animate, plan, accompany, appraise, and communicate the future territorial dynamics: this means the growth of local technical competences to help local autonomy versus central authority, and transparent processes of development in the relationship among institutions, and between rulers and those governed.

4.4 Participation

This determines the involvement of local populations in the elaboration of politics, and the recovery of community power towards active expression. Participation in the sharing of knowledge, choices and actions, implies a form of balance among the different subjects, a redistribution of power compared to an initial configuration in which there are 'strong' and 'weak' interests, and suggests the necessity of complementary processes: the top-down approach in which a strong actor, the public sector, typically represents the local community, or the bottom-up approach in which the same community promotes the involvement and development of the territory with which it is identified.

4.5 Partnership

The construction of a network and channels of communication for explicit and tacit knowledge is necessary to facilitate the identification of common cultural, political and economic interests. An improved strategy for cultural landscapes as an economic resource is founded on systemic environmental knowledge of site, local and traditional knowledge and living heritage, governance, participation, and partnership and demands a key role of research:

- To sustain training strategies, adapted to different Drâa Valley communities;
- To sustain the building capacity of technical operators of communities;
- To facilitate the communication among rulers and those governed;
- To supply scientific knowledge in the sector of integrated appropriate technologies with local and tacit knowledge;
- To contribute to the experimentation of strategies and technologies in accordance with local communities.

Notes

(1) INN-LINK-S: Research Center on Innovation and Local and Indigenous Knowledge Systems.

(2) Caption of the Fig. 2. In red color, the defensive walls and tower. In orange color, the only original door access. The orange arrows indicated the door opened in the '70 of the 20th century. In dark green color, the main streets along the defensive walls. In light green color, the streets and the alleys (derb) for access to the houses, with shafts of light indicated with yellow dots. In pink color, the Chorfa and Mrabitine district. In blue color, the Imazighen districts, descendants of two different tribes, and the Kasbah (at the bottom). In grey color, the Harratine district, probably added in a second time.

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EARTHEN ARCHITECTURE IN PUNA DE ATACAMA, ARGENTINA: LOCAL KNOWLEDGE AND PRACTICES

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Theme 5: Local and Regional Knowledge, Intangible Heritage and Social Impact
Keywords: Puna de Atacama, local knowledge, construction rituals

Abstract

Earthen building techniques form a corpus of relevant technical and social knowledge that has not always been nor is duly recognized. A significant issue about these techniques is that they assume, in Latin America, a remarkable diversity in both names and specific procedures. This great variability, which often acts as an identifying brand differentiating between different societies, arises from the recognition of needs and possibilities, as well as the particular historical trajectories of these societies. Diversity of local knowledge is then established as a value of earthen building, which must be recognized and sustained.

In this paper, the characteristics of earthen building techniques used in the area of Susques, in Puna de Atacama, province of Jujuy (Argentina) will be analyzed. These techniques will be understood and described within an integrated construction system that ranges from stone and earthen foundation, the use of adobe, and even roofing, made of earth and guaya (straw). The particularities of each of these techniques, as well as their interrelation, will be discussed. The transformations that have occurred to procedures and materials in recent years will be considered as well. The starting point will be the understanding of the act of building, which is not only embedded for technical reasons, but fundamentally is a social fact that interlocks with other dimensions of people's life within a society. Also in this regard, the sociability that comes into play in the construction practice of Susques is considered. The material presented in the text comes from continuous ethnographic fieldwork in Susques since 2003.

1. INTRODUCTION

In recent decades, and especially since 1970, researchers from different backgrounds became interested in the vast field of earthen construction. While historical stigmas have not yet ceased, the different techniques that have been part of the knowledge corpus of many societies in different places and times began to be incorporated into academic agendas. The same has occurred throughout Latin America, where the dense and varied traditions in the use of raw earthen materials that characterizes our countries, has been recorded. In fact, certain collective efforts were explicitly used to account for the variability in Latin America with respect the earthen building, and thus promoting, in turn, the dialogue between researchers from different countries (e.g. Viñuales, 1994).

The Andean highlands have particularly benefitted from analysis, both by the diversity of the techniques involved, and by the amount of time that has been devoted to recording earthen architecture usage and important symbolic connotations. In Argentina, from the first decades of the 20th century, and especially since 1970, important workings allowed visualizing earthen building techniques from historic (Asencio, et al., 1974), geographic (Ardissone, 1937) or from a more technological standpoint (IIV, 1972), focusing specifically on an area known as Puna. From different fields of study, in recent decades, various researchers have addressed this area's architecture, making significant contributions (Rotondaro, 1988; 1991; Delfino, 2001; Göbel, 2002; Pujal, Marinsalda, Nicolini, and Demargassi, 2002; Ramos, Nicolini, Demargassi, and Marinsalda, 2004). This paper will focus on the Susques area (Jujuy province, Argentina) with the objective of recognizing the local reasons for using earth as a building material.

