

WORDS LIA LABUSCHAGNE PICTURES AND DIAGRAMS ANDY HORN

Straw bale

One of the oldest natural building materials is once again gaining ground as an excellent choice in the right conditions.



Straw as building material has a long heritage: the medieval Tudor frame, and clay and straw buildings of Europe, 7 to 9-storey skyscrapers in Yemen (of which some are older than 1 000 years), and parts of the great wall of China are examples.

Its commercial use only began with the advent of the baling machine, and therefore the earliest known surviving straw bale house was built in 1903 in Nebraska, USA, explains Andy Horn from Eco Design Architects & Consultants, whose practice specialises in ecological-friendly green building and consulting. In addition to specifying and building with natural materials, Horn has put together a straw bale building information package and a manual for a straw bale building system. His two-day "earth and straw bale building workshop" was recently registered with the South African Institute of Architects.

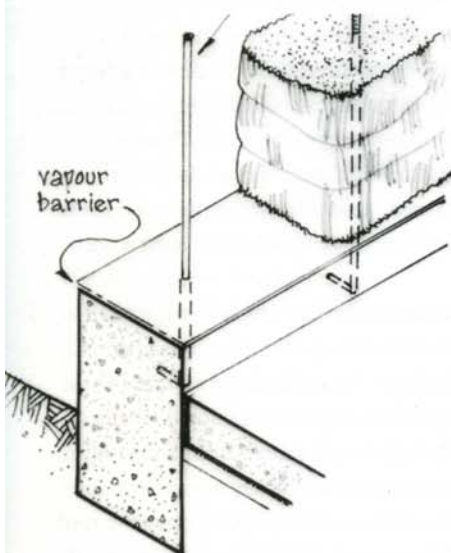
HOW DOES THE STRAW BALE BUILDING SYSTEM WORK?

The straw bale building system comprises a structural frame of timber or masonry with in-fill panels of straw bales. Securing a supply of bales is ideally done around harvest time, which is towards November in South Africa. Typically you need the foundations, window

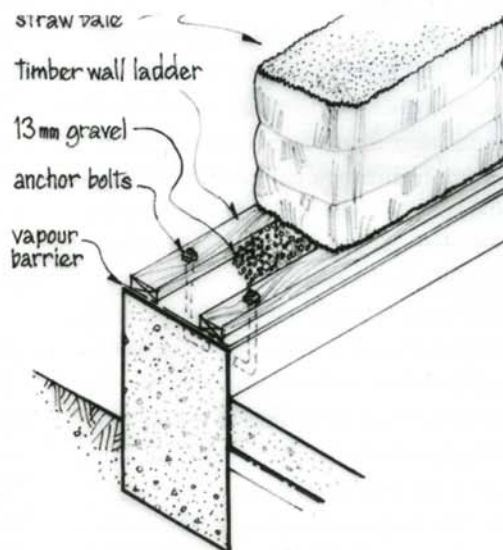
and door frames, roof structure and structural sub-frames in place before starting to build with the straw. "If the roof is not on when one starts the bale raising, then large tarpaulins or sheets of plastic are needed to protect the walls from any rain until the roof is on," explains Horn.

A technique developed by Tom Rijven in France, and which Eco Design has used since 2004, involves dipping the bales in a clay slip consisting mainly of clay and sand. It helps solve some of the issues traditionally experienced with straw bale construction: it saves time in the pre-plastering of the walls, helps make the walls more solid and stable, and better protects them against risk from fire and moisture during construction.

Walls made with straw bales are finished off with earthen and/or lime-based plasters and breathable paints.



TRADITIONAL WALL
PINNING METHOD



CONTEMPORARY BASE
PLATE METHOD

Securing a
straw bale wall.



Gatehouse of the Nieuvoudteville Caravan site upgrade project.

THE POSITIVE SIDE

The main advantages of naturally-plastered straw bales as a building material lie in its “superior thermal performance, due to its unique combination of super insulation, thermal mass and humidity regulation. The hygroscopic nature of the clay and lime plasters regulates the humidity. Furthermore all clay and straw waste is entirely recyclable and biodegradable,” says Horn.

“As a method of building, it is also very inclusive, since the building process lends itself to an owner-builder process where one can involve friends and family or the local community in the building process.” He also points out that, as an agricultural by-product of grain farming, straw is annually renewable. “We produce enough straw to provide approximately one million new homes a year.”

For architect Kate Shimwell of Shimwell Designs, the main advantage is “the finished product. Straw bale buildings have a wonderfully warm and quiet feel, the walls are not angular and corners are slightly rounded. For the naturalist this is heaven.”

SCALING PRACTICALITY

Shimwell shares her experience with Project Starflower, a private home in Johannesburg North: “The best shape for a straw bale building is a simple rectangle or square single story unit. Project Starflower presented a challenge as the clients’ brief required a double storey building to maximise views and security. They also did not want a barn type feel.”

