‘The Green Swing’

Choice of building materials

By Eugenie Stockmann

Following on from TOB 170 Apr/May 2012, a development in inner-city Perth continues to test the builders’ sustainable goals.

As I write this article I am still recovering from transporting 2,000 bricks from the back yard to the first floor of our new house, now under construction. Bricks that Helmuth and I collected and cleaned by hand; you learn quickly that lime is a lot easier to remove than cement mortar! The use of (some) recycled bricks is, however, only one of the many choices we made when deciding on the building blocks for the two townhouses and two apartments that will make up The Green Swing, a small sustainable development close to Perth’s city centre.

The Green Swing and our current housing development are about the journey towards building a sustainable community. We are aware that our choices have not necessarily always been the ‘right’ ones. But this is a journey that has been called a ‘wicked’ problem and that ‘involves complexity, uncertainty, multiple stakeholders and perspectives, competing values, lack of end points and ambiguous terminology’.*1

Overall, this project is heading in the right direction, towards creating a more sustainable community model. I love sharing our experiences with you and hope that our story provides inspiration.

Decision making criteria

Most people will consider price, performance and aesthetics when selecting building materials. If your goal is to be sustainable then you need to also consider other factors including local availability, toxins, and embodied energy. The Your Home technical manual provides a comprehensive list of quick tips on how to reduce total amount of materials consumed and their impact. (See Your Home sidebar p.29).

Size matters

What is often overlooked is the size of the new dwelling. Small and smart was one of the main design criteria for our project. As a result our dwellings range from 120 to 150m² for the two townhouses and 60 to 65m² for each of the apartments. This is well below the Australian average of around 240m². A lot less materials (bricks, mortar, concrete, wood, etc.) will be needed to build these much smaller dwellings. This not only decreases the project footprint and material costs, it also inspires creativity and innovation on the inside design of floor space, storage and functionality.

Restrictions of government regulations

We found that our choice of building materials was sometimes restricted by current government policies and regulation. In particular, the building that houses the two apartments posed additional challenges compared to the individual townhouses. For instance, a suspended concrete slab (instead of lightweight framing) and glass blocks (instead of operable windows) were required to comply with the fire construction requirements.

Local council streetscape policies created a range of minor restrictions. For example, they do not allow the use of Colorbond cladding (the typical alternative, cement based weatherboard, has a much higher embodied energy); driveways were required to be paved with red bricks (which we have been able to source second-hand); and the requirement for the whole development to have a consistent appearance meant we were unable to use salvaged roof tiles for a storage shed, or face brick on one of the units.

Material choices

Let’s have a look at some of our choices.

Floors

Starting below ground level, we have selected a Termguard reticulation system to control termites. This uses a toxic chemical called Biflex which we have some misgivings about but we have similar misgivings about the other treatment options, and we know that, particularly with wood-framed construction, to do nothing could mean losing an entire house – which is really not sustainable either.

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1. Colourful array of hardwood framed double glazed windows waiting to be installed.
2. Solar PV panels and solar hot water.
3. Timber upper floor and framing.
4. Straw bale townhouse under construction.
5. Perspective rendering of the development.
6. Front door made from recycled timber.
7. Helmuth doing some finishing work on the hand made solar awnings.
8. Reverse brick veneer timber framed townhouse under construction.

9. Helmuth testing wall opening size for hand made door frame.

10. First wall of recycled bricks on the straw bale townhouse – cause for celebration after all the hard work of cleaning them!

11. Timber weatherboard and window frame.

12. Door frames made from recycled jarrah.

13. Colour matched double glazed window.

14. Work in progress – timber to be used for the kitchen cupboards.

15. Much of what would normally go to landfill as waste has been saved for recycling or reuse. Cement bags...

16. ...various plastic items...

17. ...sawdust.

Opposite page: Windows and awnings will control ventilation and solar access.
which contains a higher amount of blast furnace slag and recycled material than conventional concrete.

We didn’t use a suspended concrete slab for the upper floors of both townhouses, choosing wooden truss construction instead. One benefit of this is a quicker build time. (Note: for the apartments a suspended concrete slab was required to comply with fire construction requirements.) As a way to compensate for the reduced thermal mass upstairs, we’ve engineered the subfloor in one of the townhouses to support the load of a granite and marble tiled floor.

