Roofing for strawbale walls

The design of the roof for a straw bale house is not unusual nor particularly different from that for any other building. The main consideration for load-bearing and compressed frame designs is that the loading is spread as evenly as possible around the perimeter walls, across their width, and the load is directed down the centre of the wall. Unlike masonry design, where the roof weight is usually carried on timber placed on top of the inside wall, with straw it is **vital** that the roof weight is transferred down the centre of the straw bale wall, and not on one edge or another.

All loading through straw walls should be vertical as much as possible, otherwise it will tend to knock the walls over. These principles must be remembered during all aspects of construction. Truss rafters during construction should be spread across the walls, not stored at one end of the building before fixing. As the roof is loaded up with slate, tiles, etc., these should also be distributed evenly and not loaded in one spot; nor should half the roof be slated before the other half.

Types of roof

The earliest straw houses, built 150 years ago, had hipped roofs. This is a particular design with no gable ends where the roof weight is carried on all four walls. It's a very stable design, very well suited to straw bale houses, because the roof load is evenly spread around all the walls and there are no unprotected gables exposed to bad weather. This type of roof is far less common now because it's more expensive to build and we live in a society that values low-cost more than quality.

More common today is a duo-pitch roof, usually with a pitch of 30º for grey slate, 45° for Welsh slate or tiles and 52° for thatch. Planted ('green') roofs are at a pitch between 10° and 25°, and shingle from 14°. Flat roofs are notoriously prone to failure and should be avoided if at all possible (this is the roofer in me speaking!). You will also see mono-pitch roofs working very well, especially for smaller buildings and extensions. Circular or curved roofs of various pitches are also quite popular designs on many straw buildings.

Wall plate or roof plate

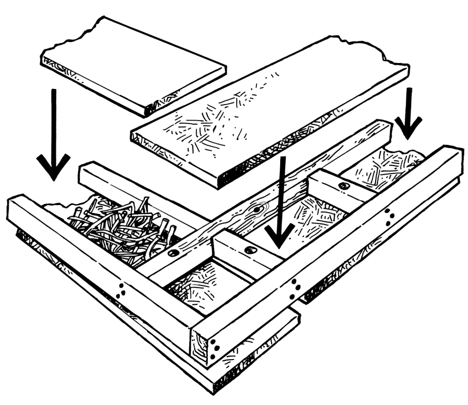
This is a continuous, rigid, perimeter plate that sits on top of the straw bale walls at each floor level and under the roof. It is usually made beforehand in sections for ease of installation, and fixed securely together once in position. The size of timbers used will depend on the loading it will carry from above, the span of the building, etc. They would never be less than 100mm x 50mm (4" x 2") laid vertically not flat and can be as much as 225mm x 50mm (9" x 2") or even be made out of I beams. To give this plate structural strength and make it into a box beam it will need to have a strip of board, preferably 18mm SmartPly (because it doesn't use formaldehyde) glued and nailed to the bottom and top. The top plate is added only once the wall plate / roof plate is in position and hazel pins have been fixed down into the bales.

The wall or roof plate performs various functions:

- It evenly distributes the load of the roof or floor across the width of the wall, and around the perimeter of the building.
- It provides a rigid perimeter plate that affords compression of the straw walls at an even rate around the whole building.
- It provides a fixing point for strapping or anchors to the foundation in order to hold the roof structure down against wind uplift, and the fixing point for the rafters themselves.

The foundations or base plate provides a good template for the wall plate, and it's sensible to construct one on top of the other and place the wall plate to one side for use later. Don't worry if your straw walls don't seem to be quite level once you've finished building – the wall plate will sit on the high points first, compress those, and then compress the rest of the walls evenly.
Make the wall plate sections as large as physically manageable; a well-coordinated team can move surprisingly large and heavy objects with ease. The fewer joints you have in this perimeter plate the better, as it will be stronger. Once the wall plate is in position, any distortion in shape that the walls have suffered as a result of their flexibility, or bale frenzy (over-excitement when working with straw!) can be adjusted. The weight of the plate immediately gives the walls greater stability. It's hard to describe the transformation that takes place from working on very flexible walls that sway like a ship when you're walking on top of them to finding that most of that movement has disappeared when the plate is placed on top, even before compression.

Fitting the wall plate
Beginning at the place of best fit, the walls should be persuaded back into correct alignment if they need it, and the plate pinned down with hazel pins 25-38mm (1-1½") in diameter, 1m (3') long or longer; two pins per bale. Once all the hazel pins are in place the box should be well insulated with tightly stuffed straw or sheep's wool and the top plate should be glued and nailed down firmly. This is essential as you must cover the tops of the pins so that any rain cannot possibly hit them and be taken down to the centre of the bales.



