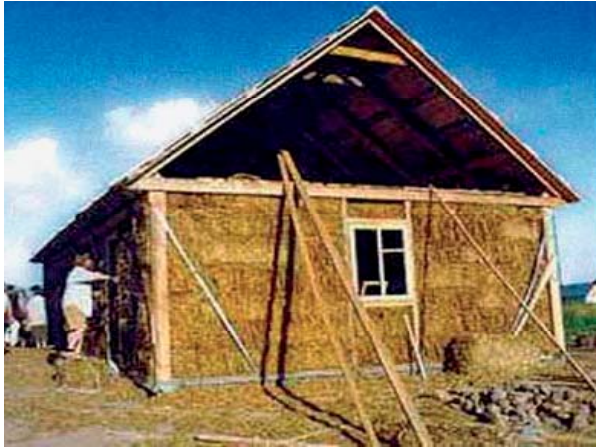


## Strawbale buildings

Compared to competition products, strawbale buildings show considerable advantages in the event of natural disaster. They can provide the victims for decades with sustainable and low-cost housing fit for human habitation.



### History

Straw and loam rank as the oldest building material known to mankind. Consider the thatched roofs and the timber-framed houses with compartments of straw and loam which can be seen in our cultural circle, or the hovels of straw in Africa and Asia and the Pueblos in New Mexico made from straw and clay by North American native inhabitants.

In the United States of America building with bales of straw has become popular since about 1800 when the strawbale press was developed. Settlers from Nebraska, a state characterized by grain farming, discovered a way to erect buildings with these huge straw bricks. Erecting bale walls went amazingly quickly and did not take a lot of skill, so in the early days these buildings were meant to be only temporary. But soon the owners realized that the buildings not only endured their designated life span, but had excellent insulation properties all over the year.

Particularly in the southern regions of the United States where forests are scarce, many strawbale houses were erected in so-called "Nebraska-style". The strawbale walls sustain the weight of the roof, so they are "load-bearing".

In 1936 the first two-floored strawbale building was erected with a post and beam framework that supported the basic structure of the building, the bales of straw were used as infill.

From the 1950s and the early 1960s the upcoming serial construction technologies pushed strawbale construction to the back of people's mind. It was only when the environmental idea came up in the 1970s that strawbale construction was reborn and implemented in American "green home building" as well as in prestige buildings all over the world.



prestige building in Ticino, Switzerland  
architect: Werner Schmitz (Switzerland)



ancient church, USA

### Structural engineering and construction works

Within strawbale construction distinctions can be made in supporting structure, we distinguish between **load-bearing** and **post-and-beam construction**.

Within the scope of the research project "strawbale housing for victims of natural disaster or migration" the load-bearing construction suits best. Additional material for timber post-and-beam structure is not needed and strawbales are fairly easy to build with.

**Load-bearing building** with strawbales is also called "Nebraska style" because if we look back, this constructive form was mainly developed in the US-state Nebraska. Strawbale walls direct the load of ceiling and roof to the grounding. Due to structural analysis the number of storeys is confined to two full storeys. The bales of straw are laid horizontally in composite construction, they are getting linked and fixed by bars made of wood, metal or bamboo. A peripheral tie beam is imposed and tied down by chords and threaded bolts. Thus the walls are prestressed and subsequent settlement due to load transfer of the roof and the upper storey can be prevented. Load-bearing strawbale construction features high earthquake resistance and good price performance.

In **post-and-beam construction** we usually apply timber studs, sometimes steel or reinforced concrete columns. This framework supports the basic structure of the building, the bales of straw are used as infill walling. The bales can be laid both horizontally and vertically so that thin walls can be built, too. The building outlay for the structural skeleton is quite high so that in comparison to load-bearing construction the price performance ratio is lower.

In load-bearing and post-and-beam construction the both sides of the strawbale walls are **plastered with loam** rendering to keep the straw dry and to ensure fire safety. In Austria and Germany this wall make-up is already registered as fire classification F90, which means refractoriness for 90 minutes, for non-load-bearing components; registration for load-bearing components is in progress. Moreover, loam rendering regulates the interior air moisture to 45–55% humidity, which has positive effects on a healthy indoor climate.



## Initial position

Particularly in developing and threshold countries global growth of population gives rise to housing demand, in many cases also the economic set-up forces people to abandon their ancestral property.

These are the conditions for populating geologically, meteorologically or socially unstable territories in which people are affected by volcanic activity, earthquakes, gale-force winds, flash floods, environmental and technical catastrophes or civil war. Homelessness and migration is the direct consequence.

## Humanitarian aid organisations

Aid organisations practise a 3-phasic help program:

### 1. Emergency

Surviving victims receive medical assistance and tent accommodation. Usually phase 1 should require only a few weeks, based on experience it can take years.

### 2. Rehabilitation

Victims are placed in temporary living accommodation until the destroyed houses are reconstructed. Alternative proceeding: temporary residence accommodation is developed and extended to steady accommodation.

### 3. Longterm Development

Gradually people accustom to everyday habits, they are supported in the development of a self dependent life.

**The strawbale construction method suits phase 1 and 2 in particular.**

## Advantages of load-bearing strawbale construction

- Load-bearing strawbale construction is a quite simple technology which does not take a lot of skill.
- Victims of natural disaster and migration can get involved in the process of construction. Self-dependent overcoming of victimhood can prevent or lessen post-traumatic stress disorder.
- Support by the victims and short haulage distances reduce logistic and manufacturing expenses.
- High performing thermal insulation (U-value 0.12–0.14 W/m<sup>2</sup>K) and loam rendering moisture barrier offer comfortable living, particularly in climatic extremes.
- Natural building material and low application of primary energy during construction period and life time cycle stand for sustainability.
- In the event of earthquakes straw bale walls absorb and attenuate energy to a high degree which makes load-bearing strawbale constructions safe and reduces the risk of injury when collapsing.

## Project partners



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## Research Project

### Strawbale housing for victims of natural disaster or migration



low cost  
simple establishing  
involvement of victims  
low application of primary energy  
earthquake-proof  
high dwelling quality  
sustainable

in cooperation with:

