

# Award winning hemp house

## Part 1: Making the choice

BY KIRSTIE WULF

I am passionate about natural building and when the opportunity arose to build a house myself I started seriously investigating the options.

I had built with mud bricks previously, but did not want to repeat the hard work over a whole house. The mud brick shed I had built only used half size mud bricks, but once I got over shoulder height and was working off the ground, the heavy lifting became less enjoyable.

The use of straw bales was dismissed; on an 800m<sup>2</sup> block I did not have the space to 'waste' on thick walls.

Light earth (straw coated in clay slip and built around a frame using a temporary formwork) appealed to me as it has thinner, flatter walls and I began to seriously investigate this option. I read many books (list at end) plus anything I could find on the internet or in magazines about light earth.

However, my research at that time led me to have some concerns about the light earth drying out sufficiently and at that time I was not confident that I would be able to work out the right clay mix. Subsequent work I have done with light

earth has led me to conclude that these concerns were misplaced, but that was my thinking at the time.

### Using hemp

When I read an article in *The Owner Builder* 162 Dec 2010/Jan 2011 on building with hemp, I was interested to learn more. Hemp was a building material that could provide me with good insulation and thermal mass, it was natural and renewable, fire and termite resistant, the lime provided a chemical set, allaying my concerns about drying out and it is a lightweight material I felt I could build with. Hemp ticked all the boxes.

Again I tried to find out as much as I could about hemp building. I read the

excellent *Hemp Lime Construction* by Rachel Bevan and Tom Woolley and *Building with Hemp* by Steve Allin. Since then, *The Hempcrete Book* by William Starwix and Alex Sparrow has been published. This is probably the best 'how to' hemp building book currently on the market.

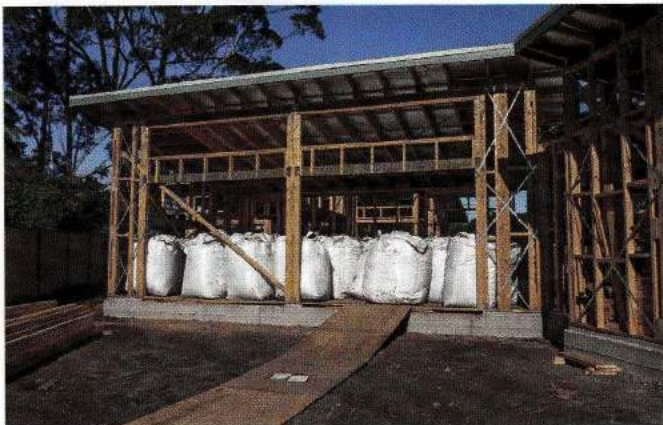
### Design

I then just wanted to do some actual work with the material to confirm that it was right for my build. Several years ago I had completed a Certificate IV in Architectural Technology and used my skills to draw my own plans. Being both designer, finance manager and owner was quite tricky. Within reason, I could build whatever I wanted and this presented endless choices to the designer in me.

In the end the awkward block and our needs set some useful parameters to the design. The block was a battle-axe with north on an angle toward the driveway. I wanted to follow good passive solar principles and have northern light in all main rooms, as well as good cross

*Below left: Once the roof was on, the bags of hemp could be delivered and stored.*

*Below right: Looking down into formwork ready to receive the hemp mix.*





ventilation. The desire for acoustic and visual privacy between our sleeping area and a guest room led to a spread out 'pavilion style' design.

This worked in well with the idea of creating a more inward looking house, that looked back on itself rather than onto neighbouring houses. The windows that faced the neighbours were placed high and looked to the trees and the sky, cleverly hiding the surrounding houses.

## Plans and permits

With plans drawn I attended a workshop conducted by Klara Marosszeky from the Australian Hemp Masonry Company. This only confirmed all the wonderful benefits of building with hemp and I found it to be an easy material to work with. One week after the workshop, plans were submitted to council.

