

TRADITIONAL WOODEN BUILDINGS IN PORTUGAL THE AVIEIRA HOUSE

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Abstract

The presence of wood in structural applications in construction was constant in Portugal until the end of the XIXth and early XXth centuries. Wood was used since the first constructions when the available resources were scarce and it continues to be present in vernacular buildings and areas whose heritage value requires their preservation. The wood as a structural material is now uncommon in residential buildings in Portugal. It often appears as partial constructive element (particularly in roof structures and floors) and occasionally as integral constructive element. In the latter case, on the vast majority of situations, it appears as a culturally decontextualized constructive system since it lost any connection with traditional solutions using wood.

Keywords: Wooden Buildings, Traditional Construction, Stilt Houses, Avieira Culture

1. Introduction

Due to the lack of efficient means of transportation, the materials used in the walls of traditional houses, mostly heavy in our climate and cultural context, were closely associated with the local availability of raw materials and labor [1]. As a consequence, the materials used for the construction of the heavy and structural elements corresponded directly to the lithological characteristics of the soil and their distribution throughout the country was the one represented in the map (Figure 1).

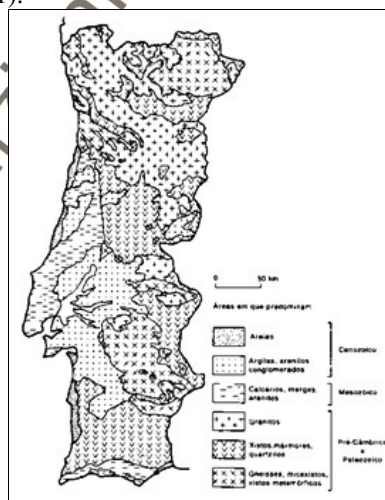


Figure 1. Lithologic diversity in continental Portugal [2]

The use of wood in the whole building was conditioned not only by the climatic characteristics and durability of the material on the outside, but mainly for the simplicity of obtaining the material, related to the existence of near pine forests. "In the northern part of Extremadura, along the low cost, the Leiria Pine Forest was a determinant element of the architecture of the region, leading the timber to occupy a predominant role and sometimes almost an exclusive one in construction" [3].

This fact was due not only to the availability of wood, but also to the non-availability of stone nearby. Even the clay needed for the manufacture of adobe blocks or rammed earth, is totally lacking in these sand soils.

While in cold countries with abundance of forests, namely the Nordic countries, the wood was and still is the whole structural and cladding component of buildings, in countries with fewer wood resources, like Portugal, it was used

predominantly in the structures and parquet floors, roof structures, windows and doors, where wood was irreplaceable due to its mechanical properties, combining low weight with a high resistance to bending stresses [1]. The wooden construction is also related to the quality of the land where the buildings are implanted. From the Portuguese cities of Espinho (20km south of Oporto) until S. Pedro de Moel (100km north of Lisbon), the coast is an extensive range of quaternary sands, as shown in Figure 1. In these coastal areas, as seen in the houses in Aveiro, "the lightness of the wood allows the raise of buildings in a sandy soil of low stability (...). The *Palheiros*, built at poles, bring to mind assumptions related and derived from pre-historic lake stilts" [4]. This solution also prevents the accumulation of sand carried by the wind. Moreover, "(...) when it becomes necessary, the house is raised rises using hydraulic systems, pulling up the stakes or adding stilts that cause the house to raise to bigger height" [4]. There is a wood scaled model used as a showcase of Avieira Culture dwelling (Figure 2) found in the village of Caneiras.



Figure 2. Scale model of an Avieira house, supported by a truck pulled trailer

The area of traditional wooden constructions of the *Palheiro* type extended along the north of the Douro coast, from Caminha to Póvoa de Varzim (Figure 3). The area of this type of construction had its southern limit in clusters in the coast of Pedrogão and Vieira de Leiria beaches, nowadays non-existent (Figure 4). From these fishing settlements south of Vouga a periodic migratory chain of the Mondego's people and of the fishers of Vieira de Leiria was created.