It is interesting to note that, as in many other places, earthen architecture in Puna was historically reviled and minimized, associating it with poverty, backwardness, lack of hygiene or structural instability. From authorities, there were even raised specific policies to eradicate it. In this context, the Puno local communities held onto their traditions and construction practices, long before architects, engineers and other professionals looked into these issues. In fact, the use of earth has had a remarkable persistence and vitality in these places, further demonstrating its ability to transform itself into

their techniques while solving new problems.

As suggested, to understand this type of earthen architecture requires the recognition that it is inseparable from a set of social practices. Technical knowledge is embedded in a web of meanings, in such a way that it is socially defined (Dietler and Herbich, 1998). In this sense, talking about earth construction involves not only technical knowledge, regarding the capabilities of materials to meet structural requirements or environmental constraints, but also a universe of social relations and symbolic universes.

Therefore, this paper will focus precisely on the practical and constructive expressions based on the use of earth in Susques, and understanding them as part of a social world. Thus, initially the constructive aspects will be characterized, not as isolated decisions, but as part of a system (Guerrero Baca, 2007). Afterwards, some brief comments on the social links established around the act of building will be addressed. The material that emerged from the fieldwork with an ethnographic approach has been collected in Susques since 2004, within a broader research on the pastoral spatiality that led to a doctoral thesis (Tomasi, 2011). Also, the research was recently published in a volume on construction techniques in Puna (Tomasi and Rivet, 2011).

2. APPROACHING *SUSQUES*

When referring to *Susques*, it is important to consider the town and the surrounding rural area where households and grazing territories, are also considered. While today it is part of the province of Jujuy, the incorporation of this region of the Puna de Atacama into Argentina's territory occurred only in 1900. Before that, it was part of Bolivia. Later, it become part of Chile. At the time of annexation, it was part of what was once the territory of the Andes (*Territorio de Los Andes*), which was dissolved in 1943 when Susques was finally incorporated into Jujuy (Benedetti, 2005). Currently, the village has about 1,500 inhabitants having had a significant population growth in the 1970s, but especially during 1990, which was directly related to the opening of Paso de Jama, linking Argentina and Chile, from which Susques is about 150 km.

Located at an altitude of 3,675 m above sea level, Susques is within Puna, which in environmental terms is a high semi-desert, between 3,500 and 4,200 m, with little rainfall, which is concentrated between November through March, and a considerable daily temperature range. These environmental parameters provide adequate conditions for extensive grazing of herds of llamas, goats and sheep. This activity remains essential for economic reasons, but especially in social and cultural dimensions. Pastoralism structures are part of everyday life, and define key-moments of the annual ritual calendar - also fundamental for social cohesion. There are about 100 domestic units that hold grazing lands. As in other pastoral societies, the management and use of herds is organized around households, which is also important for the purposes

Fig.1 Location of Susques in the province of Jujuy, Argentina (credits: Jorge Tomasi, 2011)

of construction practices. In Susques, the households are also considered to belong to a certain territory of pastures, known as 'grazing lands' (*pastoreo*). Each household has different settlements, among which the herd grazes throughout the year. Synthetically, every household has a main house, known as residence (*domicilio*), and an average of five to six line cabins or outposts (*estancias*) distributed at strategic points within their grazing lands.

3. THE LOGIC OF A BUILDING SYSTEM

When analyzing constructive logic, the first thing to note is the remarkable extent of construction techniques based on the use of raw earthen material at all stages in the building of a house. According to the National Population Census of 2001 in the village, 96% of the 199 households surveyed incorporated adobe as the main building material of the walls, with or without plaster. In the case of roofs, this proportion is lower (25%) lower, due to the use of corrugated metal roofing sheets in recent years. Nonetheless, considering that the sampling was collected from only 83 different settlements, as well as both the field and the people (and disregarding the criterion of main building material used by the Census), 100% have at least one enclosure built of adobe and 85% have some roofing based on the use of earthen techniques. The sample size does not allow extrapolation of the results, but the data itself is significant.

A central issue is that this is not a constructive scheme that at some stage includes a technique based on the use of earth, but rather a complete system that incorporates different techniques that are all based on the use of this material. This extensive use ranges from mortars, stone foundations and the production of adobes for the walls, up to the terminations of the earthen roof or "*guayado*" (straw thatch). These techniques, in general, have a remarkable length of use as stated in various descriptions of the late 19th and early 20th centuries (e.g. Boman, 1991 [1908]), and even earlier. This does not mean,

Fig.2 One *puesto* built with *pirca seca* (credits: Jorge Tomasi)
Fig.3 A case of a circular kitchen in a rural house, with a false vault in stone (credits: Jorge Tomasi)

however, that these are static practices; instead, there have been substantial changes in the continuum of know-how.

