

# ECCE BUILDING CERTIFICATE IN SUSTAINABLE CONSTRUCTION



le flocon 



## PARTNERS:



# ECCE BUILDING CERTIFICATE IN SUSTAINABLE CONSTRUCTION



le flocon 



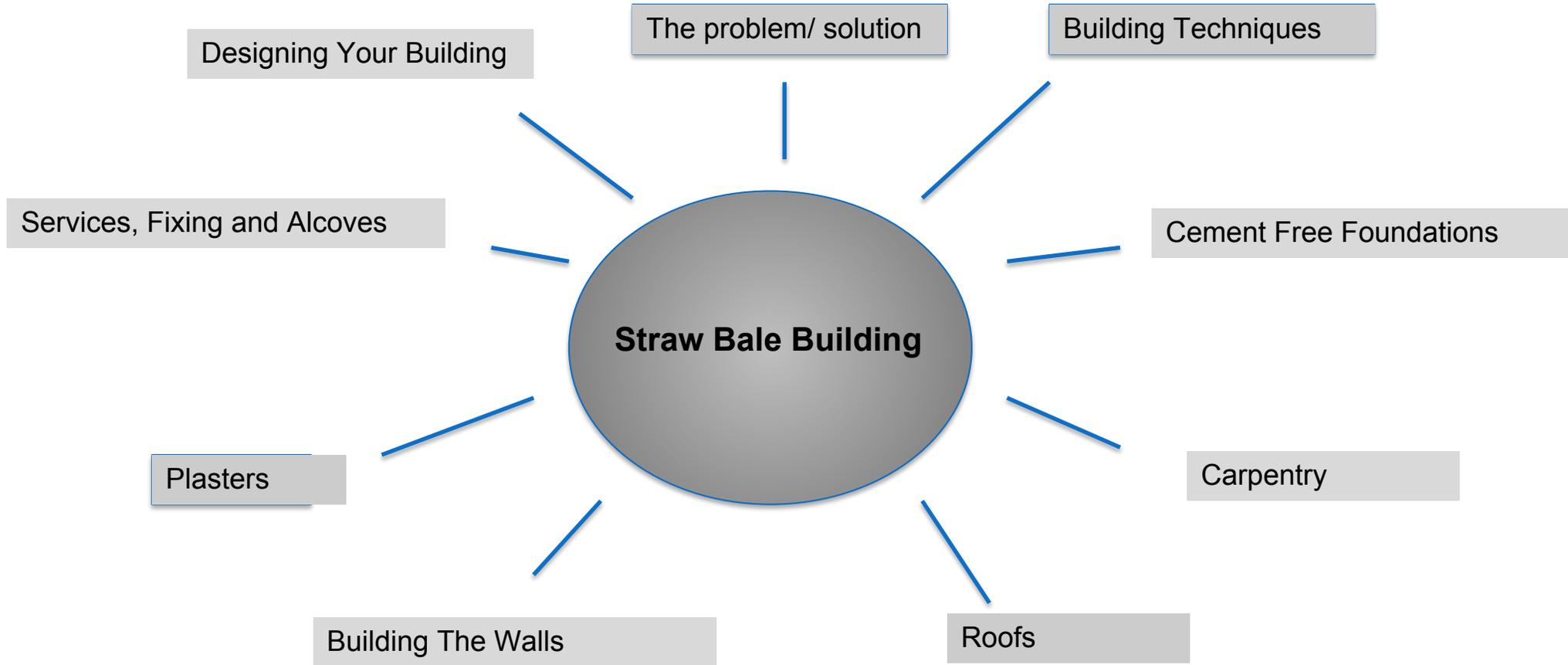
Coordinator:  
Nicholas Ward

LECTURE : STRAW BALE BUILDINGS

## LECTURE : STRAW BALE BUILDING

### CONTENT

- 1- Mind map
- 2- Case study
- 3- Workshops
- 4- Video
- 5- References
- 6- Evaluation



## The Problem:

We estimate that there are 320,000 homeless people in Britain today; Shelter, Nov 2018 The Guardian

<https://www.theguardian.com/society/2018/nov/22/at-least-320000-homeless-people-in-britain-says-shelter> )

One in three people aged 20-35 years old (14 million)) will never own their own home. More than half will be renting in their 40s - largely in the private renting sector and one third will still be renting by the time they claim their pension. This will create an explosion in state-funded housing benefits from £6.5bn to £16bn by 2060. (Resolution Foundation April 2018 The Guardian

<https://www.theguardian.com/money/2018/apr/17/one-in-three-uk-millennials-will-never-own-a-home-report>).



Photo: Independent newspaper 4 Oct 2016



Photo: citymetric.com



Mind map

Case study

Workshops

Video

References

Evaluation



Top: UK Style TV

Bottom: `interreg NEW, North Kesteven

Top: Load Bearing House, [www.lowimpact.com](http://www.lowimpact.com)Bottom: Strawbale House Brian Waite  
[www.strawbalehouse.co.uk](http://www.strawbalehouse.co.uk)**IDEA**

Straw bale houses have been built for thousands of years. Mainly used in agricultural areas. In the USA these were built in the 1800s.

**FUNDING**

Buildings tend to be funded by individuals, although local councils have commissioned social housing. Some community centres have been built in the UK.

**PLACEMENT**

On good sub soils, not damp.

**MATERIALS**

Readily available and cheap.

**EQUIPMENTS**

Uncomplicated equipment can be used.



Mind map

Case study

Workshops

Video

References

Evaluation

## A Practical Solution:

Alternative techniques for building with straw bales could solve many of the social housing issues that conventional methods have failed to resolve.

This summary has been compiled using information provided by Barbara Jones, founder of the company Straw Works and the UK's leading expert in straw bale design, construction and technical training.

Straw bales are ideal for self building and ownership as well as for social renting through community projects, housing associations and local authorities. More than any other process, (cob and clay, rammed earth), straw requires a co-operative approach where skills and common sense are shared. This leads to a positive, empowering atmosphere on site.

In 1996 the first straw bale house was built in the UK building with full planning permission. There are now around 1,000 straw bale buildings in the country with 5,000 in France and thousands more being built around the World.





Mind map

Case study

Workshops

Video

References

Evaluation

## Reasons for building with straw:

- People with little previous building experience can participate in construction
- Environmentally responsible with a reduced carbon footprint
- Use of sustainable materials
- Use of a long life, durable product.
- The first straw houses were built in the USA during early 1800s and are still standing today
- Energy and thermally efficient
- Reduces utility bills (can save up to 75% on running costs and is twice as insulating as UK Building Standards require). South facing windows increase thermal gain.
- improving air quality
- Straw is a natural, non toxic material that is breathable with minimal allergic impact. There is no pollen and so hay fever sufferers can breathe easily. Using natural plasters and paints can enhance your quality of life
- Good acoustic insulation, so suitable for use at noisy sites and for party walls in semi's and terraced housing
- Low fire risk as they contain little oxygen
- A low cost build, you can build a house of 82sq m for around £50,000
- Easy, quick and simple to build.
- It is flexible and can withstand earthquakes
- Building with materials that have low embodied energy (the energy used in the making of the product).
- Straw absorbs 0.91 MJ/kg, whilst concrete needs 4.6-5.6MJ/kg.



# Building Techniques

Building is fast, fun and rewarding. There are two main ways to build with straw bales:

## Load Bearing Structures

These carry the weight of the roof and any upper storey.

The good news is that anyone can use straw. The bales are laid like bricks and instead of mortar, they are pinned by coppiced hazel spikes not only to each other but also to two continuous rigid timber ring beams. The lower ring beams serves as a base plate with an upper ring at the top of the wall. This technique spreads the upper floor and roof loads across the whole width of the wall.

The roof plate can be fastened to the bales with coppiced hazel spikes and may be strapped down to the foundations, depending on local weather and the weight of the roof.

Windows and doors can be placed into structural box frames which are built into the bales as the walls go up. This is good for smaller houses. Otherwise you can double-up wooden uprights on either side of the opening - all fastened securely to the base plate and projecting through slots in the roof plate. These are not structural posts but they still give an airtight seal.