Horn explains that straw bale is not suited to a parapet style of building, as the walls need good overhanging roofs. Regarding buildings that use a load-bearing system he says one should ideally stick to simpler designs, but for more complex designs “an in-fill system, which typically uses a post and beam system to frame the walls and carry the roof loads... should be used. With either system and if building multi-storey or very high walls, some kind of ring beam is needed at each floor – typically done in timber – so that each in-fill panel is only one storey high.”

Shimwell believes interior walls are not suitable



01.



02.



03.

for straw bales because of their thickness. “There are cost implications: the foundation and roof size must be larger to allow for the additional space taken by the walls. We would recommend that drywall or a 115 brick wall be used,” she says.

Edwin Anderssen of Dumani Architects adds that straw bales “do not take kindly to specific interior designs which are dependent on wall hangings as features. The insulated straw core is not dense enough to form a solid backing unless dedicated pegs are pre-planned and inserted at an angle to form supports.”

Structurally, the Didimala Game Lodge at Hammanskraal “has proven that building with straw bales should not necessarily be limited to minor experimental projects,” says Anderssen. The resort was created with 10 000 straw bales and at the time of its completion in 2004, Didimala was the largest straw bale construction in the world. Anderssen says to his knowledge it still is.

Didimala was the first straw bale structure in Africa registered with the International Straw Bale Registry Project, which is working with a

number of bodies to build a database of buildings constructed using this material. Didimala was given international recognition as venue for the International Progressive Governance Summit in 2006 and was a finalist in the inaugural tourism investment awards of the Tourism Business Council of South Africa (2007).

Much of its recognition came from the original standards of maintenance and management. The lodge has since changed ownership and “when I last visited Didimala in September 2011, signs of neglect and lack of maintenance was visible. The structure, however, remained intact and the straw bale construction seemed to be in pristine condition,” states Anderssen.

UNDERSTANDING THE LIMITATIONS

Shimwell explains that straw bales are generally about 460x900 mm in size, “but with no inherent stability, unless you use timber stakes or design an ‘infill’ style structure similar to building a warehouse.”

01. Village of Hope project in Grabouw.

02. Timber frames window reveal.

03. The exposed ends on either side with parapet walls were designed as store rooms – in concrete block, while the bedrooms well protected under the roof, is in straw bale.

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[SOUTH AFRICA] PRODUCES ENOUGH STRAW TO PROVIDE APPROXIMATELY ONE MILLION NEW HOMES A YEAR. - ANDY HORN



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She adds “it is critical that the bales remain dry. Even after they have dried out they will begin to decompose and this can weaken their stability.”

Horn agrees that water is the single biggest risk, but that this can be managed. “Problems arising from water damage range from complete disintegration of the bales to problems with mould and mildew. The problem arises when moisture becomes trapped within the walls. For this reason, it is important to allow the bales to yellow or season before plastering begins. Likewise time should be allowed for the plastering to cure properly before any finish coatings are applied. The idea of a breathing wall, which allows for walls to dry out, will avoid this potential problem.”

CLARIFYING MISCONCEPTIONS

One might think that issues about pest control, allergies and odours would be high on the risk list, but experience in both old and new homes has shown concerns relating to rodents and insects to be unfounded. Straw bales have fewer spaces for insects than conventional wooden structures, and a well-applied and maintained coat of plaster denies access to even the smallest pests. “Straw is a dead material of no nutritional value, and thus insects are not attracted to it,” comments Horn.

Clean straw has little mould or allergy potential as hay fever is aggravated by the presence of pollen found mainly in hay, rather than straw. Although asthmatics could have trouble with mouldy straw, the tight sealing with plaster that is also required to combat any issues with water,

fixes this problem.

Straw bale structures have proven to be exceptionally resistant to fire. Since straw bales are firmly compacted, they do not hold enough oxygen to facilitate combustion: when exposed to fire, straw bales will smoulder rather than ignite. “Due to the incredible insulation provided by the bales, fire tests showed the walls actually prevent fires from spreading as they do not transfer heat,” explains Horn.

Extensive fire tests were conducted on straw bale structures in Germany, Canada and the USA. In the German F90 fire test, a straw bale wall clay plastered on both sides was heated on one side to 1 000°C for 90 minutes. The surface on the other side heated up less than 10°C.

