BRE Lighthouse

1. Project Basics:

- Location: Watford, UK
- Latitude/Longitude: 51°40'N, 0°24'W, alt. 110m
- Annual Precipitation: 23 inches
- Building type: Residential
- Square footage 2000; Stories: 2 story
- Completion: First phase in 2008, Continued Construction
- Design Team: British Research Institute (BRE), Sheppard Robson, Arup, Davis Langdon, MacFarlane Wilder and CCB Evolution

2. Background and Context:

Kingspan Off-Site is part of Kingspan Group plc, a building products business focused on establishing leading market positions by providing innovative products, systems and solutions with a global reach. The Off-Site division is one of the largest and most experienced providers of modern methods of construction (MMC), a factor that was integral to the company's development of its zero emission home, Lighthouse at the Building Research Establishment (BRE) at Watford.

Kingspan's formula has been to develop strategic approaches to markets to move them from niche to mainstream, and therefore Off-Site is no different. Kingspan Offsite's response was to build a strategy based around 2D panelised systems. The hole strategy is the development and application of 2D panelised systems right across the construction sector which includes residential private and affordable housing, apartments, , education, healthcare, hotel and leisure, and student accommodation.

1.1 The BRE Lighthouse is located in the southern part of the United Kingdom, in Watford.

1.2 The Lighthouse is part of the largest and most experiece providers of MMC.

Additionally within the other businesses in the Group they have the capability to integrate a package of renewable technologies, sustainable urban drainage (SUDS) water conservation methods including rain water harvesting. Therefore we are in the business of providing property developers, constructors and their design teams a range of frame solutions in timber, structural insulated panels (SIPS), steel and hybrid. This coupled with a massive range of rainscreen facades enables us to provide a frame and shell package across any masterplan.

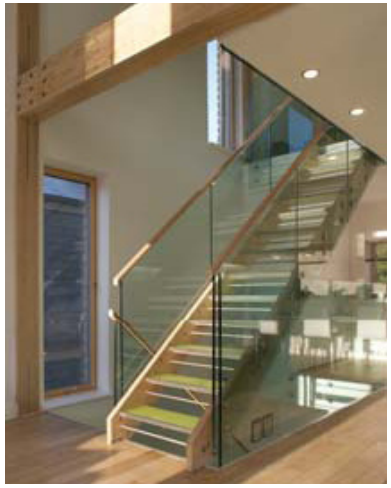
3. Design Intent & Validation:

'Lighthouse' was launched at BRE's Innovation Park and is the most advanced house ever produced for mainstream construction. With annual fuel costs of just £30, Lighthouse has pushed the boundaries of modern housing design to become the first to achieve the highest level of the government's Code for Sustainable Homes, level 6.

Kingspan Off-Site worked alongside a number of experienced partners in its development of Lighthouse, including Architects Sheppard Robson, Arup, Davis Langdon, MacFarlane Wilder and CCB Evolution. Every material and component that was used was chosen specifically for its ability to optimise the house design's overall sustainability credentials. The company was in the perfect position to develop the innovations required to get to level six. "Kingspan has an excellent track record in delivering timber steel and hybrid frame systems. This means Off-Site can accommodate MMC needs and call on wider group capability and products, for example renewable energy products," says Tom Paul.

Lighthouse is a net-zero carbon home of the future, which meets the standard to which all new homes must be constructed by 2016, according to the new CSH. This super insulated, airtight building has been designed to provide a way of living that encourages lifestyles that are inherently 'light' on the world's resources. It includes effective solar control, together with integrated building services, which are based around a platform of renewable and sustainable technologies, water efficiency techniques and passive cooling and ventilation.

1.3 Every building material and component used has been specified for its ability to optimise the house's overall sustainability credentials and minimise embodied energy and maximise reuse.



1.4. Materials: Timber frame, Sweet chestnut cladding, Screw piles, Floating ground floor, replacing concrete slab, Wool carpet, Natural rubber flooring.

Lighthouse has been designed to provide a blueprint from which a range of sustainable house types will be developed. Kingspan Off-Site has devised the technical systems and solutions to allow housebuilders and developers to incorporate the concept of the Lighthouse design into any masterplan scheme, enabling them to create homes with performance levels specifically tuned to meet whatever level of the CSH they require.

4. Key Design Strategies:

Inherent to the design of the Lighthouse is the response to the predicted increase in temperature due to climate change. This is achieved through a combination of design techniques and systems.