Photo: [researchgate.net](https://www.researchgate.net)



Photo: [designingbuildings.co.uk](https://www.designingbuildings.co.uk)



## Building Techniques... cont.

Curves are easy to achieve but will be more expensive due because they involve more complex timberwork.

As usual in the UK, when the weather is wet everything can be prepared in advance (prefabricated) and covered with tarpaulins. The sequence is simple: build roof/floors first and hold in place with temporary support posts; then the straw goes underneath; then lower the top level; build underneath a marquee or large tent; increase the height of the scaffolding to provide a temporary protective cover.

Jumbo bales can be used to increase insulation and acoustics but you need a forklift truck to install.

Buildings with at least four storeys have been built successfully with load bearing straw.

### **In- fill Technique using a structural frame of timber or steel.**

This technique is used if you like more timber in your design or if you have larger openings or glazing.

The frame takes the weight of the roof but it requires a high level of carpentry skills and has higher cost and environmental considerations.

Posts can be: separate from the straw; placed internally; partially housed in the straw or placed at the centre of the bale.



Photo: [greenbuildingadvisor.com](http://greenbuildingadvisor.com)



Photo: [en.wikibooks.org](http://en.wikibooks.org) 10

## Selecting Your Straw Bales

They must be:

- ◆ Dry with a moisture content below 20%.
- ◆ Humidity should not exceed 84%.
- ◆ Dense and compact;
- ◆ The baling machine must be set to maximum compression.
- ◆ Density between 100-155 kg/m cubed.
- ◆ Regular and uniform
- ◆ Twice as long as wide, (1.05m long)
- ◆ To get a true estimate of size you must measure 10 bales and divide by 10 to get an average length.
- ◆ Bales are dressed first and this will reduce the size by 30-40mm. You can get bales from local farmers or from a supplier listed under Agricultural Merchants or Straw Merchants
- ◆ Baling strings should be sufficiently tight to make it is difficult to insert a finger under them. String should be sisal or hemp to reduce environmental impact. Do not use wire.



Photo: thenbs.com

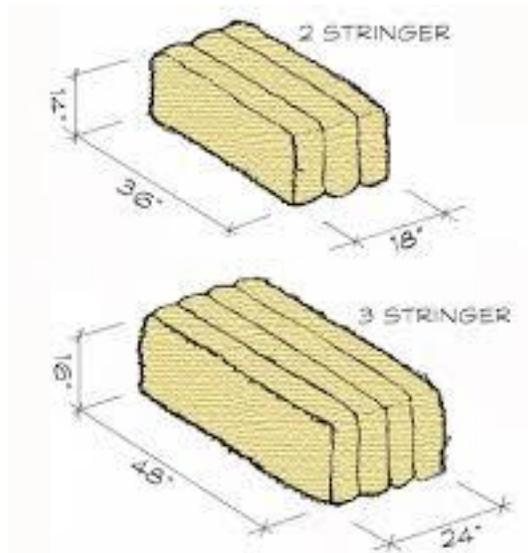


Figure 1 - Approximate dimensions of two and three string straw bales.



## Selecting Your Straw Bales... cont.

- ◆ You can use any type of straw – wheat, barley, rye, oats, rice etc.
- ◆ Rye contains a natural fungicide and is very resistant to rot.
- ◆ Winter wheat would be a second choice as it is very durable.
- ◆ The longer the straw the better, from a Straw-Walker machine.
- ◆ Stored bales should be raised off the ground on pallets and weatherproofed but ventilated.
- ◆ The age of the straw does not matter.
- ◆ You need to estimate how much the bale will compress under load.
- ◆ Construction drawings should mention uncompressed and compressed values.
- ◆ The orientation of the straw in a bale has little difference on stability or structure.
- ◆ An average 3 bed house takes about 350 bales.
- ◆ ordinary straw bales cost around 80p each but **construction grade bales coat around £3.50 each** because they contain more straw.
- ◆ Remember, the walls represent 16% of the total cost of the build.

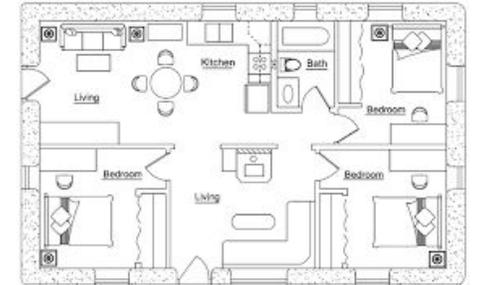
# Designing Your Building

Think first of all about the outside look of the house – for example, its shape and its position in the landscape. Then start to think about how you want your house to feel when you are inside - which areas of your home are you going to spend more time in and make these more spacious and more of a focal point.

Straw makes it so easy to design and assemble your own personalized house.

## Points to bear in mind:

- ✓ Think about the building's orientation in the landscape
- ✓ The rooms you live in should face south to maximize solar energy
- ✓ Draw a rough shape of the building you want and then refine it once you have your bale dimensions
- ✓ Draw the elevations from north, south, east and west, show the position of each bale is and how they turn the corners
- ✓ From these drawings you can work out the following numbers:
  - ✓ How many bales you need
  - ✓ How many hazel stubs (two per bale on the first course)
  - ✓ How many pins (two per bale for fourth and sixth courses)
  - ✓ Reinforcing staples for corners or wherever the bales change direction on a curve
  - ✓ Always allow for bale settlement once compressed
  - ✓ For walls that are seven bales high allow 70mmshrinkage/compression)
- ✓ Make sure you think about possible future adaption or extension... a granny annex or a growing family.



Once you have these plans you will then be in a position to seek outline Planning Permission.



Mind map

Case study

**Workshops**

Video

References

Evaluation

## Cement Free Foundations

Straw bale buildings need good, self-draining foundations. Barbara Jones recommends a really simple, cost effective method that should last for hundreds of years.

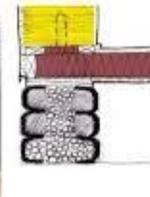
First, find out what type of earth you are going to build on. Each type of earth can carry a different load - for example, gravel soil will carry more than soft clay. This will determine how your foundations should be built. Look at other old buildings in the area and examine their foundations. Consult the local Building Inspector. Dig some pits about 800mm deep and look at the profile. Most types of soil are good with the exception of heavy clay soil, made up ground, wet soil and moving sand.

Basically, the foundations need to provide a dry, stable base so that there is no unequal settlement throughout the building. At the same time you can build in flexibility by using only clay or lime mortar.

Foundations need to be designed with three things in mind: moisture from the earth must not travel upwards through them rain bouncing off the ground should not be able to pass through any moisture that is produced inside the house must be able to escape externally or return back to the earth



Car tyre pillar foundations  
Extremely cost effective and easy to build



Great for volunteers!

Rammed stone car tyre pillar foundations with insulated suspended timber floor

Photo:  
Straw Works  
Sideshare.com

An average 2-storey straw bale house with a foundation width of 450mm has a bearing pressure of 43kN/m<sup>2</sup>.



## Controlling Moisture

Traditionally, non-porous materials such as stone, brick or recycled Foamglas will prevent then moisture from the Earth passing through them. If you use vapour permeable mortar like lime or clay then any moisture is taken out through the joints.

It's essential to create a capillary break to prevent any moisture from the earth moving into the foundations or upwards into the walls. This is a double layer of stones about 40mm wide with gaps at least 75mm thick between them with so water cannot pass upwards. Capillary breaks can be used rather than plastic in a DPC, particularly under solid floors. Rather than create an impermeable barrier we want to create walls that conduct moisture downwards either to pass through or just to sit on foundations.

## Thermal Efficiency

Energy efficient houses need to create a thermal envelope without gaps. Foundations must not allow cold into a house via what is called a Cold Bridge. Success all depends on the materials we use. They must be non-porous, load bearing and environmentally sustainable. The best artificial choice today is to use Foamglas block with an infill between the outer and inner skin of load bearing Foamglass chunks. However, no other insulation material can compare to the low cost of straw bales.



