

Low/Zero Carbon Homes for Sustainable Cities

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Summary

The paper is concerned with the design and construction of creative low/zero carbon homes for sustainable cities. These innovative dwellings will be function as tools to address the challenges faced by the construction industry in its endeavor to create a sustainable urban environment. Six homes have been constructed on the University Park Campus, University of Nottingham, UK. The homes are designed by leading architects to various degrees of innovation and flexibility to allow the testing of different aspects of building construction including layout and form, materials, roof structure, foundations, glazing materials, thermal performance and sustainable/renewable energy technologies.

These Creative Energy Homes are used for research and development projects, student training and promotion of sustainable technologies worldwide.

Innovative Aspects of the Project

The purpose of the project is to work with house builders, the energy sector and related industry to create a showcase for innovative low/zero carbon homes. The homes will act as test beds for innovative building construction designs/methods, materials and sustainable technologies to meet guidance set out in the 'Code for Sustainable Homes'. The purpose of the project is also to train students in all aspects of sustainable energy.

The project has the following innovative features:

1. Development of range of homes which allow incremental step change modifications to provide industry with research data and cost effective guidelines on practical solutions to achieving Code Level 6 (zero carbon homes).
2. The creative energy homes are used for practical training of students in all aspects of sustainable technologies.

Cost/benefits

a) Cost/environment benefits: Traditional building techniques yield a product that is relatively inflexible in terms of spatial layout, servicing and ability to respond to the environmental challenges being set for the mid- and long-term. The construction sector is also facing challenges associated with a shortage of skilled staff and pressure to achieve new ways of construction.

A key feature of the Creative Energy Homes is their flexibility to allow testing of different aspects of building construction and sustainable technologies in order to identify the most cost effective and environmentally sound solutions for affordable homes.

The six Creative Energy Homes will allow testing and demonstration of a range of new construction methods and energy systems. The houses have been constructed in collaboration between the School of the Built Environment and industrial partners including, Stoneguard Ltd., Roger Bullivant, BASF, E.ON and Tarmac. Each home is unique and has been designed by leading architects in collaboration with the School of the Built Environment.

Stoneguard C60 House: The C60 house reduces carbon emissions by 60% (to meet the UK Government's goal to reducing CO₂ emissions by 60% by 2050): This house has been constructed on site using a light weight steel frame.

E.ON 1930s House: This home is designed to replicate a 1930s house. The house will allow for incremental step change modifications (in terms of insulation, glazing and energy systems) between Level 1 to Level 6 (zero carbon).

BASF House: This is a solar passive house designed to maximize the use of solar energy and use of a phase change material (Smart Boards) to enhance thermal mass and reduce overheating in summer.

Roger Bullivant House: This is a 60k House (i.e., maximum budget of £60,000 to build the house), which is made of light-weight concrete panels. The house incorporates unique geothermal heat pumps/thermal energy storage.

Tarmac Houses: These form a pair of semi-detached houses (Codes: Level 6 and Level 4) which are designed for the social/affordable market. The houses uses innovative materials that are of biological and recycled origin (houses constructed using zero Portland cement).

b) Education benefits: The conceptual design of the homes has been carried out by staff and students of the School of the Built Environment and a large number of students have been given on-site training. The School of the Built Environment, University of Nottingham has a world-class reputation for research and education in sustainable technologies/eco-buildings is ranked number 1 in the UK University league tables 'Building Category' published by the Times Higher Education Supplement. The School of the Built Environment benefits from its strong links with industry, has a large interdisciplinary team of researchers and over 800 students.

c) Public Awareness: The project has been publicized through numerous channels including BBC television, radio and local/national press. Research and demonstration projects associated with the Creative Energy Homes have been presented at exhibitions, seminars, and national and international conferences. The School receives many visits each year from UK and overseas academics and professionals. Each group is provided with a guided tour of the School's demonstration buildings. Information about the Creative Energy Homes is given in the University's website.

Replication potential

The Creative Energy Homes are designed to be replicated worldwide. Six homes identical to those built in Nottingham will be constructed in Ningbo, China to bring the concepts of sustainable construction to the Chinese sector. The houses are designed to be suitable for mass market use, e.g., social housing and affordable homes.

Environmental Compatibility

Concern over global warming and depletion of the ozone layer has stimulated research to develop energy efficient systems and sustainable buildings. Diminishing reserves of fossil fuels will also increase pressure to use renewable energy sources. The UK Government is committed to reducing carbon dioxide (CO₂) emissions by 20% by the year 2010 but this is set against the projection of a further 4.2 million new houses being constructed between now and 2016. Dwellings in the UK account for approximately 28% of the UK total of carbon dioxide emissions through the burning of fossil fuel for heating, lighting and appliances. The demand for energy to run heating/hot water systems and other home appliances such as refrigerators, cookers, lighting, etc is expected to be 13% higher in 2010 than it was in 1990. If the CO₂ emissions target is to be achieved, it will be necessary to develop better construction techniques and new and renewable energy technologies for building applications.