I was a little naive about the requirements council would need to approve the hemp walls and the general information I provided was insufficient. The Australian Hemp Masonry Company then provided me with an engineers report. The hemp walls satisfied the

*The completed hemp house was the winner of the 2015 National Building Designers Australia Award in the category New Residence to 250m<sup>2</sup> under \$2,000/m<sup>2</sup>.*

Building Code of Australia (BCA) but council was a little bit pedantic in how the report referred to each section of the BCA; a little bit of time and a few rewrites later we had council approval.

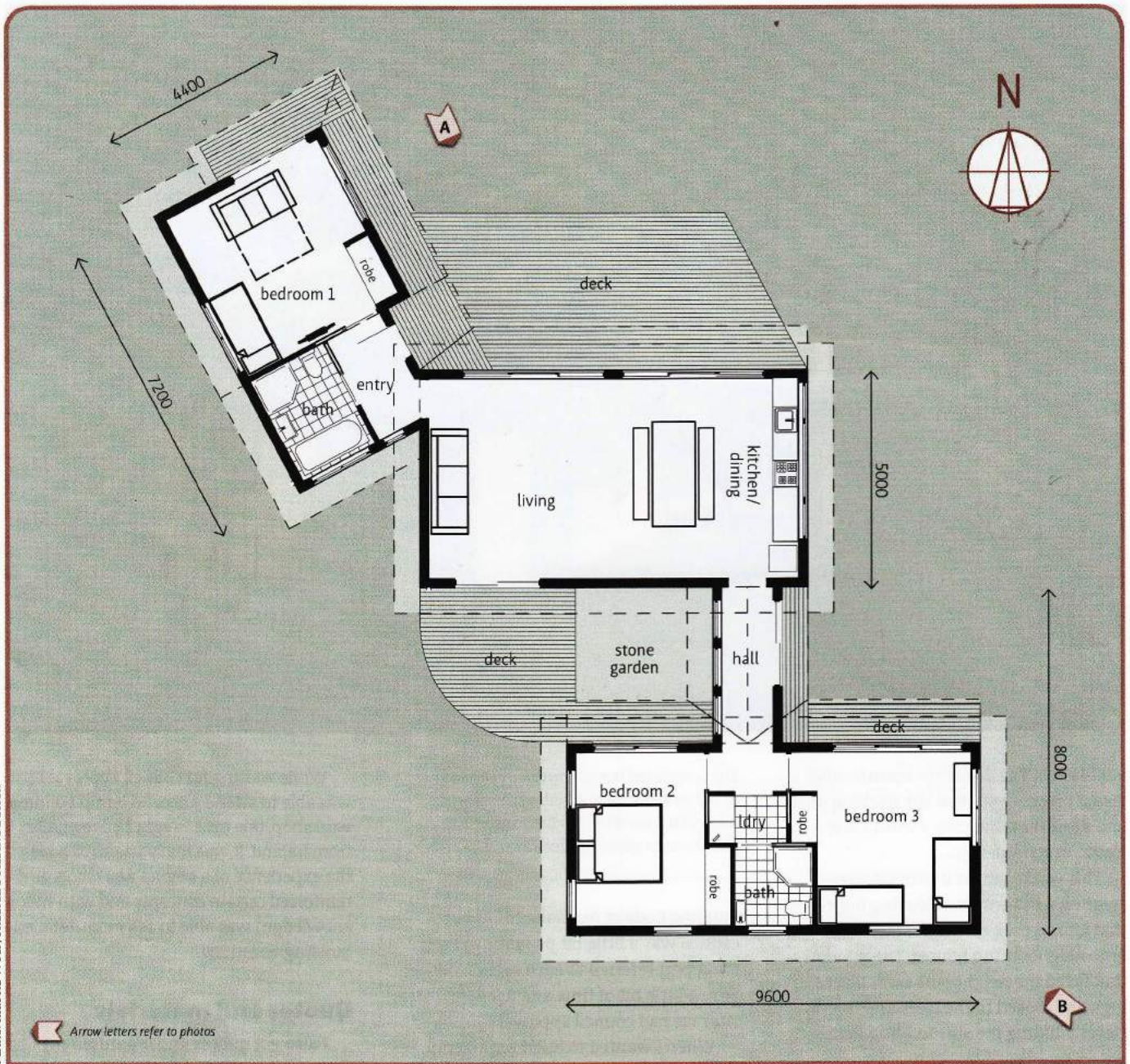
When I wanted to build with hemp, I falsely assumed that there would be plenty of hemp houses out there that I could go and have a look at. As it turns out, we were probably one of the first ten hemp houses in Australia. Klara helpfully put us in touch with a couple who had built with hemp on the NSW north coast, and we were able to visit them and talk about their experience.

