

Wooden Vernacular Architecture as a Sustainable Development and Security Mechanism. The case of the Palafitos of Chiloé, Chile.

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Abstract - The present research aims to explore how the palafitic construction can be a strengthening mechanism of Sustainable Development, Education and Safety.

The construction study of the stilt houses of Chiloé, Chile, has been selected as a case because: (1) Chiloé has a unique vernacular architecture; (2) it has a geographic morphology that has allowed since its genesis as a city to build structures in wood and sustainable materials, (3) its stilt houses are used as a source of sustainable development, being used for residential, commercial and tourist uses (5) the supporting structure works independent of the habitable volume.

The methodology is developed through the analysis of discourses of relevant actors in the area (associated architects, local authorities, specific groups) together with studying the stilt houses of Barrio Gamboa and Pedro Montt in the town of Castro.

It is concluded that construction in stilt houses has turned out to be a strengthening mechanism for Sustainable Development, Education and Safety and territorial resilience, as has happened in the construction case of stilt houses in Chiloé, Chile.

Keywords: Stilt structures, Sustainable development, Education and Safety, Vernacular architecture, resilient construction, Chiloé, Chile.

1. Introduction

Chiloé is an island located in the south of Chile, it is surrounded by the Pacific Ocean and is of patrimonial value both for its richness in traditions, its culture and its vernacular architecture that can be seen in the existence of stilt houses on the coastline. Construction on the island of Chiloé is characterized by the use of local materials, mainly native wood and other vegetable fibers; these materials are present in buildings of heritage value, such as stilt houses, which correspond to the object of study.

The arrival of the Jesuits in the 11th century and later of the settlers in the 9th century was important to generate the current Chiloé architecture, the Jesuit influence together with the knowledge and cultural values of the tenants, allowed to maximize the use of natural resources within the area. Wood, a fundamental material because the construction of the Chiloe culture has been based on it since pre-Hispanic times, was determining both for the work of the Chilotes, as well as for their mentality and social life, such as their homes, tools and roads. [one]. The foregoing is implied for geographical reasons, its location in the southern hemisphere allows the development of an exceptional forest with vegetation largely composed of a variety of trees such as Ciruelillo, Avellano, Coigüe, Ciprés, Canelo, Alerce, Ulmo, Mañío, among others. Each one with characteristic properties that are used for the construction of houses on the island.

The first stilt houses appeared in the 20th century due to the migratory process from the countryside to the city and were born in response to a city saturated with urban infrastructure, which is why part of the population located their homes on the

edge of the sea and the mainland. Mainly as a source of economic sustenance for the home, linked to fishing activity, characterized by being simple volumes with gabled roofs, with a facade facing the sea and another facing the street.



Fig. 1. Los Lagos region map, own elaboration.

2. Theoretical Framework

The theoretical framework of the present study focuses on the review focuses (1) Palafitic structures, (2) Resilient construction, (3) Vernacular architecture.

Culture and context are elements that make up Vernacular Architecture, an architecture typical of each region in particular and that follows a certain logic in functional terms such as physical and social responses to both the environment and lifestyles. This generates a constant transformation of construction techniques acquired by cultural knowledge or evolutionary processes, also in the use of materials, generally extracted from the nearby natural environment and from the use of natural resources present in each area [3].

The palafittic structures consist of a series of stakes or right feet driven into the ground that are characterized by protecting the house at ground level, the chilote stilt houses, perch on the edge of the sea and are driven one meter deep, built mainly in carved wood and later sawn wood, such as Ulmo or Alerce brought from continental Chiloé [4]. These stakes are arranged aligned and connected by diagonals that function as bracing, "as the stakes have diagonals, this generates rigidity, triangulating the structures, in this case passing through the earthquake loads, which are generally horizontal, (. ...) quickly to the ground" [5] [Figure 2]. Along with this, the wood has excellent resistance to bending and thanks to the fact that Chile uses more generous sections of wood than in other parts of the world, stilt houses are less prone to breakage. This, added to the low weight of the constructions based on this material, results in a very good behavior to earthquakes. Proof of this was the magnitude 7.6 Richter earthquake in which, for the magnitude of the earthquake, the damage was minor and only in some specific cases, structural. [5]

