Changing plans

Every project starts a long time before the first sod is turned...

BY MATTHEW WALTERS

Like many self-builds, ours is taking way longer than desired.

After many years of designing the home we thought we wanted to live in, we came up with a floor plan that wasn't getting changed. At that stage the walls were going to be straw bales covered with a simple earth/lime render.

During a tour of energy efficient homes in our area we were introduced to two carpenters who had helped a fellow owner builder with her straw bale home. They liked to do their own drafting, and offered to get us started by turning our design ideas into early formal drawings.

We got on quite well together, adopted their suggestion for a fancy roof design, and agreed to their suggestion that we employ them to run the build so we could move in by Christmas.

Change of heart

Now we are building a hempcrete house. Hempcrete is like concrete in that it doesn't leak air, but is much lighter. It also has helpful thermal mass characteristics, but is a much better insulator than concrete.

Like conventional concrete it can be cast. We will cast it between plywood formwork so that it envelops the timbers of our exterior wall frames. These wall frames will be made of pine and hold up the pine roof trusses, steel roof and lots of solar panels. We will have a subfloor constructed from hardwood bearers. The subfloor will also be insulated with hempcrete, to improve fire resistance.

The 6500m^2 block is fire prone and we are building out over a 1 in 10 slope. The

views will be great, but the clay from the basalt rock our valley slope is eroded into is known for its significant expansion and contraction. Our present solution to keeping the subfloor level as the house settle into this reactive clay is pin foundations, steel piers and adjustable pier heads.

Listen to the universe

The low-environmental impact of earth/lime render over straw started to look problematic. Firstly, the clay on the block didn't seem to be appropriate for rendering and accessing other suitable local sources of clays and sand was likely to delay our build. Secondly the roof design we really liked doesn't visually suit a verandah. Verandahs are highly recommended when building with straw and earthen or earth/lime renders. Building with straw – and we had secured bales of a long-stemmed heritage wheat variety – started to look too risky. Without verandahs, the walls could get wet. In many climates, a wet wall render will dry out quickly and without fuss, because the outside air humidity is low. If the air is humid, however, the wall may take a very long time to dry out and the wet render may transfer moisture into the straw.

A water repelling surface treatment applied to the final surface of an exterior earthen or lime/earth render is a common strategy used to minimise this sort of heartache. Pre-filled straw wall modules made from pine framing with a mandatory external moisture control barrier fabric (Europe) or loadbearing plywood frames where the straw can be re-packed if disaster strikes (Australia) are other common control strategies.

We were planning on using pre-built straw wall module and a water repellent surface treatment, but had some rather troubling concerns: What if we didn't later have the capacity to re-apply such a critical treatment? What if a later owner didn't appreciate the importance of such ongoing maintenance?

And then it rained at Gnarwarre, where we are renting while we build at Shelford. The locality name, Gnarwarre, is said to be from the Aboriginal words for wind and water. Horizontally driven rain. Wind-tunnel-force winds. Rainwater draining down through the inside of the insulation filled shed walls, flooding a bedroom and threatening our much loved book collection stacked in cardboard boxes on the concrete floor, protected underneath only by a meagre layer of plastic sheeting.

Poorly installed window and roof flashings were the cause. Was the universe trying to tell us something?

A new route

We decided we didn't want to build a house that relied on recoating its walls with a water repellent treatment to stop our house without verandahs rotting from the inside.

At the eleventh hour, I decided that hempcrete, which admittedly was Narelle's original choice, was the way to go. I had considered hempcrete too expensive, neglecting to see that wall material costs are only ten or 15 percent of a build's costs. Straw had offered ideal insulation performance, but hempcrete 300mm thick is not far behind.

Our plan with our hempcrete home is to paint it with a simple lime wash and a water repellent additive every five years or so. If we or the next guardians/owners of the property don't get around to a coat of lime wash for ten years or more, because life gets in the way, it shouldn't really matter, because the wall is built well from the start, from a construction material that is well proven in wet and cold regions of Europe.