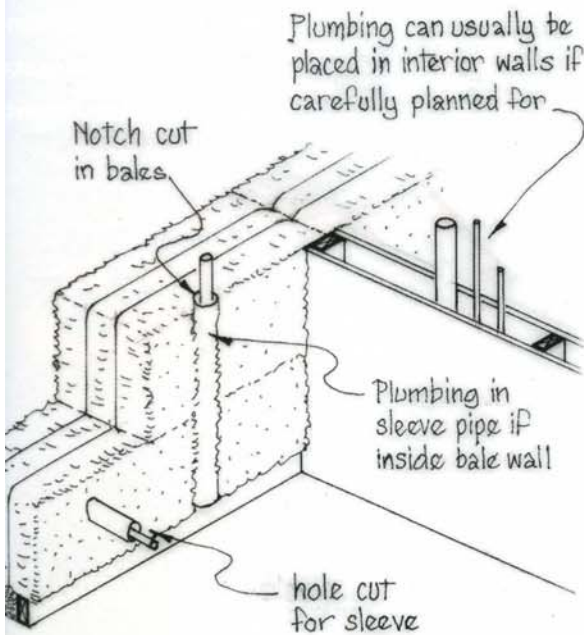
“However, it must be stressed that during those phases of the building process when one generates a lot of loose straw, there is a definite fire risk and precautions must be taken in terms of limiting welding and smoking on site and having fire extinguishers at hand,” warns Horn. Fire retardants such as boron compounds could be used in high-risk areas and these also act as further deterrent for termites and pests.

Shimwell notes that straw bale building material “is not cheaper than building with bricks, unless the client is prepared to train labour and work with them in the building process. If you hire a contractor unfamiliar with straw bale building, he would take time to understand aspects of the building, which will take much longer to complete - and time is money.”

IMPORTANT POINTERS

Horn says people need to realise that one does not have to compromise on design aesthetic. "Always design with the principle that a straw or earth building needs a good pair of boots and a hat. Also do not use cement plasters... use clay and/or lime based plasters."

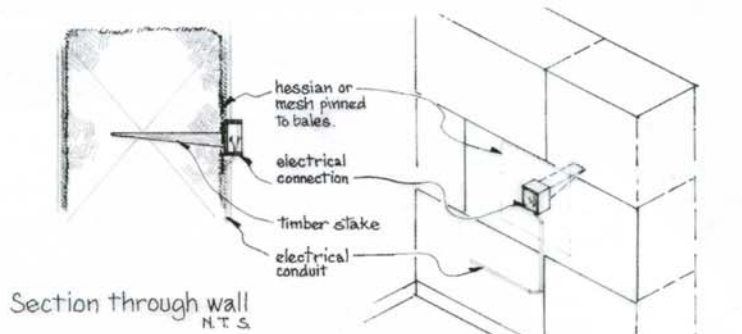
Shimwell points out that "all trades are impacted by the change of basic building products. For example, our plumbers and electricians have no experience with working with any other construction material. Plumbing and electrical are usually chased into the walls after they are built. However in straw building the bales are often built around these services. We designed a vertical brick & mortar plumbing service duct, to contain all the waste and



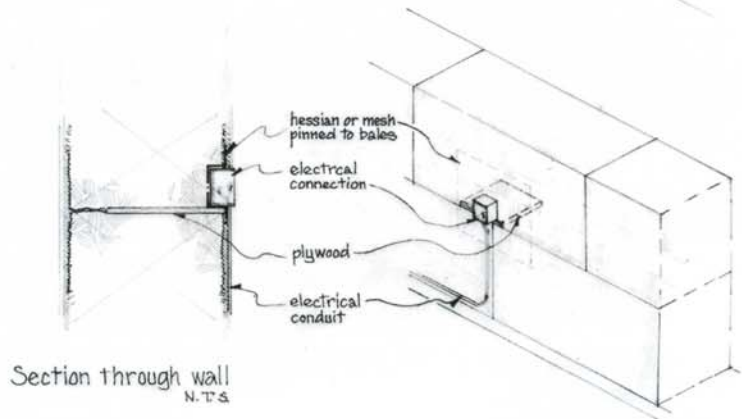
inlet pipes with removable panels on one side."

Anderssen elaborates, saying that wet areas in kitchens and bathrooms function better with the addition of an inner brick skin "that allows water supply and waste pipes to be concealed with better control over the dew point".

He adds the choice of the type of paint to finish the walls is crucial to ensure that moisture



Section through wall
N.T.S.
WOODEN STAKE DETAIL



Section through wall
N.T.S.

migrates to the outside of the wall in the direction of the warmer environment through a process of evaporation. "Be conscious that the process may reverse in winter when it is warmer inside. Therefore the paint on the inside has to form a waterproof barrier while the paint on the outside should be able to breathe.

"Importantly, in terms of the principles of green design, the availability of raw materials plays a major role in the decision process," advises Anderssen. "Straw bale buildings should obviously be situated in areas where the material is readily available. Although it would be the ideal material to use in arid desert areas, it does not make sense to transport straw bales at a huge expense to remote areas." ◉

Building with straw bales requires an alternative approach to installing electrics and (above) and plumbing (left).

RESOURCES

- Eco Design Architects & Consultants** 021 462 1614
www.ecodesignarchitects.co.za
- Dumani Architects** 021 853 7795 www.dumani.co.za
- International Straw Bale Building Registry**
<http://sbregistry.sustainablesources.com>
- Schimwell Designs** 011 803 4407
www.shimwelldesigns.com