Figure 3. Aguçadoura, Póvoa de Varzim

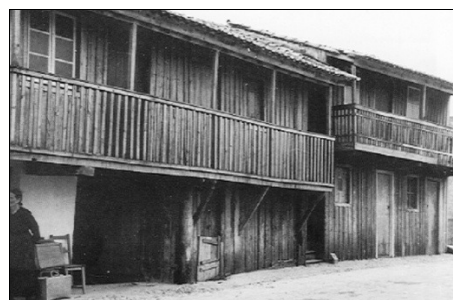


Figure 4. *Palheiros* in Vieira de Leiria [2]

The latest, during fishing low season, work in the rice fields of the Sado River and in the fisheries and transport of the Tagus River [2]. Thus they have settled in this area bringing with them their traditional building types. Examples of these Avieiros houses are located in the basin of the Tagus River, particularly in the area of Santarém, which features clusters in the villages of Caneiras, Escaroupim, Pallhota, Valada and Patacão, among others the only elements in these construction that are not made of wood are the chimney and the pillars, which raise the house from the soil, protecting from the humidity and the floods of the Tagus River. This situation is related to the ground type.

2. Avieira Architecture

The stilt constructions of the Tagus river began to appear in the landscape for periodic use – fishing season to the fishers of Vieira de Leiria. At first, the buildings were canvas tents and reed roofs supported on stakes. With time and the desire to remain along the river lead to the houses becoming permanent, which induced better quality. These were the origins of the first stilts constructions - typical of Vieira de Leiria beach - huts built with material available at the mound.

Nowadays there are still some examples of these constructions in the area of Santarém, despite some differences, particularly in their construction process. Originally the houses, being entirely of wood, were materialized by a horizontal grid over the stakes where the skeleton of the house laid, formed by horizontal and vertical logs. Today, this skeleton is built on stakes of concrete instead of wood. The roofs, in the past made of stern, are now composed of tile gutters and the false chimneys, before consisting of two up lifted tiles, were now replaced with conventional masonry chimneys.

Due to comfort and evolution, most of the houses in the rest areas (rooms), are internally coated by vertical varnished pine planking. The living areas "(...) are tidy, clean, lined with flashy papers and colorful fabrics" [5]. Other compartments such toilets, are generally outside, following the porch (if it exists) and the kitchens are completely separated from the housing area, as in the house visited in Caneiras, Santarém. It is situated across the road that provides access to various huts, for the sake of fire safety.

The settlement of Caneiras is organized along the Tagus river in two rows with access paths between them. Some units have a warehouse directly placed on the ground (Figure 5), while the housing is supported on pillars. The house represented here dates from 1980.