Additionally, we see hempcrete as being a sustainable building material for Australia. It can be grown in a paddock, without herbicides or pesticides. In some parts of our region it is reported that four crop rotations a year of industrial hemp can be achieved due to the absence of a trace mineral in the soil. The fibre can be used for clothing. Other parts of the plant are used as food and a source of a high quality edible oil. Longer term may see the development of composite hempcrete products that allow a home to be constructed with less plantation timbers.

Our hempcrete wall will be made from hemp cellulose from the middle of the stalk of the plant mixed with a quick setting but moisture permeable lime-based cement manufactured at lower temperatures than the cement commonly used today by the construction industry.

Eventually hemp hurd will be processed in greater volumes in Australia. At present securing local product can be challenging. For our build we have chosen ease of supply, reassurance regarding quality control and the greater ease with which our European sourced hemp hurd and binders can secure building approval due to our importer, OzHemp, investing in Australian CodeMark Certification.

Structural detailing

Our walls will be 300mm thick before sand and lime renders are applied. They will be formed by mixing the hemp hurd and binders with water in a pan mixer to a porridge-like consistency then casting it from small plastic buckets into formwork, also known as shuttering, where it sets within an hour or so, ready for the next layer to be laid.

Our 90x45mm stud wall timbers will be 115mm behind the external and internal render surfaces. Should these internal timbers ever get wet after a week of driving rain, which seems unlikely where we are building half way down the side of a valley, the hempcrete encapsulating the timbers will quickly wick the water away and return the moisture levels of the timber to normal. To be more sure, we could use hardwood timber in the stud walls, but I don't like to see hardwoods used except where they will be on display, or where their strength characteristics make them the ideal choice.

In the floor, strength of the bearers will be more critical, and we have chosen to use graded kiln dried hardwood for an easy, safe solution. On top of the hempcrete floor insulation will be a sand and lime screed within which is buried plastic pipes for hydronic heating and cooling. Above that will be tongue and groove hardwood flooring, sealed with a wax based product. Because we will lay lots of hydronic heating coils, and design the floor to safely carry this extra mass, water temperatures of only about 22 or 23 degrees will be required to comfortably warm our rooms, a much lower temperature than the same floorboards exposed to sunlight on a hot day. In winter, heat for the floor will be stored during the day in a phase-change heat storage unit heated by electricity, usually from solar voltaic panels on the roof.

We have made provision for the later installation of a slow combustion wood

stove, but are hopeful that we will be able to stay warm in winter without it. The heat of the sun coming through the north facing windows should be sufficient. The below-floor hydronic system can be used to transfer the heat from areas where sunlight falls to other areas. We would like to do some thermal modelling, perhaps with the tools used by *Passivhaus* practitioners, but so far our design work has been using rules of thumb regarding glazing areas compared to floor areas or sun facing wall area.

Comfort a priority

To achieve our dream of a house that is comfortable and cheap to live in, we will invest in top quality double or triple glazed windows that don't leak air and with frames that don't allow too much heat to flow in or out of the building.

We will lay larger diameter polyethylene pipe a metre or more under the ground to provide pre-cooled air to our pantry area and to the fresh air intake of our mechanical ventilation with heat recovery (MVHR) unit. We will use MVHR techniques to achieve excellent thermal performance; 90 to 95 percent of the heat in the outgoing air gets transferred to the incoming fresh air, and the opposite occurs in summer. The house is being designed to minimise the leakage of air into or out, because leaking air transfers hard-won heat from inside the house to the outside in the winter, and outside heat into the house during summer when cooler inside temperatures are desired.

Living in a shed has taught us a lot about how heat is lost and gained. Heat loss by dilution through cold dense air leaking into the warmer less dense air inside seems to be the biggest culprit, rather than heat lost radiantly through a poorly insulated steel wall.

We call the wood heater in our present dwelling a 'fast combustion wood stove'; feeding it has taken a lot of effort over winter. Our fancy double or triple glazed windows will still open and have fly wire screens fitted, but we look forward to the better indoor air quality that using a high quality, quiet MVHR unit offers.

