

# Report on the viability of strawbale houses as an affordable ecological option for self build

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## Introduction

Strawbale houses are well known for being eminently suitable for self build. They can be designed very simply, use local and natural materials, and the build technique is very straightforward. These aspects make them affordable and ecologically viable.

There are several hundred strawbale houses built by self builders in the UK to date, and we have produced here designs that fulfil the above criteria, have been tried and tested, and can be built for under £50,000.

## Design

A successful self build design must be relatively easy for a novice to understand and construct. It should involve simple, easy to follow techniques that do not require expensive machinery, specialist equipment, or non-standard building products to achieve. As well as these considerations, it should be readily adaptable to changing personal/family circumstances, be built of materials that do no harm to our planet, and be possible to build between the beginning of spring and the onset of winter.

The loadbearing strawbale building technique (that requires no extra framework to support floors and roofs) has proved that it can meet these criteria, and also produce buildings with a lifespan of upwards of 100 years. Straw Works, led by Barbara Jones, previously of Amazon Nails, has refined the design and construction techniques over the last 20 years to produce the options contained in this report.

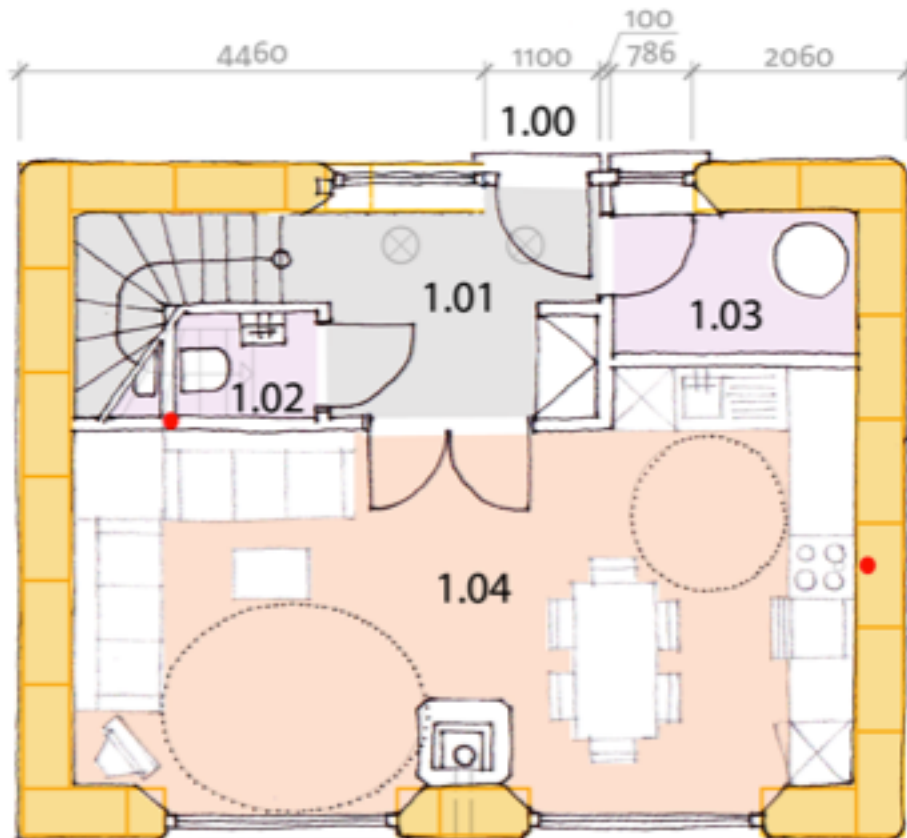


### Basic option – meets all needs

We have produced a Basic option for a 2 bedroomed 2 storey house with an internal floor area of 82 m<sup>2</sup>. This is a simple design, being a rectangular shape, open plan downstairs with the addition of a partition upstairs to create the bedrooms. It is designed to face south, with large windows to maximise solar gain, with utility rooms and access to the north. The ground floor is accessible by wheelchair users. Heating is via a woodburning stove on the ground floor, and the doors to the living/dining space can be opened to allow heat flow to the upper floor, or

closed to retain the heat. Bedrooms and bathroom can have electric water filled radiators fitted but are not expected to need them as this is a very thermally efficient design. Hot water is provided by solar thermal panels on the roof and an electric immersion heater if required. There is ample storage, and light is brought to the upper landing by a skylight, and to the downstairs hallway by light tubes hidden in storage areas.

