UK7

Classrooms of the Future, Telford, UK

1 Photos

Figure 1: Classroom of the future.
Left: The Lord Silkin Secondary School classroom.
Below: Wrockwardine Wood Junior School classroom.

2 Project summary

Project objectives:
The aim of the project was to provide a high quality, flexible and sustainable teaching and learning environment with ubiquitous ICT system infrastructure and the potential for features of the building to be used to demonstrate sustainability principles and techniques. Specific objectives included:

- To use off-site (pre-fabricated) construction techniques, and to demonstrate that these can provide interesting designs that are attractive and in keeping with their surroundings.
- To use the most environmentally friendly materials.
- To include embedded sustainable energy technology.
- To demonstrate the cost effectiveness of this approach to building based on whole life costing (including ongoing maintenance costs).
- To bring sustainability and monitoring performance into the curriculum and to give maximum access across the community to the interconnected environment/network world.

Short project description:
Two classrooms have been built in Telford – one at a primary school and the other at a secondary school. They are detached buildings made up of four 'Yorkon' prefabricated modules with conservatory areas and external decking on the southern side. They include maximum use of active and passive solar energy. It is planned to use them for visits from other schools and teacher training as well as for the host schools and evening community use.

Stage of construction:
The buildings were completed in March 2003 but will only come into full use from September 2003.

3 Site

Telford, UK, latitude: 52.4°N., longitude; 2.3°W, Altitude: 120 m. Temperate coastal climate. Mean annual temperature (Midlands): 10.1 °C, mean winter temp.: 4.8 °C.

4 Building description/typology

4.1 Typology / Age

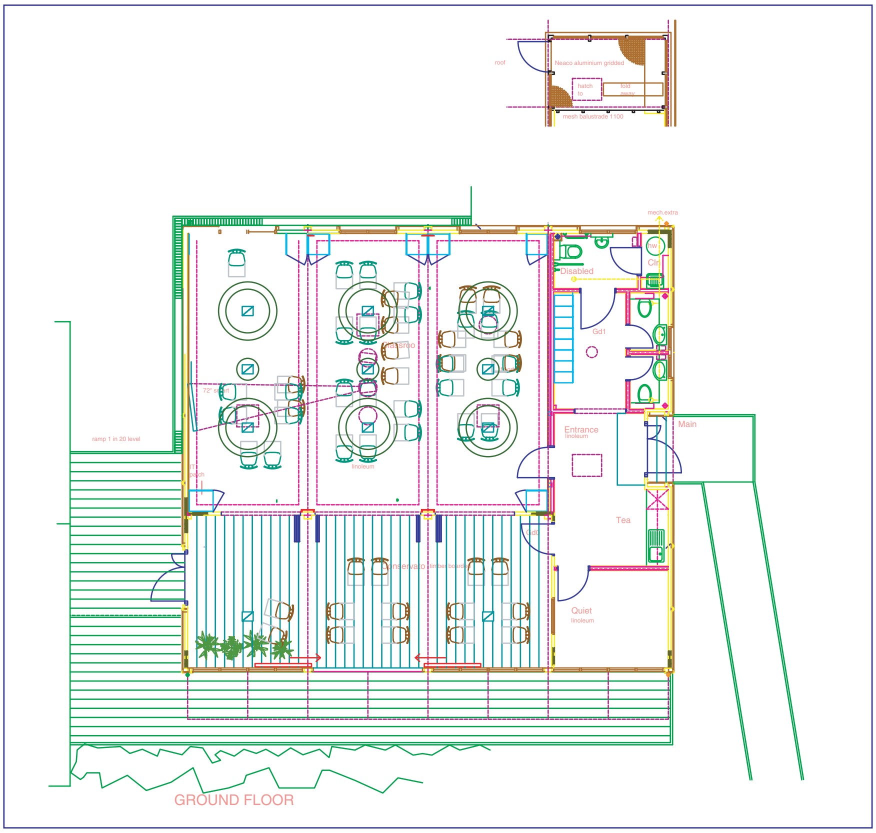
Educational level: The classrooms are located at two different schools – one primary and one secondary (Wrockwardine Wood Junior and The Lord Silkin Secondary).

4.2 General information

Year of construction:	2002/3
Year of renovation (as described here):	Not applicable
Total floor area (m2):	312 m2 (156 m2 at each school)
Number of pupils:	30 at each
Number of classrooms:	1 at each
Class room size:	67.6 m2 (excluding conservatory)
Window/glassareas:	Only about 3 m2 at rear and side, plus conservatory and light pipes.
Hours of operation:	Still to be confirmed but likely to be daytime and evening, 5 days per week during school terms.