Other floor finishes include either bamboo or recycled wood for bedrooms, with tiles or concrete for wet areas and living areas.

**Roof and Framing**

The two townhouses use wood-framed construction, with a small number of steel beams where required by engineering. The use of plantation and recycled timber minimises our carbon footprint compared to steel. Almost all the structural wood is treated pine; the use of recycled wood for structural purposes is very difficult because of question marks around compliance with the Building Code of Australia (BCA). The builder was able to use some six metre long glued laminated timber beams (glulam) in the attic floor of one of the townhouses. These beams were rescued from a demolition site as they were heading for landfill.

The roof material is **Colorbond**. The other option was tiles. We chose **Colorbond** for its durability and low weight which reduced the amount of structural timber required.

**Walls**

*The Green Swing* development is unique in that it showcases three different construction materials for the walls: double brick, reverse brick veneer and straw bale with earthen render.

Straw bale was chosen for its low embodied energy (being a local waste product) and excellent insulating properties. The walls are breathable and moisture regulating which improves indoor air quality. If the house was ever demolished the straw walls (including the clay and lime render) are biodegradable.

We used a combination of recycled and new bricks. The straw bale house that will be my future home uses recycled bricks; due to the high cost (both supply and labour) and difficulty in getting large quantities that match, the other two buildings use new bricks. Face brick has been used where possible because it has lower embodied energy compared to a rendered/plastered finish.

Insulating the walls is important to reduce operational energy requirements. The town houses use both damaged stock (earth wool) and **GreenStuf**, a locally produced product made from recycled plastic bottles, while the apartments have standard double brick cavity insulation, which is the cheaper option.

**Windows frames and glazing**

Single-glazed aluminium framed windows are very common in Australia, but not compliant with building regulations in other parts of the world due to their poor performance as they transfer heat easily (in during summer and out during winter). Because the embodied energy in aluminium is one of the highest among building materials (according to Your Home Technical Manual section 5.2 Embodied Energy), we aimed at minimising its use. We chose aluminium only for the outdoor balustrade, which is exposed to the weather and difficult to maintain (aluminium is very durable under these conditions).

The alternatives to aluminium window frames are uPVC (unplasticised polyvinyl chloride) or wood. The choice was very difficult and we did a lot of research. uPVC is more widely available in

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**Your Home**

The Your Home Technical Manual has the following quick tips on how to reduce the total amount of materials consumed and their environmental impact:

- Design and build for de-construction, re-use, adaptation, modification and recycling.
- Make more efficient use of existing materials.
- Use fully recycled materials or materials with recycled content.
- Choose materials with a lifespan equivalent to the projected life of the building.
- Encourage development of new, efficient, low impact materials and applications by creating demand.
- Consider how and where the materials are sourced and the impacts this causes.
- Minimise the energy used to transport materials by using locally produced material.
- Use of lightweight material where appropriate also reduces transportation energy.
- Minimise the energy used to heat and cool the building by using materials that effectively modify climate extremes.
- Understand how chemicals used in the manufacture of some materials might affect your health.

*Source: www.yourhome.gov.au/technical/fs51.html*
We have used recycled materials where possible. Both Helmuth and Mark, the two men involved in the project, are keen woodworkers and have made the solar awnings, doorframes, and some doors from recycled wood (mostly jarrah). Helmuth has started working on the cabinets for our kitchen using recycled jarrah and (new) plywood for the base. The stair threads of both townhouses also promise to be a work of art and will most likely be made out of recycled timber, as will architraves, skirting boards, pelmets, and so on. Yes, we are always hunting around for supplies of quality recycled timber...

Another conscious choice for the interior was to reduce the use of plasterboard. The plan is to line the ceilings in the attic space of the townhouses with hessian bags (supplied by our favourite local coffee shop) and perhaps experiment with a traditional papier mâché finish on the walls. This decision has also saved us money as it would have been necessary to use a crane to lift the panels into the attic.

Cabinetry will be made from low-VOC materials.

Waste management

When talking about our materials selection I cannot avoid mentioning waste. Our material selection also helps to minimise waste. For instance, any excess insulation material (manufactured from recycled plastic bottles) can be returned to the factory and used again in the manufacturing process; left over straw bales will be used on the garden. We have also asked the builder to use bricks with small chips (yes, they are normally thrown out) and to try and order the right quantities. Something as simple as a plastic sheet at the bottom of the pile of sand is a great suggestion too as this helps keep sand loss to a minimum. The steps required to reduce waste sound simple but they can be difficult to implement in practice largely due to current work practices within the building industry.

