

Cow dung meets steel and straw bale at Wensleydale

BY ROY ADCOCK

John Budd has a long history with low impact, energy efficient buildings and systems. His wife Simone's specialty is in the area of environmental education, waste management and minimisation, so its no surprise that this couple have planned and built a house that consistently follows through with their experience and philosophy. Applying high ideals, they have owner built a remarkable and sensitive environmental house at Wensleydale, Victoria, with a huge amount of planning and attention to passive low impact principles.

Like every house, there are compromises but it's hard to tell where these may be in the final construction. However, the reality is that one only achieves what one aims for. Juggling between ideals and compromise was an ongoing feature of this building. John likes to quote Henry Thoreau.

'In the long run, men hit only what they aim at. Therefore, though they should fail immediately, they had better aim at something high.'

Henry Thoreau, 1854



Building philosophy

The building had to incorporate renewable low energy construction methods, with low embodied energy materials. It had to be passive, efficient to run and produce a minimum of waste. Compromises occurred right from the start when John and Simone had to weigh up the placement of PVC conduits (not desirable) within the rammed earth walls. Alternatives to PVC were not readily available and construction could not be delayed.

John believes that in absolute terms the building is bigger and used more resources than they really needed as a family of four.

Specified building elements included:

- Organic tactile feel using natural materials.
- Low embodied energy materials, low cost, minimum waste.
- Using waste in construction (cow poo and straw bale).
- Steel frame structure including steel sub-floor (recycled and recyclable).
- Straw bale external walls, lime rendered (insulation and fire rating).



- Rammed earth central courtyard.
- Fire resistant deck and eave construction (wild fire exposure).
- Steel roof without roof battens; large overhanging eaves protecting walls (fire-resistant design).
- Insulation in excess of minimum requirements.
- Composting toilets with courtyard heat traps to aid efficient composting.
- Solar hot water system.
- Solar power system, LEDs and compact fluorescent lights.
- Salvaged flooring finished with natural wax and oil.
- Cow dung earth floor in main lounge area.
- Own labour in construction as far as possible.

Architectural brief

The building sits within a densely forested area so orientation to the north for light, passive heating and optimal placement of solar panels was essential.

The house is conceived in four blocks, which wrap around an open internal rammed earth courtyard. This was devised to provide thermal mass and also bring light to the central areas of the house. It importantly creates an internal north-facing wall area which ensures that the central bathrooms have plenty of light and ventilation and the composting toilets' air intakes could be pre-warmed by the sun to make them more efficient.



1. The nearly completed house is an absolute credit to its owner builders and their quest for an energy efficient home.
2. Living area is on the lower level with expansive north facing windows. Stairs lead up to dining area and kitchen.
3. Bathroom basin area has an adjacent composting toilet.
4. Cooking and food preparation are accomplished with minimal fuss and energy waste by using either the gas or wood-fired stoves.



- 5. A thoroughly considered combination of good design and sensible usage.
- 6. Beautiful cow dung and earth floor plus rammed earth walling combines organic beauty with additional thermal mass.
- 7. Compact and efficient kitchen.
- 8. Dining area is on the middle level.

The house design features four levels, grading up progressively away from the north to facilitate efficient passive convection airflow. The lowest level with a natural earth/cow dung floor, leads to the progressively elevated areas including kitchen, dining, living and sleeping areas. Flooring is salvaged jarrah (*Eucalyptus marginata*) sealed with natural oils and wax.

All external walls are non-loadbearing straw bale infill within a light-weight loadbearing steel structure. Internal walls are steel frame clad in plasterboard.

The roof line is pitched at 11 degrees to allow maximum northern sun penetration to the living areas in winter and also allows sunlight to reach the internal courtyard. The roof carries an array of photovoltaic panels that powers the whole building.

John drew up the detailed plans himself and then consulted architect Richard Lowe to develop the concept plans. Thereafter, they consulted Glenda Shomaly who has extensive experience with non-conventional building materials with a strong focus on energy efficient construction.