Sloping site

Our site is sloping, dropping two metres over the length of our 20m long house, from west to east. The house will be sited away from the shadow of a shelter belt of mature, now 23m high, sugar gums on our northern boundary. The north edge of the house will be just to the south of where surface water sheets off our neighbour's heavily grazed horse paddock. The alluvial soil that is delivered fresh once or twice a year during big rains will make for excellent vegetable gardens.

Amazingly, we were assessed as only needing to comply with BAL-12.5 building standards. Hempcrete has gained a BAL-40 fire resistance rating, however. To reduce the labour required in installing then removing temporary shuttering to hold the floor insulation hempcrete as it sets between the bearers and floor joists, we have been advised by our building consultant, Joe D'Alo of The Hemp Building Company, who specialises in hempcrete builds, to use a quality magnesium oxide board fixed directly to the undersides and protecting the bottom edge of our hardwood bearers. Magnesium oxide board is similarly fire resistant to hempcrete and could also be manufactured in Australia – we export it overseas – but the MgO boards sold in Australia are presently a product of China.

To make it hard for embers to get into the roof space, the external hempcrete walls rise up to meet the roofing metal, with a tight sandwich of mineral wool between. We will fit two access hatches into the roof, to allow all areas of the roof space to be easily squirted with water from a fire hose by somebody standing on a ladder, in case the roof space catches fire (one of the most common places for a house to start burning down when exposed to high speed ember attack and the intense heat arising from a fire front).

Hardwood headache

I campaigned for years against logging of old growth hardwood forests and water catchment reserves. I am not, however, a fan of the monocultural, quick-growing, herbicide-ready pine plantations either. We'd like to be able to source hardwoods from selectively logged forests.

The very helpful resource while at that stage of exploring what sized beams could likely support the higher than usual loads of a hempcrete wall and subfloor insulated elevated home – possibly the first to be built in Australia – was the excellent online span table software from *SpanMan* that identifies a range of beams that will carry the designated loads over the desired span.

Ready to roll

Our hempcrete materials were ordered from Europe before we got our final drawings back from our draftsman. Hopefully the allowances will be sufficient – the lead time to order more from Europe is about eight weeks.

So at present we have the land... and two shipping containers of hemp hurd and the matching lime based binder arriving from Europe before Christmas 2017. The block needs to be slashed again, and a driveway prepared to take the weight of a semi-trailer carrying 23 tonnes of lime binder in a 2.4 tonne 6m long shipping container. Another container will hold a measly 10.5 tonnes of hemp hurd in a twice as long 4 tonne 12m container.

The shipping containers were purchased on our behalf in Europe, so that we can use them to store the materials on site during the build. Once they are emptied we may turn them into a radio-shack for myself, a sound recording studio for our son, and some workshop spaces including a sink for making printed circuit boards. We think we may have sufficient surplus hempcrete to insulate our steel containers to a depth of 200 mm, mainly on the outside. This is because the timber in the walls occupies about 5% of the hempcrete volume, and we allowed an additional 5 % for wastage.

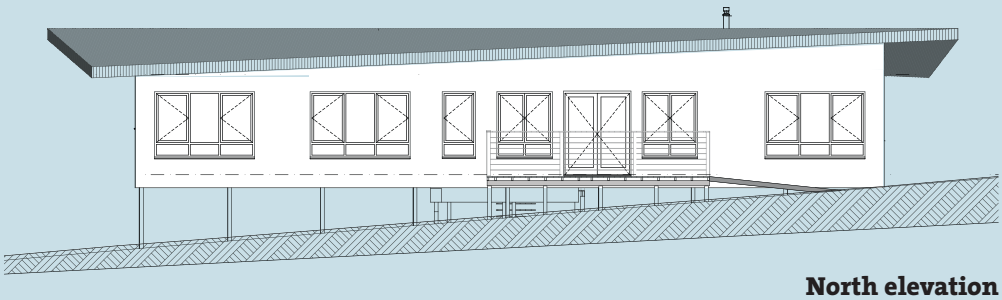
Stand by for the next instalment! ◆

Links & resources

◆ **Ozhemp**
Focussed on the development of hemp for commercial products and applications.
08 6424 8262, www.ozhemp.com.au