The roof is designed with trusses to allow insulation to be laid effectively on the horizontal, (apart from around the skylight), ensuring a secure thermal envelope. It is hipped and has an overhang of 450mm all round, thus giving maximum protection to the straw walls and avoiding the use of gables.

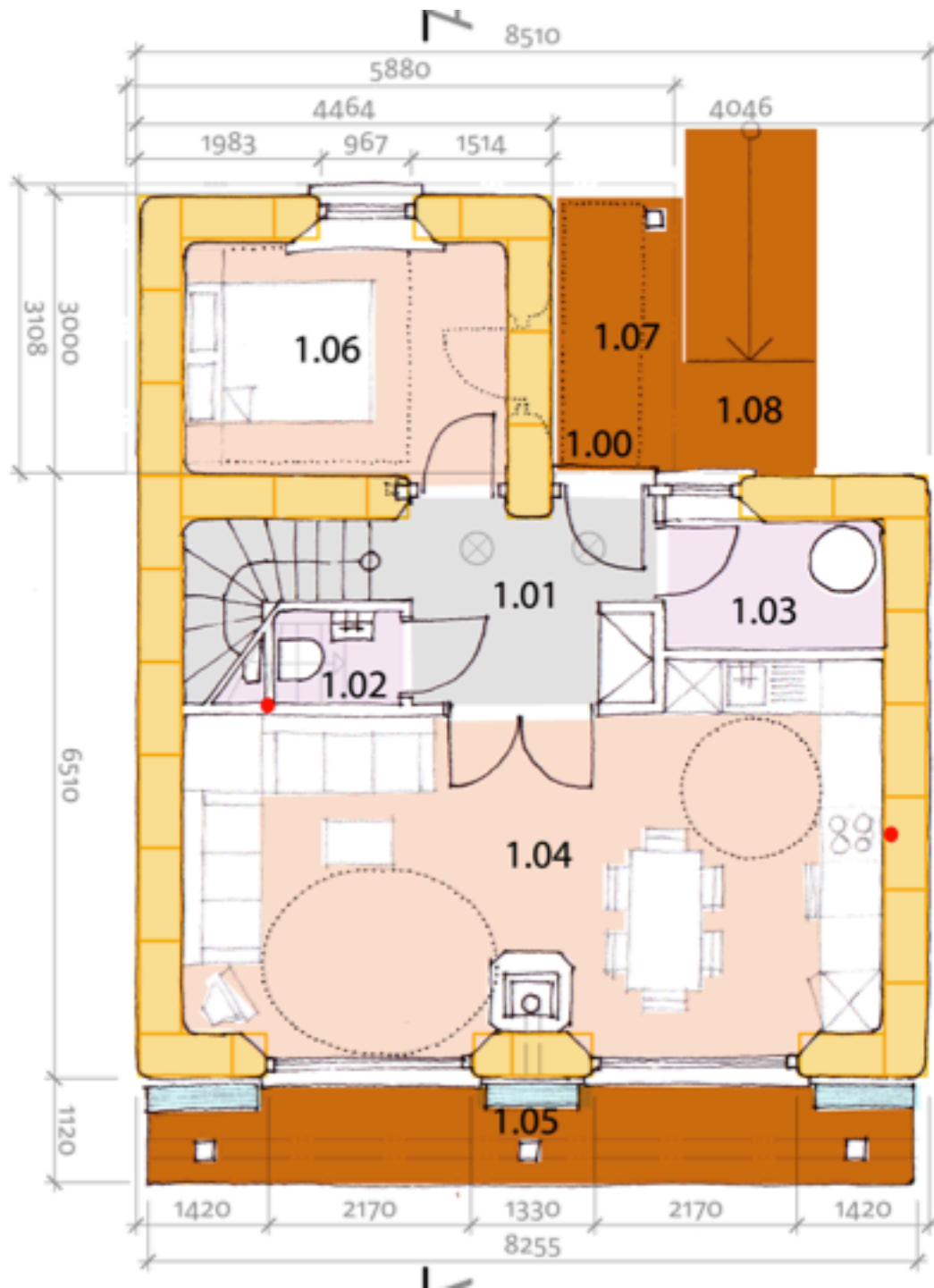


*Basic option, Ground Floor*

Full designs containing more information can be viewed separately to this document

