CIBSE BUILDING PERFORMANCE AWARDS 2014

# ENTRY FORM

## New Build Project of the Year (value up to £10 million)

The New Build Project of the Year Award is presented to the building project that most effectively demonstrates the achievement of high levels of user satisfaction and comfort and delivers outstanding measured building performance, energy efficiency and reduced carbon emissions.

Entries should be for projects completed during the period **1 April 2011 to 30 September 2012**. Entries may be submitted by any or all members (together) of the project team. This allows for a full year of data on the actual performance of the building.

Please complete the entry form below. The headings reflect the judging criteria and the judges will be looking for you to provide the relevant information under each heading.

## Project Details

**Project name**

*As you wish the project to be referred to throughout the competition.*

Montgomery Primary School

**Project Address**

Redvers Rd Exeter EX4 1BS

**Organisations**

*Please provide the names of all organisations that you would like to be credited in your entry. Please ensure that the company names you list are accurate as we will be reproducing these on screen and in print. It is essential that you have the consent of all those named below to include them.*

| | |
|---|---|
| Building Services Engineer: | Hamson JPA |
| Building Owner: | Devon County Council |
| Building Occupier: | Montgomery Primary School, Martyn Boxall, Head Teacher |
| Project Manager: | W T Hills, Exeter |
| Quantity Surveyor: | NPS Group Exeter |
| Brief Consultant: | Click here to enter text. |
| Architect: | NPS Group Exeter |
| Interior Designer: | Click here to enter text. |
| Mechanical / Electrical Engineer: | HamsonJPA |
| Contractor: | Bam Construction |
| Investment / Property Company: | Click here to enter text. |
| Developer: | Click here to enter text. |

## Entry Details

**Summary**

*Please provide a synopsis of the project and its building performance, low carbon and energy efficiency objectives.*

Montgomery Primary School has proven to be an Exemplar Zero-Carbon project commissioned by Devon County Council, primarily funded by the Priority School Building Programme with a "Zero-Carbon Task Force" grant and matched funding. Full functionality for teaching and learning were required, including integrated ICT. The School was awarded a Quality Approved Passivhaus certificate on the 1st February 2012. It is one of the first Passivhaus schools in the UK and the first 'true' Zero-Carbon in-use school in Europe.

Utilising the Passivhaus principles and a main heat source of the pupils and the building is constructed to minimise heat loses. The building has a high thermal mass, from the pre cast concrete panels. The design will be expected to not only pass the requirements of BB101 for the current climate, but be Climate Ready for 2080.

On a Sustainable front the focus was on many elements of the schools design aspects of a with the main ones considered being:

1. Orientation of the building – maximized on site PV generation.

2. Use of materials from sustainable sources – minimal impact on planets resources.
3. Minimisation of construction waste – Use of off site construction techniques
4. Design for low maintenance – Whole Life Costings undertaken to maximize VFM.
5. Providing a suitable thermal environment for the lifetime of the building – Climate Change ready!

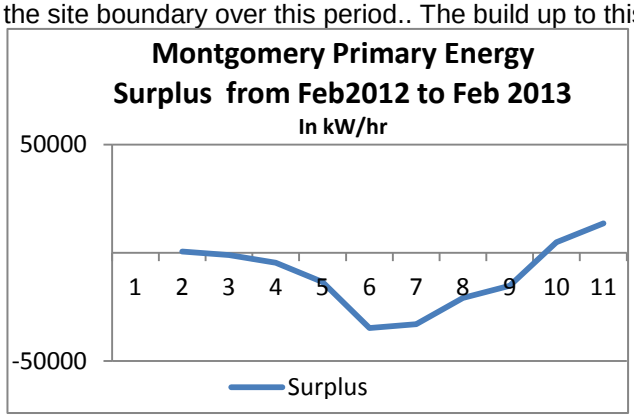
Over the life of the building we believe the most important aspect is to design for low energy usage in operation. This not only limits use of fossil fuel but also reduces ongoing $CO_2$ emissions in the buildings operational life time. Exeter University assisted in setting the technical performance requirements of the building. This has been borne out in the data collected whilst the building has been in occupation and as submitted on the Carbon Buzz website.

**Please outline how your entry meets each of the entry criteria – judges will be looking for information in each of the sections when assessing the entries:**

*Any documents, charts or photos can be referenced and included in your supporting documents.*

One year's evidence of measured building performance and energy use data, ideally including a DEC and an entry on the Carbon Buzz site.

A copy of the buildings first DEC is attached, this shows the building to be in band "B". A DEC is over a full 12 months so is compared to benchmark over a year, the main reason the DEC is "only" a B (which is actually a very good rating) is because it is heated using electricity. Overall the energy use is actually extremely low (doing what it set out to do) and with the PV offsetting it is genuinely net-zero carbon. The building has generated as much energy as it has consumed (the only fuel used is electricity), and so is net zero carbon in use. There are very few, if any buildings that generate ALL the power consumed over a 12 month period on site, the graph below shows the energy transfer across the site boundary over this period.. The build up to this graph can be provided if required.




