ARUP

A1 General Energy Issues

Due to the targets imposed by the approved document Part L, it has become necessary to look not only at the mechanical and electrical plant for energy savings, but also at the building itself.

To look solely at the mechanical and electrical equipment to obtain the necessary improvements would be highly cost ineffective, and would probably need the introduction of renewable technologies to meet the requirements.

Instead, a balanced approach should be used, where early stage building decisions on shape, orientation etc, are recognised as being as important as specifying high efficiency equipment later in design.

It is becoming increasingly important that architects are involved with energy reduction at the early stage of the design process. The most notable contributions are through minimising the U – Values beyond the minimum required quantity, and to increase air tightness beyond its minimum requirements. Both in order to minimise heat loss from the building.

In principle, the passive design approach reaps more reliable energy reductions than adding ever more complex mechanical systems with features like heat recovery. Adding mechanical systems tends to have diminishing returns because additional high-grade energy is generally needed to yield the recovered lower-grade energy. On the economics side, mechanical systems tend to be a significant initial capital cost, but additionally also have limited life compared with the building fabric, resulting in continued financial and energy consumption. In building whole life cycle terms, investing in enhanced passive building envelope performance to deliver comfortable indoor comfort tends to result in significantly reduced whole life cost and whole life environmental impact.

Minimising the whole life environmental impact is also served by avoiding the need for periodic refurbishment / replacement intensive resource input to keep the provision of a useful building. The principle of 'Long life, loose fit' is important in this respect. The aim is to allow evolving uses and changes to building function without significant changes to the building fabric and systems. This often needs careful thought because many clients' requirements are closely related to perceived immediate building use needs and have to be reviewed against long-term use. A flexible building is normally one that can be adapted easily to a variety of ways of use, without the need for significant change or system reconfiguration. In simple terms if the basic building form and structure has twice the normal design life, it also has something in the order of half the embodied energy.

A2 Strategy Adopted

In order to comply with Part L2A (2006) we have adopted a strategy of Reducing energy usage and Re-using energy wherever possible.

We have reduced the energy requirement of the buildings by:

- Recommending highly insulating the floor, walls, windows and roofs;
- Recommending an above average level of air-tightness;
- Providing good levels of natural daylight;
- Providing sophisticated artificial lighting with occupancy sensors and daylight dimming;
- Specifying energy efficient fans, condensing boilers and plant items.

We will re-use waste energy by installing heat recovery on air handling units where practical.

A3 General Philosophy

Efficient use of energy is central to the school design: incorporating a well insulated building fabric; optimised design for daylight employing measures that enhance daylight penetration, such as clerestory windows; enhanced natural ventilation with stack effect; minimal use of mechanical ventilation; use of the thermal mass of the structure to achieve efficient heating and cooling; heating supplied by high efficiency gas boilers; energy efficient lighting; efficient control systems and zoning to achieve appropriate comfort levels.

These design measures will enable the schools to produce low CO2 emissions in operation. Minimising the need for refrigerant based mechanical cooling reduces maintenance and energy demands.

The building design makes maximum use of natural ventilation and passive cooling techniques to minimise the need for mechanical ventilation systems and air conditioning as far as possible. Certain areas will require the use of mechanical systems to achieve comfortable internal environments despite the background passive approach.

The BEMS system will collate all utilities metering. All utilities will be metered and sub-metered to allow true consumption to be allocated to plant items and users. This information will also be made available to staff and pupils via the school's intranet system.

A Building User Guide will be produced so that non-technical users can understand the operation and environmental performance of the building with a view to minimising energy use.

A4 Further Details

Natural Ventilation
Natural ventilation has enabled the elimination of fans, ductwork and air handling plant, with the associated cost, maintenance, energy consumption and replacement resource consumption.

Natural ventilation is generally better liked and more understood by occupants than mechanical ventilation. Further reductions in carbon emissions can be achieved if the heating is from a relatively low carbon intensity fuel like gas.

Natural ventilation has been considered appropriate for this school building due to the relatively quiet and pollutant free location.

By having exposed thermal mass, natural ventilation is further enhanced by storing useful thermal energy.