### **Extended Option – allowing for change**

The Basic option can be added to quite easily as families grow, needs change, or more details can be afforded to create a 3 bedroomed house of 91m<sup>2</sup>. From comparison of the 2 options it is possible to see how this can be achieved with very little alteration to the basic design. A disabled access shower and bedroom can be added on the ground floor, for instance, or a study/therapy room, giving options for life and work changes. A balcony and terrace can be added to the south aspect, giving more space to the rooms above and below, and together with replacing windows with patio doors gives a feel of the outside inside. In this option a ramp is shown should there be a need to include one for access, and photo voltaic panels on the roof provide for self-generated electricity.



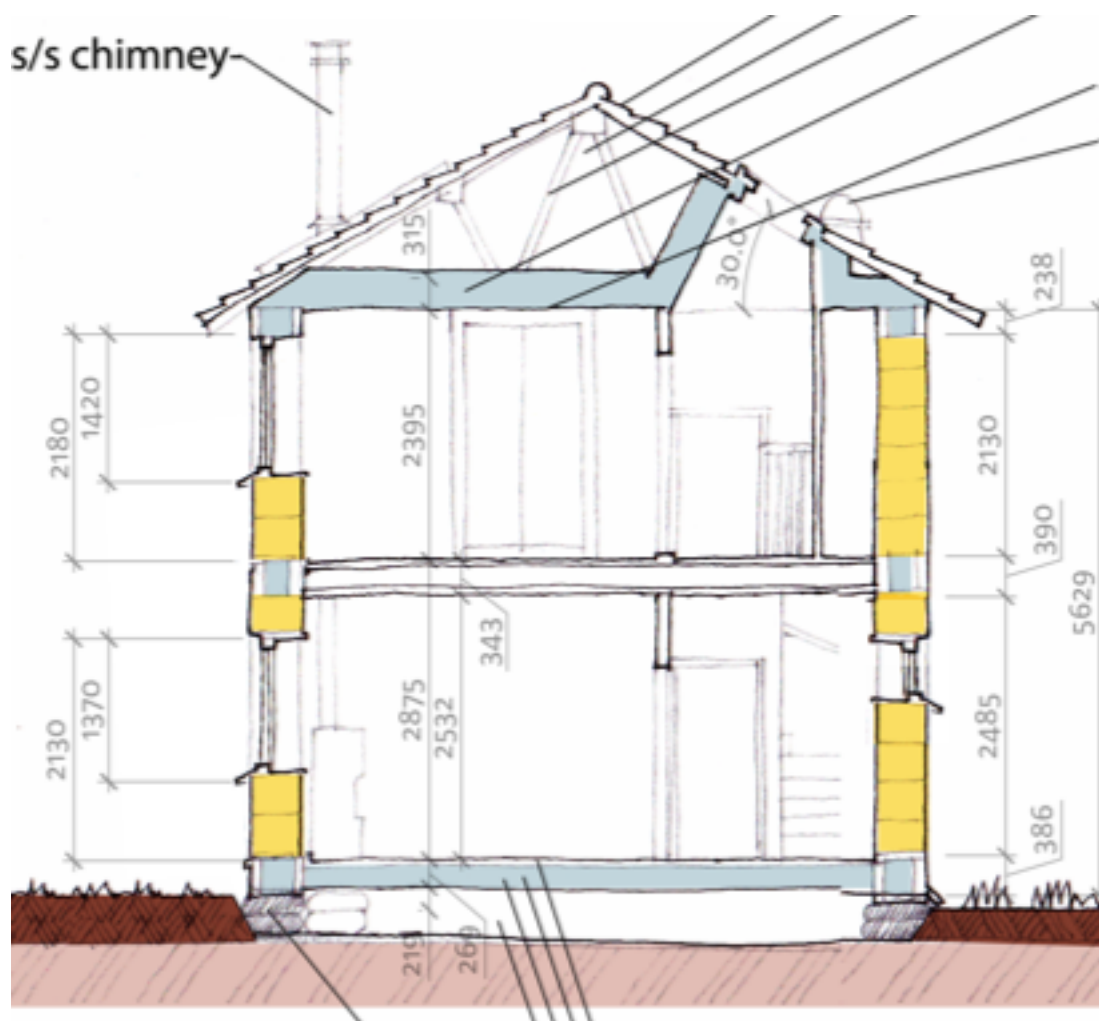
*Extended option, Ground Floor*

### **Construction**

Both options are based on strawbale sizes thus minimising work during construction. They can use 'off the peg' doors and windows, and factory made trusses to keep the costs down. All carpentry, strawbale building, insulation and clay and lime plastering can be done by the self-builder with some dedication to learning the required skills.

They are designed so that the first floor and roof to waterproof layer can be constructed before the walls. These are held in place using temporary props, thus giving weather protection with the addition of either sheeted scaffolding or tarpaulins draped from the eaves.

The basic option is designed with foundations made from car tyres rammed with 10mm pea shingle, with a suspended timber floor above using timber of standard dimensions, or manufactured I beams. This is a very affordable option, but we have shown an alternative for a solid floor construction in the extended option, using foamglass and limecrete. Clearly it is possible to use ideas from both options to create the home of choice.



*Cross section, Basic option*

## **On site training and community involvement**

It is very common for self-build strawbale houses to have a high level of on-site training and community involvement. It has been shown by the work of companies such as Amazon Nails and Straw Works to be an effective and empowering way to work, sharing skills and knowledge at the same time as constructing something real and necessary. Courses on site also have the potential to keep costs down, as fees paid by course participants can cover training costs, whilst the building is constructed. Self builders then benefit from a network of like-minded enthusiasts who want to help, and a local community that is informed by and interested in the build.

## **Affordability**

Affordability must take account not just of build costs, but also of long term maintenance and running costs.