Mind map

Case study

**Workshops**

Video

References

Evaluation

## Thermal Efficiency... cont.

Your straw bale house needs to be raised off the ground by at least 300mm - and preferably 450mm.

There are several different types of foundations: Strip foundations; Pillars or Pier Foundations; Gravel bed foundations; Gravel Trench Foundations and Raft Foundations. Here, we will just give you details of Pillar or Pier Foundations. For all the others please contact Barbara Jones at Straw Works.

## Pillars or Pier Foundations

This is a cheap, fast way of providing foundations where a structural timber box beam carries the weight of the building across the gaps between the pillars. However, the ground below has to be strong enough to take this concentrated weight.

Pillars can be built of car tyres, bricks, stone, gravel in cages and timber. We prefer to use car tyres because they are an inexpensive, recyclable waste material that can last for thousands of years. It is usually best not limit the pillar height to a maximum of 5 tyres using a tractor tyre as the base for up to four smaller ones that are then laid on top. Each tyre only needs to be filled with pea shingle for bulk.

## Pillars or Pier Foundations... cont.

Your foundation design also needs to take into consideration the timber base plates that provide fixing points for render, skirtings, tie-downs and for the short hazel stubs on which the first course of bales is impaled. The straw bales themselves also need to be raised at least 25mm above the finished floor in case of water spillage in the house. Finally, the foundations must provide a way of attaching the compression/ratchet straps that will be used to compress the straw bale walls. Provision for door and window posts must also be made.



Photo: [celticsustainables.wordpress.com](http://celticsustainables.wordpress.com)



Photo: [lowimpact.org](http://lowimpact.org)



Mind map

Case study

Workshops

Video

References

Evaluation

# Cement Free Foundations

## Straw Works pdf of tyre foundations

These foundations are specifically designed to be cement free. There must be no deviation from these details without written agreement from Straw Works Ltd.

**Base Plate construction:** 1no. 50x100mm C16 sawn untreated larch or douglas fir laid flat to outside, 1no. 50x150mm C16 sawn untreated softwood laid flat to inside with 50x100mm C16 softwood noggins.

32mmØ hole drilled through noggins to receive hazel stakes. Noggins to be at centres to suit overall straw bale sizes and bale plan layout.

Spaces between noggins to be filled with loose LECA or RFG to provide insulation and moisture control

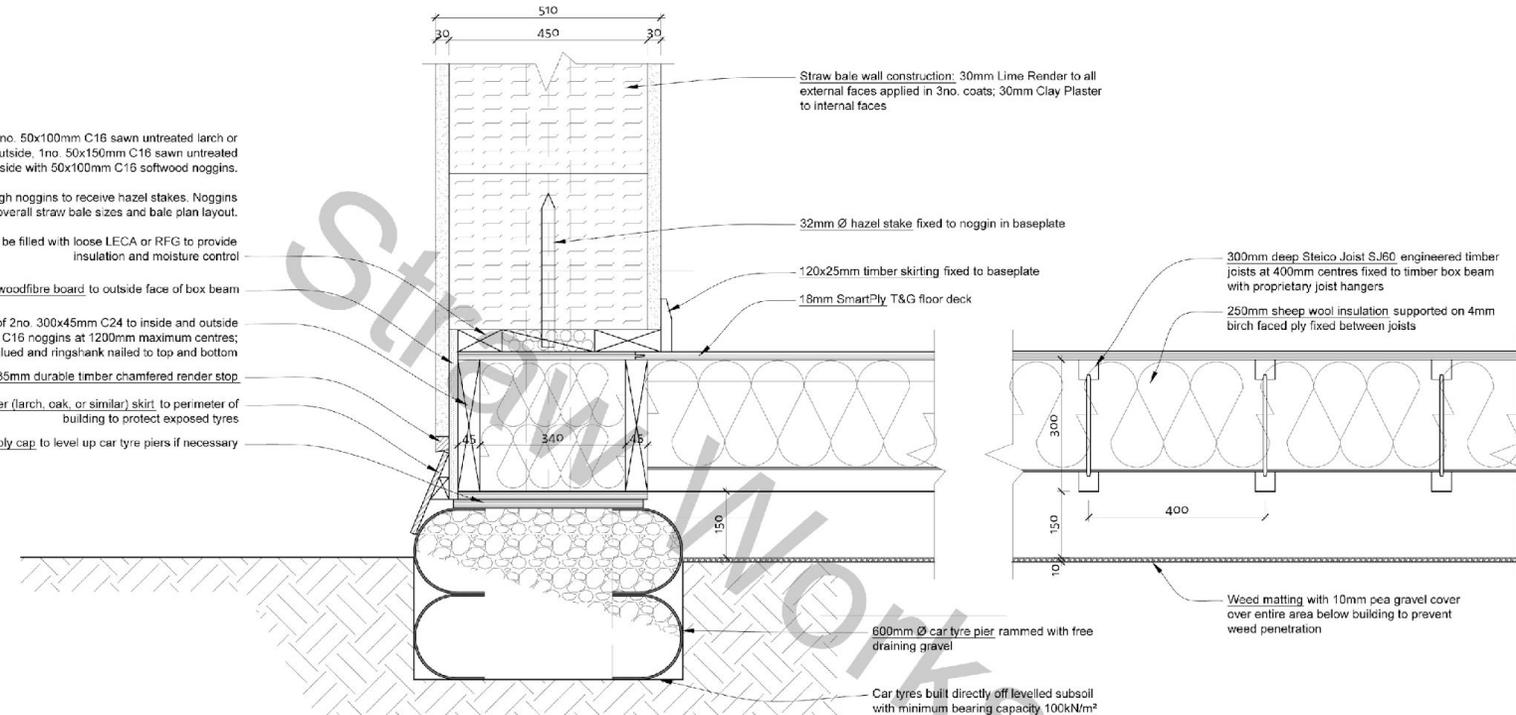
20mm woodfibre board to outside face of box beam

**Timber box ring beam** of 2no. 300x45mm C24 to inside and outside edges with 300x45mm C16 noggins at 1200mm maximum centres; 18mm T&G SmartPly glued and ringshank nailed to top and bottom

30x35mm durable timber chamfered render stop

12x200mm durable timber (larch, oak, or similar) skirt to perimeter of building to protect exposed tyres

Marine ply cap to level up car tyre piers if necessary



Section through tyres  
(parallel to joists)

Section through joists

**Rising Damp & self draining foundations:** car tyres and gravel are non-porous materials that do not allow moisture to wick upwards from the ground. The use of non porous materials means that there is no need for a damp proof course.

This drawing is the property of Straw Works. Copyright is reserved by Straw Works and the drawing is issued on condition that it is not copied either wholly or in part without the consent in writing of Straw Works.

Straw Works Ltd  
Hollinroyd Farm  
Todmorden  
OL14 8RJ  
strawworks@gmail.com

Date: February 2013  
Scale: 1:10 - @ A3  
Drawn: Straw Works

Client: -  
Project: Standard Details

Drawing: Tyre pile foundations  
Drawing No: 05-29  
Revision: -

## Carpentry for Load Bearing Buildings

First, select durable timber for the areas that will be exposed on the North side to the worst weather... for example, the external parts of the ring beams, the ground floor base plate and the structural box, cladding and gables.

The ring beams are constructed in sections and brought together before any straw building can take place.

Barbara recommends SmartPly (OSB3) as it does not bend. Remember to make provision for tie-down polyester straps. The Structural box beam or floor plate must be firmly nailed and glued together using timbers 250 x 47mm deep to bridge spans between pillars of between 2m-3m. The base plate comes next. This is the division between masonry and straw that will raise the bales above the finished floor level and provide a fixing board. Fixing posts are used on either side of openings.



