

How to choose good building bales

Bales should be dry, well compacted with tight strings, be of a uniform size and contain virtually no seedheads.

Bale Standard

- Bales must not have a moisture content higher than 20%, and must be protected from getting wet during the building process. This includes storage on and off site, during transportation, construction and prior to plastering.
- Bales should be as dense and compact as possible. The baling machine should be set to maximum compression; in general this means bales contain about one third more straw than usual. Weight should be between 16kg and 25kg.
- Bales should be more than twice as long as they are wide and are usually measured in imperial units rather than metric: about 41" (1.05m) long on average is good. Strings must be very tight, so that it is difficult to get your fingers underneath. They should be about 100mm (4") in from the edges of the bale and not sliding off the corners. String should be sisal or hemp baling twine for a low environmental impact or polypropylene, preferably not wire, as metal is best avoided within a straw wall.
- The type of straw doesn't matter as long as the above guidelines are followed. It can be wheat, barley, rye, oats, etc. Rye would be a good choice as it contains a natural fungicide so is very resistant to rot, but it's almost impossible to get it in the right size of bales. Winter wheat would be the second choice as it is more durable, having had to survive harsher weather conditions.
- Straws should be long, 150mm (6") minimum, preferably 300-450mm (12-18").
- The age of the straw does not matter as long as the above conditions are fulfilled, and it has been stored correctly.

Usual Bale sizes

Most UK baling machines produce two-string bales that are 18" (450mm) wide x 14" (365mm) high and are of variable lengths from 36" to 45" (900-1125mm), although a few machines are 20" (500mm) wide and 15" (390mm) high.

Mini Heston bales of 7ft 10in x 3ft 10in x 2ft 3in (2.4m x 1.2m x 0.7m) or Quad bales of 7ft 10in x 2ft 7in x 2ft 7in (2.4m x 0.8 x 0.8) can also be used, and are especially good for building extremely large spaces such as warehouses.

Straw and hay

Do not confuse straw with hay or grasses. Straw is the baled-up dead plant stems of a grain crop. It has had virtually all its seed heads removed, and contains no leaves or flowers. It is a fairly inert material, with a similar chemical make-up to wood. It does not decompose easily, usually requiring the addition of nitrates to do so. Hay, on the other hand, is grass baled up green, with lots of feedstuff (leaves, flowers, etc.) deliberately left in there because it is fed to animals. It readily decomposes, unlike the dead plant stalks of straw.

All the above conditions apply equally to all bales, whether they are being used for load-bearing or infill.

Bale size for design

It is important to know the size of bales you will be using before finalising the dimensions of foundations, wall plate, roof plate, etc. Bales can vary a lot in length, from supplier to supplier and within each load, since whether or not the straw is picked up uniformly as it is baled depends on the skill of the tractor driver and the evenness of the field.

In practice, relying on the farmer to tell you the length of bales is not a good option, as you are unlikely to get an accurate picture. Besides which, you will need to satisfy yourself that the straw is baled dry, and kept dry while in transit and storage. It is far better to look at the bales once they're harvested and determine the average length of bale at the same time. The best way of doing this is to lay ten trimmed bales tightly end to end. Measure the whole and divide by ten to find the average. (It is almost impossible to measure the length of one bale accurately). However, if you find that your delivered bales are not the same length as you expected, this is not an insurmountable problem. It may mean a little more work in shaping the bales to fit, but this is straightforward and not too time-consuming.

Construction-grade bales

As more and more buildings are being constructed out of straw, this has given us the opportunity to really find out which are the best bales for building. It is possible to order 'construction grade' bales from particular wholesalers who are familiar with the above requirements. These bales are often made using a modern baling machine which creates very dense, uniform bales that are delivered to site in packaged bundles with 21 on a pallet. Their dimensions are 1,050mm x 365mm x 450mm (42" x 14.6" x 18"). Knowing what your bale dimensions and properties are makes a big difference when you are designing and building. If using pre-compression methods, these bales are so dense that they will each compress by no more than 10mm (3/8"), so you can also predict with greater accuracy what the settlement of the walls will be and factor that in to the building process. Although it is still possible to use other types of bales, you must remember that there may be greater settlement on the walls, and allow for up to 25mm (1") per bale.

As straw bale building becomes more widespread, good-quality construction bales are becoming more readily available and there are wholesalers in the UK who can supply them. These can be found listed under Agricultural Merchants. It is possible to harvest and store straw in bales of uniform length and moisture content, ready for the building market each season, and wholesalers will start to do this as demand increases. As long as they are kept dry and well ventilated, they can be stored for a long time before using. As demand increases, so will the reliability and availability of supply.