Passive Cooling using direct Thermal Mass
Passive cooling uses dense materials with high thermal capacity to store cooling until it is needed. It is exposed directly to the occupants as part of the room surfaces. Normally cool night ventilation is used as the cooling source. Generally uses normal building materials like concrete, brick and blockwork. Very cost effective for achieving a limited cooling capacity

Solar Shading
Windows will also be fitted with solar shaded glass on certain exposed facades to minimise the solar heat gain, but a balance will need to be reached between minimising solar gains and maximising daylight.

Variable Speed Motors
Varying the speed of mechanical ventilation fans to match ventilation demand can greatly reduce conventional fan power if appropriate controls and fans are used. For low energy buildings there is diminishing carbon

savings. Arguably it is best to reduce or eliminate the need for the fan in the first place. Same principles can be applied to pumps.

Ventilation Heat Reclaim
Recovers heat from the exhaust air and uses it to preheat fresh air. Only appropriate for mechanical ventilation systems. Care is needed to ensure that the year round added fan power with its high carbon intensity does not exceed the carbon savings of gas sourced heat with lower carbon intensity.

Condensing Boilers
Condensing boilers have superior energy efficiency over non-condensing boilers. This is achieved by re-circulating waste gasses in the flue, to reclaim potentially wasted energy.

Luminaire Daylight Auto-Control
This system switches off luminaires when there is adequate daylight. It is particularly effective when coupled with windows designed for daylighting and appropriate control sensors. Best when used with a gradually dimming luminaire, as the occupants are less likely to notice the switching. With electronic dimming, the energy saving (and hence carbon saving) is realised as soon as the luminaire begins to dim. The more the luminaire is dimmed, the greater the saving, and when the luminaire is switched off, there is no energy use.

Luminaire Occupancy Auto-Control
The system senses when the room is unoccupied, and automatically switches off the artificial lighting. Particularly useful in cellular rooms such as store rooms, and WC's. The risk of leaving the lights on in unoccupied cellular rooms is mitigated, and therefore a carbon saving is made.

Time-clock and Photocell Control
For external lighting, the combination of a time-clock and photocell ensures that the lights do not switch on before they are needed, which can save carbon. Also, the time-clock may be used to switch off the lighting after a given time (e.g. 2am when the lighting is unnecessary), and then switch them back on again when they are deemed necessary (say at 6am for example).

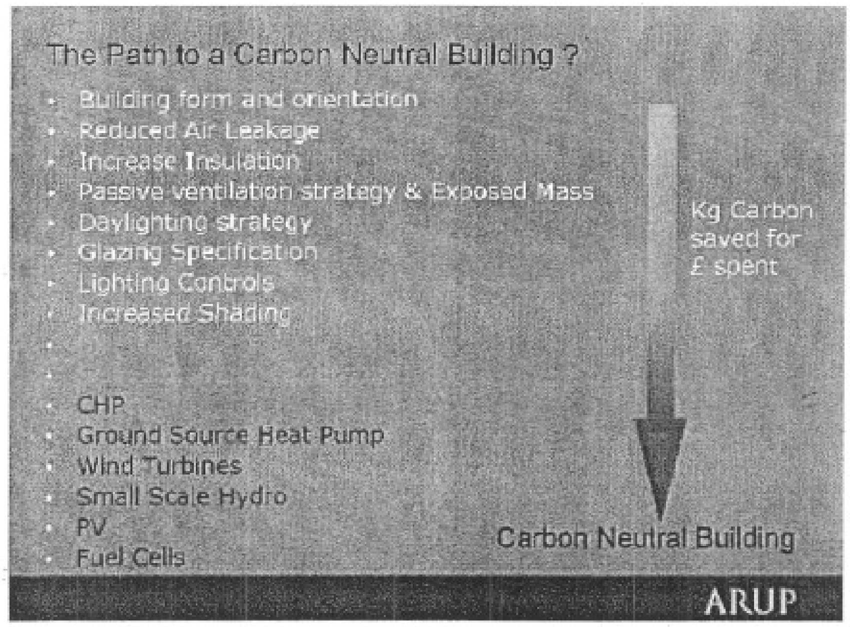

Figure 1. Relationship between Carbon Reduction versus Cost