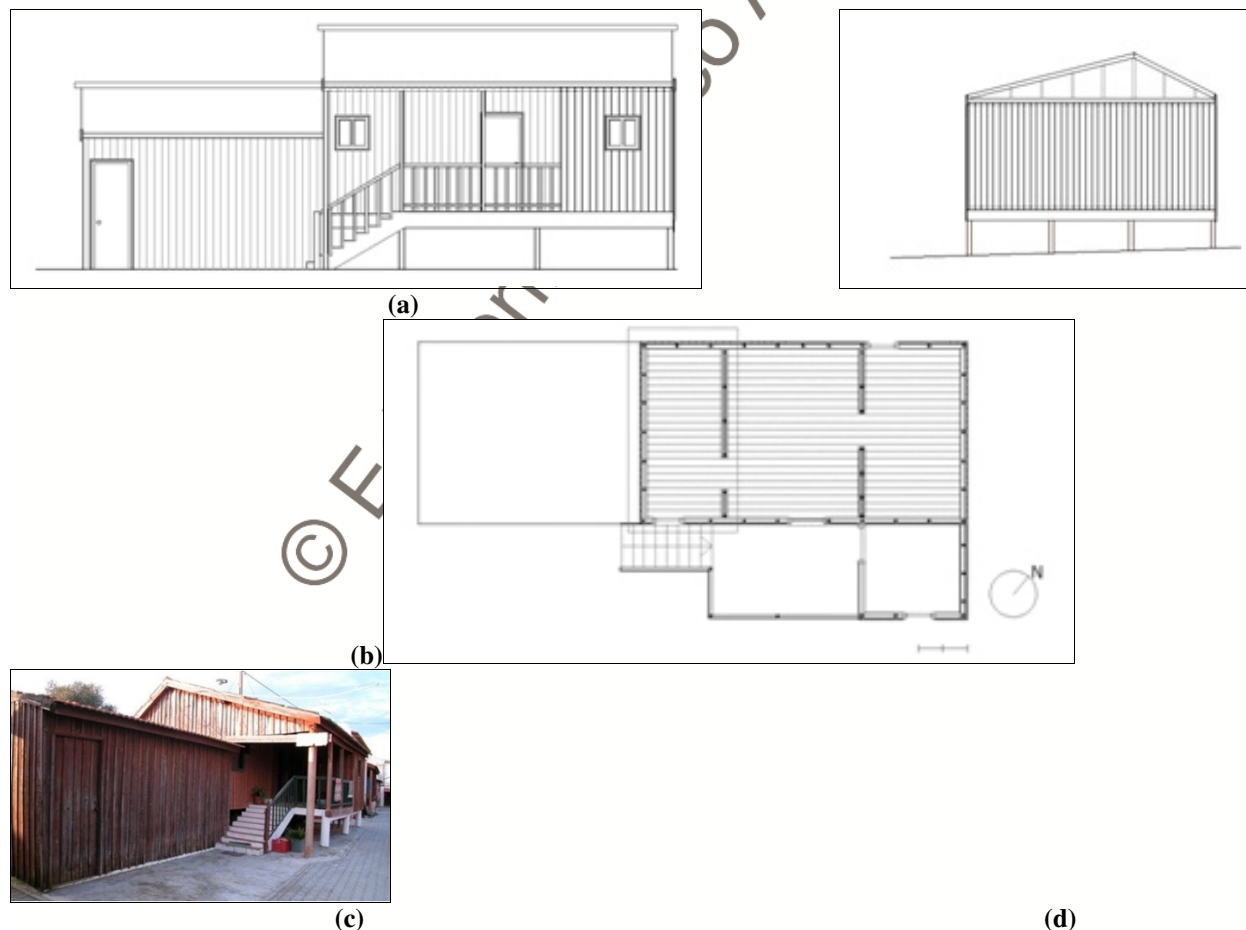


Figure 5. Elevation (a), structural section (b), plan (c) and outside view (d) of an Avieiros house located in Caneiras.

2.1. Wood as a structural material

The use of wood has several structural advantages: its immediate capacity to be put under load, good flexural behavior, which offers the facility to absorb defects in execution, low self-weight, in addition to the environmental

aspect. The embodied energy is very low and is a reusable material, recyclable and biodegradable when using local and little-transformed wood.

The structural use of wood has however some disadvantages, such as problems of durability, its inadequacy for tall buildings, the possibility of presenting some distortion over time, its fuel like nature and its need for maintenance. There are however treatments and even wood products that have mechanical properties and higher durability than natural wood, even though under the environmental point of view its utilization has to be weighted as a function of use and expected performance.

There are no alternative materials to wood (from the structural perspective) which may present a better compromise between the environmental, mechanical and functional performances, so its use will always be one to consider, especially in single-family housing or buildings of small height.

The walls in wooden ruler resting on a wooden structure are characteristic of some coastal areas of Portugal, representing an evolution of stern walls. However in these buildings, the coverage remained in stern or has evolved to tile roofs.

The facade solutions found in the traditional light weight building are light-weight, consist of a punctual support material with a structural function and a differentiated clenching material. Usually the wood structure is inside two clenching materials that form respectively the inner and outer face of the wall. In constructions studied, air cavity do not show any filling material. Currently the air cavity between two panels is almost always filled with insulation materials. In some buildings prior to the XIXth century, particularly in urban settings such as the Lisboa Pombalina or in Guimarães, the air cavity was filled with heavy materials such as clay or brick, in mixed system, as in half timbered and wattle and daub.

The primitive beach huts and *Palheiros* (Figure 6) more or less evolved, which could reach two or more floors were always in wood, from the poles in the foundation to the cover of floorboards, stern or reed, which only much later gave way to roof tile gutter. In the majority of cases the foundations were gradually replaced by more durable materials such as stone and concrete.

