



CRAFTING THE CURLY HOUSE

AN ENERGY-EFFICIENT RETREAT NESTLED IN THE ENGLISH COUNTRYSIDE

Text by SHARON HARPER | Photography by JAKE WHITE of Ecotecture, Ecological Architecture, Sussex, U.K.

Rural Sussex in the south of England harbors the sunniest of the climates in the British Isles, but the location also is assaulted by the cool crosswinds and biting winter conditions of the English Channel. It was this coastal environment damaging an aging, energy-gobbling farmhouse that prompted property owners to ask U.K.-based architects Ecotecture to design a contemporary energy-efficient home to replace the existing structure.

The dynamic Curly House design is an eye-catching, award-winning 410m² (4,411-square-foot) home nearly five times the size of average for British newbuilds, yet far more energy efficient. That efficiency is built upon landscape features and Passive House design techniques that incorporate Insulated Concrete Forms (ICFs), a system known for significantly reducing energy usage. Named the “Curly House” for its unique curved shape that cuts into a hillside, grass roofs cool the building’s lower levels, which are set down into the rolling natural landscape.

According to an article published by Ecotecture Ecological Architecture, the architects used an innovative plan with wide expanses of windows “to draw the garden with its views over

the Sussex Downs into the house and take full advantage of the orientation of the sun.” Thus, the crescent shaped structure capitalizes on summertime and wintertime sun taking full advantage of its seasonal orientation for providing low energy consumption, following Passive House principles and using passive solar gains when appropriate.

The building’s green architectural design helps distribute heat throughout using a natural ventilation strategy in conjunction with a mechanical ventilation heat recovery system. While there are no incentives in the U.K. for energy efficient homes and zero energy homes are extremely rare, the clients who sought out Ecotecture welcomed an update to their environmentally unfriendly building in the Sussex Downs Area of Outstanding Natural Beauty (AONB). England has designated 33 of these natural areas as protected scenic areas. It is no surprise accordingly, that the clients wanted an elegant home that drew attention.

Jean-Marc Bouvier, NUDURA Sales and Business Development Director, said the Curly House project exemplifies how ICF technology delivers on design, ease of construction and long-term energy efficiency. “ICFs are making great strides in

becoming recognized as a superior alternative to traditional and other sustainable building envelope technologies.”

Air tests show the Curly House property achieved remarkably low 0.2 air changes per hour. Bouvier believes that the Passive House techniques implemented in the building plan were major factors in reducing energy consumption. The clients who wanted to exceed typical construction methods often seen in the area welcomed the concepts used.

“There is a push for Passive House from certain circles but most of the established homebuilders are very reluctant to move away from their traditional building style,” Bouvier explained. “The architect and the owner agreed on the Passive House principle because they were looking for something beyond the traditional norm. He understood how important ICFs are in the process of reducing wasted energy.”

Heating a dwelling typically accounts for approximately 60 percent of energy costs. Data from energy usage at the Curly House demand was modeled in IES thermal analysis software and based on actual consumption in late 2011; the ICF system reduced typical energy demand by 98 percent, addressing Passive House Standards in the U.K., by reducing energy consumption by more than 80 percent.

Studies in the U.S. show that a new residence built with Passive House techniques is 90 percent more efficient than other homes. This is a result of minimal heat loss as a result of additional insulation and specialized thermal construction. It attracts heat gain through strategic positioning of high performance

windows. The Curly House positioned its windows in the curve at optimal locations. It also used rooftop solar-heated water and photovoltaics, devices that produce electricity from sunlight via an electrical generation through semiconductors.

Bouvier adds that trends for energy efficient homes in the U.K. new home construction market are “like goal posts in shifting sand – they move all the time. In the seven years I’ve been here, they are now on their third incantation,” the Canadian said.

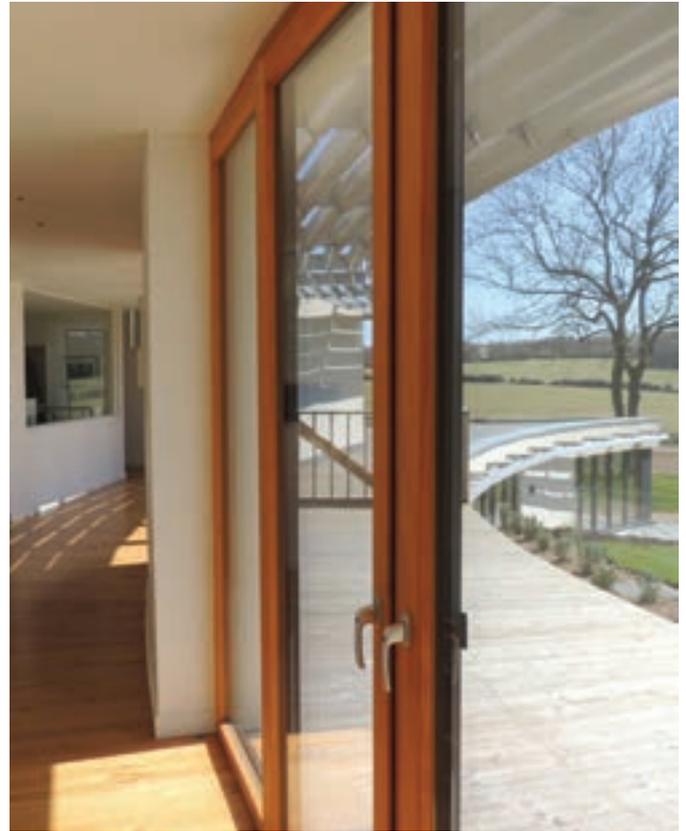


Above: The footprint of the house shows the first course of ICF forms have been placed. **Below:** The ICF forms are ideal for the curved structure and below grade construction.