4.3 Architectural drawings

Figure 2: Typical floor plan



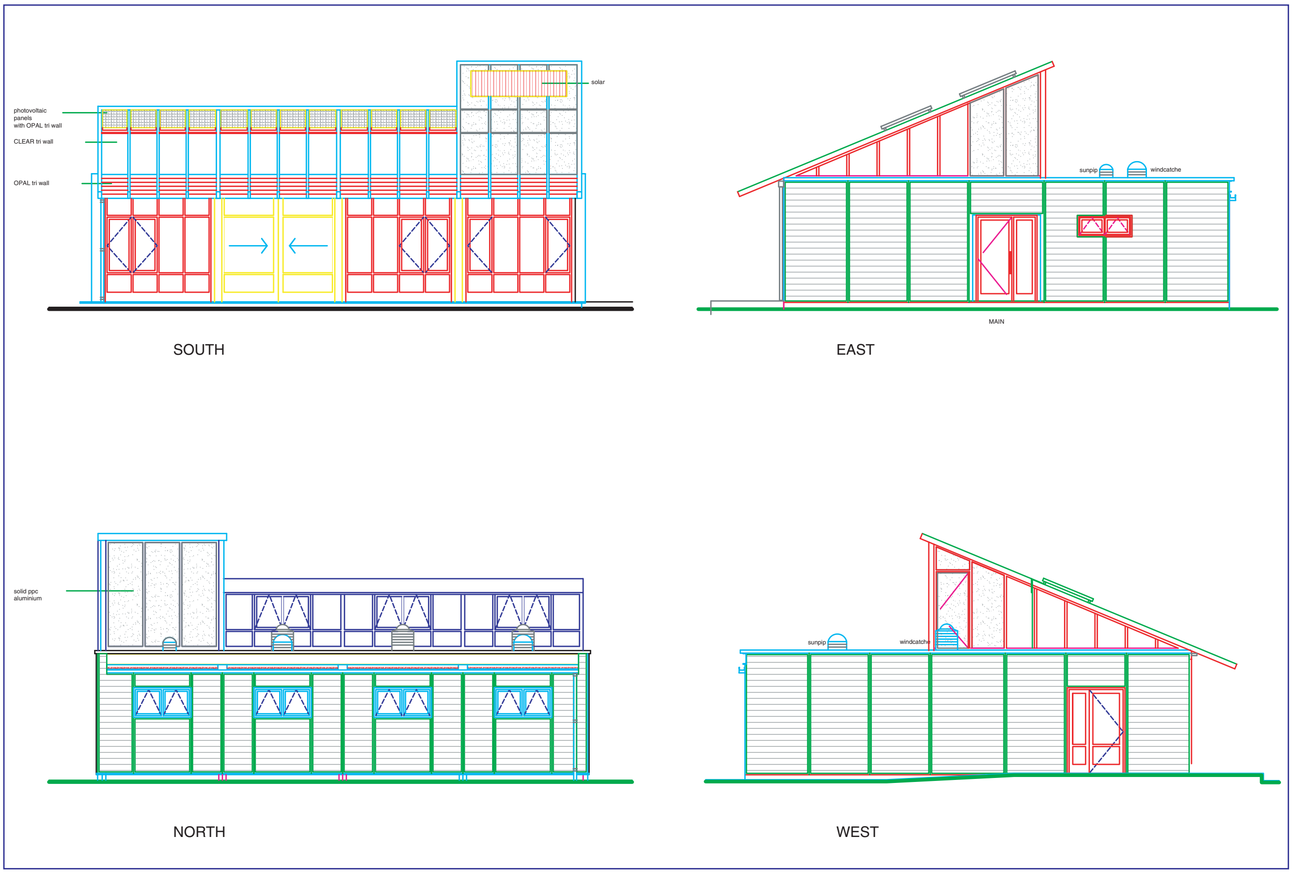


Figure 3: Elevated drawings

5 Previous heating, ventilation, cooling and lighting systems

The host schools are both heated by gas boiler and radiator systems, with natural ventilation and standard lighting systems. The services to the new classroom buildings are totally separate from those to the previously existing buildings.

6 Energy saving features

1.6.1 Energy saving concept

The building is designed to be highly energy efficient, with a highly insulated pre-fabricated construction including a sedum roof and a south facing conservatory to maximise passive solar gain. Energy use for lighting is minimised through the use of light pipes and automatic lighting controls, with the latter being designed on the assumption that the building users are "eco slobs". There is a passive ventilation system, a solar hot water system that supplies hot water to the toilets and solar pv panels (2kW) and a small wind turbine (600W) that produces some of the electricity used in the building (with this electricity being used elsewhere on the site when the building is not in use).

6.2 Building

The U-values of the building elements are: walls 0.35, flat roof 0.25, floor 0.25 and glazing 2.0. The solar pv and hot water panels are 'bolt on' rather than building integrated. Daylighting is enhanced by the use of light pipes.