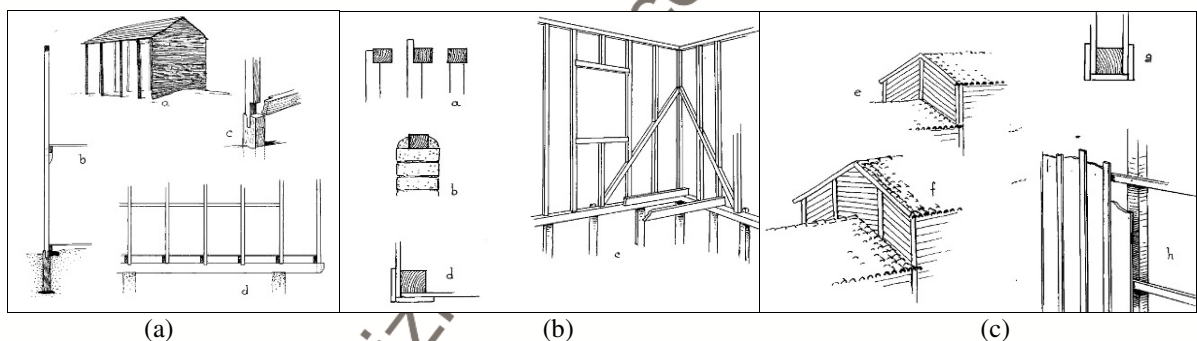
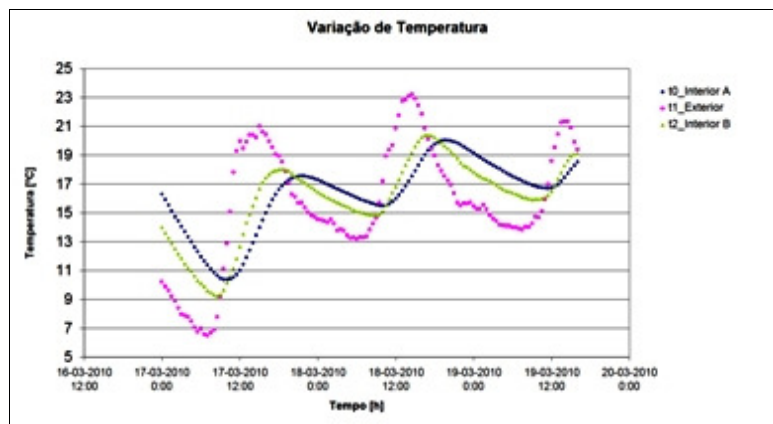


Figure 6. Construction details of *Palheiros* at Esmoriz beach, Aveiro (a) and Mira beach, Coimbra (b and c) [3]

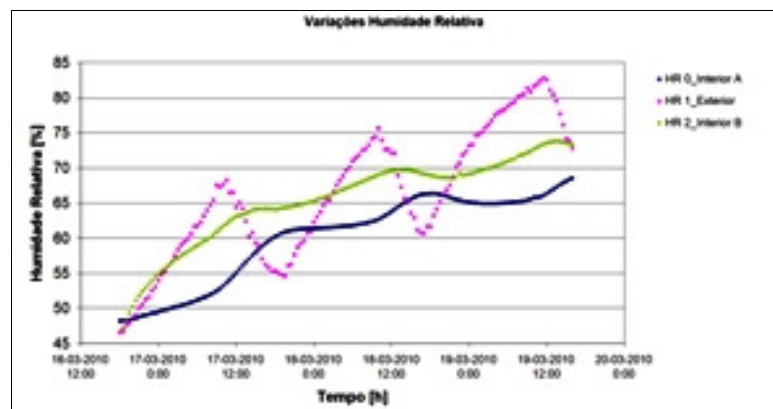
2.2. Hicrothermal performance of wooden houses

A problem related with buildings entirely built with light-weight materials, in the climate of Portugal is its low thermal inertia which results in excessive daytime thermal fluctuations of inside temperature. Hence they become more suitable for invariably cold or hot climates with little diurnal and annual temperature fluctuations and are therefore characteristic of Northern Europe countries, where the insulation capacity is more important than inertia. In tropical countries, the protection is mainly intended to shelter from rain and excessive sunlight which does not imply inertia or thermal insulation, but shading and ventilation strategies. In coastal areas of temperate countries, like Portugal, the lack of thermal mass of the building elements is made obvious by the presence of water which ensures a natural regulation of thermal fluctuations.

In the studied house the placement of a monitoring hygrothermal system was conducted, during three days of March (2010). From these measurements it can be concluded that, despite the outside temperature displaying a high thermal amplitude, between 5°C and 7°C, the interior temperature fluctuated significantly less, between 2°C and 3.5°C, with a maximum temperature of 19.5°C (Figure 7). On what concerns the relative humidity of the housing the results were even more positive, since the oscillations were less than 10%, while outside the house the fluctuations were around 30 to 45% and the maximum relative humidity remained more than 10% lower than the exterior in the interior compartments.



(a)



(b)

Figure 7. Temperature (a) and relative humidity (b) in the house visited in Caneiras, Santarém

4. Conclusion

This paper aims to present and characterize the solutions that exist in the traditional wooden village of Caneiras, Santarém. Within this goal; plans, elevations, sections and exterior and internal photographs of the building are presented, as well as the results of hygrothermal monitorization carried out during the heating season. This study has the intention of contribute to the formalization of a methodology of intervention that does not confine itself to simple restoration, but that can also introduce an added value in terms of implementing new comfort standards in rehabilitation, as well as the application of some of the concepts in new construction valuing the wood as noble material.

Face hygrothermal measurements we concluded that in terms of humidity and temperature, the results were satisfactory, taking into account that the situation is not optimal.

Acknowledgements

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