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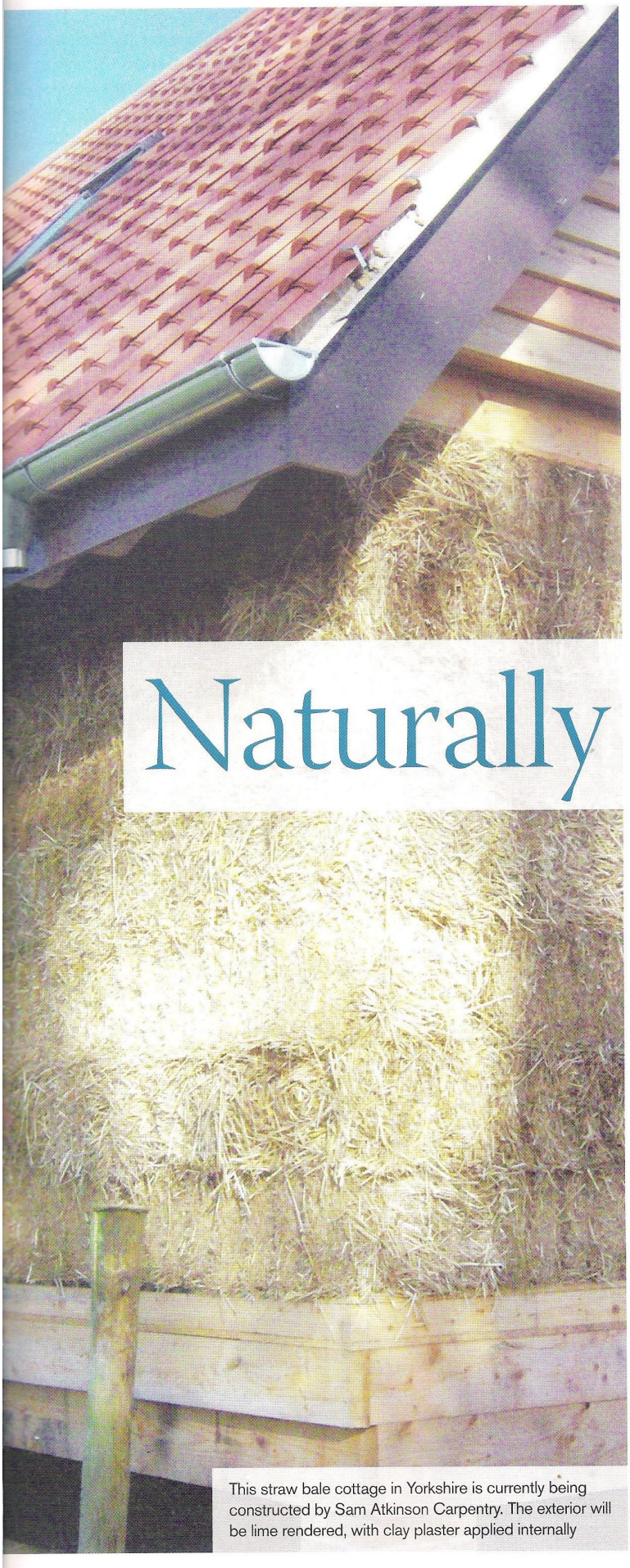


This straw bale cottage in Yorkshire is currently being constructed by Sam Atkinson Carpentry. The exterior will be lime rendered, with clay plaster applied internally

Naturally built homes

The environmental impact of using sustainable building materials to construct a house is very low. Straw, earth, hemp and logs are often available locally so have fewer miles to travel, and they don't need processing in a factory like manmade alternatives. Building with natural products often appeals to the self builder who wants a true hands-on experience, but it's just as easy to find a company that can do the work for you. Here's what you need to know about building the natural way.

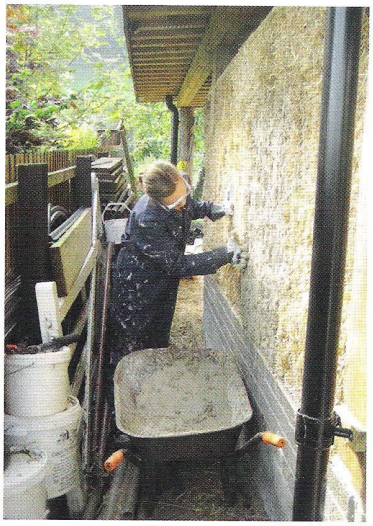
Straw, earth, hemp and logs may be lesser-known alternatives to standard building materials, but they are gaining traction among eco-conscious self builders who are attracted by their sustainability and the chance to really get hands on, says Jane Crittenden

Straw bale

"The UK produces 4m tonnes of surplus straw every year – enough to build 250,000 homes – so it seems logical to use a natural material that mostly goes to waste," says Brian Waite, an engineer who designed and built his own straw bale house in 1999 (www.strawbalehouse.co.uk).