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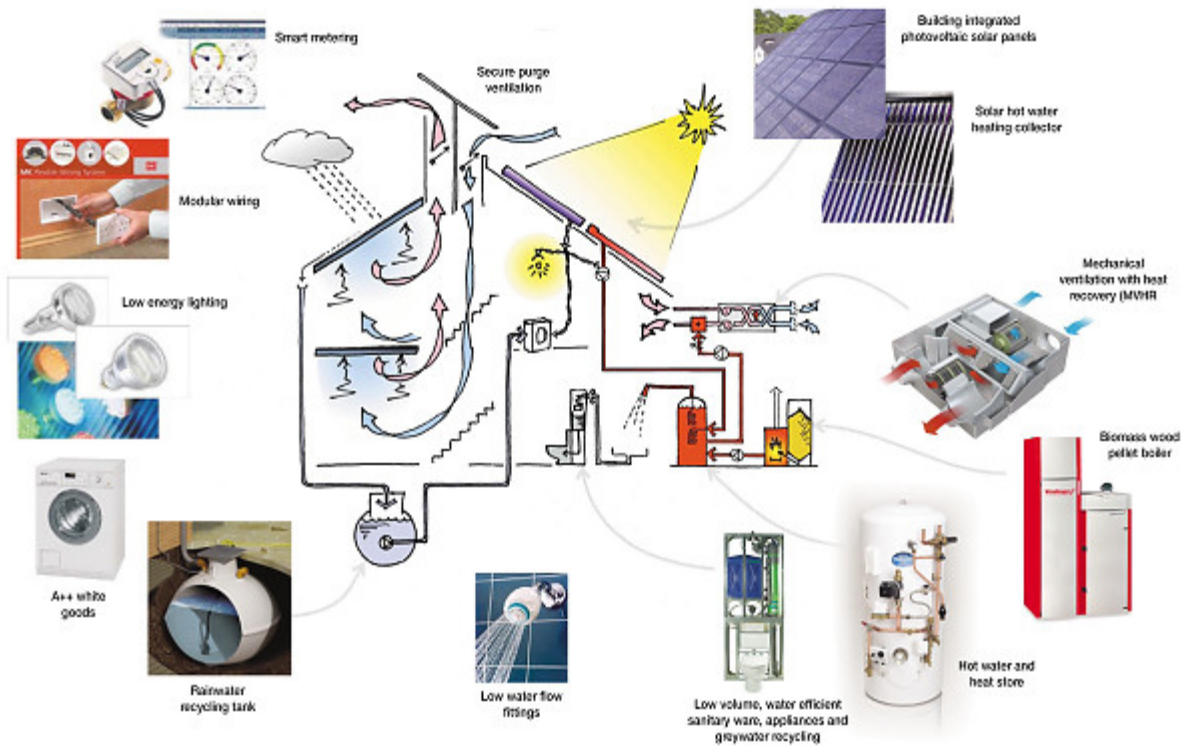
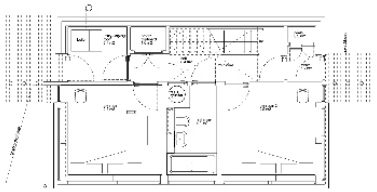
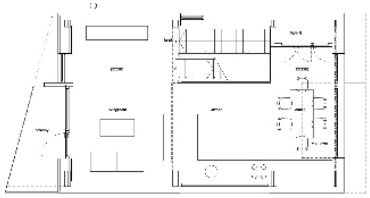
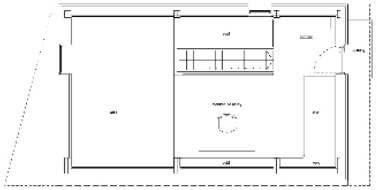




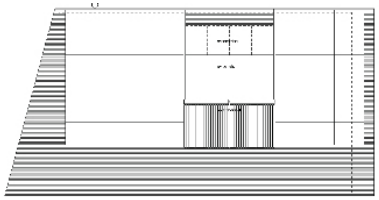
1.5 Ground Floor



1.6 First Floor



1.7 Mezzanine Plan



1.8 Roof Plan

1.9 The materials used include highly insulated, airtight building fabric which has been designed to provide generous daylight levels and includes effective solar control, together with integrated building services based around a platform of renewable and sustainable technologies. These include water efficiency techniques, renewable energy technologies, passive cooling and ventilation, as well as mechanical ventilation with heat recovery (MVHR).