Moisture and straw

If we leave a bale of straw out in the field to be rained on, it quickly becomes too heavy to lift because of water saturation and is of no use other than as mulch for trees. However, if we stack lots of bales carefully, raise them off the ground and put a good roof over the top, they will withstand the weather and the outside edges simply get wet and dry out again - this is how straw (and hay) was traditionally

stored – in the field for ease of access. The bales would be raised off the ground first, usually by using a sacrificial layer of bales (i.e. those that would go to waste later) laid on edge, and the rest would be stacked flat, with a roof of thatch over the top. The sides of the bales would be exposed to the rain and wind, but getting wet was not a problem. Straw does not ‘wick’ (suck) water into itself like concrete does. It simply gets wet as far as the force of the wind can drive the rain into it. When the rain stops, the natural movement of air or wind around the bales dries them out. This cycle of wetting and drying does not normally damage the bale.

There have been problems in recent years in some modern grain crops. If the straw contains an excess of nitrates (owing to the use of too much fertiliser) and then it gets wet, the combination of the two can create great compost! This fact is utilised when using straw for DIY urinals, as the added natural nitrate helps it decompose. Too much nitrate in straw from farming practices has been a particular problem with thatch, which obviously gets wet rather frequently in our climate, but is not a worry with straw walls as they will be designed so that they don’t get wet.

Use organic straw?

Modern growing methods and the development of hybrids for grain crops has definitely changed some of the properties of straw, making grain for food more commercially viable but not necessarily improving the durability or length of straw for building. Organic farmers often grow older varieties of straw and do not treat their crops with commercial fertilisers or pesticides, which gives it some advantages over non-organic straw in that it is longer and will not rot down quickly. Clay plasterers report that organic straw has a natural waxy surface that prevents uptake of water, which is not what they want for plastering but is what we’d like for wall building as it is more durable. Allergy sufferers also find organic straw easier to live with as it doesn’t contain chemical residues. However, sometimes organic straw can contain a lot of weeds, which makes it more like hay than straw, so it needs to be selected carefully. In fact, however, it is usually quite hard to find organic straw bales, because it is mostly used by the farmers who grow it and is not available for sale.

The cost of bales

The cheapest way to buy bales is straight off the field after they’ve been made, and to buy locally so as not to pay large transport costs. This has the added benefit of minimising the environmental impact of transportation. If you collect them yourself they can cost as little as £1 per bale plus your fuel costs. When you consider that the average 100m² three-bedroomed house will use about 350 bales, this represents a material cost of only £350! However, most of us will have to buy bales and have them stored for us and then delivered to site, which will increase the price.

Construction-grade bales bought in bulk from a wholesaler, delivered to the site, can cost about £3.50 each, which would bring the price of 350 bales up to £1225 (plus VAT). These bales generally have about a third more straw in them than ordinary bales.

Although the walls represent only about 16 per cent of the total costs of a finished building, using straw instead of masonry is a significant saving and becomes more so for construction firms building more than one house. Together with this, the labour time involved in straw bale building is vastly reduced once the labour force is familiar with the material. Plus, you can run training courses to install your straw, learn how to do it, build your walls, have no labour costs and have a lot of fun!

Can you afford *not* to build with straw?

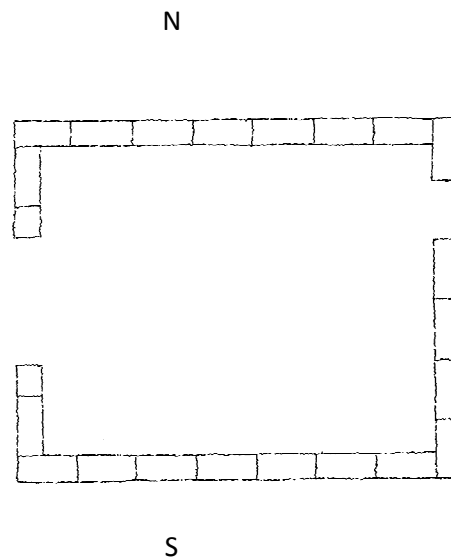
Designing a simple strawbale building

The design of straw bale houses is usually simple and elegant. Straw buildings are based on a block design and therefore different elements of the structure can be built up easily from the initial shape and dimensions of the foundations. Each section of the house has an obvious relationship to the other sections, and many different houses can be designed quickly and easily from the same basic plan.