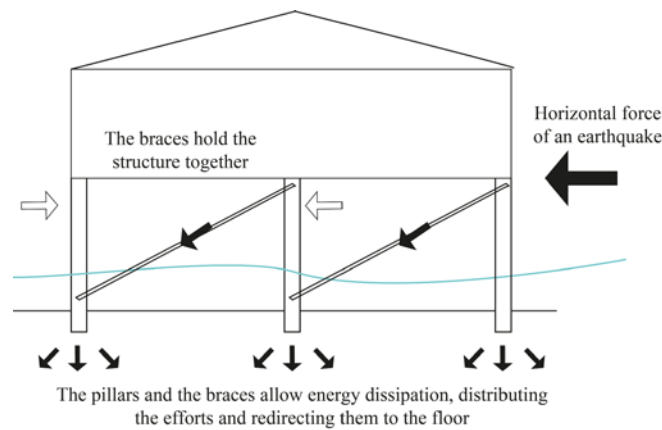


Figure 2. Force Diagram, own elaboration.

The stilt houses have been reconverted to be inserted into the tourism industry, a direct effect is the arrival of new programs related to tourism, housing different programmatic typologies, from homes, hotels or restaurants and tourist attractions that are maintained in a sustainable way, not only by materiality but also by the way in which the tenants have promoted the palafittic heritage, both for the sustainability offered by the accommodation services, as well as for the certification and the participation of the community in conjunction with a culture of self-consumption and elaborated products. locally [6].

The stilt houses that remain standing are considered as inserts [7], since they use the existing traditional models to include them and rethink their uses in a positive way. The island of Chiloé is considered resilient because it has been affected by natural disasters, mainly by earthquakes due to the seismic condition of the country. To this is also added the oscillations of the tide that can reach up to seven meters, which is why the structure is designed in such a way that the set of piles works independently of the upper structure that is the one that contains the habitable enclosure. [4] and the wood for the supporting structure is from Ulmo, which is characterized by having a high mechanical resistance. Barcelona is another case of a resilient city, but not due to natural disasters, but rather due to exposure to large concentrations of people [8]. Similar is the case of Chiloé, the demand for tourist use that has been conferred on stilt houses is high, and unlike Barcelona, Chiloé does not have strategies as advanced as the European case to mitigate the effects of tourism and gentrification. On the other hand, Rio de Janeiro, Brazil, is another case of a resilient city, in which one of the problems experienced in the region is natural disasters linked to the climate: extreme rains and droughts. The rains of 2010 were key to starting a resilience work, mainly investing in sustainable city initiatives [9].

The protection at ground level against humidity is what distinguishes the typology of palafitic structures. The Negishi Communal House [10], is another case of palatial vernacular architecture where the structure and materiality of its roofs is justified by strong climatic changes, snow conditions and heat that must be resolved through architecture using materials available in the area, or in the case of the Villa Palafítica de Bad Buchau, in which the supporting structure is an important series of palafitos that support not only the house, but also corridors that make up the town as a whole [11] In addition, they contain elements such as wood and straw, both resources available in the area and valuable as a climate solution. Sustainable logic, within this framework of vernacular architecture, is present in the case of the Ciénaga Grande del Magdalena [12], an island that works with the essentials of the environment and produces what is necessary for self-sustenance, being a clear example of a sustainable habitat in the occupation of the territory. All the houses in the complex have a palafitic character, they are built on piles driven into the bottom of the swamp and on them a wooden platform that has the function of supporting both walls and the structure, while the roof has a covered wooden skeleton by fiber cement.

3. Methodology

The study will be carried out through the analysis of secondary sources, specifically academic writings associated with the object of study, added to public access interviews carried out with relevant actors for the case such as architects who understand the social and constructive dynamics of Chiloé, and agents linked to restorative processes of Chiloé architecture, both local and national.

To understand the constructive and cultural logics behind the archipelago's architectural production, it is first necessary to account for the historical processes that consolidated them, establishing that what is seen today is nothing more than the evolution of a key vernacular architecture for the understanding of the area, not only from constructive aspects where wood takes center stage, but also as a representation of the local culture. In this sense, it is necessary to explore the Chiloe idiosyncrasy and its cultural richness as part of its architecture and development. In relation to this, the geographical context of the area must also be understood as a fundamental part of the development and consolidation of these processes.

Thus, an initial analysis is proposed that seeks to establish the relationship between geography, materiality and vernacular culture as the antecedent of stilt houses. In this way, these are presented as a typology that expresses both material and intangible culture, becoming part of the cultural heritage of the area and, therefore, part of processes of protection, promotion and restoration or intervention, as the case may be. This last relationship associated with heritage issues will be the second branch of analysis of the study, understood as essential for the current characterization of this architectural typology.

