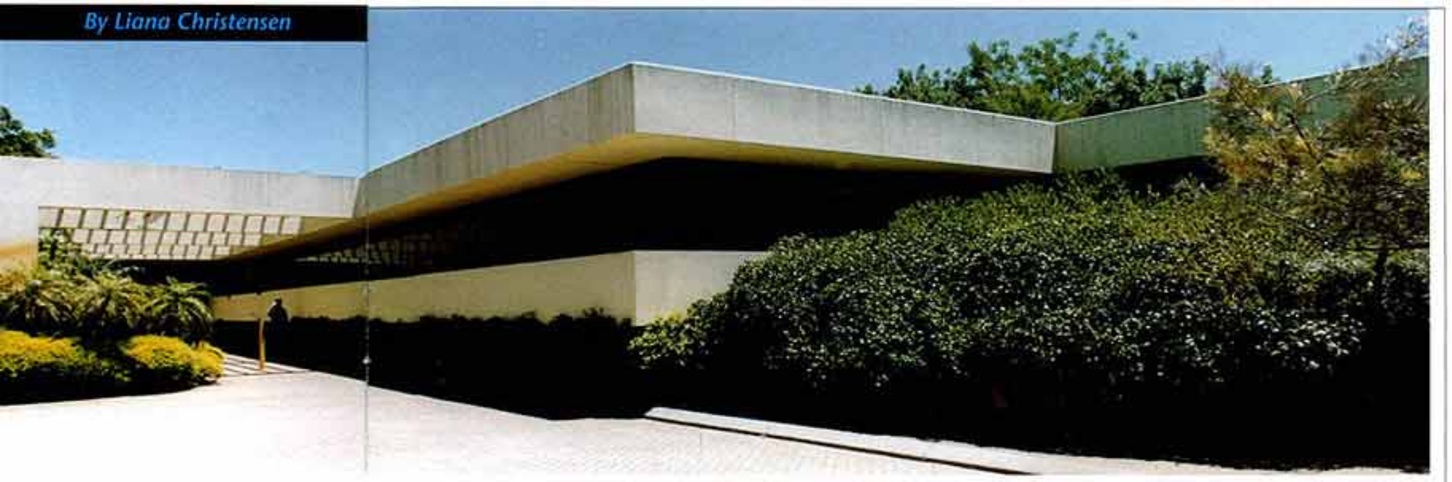
By Liana Christensen



Above: City of Bayswater administration centre.

Right: Perth Zoo's administration building. Passive solar design principles, a roof-mounted solar air collector, night cooling and indirect evaporative cooling all contribute to reduced energy consumption.

Below: Two detailed views of the Zoo building. First, looking up to the glazed internal atrium roof, showing solar control blades and second, the solar pergola, making the most of winter sunlight while keeping summer sun at bay.

Why it's cooler at the zoo

What's the difference between two similar sized office blocks, both winners of Royal Australian Institute of Architects Awards and having comparable administrative functions?

A COMPARATIVE study of energy use in the City of Bayswater administration centre and the Perth Zoo administration building showed that the zoo building was 80% more energy efficient.

"We already knew in a general way that the zoo building was energy efficient," explained University of Western Australia researchers Katia Defendi and Wendy Lindon.

"After all, it was designed to be solar-efficient and had won a WA Energy Efficiency Award in 1996. But we wanted accurate measurements of the degree of energy efficiency and potential cost savings, especially in comparison with a similar building of traditional design.

"This sort of information is available for houses but not so readily available for commercial buildings. We particularly wanted to know how the staff rated both buildings in terms of comfort in the workplace."

Ms Lindon explained that the zoo staff's work required them to enter and leave their building frequently.

"Consequently, the zoo building was designed to function between 19°C and 26°C so that staff were subject to smaller temperature swings between internal and external temperatures on entering or leaving the building," she said.

"In comparison, the control building was designed to operate between 20°C and 24°C."

But results showed that both buildings achieved similar comfort levels.

"The big difference is that the zoo building consumed 80% less energy than the control building in doing so," said Ms Defendi.

A proportion of the energy saved was due to the wider temperature range allowed in the zoo building but most of it was achieved by innovative design. (see box , this page).

The researchers measured the performance of both buildings over 12 months when outside air temperatures ranged from 0.9°C to 41.4°C. Across this temperature range, at least twice as many zoo staff reported feeling more in control of the heat, noise and light levels of their offices as staff in the control building.

"One big advantage gained through the energy efficient design of the zoo building was that the zoning of offices created a quieter, more pleasant workplace," said Ms Defendi.

Of course, no system is perfect. There were small operational glitches with the air conditioning systems in both buildings during summer.

"The perceived comfort levels in both buildings dropped considerably in summer because of these problems," said Ms Lindon, "but they were easily fixed and we expect comfort levels to rise accordingly."

Like conventional designs, the energy-efficient system requires good maintenance and a swift response to reports of faults to operate well. However occupants do need training to understand when to open windows and blinds, according to the UWA researchers.

"Training the maintenance people might be a good thing too," added Ms Defendi.

"We only found out very late in the study that, from time to time, the air conditioning system was being manually switched off at the mains. So the zoo building may be even more energy efficient than our figures show."

To see a copy of the report, please contact The Office of Energy on phone (08) 9321 1477, or Baverstock, Murphy & Associates on phone (08) 9474 2770.

The roof-mounted solar air collector.

How did they do that?

Baverstock, Murphy & Associates, designer of the Perth Zoo building, has refined its innovative, energy-efficient building designs over 20 years.

"Our strategy is threefold," explained Garry Baverstock, the firm's senior partner. "The Perth Zoo building was designed using a blend of passive solar principles, backed up with minimal electrical and mechanical systems."

Passive solar design principles aim to optimise temperature and comfort levels through correct solar orientation and the use of building materials with a high thermal mass.

North-facing windows capture the abundant and free energy of the sun during the colder months. This heat is stored in the thermal mass during the day and released when the sun has set, providing baseline heating in winter.

Added to this is a roof-mounted solar air collector that heats air in much the same way as the common solar water heater heats water. Fans direct this warmed air through the building. On only the coldest days is it necessary to boost temperatures by using the heating cycle of a reverse-cycle air conditioner.

On summer nights, the night cooling mode is activated. Heat accumulated in the thermal mass during the day is ventilated through exhaust fans and the building cools down to within one or two degrees of the outside temperature.

"That way we get 12 hours ahead of the weather," explained Mr Baverstock.

The next step is indirect evaporative air conditioning, which supplies interiors with dry, cool air. This is an improvement on the humidity associated with standard evaporative cooling.

Finally, the cooling cycle of a conventional refrigerative reverse-cycle air conditioner is used to maintain comfort during the worst heatwaves.

The results speak for themselves; the zoo building achieved a 50% saving in lighting bills and a 75% saving in air conditioning costs.

North facing windows with eaves