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Something for nothing

The Elizabeth Fry Building was conceived as a benchmark environmentally benign project, but the design team was allowed no extra capital to achieve this. Could it be done? **David Olivier** reports.

Many reports continue to highlight the differences in building practice between the UK, Scandinavia and North America and one of the many recommendations made for the Elizabeth Fry Building (EFB) at the University of East Anglia was that it should incorporate the high levels of thermal insulation and energy-efficient windows which are characteristic of these two regions.

The average width of the wall cavity is 150mm and that cavity is fully-filled with rock fibre batts. Danish plastic ties reduce thermal bridging. The flat concrete roof has 300mm of rock fibre and there is a continuous layer of insulation under the concrete basement floor. Some thermal bridges were unavoidable, but the extra heat loss is tolerably low.

Mass-produced in Sweden, the windows are triple glazed, argon-filled, low-emissivity, inward-opening in aluminium-clad redwood frames. The windows on the south, west and east walls of the EFB have white venetian blinds in the outer non-sealed airspace for solar control.

Blockwork

Air tightness was another important issue with the building. The EFB has a reinforced concrete frame. Between the columns are panels of dense 140mm concrete blockwork. This forms an inner leaf of a cavity wall, and is plastered to act as an efficient air barrier. The specification also required the doors, windows and services penetrations to be sealed to the walls and to the roof.

There seems to be general support for maximum air leakage standards in new UK buildings. To succeed with this, we need not only good workmanship, but care to select the right construction details. It seems significant that by paying attention at design stage we produced a building whose air leakage was 10-15% of 'normal' on its first test - without even any extra visits to ensure correct execution of the new details.

The predicted heat gains were high - occasionally up to 850 occupants - but UEA's policy ruled out refrigeration plant and the EFB became the UK's second application of the Swedish Termodeck system. Termodeck was developed in the 1970s and Sweden and Finland have about 300 Termodeck buildings, often with no other cooling plant.

The principle behind Termodeck is using the hollow-core concrete floors to store surplus heat on winter days, or to store coolth on summer nights. By flushing heat out of the building mass in heatwaves, using cool night air, it is pre-cooled for the following day. The building fabric becomes an integral part of the heating, cooling and ventilation system, and acts to stabilise internal temperatures.

The heat needed is delivered by warming the ventilation air and a 3,250m_2 building is heated by three wall-mounted domestic boilers, the third boiler being for backup only. The total boiler capacity is about 10% of the usual figure in non-domestic buildings.

In winter, 85% of the heat from the outgoing stale air is recovered by heat exchangers to preheat incoming fresh air. The incoming air is heated as necessary, using water-to-air heat exchangers in the ductwork, and it passes into the rooms via the hollow cores in the floors. Thermal comfort is regulated by controlling the temperature of the floor slabs, not the air.

Primary

The services engineers kept the fan-power down by selecting good quality fans and designing the ductwork for low air speeds. Consequently, the mechanical ventilation saves more primary energy, in the form of gas, than it consumes in the form of electricity.

The DETR provided funds to monitor the EFB for a year. Later this was extended into a second year, perhaps to double-check the first year's very low figures. Electricity consumption has been almost level.

Gas consumption fell steadily as the controls were refined. By 1998, the running total had stabilised at 25kWh/$m_2$yr and the EFB now burns less than £1,000 worth of gas in a normal winter - a cost which UEA describes as 'negligible' compared to the building's other running costs; e.g. cleaning, security, staff, etc.

Frugal

A frugal gas consumption provides a f r from frugal comfort standard, with a strongly radiant heat output from the concrete slabs, an air temperature of 20-21°C and an absence of draughts. Short cold spells have no effect on internal conditions. In January 1995, someone in-advertently switched off the heat recovery in the offices. No-one noticed until February, when someone saw that the third boiler was on.

With a very high thermal capacity and a low-powered heating system, the system operates day or night in winter, whenever there is a call for heat. This thermal inertia of Termodeck buildings has always been a quid pro quo for the summer conditions and the ability to store surplus daytime heat gains from solar, equipment, etc. in the building mass.

In its first few months, the newly-occupied EFB had to cope with one of the hottest summers of the 20th century.

In 1995, conditions in the EFB were said to be excellent, and by far the best on the UEA campus.

The EFB provides the summer and winter comfort standard which were the raison d'être for air conditioning, but it possibly cost 20% less to build than an air-conditioned office building.

It also costs about 80% less to run and leads to CO2 emissions which are 75% lower.

It is a clear case of negative costs for added energy efficiency. In the words of Amory Lovins, it provides: "not just a free lunch, but a lunch which one is paid to eat".

By replicating such technology, we could abate global warming at a profit.

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