

# Your new house of **STRAW?**

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## A Design guide

A map to the decision making process when designing a building

General considerations and suggestions for suitable approaches to specific cases





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## Introduction



During the past decades the building industry has had a great focus on energy consumption during the use phase of a building, but currently a more holistic view of the entire lifecycle of a building is starting to emerge. With this follows a greater interest in which building materials and techniques of construction are considered. At the same time the request for a living environment free from toxins and allergenic substances, providing the basis for stress-free living and working conditions is increasingly demanded by clients for newly built homes. Since straw built houses supply a possible solution for these demands, while also offering the opportunity for very financially competitive solutions, it is of interest to determine their appropriateness in the design phase of a building.

### What the guide provides

This guide aims to provide a decision making map to support communication between clients and the consultants in the design process. The guide is intended for residential houses but can

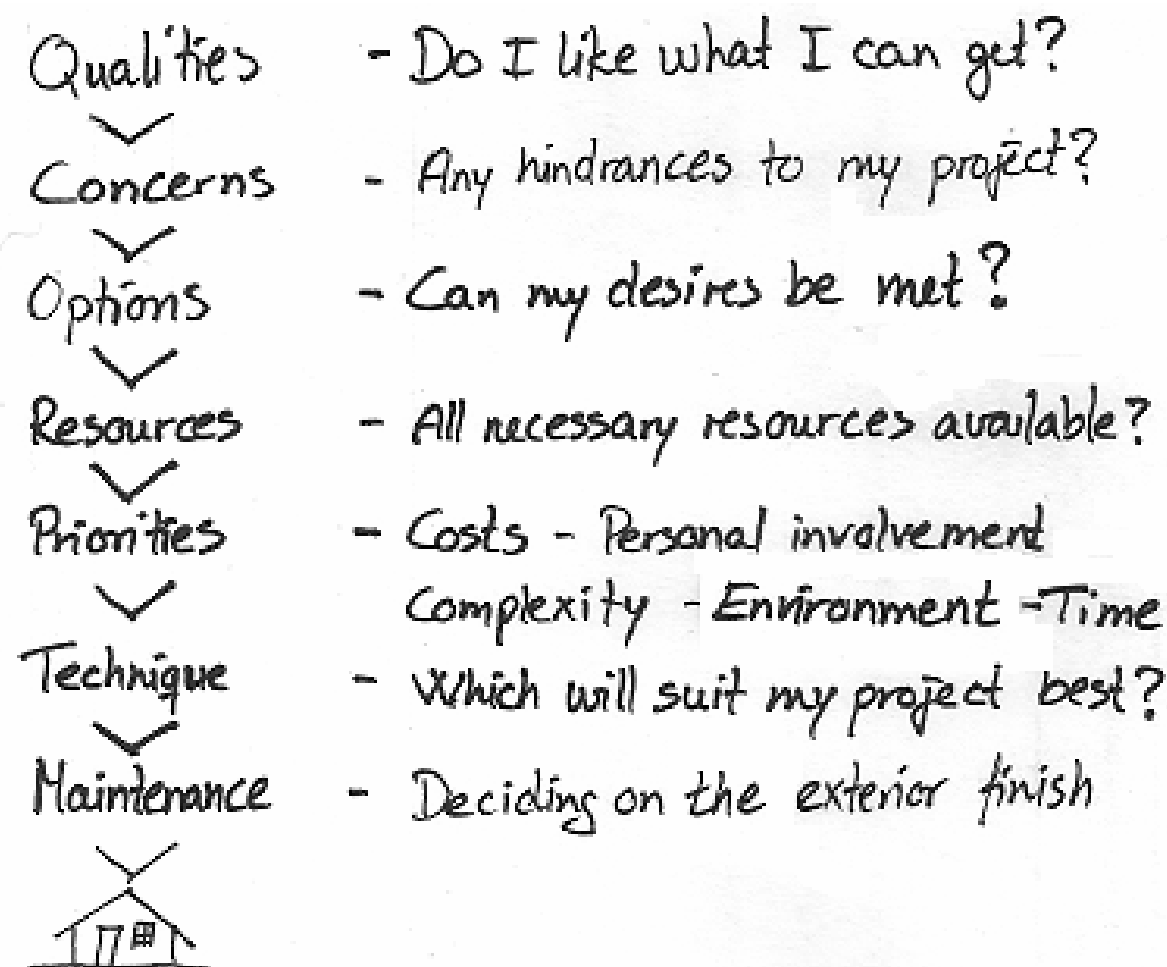
be used for other smaller buildings. The aim is both to determine whether straw construction would be suitable for a given project and if so to suggest a specific approach. The intention of the guide is not to present a comprehensive work of all the technical specifications and the innumerable material properties related to straw build, for this you will need to conduct with the existing research on the topic. The guide can be used merely as inspiration for considering straw in the initial idea phase, or as a step by step approach running through the main considerations and pitfalls, to support a successful building project.

