Passive House

ACTIVE PLANET CARE

A certified passive house in Wonthaggi, Victoria, constructed by www.superpodhome.com.au. Photo: Fiona McKenzie, Superpod Pty Ltd.

Architect, **Eric Zehrung** of Green Point Design, has been passionately involved in the sustainable architecture movement since the mid 1990s. Here he describes an exciting new design method that goes way beyond 'star ratings' for slashing home energy use.

I HAVE witnessed many improvements in the way we build. One of the latest tools to emerge in Australia is 'Passive House' – a building technology combining a high quality air supply with ultra energy-efficient heating and cooling. It is based on the physics of heat transmission and is accurate, predictable and verifiable.

My own path into sustainable buildings started 20 years ago when we bought rural land and built a small mudbrick home with whitewashed walls, bush poles, solar power and a composting toilet — near Daylesford in Central Victoria. At the time, we relied on rules of thumb for proportions, glazing area, and thermal mass to incorporate passive solar principles. Several years later, circumstances changed, and we moved into town and built another home. That was an experiment in readily available materials, and incorporated earth-sheltered and passive solar design principles. It too was very comfortable to live in.

Throughout our moves, I was establishing my architectural practice and worked on many interesting projects with enthusiastic clients exploring all aspects of energy efficiency and sustainability.

Around 2003 the energy star rating system was becoming embedded into the national building code, and while I support the concept of energy efficiency, I have never been inspired by star ratings. It is too simplistic, lacks detail, omits important criteria, is not inspected, and has had little post-occupancy assessment.

For those of us wishing to push

A thermal image of an 1899 Brooklyn brownstone building renovated to Passive House level on a cold evening in New York, USA. The infrared camera shot demonstrates the energy efficiency of this Passive House home compared to the surrounding buildings. 'Tighthouse', Brooklyn, New York, USA by Fete Nature Architecture. Photo: Sam Mcafee.

Airtight connectors between wood components in a Passive House under construction. Passive House Institute, Darmstadt, Germany.

further, there was little empirical information. Some well-performing buildings were built, but there was often a gap between expectation and reality.

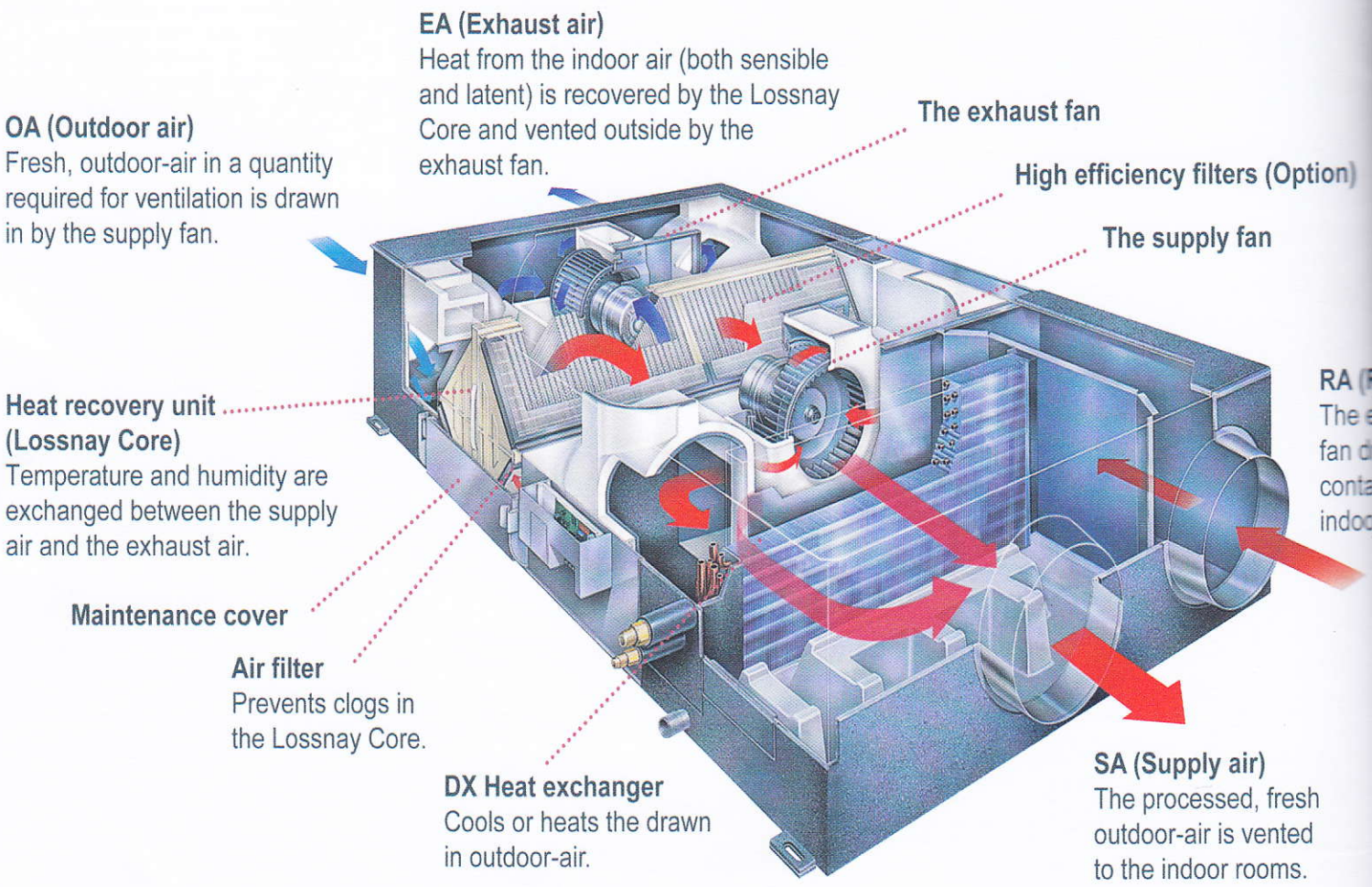
A few years ago, I stumbled across the Passive House concept — already common in Europe — and was impressed by its simplicity and accuracy. Passive House is easiest to describe back to front – beginning with indoor air quality. Most buildings obtain fresh air by opening windows in fair weather, and at other times rely on infiltration through gaps and cracks in the floor, walls and roof. Passive House on the other hand, begins with a small ventilation system that delivers continuous filtered outdoor air evenly throughout the building. The ducts are only about 10cm in diameter and run continuously at low power to deliver about eight complete air changes per day. The real innovation was combining the fresh air system with a honeycomb-like heat exchanger. As warm indoor air is expelled, it transfers at least 75 per cent of its heat to the cool incoming air.