I recommend anyone to consider waste management before you start a construction process. While it’s not very sexy, it is an area where you can make a big impact and is a very important part of the sustainability story.

Measuring energy performance

While we were confident that our decision making process had resulted in a reduced environmental footprint, it is incredibly difficult to calculate exactly how much. We were particularly keen to find out how the different buildings compared considering they all used different building materials: conventional double brick, reverse brick veneer and straw bale.

We considered carbon emissions relating to transport in our decision making and found that sea freight is comparable to, if not better than, transport by truck from Melbourne to Perth. We worked this out using the calculator on the Climate Friendly website.

Keep in mind that whilst it is possible to have imported window frames and glazing products certified to the required Australian Standards (AS 2047-1999: Windows in buildings – Selection and installation and AS 1288-2006: Glass in buildings – Selection and installation), it can be a time consuming process. Nevertheless, this step is necessary to comply with the BCA and to get a certified energy assessment. We used Peter Lyons & Associates.
Service Life
Our development was deemed to have a service life of 115 years while the maximum durability ceiling for the project ranged from 125 and 175 years. This means that the dwellings could last for 125-175 years, but it is likely that they will only be used for 115 years.

Most buildings are limited in service life due to redevelopment potential: less than 10% of buildings are demolished due to structural issues. The service life estimate for The Green Swing is high compared to most other developments and resulted from two things; first, it is a medium density development in a low density area; second, the development will be strata titled which makes future redevelopment more difficult.

Occupancy
The higher the occupancy, the better the energy performance of the dwelling. eTool set the occupancy for The Green Swing as follows:
Unit 1 (double brick, two apartments): 3.5
Unit 2 (straw bale townhouse): 2
Unit 3 (reverse brick veneer townhouse): 4

eTool currently assumes that a three bedroom house has an average occupancy during its service life of 2.4 people. In comparison, the averages for The Green Swing’s units 1 and 3 are high, thanks to lifestyle benefits, locality and likelihood of being in high market demand. eTool also considered that the two couples behind the project will be the original occupants, and as such will determine the first significant part of the service life of the buildings (Unit 3 will initially have 5 occupants).

Operational Energy
Solar passive principles were applied to the design of The Green Swing and resulted in very high energy ratings ranging from 8 to 10 stars. These results reduced the estimated operational energy use of each dwelling significantly and, combined with the 3kW photovoltaic (PV) power systems for both townhouses, resulted in negative operational energy over the life of the dwellings.

Conclusion
The selection of materials for a new house can be difficult and at times overwhelming, particularly if your aim is sustainability. There are lots of factors to take into consideration when making a choice (and lots of materials to be selected!). In this article I have provided an overview of the main building material choices made for The Green Swing Project. Our experience has taught us that energy efficiency (solar passive design), service life and occupancy have a large influence on the total energy use of a dwelling over its life; you need to be very diligent in your material choices to keep embodied energy under control. Our project has also taught us that it is okay to make compromises – the world is not perfect – as long as, overall, you are heading in the right direction.

Follow the progress of The Green Swing on www.thegreenswing.net

The Green Swing in brief

Why
Demonstrate that medium density development can be more sustainable.

Where
• 96 Rutland Ave, Lathlain
• 400m from train station
• 5km from Perth CBD

What
• 839m² land size
• 2 townhouses
• 2 apartments
• main construction materials: straw bale, reverse brick veneer and double brick
• 8 – 10 star energy ratings

Links & resources
◆ Termguard
Long-term termite management and damage prevention systems.

◆ GreenStuf
Polyester insulation manufactured using up to 85% recycled content.

◆ Climate Friendly
Online tools to offset and manage carbon footprint and emissions.
02 9356 3600, www.climatefriendly.com

◆ Business Recycling
A site listing national and local re-use and recycling options for around 90 different materials.
1300 763 768, www.businessrecycling.com.au

◆ eTool
Provides you with the tools and services to design and build with the lowest environmental impact.
08 6364 3805, www.etool.net.au

◆ Peter Lyons & Associates
Consulting firm specialising in building energy efficiency.
0408 808 556, www.fenestralia.com