### Who can make use of the guide?

The intended audiences for the guide are clients of small scale construction projects, architects, engineers, builders of straw construction, homeowner-builders and entrepreneurs considering the use of, or using, straw construction.

Enjoy!

### The Decision Making steps this guide will take you through



## Why would I want a Straw House?



### Energy efficiency

### A toxin free living environment

### Affordability

### Sustainability

### Durability

### - and a flexible esthetic expression

If any of the above is on your list of interest a straw built house is worth considering.

### Superior indoor climate

Straw buildings provide super insulation and thermal heat storage through the plastered straw walls and breathability of the walls as they are open to vapor transport. If combined with interior clay plaster the walls regulates the humidity in the air and supply a very comfortable acoustic space. Straw buildings can be created from entirely natural non-processed materials. They provide indoor living environments far superior to that of conventionally built houses, as they are free from toxins and odors



emanating from chemically processed materials, which contribute to asthmatic and allergic reactions.

### Proven to last requiring a minimum of maintenance

When designed and built in accordance to the site and the design specifications of straw construction, the durability of straw buildings has proven to easily be comparable to that of traditional construction systems, with straw-built houses from the late 1800's still in use in USA today. And when designed and built in an appropriate manner straw buildings require a minimum of

maintenance, similar to that of a conventional building.

### Thoroughly documented

By now all the specifications of straw construction have been documented by academic institutions around the world, addressing common concerns with respect to structure, insulation, fire, moisture, pests and indoor climate. Straw buildings can provide remarkably high seismic resistance when constructed using the right techniques.

### Low environmental impacts

Straw buildings leave nearly no environmental footprint, but a carbon storage through materials which are reproducible in just one year, leaving no hazardous waste materials or adding waste to landfills when there is no more use of

the buildings.

### The Design – is up to you

Straw buildings are perceived in many different ways. But in reality straw is a material and the expression that comes with it is entirely up to the designer. Whether you desire straight lines or organic curved shapes to your building, a cottage feel or an open, architecturally contemporary expression - the material in the walls can be straw.



Qualities - Do I like what I can get?

Qualities - Do I like what I can get?



## Common concerns

### Fire

Because straw is a carbon material, we intuitively know that it can burn. Most people have seen straw burned in the fields where it grew after a harvest. But when compressed into bales, straw burns very poorly, as has been proven by the innumerable fire tests it has been subjected to around the world, whenever, a straw builder pioneered with his ideas to building officials. A straw wall plastered with 3 cm of clay, lime or cement is in most countries graded to withstand fire for 2+ hours. The plaster skins become harder when heated, and the straw remains untouched behind them. If a crack or larger portion of plaster has fallen off, the straw will char as there is not sufficient oxygen to ignite a fire. It is very important to ensure that all straw surfaces are plastered. If e.g. straw is used as insulation in the roof, even though no weather protection is required, it must be plastered for fire safety. As a side benefit, the clay plasters also "impregnate" the straw making it more moisture resistant.

When considering fire in a building, it is recognized that many building materials, such as wood, burn. The question is one of knowing how long they can prevent the fire from spreading to allow people time to escape the building. When a plastered straw wall with exposed wooden studs was fire

### Costs

The materials for straw build houses are cheaper than those of conventional buildings. If one combines the right choices of techniques and construction process with the available resources, a straw built solution can cost less than a similar house built with conventional materials. It is however not a given that straw build will cost less, as any project involves many parties, levels of expertise and available solutions.

Concerns - Any hindrances to my project?

## Common concerns



tested in the Danish Fire Technical Institute by being subjected to 1000°C for 30 minutes, the temperature rose 1°C on the other side of the wall from the furnace: the maximum increase in temperature in required to pass the test is 80°C.

