Adapting to Climate Change: Red Hill Primary School, Worcester

The redevelopment of Redhill School, Worcestershire is one of the first in England (if not the first) to have a climate change impact assessment carried out from the start of the design process. The £2.7 million project involves a replacement primary school on the site of the former 1960s building. The school aims to have a low carbon building that is able to cope with climate change to maintain a comfortable and robust teaching environment over its lifetime.

Worcestershire County Council is a key member of the Sustainability West Midlands Climate Change Partnership. Through this strong association the Council's enthusiastic team has access to the science, experts (e.g. UKCIP), tools and techniques for considering climate change impacts and developing adaptation strategies.

Robert Lewin-Jones, a Principal Architect at the council and project lead piloted the UKCIP Adaptation Wizard to assess the impacts of climate change on the new school at the design stage and develop an adaptation strategy. This strategy applies to the design and construction phases of the building and throughout its design life. The building is now under construction and due for completion in March 2007. It will be formally opened on the 18th of June 2007.

Robert summarises the adaptation strategy and the application of the adaptation wizard below.

Higher rainfall in winter, more intense periods, driving rain

- A sustainable urban drainage scheme has been implemented on site using swales, ponds and underground box storage.
- A rainwater harvesting scheme, used for flushing toilets, takes rain from approximately half the roof area.
- Other roof areas have a planted roof finish (sedum) to reduce run-off.

Computer generated image of the main entrance of the new school at design stage

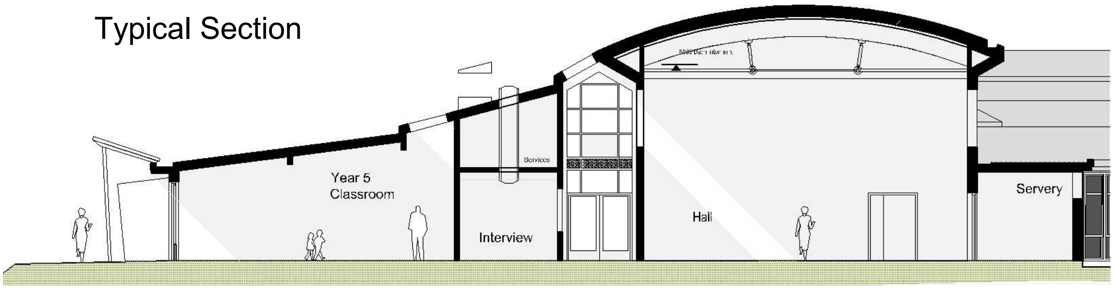
- Large overhangs on the roof and canopies have been provided to protect level thresholds (required for disabled access) from heavy rain.
- We chose not to set the windows behind the cladding (Scottish approach) but instead used a polythene membrane to provide a seal between the window and wall for airtightness.
- Durability of materials – areas of cedar boarding are protected by the larger roof overhangs. Other cladding materials are brickwork to external walls and low-maintenance zinc standing seam roofing.
- Wide gutters with emergency overflow points provide for periods of sudden intense rain. All gutters are protected by zinc mesh gutter guards to reduce risk of blockage from leaves.

Milder winters

- To avoid problems of mould growth, we have tried to ensure that there are no cold spots ('thermal bridges') in the building fabric, by ensuring continuity of insulation.
- All vulnerable areas are well ventilated, particularly wet areas like toilets and showers. We are using proprietary extract vents powered by small photovoltaic panels.
- The building is heated using a ground source heating system feeding an underfloor system. The heat pumps will run on electricity purchased on a green tariff. Overall, this provides a heating system with low carbon emissions.

Hotter drier summers

- Shade is provided by overhanging eaves and external canopies to the classrooms.
- Due to external noise problems (close proximity of site to roads and railway), acoustically lined ductwork is used for incoming and exhaust ventilation. This provides enough ventilation for normal summer temperatures. In extremes, additional windows and patio doors can be opened to provide additional ventilation.



- The ICT suite, which is the area of highest heat load, has air cooling which uses a heat pump linked to the ground source heating system, operating in reverse.
- Foundation design: the location of trees was taken into account in designing the raft foundation for the building, which was thickened at the perimeter where clay heave could have caused problems.

Increased wind speeds/extreme storms

- The profile of the building is relatively aerodynamic having a low double pitch with a smooth curve over the roof of the hall.
- Roof coverings are zinc sheet with standing seems which may be less vulnerable to high winds than roofing tiles.

Priority Risks:
Priority risks were also identified. These are recognised as those risks that cannot be changed within the lifetime of the building. These risks are too expensive to change later, and include the following:

- Location of building
- Building orientation
- Thermal mass of building
- Structural building materials

Reviewing these again after completion of detailed design, it is interesting to note that a number of decisions were driven primarily by other site constraints and environmental consideration a rather than climate impact concerns. However, we have sought to mitigate some of the effects of these decisions by other means to assist resilience against climate change impacts.

Location of building – we used the lowest part of the site, though this was potentially prone to flooding. This was because, on this long, narrow site, only this part of the grounds was wide enough to accommodate the school building and provide suitable access. However, raising the floor level by 150mm compared to the previously building on the site, and implementing the sustainable urban drainage scheme mitigated the risk.

Building orientation – The classrooms face south away from the main noise sources of the road and railway. However, the classrooms now benefit from south facing terraces, which are shaded by existing mature trees. External canopies and blinds provide further solar shading.

Thermal Mass and Structural Building Materials

These items are clearly interrelated. The main framing material for the building is steel, which helps form the curved geometry of the building and provides some future flexibility, as internal walls are non-loadbearing. Internal and external walls are mainly timber framed, which was chosen as a renewable resource with low embodied energy content. This was used in conjunction with high levels of insulation, using materials of high recycled content. For robustness and for added thermal mass, a double layer of plasterboard is used on both sides of every internal wall. As is normal for a zinc roof, this is fully ventilated beneath the timber boarded substrate which supports the zinc, allowing warm air to naturally circulate in summer reducing heat transfer into the building. An underlayer of bitumen impregnated fibreboard provides further insulating separation between external and internal conditions.

The school hall and kitchen areas have the greatest building mass as these are constructed in concrete blockwork. A block of high recycled content was used to reduce its embodied energy. Blockwork was chosen in these areas for its robustness as well as its thermal mass.

Conclusions

Reviewing the effect the use of the UKCIP adaptation wizard had on the completed design of the school, I note that it had a positive impact in shaping the design in many ways, for instance in terms of shading, roof overhangs and rainwater management. Site constraints have also tended to shape the building in many other important respects, for instance orientation. Summer overheating remains a concern in much of the building stock, given recent and predicted summer temperatures. We have found some conflict between providing thermal mass and using materials of low embodied energy, chosen for environmental reasons. It has therefore been particularly important to provide sufficient natural stack ventilation in the building, not only to cater for fresh air needs but also to boost cooling when the weather produces higher temperatures outside.