Figure 4: Controlable blinds ensure comfortable inside temperatures

6.3 Heating

Underfloor electric heating is provided to pre heat the classrooms in cold weather. The domestic hot water is provided by solar thermal panels with electric back up.

6.4 Ventilation

The buildings are passively ventilated with vertical 'Monodraught' passive ventilators mounted in the roof. These, together with controllable blinds to the glazed areas will ensure that temperatures are comfortable without the need for cooling or mechanical ventilation. In the heating season the conservatory area will effectively provide some pre-heating of ventilation air.

6.5 Lighting

The need for artificial light during the day has been minimised due to the large area of glazing to the conservatory on the south side and the ability to fully open up the classroom to this, plus the provision of light pipes. A sophisticated lighting control system in the classroom itself allows the dimmable T5 lamps to be readily adjusted to provide an appropriate level of lighting according to the activities while limiting energy wastage. In toilets and other small rooms the lighting switches on/off automatically as people enter or leave.

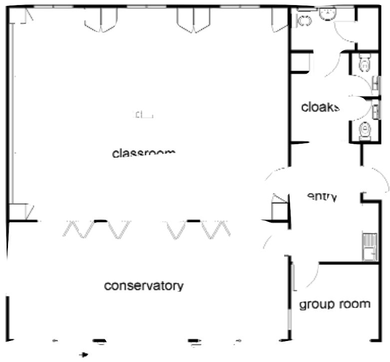
Figure 5: The sedum roof with the sun pipes and passive ventilation units

6.6 Other environmental design elements

The sedum roof is designed to significantly reduce rain water run off and water conservation measures, including aerated spray taps, have been designed in the toilet areas. The use of 'Screwfast' footings (which took just one day to install) enabled a site to be used that would otherwise have been very difficult to build on, due to made up ground to a depth of 3 metres and site gas and electricity supplies running under the building at a depth of 2.5 metres. As the buildings are modular, potentially they could also be moved to another site leaving the location without any significant damage. External treatment of each module is different, one with cedar cladding and the other with weldmesh and plants trained to grow up the walls.

Figure 6: One classroom has cedar cladding, this classroom has weldmesh for plants to grow up the walls

Figure 5: Specialy designed adjustable furniture



The furniture for the classrooms was also specially designed for the project by the Counties Furniture Group. This included an existing design for fully adjustable chairs and special desks with surfaces made of recycled plastic materials and fully adjustable to provide a comfortable working position for each individual.
The building itself is designed to be used as a teaching tool and a demonstration of what can be achieved. Displays of current and historical energy consumption are available using the 'Eco Warrior' system as these will be used as a learning aid as well as to monitor the performance of the buildings. This is supported by radio and Cat6 wiring, floor sockets and a yet to be developed "capstan" cable management system to plug into floor sockets and each distribute to 6 desks. There is high quality video conferencing and two interactive white boards together with a plasma screen. There is also a high quality sound system and a DVD video player, individual tablets and lap tops for the students together with normal desk top computers. The whole system is connected to Telford's National Grid for Learning network, possibly the largest community network in the world (see www.ngfl.gov.uk for further info).
Due to the presence of all of this ICT equipment, the security of the sites is a high priority and external railings, Red Care security system, Smoke Cloak and mechanical shutters to the main classroom have been installed.

7 Resulting Energy Savings

As these are new buildings, no energy savings will actually be achieved. However, the energy consumption has been estimated in order to calculate the Carbon Performance Rating to demonstrate compliance with Part L2 of the Building Regulations 2002. Before subtraction of the credits for the pv panels and the wind turbines, this indicates total carbon emissions for each building of 883.6 kgC per year, which corresponds to 7,819 kWh/year using a conversion factor of 0.113 kgC/kWh. A breakdown of this by end use is not currently available. The estimated electricity that will be generated per building by the wind turbines is 181.4 kWh/year and by the pv panel is about 1,100 kWh/year, which when subtracted brings the estimated net energy consumption down to 6,538 kWh/year.

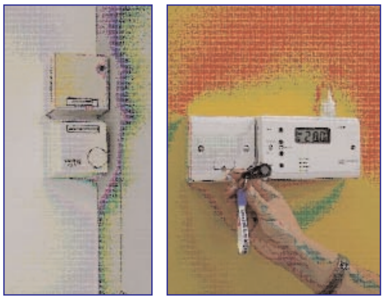


Figure 6: Override and adjustment controls are easy and conveniant to use

When this estimated net energy consumption is converted to estimated carbon emissions in kgC/m^2/year, these come to 6.7 kgC/m^2/year based on the heated floor area of 110m^2 or 4.7 kgC/m^2/year based on the total floor area including the conservatory of 156m^2.