There are now many more hemp houses in Australia and getting council approval for building with hemp is no longer a problem, as the manufacturers of the binders used will be able to provide you with the appropriate documents to be lodged with council to obtain approval for the hemp walls.

While waiting for council approval I was able to attend a second hemp building workshop, this time taught by Steve Allin from Ireland. It was really useful to have the experience of a second workshop, as it reinforced certain concepts and with more knowledge I was able to ask more detailed building questions.

## Quotes and materials

I also got quotes and organised my contractors and suppliers while waiting for approval. Looking on the internet for a cheap source of plywood to use as formwork for the hemp walls, I saw a semi trailer load of second-hand OSB (oriented strand board) and timber for \$20. I put in my bid and they had no other offers. The seller had offered 100km free transport from western Sydney. In a fantastic deal for me they agreed to drive the load to the South Coast for the price of the fuel, so for another \$110 I got it delivered. They saved what would have been very expensive tipping fees and I got a lot of timber. The timber and OSB were from packing crates, very large packing crates which I later found out were used to import large billboard signs.



After a day of work I arrived on site in the late evening the day before the excavator arrived and was confronted by mountains of timber and boards, some stacked in piles, some as half pulled-apart crates and others just a huge jumble. I worked by head torch until midnight removing as much as I could from where the excavator would need to be the following morning.

Four days of working 12 hours a day, pulling apart, sorting and stacking, I had a great usable source of timber and OSB. The work was worth it. This pile of timber and OSB provided all the formwork for my house, the formwork for a friend's house,

covered the polished concrete floor during the build, made great duck boards when the site got muddy, provided blocking for attaching the ceiling and with a bit of planing and sanding the built-in wardrobe fit out too.

This was my first foray into owner building a whole house and I did not want to get the basic structure wrong, so I contracted out the concrete slab, frame and roof. As the first hemp house in the area, I had to explain how we were building to every trade. Some of the trades were really enthusiastic and keen to see the finished building. I am convinced that others just thought I was mad.

### Waffle pod slab

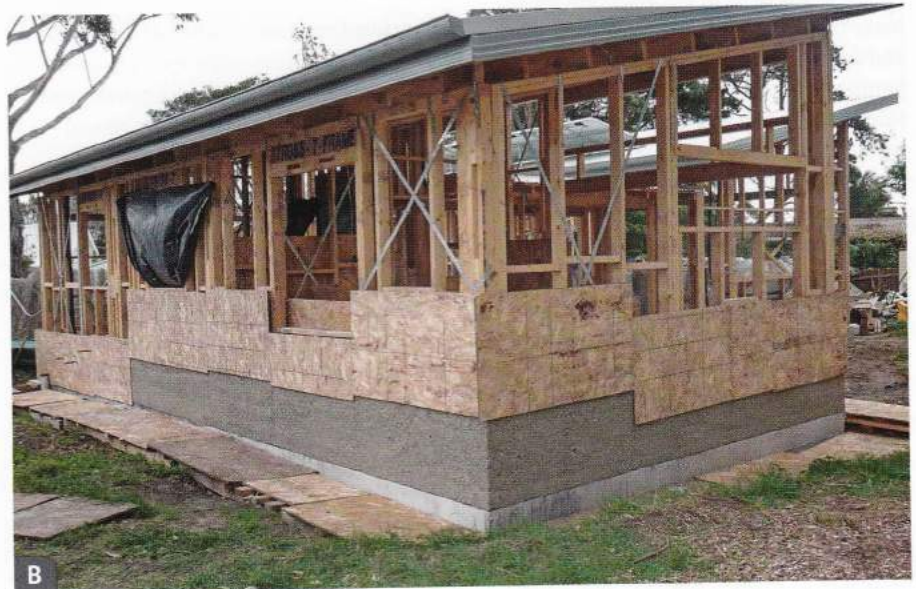
Concerned to get the site layout correct, as I was building close to the minimum setback on one boundary, I engaged the surveyors who did my site survey to do the set out. This was one of the few jobs I was not able to be on site to supervise.

