Notes

(1) The village is almost entirely covered by the dune, except for the excavated structures. The top of the walls are the parts exposed to weathering, which, as the dune advances, are swept by the wind that carries sand, causing irreversible damage to the site.
(2) The function of covering of the top of earthen walls is to protect the original material and to serve as a sacrificial element to weathering agents.

References

Bahamondez, M. & Muñoz, E. (1997). Sitio Arqueológico Tulor 1 consideraciones para su conservación y caracterización de materiales. *Conserva, Revista del Centro Nacional de Conservación y Restauración*. Santiago, Chile: DIBAM, pp 40-60.

Barón, A.M. (1986). Tulor: Posibilidades y limitaciones de un ecosistema. *Revista Chungará*. Arica, Chile: Universidad de Tarapacá, pp. 16-17.

Le Paige, G. (1957-58). Antiguas Culturas Atacameñas en la Cordillera Chilena. *Anales de la Universidad Católica de Valparaíso*, 4-5. Valparaíso, Chile: Universidad Católica de Valparaíso.

Llagostera, A., Barón, A.M., & Bravo, L. (1984). Investigaciones arqueológicas en Tulor 1. *Estudios Atacameños*, N° 7. Antofagasta, Chile: Universidad del Norte.

Morales, R. (1983). La conservación de estructuras y decoraciones de adobe en Chan Chan. *EL ADOBE, Simposio Internacional y Curso – Taller Sobre Conservación del Adobe*. Lima – Cusco, Peru: PNUD/ UNESCO/ ICCROM.

Muñoz, E. & Bahamondez, M. (1990). Conservación de un sitio arqueológico construido en tierra. Adobe 90. 6th International Conference on the Conservation of Earthen Architecture. Las Cruces, New Mexico, USA: Getty Conservation Institute.

Muñoz, E. & Bahamondez, M. (1992-93). Conservación del sitio arqueológico Tulor 1". *Hombre y Desierto,* No. 6-7. Antofagasta, Chile: Universidad de Antofagasta.

Muñoz, E. & Bahamondez, M. (1993). The Consolidation of an Incan Kallanka on the site of Pukara de Turi. *Bulletin D' Information NLI 13 CRATerre - Projet Gaia*. Villefontaine, France: CRATerre

Schwartzbaum, P.M. & Seymor, Z.L. (1983). Investigación sobre el efecto a Largo Plazo del uso de un consolidante a base de silicato de etilo para el adobe. *EL ADOBE, Simposio Internacional y Curso – Taller sobre Conservación del Adobe*. Lima – Cusco, Peru: PNUD/ UNESCO/ ICCROM.

Teutónico, J. M. (1998). Caracterización de suelos para la construcción con tierra. *Project GAIA, Earthen Architecture*. ICCROM/CRATerre – EAG/ New Mexico State Monuments Museum of New Mexico, US.

CONSERVATION OF RAMMED-EARTH STRUCTURES: THE HISPANO-COLONIAL ARCHAEOLOGICAL SITE OF SANTA FE LA VIEJA, ARGENTINA

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Abstract

The archaeological site of Santa Fe La Vieja in Argentina preserves the urban and architectural material record of the first settlement of the city (1573-1660). All archaeological structures excavated since 1949 are of rammed earth, and correspond to the lower parts of the walls and foundations of the Council (Cabildo), three churches and dozens of houses.

Since the first excavations, the site was recovered for research and museum use, and various forms of protection and conservation were applied. Due to the loss of the original roofs and the vulnerability of the construction material to the action of environmental agents, the broadest and most controversial issues of design and erection of shelters to protect archaeological structures are questioned.

In the case of Santa Fe La Vieja, from the time the remains of rammed earth walls were excavated, it was necessary to protect them from environmental agents, especially intense and frequent rainfall in some periods of the year. In parallel, the transformation of the site into an Archaeological Park has created demands for visitor access inside the protective shelters, as well as to guarantee its museological treatment. Finally, the inclusion of shelters in the context of a landscape with a strong presence of nature is another issue that should be taken into account when designing protective measures.

The paper discusses conservation actions taken to date. The shelters that have been protecting the archaeological structures are evaluated, and current projects, which aim to achieve better protection, are presented.

1. SANTA FE LA VIEJA: BACKGROUND AND PROBLEMS OF THE SITE

1.1 From city to site and archaeological park

The Santa Fe La Vieja Archaeological Park (SFLV) corresponds to the site of the first settlement of the city with the same name in Argentina, which was founded in 1573 and lasted until around 1660.

In a region populated by hunter-gatherers, the Spanish transplanted their construction techniques to meet the demand for housing and institutional buildings, using earth and wood as building materials. The urban plan refers to the typical grid layout used from the Spanish colonization of South America, which follow the model from Lima (Calvo, 2004, pp. 113-117).