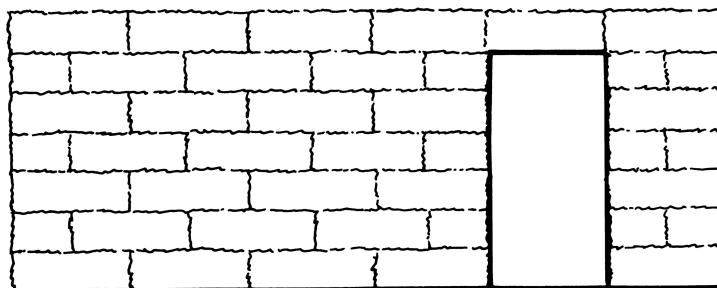
For most small buildings, it should be possible for owner-builders to design their own with a little guidance, and certainly to work out the straw elements. The way a straw bale house goes together is simple. It follows common-sense principles and it is effective.

Once you've decided on what the building is for, what you want it to look like, and what you want it to feel like, think about the building's orientation, design the rooms you live in or use most to face south, and have more or larger windows on this side to maximise solar gain.

Draw the shape of the building you require, as though you were looking at it from above. This is called the PLAN view. You will need to know what size your actual bales are. Draw in the shape of the bales, their width and length, planning where they lie on the first course of the wall, as in the drawing below



Now imagine you are looking at the finished building, standing on the ground looking north, south, east and west. Draw the face of the building you see from each direction, showing again where each bale is and how they turn corners or curve, etc. These drawings are called Elevations. See below for East elevation of the above Plan



From accurate bale plans you can work out how many bales you need, as well as how many hazel stubs (two per bale on the first course), pins (two per bale for the fourth and sixth courses) staples (in every bale where it changes direction, e.g. corners) and other quantities of materials. Details of foundations, windows, first floor and roof can be worked out. You also now have the basis for drawing your own plans for planning permission.

Principles of bale design and layout

- Before you draw your final plan, and before you finalise the dimensions and lay out the foundations, you need to know the dimensions of the bales you will be using, as they can vary a lot!
- The bale plan should be made up of a whole number of bales wherever possible. Any half bales should be only at an opening.
- Do not have any places in the wall (e.g. beside a window) that are less than half a bale in length.
- Window and door openings must be at least one bale length away from corners in load-bearing designs.
- If at all possible, choose window and door sizes that, together with their framing, are multiples of bale dimensions.
- Try to design frameworks so that the distance between posts is equal to a whole number of bales or half bales, thereby reducing the labour time involved in customising.

In a load-bearing design the walls will settle a bit once the weight of the roof is on, and after you have done the compression, so allow for this by leaving gaps above windows and doors that can be filled in later. With construction-grade bales, settlement in a seven-bale-high wall should be about 70mm (2¾"); for less-dense bales you need to allow for more settlement than this, unless you have a lightweight roof. The amount of settlement depends on the density of the bales and the amount of loading applied to them (such as the weight of the roof, whether there is more than one floor, etc.).

Interestingly, some of the laboratory tests done to find out how much load strawbale walls can carry have appeared to show that only single storey houses can be built this way. This is patently not true in practice! We need to be very careful when looking at research findings and especially when talking to engineers to make sure that everyone knows exactly what they are doing, and are measuring the thing they claim to be measuring. Common sense and practical experience should be our guides. After all, it was engineers who proved that a bumble bee cannot possibly fly....

Durability

Because of the simplicity of straw bale building, it is possible to build a wide range of quality structures, from a straw bale shed that might only last ten years to a straw bale house to last several generations. We can design to a standard of 200 years minimum – anything less is not sustainable, either environmentally or financially. In the UK and Ireland, the oldest buildings date from 1994, and some of the early ones were never intended to be more than experiments. However, there are now two-storey semi-detached load-bearing homes for social housing, classrooms and whole schools, retail spaces, centres for community groups and new extensions

to existing houses, as well as hundreds of owner-built houses, offices, studios and garages, animal shelters, food and machinery storage barns, and so on, all of which are expected to have a usable life of more than 100 years. In the USA, where it all began, there are about a dozen houses built around 1900 that are still inhabited and in good condition, and thousands built since the revival began in the late 1970s. **No straw bale building in the UK or Ireland has ever been refused planning permission or building regulation approval on the question of durability.**