Smart Metering. Building services are integrated with Smart Metering and monitoring that records energy consumption and enables occupants to identify if any wastage is occurring, helping to promote more environmentally aware lifestyles

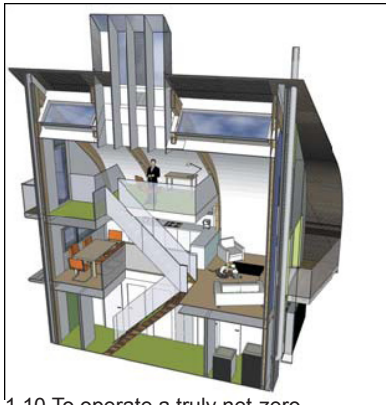
Selective Thermal Mass. Phase changing material in the ceilings absorbs the room heat by changing from solid to liquid within microscopic capsules embedded in the board. This process is reversed when the room is cooled with the night air, working with the passive system of the windcatcher.

Passive Ventilation. Located on the roof, above the central void over the staircase, the windcatcher provides passive cooling and ventilation. When open this catches the cold air forcing it down into the heart of the houses, living space and the ground floor sleeping accommodation, dispersing the hot air, allowing it to escape. The windcatcher also brings daylight deep into the plan of the house and provides the ground floor sleeping accommodation with secure night time ventilation.

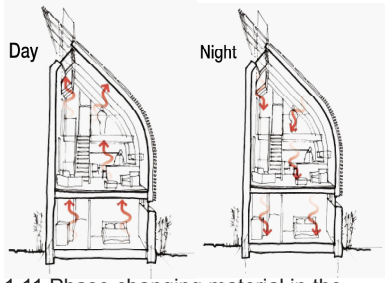
Solar Gain & Shading. Shading to the west elevation is provided by retractable shutters restricting direct sunlight, minimising heat gain in the summer. These can be folded away when not required to shade the space from evening sun. Future temperatures in the UK may reach those similar to southern Europe, however, our sun angle will remain low; we still need to maximise sun and daylight midseason and winter. The passive design of the house must balance the technical considerations with the occupants' expectations who are more accustomed to light and airy living.

Reduced Glazing. Complying with the U values of the Code, the glazing is 5 - 10% less than that in the traditional home. The living space is adapted to accommodate this with a large double height volume on the upper levels with sleeping accommodation below.

Photovoltaic (PV) Array. PV panels capture energy from the sun to supply electricity for the whole house. Any surplus is sold back to the grid.



1.10 To operate a truly net-zero carbon home, making optimum use of appliances and systems that reduce consumption and generate renewable and alternative forms of energy in necessary.



1.11 Phase changing material in the ceilings absorbs the room heat by changing from solid to liquid within microscopic capsules embedded in the board, releasing it at night.

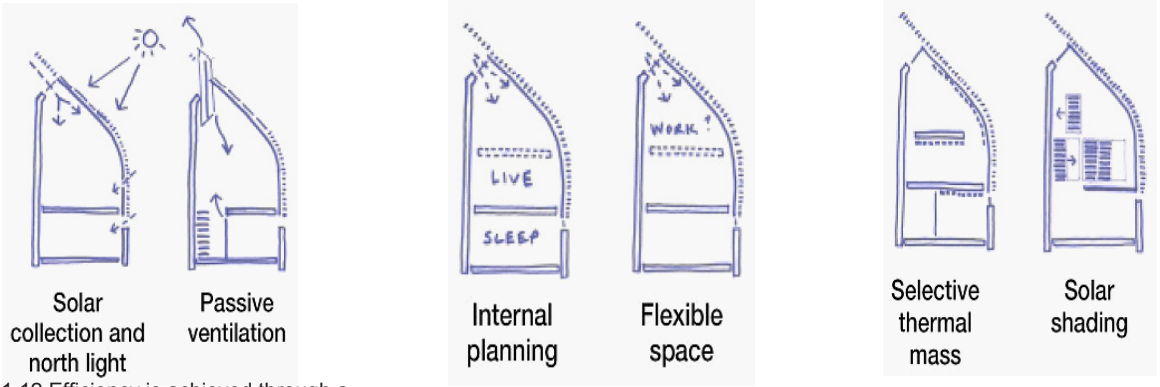
Material. Every building material and component used has been specified for its ability to optimise the house's overall sustainability credentials and minimise embodied energy and maximise recycled content and reuse. These include: Timber frame, Sweet chestnut cladding, Screw piles, Floating ground floor, replacing concrete slab, Wool carpet, Natural rubber flooring.