Straw bales comprise of wheat, barley and oat and come in different lengths and densities, but they must be made with clean, dry straw and stored in a dry place until they are used. Despite common beliefs, there's no fire risk because the straw is packed so tightly that there's insufficient oxygen to support combustion. The lack of voids and the inhospitable finish – lime or clay render – also means there's no risk from vermin either.

There are two ways to build with straw: the bales can either be used as the structural building blocks of a home, or as the infill of a timber frame that supports the house. Brian recommends the latter. "Straw is an organic material that will lose some of its structural integrity over time, which can transfer the roof loads on to the plaster/render – personally I would only use straw as an infill," he advises. ModCell has taken the infill concept a step further by



Top left: Husband-and-wife architects Steven Harris and Catherine Roberts of CRSH Architects tried out straw bale construction by building their garage-workshop with a curved wall under a large projecting roof. Top right: The garage has the first of its lime render coats and will eventually be painted. Above: The finished structure

devising a prefabricated straw bale panel system. The walling elements can be supplied lime rendered and some versions have a U-value as low as 0.11 W/m²K.

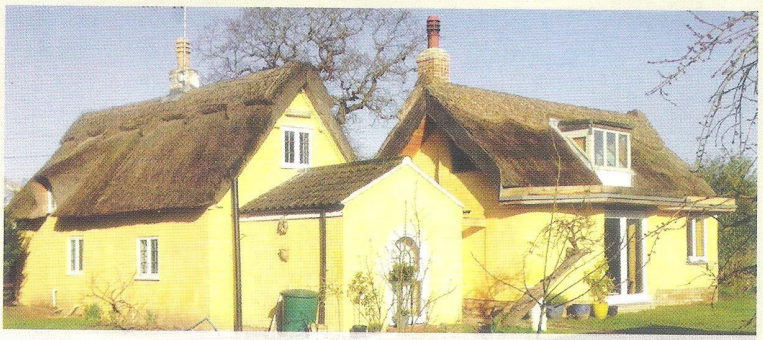
Once the structure of a straw bale house is in place, a breathable lime or clay plaster/render must be applied to the inside and outside of walls to help control humidity and indoor air quality, as well as further insulate the building. Carol Atkinson, from Home Grown Home, says the roof should be designed to overhang the walls by at least 500mm for weather protection. Architects Steven Harris and Catherine Roberts, who own CRSH Architects, built their own straw bale garage-workshop. "We constructed a 450mm thick wall, to match the width of the straw bales, starting at 300mm above ground level with a 700mm roof overhang," says Steven. "But you have to know this is how you're building from the start, because bales are imprecise and lumpy and the design needs to take that into account."

Prices for building the shell of a straw bale house aren't dissimilar to that of a block wall – unless you save money by doing the work yourself. In this case you'll need to source straw bales from a farmer (Steven paid £3 each) and enrol on a straw bale building course like those offered by the Brighton Permaculture Trust, Home Grown Home and Straw Works, run by Barbara Jones, author of *Building with Straw Bales* (available through Amazon).

The alternative is to go to a specialist company like Yorkshire-based Sam Atkinson Carpentry (who also builds in hemp and timber) or Brian Waite at Strawbale House, where you can buy a straw bale home building kit that replicates his own property.

CONTACTS **Brian Waite** 01900 823318 www.strawbalehouse.co.uk **Brighton Permaculture Trust** 07746 185927 www.brightonpermaculture.org.uk **CRSH Architects** 01873 853238 www.crsharchitects.co.uk **Home Grown Home** 01430 410662 www.homegrownhome.co.uk **ModCell** 0117 955 6731 www.modcell.com **Sam Atkinson Carpentry** 07872 012901 www.sacarpentry.co.uk **Straw Works** www.strawworks.co.uk

Earth building



An original 'clay lump' house, extended with cob and straw bale, with a cob staircase and fireplace inside. The project, carried out by Edwards & Eve Cob Building, doubled the size of the cottage for just £10,000

Using earth as a building material is a resourceful way of making use of excavated subsoil from a site. When it's formed as a wall, earth has good acoustics and high thermal mass, which acts like a thermal store, absorbing and storing the heat from the sun and then slowly releasing the warmth into a home as the air temperature cools.

There are three traditional building techniques: cob, rammed earth and earth bricks or adobe ('clay lump'). "Cob is the most common method employed in the UK," says Dr Paul Jaquin, an engineer and the director of Earth Building UK. "There are a couple of modern rammed earth houses and forays into building with unfired earth bricks, but they haven't ever really taken off here."