It is common to build a stone-plinth foundation with up to 1 m in height and 30 to 40 cm in width made with earthen mortar. These plinths aim to improve not only settlement, but also protect the adobe wall from the possible rising damp, and the backsplash and runoff of rainwater (Schilman and Reisner, 2011). *Estancias* and other specific types of constructions, such as *fuegueros* (open spaces for cooking) or farmyards, and even today it is common to find walls built that are built in *pirca seca*, a type of crude wall construction of dry-laid unshaped stones without using mortar.

Although the use of stone today, in general terms, is limited to the foundations, the oldest buildings show that it was usual that all the walls were raised using this material. Stone construction was involved even in the execution of false vault ceilings. The descriptions from the early 20th century are consistent with these observations. In fact, Eduardo Holmberg, who toured Puna in 1900, referring to the characteristics of the houses, noted that *"the walls are always of stone, some also being observed of adobe, the roofs use Puna pasture, and are supported by crossbeams or tie-rods of cardón"* (a giant cactus species) (1988, p. 74-75). Throughout the 20th century, it is possible to notice a change, mostly from the mid-20th century on, in the role of stone as a building material. This is noticed by a continuous growth in the use of adobe up to today. In some cases, it becomes the exclusive material used when building a house. On the one hand, the construction of adobe walls is faster and more accessible to less skilled builders. On the other hand, the increased availability of vehicles to carry the adobes to country houses has allowed overcoming the problem of the lack of sufficient water to produce the adobes in many places.

While it is true that it is now possible to recognize in Susques certain people dedicated to the production of adobes for sale, the most common practice is that each household, with the collaboration of other people, produce their own adobes. Usually, more adobes are produced than what is required for use in the immediate future. The study found that the measurement of older adobe blocks shows some variability, whereas current adobe measurements have homogenized at 40 x 30 x 12 cm.

The blocks are used in two different ways, either as a running (stretcher) bond (*muro soga*) or in a header bond (*muro doble*) (Barada et al., 2011). In the first instance, the blocks are used on the short side, while the second, uses the longer part, thus obtaining a wider wall. Since the incorporation of processed wood, providing greater strength, and the use of zinc sheet metal, significantly lighter than traditional roofs, there has been a tendency to use muro soga, which also allows for greater material savings. Another important change is that the oldest buildings have battered walls. In this way, the horizontal thrust of the *tijeras* in gabled roofs was counteracted. This practice has been completely abandoned, and it is common to see the cracks in the walls as a result of structural efforts. The mortar used for bonding of both the stone walls and adobe walls, varies in a ratio ranging from 1:2 (clay to sand) to 1:3, depending on the preferences of the builder and the varying purity of the clay used.

Roofing is either the historically common gabled type or single-pitch roof, which has a greater presence today. In the case of gabled roofs, trusses (*tijeras*) are assembled, consisting of rafters that create the slope of the roof and are crossed with a horizontal piece known as tie-beam (*torillo*) (Corrales Barboza et al., 2011). Although nowadays, wire is often used, the various parts were traditionally joined with tientos, a kind of rope that is cut from leather, preferably from llamas, allowing further adjustment as it shrinks when dry. These trusses (*tijeras*) are placed every 60 cm and are crossed by perpendicular wood pieces, known as purlins (*costaneras*).

On the trusses and on the purlins is placed a layer composed of teasels, reeds, branches or bunches of woven straw, which must provide a firm surface for the roofing material. The roof can be built using one of two techniques: earthen roof (*torteado*) or straw thatch (*guayado*). The first is based on the application across the roof of one or two earthen layers mixed with straw, between 5 and 10 cm depth (Rotondaro, 1988). Guayado consists of the successive placing of rows of bundles of straw (Daich and Palacios, 2011). Unlike what happens in other sectors of the Andes, where the straw on the roof is attached to the ceiling using ropes, in guayado, straw bundles are partially soaked in mud, which once placed, causes the layers to stick together.

3.1 New materials

As in many other places (Göbel, 2002), in Susques, the use of certain materials, such as corrugated metal roofing sheets, fired brick or reinforced concrete has expanded significantly over the past 20 years. The use of certain formal materials (Delfino, 2001) has been actively fostered by certain public, academic and private initiatives, virtually making these synonymous with progress and social advancement. At the same time, as already stated, some technical and constructive knowledge has been looked down upon historically from these fields, while associating them with backwardness or lack of strenght and cleanness. While reviewing the real use of these formal techniques within the study area, it should be

Fig.4 Domestic church (*oratorio*) with the *guayado* technique (credits: Jorge Tomasi)

noted that in 48% of the houses, reinforced concrete has been integrated either for the entire structure of the building or at least the lintels; in 62%, there is a partial use of cement mortars generally for joining the foundation stones, as well as cement-based plaster in some rooms or concrete flooring; and finally, 76% of the houses have at least one enclosure roofed with corrugated metal roofing sheets.

