



POLITECNICO
DI TORINO

Honors thesis

COURSE OF DEGREE IN ARCHITECTURE FOR THE
SUSTAINABLE PROJECT

Abstract

**Technologies for the improvement of thermal comfort:
The case study of soil houses in
Huanutuyo-Pacaje**

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The question of the cold is a common problem in the Andes of Peru. Each year more than 500 people die. This is because the houses do not protect people from the cold and into the houses during cooking food on the stove is made of smoke.

To solve this problem Grupo PUCP offers three technologies: *trombe* wall, ceiling insulation, and chimney. These three technologies installed together are called "*Casa Caliente*". It has improved the quality of life in Andean rural village through interventions in houses.

This thesis objective is to propose technologies that improve the population quality of life, such as technologies recently made by the Group PUCP. This model can be improved in two ways. First of all, it is necessary to ensure durability of housing, because houses could be damaged due to impairment, such as walls erosion due to rainwater. Another way is to add other technologies to improve house insulation.

The material useful for making the work was collected on site during the journey of training done in Peru. With the site inspection made it was possible to see the reality in where people live in the Andes, very different from the European reality.

In the thesis, for starters, it was study the organization of housing and typological characteristics of indigenous houses. And then it was to explore the theme of materials used, such as clay and straw, and understand the characteristics and the reasons that make them suitable for the building materials in Andean areas.

The next step was a study of the project "*Casa limpia caliente*" and I describe the journey made in the Andes. Then, I choose a house where it was applied this model in the province of Carabaya, Puno, and implement improvements to it passing through the analysis of the climate.



Fig.1 e 2 The case study

The project studies problems and proposed technologies to improve the model of "*Casa Caliente limpia*". It was possible to show the study of construction details and choice of

materials and technologies. This was done thinking about materials, which in addition to being environmentally friendly by its nature, were almost "zero cost" and "zero km". The reason for these choices are transporting difficulty of raw materials, and from limited economic possibilities of the natives. In fact, some of materials derived from waste or secondary uses of agricultural products. All without precluding same potential applications in other houses in same conditions.



Fig.3 Technologies for the improvement in the roof, wall and floor

It is thorough, the theme of the insulation in walls to give indications on how to make it in self-construction and which are appropriate proportions; this through the samples made in the laboratory.

In order to better define quantitatively the design assumptions, I was calculations to verify the extent of the performance of new construction elements.

The results show that, with an initial investment of time in sourcing the materials and build their own technologies, it is possible to obtain the best thermal performance in the building element; services are not comparable to materials available on the market, but that the natives could not afford to buy. Therefore, in addition to being an ecological choice, this proves to be a suitable solution for this type of villages.

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