The steel structure

The steel structure was slightly unusual in a few respects.

1: The straw bale was supported in the elevated areas on the steelwork, and not built from the ground up as would be the normal practice. In the end this exceeded wall load estimates and additional steelwork supports were required on perimeter walls.

2: The roof is designed with graded rafters and no roof battens. This eliminates some construction elements but is more complex to design as almost all rafters are of a different size.

3: The eaves incorporate reinforced outriggers to eliminate cavities and fire entry points on all sides, while at the same time providing the required overhang and sun protection specified. External sub-floor openings were framed in steel and clad in cement sheet, then rendered to match the straw bale walls above. Again, this is a fire entry precaution but also completes the solid structural look of the overall building.

4: The straw bale framing columns were set back from the face of the bale to allow additional render and limit thermal bridging.

Straw and earth

Bales were laid on steel floor ladders filled with scoria for drainage, and sandwiched between the 350mm wide steel columns. Bale compression was achieved using wide nylon webbed truck restraints, then bundled down with nylon packing straps and crimps. Thereafter the bales were groomed and strapped with steel straps and tensioners. Bales were generally compressed in lots of four between horizontal ladders and screwed off to the side columns progressively.

Wire mesh was then attached to the bale inside and outside with wire staples (an endless job according to John!), before the render was added. Rendering up to 50mm thick was applied by hand in three lime and sand coats with an oxide finish wash. John and Simone deliberately chose hand applied rendering as this promised the best overall results. Well rendered straw bale also offers excellent fire rating qualities.

Although the rammed earth walls are the weakest point in the building thermally from an R-rating point of view, the thermal mass combined with the organic and tactile feel was the desired result. Overall cost of this sub-contracted component amounted to \$20,000.

Eventually, the courtyard created by these rammed earth walls will contain lush green planting with important additional functions for light and compost toilet efficiency.

Cow poo floor

Probably the most unusual feature of this home is the earth/cow dung floor in the lounge room area. It looks fabulous and has the feel of leather underfoot. The finish is subtle and has a dark gentle lustre. Kids like to lie on it. It is organic and warm to the touch.

Using the guiding construction principles of low material cost with their own intensive labour, John and Simone laid a deep bed of crushed rock as the base. Then followed a sand bed, polyethylene membrane and structural polystyrene insulation. On top, two layers of clay/sand/cow dung were laid in two separate passes culminating in a finished thickness between 90 to 130mm, with the last layer trowelled into level. Over the weeks, as the material dried out, repairs were made to the cracks and the surface was then



All good OB projects deserve a solar shed!

finished with several coats of boiled linseed oil, citrus thinners and tint. Finally a wax polish finish was applied. From start to finish the process took around three months, but for most who see and 'feel' this space, it is the icing on the cake and somehow welds all the organic low impact principles into a convincing whole.