### Termites, pests and mice

Straw buildings are found in Australia, South Africa and many other countries around the world where termites exist. When detailing around the base of the straw walls is done with a small metal flashing, just as it would be for any building needing protection from termites and pests, attacks are prevented. This combined with a tight plaster skin, which should be applied shortly after the walls are raised, keeps out mice and other insects. As with any building, a straw construction calls for these considerations but the solutions are there and are no more complicated to put in effect than for a conventional building.

### Allergies and asthma

As allergies are caused by pollens and dust and not by the fibrous once contained grain a plaster wall has never been reported allergic reactions. During construction with straw materials, attention should be given to dust and people with allergies or asthma may not be comfortable staking the bales for the walls. It remains the case that many people have come to build straw homes, out of a need for a chemical free environment.



Concerns - Any hindrances to my project?

## Common concerns

### Permits, mortgages and insurance

In most all of Europe and North America, obtaining a building permit for a straw structure is no longer a problem; there are always projects in a nearby county or nearby region to refer to, and more than sufficient documentation to bring to building officials. If you are a straw building "pioneer" in a given region or country, prioritizing a meeting with local building officials at an early stage before major decisions have been made, can be a good idea. In some cases you may need to present more engineering details for loadbearing structures and some fire inspectors may ask to be shown some of the abundance of fire tests documenting the high fire resistance of straw walls. An initial meeting where good open communication is established from the outset is all it has taken for straw construction to go through inspections so far.

To know one's financial resources is essential before starting any building project. When applying for a mortgage for a project, it may be necessary to

present a draft design prepared together with an experienced advisor, e.g. an architect or engineer, to the bank. In regions where an active straw bale company or organization has been operating for some time, there are always some banks and mortgage lenders open to financing straw buildings and insuring companies open to insure against all the same incidents as for a conventional house.



Concerns - Any hindrances to my project?

## Common concerns



### Moisture

Moisture is something that most people intuitively consider to be a problem when contemplating straw building, and there is something to such concerns. If the right conditions of high temperature, oxygen and moisture are present over a certain period of time, straw begins to decompose. The thousands of existing houses around the world have proven that this only is a potential problem in warm AND humid climates – the tropics. In all other climates the thing to pay attention to is that no water seeps directly into the straw materials, which in such cases should simply be replaced with dry straw. Therefore the two most important considerations when building with straw are to have the detailing done right to prevent water from leaking in to the straw and moisture to build up inside a wall. To achieve this, straw buildings need to be constructed to be vapor open, which as mentioned earlier is part of why they provide an optimal indoor climate. As with any type of building it is important to ensure that

no water enters the building during the construction phase. Fungi and a resulting toxic indoor climate can arise in any type of construction if sufficient care is not given to detailing and protection during the construction phase. As such, straw building does not necessarily require more attention; however the consequences of poor construction will be more evident.

### Warm and humid climates

If high average humidity is combined with high temperatures, straw buildings will need a lot more attention than in other climates. If at the same time



Concerns - Any hindrances to my project?



## Common concerns

there is less need for thermal insulation other locally traditional building techniques are likely to be more suitable. If air-conditioning will be used in the building, it will dry out the building from the inside and support an environment where straw build walls can work well, but in general, in warm and humid climates straw buildings have yet not been tested sufficiently to fully know how they will perform over time.

### Ensuring a healthy structure

The ways to build a long-lasting healthy straw house is:

- Provide good overhangs to the roof
- Ensure that a plinth raise the straw off the ground protecting it against surface water and rain splashing from the ground
- Ensure good drainage around the house (which is a general building condition)

- Work out details with experienced builders, ensuring that no water will enter any joint in the structure.



Options - Can my desires be met?

## But can MY house be straw build?



### Flexibility of design

*"We have put bales on every kind of foundation and every kind of roof on bales". Chris Magwood, contractor and teacher at Endeavour Center, Ontario, Canada.*

Regardless of whether you want a tile roof or a living grass roof, a straight lined modern look or a curved organically shaped feel to your building straw build can provide it. However some things are easier than others when designing with straw. If you can meet the advice offered in the section "Ensuring a healthy structure", your

*Disregarding the material in the walls, to every building a lot of details must be decided on and prepared carefully. To choose a straw building will not make this list significantly longer or shorter. Bruce King, Design of Straw Bale Buildings.*



project is absolutely durable as a straw build.

