. This will allow free air movement between the floors and is a consequence of the inclusion of the solar chimney.

The ground floor is constructed from inverted concrete T-beams supporting concrete blocks. These are used to create a 900 mm crawling void to allow for any wiring or pipework modifications and also the installation of a ventilation system to work in conjunction with the solar chimney.

The future

The majority of the systems currently installed on the house are fairly conventional, some are available off-the-shelf although many are not yet mainstream. Ground source heat pumps, for example, are not widely used for domestic applications in the UK partly because of cost. The university will be looking at ways to increase the efficiency of such systems in order to reduce capital costs.

The role of the Eco House has purposely not been designed to be, for example, thermally massive or to have unusually high levels of insulation. This is so that the university can simulate the conditions of a typical modern house and gauge the real impact that these technologies will have on them.

David Wilson Homes, who build around 4000 houses a year, acknowledge that no one housebuilder will change the UK's housing stock. However, it sees the project as a way of getting a steer on emerging technologies and as a test bed for products before they reach consumers.

With something in the region of four million houses to be built in the UK over the next 20 y, this house may be what influences their design and the technologies they incorporate.