A possible interpretation is to consider these formal materials, such as corrugated metal roofing sheet or concrete, in sharp contrast to those considered 'traditional'. In practical terms, the situation is more complex and should be considered more than a mere imposition of new materials, acceptance, and resistance or negotiated appropriation from the settlers. The use of corrugated metal sheets for roofs is interesting in terms of this issue. In many cases, its use is locally associated with certain 'improvements', such as quick erection or less maintenance, even if it means less thermal and acoustic insulation. The percentages shown have demonstrated the coexistence of different techniques. Many families that have incorporated corrugated metal sheet for some roofs of their houses, such as kitchens, prefer to continue using the earthen roof or guaya for others. Without losing sight of the processes of imposition of a certain constructive logic, it could be said that both the corrugated metal sheet and other materials have been incorporated into the repertoire of technical options that a builder has at his disposal.

4. THE SOCIABILITY OF TECHNIQUES

Constructive logic is embedded in a complex social and symbolic world. On the one hand, it must be considered the dense mesh of relationships that come into play around the construction of a house. On the other hand, these construction practices constitute a space in which from childhood, people incorporate important aspects of their life in society.

A first fact to note is that there is some organization of labor by gender. While women are generally those engaged in the daily care of the animals, men, on the other hand, among other activities are responsible for all tasks related to construction: building new houses and corrals, or maintaining the existing ones. This does not mean there are no mutual collaborations; and, indeed, women frequently participate in some specific construction tasks.

In any case, within the tasks daily or periodically performed by families, there are some that involve pressure related to available resources and, in some cases, exceed the possibilities of work of the closest family. Often these tasks are linked to annual ceremonies in connection with the animals; others have been historically associated with journeys to the valleys. And in what this research concerns, construction activities are one of those moments. Building involves the mobilization of a significant amount of resources, both material and human. Building materials (such as water, earth, stone, wood, leather or straw) are not always available in the domestic territory, or those that are, are not considered ideal. In the current context, characterized by fewer people who remain in the field and are in most cases, elderly or young children, the presence of more hands for work becomes indispensable.

Consequently, when building new corrals, repairing a room or even producing adobes, a series of social relationships, in which kinship plays an important role, are at stake, but it is not the only link available. In this context, multiple relationships of cooperation and reciprocity are established. When building a house, a number of important social ties are required. These will affect the possibility of having a certain number of people join the work, certain materials procured that are not owned, or some means for transporting them.

For the purposes of a thorough understanding of the significance of everyday construction practices, another aspect must be considered. As is common in other places, houses in Susques are in a continuous transformation process. This occurs in a context in which constructive knowledge is not only in the hands of a few specialists, but is remarkably extended to the whole population. Throughout life, a person in Susques undoubtedly makes multiple changes, some substantial, to the family home. It is very common in most homes that families produce adobes throughout the year; they are then stacked in a corner of the yard and are ready to be used. Construction practices are not sporadic, but rather an everyday practice. People then socialize in ordinary ways, of which building is a part.

The result is that building is not only a daily task, but also a body of extremely widespread knowledge within the population. Most of the people cannot only explain any of the techniques used, but could also and, in fact do, build their own house. From early on, children learn the different techniques, either participating in the work at home to the best of their ability and knowledge, or playing different games that usually involve building their own miniature houses. When a child recognizes this knowledge, he is not only learning to build something that will be necessary in his adulthood, but he is also incorporating the relationships that exist in their domestic group while being part of it, which is a certain way of constituting spaces and understanding the world.

5. CONCLUSION

Throughout this paper, it was intended to outline some characteristics of earthen building, as has been observed from the fieldwork in Susques. In this sense, the aim has not been to define the characteristics of the building systems and different techniques, but rather to summarize different dimensions of these practices, such as methods of technical resolution, the processes of socialization when building, and collaborative networks established. The superposition and the network of these different dimensions expose the complex universe that is present in any constructive practice.

Following the path taken by many researchers, case studies become important to recognize assumed local forms of building with earth in our countries, as well as to establish overviews. The study of these peculiarities helps to highlight on the one hand, the extent and present condition of these techniques, and on the other, the current wealth of their diversity. In many cases, significant differences in construction methods between neighboring towns and even between different domestic groups are found, while the singularity in the execution of a technique can act as a brand identity.

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