The concreters came in and poured the piers under the slab in accordance with the surveyed layout. I was on site when they were installing the formwork for the waffle pod slab. They were doing a great job and then realised that two sections of the house did not meet up properly. We measured and remeasured. Thankfully I had the plans on my laptop and could

accurately measure off multiple diagonals to double check.

The building set out was wrong. Not all of it, just the back two thirds of the house. However, it was easier to move the front third of the house to fit with the rest rather than the other way around. Luckily this move meant I was 200mm further away from the boundaries to the north and west, taking me further away from my minimum setbacks. This move meant that three more piers had to be poured and the surveyors agreed to pay for this additional cost.

The waffle pod slab was an easy way to deal with our 'P' for problem rated soil. After my partner Ben and I bought the block we found out that there was a filled in swimming pool on part of it, which meant that we had an uneven soil profile, as well as being on clay soil. The waffle pods are large pieces of polystyrene that go under the slab. They make excavation easy, as the site just needs to be cut flat. The waffle pods then form voids, creating a series of concrete beams as part of the slab. This extra reinforcement provides additional stiffness, to deal with any potential soil movement.



## Polished concrete floor

We chose to have a polished concrete slab in the house, to provide thermal mass and an easy clean floor. About a week after the slab was poured the concrete polishers came and did a first grind of the slab, cutting through the first layer to reveal a small amount of aggregate, creating a salt and pepper look. When I was first looking at having polished concrete I visited the Boral showroom at Granville and saw a huge array of colours and aggregates.

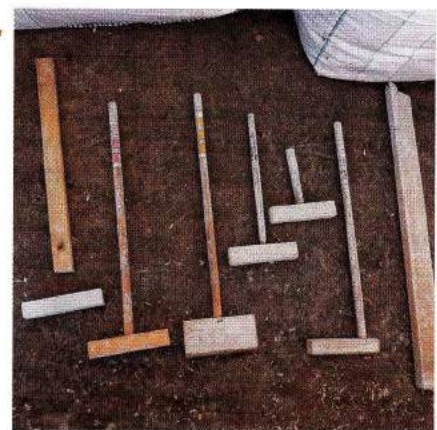
In Nowra, we only had a choice of two aggregates for the floor, blue metal and mixed river stone. The mixed river stone had a blend of cream, tan and olive colours. It was the clear choice. I then had 3% onyx (dark grey) oxide added to the concrete. The darker concrete showed up the flecks of colour in the ground and polished concrete nicely.



*Top: Hemp mix allowed to set after tamping.*

*Centre: Walls go up in a series of 600mm rises using the temporary formwork.*

*Bottom: Walls are up and the windows in!*



## Framing and roof

The frame was built off site by Truss T Frames at Bellambi near Wollongong. My specific requests for the frame were for the studs to be at 600mm centres, to make it easier to fill with the hemp mix and for there to be no sheet bracing. The hemp needs to key into itself on each side of the frame so any sheet bracing would interfere with this. The design of the house, in particular the location of the windows, meant that the bracing requirements were outside the standard tables and I had to get an engineer to design the metal strap bracing. This was not difficult and only a small expense.

In retrospect I would have provided a more detailed plan to the framing company, to place the studs at the corners in particular places to make it easier to attach the formwork, to avoid having so many triple studs, particularly near doors, and to place the noggins vertically, to make it easier to place the hemp around them.

The frame was delivered to site on one large 'oversize' truck. To my surprise the truck needed a police escort to cross the bridge over the Shoalhaven River at Nowra. I engaged a local builder to erect the frame, but was on site for this exciting part of the build. As I intimately knew the design I was able to quickly identify and locate the frame sections. In two days the frame was up and in a few more the roof structure in place.