Photo:  
Suffolfstrawbaleholidaycott  
age.wordpress.com



Photo:  
Huffpuffhouse.com



## Carpentry for Load Bearing Buildings... cont.

Barbara uses 'I' beam timbers that act like an RSJ and carry lots of weight without using whole trees. The size of the timbers depends on the weight of the whole building. When constructing the walls the top timber ring beam needs to be kept loose until the hazel pins are finally hammered down into place, the ends finally covered and the fixing posts aligned/insulated. Once compression has been achieved everything can be secured and the lid sealed. At this point the walls become rigid and strong.

Lintels carry loads over openings. These need to be incorporated in the ring beam. A lintel of 150mm x 50 mm will allow an opening of up to 900mm. In the same way a lintel made up of 225mm timbers will bridge up to 1.5m openings. You can also use flitch beams (steel inside timbers) to give added strength.



Photo: Barbara Jones,  
[strawworks.co.uk](http://strawworks.co.uk)



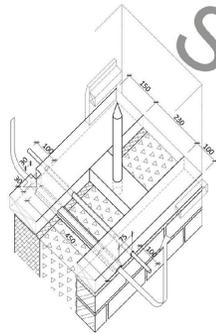
Photo: [houseplanninghelp.com](http://houseplanninghelp.com)



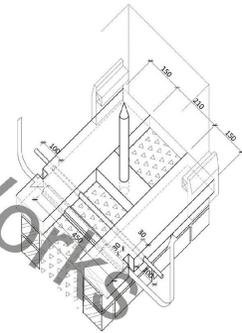
# Building The Walls.. Cont.

. PDF from Straw Works on Building the Walls

There must be no deviation from these details without written agreement from Straw Works Ltd.

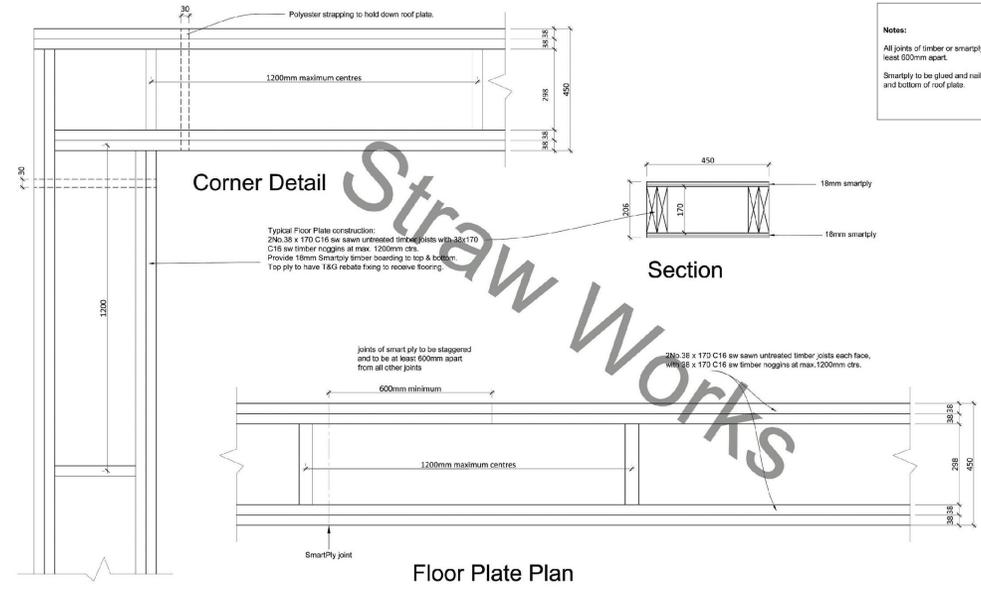


Baseplate at External Walls



Baseplate at Party Walls

- Compression strap spacing:**
1. Locate first compression straps as close as possible into corners (approx. 100mm from surface of bale wall) both sides of corner.
  2. Thereafter, straps to be at approx. 1200-1500mm centres along wall length.
  3. Window/door openings to have straps to both sides.
- General Notes:**
1. 25mm flx PVC channel notched into underside of baseplate to guide straps through LECA Filled spaces (Remove the channel supports after the straw has been laid).
  2. Lorry ratchet straps to be hooked onto lengths of 12mm rebar passed through pipe, pipe and rebar to be removed after compression has devide.
  3. Use 16mm composite polyester strapping to hold wall in compressed position after compression with lorry ratchet straps (Remove the strap supports after the straw has been laid).
  4. LECA within baseplate voids not shown for clarity.



Floor Plate Details

**Notes:**  
All joints of timber or smartply to be staggered and at least 600mm apart.  
Smartply to be glued and nailed with ringshanks top and bottom of roof plate.

This drawing is the property of Straw Works. Copyright is reserved by Straw Works and the drawing is issued on condition that it is not copied either wholly or in part without the consent in writing of Straw Works.

Straw Works Ltd  
Hollinryd Farm  
Todmorden  
OL14 8RU  
strawworks@gmail.com

Date: February 2013  
Scale: 1:10 @ A3  
Drawn: Straw Works

Client: -  
Project: Standard Details  
Revision: -

Drawing: Ground Floor Baseplate Isometrics  
Drawing No: 05-40  
Revision: -



This drawing is the property of Straw Works. Copyright is reserved by Straw Works and the drawing is issued on condition that it is not copied either wholly or in part without the consent in writing of Straw Works.

Straw Works Ltd  
Hollinryd Farm  
Todmorden  
OL14 8RU  
strawworks@gmail.com

Date: January 2014  
Scale: 1:10 @ A3  
Drawn: Straw Works

Client: -  
Project: Standard Details

Drawing: Floorplate Ring Beam Details  
Drawing No: 05-09  
Revision: -





## The Roof

There are two types of roof construction but before you make a decision it's best seek some professional advice from an engineer.

Firstly, you can use traditional, hand Cut Roofs made from sawn timber. However this is a really heavy construction form using huge beams and they draw strength from the force of the timbers pushing against each other. Secondly, are Truss Roofs.

Roof insulation is always essential. Straw bales can be used but as they are more of a fire risk they need to be fireproof coated. A plasterboard ceiling on one side and clay on the other should achieve this.

Roof coverings need to be environmentally sustainable and watertight:

- Wooden shingles are an excellent choice in cedar or oak if possible. They swell when wet so that the gaps become watertight. However, they need to be laid with the correct spacing.
- Another good, breathable choice is thatch (wheat straw or reed) which has been used for thousands of years. However, you need to be taught to lay this or employ professionals.
- Alternatively, try planted roofs where 25mm of gravelly soil laid on the roof frame itself provides the base for plants with shallow root (sedum, sea thrift or strawberries).



Mind map

Case study

**Workshops**

Video

References

Evaluation

## The Roof... cont.

Whatever you choose, it's essential to build a large overhang of about 450mm on a straw house to protect it from weather. For two storey houses a hipped roof will help with protection and a veranda on the south west side can protect the ground floor.



Photo: pinterest.com



Photo: pinterest.com

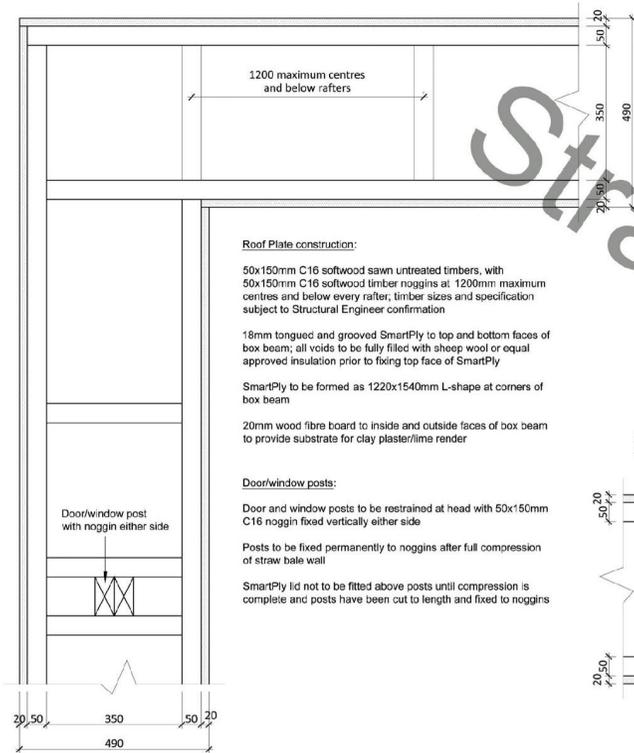


Photo: theyearofmud.com

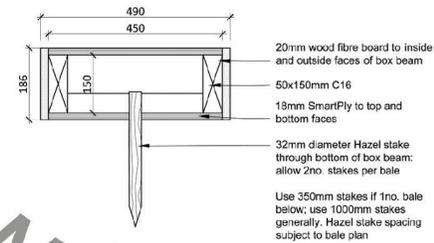
## The Roof... cont.