Finally, he will touch on the characterization of the palafito as a present and current object, from its role as an object of fundamental cultural interest both for the urban imaginary of the archipelago, and for its development from social, cultural and material perspectives, associating wood as part of sustainable architecture and its heritage valuation and promotion as part of the transmission of the archipelago's own identity. This analysis seeks to raise the relationship of the material with the immaterial, understanding the former as a means for promoting the latter, thus, construction becomes a strengthening mechanism for the city and its society, also understanding its adaptability throughout its history.

4. Results

To understand both the urban development of Chiloé and the specific development of the elements that make up its architectural image, it is necessary to first understand the conformation of its vernacular architecture, understood as the basis of the entire current Chilote imaginary. In simple terms, this arises thanks to the cultural syncretism between indigenous peoples that inhabited the area, Huilliches and Chonos in particular, and the arrival of the Jesuits [14]. Although there were already Spanish settlers prior to this contact, it is at this point where relationships are opened, giving way to the aforementioned syncretism, which allowed the mixture of indigenous and Spanish knowledge, resulting in a unique carpentry school that evolved with the time given other factors, such as the arrival of German settlers, but which is the basis of the archipelago's architecture [4]; This mixture of indigenous and European knowledge is what is known as the Chiloe school of architecture [15].

This architectural style, which is still in force, is characterized by the construction of simple, low-rise volumes, generally separated from the floor by piles and with a gabled roof, with a clear predominance of the full over the void. The predominant materiality is wood, both because of its abundance and the difficulty of accessing other materials given the island condition and because of the thermal capacities and resistance to humidity of certain native species, both highly necessary characteristics for Chiloé housing. Along the same lines, the construction was organized with the kitchen as the center, where the stove became the heart of the house to be able to give heat to the rest of the rooms [14]. The spatial and constructive decisions are strongly associated with the climate of the area, where the rains are present throughout the year and the temperatures in autumn and winter can fluctuate between 2 to 11 ° C, while in spring and summer from 11 to 20 ° C, therefore, the priority is to maintain thermal comfort with the least possible effort and expense [16].

The archipelago is framed by three specific geographic conditions that need to be specified. These are the sea, as a productive space, a means of connection between the islands and as a limit, the land, as an available and productive space, and the edge of the sea, as a diffuse limit that relates the two conditions mentioned.

The restrictiveness of living on an island with respect to the availability of land, added to the migration processes from the countryside to the city experienced during the late nineteenth and early twentieth centuries [14] - [4]; mark the birth of stilt houses, self-built houses. Due to the lack of land, they were located on the sea supported by wooden piles, or lumillas with which they are called the chilotes [13]. This construction typology maintains the logical base of the vernacular chilote exposed previously, but adds its constant relationship with the sea and its edge, which implies a new facade towards it and its addition as a backyard, all this within the framework of fishing as a productive activity [13]. Thus, the palafito is presented as a material expression of a culture handed down from generation to generation, which, despite having meant precariousness at some point given its association with the lower ranks of society, today it is a primordial icon where part of it is materialized. of the archipelago's cultural heritage [14] - [17].

Given the passage of time, fires, earthquakes or other calamities, the number of stilt houses within the archipelago has tended to decline, thus, today stilt houses are kept in specific neighborhoods within the archipelago, such as the Pedro Montt I, II or the Gamboa neighborhood, all in Castro [17]. Despite this, within their role as the materialization of a culture, the stilt houses become gravitating centers of both social and economic development within the archipelago, being even important elements for tourism in the area, which has become an important economic activity for Chiloé, as for example in the Gamboa neighborhood. This is the oldest neighborhood in the city and also one of the best known as it is located at one of the most visible entrances, at the southern entrance on the way to Quellón. [13] It transitioned from its housing-economy origin focused on the sea, to become the most representative tourist neighborhood of the Chiloe typology and with more renovation in its programs, redirecting the residential use of the stilt houses to a tourist one with cafes, rooms of exhibition, boutiques, hostels and hotels, among others. Of the 42 stilt houses historically built in the neighborhood, 11 of them have had a change of focus, completely oriented to the commercial-service aspect. [7] The change in focus not only means including the buildings in these tourist neighborhoods in heritage restoration processes within their condition of valuable objects, but also their transformation to respond to new needs, both spatial and programmatic.