The link to the CarbonBuzz website is http://www.carbonbuzz.org/casestudiestab.jsp?pid=186724

Special challenges, objectives or constraints and the design solutions adopted.

Using the Passivhaus standards to reduce energy in used this school is aiming to be the UK's first **climate-change-ready** school. The simplest way to produce a zero-carbon design would be to build a typical school replacing the gas boiler with biomass and buying electricity via a green tariff. We considered such an approach was unsustainable and without added value. Utilising an innovative approach we aimed **to use the minimum amount of resources** including fuels. This produced a number of challenges in modelling the predicted energy usage to ensure the correct sizes of PV Panels were installed.

The design philosophy can be summarised as:

1. Resource lean: built to **Passivhaus standard**, setting a limit of **15 kWh/m$^2$** for heating. Obtaining certification is considered a challenge in its own right, which we did achieve in February 2012
2. Heating system: This will **be mechanical ventilation with heat recovery**, with air being moved from high occupancy spaces to low occupancy ones. Additional heat will be supplied via simple electrical heating elements in the air ducts.
3. **All electricity will be provided on-site** via photovoltaics. The site will be connected to the national grid, with a philosophy of balancing the electricity imported and exported over the annual cycle.
4. The design will be expected to be **future climate ready to 2080**.

This had to be achieved without any impact on the way the building functioned as a Primary School. This ensures that the potential of every young person and improving their life

chances is maximized. Buildings have a major impact on the environment, not just in terms of materials used in construction, but also due to energy usage during their long lifetime. Thus sustainability as both an environmental and social aim, will be carefully considered throughout the design, building and operational process.

Warm Consultants provided cold bridging modelling and undertook the Passivhaus modelling and certification.

Specific elements of excellence and innovation in terms of design, equipment or application including lighting, heating, and cooling, façade or public health services.

The Passivhaus approach taken at Montgomery is a holistic, fabric-first approach to construction, which focuses on the air movement and heat transfer within the building as a system and makes use of passive heat gains and solar shading as sources of energy and control. The general strategy is for air to be supplied to the classrooms, gain heat and be extracted through the spine of the building – either providing residual heating to these areas in the winter or exhausting via roof-lights in the summer. To prove this in the design, extensive thermal modeling of the concept was undertaken in the "IES: Virtual Environment" software package to ensure the design team were satisfied.

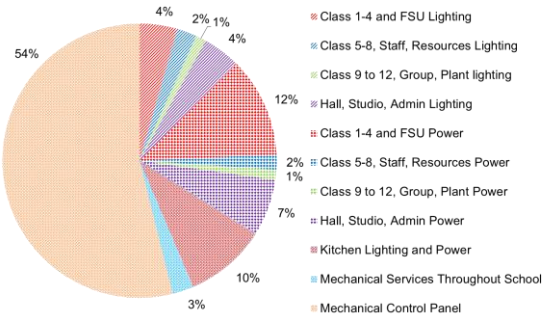
To optimize the heat recovery required by Passivhaus in the winter but limit summertime electricity consumption, the building operates on a mixed-mode ventilation strategy. During the winter, the building is predominantly mechanically ventilated, distributing via a variable air volume system. This operates under the dictates of temperature and $CO_2$ sensors located in each space to provide fresh air only where and where it is needed. To accompany this, a 'reversing-regenerator' air handling unit was selected which offers a heat recovery efficiency of 90%. In conjunction with the super-insulated building fabric, this transfers sufficient heat to the supply air to eliminate the need for a conventional central heating system. During the summer, the building operates on a predominantly naturally ventilated strategy. Large roof lights located over the central corridor/atrium space are automatically opened based on the local environmental conditions to create a low-pressure ventilation "stack." Each classroom adjoining the corridor is provided with a bespoke, acoustically rated transfer grille at high-level, which allows warm exhaust air to rise into the adjacent corridor when operated in conjunction with the manually opening windows in each classroom, while attenuating and reducing noise transfer.

Extensive calculations were also carried out to determine the best strategy for domestic hot water (DHW) provision. This led to the inclusion of a high-temperature $CO_2$ air source heat pump to provide the main heat source. In conjunction with a trace heated distribution system, this showed the lowest predicted overall energy use of the options considered.

To reduce lighting energy consumption, room reflectance was considered early on in the scheme and materials with light colours and high reflectance were specified. This resulted in light fittings of a lower lumen output being specified to achieve the required lighting levels. In addition to this, absence detection and daylight dimming were employed within class areas, requiring manual switching to turn the lights on. This allows teaching staff to leave the lights switched off until they deem necessary. Manual dimming has also been provided to all classrooms, enabling teaching staff to manually reduce lighting levels, and consequently energy consumption, as required.

Specific energy efficiency aspects of the project, such as energy metering, monitoring and targeting, use of recycled/recyclable materials and other low carbon features.

During construction sub meters were installed to monitor the overall energy usage in the building. From the overall annual consumption of 167,358 kW h can be split into:




Sub-metering of the mechanical control panel is via the BEMS. The full report on the building energy usage produced by Exeter University is attached.