### A thin envelope

What straw build cannot provide is a very thin envelope for your building, if that is of high importance you will need to look for other wall solutions. To some the thickness of the walls is a quality that is appreciated and emphasized in the design. If it is not of interest to give extra attention to the thickness, design solutions that emphasize on something else can be made. Note that as insulation requirements are enforced in accordance with building regulations for any type of building, straw built walls are no longer thicker than those of brick houses with cavity insulation.

Options - Can my desires be met?

## Elevations and Design options

There are no limits to the floor-plan area of a straw building.

When planning for more than two stories some choices need to be made. The following is a quick overview of the elevations for which the various techniques of straw building are suitable:

**Up to two stories:** Loadbearing, pre-fab, post and beam, hybrids.

**Three stories:** Loadbearing might be a

possibility depending on the weight of the roof and other details, otherwise pre-fab, post and beam.

**Four to eight stories:** Post and beam, possibly in a pre-fab module solution.

**Entire facades open with glassing**  
Hybrids of loadbearing and post and beam, pre-fab and post and beam or only post and beam.

The techniques are described in more detail later.



Options - Can my desires be met?

## Functionality first



To determine the functions of the building before choosing one's building material is essential. In many cases a straw built house will be an absolutely durable and highly appropriate solution, but the function of the house is more important than the materials in the walls. To go through your daily routines and map them down as functions needed to be provided by the space you inhabit, should be the first step when designing your new building.

Keep in mind that the orientation of the building has a high impact on the

passive solar energy that will be harvested. It is important to combine the view with the direction of the compass to get the sunlight directly inside when heat is needed and kept out when heat is in abundance. This is mostly done with the right length of overhangs and windows in the right directions. Do also ensure that the comfort of the residents is not compromised because of direct sunlight from skylight windows in the warm season.



Options - Can my desires be met?



## Required resources

### Materials

In most parts of the world straw, sand and clay or lime are available within a reasonable distance and can be found in a quality that is sufficient for construction. It is important that the straw bales be compressed after the straw has completely dried, that the moisture content in the bales not surpass 18% and that the bales be sufficiently compressed and square in shape. If a neighboring farmer cannot provide this, then it is preferable to transport bales a short distance to get the necessary quality.

### Labor and expertise

To get the drawings and detailing done right is essential for a successful and economically viable project. Expertise can come from professionals or experienced homeowner-builders. In communities where the majority of the houses are owner-built, new-comers can draw a lot on existing experience. Establish clear and good contact with an experienced source of expertise. Skilled

IF any of the resource materials, consulting expertise or experienced labor are lacking to support a straw build house, you may consider a **pre-fabricated** solution.

carpenters and masons, electricians and plumbers are good consultants and builders on the foundations, roofs, wiring, plumbing and all the other elements around the straw. But straw construction is a very different approach not always intuitive to craftsmen trained in conventional construction, as a plastered straw bale wall *is* structure, insulation, air barrier, finish, fire resistance and acoustic regulation all in one – as opposed to most building materials, which typically perform only one of these functions. It is therefore important to focus on where you can get experienced builders and support throughout your project.

Resources - All necessary resources available?

## General considerations



Any building project involves several considerations. The following list comprises general considerations which are good to keep in mind regardless of whether your house is a straw building or conventional structure. This is not a comprehensive list but a place to start when considering any unusual circumstance that could complicate your project:

- Is there any surface or groundwater present? Good drainage must always be implemented, but make sure if you need to make space for unusually large amounts of water.
- Are the soil bearing capacities on the site so poor as to require extraordinary support for the foundation?
- Bed rock presence can provide some of the foundation for you building, but can also lead to water appearing from the ground.
- Any sloped site needs careful designing. If the slope is great enough to require a retaining wall,

straw will be possible either within the retaining wall, with a good passage behind it or, if the retaining wall simultaneously provides for an open basement, then straw will be possible for the stories above the basement.

- Building in a congested area can require extra attention to the ways in which materials are brought to the building site. It may require that the building process be meticulously organized – as with any type of construction in an urban site.



Resources - All necessary resources available?

## Priorities

Before deciding on any particular approach or material to use in your building project, it is very important to have your priorities clearly defined. In the following we offer some guidance regarding which things to consider. You may have additional personal priorities, which should then be added.