When the city moved 80 km to the south, the founding site was definitively abandoned. During the colonial period, the former enclave was part of a rural area sparsely used. In 1867, the foundation of an agricultural colony of European immigration generated a new and stable occupation; at that date, the area of the old urban plan became agricultural land (farms).

In 1949, Agustín Zapata Gollan started archaeological excavations on land belonging to one of those farms, which uncovered the vestiges of the old town . The excavations lasted for several years and exposed the urban architectural material record the first settlement of Santa Fe (1573-1660) and the structures of its main buildings: foundations and lower parts of walls from dozens of houses, three churches and the Cabildo (Zapata Gollan, 1971, pp. 80-81). A significant number of rammed earth wall structures were not excavated; instead, their location was recorded and they were kept buried to ensure a better conservation.

All archaeological structures are constructed of ordinary rammed earth. Although the French pisé was also used, no evidence of such construction was recovered, possibly because of the methods used during the archaeological excavations.

Fig.1 Santa Fe La Vieja (credits: II Air Brigade of Parana, 1980)

Fig.2 Archaeologist Agustín Zapata Gollan with the remains of rammed earth walls of a house he excavated (credits: Ethnographic Museum in Santa Fe, near 1952)

1.2 Site management

Since the first excavations, the site was recovered for research and museum use. In 1950, the provincial government acquired the land through an expropriation law, and since then has adopted a management structure that has incorporated the necessary facilities for conservation and exhibit.

From the beginning, the Department of Ethnographic and Colonial Studies (DEEC), currently under the Ministry of Innovation and Culture of Santa Fe, has been in charge of the management of the property. The site was declared a National Historic Monument in 1957, so both the nation and the state have joint jurisdiction of its guardianship.

The Archaeological Park covers more than 60 hectares, and its management involves research, conservation, and educational touristic use. Over seven decades different planning forms have been tested, with three recognized stages:

1. From 1949 to 1980, actions were taken to resolve the various emerging issues; these were not part of a comprehensive plan.
2. From 1980 to 2002, the Conservation Plan of Santa Fe La Vieja site was defined with the participation of specialists required by the Organization of American States, which for two decades set the tone for intervention in three areas: architecture, archeology and bio-anthropology.
3. Since 2003 with funding from the Federal Investment Council, a team of professionals in six specialties was convened to develop the Management Plan, which currently serves as a tool for decision-making within the management of the site.

1.3 Physical scale of conservation concerns

For its size and complexity, the site presents challenges for heritage conservation at very different scales:

- Territorial scale: Fluvial erosion affects the integrity of the area over which the ruins of Santa Fe La Vieja were established (1).
- Urban scale: Closely linked to the previous one, the integrity of the old urban plan depends on the relation with the riverbank.
- Architectural scale: Refers to the conservation of rammed earth structures.
- Artifact scale: Related to the conservation of excavated objects in relation to the structures.

For reasons of thematic relevance, this paper only addresses the question of the conservation of archaeological structures. First, a characterization of the structures was carried out, and then, the protection and conservation measures that have been adopted in the management of the site since 1949 are discussed.

2. ARCHAEOLOGICAL STRUCTURES

2.1 Typological features

The structures respond to three distinct architectural typologies:

- Houses, whose main bodies are made up of rooms (living rooms and bedrooms) arranged in a row, which define built-up structures inside the plots parallel to the streets, but recessed from the front property line and perimeter boundaries. Forty-nine excavated houses are preserved.
- Churches, single naves without transepts, of which three of the six churches that the city had are still preserved: San Francisco, Santo Domingo and La Merced. On one side of the first church excavated was the cloister of the convent.
- A Council (Cabildo) comprised of a series of rooms with a similar scale to the domestic architecture, but differing in location at the front of the plot.

2.2 Technological features

The geological composition of the area (levee of the river) offers an almost pure mixture of sand and clay, ideal for the construction of rammed earth, with a composition of between 25% to 30% of clay and 75% to 70% of sand (Rodriguez Camilloni, 1980, pp. 19-20). All excavated structures thus far are of ordinary rammed earth and there are historical records documenting the use of this system since the early years of the city.

The foundations and lower parts of the walls remain. Its thickness depends on the type of building, which can vary between three-quarters of a measuring rod in the houses (approximately 60 cm), up to one-and-a-half measuring rods in churches (approximately 120 cm). The original roofs were of straw or terra-cotta tile, and only fragments of the latter associated with the archaeological structures are preserved.

3. CAUSES OF DETERIORATION

3.1 Rain and wind erosion

SFLV is located in an area of subtropical climate without a dry season, and with rainfall reaching 1,100 mm per year, and winds with an average of 12 km/hour.