### Diagram for Roof Plate from Straw Works.

#### Roofplate Corner Detail



#### Roofplate Section



#### General Notes:

All joints in timber or SmartPly to be staggered and at least 600mm apart.

SmartPly to be glued and nailed with ringshanks top and bottom.

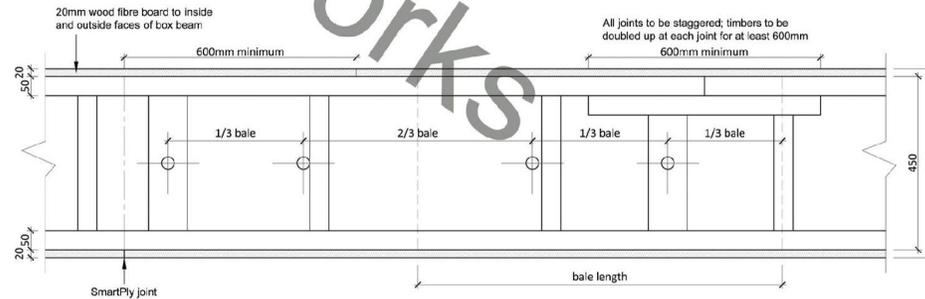
Wood fibre board to cover all joints to create air tight layer and form substrate for clay plaster/lime render.

#### Hazel Stake Location:

Holes for hazel stakes to be located approximately at  $\frac{1}{3}$  points of each bale, 2no. stakes per bale. Where this falls close to a noggin, move hole next to noggin.

Where hole falls between noggins, add extra 100x50mm noggin laid flat on bottom of box with hole through for hazel.

Hazel can be inserted through SmartPly only, as long as it is next to a noggin. Where hazel is not next to noggin, it must also go through a flat noggin on base of box.



#### Roofplate Plan



## Building The Walls

*Before starting the walls:*

- have all your plans and calculations ready.
- make all the timber elements the ring beams for bottom/first floor/ roof, plates, hazel, roof etc.
- brace all of your timber work, especially the corners so everything is straight and along the length of the wall.
- get everything on site.
- order or make your doors and windows.
- get the site ready, foundations ready, drainage ready and add services.
- put up scaffolding
- create somewhere warm and dry where you can consult plans, sit, drink tea and enjoy music!



Photo: Glassford.com.au



Photo: en.wikipedia.org



## Building The Walls

### Dressing or Trimming the Bales

Straw is often unevenly packed so they need to be shaved to make sure they are uniform otherwise the airtightness is effected. You'll need to take the effect of 'dressing' bales to size when you are working out the length of your bales and the number needed for the building. Trimming the bales to size is easy and you can use your hands, a claw hammer or an alligator saw to correct your bales. You will want to cut bales in half for lots of situations including:

- achieving the correct overlap for walls building
- putting in notches around window/ door fixing posts so that there are no draughts.

Select your best bales for around doors and windows.

You may also want to cut a bale in two vertically... in which case, you need to tie it into two separate bundles using a baling needle before cutting the main strings that encompassed the whole bale.



Photo: treehugger.com

## Building The Walls

You can also correct uneven walls with infill using what is called the 'Flakes'. These are straw clumps that fallout whenever you cut the string on a bale Only use 'flakes' to stuff at joints between bales not underneath them... as these disappear upon compression.

Feel free to jump on the bales once you have laid a line as this also compresses them and helps to create a tight fit. However, if they are too tight then the wall will bend, so keep checking the line for accuracy.

**Curving bales:** do this by bending the bale over a log and then jumping on it until you have the correct angle.



Photo: earthtouchbuilders.com



Photo: treehugger.com



Photo: caneloproject.com



Mind map

Case study

Workshops

Video

References

Evaluation

## Building The Walls

### Pinning

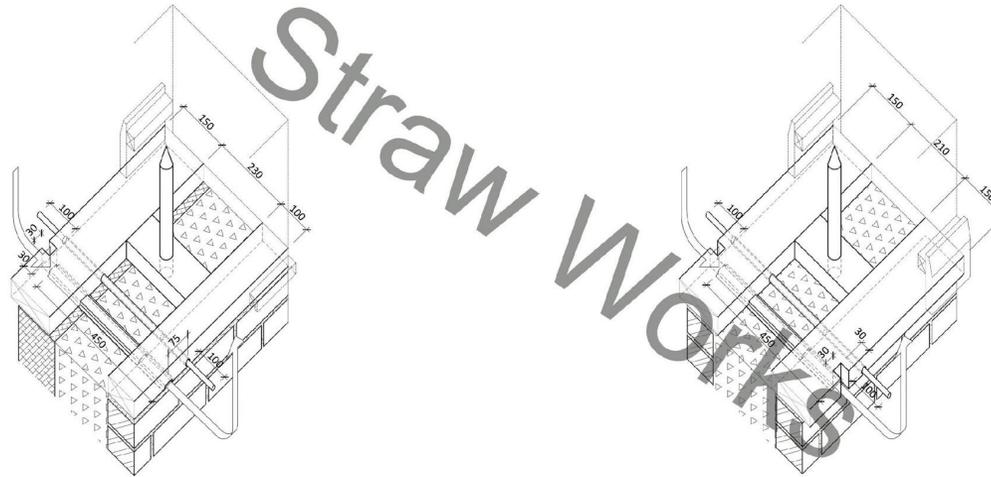
Hazel or sweet chestnut stakes can be used and we need a nice straight branch that will last a long time. The stakes or stubs on the base plate on each level are 32-38mm diameter and 350mm long. Work on using two stubs per bale and make sure that they do not poke through the tops of any bales. Stubs can also be used like rawplugs for fixings in the house, eg. Radiators, sockets, kitchen cabinets. Hazel staples can also be used at weak points such as corners. All you need to do is just twist and bend the ends.

Once the walls are stacked at four bales high they need to be pinned with long lengths of hazel. The length needs to be the height of four bales. Allow for two pins per bale which overlap the hazel stubs in the box foundation. The same lengths are used on walls stacked at 6 or 7 bales high (usually the height of a single storey building). If you have box frames around windows and doors then these need to be pinned in after settlement or they will snap. Instead of pins you can compress your straw walls instead.

# Building The Walls

Diagram from Straw Works.

There must be no deviation from these details without written agreement from Straw Works Ltd.



Baseplate at External Walls

Baseplate at Party Walls

#### Compression strap spacing:

1. Locate first compression straps as close as possible into corners (approx. 100mm from surface of bale wall), both sides of corner;
2. Thereafter, straps to be at approx. 1200-1500mm centres along wall length;
3. Window/door openings to have straps to both sides.

#### General Notes:

1. 25mm flat PVC channel notched into underside of baseplate to guide straps through LECA-filled spaces  
(See example: [http://www.strawworks.co.uk/strawworks/Pages/25mmFlatPVCChannel.aspx](#));
2. Lorry ratchet straps to be hooked onto lengths of 12mm rebar passed through pipe; pipe and rebar to be removed after compression for re-use;
3. Use 16mm composite polyester strapping to hold wall in compressed position after compression with lorry ratchet straps  
(See example: [http://www.strawworks.co.uk/strawworks/Pages/16mmCompositeStrapping.aspx](#));
4. LECA within baseplate voids not shown for clarity.