- **Costs**
- **Personal involvement**
- **Complexity**
- **Time**
- **Environmental concern**

*'Cheap, fast, beautiful – pick two out of three, you might get one.'* Kelly Lerner, architect, *One World Design, Washington State.*

### Costs

Is it of great importance that the budget be kept at a minimum or are there sufficient funds for testing more experimental ideas? Do you have other particular concerns that you wish to

prioritize? These considerations will influence your options of course, but no immediate conclusion can be drawn here, as what is most cost effective for you will have to do with your specific situation which will be determined as you go through this guide. Cost is however very important primary concern, which is why it comes first. In general, if you are working with an experienced consultant and builder, there is a link between an interest in minimizing financial and natural resources. An effective straw builder may be able to provide you with one of the markets cheaper building solutions. At this point it is recommended that you contact the bank you intend to work with, in order to inform them of your particular priorities and to ensure that you can finance the project you are preparing.

### Personal involvement

When determining your own personal engagement in the building project, it is important to know your own personal resources, strengths and weaknesses. If

Priorities - Costs - Personal involvement  
Complexity - Environment - Time

## Priorities



you have a family, make sure you have realistic ideas about how much time you can devote this project in your daily life and when you will need return to an income generating activity.

### Homeowner-builder

For some being a homeowner-builder can be a really creative and satisfying experience while for to others it may be an extremely tedious, difficult and tiring process in which relationships and families have been put to the test. If you are considering building your own house, the following suggestions are offered on the basis of the experience of many previous builders.

If you are a novice builder, do always consult with professionals. Better still – Participate in a couple of workshops where you are guided through the entire building process by experienced professionals.

Take the time to work out all the small details together and discuss them with experienced builders. An hour of work

by your desk figuring out the detailing can save you days on site as well as many resources. – So if you can't draw up or better still make a mock-up model of it, then don't start building it.

What motivates you to build this house yourself? Is it a desire to put your own mark on your house? Or perhaps a need to save money on the construction process. In either case, take the time to get an experienced builder to look at your design and final drawings and go through a work plan together. Be realistic about how long things take, and give some thought to whether you would be better off earning money to pay to someone else to do the house, or



Priorities - Costs - Personal involvement  
Complexity - Environment - Time

## Priorities

doing it yourself. Somewhere in between, where you work with a builder and take on all the tasks suited for you and let him/her do the more advanced tasks and be there to supervise you along the way - has worked out as an ideal solution for many homeowner-builders in the past.

**START SMALL** Most homeowner-builders grow tired at some point, and so a break is required. If by then you have completed a kitchen and a small space for a sofa, the break will be more pleasant than if you still have an uncovered structure. A house can almost always be designed to be built in two phases, which to many has been the right approach. If you are not 100% sure about your abilities and at the time ready to begin your project, then start

out with something small - a chicken coop, garden shed, guesthouse etc. Make it a project where you get to test all the detailing of windows, doors, installations, roofing, foundation etc. so that you can add the lessons learned to your house project.

To build a straw house may not require MORE 'education' for an inexperienced builder, but it is important to not underestimate the huge task that a building project represents. If you are confident in your abilities, have cleared it with your family that you are able to take the time needed, have good consultants to draw upon and are inspired to get involved, then endure!



Priorities - Costs - Personal involvement  
Complexity - Environment - Time

## Priorities



### Complexity

Because straw and clay are highly malleable materials, many homeowner-builders have been especially inspired to give their houses a very soft and rounded look. If a very organic, curvy, cottage-like, cozy feel is what you're looking for, then straw building can certainly provide that, and perhaps do so better than many other building solutions. But do still pay close attention to your resources, as sculpted houses can be time consuming to build. In this regard, design will be linked to your resources. If time and money are infinite, then you can design both big and sculpted, with every irregularity your heart desires



But if time (and usually that means money too) is of any importance, then a fairly simple design is the solution to a successful building process. There are however also ways to get the experience of the curvy sculpted shapes in a less time consuming manner. If you plan your exterior straw walls as straight lines, but then plan a partition wall to have a soft curve and add a few hand-sculpted details to the interior walls, it will add a lot of personality to your home without taking several months and complicated preparatory detailing.



Priorities - Costs - Personal involvement  
Complexity - Environment - Time



## Priorities

### Environmental concerns

If environmental concerns are your priority, give careful consideration to a fully contracted house, possibly load-bearing or using prefabricated panels, as there is an efficiency rate where less energy and less material are wasted. The use of 1) pre-fab straw wall panels or self-built walls constructed with careful attention to resources (without making mistakes that will require the purchase of new materials), in combination with 2) reused or recycled materials for as much of the rest of the house as possible will result in the most environmentally friendly construction possible. But again: Pay close attention to your detailing! If the house is completely built with re-used materials but is not airtight or optimally insulated due to the materials you have scavenged, you will end up losing more energy in the use phase and thus expend more resources on heating. In the long run, this will result in greater resource depletion than that of producing new construction materials.