Simplicity is the key to affordability, together with use of easily obtained standard materials, both in terms of timber sizes and 'off the peg' doors and windows. Strawbale buildings have proved themselves to be buildable by relatively unskilled people. They use materials that are predominantly of low embodied energy – not highly processed, and locally sourced – such as straw bales, recycled car tyres, pea shingle, and clay. These materials generally require more labour time to source and use, but cost less.

## **Labour**

As approximately half the cost of a conventional house is labour, it is easy to see how to bring build costs down. By far the major saving on a self build straw house is by providing one's own labour and that of friends, family, course participants and volunteers. The loadbearing straw method has simple designs, is an accessible building technique, provides the opportunity to learn and build at the same time, and does not require a high level of carpentry skills. All of these attributes mean it is possible to self-build.

## **Materials**

The use of low embodied energy materials as an integral part of the design, and materials that are extremely user-friendly such as bales of straw, lime and clay plasters (because they do not 'go off' quickly) keeps the cost down by being cheap to buy (a bale of straw is about £2 from the field), easy to use, and mistakes can be rectified easily.

Many savings can also be made by using pre-owned materials and recycling others.

## **Maintenance**

Once built, the strawbale house requires the same level of maintenance as other houses, that is, regular clearing of gutters and downpipes, garden maintenance to keep edges away from the building, re-decoration of timber parts and lime washing according to weather conditions.

By spending a little more on decoration at the outset and using an active silicate paint such as produced by Beeck instead of limewash, re-painting of the external render need only be done every 15 years.

By investing in durable timber windows and doors made from good quality larch or douglas fir, re-decoration is not necessary.

### **Long term savings on fuel bills**

One of the major assets of a strawbale house is the long term savings that can be made because of their extreme thermal efficiency. Plastered strawbale walls have a U value of 0.11 and an airtightness of less than 2.62. These results were achieved by the Council houses at North Kesteven designed and built by Amazon Nails with the design team who now work for Straw Works. See [North Kesteven District Council website](#). This means that self builders can expect to make savings of at least 25% compared with a typical Code for Sustainable Homes level 4 house. It is also possible to build strawbale houses to a Passivhaus level of airtightness, which will bring fuel costs down even more – depending on how much the windows are left open!

