Wakehurst Public School
A Sustainable Approach to Thermal Comfort

Wakehurst Public School, with a student population of 330, is located on a ridge within the northern beaches region of Sydney in New South Wales.

Activity

Wakehurst Public School undertook an investigation to find the most sustainable and effective solutions for an assembly hall that was too hot for students and staff in summer. One solution, air-conditioning, was assumed to meet the need to cool the hall. However, this solution meant ongoing costs and had far reaching consequences for the school finances and air quality, and there would be an environmental impact of adding CO_2 to the atmosphere. This raised an important question – was there a better and more sustainable approach to cooling the hall? Both the architects and the builder who completed the work were keen to be involved; they are aware of the problems caused by the trend to instinctively rely on electrical appliances rather than imaginative passive solar building practices. The recommendations were approved by the school community and implemented, and have proved to be an affordable as well as environmentally friendly solution.

The Process

The Wakehurst PS Parents & Citizens (P&C) successfully applied for an 'Investing in our Schools' grant, an initiative of the previous Federal government and available to parent bodies. An amount of $80,000 was allocated to cool the school hall and classrooms. The first idea was to use air conditioning systems for the hall and metal louvre awnings to shade classrooms.

A common reaction to climate comfort or 'control' in many homes, schools and businesses is to install air-conditioning to combat the summer heat and coolness in winter. Here we show school

communities how we researched our needs using a simple survey, investigated all solutions using a problem solving model and called for professional advice to develop sustainable solutions.

The collaborative process was of great importance for our school community, allowing issues to be identified and resolved in a harmonious way. We now have more comfortable buildings and a reduced, rather than increased need for power.

The key steps in our problem-solving process were:

- Conduct a survey of teacher perceptions of climate comfort throughout the school.
- Carry out an audit of existing buildings, recording any relevant features, e.g. insulation, state of windows and doors, orientation, shade.
- Analyse problems and evaluate possible solutions offered by the architects.
- Present the architects' report to the school community and adopt their recommendations.
- Find a builder with a reputation for sound, sustainable building practices.

A survey was written to find out how staff rated the 'climate' in their classrooms. This showed that overall there was a high level of satisfaction with many classrooms, a few with mild issues and one block that stood out as both the hottest and the coldest. When we asked the General Assistant to investigate whether we had insulation, we discovered that this block had no insulation. While the rest of the school did have bulk thermal insulation, it was old and not very effective. The building with the most extreme heat and cold not only had no insulation, but faces west across a large section of asphalt with no protection from the hot afternoon sun.

Our school is situated on the ridge at Belrose, with the usual coastal summer winds and climate. The original architects had done a great job in providing maximum light and ventilation opportunities, as each classroom and the hall are well equipped with windows: all have two complete walls with three levels of windows, a row of small hoppers top and bottom, and large double opening casement windows in the middle. In the hall, the whole north-facing wall consists of opening glass doors leading onto a covered verandah. We used a light meter for our energy audit, and found that nearly all classrooms had adequate natural light.

However, in the hall many of the numerous doors and windows were either not being used at all, or were not being used effectively. The main (opening) windows in the front stage area had been covered with timber to prevent children falling into them. When the painters came about fifteen years ago, they removed the winders on the high hopper windows and never replaced them, so most were permanently shut, with some smaller ones permanently open. Yet if opened, these high windows would draw the hot air out. The French doors opened inwards to the hall and therefore were mostly kept shut for assemblies in order to maximise space. Hence our hall, beautifully designed and situated to catch the north-easterly breeze in summer, was instead often hot during afternoon assemblies in the summer months.

Steve Crosby, an architect, who has been designing environmentally sustainable buildings for over thirty years, came to advise us. He immediately gave many simple, practical suggestions to improve airflow and temperature. We decided we needed an architect to evaluate the current situation and options according to the economic costs, durability, environmental costs/sustainability, functionality and aesthetics. This information was presented to the P & C and staff so that we could decide how best to proceed.

Unfortunately, Steve was unable at the time to accept the job of preparing such a report, but offered to supervise an advanced architecture student. We found Matt Trigg, who had completed his architecture degree and was finishing his Masters of Sustainable Building.

Matt prepared the report, which is arranged in a carefully thought-out sequence. He started with the individual: how age and weight influence the individual differences in how temperature is experienced, our sometimes unrealistic expectations, the need to dress appropriately, how exercise improves our circulation and why fresh air is healthier than air-conditioned air. There is also some

evidence that humans need to experience in childhood the range of temperatures which they will experience in adulthood. It may be detrimental to health to maintain indoor temperatures between 20 and 26 degrees, rather than allowing the body to acclimatise to different temperatures.

The architects explained the need to use existing buildings in the most effective ways by understanding the correct use of windows, blinds, heaters and fans, for example understanding which of the double opening casement windows to open. People sometimes opened both together, not realising they blocked each other and so prevented air flow. Steve explained how to determine the direction of the wind to decide which window to open on each side of the room. By observing the school flag or nearby branches it is easy to see which way the wind is blowing. Then the windows on one side of the room are opened to catch that breeze and direct it into the room. To create airflow, it is vital to open windows on both sides of the room. On the opposite side, it will be most effective to open the windows which the wind will bounce off, creating an area of low pressure so that air is drawn out of the classroom to equalise the pressure (the Venturi effect). He emphasised the helpful role of carefully planted vegetation in providing shade and cooling air.