The beauty of cob is in its flexibility. As there's no need for bricks and straight edges, it can be moulded and sculpted – which makes it ideal for a house with curves. You can also use cob inside to create fireplaces, stairs, floors and shelves burrowed into the walls.

There can be issues with how earth homes meet Building Regulations for insulation and energy conservation, so it might be worth using an independent building inspector with this knowledge to help smooth the way with building control. For example, Kate Edwards, from Edwards & Eve Cob Building, can offer consultation and advice on Building Regulations. "One of the greatest benefits is that cob is free if it's dug from your site," says Kate's colleague, Charlotte

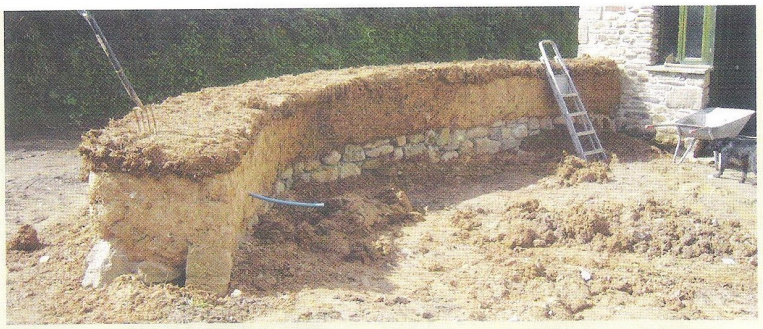
Eve. "The subsoil from the foundation trench can be used and it's easily made in large quantities by using a digger head to crush the particles together in a pit."

Cob is ideally a 75% sand and 25% clay mix; straw is added to improve tensile strength, provide some insulation and to make the cob easier to compress, while mixing in water makes it more malleable. Some self builders prefer to work the cob themselves, rolling the mix into balls that can be easily handled. Cob walls for houses are around 600mm wide and built onto a brick or stone stem wall which sits on a limecrete footing on a gravel foundation. "The base of the cob must be at least 450mm above the external ground surface," says cob and lime specialist, Leslie Cornell from Leslie Cornell Building Restoration. "This stops excessive moisture going into the base, which is the highest load bearing area of the earth walls."

Note that each level in a cob house needs to dry out before constructing the next. But in theory building the walls is relatively inexpensive. "If you dig all the material on site and build the walls yourself, it costs nothing except the straw you mix in," says Charlotte Eve. "At the very worst, if your soil needs more clay or more sand it will be about £5-£10 per tonne, so really the structure of a small DIY two-storey cob house should cost no more than £200 to build."

Leslie Cornell, David Joyce Cob & Lime Specialists and Edwards & Eve Cob Building all design and build cob houses. If you decide to have a go yourself then the latter also runs a four-day Complete Cob Building Course, as does Ireland-based Mud & Wood, while Devon Earth Building has a list of course providers on its website.

Rammed-earth walls are formed by pressing layers of loose, damp soil into a formwork. Ramming is done by hand or machine and when the formwork is taken away it leaves a freestanding wall of around 300mm-600mm thickness. Cement can be added to make the walls stronger, provided the correct moisture content is preserved. Building is still slow going, but there's no need to wait for walls to dry out.



Top: A project by Leslie Cornwell Building Restoration, showing cob walls being built. Above: The finished house. The first floor was repaired using cob blocks and a cob mix, both made on site. Three coats of natural hydraulic lime/sand render were applied along with four coats of natural lime water-based paint

The Centre for Alternative Technology (CAT) in Wales runs an annual summer course on rammed-earth building, as does the Brighton Permaculture Trust. However, if you're looking for a firm to do the work for you, then try JR Building or Earth Structures; the latter has produced its own stabilised rammed-earth wall that looks like cut stone.

Earth or adobe (soil and straw) bricks are formed in a mould; earth bricks are laid on to a clay slurry, while adobe uses an earth and lime mortar. This building tradition is mostly seen in East Anglia, but neither method is load bearing. The East Anglia Earth Buildings Group (EARTHA) lists architects and contractors that specialise in this area. Even the more conventional brick manufacturers are getting on board with clay-based products: Ibstock, for example, makes Ecoterre, a range of unfired clay bricks and blocks suitable for internal walls.