8 User evaluation

As the buildings will not come into full use until September 2003, it is not yet possible to include any user evaluation. However the school users have already experienced the benefit of minimal disruption during the construction due to the short time needed.

The controls for the building services are designed to be convenient and easy to use. The heating and ventilation controls are located just inside the classroom door (see picture far left). The top control is for the ventilation (button for one hour opening override) and the lower control is the thermostat for the under-floor heating – set to 12 degrees for frost protection and preheating.
The automatic conservatory ventilation controls can be adjusted manually. The automatic opening and closing settings can be adjusted by pressing either the open or close buttons and at the same time pressing the + button. The temperature will scroll up to 69° and then start again at -16°. The closing temperature must be set at least 4° below the opening temperature. When locking up, the control must be set to manual with the vents closed and the keypad is then locked with the magnetic fob shown.

9 Renovation costs

The total cost of the project for the two sites was £1.08 million, with the £900,000 grant from the DfES Classroom of the Future project supplement by additional costs of about £180,000. Specific costs for some of the key items were as follows:

Building shells, including fit out:	£294,046
Sun pipes and passive ventilators:	£27,210
Mechanical and electrical systems	£128,000
PV panels (including 50% grant)	£8,704
Conservatory roofs and plant rooms	£106,600
Screwfast foundations	£10,000
Wind turbines (including grant)	£7,200
Sedum roofs	£21,480
Monitoring equipment (Eco Warrior)	£17,531

10 Experiences/Lessons learned

10.1 Energy use

Actual energy consumption data is not yet available as the buildings have not yet been in full use. The energy consumption will be monitored on a half-hourly basis by the 'Eco Warrior' system (see the Ketley Junior School case study, UK5 for further details of this system).

10.2 Impact on indoor climate

The buildings have been designed to provide a high quality indoor climate using the passive ventilation system. However they have still to be tested in occupation through the annual range of external climatic conditions. The 'Eco Warrior' system will monitor the temperatures in the buildings as well as the energy consumption.

10.3 Economics

These buildings were very much more expensive than standard new school classroom buildings, at a total cost of £3,600 per m^2 including fees (or £2,300 per m^2 excluding fees) compared to the usual £1,000 to £1,200 per m^2 (including fees). However it is likely that they could now be replicated at significantly lower cost given that the design is done and there is potential to do more of the work at the factory rather than on site.

10.4 Practical experiences of interest for a broader audience

The project was implemented by the local education authority in partnership with Integer (design consultants) and Yorkon (manufacturers of the prefabricated building modules). The involvement of these partners enabled the local authority to transform the 'blue sky' concept into reality and brought realism of the market to the design process. The full commitment of the partners, and an acceptance of a share of the risk in the project, was crucial to the success of the project.

Teachers and pupils were engaged in the design from the start, but this was compromised to an extent by the need to meet deadlines imposed by the funders and the tight timeframes required by manufacturers. There was also an attempt to reduce costs by not managing the project through a single main contractor and without a dedicated project manager to oversee and co-ordinate the work, and in retrospect this was a mistake. Unforeseen delays also led to less construction work being carried out at the factory and thus more pressure on site.

10.5 Resulting design guidance

There are a number of innovative aspects of this project that could be replicated in other projects that are seeking to adopt and promote sustainable building techniques. These include:

- The use of passive solar heating and ventilation
- High quality lighting using light pipes and sophisticated lighting controls
- A comfortable working environment for pupils as a result of the inside/outside environment through the conservatory and the adjustable furniture.
- The use of the building as a learning tool.

11 General data

11.1 Address of project

The two sites are as follows:

1. Wrockwardine Wood (C of E controlled) Junior School,
Church Road, Telford, TF2 7HG
2. The Lord Silkin Secondary School,
The District Centre, Stirchley, Telford, TF3 1FA

11.2 Project dates

Project initiation:	May 2001
Design completed:	December 2002
Renovation construction completed:	March 2003
Monitoring and evaluation completed:	Not yet completed

11.3 Date of this report/revision no.

Draft 4 – 27/08/03

11.3 Date of this report/revision no.

5 September 2003/Revision 5

12 Acknowledgements

Builder: Yorkon (www.yorkon.com)
Architect: Integer (www.integerproject.co.uk) The Integer team consists of Cole Thompson Associates (architects), i & I (technology), enabling concepts (education and communications) and BWP (M&E consultants).
Engineer: Integer (BWP)
National, international support programmes: DfES provided the bulk of the funding for this project. Grants for the renewable energy systems were provided by the Energy Saving Trust (Solar Grants – www.solargrants.org.uk) and the Clear Skies programme (www.clear-skies.org).

Author (of this description): Alan Pither

13 References

Classrooms of the future website: www.teachernet.go.uk/classroom_of_the_future
Eco Worrior website: www.sotaew.co.uk
Smoke Cloak: www.smokecloak,com