The programmatic evolution that this entails and that stilt houses live, going from being homes to boutique hotels or businesses associated with tourism, not only implies a social change regarding the user and care with issues such as gentrification thinking of the current inhabitant and its possible displacement [13], but also put in tension the adaptability capacity of a typology designed for housing and that is strongly rooted in cultural elements that build identity, which is fundamental for understanding the archipelago's cultural heritage. In this sense, being able to transform the building, maintaining not only a typological base that gives value to the object, but also taking charge of the social, cultural and identity relations that this entails are key steps for the correct sustainable development of the city. understanding that this must not only be done from a material perspective based on a low carbon footprint, as is the case with wood for example, but must also be based on the promotion of self-sufficient and resilient communities capable of withstanding these changes. , understanding that in heritage valuation contexts, they have a leading role with respect to valued buildings.

These programmatic changes do not only imply reconfiguring the use of the building per se, but also entails the construction of a new habitability that respects the typological base that gave rise to it through the inclusion of new materials and new technologies capable of supporting the evolutionary process. Thus, decisions such as keeping wood as a flagship material or supporting construction using piles must go hand in hand with the inclusion of new ways of taking care of climatic comfort when there are programs that need more openings in a typology that does not contemplate this [14].

The inclusion of urban regulations should also be considered as part of the process of reconversion and interpretation in objects that never had it, understanding that this typology is born from the hand of self-construction and a certain degree of illegality, therefore it becomes important how respond to these new restrictions and considerations such as fire walls, usage loads, seismic considerations, etc.

The base materiality of the palafito used luma or cypress wood for the piles, which remains to this day. On these a kind of platform was built with main beams and floor beams with woods highly resistant to humidity such as coigüe, tenío or tepú, on which the partitions were raised and covered with these or other less resistant woods such as canelo or the tepa. This last wood and the mañío were used for floor, ceiling and wall coverings, while the most important wood for the house became larch due to its imputrescence, which is why it was used as an exterior cladding on both walls and ceilings in shape. of tiles,

creating a waterproof environment [18]. All this together with the spatial conditions already mentioned at the beginning as bases of the typology.

Thus, among the changes that the new programs imply, the elimination of the stove as a central space stands out, which implies kitchens of another scale and new heating systems associated with new technologies. The increase in the height of the roofs, both for the construction of complete floors and for the enabling of space operations such as a double height, regardless of this, the change implies a greater energy expenditure associated with the greater difficulty of heating the space, this associated also to the incorporation of more openings for windows and viewpoints necessary for tourist activity, which finally translates into worse insulation of the property and greater energy consumption[16], although again, it is mitigated by improvements in insulation in walls, floors and roofs that imply the construction advances of this time. Also understanding that today the exploitation of protected species such as larch, which can only be exploited by fallen tree or by reusing elements, it is necessary to include new materials for cladding, such as fiber cement, PVC, metals or exotic woods of industrial exploitation [18], this mainly in homes.

Beyond the specificity, sustainable development must consider three edges. Wood as the protagonist considering its adaptability from the base typology of the stilt house (structurally and historically). The role of social and urban catalyst of stilt houses, understood as a focus of local development and space for interaction. And its role from the cultural perspective, understanding that sustainable development cannot be carried out without assuming and promoting the cultural wealth of the sector from its associated communities, which are fundamental for the heritage dynamics of Chiloé. Sustainable and resilient development cannot renounce the Chiloé idiosyncrasy; There is no Chiloé without its cultural heritage.

5. Conclusions

Although sustainable development tends to manifest itself more clearly in physical interventions, a fundamental part of this is the cultural variables of each context. Thus, the correct development must be considered from three points of view: the material, the social and the cultural. In this sense, the stilt house as an object of study allows us to observe a case strongly rooted in its context from the three aforementioned perspectives. It presents a distinguished materiality, it is a representative part of the culture of the place as well as being strongly rooted in its population as an object of identity; it is established as the materialization of a culture, a history made object. Thus, on the one hand, a case of sustainable development with respect to a cultural heritage can be identified as an example for other contexts, but also the debate on the subject can be raised understanding or rather wondering if it is the correct path considering that within the processes We speak of a heritage in constant change, as is the historical trend of the object, therefore, the current responses may not be the correct ones in the future, despite the fact that today they bear fruit. In addition to this, it is also worth asking the influence of gentrification processes, how to deal with these, among other factors, which could further complicate the debate beyond the material expression of development.

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