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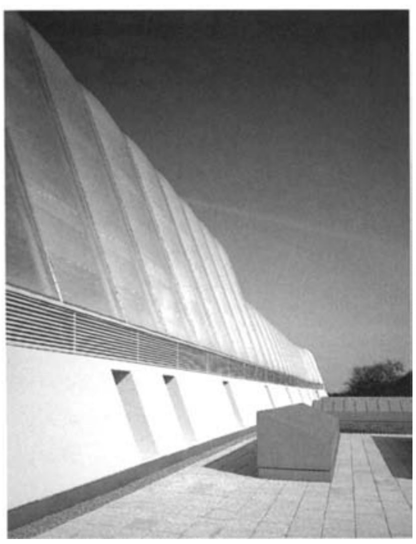
Sustainability

Making any building sustainable requires a significant amount of effort in the design stage. But doing this for a new school presents a whole range of challenges specific to the sector: from the partial occupation of rooms to the number of concerned stakeholders.

The task requires much more careful consideration than simply implementing the standard list of low energy building services equipment. A good example of this is the Academy of St. Francis of Assisi, engineered by Buro Happold. This is a city academy in Liverpool which opened in September 2005 and has environmental studies as its specialist subject. As a result, it has exemplary renewable and low energy building services, including 24kW solar photovoltaic panels, solar thermal system for heating water, rainwater harvesting for flushing toilets, intelligent lighting controls and enhanced sub-metering to aid energy management. This equipment is in addition to building fabric measures, which include: a south-facing ETFE atrium to maximise ingress of natural light and passive solar heating and exposed concrete soffits to reduce internal temperature fluctuation and the need for cooling. A national newspaper dubbed it "Britain's greenest school" in recognition of its successful low energy technologies.



South-facing passive solar ETFE atrium. Academy of St. Francis of Assisi, Liverpool, Buro Happold

One of the first steps in this process is making sure a sustainable engineering design is well-defined and measurable, if is to be of use to the design and construction teams as well as the client. The client may be made up of many groups: the Local Education Authority (LEA), the government or private funder of the project, the school staff and students as well as their parents – all of which will have a voice and so have to be kept informed of progress. The design team can develop the school in a positive and productive manner only after it is clear who makes up the client group and who within that group is able to make financial and operational decisions.

The design team then has to agree with the client a definition of sustainability for the project and create a method of assessment to measure this throughout design, construction and operation. The process is most effective when the overall sustainable target is understood by all the parties involved at the earliest possible stage. It means design and educational decisions for the school can be made in an integrated, sustainable and supportive way, but also means most of the design choices will be influenced by engineering knowledge of sustainability.

Keeping sustainability to the fore throughout the design process means the building services should become the last resort for cutting carbon dioxide (CO_2) emissions. All the issues associated with sustainability – maximising the amount of natural light by aligning the building appropriately with the sun path, minimising the amount of soil removed from site, considering refurbishment and re-use of materials before a new build (which inevitably consumes more energy in creating the new materials used), and the effect of materials and building form on the internal environment and energy consumption – all must be thoroughly examined before specifying low energy buildings services equipment.

Many other issues are of great importance to schools. For example, air quality and noise levels should be assessed to make sure occupied areas are away from polluted and noisy areas on the grounds of preserving the health – and concentration – of building users.

With transport one of the biggest emitters of CO_2, significant attention needs to be paid to developing a travel plan. Transport and civil engineers must consider the travel methods used by staff and students each day and assess the sustainability of this against the agreed sustainability target.

23.76 kW photovoltaic panels system. Academy of St. Francis of Assisi, Liverpool, Buro Happold

This has to take into account many factors, such as the catchment area of the LEA, the optimum number of schools that an area can support, the anticipated student population of each school, the location of each school, the availability of different forms of transport and the potential for additional, more sustainable travel options. Civil engineers can then take the travel plan and develop it to ensure the roads, pathways and bridges within the school site, and beyond if necessary, are constructed in a sustainable way. This means minimising the amount of soil removed from the site and specifying the use of recycled materials where possible.

Having incorporated all these issues in the building form, the team must specify building services with a low environmental impact. So, water use should be minimised by the selection of low or zero usage fittings and by collecting rainwater for re-use in non-potable functions such as urinal wash down or toilet flushing. Artificial lighting should be provided with daylight controls and presence detectors.

Ventilation design should first try to use the natural movement of the outside air into the school building by using the rising warm air leaving the classrooms, or the prevailing winds, to draw the fresh air into the rooms. Where mechanical ventilation is necessary or desirable, there are a number of techniques to minimise the energy it requires, including heat recovery or drawing in fresh air through earth tubes that use the relatively stable earth temperatures to cool or pre-warm the air entering the building. Again, the need for cooling can be reduced through sympathetic IT equipment specification, which can operate at higher temperatures or have lower heat gains.

Energy consumption should be limited by all these choices, but once the maximum potential of this has been achieved, then the source should be considered. The national grid can provide power from renewable sources, but alternative localised power sources using wind, water or photovoltaic can also be assessed, along with the option of local power generation using gas-fired combined heat and power (CHP) units. Biomass and thermal solar heating can be used to reduce the CO_2 emissions resulting from the heating and hot water demands of the building, often at surprisingly low costs.

All these measures can be supported by pupils too, which helps meet broader sustainability goals. By not hiding this equipment in the building fabric and running campaigns on their usage, great support for the school and its sustainability goals can be garnered.

Measuring the effect these innovations have on CO_2 output, water and electricity consumption and rainwater harvested – data that is simply retrieved from the building management system and can be relayed to pupils via plasma screens around the school – is a good way of gaining pupils' support. This helps educate pupils about the design of their own building and therefore illustrates the impact of all buildings on the environment. Thus, the building is helping the educational process and wider sustainability issues by raising awareness with the consumers of the future.

The final issue in ensuring that the building performs well for the users and the environment is how the building is used. Its systems should be designed to be simple to use for both the occupants and the facilities management and all parties should receive training and support, preferably on an ongoing basis to assist with the operation of the building over the first year or two.

The building services engineering should be the last issue, in terms of sustainability, to be tackled after refurbishment, location, orientation, layout, form, function and operation have all been considered – all topics engineers can contribute positively to. This should provide a school building that reflects the educational needs of the students and allows the staff to teach in a sustainable but still comfortable environment.

Internal views of ETFE atrium. Academy of St. Francis of Assisi, Liverpool