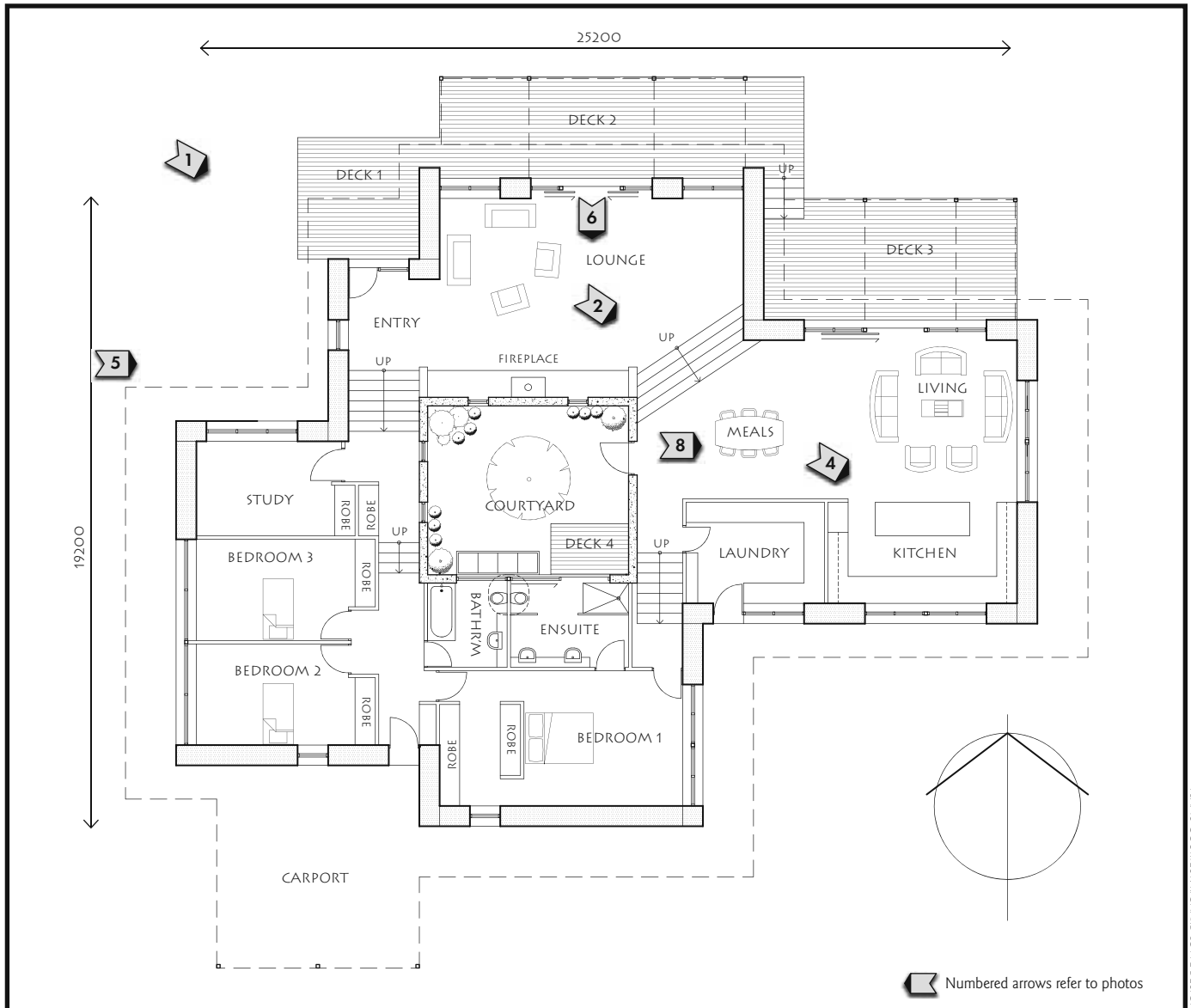
Insulation

Because the roof rafters were 300mm deep, the space was used to optimise insulation by adding additional ceiling batts. Two layers of R3.5 battens were used to achieve something between R6 and R7. Note: the analysis of energy ratings on domestic buildings aims to achieve minimum standards, so it is sometimes difficult to exceed the standards and get full credit for doing this. The same applies to straw bale R values, where the rating system significantly underrates the performance of a fully rendered straw bale wall.

Solar systems

Living with the natural limits of resources including solar power and understanding one's usage and footprint, is part of this home's philosophy. No power is connected to the grid although it is available.

A fully stand-alone solar system of 3kW with an auto-start generator backup powers this Tardis. In due course a wind generator is planned to help overcome the lack of sunshine in those southern Victoria winter months. What



PLANS COURTESY RICHARD LOWE DESIGN

power is harvested and can be stored is all that is available, and the family has to fit in with these limitations. All aspects of power usage were considered from the choice of appliances and lights to the appropriate duration of showers. The system features:

- Low energy lighting throughout, with LEDs for task lighting and hallways and compact fluorescents for ambient lighting.
- A laptop computer controls the system and monitors inputs and outputs.
- All batteries and other components housed out of sight under floors or on roof.
- Wood stove booster to solar hot water system, with gravity feed lines (low energy use).