This drawing is the property of **Straw Works**. Copyright is reserved by **Straw Works** and the drawing is issued on condition that it is not copied either wholly or in part without the consent in writing of **Straw Works**.

Straw Works Ltd  
Hollinroyd Farm  
Todmorden  
OL14 8RJ  
strawworks@gmail.com

Date: February 2013  
Scale: 1:10 - @ A3  
Drawn: Straw Works

Client: -  
Project: Standard Details  
-

Drawing: **Ground Floor Baseplate Isometrics**  
Drawing No: **05-40**  
Revision: -



# Building The Walls

Diagram from Straw Works.

There must be no deviation from these details without written agreement from Straw Works Ltd.

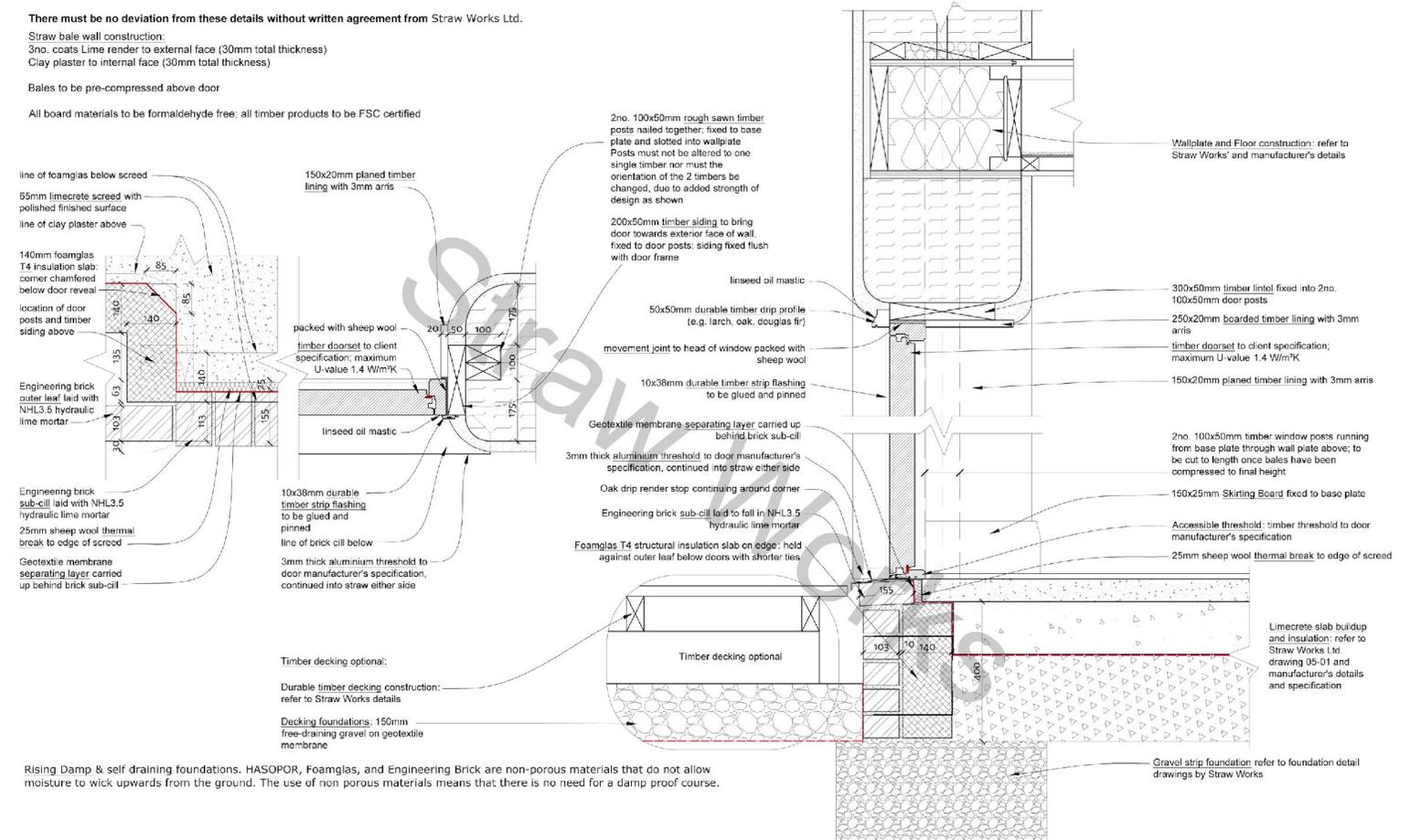
Straw bale wall construction:

3no. coats Lime render to external face (30mm total thickness)

Clay plaster to internal face (30mm total thickness)

Bales to be pre-compressed above door

All board materials to be formaldehyde free; all timber products to be FSC certified



Rising Damp & self draining foundations. HASOPOR, Foamglas, and Engineering Brick are non-porous materials that do not allow moisture to wick upwards from the ground. The use of non porous materials means that there is no need for a damp proof course.

This drawing is the property of Straw Works. Copyright is reserved by Straw Works and the drawing is issued on condition that it is not copied either wholly or in part without the consent in writing of Straw Works.

Straw Works Ltd  
Hollinroyd Farm  
Todmorden  
OL14 8RU  
strawworks@gmail.com

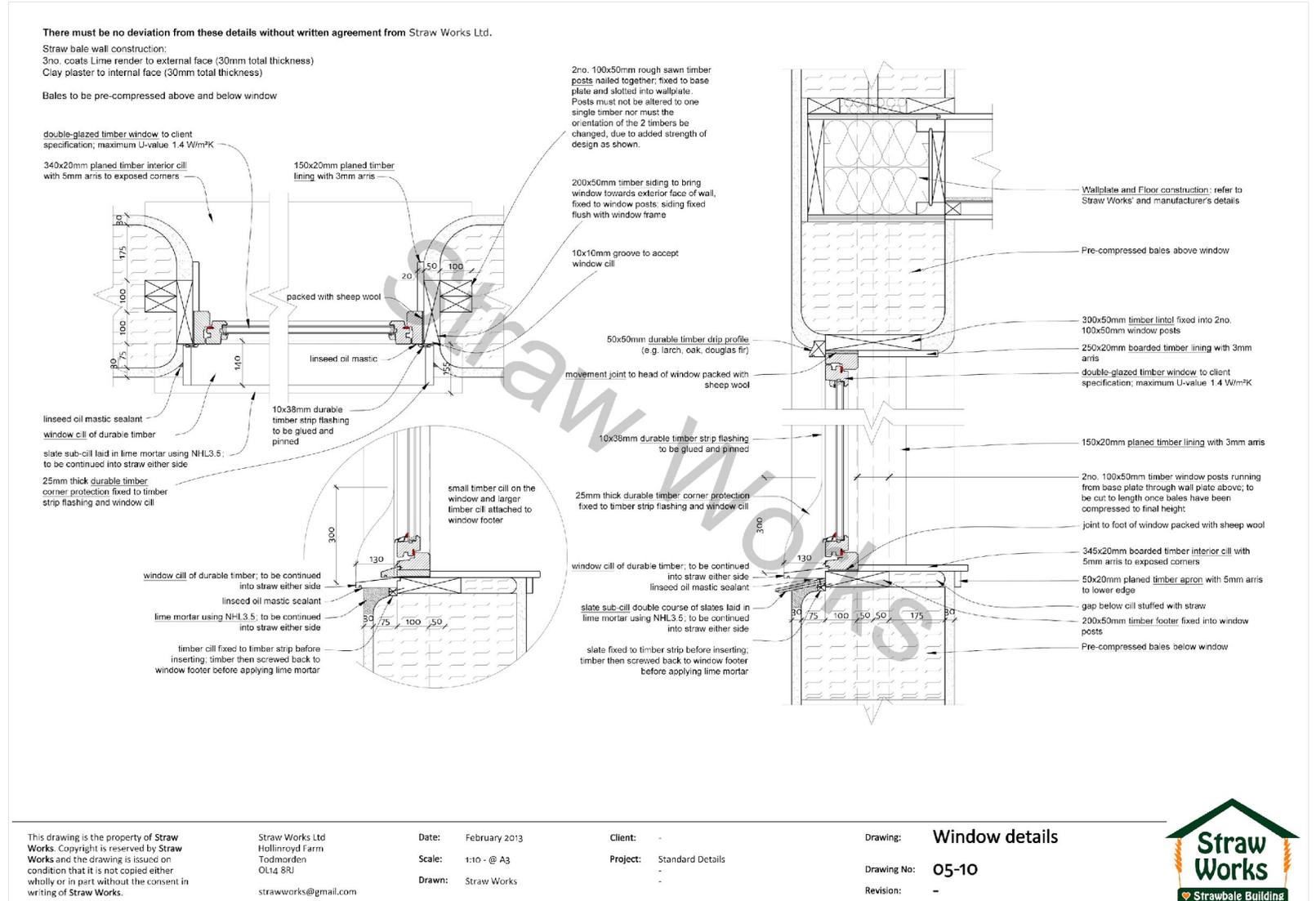
Date: February 2013  
Scale: 1:10 - @ A3  
Drawn: Straw Works