Biomass Boiler. The boiler provides hot water and space heating in winter, fuelled by wood pellets. It is located in the utility room to provide a dedicated drying area, as an alternative to the (electricity sapping) tumble dryer.

Solar Thermal Panels. The panels generate all the hot water in the summer and some in the spring and autumn, reducing the demand on the biomass boiler and the amount of wood used, keeping costs to a bare minimum.

Water. Increased awareness about what water to use where - rainwater for the garden and washing machine and used shower and bath water for the WC. An average saving of 50% compared to a onventional house.

Air Tightness. Lobby areas designed to the front and back of the house maintain the high level of air-tightness in the build.



1.12 Efficiency is achieved through a combination of design techniques and systems.

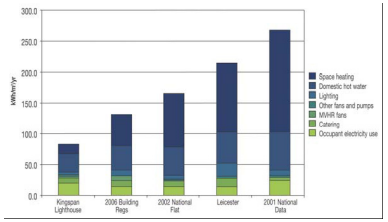
1.13 The simple barnlike form, derived from a 40 degree roof pitch accommodating a Photovoltaic (PV) array, which generates all the electricity for the house. The sweeping roof envelops the central space.

5. Performance Studies:

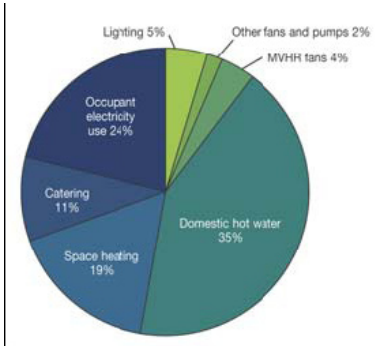
From the experience of building the show house at the BRE, they have been able to accurately calculate the energy use.

SAP has been adapted as follows:
- 100% low energy lighting rather than 30%
- 0% secondary heating rather than 10% electrical
- 88% heat recovery efficiency rather than 66%
- specific fan power (SFP) of 0.92 W/l/s rather than v2 W/ l/s
- 2940 kWh/yr solar thermal (calculated by manufacturer) rather than 1475 kWh/yr
- water heating based on reduced shower water flow rate

The entire energy cost of running the lighthouse by Potton would be about £31 per year for the wood pellets, assuming wood pellets cost 1.8 p/ kWh. The electricity is free, from the sun! A house of the same size and shape but built to 2006 Building Regulations Standards, would cost about £500 a year in energy bills. Most of the domestic hot water energy is provided by the solar thermal panels. There is a small amount of carbon dioxide emissions associated with the growing, Processing and delivery of the wood pellets for the remainder of the hot water and for the space heating. This is offset by extra renewable electricity that is generated from the sun by the photovoltaic panels and exported to the grid. In this way, the show house at the BRE is net-zero vvcarbon on an annual basis.



1.14 Operational Energy Use. This chart compares the estimated energy use for lighthouse by Potton with benchmarks and measured data.



1.15 Lighthouse Energy Use. The Building Regulations estimates were done for a similar size and shape house designed to Building Regulations standards for 2006 and for 2002.

6. Further Information:

Kingspan Off-Site website http://www.kingspanoffsite.com/kingspan/
BRE website http://www.bre.co.uk/page.jsp?id=959

7. References:

"Kingspan Lighthouse." 5 May 2009. <http://www.kingspanlighthouse.com/introduction.htm>.
"Lighthouse Brochure." Janurary 2001. Potton Building Dreams. 5 May 2009. <http://www.kingspanlighthouse.com/lighthouse_building_services.htm>.
"Zero-Carbon BRE House." Sustainable English Homes. 5 May 2009. <http://www.e-architect.co.uk/england/bre_house.htm>.

Images 1.1 - 1.15:
"Lighthouse Brochure." Janurary 2001. Potton Building Dreams. 5 May 2009. <http://www.kingspanlighthouse.com/lighthouse_building_services.htm>.

8. Map & Transportation Options:

Time	Details	Information
05:51	WC1H 0PW	**Transfer time: 13 mins**
	Walk to Euston	
06:04		
06:04	Euston Rail Station	**Average journey time: 12 mins**
	Take the **London Midland** towards Tring Rail Station	
06:16		
	Zone(s): 1, 5	**Zone(s): 1, 5**
06:28	Harrow & Wealdstone Station	**Average journey time: 23 mins**
	Take the Route Bus 258 from Stop: N towards Watford Junction Railway Station	
06:51	Watford High Street (WD18)