With ventilation and air quality addressed, we are free to make the external walls, roof and floor as airtight, insulated and robust as we like without risking a stuffy building. Passive House buildings typically have more insulation and better quality windows than standard code-compliant buildings. They are also airtight and able to retain heat very well.

While a number of technical criteria must be achieved*, the one that excites people is the "maximum heat load". A Passive House can use up to 10 watts per square metre for heating. (A similar figure for cooling in warm climates.) For example, a 150 square metre home must be built to require no more than 1500 watts to remain between 20 and 25 degrees on the most extreme day of the year. That equates to a single heating panel for an entire building!

IS IT CHEAPER TO RUN?

Making comparisons can be complicated by a number of variables

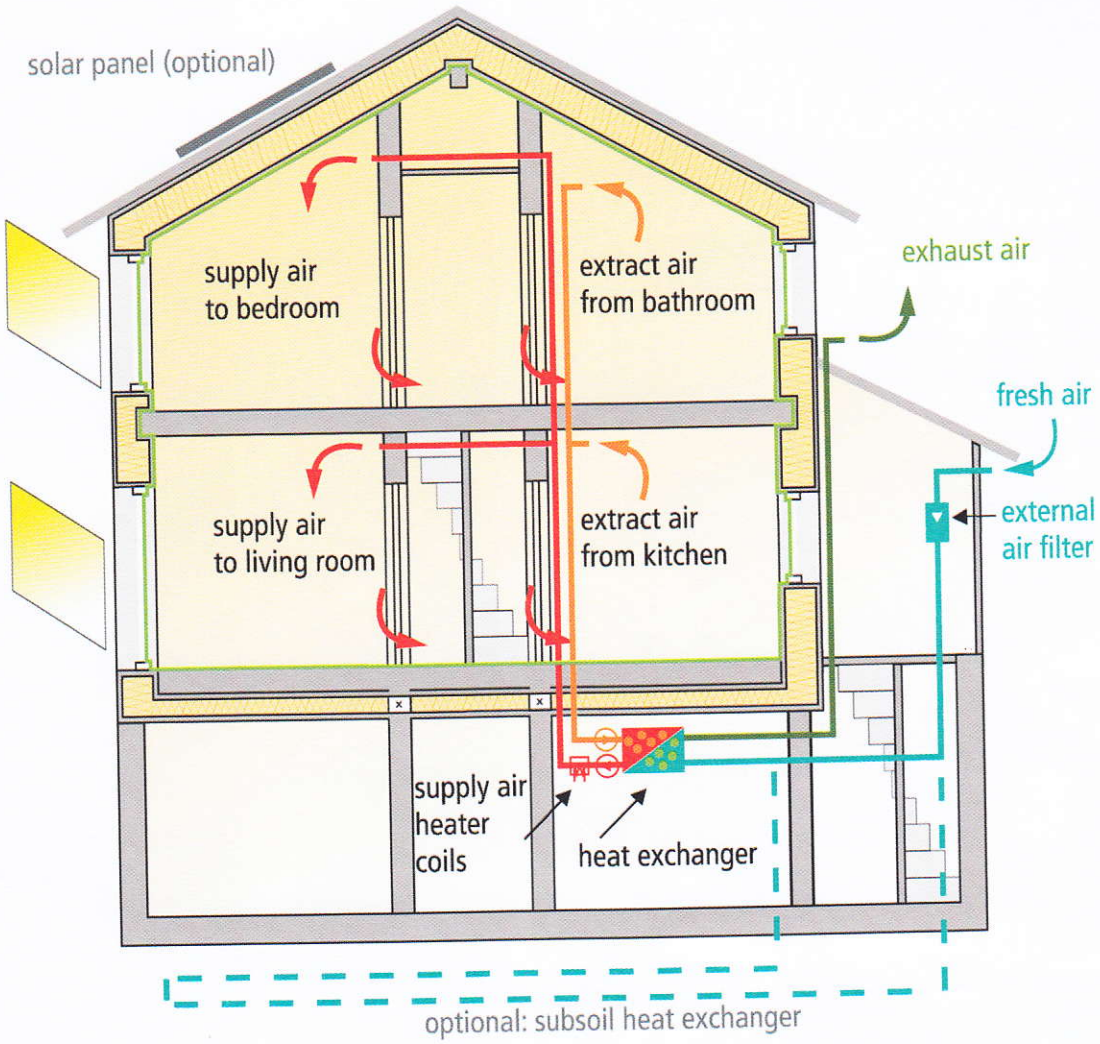


A heat exchange pump used in a typical passive house to cool or heat the drawn-in outside air. Unit by Mitsubishi Electric Australia.

and assumptions, but I will offer some calculated examples based on our 150 square metre home. The Passive House version is simple since in the standard it's defined as requiring 15Kwh per square metre per year each for heating and cooling no matter the design or location. (150sm x 15Kwh/sm.yr = 2250 Kwh/yr.) For the code compliant common Australian house version, I modelled a simple "L" shaped building with standard materials and electric heating and cooling. The type of building that would achieve a 6-star rating, but nothing special. It is based on Melbourne climate data requiring a mix of heating and cooling to remain within the 20-25 degree range. I ran an energy simulation with the following results.