Roof construction

Originally (that is, several hundred years ago), all roofs were what is know as 'cut roofs', hand cut from sawn or in-the-round timber. They were pretty heavy and often used whole trees for purlins, king posts and A-frames, with rafters being in lighter, smaller-dimension timber. As the years went by, timber grew scarcer and smaller houses were built, we still had cut roofs but they were now a simple ridge board, usually a floorboard, with pairs of rafters 100mm x 75mm (4" x 3") pushing against each other, held together by a crosspiece of 100mm x 25mm (4" x 1") placed one-third of the way down the slope, with the rafter ends sitting on a 100mm x 75mm (4" x 3") timber wall plate. Sometimes these roofs had a couple of purlins under the rafters of 200mm x 100mm (8" x 4") on either slope, particularly for the heavier roofs, which carried the roof weight horizontally on to side walls of stone or brick.

Nowadays it is far more common to see truss rafters, made of small-dimension timber in a factory and held together with metal ganger plates. It can be much more cost-effective for a self-builder to buy trusses than to build her or his own cut roof. The manufacturer needs to know the location of the house (to calculate wind and snow loadings), the dimensions of the building, the size of overhang, where the bearing weight needs to be (crucial for straw buildings) and any other particular features of the design. From this can be calculated the size of trusses required and a quote for supply and delivery. The main drawback to the use of trusses is that they can never be altered. So you won't be able to add an extra room in the roof, or add a dormer, without also adding major structural timbers to replace the trusses you wan to change.

All sorts of different designs can be used for the roof, depending on such things as the span, internal walls, open-plan ideas, weight and choice of roof covering, etc. It is usually sensible to get someone with experience to check over your ideas before you build, unless you are copying straight from a tried-and-tested method.

Ensuring the roof weight is central to the wall

The wall plate is designed to have cross noggins underneath each rafter. Rafters are fixed to a continuous length of timber, fixed to the centre of the wall plate through these cross noggins, and with an angle on the top that matches the pitch of the roof. This ensures that the roof weight is transferred directly down the centre of the wall.

Alternatively, the rafters are tied together with ceiling/floor joists, and these joists lie across the wall plate, distributing the weight across the whole width.

The distance between rafters is determined by the strength of what spans between them, the strength of the rafters themselves, and the need for insulation. Battened roofs rarely have rafter centres wider than 400mm because slate battens will bend or break as slate nails are fixed if they are supported any less.

Roof insulation

In the past, roof design did not take into account today's need for adequate insulation, and most of our older roofs are difficult to insulate because the rafters don't have enough depth. In order to get enough insulation into the roof, rafters usually need to be at least 225mm (9") deep, and/or the insulation has to be placed above or below the ceiling joists. Rafters of this depth are so much stronger than required that their width can often be reduced to 38mm (1½") and the spacing increased to 600mm (2').

Straw can be a cost-effective solution for roof insulation but it is heavy compared with other choices, and ceiling joists or rafters need to be strong enough to take the extra weight. However, it is easy to design the roof so that a bale of straw can either fit between the rafters or sit on the ceiling joists. Straw as part of a compressed and plastered wall is not a fire risk, but extra protection needs to be given to it when used in single bales, as it would be for roof insulation, because the strings are vulnerable if there was a fire and the ordinarily dense bale could become a hazard with no strings, as loose straw is very flammable. Therefore it should have a fireproof coating on both sides – 30mm (1¼") of clay would do this.

Roof coverings

While any type of roof covering can be used, as long as basic design principles are followed, there are some choices that particularly complement a straw bale house because they're more environmentally sustainable.

Cedar or oak shingles has to be one of the best choices, for environmental and aesthetic reasons. They are natural materials and do not require a waterproof membrane such as roofing felt underneath them, as they are breathable and rely on good-quality installation and ventilation for their extremely long life It is advisable to use a vapour-permeable membrane, however, to protect the rest of the house while it is under construction, as shingling is slow (albeit satisfying) work, and also to act as a wind barrier. When it rains the shingles swell with water, which seals up any possible cracks between them. They hold this water – it doesn't drip through – so the rain itself in the shingles makes it water-tight! It's a bit scary to watch underneath your shingles as they get wet for the first time, until you find out that they really don't drip. They need to be laid with the correct spaces between them, so they can expand and contract with the rain, with a 3 layer coverage, (unlike slates which only have 2), and good ventilation so that any moisture can evaporate safely away. Shingles are very compatible with the equally breathable straw bale walls.

Wheat straw (or reed) thatch is also a great choice as a roof covering. Again, it is a totally natural, renewable and beautiful material that should last a long time.

Planted ('green') roofs also complement straw houses, particularly the more modern versions of such roofs, which use only about 25mm (1") of a gravelly soil, with shallow-rooted plants such as sedum or strawberries growing in them. There are many companies selling different versions of roof build-up for natural roofs, but it can be done quite simply and cheaply.

Overhang at the eaves

Straw houses need a good 'hat' to protect them from the weather. A large overhang is a feature of straw bale buildings, especially in the UK and Irish climate. Just as traditional thatched houses have a roof overhang of about 450mm (18"), so too do straw ones. This gives really good protection to the top of the walls against the rain.