## Hemp and binder supplies

I also engaged a company to install the roof. Once it was on, I could take delivery of the hemp and binder and store them undercover. I purchased my hemp from Ecofibre in the Hunter Valley and

*L-R: The hemp as supplied; a special mortar mixer was required to cope with the sticky hemp mixture; a range of shapes and sizes for the tampers enabled all areas to be reached.*

it arrived on a semi trailer. At that time the hemp came in cubic metre bulker bags. It now comes in more convenient compressed bales, in a similar size to sugar cane mulch.

The semi trailer could not get down the battle-axe driveway, so 24 cubic metre bags of hemp were offloaded at the end of the driveway. My idea to roll the bags was unsuccessful as the hemp was loose in the bag and moved too much. We were saved by JP from Culburra Hardware who loaned us a pallet jack – one of the benefits of building within 200 metres of a hardware store. With the weight of the bulker bags the pallet jack needed to operate on a hard surface. So, like good Romans, we used our eBay load of timber and OSB to make a temporary road and ramp, which ended up staying in place until the windows went in.

Three pallets of binder were also hand loaded into the house, thankfully from the house end of the driveway. The 4.30pm delivery time in the middle of winter did not help and this task was finished by torchlight. I used a proprietary binder made by the Australian Hemp Masonry Company. This binder is made in Australia and was developed through research at the Centre for Construction Innovation at UNSW.

## Mixing hemp walls

To mix the wall material I used a pan mixer, also called a mortar mixer, which I purchased from Aardwolf Australia. The hemp mix is light and sticky and is not

easy to mix in a usual drum mixer, as it does not fall from the top like concrete. The pan mixer has vertical sides and paddles that push through the mix at different levels, while also scraping the bottom and sides of the mixer.

The 120-litre mixer was the largest I could buy that operated on single-phase power and used the smaller 9kg bags of binder. To use a larger mixer I would have needed either three-phase power or a petrol driven mixer.

Making the hemp mix was a bit like cooking. The ingredients were: 5.5kg hemp, one 9kg bag of AHMC binder, 8.5kg of sharp sand and about 10 litres of water. The hemp was put in the mixer first then most of the water. Once the hemp was evenly wetted the binder was added, then when the hemp was evenly coated with binder, the sand was added and the remainder of the water, as needed.

The amount of water varied a little depending on the weather and the moisture in the sand. The mix needed to be moist enough to be sticky, but not too wet. It was a bit like making a loaf of bread; you know when the dough is too wet or too dry, and that 'right' amount of water comes through knowing the feel of the mix you want to achieve.

The hemp mix was then placed in 150mm layers into a temporary formwork and tamped down. One of the great things about hemp is that it is cast on site, forming one monolithic gap-less wall around the timber frame. We used our load of OSB for formwork, putting it up in 600mm rises. It was attached to the frame with coach screws, held out the right distance from the frame by spacers made of off-cuts of conduit. After the formwork was taken down, the spacers were removed and the holes filled.

Subsequent work on other hemp builds has shown that bugle batten screws are more efficient than coach screws, as they do not need to be pre drilled through the formwork and that, unless your formwork is bowed, the spacers can be removed after the formwork has been put up and before the hemp wall is cast, so that there are no spacer holes to fill later.

Each layer of hemp mix was tamped down, using purpose made tampers for the job – a block of wood on the end of a stick. As the build progressed we made many different tampers to fit different heights and locations. The tamping process was not ramming, but a moderate tap, sufficient to ensure that the hemp particles interlock, but not sufficient to push the air out from between the hemp or to push the binder past the edges. Once the 600mm high formwork was filled, it was left overnight and the formwork could be removed the following day.

The process of making the hemp walls was continuous, but not hard work. The walls were built by Ben and me, and our then three and a half-year-old son, working on weekends, with occasional help from friends. We usually spent two days building walls followed by half a day moving formwork. A larger team would have been able to work more quickly, but we used the resources we had.

## Cracks

We learned a lot on the job, for example, how to best place the hemp mix under window sills and under the roof. However, it was not all smooth sailing. After we had finished the first third of the house, we noticed that there were a couple of cracks in the walls. We were advised that this could have been because we used too much water in the mix, so we did a day's work using strictly nine litres in each mix. The mix seemed very dry and Ben helpfully suggested that we wait and see how the wall worked out before we did another day's work.