- 240v power for fridge, washing machine, computers and television.
- Waterless toilets (solar charged 12v air extract system).

Composting toilet system

The toilets installed are waterless composting units manufactured by *Rota-Loo*. The system uses multiple rotatable bins so that material can decompose progressively and does not mix old and new. A fan with backup power supply keeps air flowing continuously and ensures the system is completely odourless and liquids are evaporated out through the flue. Evaporation is helped with solar pre-heated fan air intakes on the northern wall within the courtyard. Generally the rotation of the bins is done every six to eight

weeks (takes 10 minutes to do), and the final decomposed bin will therefore be emptied after about 12 months from a new installation. The material at this end stage is completely broken down and ready to use as fine compost. Of course no water or chemicals are used in these toilets and organic material such as a handful of pea straw is all that is required once a week to help maintain aerobic action in the bins. A beautiful environmental and sustainable solution for taking responsibility for one's own waste.

John has had prior experience with retrofitting one of these toilets to a former home and he and Simone wouldn't ever consider installing anything else. The only slightly odd thing with these toilets is that for a while one keeps wondering why the last



guest did not flush... then the penny drops! After a life-time of pouring clean water down the drain it's a great thing to get used to.

Heating

There is a gas stove fuelled by bottled gas and a separate wood-fired stove, which also acts as a booster to the solar hot water system.

When you make your own power, it's not a matter of simply turning on a new appliance. Everything needs to be balanced with your capacity to generate power and heat. Heating and cooling need alternative solutions and the more these are designed into the structure as passive elements the better. As noted in the introduction, the house is ramped up through several levels, so that warmth generated at the lower northern exposures will move via convection into the upper areas.

The rammed earth, solid floors and long concrete shelf near the main fire all act as heat banks for passive heat storage during sunlight hours or when the fire is operating. The four 'compartments' of the house can also be closed off from each other to help manage temperature flow. Adjustable sunshades on the northern exposure help manage summer and winter sun.

Liveability

John believes that this is a \$450,000 building if it was constructed in the conventional way. Being an owner builder his overall costs have come in around \$250,000.

There is so much in this house that it almost needs a book in its own right. Some of the features I have described may go a little way to explain the story and workability behind each decision,



Above left: Open plan kitchen, dining and living areas are on one level.

Above: Enclosed sub-floors minimise fire risk.
Right: A perfect window to display a treasure.

but each is only a part of this organic whole. The whole is a thoroughly considered but calm statement that is welcoming, tactile, gentle and organic.

It feels right and is an absolute credit to its owner builders who believe passionately enough to attempt to achieve what every building in Australia should be aspiring to achieve every day. ■



• Radiant Energy Systems

Design, installation and maintenance of grid feed and stand-alone solar PV systems, as well as vertical and horizontal axis wind generators. 1800 241 670, <http://users.pipeline.com.au/~solar>

• Balance Steelframe

Manufacturer of steel house frames, roof trusses and floor systems, mainly for the owner builder. 03 4208 0261, www.balancesteelframe.com.au

• Richard Lowe

Architect. 03 5222 6314

• Glenda Shomaly Eco Building Design

Building design consultant. 03 5261 6266

• Michael Meesen

Builder. 03 5266 1570

• Rob Phillips

Straw bale render/earth floor. 03 5236 3205



• Nullabor Sustainable Timber Industries

Recycled and salvaged timber. 03 5248 3377, www.nullarbortimber.com.au

• Stabilised Earth Constructions

Rammed earth construction. 0408 360 245

• Rota-Loo

Waterless and odourless composting toilets. 1800 250 950, www.rotaloo.com

• J & K Windows and Doors

03 5231 2340, www.jkwindowsanddoors.com.au

• Brax Window Treatments

Custom made curtains, security doors and aluminium privacy screens. 03 5221 5533, www.braxwt.luxaflex.com.au

• Sonic Lighting

Low energy lighting. 03 5277 9977, www.soniclighting.com.au