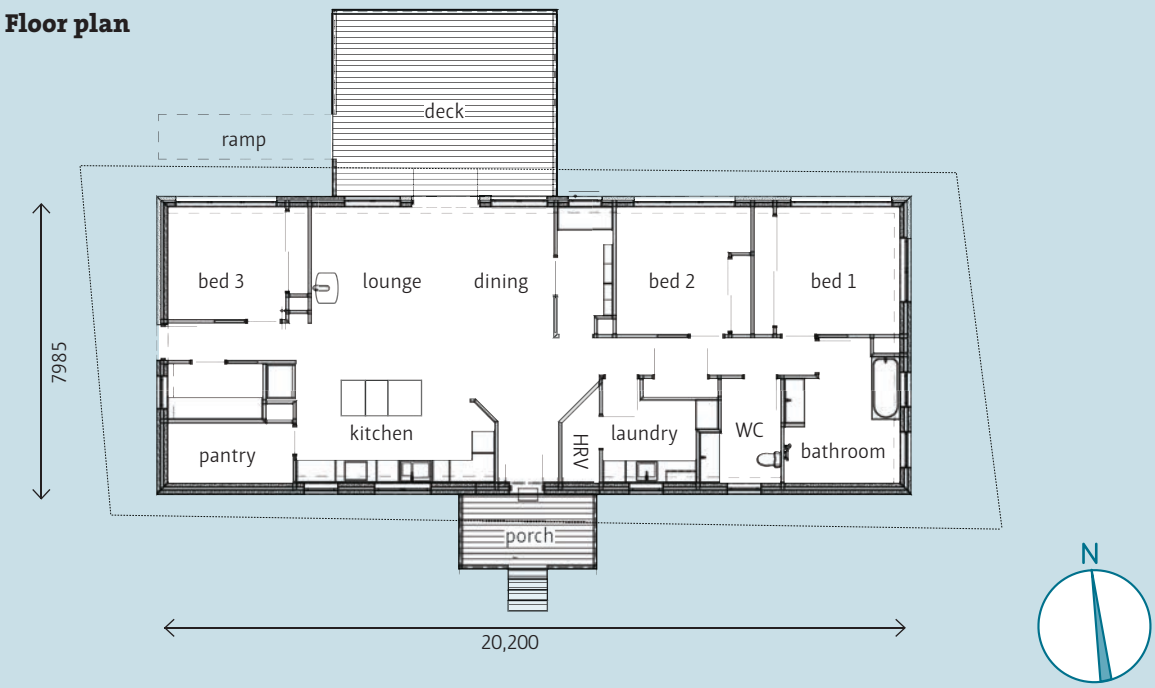
◆ **The Hemp Building Company**
Providing building consultancy, education and supply of material and equipment.
0417 517 081, www.thehempbuildingcompany.com.au

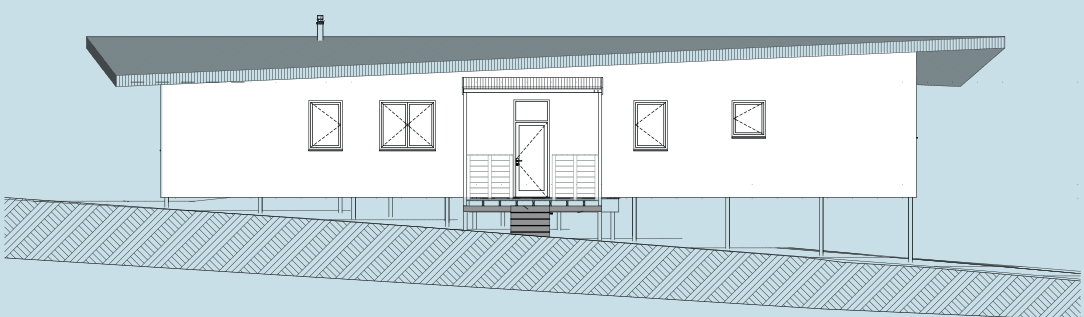
◆ **SpanMan**
Online timber and steel framing manual.
www.spanman.net



North elevation

Floor plan





South elevation