



**Politecnico
di Torino**

Honors Thesis

Master of Science in Sustainable Architecture

Abstract

Design of a load-bearing straw bale pavilion

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July 2022

The current consumption model is unsustainable in the long term. We use more resources than we have available, we emit climate-altering gases without being able to dispose of them, we produce waste that we cannot absorb.

Climate change requires a change of habits in the lives of every single citizen. Everything is interconnected: every man, every government, every living being, every ecosystem. Everything was in balance and we, a single species among all the existing ones, broke that harmony.

The construction industry has an important impact on the environment, so a change in this sector could greatly improve the situation.

This master's degree thesis is part of a DIST initiative Department of Excellence 2018-2022, funded by the Ministry of University and Research, which involves the design and construction of three pavilions with construction techniques respectively in lime-hemp, straw bales and lightened earth.

These three prototypes will be built respecting, as far as possible, the principles of *vegetarian architecture* and they will be compared in terms of thermo-hygrometric performance, structural resistance, building site management, availability of materials, costs and environmental impact.

In particular, my thesis project deals with the load-bearing straw bale pavilion.

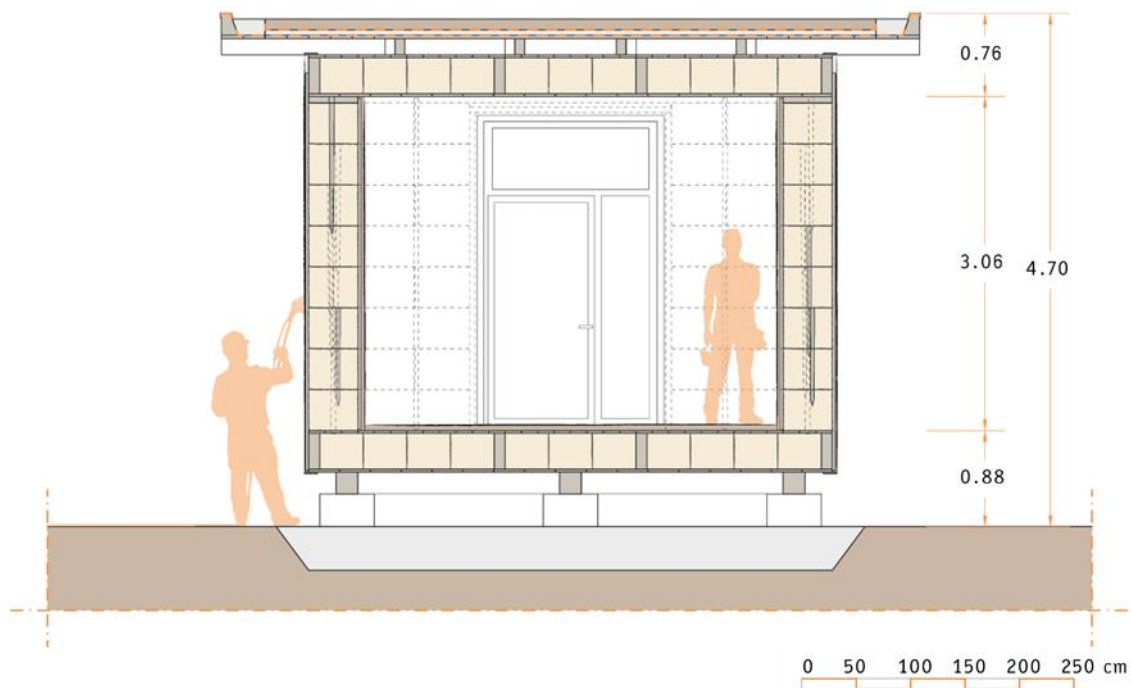


Figure 1 Pavilion cross-section.

The first part of the thesis explores the global climate situation and the state of the art of the use of straw in architecture.

The second part shows the different hypotheses developed for the morphology of the pavilion plan and for the construction technique of floor, walls and roof. These options are then compared in terms of quantity of raw materials used, thermo-hygrometric performance, quality of natural lighting, ease of construction and site organization.

After an accurate design process and a review with the Swiss architect Werner Schmidt, I defined the design of the pavilion up to the level of executive detail.

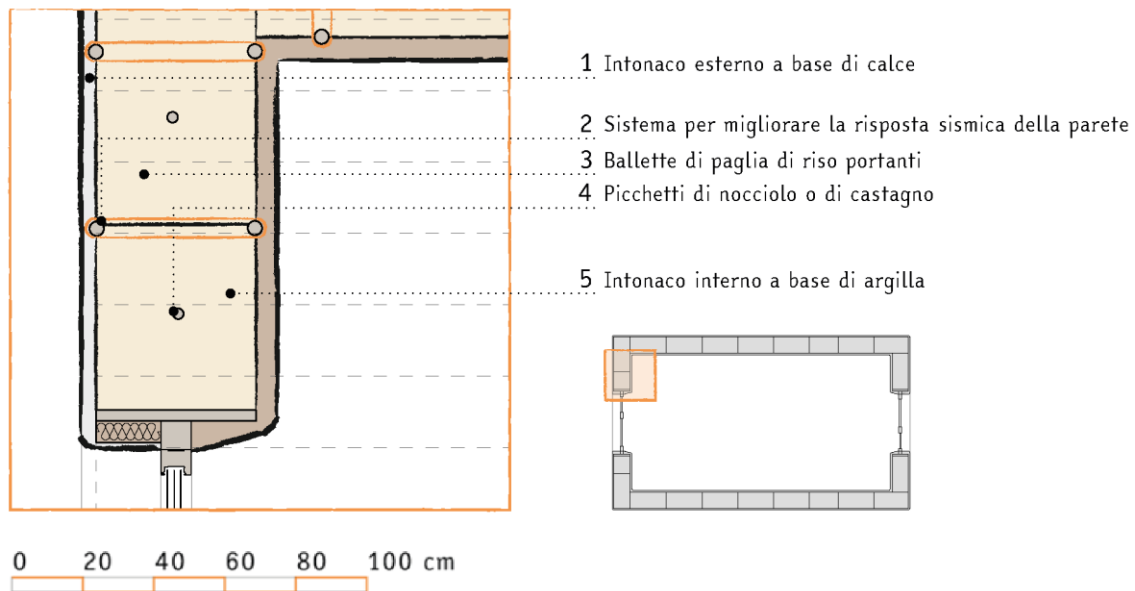


Figure 2 Example of a construction executive detail.

The third part of the paper presents: calculations for the structural sizing of wooden load-bearing elements (support software: Ftool); simulations concerning the thermal transmittance of the stratigraphy of the envelope, the dispersion through thermal bridges and the global average heat transfer coefficient per transmission (support software: Termolog 13); studies on natural illuminance and the average daylight factor (support software: Velux Daylight Visualizer 3).

The last part of the thesis concerns the organization of workshops in Grugliasco (TO), during which PoliTO students will build the pavilion.

First, I drew up a timeline of the different phases of the construction site, a list of the necessary equipment and useful forms to collect some monitoring results and for the construction of the pavilion. In addition, I collaborated in the research for suppliers and in the management of requests for quotes for straw bales and wooden elements.

The use of straw bale in construction industry is spreading in Italy; this material, however, is not part of the NTC 2018 as a building material that can be used for

load-bearing structures and there are few professionals who use it as a thermal insulation.

This thesis aims to contribute to the acquisition of further data, which can facilitate the inclusion of this material in the Italian legislation, and to encourage the acceptance of this unconventional and environmentally friendly construction technique.