	Common Australian house	Passive House	* Passive House with high-efficiency heat pump.
Heating	4879 Kwh/yr	2250 Kwh/yr	608 Kwh/yr
Cooling	3551 Kwh/yr	2250 Kwh/yr	608 Kwh/yr
Total	8430 Kwh/yr	4500 Kwh/yr	1216 Kwh/yr

* Assumes a heat pump with coefficient of performance of 3.0 and distribution efficiency of 90% = 2.7.



A Passive House Ventilation Diagram. Passive House Institute, Darmstadt, Germany.

I prefer to present the figures in terms of Kwh/yr rather than dollars since energy sources and costs vary so much. For example, if you heat with your own wood supply (which is possible with Passive House) the saving might be in the form of sweat rather than dollars. Passive House calculations also include economics modelling to compare the upfront additional building costs with energy savings over time. The Passive House Institute is very aware that the approach will only achieve widespread acceptance if it makes economic sense.

I was initially uneasy at the thought of being sealed up in an airtight house. In mild weather, however, open the windows and enjoy the breeze! Once we start using energy to heat or cool, we naturally close windows anyway, so day to day life need not be different in a Passive House.

My architectural practice had adapted some exciting 3D design software that dovetails with energy modelling and Passive House. This allows us to generate real time reports as we design. For example, I can add a window or extend an eave overhang and get immediate feedback on the annual energy use.

With only a handful of certified buildings in Australia, Passive House is just emerging here. I am really excited to be working at the beginning of this new development in the broader conversation of sustainability in Australia.

- *www.greenpointdesign.com.au*