Evidence of costs and expected savings associated with these measures and anticipated payback periods.

Based upon the FIT tariffs the additional capital for the PV panels is expected to be paid off in 12 years. In the Life Cycle costs the capital costs were compared against another recently completed

school with the following high level results

| Building Standard | % Construction cost Uplift | % Current Costs | % NPV Saving |
|---|---|---|---|
| Exwick Heights (less externals) | -0.31% | 5.49% | 4.97% |
| Exwick Heights | 10.83% | 7.73% | 6.47% |
| Zero Carbon | 14.29% | 8.52% | 7.22% |
| ZC less (less externals) | 9.10% | 13.28% | 10.33% |
| PassiveHaus Standard | 9.37% | 5.88% | 5.36% |
| PassivHaus (less externals) | 5.34% | 12.90% | 10.30% |

These were presented at the UK Passivhaus conference in 2011, the full presentation can be found at http://ukpassivhausconference.org.uk/sites/default/files/Chris%20Rea.pdf

Description of commissioning, handover and soft landings processes, and how they contributed to achieving the designer's intended building performance.

Compliance with the Passivhaus standard put strict performance criteria on the design, over-and-above that of a conventional build (notwithstanding the design objective of achieving zero carbon in use). Studies have shown that a large part of unexpected energy consumption in operation comes through poor commissioning of services and a lack of follow up user education. To ensure the commissioning and handover process ran smoothly, the BSRIA "Soft Landings" approach was adopted, in addition to an extended commissioning period being specified in the contract.

Through the Soft Landings structure and the follow up visits with the school staff, the design team, client and contractor have worked together to identify and resolve many items that will reduce the energy consumption and improve the overall operation and client's satisfaction with the project.

Todate the extensive building modelling undertaken has almost perfectly predicted the energy and comfort requirements of the building in use.

Evidence of collaboration between members of the project team that has contributed to improved performance.

From the start a high level of collaboration has been undertaken, assisted by Exeter Univeristy's Centre for Energy and the Environment and Devon County Council funded a PhD student to anaylsis this project. The whole design team worked well together and BAM Construction, were able to call upon sister companies for assistance on Passivhaus techniques widely used in Holland and Germany albeit mainly in housing. This support including flying two Passivhaus consultants over from Germany to assist in design workshops.A key message was the importance of ensuring the design conformed to the strict requirements of the Passivhaus planning package design tool and the technical brief.
The early involvement of key supply chain members before contract award was considered essential to achieve the quality required. Both the frame and Building Services specialists were appointed during the design phase to call on their experiences. In this instance from the outset everyone working on the project was expected to work at the top of their game and more often than not work outside the scope of recognised traditional building technology.
Through the early stages the level of expertise needed was identified and as a result a number of key individuals have been vital in the process. The total commitment of these individuals to achieving a fully functioning primary school and working with the current students in running "Energy Workshops" to increase the awareness and start a behavioural change as the school transferred across to it's new buildings.

The design team continue to work closely with one another with Exeter University commissioned by Devon County Council to monitor the ongoing performance of the school for a period of 5 years post-completion.

Evidence of any BREEAM or LEED assessment, or other third party evaluations.

Copies of the Passivhaus Certificate, BREEAM (Very Good) and the first DEC are attached.

**Further Information**

*Please provide any further information, evidence or references that you would like to include in your entry.*

Since the project completion in October 2011, the following comments have been received.
**Leo Critchlow, Project Officer, Devon County Council**
"From the outset everyone working on the project was expected to work at the top of their

game and more often than not outside the scope of recognised traditional building technology.
Through the early stages the level of expertise needed was identified and as a result a number of key individuals in the NPS team have been vital in the process, the total commitment of these individuals to achieving a fully functioning primary school that was also was going to meet Passivhaus certification and Zero Carbon in use, has been unstinting. Compromises have had to be made and these have been resolved over time without losing the school as the centre of our focus. The attention to detail has been carried through to the construction phase and the project has reinforced the need for good integrated team working which includes the Client and end users fully in the process."

**Martyn Boxall, Headteacher.**

"The children absolutely love it and they are very clear the focus is learning. The staff love it too. There is just no comparison to the old building. This is warm, welcoming and spacious with a calm environment. We have designed the rooms individually and they are purpose-built so that all the children's time is spent on learning. The classroom furniture is even bespoke so that it meets the needs of the specific age ranges."
The school has a light and airy hall and a modern kitchen and the number of school dinners has doubled since the move. There is a bright library and meeting rooms including a parents' café so they can come in and socialise and discuss matters informally with the staff."

**Thomas Wood, Pupil at Montgomery Primary School.**

"It's an awesome building. It's the best school in the world."

**Supporting Documents Check List**

*Entries should include supporting documents or evidence to supplement this written part of the submission. All supporting documents should be collated into one PDF document for upload.*

☒ DEC
☐ BREEAM Certificate
☐ LEED Certificate
☒ CarbonBuzz entry (please supply a link):
http://www.carbonbuzz.org/publishedproject.jsp?pid=186724
☒ Other (please specify): Click here to enter text.