### **Actual Costs**

The basic option of 82m<sup>2</sup> shown here can be built by a self builder for between £600 and £650/m<sup>2</sup> giving a build price of £49,200 - £53,300. This saving is usually won by spending more time on the build than would be the case should it be built by a contractor.

Self-builders near Canterbury are currently completing 3 terraces of 2 storey loadbearing strawbale houses to a Straw Works design. The build cost is £60,000/house with a timescale of approximately 8 months per house - see [www.facebook.com/ElmfieldStrawCottages](http://www.facebook.com/ElmfieldStrawCottages) At 90m<sup>2</sup>/house this gives a build cost of £667/m<sup>2</sup> for a design much more complicated than that given here.

The 2.5 storey 3 bedroomed loadbearing strawbale house that won the Eco-home of the year award from Grand Designs in 2008 (see <http://quietearth.org.uk/story.htm>) cost £70,000 and 4 years to build. At 120m<sup>2</sup> this gives a build cost of £583/m<sup>2</sup>

### **Foundations**

One of the highest costs of a build can be the foundations, depending on the ground conditions. These designs offer a low cost solution, applicable in most types of subsoil, using recycled car tyres with pea shingle. They are very high on labour and very low on cost. The foundations for this house could be built for less than £500, as proved by foundations built by Straw Works in 2011. There are several other low cost and low impact foundation solutions that can easily be carried out by a self-builder that we have not the space to show here. The type shown for the extended option is a very thermally efficient one, but carries a greater cost.

### **Carpentry**

This aspect of the build can be a challenge to many self-builders, but these designs use simple carpentry techniques that most people can manage. The carpentry is kept to a minimum, as the straw is the structural element, and ring beams are used at floor and roof junctions.

### **Lime and clay rendering and plastering**

This is another potentially large cost of the build. Rendering externally in lime may cost about £2000 in materials, however, it could be applied by self-builders under supervision, as long as a longer time was allowed and a rougher finish than if professionally applied. This

would save about £4000. Plastering in clay could also cost about £2000 in materials, but could be applied by self-builders. This would also save about £4000 in labour costs.

There are ways that even these material costs could be reduced, by sourcing local clay instead of buying it from a producer, or using a hot lime mix, but the above represents what most self-builders could achieve.

### **Weather-proofing and access**

Ideally the build will use scaffolding for access and protection. With a long build time this can present a large cost. Self-builders are increasingly buying their own scaffolding from the second hand market and selling it on again once they have finished with it.

### **Professional fees**

It is usual for designers and architects to charge between 6 and 9% of build cost for design, planning and building warrant drawings and applications. For self-build, this cost would be based on a contractor built cost not a self-build price, as the amount of drawing work is not reduced by self-build normally. However, with these options here it would be possible to provide a package that included all of these for a reduced price, with site specific changes added on. So for the basic option, design fees would be based on a build cost of £1500/m<sup>2</sup> giving a price in the region of £7-11,000 but it is conceivable that once this design had achieved Building Warrant approval, it could be offered at a price more in the region of £3000.

The above examples show that it is possible to reduce the build cost substantially by putting in one's own unpaid labour. There is plenty of evidence now to show that this is so, see <http://strawworks.co.uk/our-self-builders/>

## **Strawbale Building and Sustainability**

- Strawbale houses are made from predominantly low-embodied energy materials - many of which can be sourced locally. These are materials like straw bales, clay, sheepswool, timber
- They store carbon instead of producing it during their construction and lifetime - unlike most modern homes. They have a negative carbon footprint, less than zero. No other type of construction can match this.
- They are structurally strong and durable, with a design life of upwards of 100 years
- They are thermally and acoustically efficient, plastered walls have a U value of 0.11 and airtightness values of less than 3 are easily achieved.
- They can easily meet Code for Sustainable Homes level 5-6

### **Appendices:**

Seven Drawings numbered 13005 01 - 07