Many builders choose straw constructions because they know it is the most sustainable approach for the area where they live, combining locally available materials with great insulation capabilities. Other locally available materials may influence the choices made with respect to various details of construction. If you are fully committed to an alternative house, foundation and roof covering materials may also be available locally and reused.

Regardless of the construction materials used, smaller houses need less energy for heating, with less energy and material consumed in the construction process, so consider the size of the house carefully.



Priorities  
- Costs - Personal involvement  
Complexity - Environment - Time

## Priorities



### Time

The project timeline, costs and personal involvement all influence each other. If you have the time to work with your builders on your project, you can save some money in the construction phase. If your timeline is flexible for you to look around for materials, invite people to workshops and have volunteer helpers on your project, it may also make the project cheaper. In general a flexible timeline will usually reduce the cost of a construction project.

If time is of importance, a pre-fab solution can make the construction phase very efficient and should be given careful consideration.

For many builders it is important to ensure that there is no stress involved in the building period by providing sufficient time (including time for unexpected and unprepared developments).

### Resilience to weather conditions

If you are building in regions with unpredictable weather during the building season, make sure that you are arranging your project and building site in a manner that makes your project resilient to bad weather. This can be achieved by post and beam structures, pre-fab solutions or load bearing where the roof is put on the walls by crane as will be mentioned in 'Techniques'. Independence from bad weather brings much more ease and joy to the building project, and will also save you time and money in the end.



Priorities  
- Costs - Personal involvement  
Complexity - Environment - Time

## Techniques of straw building

- **Load bearing** - the roof rests directly on the straw walls
- **Post and beam** - a primary structure supporting the roof, with strawbales as wall fill and insulation
- **Pre-fabricated panels**
- **Hybrid**
- **Wrapping**

### Load bearing

In load bearing straw buildings the roof is supported directly by the straw walls, which gives this technique the advantage that it is not requiring a second structure.

Roofs first - Walls first?

There are many different approaches to loadbearing, which partly have to do with the predictability of the weather during the building season. Other considerations include the climate (is it too hot for builders to work in direct

sun?) and the traditions of the builders. The common approach is to build the foundation, raise the straw walls, and then build the roof on the walls. If that approach is chosen, good tarps and good techniques for covering the building quickly need to be put in place.

Another approach is to build the foundation, then construct the roof on a site immediately adjacent to the foundation, raise the walls and have the roof put on the walls by crane in one go. There can be a big advantage to this in a location with unpredictable weather, as the raising of the walls can be done in a rather short time span, and as soon as the roof is on, the entire building is



Technique - Which will suit my project best?

## Techniques of straw building

protected. If you are paying for your building, it can also reduce costs to build the roof on ground, so that all the materials do not have to be carried up manually. But this needs to be compared with the expense of hiring a crane.

A third option is to erect a temporary structure to carry the roof, which is then built before the walls are raised and removed at the end. In this case the construction process becomes more like that of an in-fill house.

Big bales - small bales?

Only a few years ago very few houses were built with the larger jumbo bales, but in the past 8-10 years this has become a more common practice in Denmark with respect to loadbearing structures. The jumbo bales are found in different dimensions ranging from 50 x 80 x 180 cm to 90 x 90 x 220 cm, with several variations in between. In general a wall will not benefit from more thermal insulation once the bales are more than 60 cm thick, and in many places a 45cm thick straw wall will



provide sufficient insulation. The jumbo bales do have the advantages of being very regular in shape and as fewer bales are needed to cover an area there are fewer joints to make tight.

Technique - Which will suit my project best?

## Techniques of straw build

### Post and beam

Post and beam is the commonly used term for a straw building where a structure, typically of wood but at times also of steel, is erected first to carry the roof, with straw bales providing the wall in-fill and insulation. This technique has the advantage of supporting a roof to protect the walls while stacking the bales in the walls. It is also a technique which at times makes straw building appear more accessible to traditionally trained craftsmen.

### Pre-fabricated panels

Pre-fabricated straw panels benefits from all the advantages of conventional pre-fab construction, being: high consistency, low costs and efficiency which can be consistently and systematically optimized. If you are interested in a faster building process, a pre-fab wall panel solution could be right for you. The panels are produced in a protected environment, usually off-site, where the plaster can dry under predictable conditions. Pre-fab straw

wall panels are being produced in several European countries, Canada and many more locations around the world.



