SUSTAINABLE DESIGN SHOWCASED IN WANAKA

The inland Otago climate poses challenges for designers and builders. A new home close to Wanaka, created for comfort and energy efficiency, has used passive solar design to respond to the climatic extremes of the location.

By Jessica Winter, Building Project Co-ordinator, Sustainable Wanaka

The house's designer and owner, Anne Salmond, is the director of a local architectural practice, and is interested in energy efficiency and sustainable design. Anne saw the construction of her new home as a perfect opportunity to test the performance of a range of design features.

Research on the house is being carried out by Sustainable Wanaka, an organisation involved in sustainable building research. So far, they have modelled the house using energy analysis software and are now monitoring the internal temperature and energy consumption.

Figure 1: Two evaculated tube solar collectors on the north-facing roof provide all the family's hot water from September to April, and also heat water for a spa bath. The roof-lights visible provide good cross-ventilation in summer.

Many features for little cost

In winter the house site is cold, frosty and shaded until 10 a.m., when the daytime temperature range is -5–10°C. Deciduous trees provide shade in summer, when temperatures range from 10–30°C. Orientation, thermal mass, super insulation, high quality glazing, and an attached conservatory were important features to achieve a passively heated home. Other sustainable design features include solar water heating and timber and stone linings and cladding (see Figure 1). A heat pump provides energy for the underfloor heating. The house is also independent for water supply and waste water treatment.

The house is oriented to the north for maximum solar access and passive solar gain on the long narrow section. Thermal mass in the form of exposed concrete floors store heat absorbed during the day and re-radiate it at night. The levels of insulation are high compared to the New Zealand Building Code – R5 in the roof, R3.5 in the walls and argon-filled double glazing with composite timber-aluminium frames. The effect of the passive solar design is dramatic when compared to neighbouring properties oriented towards the view to the west rather than to the north. The house is considerably warmer in winter and cooler in summer.

There was virtually no extra cost for the passive design because the features were integral to the design from the beginning. The solar water heating system added approximately $4,500, the water tanks and supply from the bore and roof approximately $6,000 and the septic tank and drainage field approximately $10,000. Argon gas fill in the double glazing for the living room and main bedroom added about $300 to the glazing cost.

Conservatory heats/cools home

The conservatory is used to regulate the temperature of the house, capturing heat from the sun which is then vented into the main house (see Figure 2). The effect is especially noticeable in spring and autumn when sunshine hours are increasing but exterior temperatures are still often low. In summer, when night-time temperatures in Wanaka regularly drop below 10°C, cool air from the conservatory can be drawn into the house to purge heat which has been retained from the daytime.

Other options were considered for this house and rejected. Wool insulation wasn't used because of concerns that it may lose its insulation value if moisture got into the roof (although this should not be an issue if the construction is sound). Timber window frames were also rejected because of the high cost and reputed high maintenance.

Lessons learnt

Several lessons were learned over the course of the project. One was that a timer is essential for the solar water heating system to ensure the back-up heating only operates when

necessary. Also, the heat pump's location on the shady southern side of the house means it can extract less ambient heat from the air and therefore runs less efficiently.

House performing well

The house uses only 23 kWh of heating energy per square metre per year, which is close to the 'Passivhaus' standard of 15 kWh/m^2/yr. This figure does not take into account the co-efficient of performance of the heat-pump (generally 3:1 at 15°C), which would give an even lower figure.

Temperature recordings taken in early September, when temperatures generally range from -5–15°C, show comfortable internal temperatures despite the underfloor heating being turned off during this period. Temperatures in the living room range between 21°C at 2 p.m. on a sunny day to 13°C on a night when the external temperature was below zero. On a sunny day the conservatory reached in excess of 35°C, and the heat could then be transferred to other parts of the house. Anne experimented with various ventilation configurations to optimise the effect of the conservatory (see Figure 3).

Another particular area of interest to Anne was the passive cellar (see Figure 4) which uses the constant temperature of the earth to provide a cold store and a source of 'coolth' in summer. Initial results have shown that the cellar is very constant in temperature (10–12°C) and performs better than anticipated.

Push for Eco-Design Advisor in Wanaka

Anne has experienced first-hand how a passive house can perform in practice and has learnt what the most appropriate and cost-effective measures are. This is particularly valuable in a region where little research into sustainable design has been conducted.

Sustainable Wanaka is currently conducting several studies in the region of sustainable and energy efficient buildings. In conjunction with the local council, they are applying for government funding for an Eco-Design Advisor to offer free advice on individual projects.

For more information on sustainable design in Wanaka and the Queenstown Lakes region, visit www.sustainablewanaka.co.nz and click on Building.

Figure 2: View of the conservatory which regulates the house temperature, and pergola that provides shade.

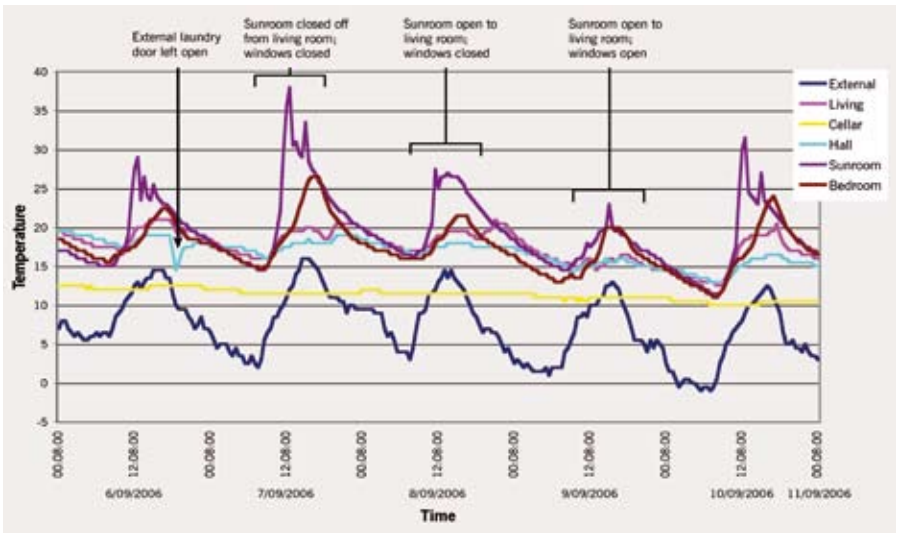

Figure 3: The conservatory is designed to collect heat from the sun and distribute it to the house as needed. The rate of ventilation in this room was varied during one week in September 2006 to test the effect.

Figure 4: The foundations are poured and the construction of the passive cellar can be seen, which provides cooling for the house.