Back on site a week later it was immediately clear that the drier mix had not held together sufficiently well. It was soft and crumbly, not at all like the firm walls we had been producing earlier. The decision was taken to demolish the section of wall made using the drier mix and go back to our earlier recipe.

As it was, the render covered the earlier discovered cracks and they did not cause any problem.

We also had a few problems with the walls pulling away from the studs where there were triple studs next to doorways. A helpful suggestion from builder Rodney Gregg, who built the first hemp house in Tasmania, was to use a screw through a large plastic washer of the type used to attach polystyrene panels. This worked well and the walls were easily brought back into line, but a better approach would be not to have triple studs next to openings.

## Windows

The windows came next. I chose to use aluminium framed double glazed windows from Rylock. With a large number of glass sliding doors and windows in the design, the windows were the single biggest expense of the build. The thermal performance of the house is such that we do not need any mechanical heating or cooling and the double glazed windows contribute to this, so I have no regrets about spending the money on them.

The Rylock windows also came with an integral timber reveal, which I had sized so that it stood 10mm proud of the internal hemp walls. This reveal was then used as a render stop for the internal render, and no architraves or other trim was needed. The timber on the window reveals was finished with *Livos* Ardvos wood oil, which has a very natural looking finish.

With the windows in and a temporary piece of OSB screwed over the front door, we were at lock up. Half way.

More on our build in the next issue! ♦

*Kirstie Wulf's house won the award for buildings up to 250m<sup>2</sup> and under \$2,000 per sqm at the National Building Designers Australia awards. She is a hemp building enthusiast and the principal building designer at Shelter Building Design. She has documented her own build as well as other hemp builds around Australia.*

*Editor's note: Since the house build, with the confidence gained from the hands-on experience, Kirstie has built a garage/workshop herself, from the concrete slab to making the timber frame. She then ran an on-site hemp building workshop to do the walls and completed the rest afterwards.*



## Links & resources

### ◆ Shelter Building Design

Sustainable, natural, healthy – new homes, extensions, renovations; design, plans, council approvals.

0400 177, 296

[www.shelterbuildingdesign.com.au](http://www.shelterbuildingdesign.com.au)

[culburrahempshouse.blogspot.com.au](http://culburrahempshouse.blogspot.com.au)

[hempbuilding.blogspot.com.au](http://hempbuilding.blogspot.com.au)

### ◆ Australian Hemp Masonry Company

Australian developed and manufactured BCA compliant hemp lime construction materials, advice and training.

0473 939 709, [hempmasonry.com.au](http://hempmasonry.com.au)

### ◆ Truss T Frames

Wall frames and roof trusses in untreated or treated pine.

02 4285 4192, [www.truss.com.au](http://www.truss.com.au)

### ◆ Ecofibre

Licensed to grow, import and export industrial hemp.

07 5499 9249, [www.ecofibre.com.au](http://www.ecofibre.com.au)

### ◆ Rylock

Designers, manufacturers and specifiers of custom architectural windows and glass doors.

02 9503 0600, [www.rylock.com](http://www.rylock.com)

### ◆ Livos

Ecological plant based non-toxic paint and oil finishes.

03 9762 9181, [www.livos.com.au](http://www.livos.com.au)

### ◆ Books

- **EcoNest** by Paula Baker-Laporte and Robert Laporte, Gibbs Smith, 2005. ISBN 9781586856915. Review TOB 139.
- **The EcoNest Home** by Paula Baker-Laporte and Robert Laporte, New Society Publishers, 2015. ISBN 9780865717770
- **Light Earth Building** by Franz Volhard, Birkhäuser, 2016. ISBN 9783035606348. Review this issue.
- **Hemp Lime Construction** by Rachel Bevan and Tom Woolley, IHS BRE Press, 2010. ISBN 9781848060333.
- **Building with Hemp** by Steve Allin, Seedpress, 2005 (new edition due). ISBN 9780955110900. Review TOB 162.
- **The Hempcrete Book** by William Stanwix and Alex Sparrow, UIT Cambridge Ltd., 2014. ISBN 9780857841209. Review TOB 186.