View of the unfinished interior of the Curly house after ICF walls have been completed.



South facing high performance, triple-glazed windows manage heat gain.



Salvaged traditional flint stone walls were incorporated into the new structure.

“They have gone from “Eco Homes” to “Code for Sustainable Homes” to the latest “Zero Carbon Hub”.

The Curly House design emerged from combining three key design principles: its crescent form on plan, its stepped arrangement on the site and a curved brise soleil sunshade structure to prevent the windows from over-heating. After considering numerous sustainable construction options, Kithurst Builders recommended NUDURA Insulated Concrete Forms for the walls. The builder also selected Op-Deck, a lightweight, yet super-insulated insulated system, used for the floors and roof. These methods contributed thermal mass advantages that balance the heat gains and losses from the large areas of glazing, which would otherwise be problematic.

No timber was used in the construction of the building envelope. The semi-subterranean nature of the design meant that materials susceptible to damp could not be considered. The insulating element of the ICF, along with the roof and floor system, acts as a buffer, allowing the slow release of heat into the building to ensure a constant internal temperature throughout the year.

Reinforcement in the building was provided by vertical and horizontal rebar. Due to the nature of the curved design, all of the rebar was shaped on-site. The use of steel beams used only to frame the stairwell provided a minimal part of the structural supports.

Thermal bridging was reduced greatly. The building surpassed the air tightness standard required for Passive House compliance, 0.6 ACH by using ICFs and concrete. It allowed the support frames for the brise soleil to be bolted onto the concrete core. Using stainless steel anchors reduced the heat loss further. Initial air tests showed the property achieving 0.2 air changes per hour.

One significant construction challenge was minimizing the height of the aboveground structure while avoiding putting the lower level, garden level floor so deeply into the ground it would impact the costs for drainage or necessitate the need for a pumping station.

First, the footing was poured and sealed with liquid damp-proof course ready to receive the knee-high wall. The curved section of the building was cut on-site but could have been custom-made and delivered pre-formed.

Once the NUDURA blocks and Op-Deck floor were positioned, a sustainable concrete mix design was poured into the formwork, completing the floor and walls as a continuous element. NUDURA's bracing platform system addressed tight specifications and provided working access. With the floor and roof installed, construction of the walls continued in stages.

Situated in a region of immense natural beauty, the simple, elegant and stylish Curly House proves that sustainable energy techniques paired with innovative construction make an attractive alternative. It has won awards for its building performance results and unique design. Bouvier remarked, "This home will be passed from generation to generation, with practically no running cost. It's likely to be unaffected by fuel hikes and provides a healthy and comfortable environment."

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WHAT IS A PASSIVE HOUSE?

The stringent energy performance standards of a Passive House project, also known as Passivhaus, are reached by achieving 80 percent less energy consumption when compared to conventional construction. Carefully considering all design and construction practices is essential. Through a process of building modeling, factors that are evaluated include capture of heat emissions by occupants and appliances and adjustable mechanical ventilation of fresh air that assures superior air quality. A few of the intended results are reducing a building's environmental footprint, reducing reliance on fossil fuels and benefiting occupants with excellent indoor air quality and year-round comfort.

PROJECT TEAM

ARCHITECT

Ecotecture Ltd., Ecological Architecture,
West Sussex, UK

BUILDER AND ICF INSTALLER

Kithurst Builders, LTD,
West Sussex, UK

ENGINEER

BLB Chartered Engineers, UK

ICF DISTRIBUTOR

Sustainawall, West Sussex, UK

ICF SYSTEM

NUDURA Integrated Building Technology

In May 2014, the Curly House project won in the UK Green-build Awards' Domestic Newbuild category. The competition honors the country's best sustainable products and projects for the build industry. The award recognized that the building's energy consumption fell far below the norm, exceeding Passive House criteria for energy conservation.

Designer Jake White of Ecotecture said, "The Curly House is an exceptional example of how low energy architecture does not necessarily equate to design limitations or inside of the box thinking."

"NUDURA provides designers with the ability to create some truly amazing design," said Murray Snider, President & CEO of Nudura. "Our innovations allow for radiuses to be cut precisely from our plant to ensure we meet the demands of the design. NUDURA has always prided itself on providing innovative products to the market and Curly House is an example of our innovations and exceptional design coming together."



Appealing garden-level walkout space is situated below grade.