Windows should be uncovered on winter mornings to allow early sunlight to warm the room. However, in summer if heat is a problem, blinds should be down overnight to stop the low early sunlight from entering.

Fans should be used, not only on hot summer days, but also on cold winter days to circulate the hot air that collects near the ceilings. Energy-efficient fans with summer/winter switches were recommended.

The report then discussed the critical need for good insulation and suggested possible modifications to the existing structures. Our original architect, Steve, provided the basic specifications for proposed works and their estimated costs. The two architects presented their recommendations, which were warmly received at a meeting of parents and staff.

Matt Trigg's report detailed the problems associated with air-conditioning: increased electricity demand on existing wiring, increased electricity usage, increased greenhouse gases, ongoing maintenance and potential health issues. He showed us that we had the opportunity to achieve a more comfortable environment with simple, sustainable measures.

The most important single recommendation was to re-insulate the whole school, as the original insulation, where it existed, was now so compressed and blocked with dust that it was very ineffective. It is the air spaces in bulk insulation which do the work. At $11,250 this was a very cost effective measure. The P & C employed a builder recommended by the architect for his intelligent, environmentally sound approach. He was contracted to make the following changes:

1. Almost the whole school was re-fitted with insulation R-value 3.5, a great improvement on what was available when the school was built in the 1960s.
2. Attractive awnings were built to shade the windows where direct sun was a problem. The architect's design allows airflow up through the gap between the awning and the building so that hot air does not build up against the windows and bring heat into the room.
3. Windows in the hall and classrooms were repaired to enable easy opening and closing.
4. In the hall, the glass doors were rehung to open outwards onto the verandah, creating more space in the hall and safer emergency exits.

5. The metal verandah roof was insulated to stop heat radiating downwards in summer or being lost in winter.
6. Louvre windows were installed to optimise airflow.
7. More energy efficient ceiling fans, with reverse winter/summer switches, were installed in all classrooms. One disappointing surprise was that current regulations meant that the new fans had to be set at a lower speed than our old ones. Hence they seemed a little less effective in summer. However, they clearly warmed the rooms in winter. The wall fans installed in the assembly room proved too noisy for a quiet assembly, though very effective at generating a breeze.
8. Native trees were planted outside the classrooms. Species were carefully chosen with branching patterns that would provide some shade, without overly darkening the room.
9. Thermometers are used in the classrooms and administrative building to help increase daily awareness of temperature and the recommended thresholds for using heaters or air-conditioners.

Much of the report has universal applicability and would be an excellent starting point for any school considering these issues.

Teaching and Learning

This has been a learning process with involved parents, teachers and students learning how we can all take steps to improve our thermal comfort without flicking a switch. To begin with, we all need to take personal responsibility by dressing sensibly. Ongoing education each year will encourage students and teachers to use the building in the most efficient way: opening the right windows to maximise air flow in summer, and shutting doors and using fans in winter to circulate warm air when the heaters are on. A laminated A4 page of instructions in each classroom explains how these simple, but often overlooked steps can make a real difference. Our student 'Green Team' leaders talk in assembly about these procedures and each class has student 'Power Rangers' to make sure that lights, heaters and computers are turned off when they are not in use, or that if heaters are on, so are the fans and the door is shut. As the class leaves the room each recess and lunchtime in winter, the door should be shut.

Outcomes

- The school now has a very comfortable hall with fresh natural ventilation and great flexibility in controlling air flow. It is also aesthetically pleasing as when all the glass doors are open, it resembles a pavilion, open to the verandah and the view of the playground trees and grass. The verandah is also much more comfortable since under roof insulation was installed.
- All the school buildings are cooler in summer and warmer in winter due to the new insulation.
- Classrooms suffering from direct sunlight are now shaded with awnings and growing trees.
- The measures were very cost-effective with relatively low expenditures making permanent, significant improvements.
- Parent and staff representatives worked co-operatively to seek appropriate advice and then easily reached unanimous agreement as to the best way to progress. The school newsletter, meetings and assemblies were used to explain the actions so that the whole school community learned about sustainable building practices.
- The decision to use sustainable building practices and not to install an air-conditioner meant that:

i) there will be no increased, ongoing costs for power and maintenance. Instead, there may even be a slight decrease in the use of heating

ii) we have not increased our CO_2 production; we have avoided using an air-conditioning system that would have consumed electricity. Each kilowatt hour of electricity from a coal-burning power station causes the equivalent of 1 kilogram of CO_2.

We have reached a sustainable solution, with the introduction of solar passive ideals as recommended by the Greenhouse Office. It has been a very satisfying process; the problem was solved and the school now has a comfortable hall and classrooms, as well as a school community which is more aware of sustainable practices.

Resources

1. Wakehurst Public School Sustainable Design Review (PDF)
2. 'Are you hot, cold or just right?' May 2007 survey of climatic comfort in rooms
3. Brief to consultant
4. A4 laminated instructions

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