### Hybrid

Hybrid is simply the term used when two or more of the above mentioned techniques are used in combination. This is often seen where a façade has a very large glassed-in section requiring a frame for support, but where the remaining walls can be of pre-fab or loadbearing straw walls.

### Wrapping

Wrapping is the technique used when an old building needing renovation is insulated on the outside with straw bales and be given a completely new façade.

*Technique - Which will suit my project best?*

## Maintenance



Whether you are planning a house that will be cared for by an engaged homeowner builder or that is a public/corporate building which should have as little maintenance as possible, it is highly recommendable that you determine the general direction of rainstorms in your area and protect these sides of the building. The design that you make can provide this protection through low exterior walls, long overhangs – perhaps created with open verandas, a high plinth and exterior cladding. It can also be provided through the use of vegetation placed where the walls would otherwise be exposed.

If you have an interested in showing that this building is made of natural materials, acknowledging the extra care it will require, then the joys of working with clay plasters combined with the benefits of the very low CO2 emissions and a unique soft look, may lead you to opt for an exterior clay plaster. It is then essential that you consult extensively with an experienced clay plasterer to ensure a durable result.

If lime plaster or lime paint is used, make sure to consult with an experienced person, since the strength and following durability of lime can vary by over 50% depending on the conditions under which the lime is applied, the thickness of the layers applied, the difference in lime products and their qualities etc.



*Maintenance - Deciding on the exterior finish*



## Decision making map



As you have read through the guide getting some ideas about the opportunities and barriers to straw build, the following provides a quick map to determine the decisions in the design process. When going through the map, consult with the respective sections of the guide to determine the conditions you are designing under.

### Overall:

Do I like what I can get? (The qualities)  
– No - SB not appropriate

Yes – move down

Can all the common concerns be addressed? – No - SB not appropriate

Yes – move down

Can my desires be meet? – No - SB not appropriate

Yes – move down

Are the necessary resources available?  
– No – Pre-fab possible

Yes – move down

### Prioritizing:

Costs: Then down scale complexity and time

Personal involvement: Then consider co-building + down scale complexity and time

Complexity: Then down scale time and costs

Environment: Then consider reused materials + downsizing + contracted or co-building + pre-fab

Time: Then down scale costs and complexity

### Weather conditions:

Predictable: All solutions possible

Unpredictable: Pre-fab / post and beam / load bearing with roof first or other solutions for fast weather protection

### Need for really high insulation?

Yes: Jumbo bales (thickness of straw in the walls between 60 to 70 cm)

No: Jumbo bales of small bales (35 x 45 x appr. 80 cm) are all useful

### Elevations & Techniques

1-2 (3) storeys: all options possible

3-8 storeys: Post and beam possibly as pre-fab possible – (Above 8 storeys have not been designed to the knowledge of the author)

Glassed in façade: Hybrid of post and beam + load bearing or pre-fab; or just post and beam.

### Maintenance:

Desiring low maintenance: Exterior lime plaster or sufficient protection of exterior walls, possibly cladding

Interest in the advantages of a clay plaster, accepting a higher degree of exterior maintenance: Clay plasters

## Resources on Straw build

*Has straw build caught your interest the follow readings can be recommended*

Design of Straw Bale Buildings, Bruce King, Green Building Press, 2006

Building with Straw, Gernot Minke and Friedemann Mahlke, Birkhäuser, 2005.

More Straw Bale Building, Chris Magwood, Peter Mack, Tina Terrien, New Society Publishers, 2005.

Building with Straw Bales, revised and updated, a practical guide for the UK and Ireland, Barbara Jones, Green Books, 2009

The last straw journal  
[www.thelaststraw.org](http://www.thelaststraw.org)

For Denmark:

Halmhuse, Udformning og materialeegenskaber, Jørgen-Munk Andersen, SBI rapport 2004. By og Byg Resultater 033,

## Acknowledgement



The guide has been produced on the basis of a survey conducted with the various stakeholders of the building industry: homeowners; homeowner-builders; carpenters; masons; architects; engineers; financing agents (banks); insurance agents and building component manufacturers, as well as with the use of current state-of-the-art literature on the subject.

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Opportunities and Barriers for Straw Construction, 2012, DTU, Denmark.