Client: -  
Project: Standard Details  
-

Drawing: Door details  
Drawing No: 05-11  
Revision: -

# Building The Walls

Diagram from Straw Works.





Mind map

Case study

Workshops

Video

References

Evaluation

## Building The Walls

### Straightening the Walls

Always make sure your walls are straight before you fix your wall plate. Before you compress fully, straighten them with a plank or scaffold board either side of the wall. Make sure the compression is centralized too.

### Plastering Preparation

You need to trim the walls to make them as flat as possible. You can use a garden strimmer, hedge cutters, a chainsaw or an alligator saw. Take care not to break the bale strings. After doing this you may need to do more straightening and stuffing. This also helps to improve insulation.

Strengthen around doors and windows with a long straw mix or jute mesh in wet plaster so there is a key for the plaster.



Mind map

Case study

Workshops

Video

References

Evaluation

## Building The Walls

**Tie downs or Strapping** These are external bands (lorry straps) that go round the base and wall plates. Set out in pairs with handles either side of the wall... they create compression using a tightening ratchet. The ties help keep the roof on and keep the walls compressed. Lorry straps are temporary and permanent polyester straps can be used - if there is high winds in your area). If your straps are permanent then they need to be protected by hessian, jute or long straw rich plaster.

Attaching the straps to the car tyre foundations can be done with metal pins under the structural box beam. Keep the handle near the floor

*Test for compression:* Make a small frame with two posts and a moveable top. Use four bales with ratchet straps and compress. Then calculate the difference between the uncompressed and compressed height.

Bottle jacks can also be added to help compression - especially around windows and doors. Once compressed, the wooden framing sides can be inserted and fixed to the fixing post.

For more information about compression email Barbara Jones at Straw Works

[Barbara@strawworks.co.uk](mailto:Barbara@strawworks.co.uk)

## Services, Fixings and Alcoves

All these can be created in your straw house using sharpened wooden pins (Hazel lathes 200mm x 32mm) to create cupboards, shelves, light switches, sockets, bathroom and kitchen fixtures, radiators. The pins should be added before plastering and should stick out by about 30mm. Attach a timber batten horizontally over numerous pins for cupboards and skirting boards. Vertical battens can be fixed for shelves.

Utilities are added in much the same ways as in a conventional house - but making sure that they don't compromise the straw bales and their insulating, water tight properties. Good advance is needed for all the utilities that are hidden after completing the final build.



Electrical Wiring (Photo: [buildingwithawareness.com](http://buildingwithawareness.com))



Batons for Kitchen Cupboards (Photo: [strawbale.com](http://strawbale.com))



## Services, Fixings and Alcoves...cont.

Electricity cables should be encased in PVC free conduit sheathing. Surface mount the conduit into a channel in the straw and cover it with internal lime or clay plaster. These plasters protect against fire risks. Any back boxes sunk into the straw should also be surrounded in plaster to give protection against fire. Plumbing should be kept in internal non-straw walls as much as possible. Pipes that pass through straw should contain no joints and they should all be encased in insulated plastic pipes. Soil stacks can go up through the straw to the roof.

No metal should be put into walls because of the condensation. For bathrooms and showers all walls with direct water should be protected by ceramic tiles. Once again use hazel pins system behind the tiles as an anchor for your fixtures and be sure to make a plan of where they are so you can find them once you have tiled the area.

For alcoves just saw out a shape. However, limit this cut-out to a depth of no more than 150mm otherwise the insulation and stability of the straw bales will be compromised. You can then add a shelf, box or bookshelves for instance.



Mind map

Case study

**Workshops**

Video

References

Evaluation

## Plasters

Straw is breathable and vapour permeable. It's for this reason that any finishes must have the same properties. Lime and clay natural, sustainable solution that regulate humidity with an in-built flexible that avoids the risk of cracking.

### Lime Plasters

First make sure that have the correct protective gear – clothing, mask, gloves, safety glasses – as this process will generate heat.

To make a lime putty add 2 parts water to 1 part quicklime and NEVER add water first to the quicklime because it can explode. Be careful as the mixture can spit and burn as temperatures soar. Rake through with a garden hoe. Mix until all lumps are eliminated and then leave to cool completely. Sieve the putty through a 1.5mm grid to get rid of any unburnt limestone. It now needs to be stored for 3 months without any exposure to the air. This can be done in a pit as the Romans themselves did 2000 years ago.

## Plasters...cont.

Selecting your sand is important and take an engineer's advice to select the correct grades of sand for the strength you need.

You need to calculate how much plaster you need and as a rule of thumb, 1 tonne of mixed plaster will cover 20 square meters at 25mm thickness. You can mix this yourself or buy it in from a reputable supplier. Lime plaster is made in a 1:3 ratio lime putty to local sharp sand. You may need to beat the mixture with a wooden mallet. Then leave it to mature for 3 months.



Photo: strawbale.com



Photo: strawbale.com



Photo: buildingwithawareness.com



Mind map

Case study

**Workshops**

Video

References

Evaluation

## Plasters...cont.

**Application:** Wear safety gear and apply the lime plaster in two or three coats of slightly different mixtures.

The first is a lime rich sticky key coat. The next two contain fibres such as chopped hemp or straw to give greater strength.

Prepare your walls by making sure they are cut neatly and any holes are stuffed. Use tarpaulins or boards under where you are working to catch any drops so that they can be reused.

Use a roller mixer to beat the plaster, not a cement mixer. Just put the key coat (mix of 1:1 and reasonably wet) straight onto the straw surface with your gloved hands and massage it in. Do not use trowels as you'll apply too thick a coat and most will just fall off. If there are any holes use a lime/ straw mix using chopped straw and a small amount of the key cost mix. For openings, work from the bottom up and use jute mesh above, below and at the corners. Drying time for the key coat takes 24 – 48 hours.



Mind map

Case study

**Workshops**

Video

References

Evaluation

## Plasters...cont.

The second or body coat contains short fibres (hemp or straw) and is best put on to a depth of 25-30mm by hand (or even a wooden/plastic float. Before you start, spray the key coat lightly with a mist of water. Apply the second coat as smoothly as you want. If it's an exterior surface then you might want to apply two coats of 12-15mm to get a good thickness. Once you have applied the mixture, let it dry a little (depends on weather) and then, if you're not doing another coat, rub it up with a wooden or plastic float. This closes the surface. Let the plaster dry slowly. In dry conditions be sure to mist it daily for 2-7 days. Protect from direct sunlight, forceful wind and frost with sacking for about a month. External plaster that dries slowly and regularly will remain completely waterproof.

When you're working on the inside of the building you can apply plaster at any time unless the temperature drops below 5 degrees centigrade.