CONTACTS

Centre for Alternative Technology 01654 705950 www.cat.org.uk **David Joyce Cob & Lime Specialists** 01297 35579 www.davidjoycecobandlime.co.uk **Devon Earth Building Association** www.devonearthbuilding.com **Earth Building UK** www.ebuk.uk.com **Earth Structures** 01858 565436 www.earthstructures.co.uk **East Anglia Earth Buildings Group** 01379 687705 www.eartha.org.uk **Edwards & Eve Cob Building** 01493 369952 www.cobcourses.com **Ibstock** 01530 261999 www.ibstock.com **JR Building** 01452 741881 www.jrbuilding.co.uk **Leslie Cornell Building Restoration** 01726 338708 www.cornellcob.co.uk **Mud & Wood** 00 353 71 930 0488 www.mudandwood.com

Hempcrete

Hempcrete is a natural and sustainable building material made using the woody waste, known as hemp shiv, from UK-based hemp manufacturing. The shiv is mixed with water and a lime binder, creating a lightweight material with excellent thermal properties (a 350mm-thick wall has a U-value of 0.19 W/m^{2}K). It is breathable, making it ideal for building external and internal walls, but also for external wall insulation and in floors and ceilings.

Hempcrete is non-load bearing and is usually mixed on site and either spray-applied or cast in formwork to provide the cladding for a structural timber frame. The curing time for walls is about four to six weeks and the external finish can be anything from a traditional lime render to timber cladding, although the inside must be lime or clay plaster.

ALEX SPARROW/HEMP LIME CONSTRUCT

Victorian cottages restored by a self builder, who cast hempcrete external solid wall insulation from Hemp Lime Construct as a new cladding

Above: A project by Hemp Lime Construct showing hand-placed hempcrete cast around a central softwood frame. Right: Two coats of lime plaster is the usual finish for hempcrete, but clay plasters can also be used internally as with this house by Hemp Lime Construct

"We can create some amazing designs like curved walls because the timber frame and formwork can be flexible," says Nicholas Leigh from eco design and build firm Homes in Harmony. It's also possible to buy preformed hemp blocks, such as Hemp Construct's HC eco block, while Lime Technology makes and sells Tradical Hemcrete (under license from Lhoist) for use with formwork.

You'll need advice if you want to build with hempcrete yourself so take a look at *The Hempcrete Book: Designing and Building with Hemp-lime* by William Stanwix and Alex Sparrow (available through Green Books from October). Otherwise, companies that can build and design your hempcrete house include The Limecrete Company, The Drystone Group or Homes in Harmony (which operates in London but also has close links with Hemp Lime Construct, which works throughout the UK).

CONTACTS

The Drystone Group 01271 327600 www.drystonegroup.com **Green Books** www.greenbooks.co.uk/the-hempcrete-book **Hemp Construct** 01206 396836 www.hempbuildsystem.com **Hemp Lime Construct** 07818 292705 www.ukhempcrete.com **Homes in Harmony** 0844 504 8867 www.homesinharmony.co.uk **The Limecrete Company** 0808 168 5463 www.limecrete.co.uk **Lime Technology** 0845 603 1143 www.limetechnology.co.uk

Log building

Below: Logs are reassembled on site after being built in British Log Cabins' yard. Below right: A log house, like this one by British Log Cabins, can be built on to a block plinth but the style of footings is flexible

Handcrafting a log house is a carbon neutral method of building, as all of the materials are grown sustainably and minimal energy is used in the labour. Logs should come from local forests that are Forestry Stewardship Council (FSC) approved and the timber is usually Douglas fir or Western Red cedar, although larch, spruce or eastern white pine are other less-used alternatives.

Handcrafted log homes are generally built with the 'full scribe' method, where each log is shaped to fit tightly to the one below. The stacked logs are held together by a saddle notch in each corner to make a strong structural wall, with insulation (often sheep's wool) in between. Prices range from £900-£1600 per m² to build the log shell depending on size and specification.

Dan Waring, owner of British Log Cabins, says that one of the most common areas they get asked about is the potential for fire risk. "There's very little risk because the logs are scribed so tightly together that there's no oxygen to sustain a fire," he says. If you're interested in building your own version then Strongwood Log Homes offers training, as does Log Home Scotland, which can work alongside you on site. British Log Cabins also runs a two-week intensive course to get you started, or you can hire the company to do the log work for you, with options for the level of finish, allowing you to take on as much or as little of the project as you like.

If you're looking for peace of mind, Scandinavian Log Homes has CE certification for its products – a European standard that guarantees structural integrity, permeability and fire resistance. British Log Cabins, meanwhile, undertakes its projects according to the International Log Builders Association (ILBA) standards, whose website is also a great source of further information.

Far right: British Log Cabins scribes its structural elements by hand on site to achieve a precise finish and sound joint that follows the natural shape of the logs

CONTACTS

British Log Cabins 0121 288 2840 www.britishlogcabins.com **Caledonia Log Homes** 01835 268317 www.caledonialoghomes.co.uk **International Log Builders Association** www.logassociation.org **Log Home Scotland** 0131 552 4928 www.loghomescotland.co.uk **Scandinavian Log Homes** 0800 033 7178 www.scandinavianloghomes.co.uk **Strongwood Log Homes** 0117 244 0080 www.strongwoodloghomesuk.com