## Plasters...cont.

Apply a limewash (lime putty diluted with lots of water and pigments for colour) in several thin coats. This will heal any small cracks. The more coats you apply, the better the weatherproofing. Generally, external walls need washing regularly every 5 years for sheltered spots and every 2-3 years for exposed walls. In England, it was traditional to do this on May Day.

Water- glass silicate paint is an alternative to limewash and has greater waterproofing properties – they only needing repainting every 15 years.

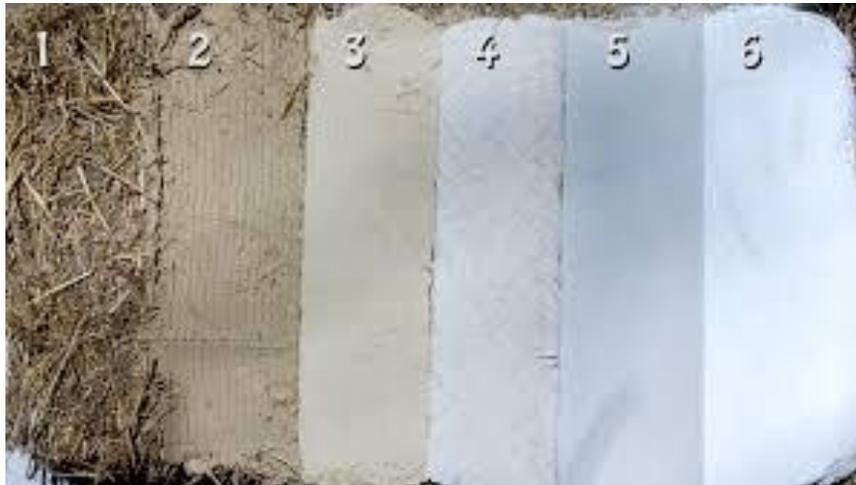


Photo: earthsafedesign.com



## Plasters...cont.

### Clay Plasters

Again, this is a flexible, vapour permeable material that regulates humidity and stops condensation so that the straw behind stays dry. As a result it is good for bathrooms and kitchens. It also offers excellent scope for creating decorative shapes in a natural colour finish. An added bonus is that it is good for human health and it's cheap.

You can increase plaster strength (inside or outside use) by adding 5-10% more lime. It is also possible to use your own sub-soil to mix with sand, finely chopped straw and water to make a clay plaster. You'll need to do a number of tests to find out the best mix using:

Put these onto bales,  
10mm deep and a 300mm square.



Photo: [digginginthedriftingless.com](http://digginginthedriftingless.com)

## Plasters...cont.

To make clay plaster from wet clay you'll need to start by building a paddling pool made from a strong tarpaulin draped inside a circle of bales. Dig up your soil, add your sand and trample the mixture with your bare feet or wellingtons. Add water and straw. Mix thoroughly. If you get bored then switch to a clay plaster mixing machine, tractor or paddle mill.

Plaster can be made from dry clay from brickworks or as a by-product of mineral works.

It is best to mix your clay and clay plaster at least 24 hours in advance as this makes it easier to use.

**Application:** Clay plaster is best for internal walls where it's protected from erosion by the rain. As with lime plaster you need to wear safety glasses and gloves before applying the mix to pre-prepared neat walls.

**Key Coat:** this is a slurry ranging from almost pure clay to a maximum ration of 1:1 clay and sand. It should have the consistency of thick cream. Apply by hand - with or without gloves - and massage onto the straw.



Mind map

Case study

Workshops

Video

References

Evaluation

## Plasters...cont.

Fill any holes or indentations with a mixture of clay and trimmed straw. As with the lime plaster, take care to build up the windows/ doors from the bottom and use jute mesh for strength especially round the corners. This can be time consuming but getting it right is important for the next coat. Allow the Key Coat to dry for 24-48 hours.

**Second Coat:** This should be applied before the key coat is dry. Use a mix of gritty sand and clay together with lots of finely chopped straw. You can put this on my hand or use a wooden or plastic float. To make a flatter surface use a Darby to scape off any high points and work systematically in small areas. Clay takes a long time to dry depending on air conditions. If your plaster becomes mouldy don't worry - just wait for it to dry a little more and the mould will die. Make sure this second coat dries before applying the top coat. **Top coat:** add this final coat only if you want a super-fine finish

Now you can use finer sand (2mm or less) with NO fibre. Apply in a layer 4-5mm thick. You can use also clay pigments if you want colour or limewashes.



Mind map

Case study

Workshops

**Video**

References

Evaluation

Please use this link to hear Barbara Jones talk about straw bale building:

<http://strawworks.co.uk/videos/>

<http://www.strawworks.co.uk/videos/>





Mind map

Case study

Workshops

Video

**References**

Evaluation

## For More Information

The UK's expert, Barbara Jones, provides useful design, consultancy, building assistance and courses so that you can gain skills and 'have a go' before you embark on your project.

Contact her at StrawWorks website: [www.strawworks.co.uk](http://www.strawworks.co.uk) or email [barbara@strawworks.co.uk](mailto:barbara@strawworks.co.uk) to book a place on a training course

Her book entitled 'Building with Straw Bales: A Practical Manual for Self-Builders and Architects' 2015 Published by Green Books ISBN: 978 0 85784 226 2 is available from her website [www.strawworks.co.uk](http://www.strawworks.co.uk)



## FAQ.Frequently Asked Questions

### What about Mice and Rats?

There is no greater risk of animals in the bale walls. The straw does not contain food and so does not attract animals. Mice and rats like to live in gaps in walls. They are more likely to live in house cavities and under floors. If you maintain your plaster and have no gaps, then you are fine.

### How long will a straw house last?

In the USA there are houses that are more than 100 years old; people are still living in them with no problems. In the UK the first buildings were started in 1994. In France, there is a house built in 1921. If your house is well made with a good design and is properly maintained, then it should last 200 years.

### Is it a fire risk?

No, it may seem strange but there is not enough air for fire to breath. Straw walls have passed all the fire tests and have been passed in the USA, Canada and Europe. In the UK, if they are plastered with half an inch of plaster then this gives enough fire protection for UK Building Regulations.



## Frequently Asked Questions...cont. 1

### Is it really cheap to build?

No it's not that cheap for most people but if you do a lot yourself this can bring costs down. Using recycled materials, designing and drawing plans yourself, using training workshops to get labour or roping in family and friends. You may want professionals for carpentry, roofing, plumbing and electrics. A small office in the garden could cost £35,000 and a two bedroom house for £50,000.

Barbara has built council houses for £110,000. The straw walls only account for around 16% of the total build cost.

### Is a straw house hard to build?

Not at all, but be careful about you read on the internet. Keep everything as simple as possible. It is fun and best done by a group of people.

### What sort of sound insulation do straw houses provide?

They offer better sound insulation than conventional houses. Research in the Netherlands has confirmed this. Houses are very quiet and calm. They have been used for meditation centres.



## Frequently Asked Questions... cont. 2

### What drawings and documents do you need to get planning permission?

Generally you need:

- ❖ Site location plan
- ❖ Site layout plan
- ❖ Floor plan for each floor
- ❖ Elevations
- ❖ Drainage layout
- ❖ Cross – section drawings
- ❖ How it fits in with local planning policies
- ❖ Any surveys that might be needed – flood risk, earthquake zones, etc.
- ❖ Transport, access implications.

### What sort of tools do I need?

Always buy tools from someone who has been recommended to you, and who uses them all the time.

## Frequently Asked Questions... cont. 3

### Should I buy expensive tools?

Sometimes it is more cost effective to buy good tools rather than hire them. You can always sell these tools after you have used them. Good tools can last a lifetime.

### What sort of safety should there be on site?

You need to have these things in place:

- Have a first aid kit and know where it is
- No smoking anywhere
- Keep the site tidy
- Have a central place for tools
- Take care when using heat or flame
- Never leave tools lying around. Sharp tools should be sheathed.
- Unplug all electric tools when not in use. Take care about leads.
- Secure all ladders and make sure they have firm footings.
- Wear hard hats always.



le flocon



Erasmus+

# THANK YOU

FOLLOW TO LECTURE