3.2 Biotic agents

Anthropic: In addition to incorrect interventions, discussed later, the use of the old urban plan as arable land, which occurred between 1867 and 1949, led to the razing of the walls that had survived the environmental conditions.

Wildlife: One of the main problems are rodents (anguyá or tucu-tucu), which dig underground passages that affect the walls. Attempts to control their presence have been unsuccessful, and are constrained by the rules for wildlife protection. Wasp nests and anthills have left their mark on the surface of rammed earth walls, but this is a more manageable problem through allowable insecticides.

Forestation: Before starting the excavations, many tree species had grown on the walls or very close to them, resulting in the infiltration of roots within the rammed earth and the development of cracks and landslides. In the early days after the excavations, improper reforestation was carry out that did not take into account the type of roots of the species planted. In recent decades' plant growth has been controlled, and the growth of trees that had grown in inappropriate places has also been eliminated.

3.3 Incorrect interventions

The excavation of these rammed earth structures allowed retrieval of the record of an early Spanish-Colonial urban site, but the decision to leave it uncovered for display, adopted from the beginning, generated much deterioration. In some structures, excavations below the original floor level affected the stability of the walls remnants. In churches, the construction of the first shelters involved the introduction of foundations very close to the original rammed earth walls.

4. RAMMED-EARTH PROTECTION

The degree of authenticity of Santa Fe La Vieja can be assessed as exceptional, considering these are archaeological structures built in earth. It is known that this type of vestige is highly vulnerable in archaeological contexts. Therefore, its conservation has presented great challenges. From the start, the criterion of maintaining as much as possible its physical condition, as the main element carrying authenticity has prevailed. Therefore, different methods have been sought to protect the rammed-earth from deterioration agents.

4.1. 1949-1980 Time period: shaping the SFLV archaeological park

While the first excavations were carried out, the remains of rammed earth were covered with straw applied directly to the top of the walls. The next immediate step was to replace the straw with aluminum sheets. Two methods coexisted in this time period:

- Aluminum plates were applied directly to the top and bent down to cover the vertical parts of the walls. Despite the instability of the system, the structures supporting these protections have been monitored and confirmed the preservation of the wall to be in a good state.
- Gabled roofs, also of aluminum sheets, supported by very low structures did not prevent wind erosion, nor have they kept away rainwater. For those reasons, they were replaced.

In terms of the three churches (San Francisco, Santo Domingo and La Merced), two types of solutions that occurred over time were adopted:

- Enclosures with brick walls, sliding windows, and a wooden structure covered with aluminum sheets were erected. They existed until 1973.
- New structures were built by 1973, similar to large sheds that consisted of reticulated metal structures, brick-wall enclosures and sheet-metal roofs. On the exterior, concrete irrigation ditches were built to manage rainwater.

In 1976, Humberto Rodriguez Camilloni assessed these protective structures (Rodriguez Camilloni, 1976, p. 24), and made the following evaluation:

Negatives:

- The structures are "shocking in the environment of the ruins because of their design and construction materials."
- They convey a false idea of spatial feature characteristics that the churches had.
- The indoor system for the circulation of visitors obstructs "the visual perspective from their respective entrance". This defect was corrected in 1988, when all cross walkways were removed, keeping only the perimeter ones.
- In the case of San Francisco church, the shed covers only the church, isolating it from the attached cloister.
- Inside Santo Domingo and La Merced churches, the supports for the walkways are anchored into the ground too close to the walls, and the walkways themselves are located almost directly over them.

Positives:

- These structures have effectively protected the rammed earth remains. Three decades after Rodriguez Camilloni formulated

Fig.3 Protective shelter for the church of San Francisco built in 1973 (credits: Luis Maria Calvo, 2005)

Fig.4 Protection of the Gonzalez de Ataide house according to the prototype designed by H. Rodriguez Camilloni (credits: Jorge Anichini, 2005)

this assessment, it is recognized that the wall structures have survived in reasonably good condition.

4.2 1980-2003 Time period: valuing SFLV

The recognition of the importance of the site at the American level promoted the technical backing of the Organization of American States (OAS). This was accomplished in periodic missions between 1976 and 1987, resulting in the Conservation Plan of Santa Fe La Vieja (1980). The three main action guidelines included architectural restoration by architect Humberto Camilloni Rodriguez, who also coordinated the integral aspects of the Plan, archeology and bio-anthropology (linked to more than 200 exhumed skeletons within the churches).

Rodriguez Camilloni also assumed the problem of rammed earth wall conservation and the proposal for protective shelters. Already in 1976, he warned that the deterioration observed in many ruins could have been avoided by covering them after excavation. He proposed this alternative as the best recommendation for some of the 49 ruins excavated by Zapata Gollan (Rodriguez Camilloni, 1976, p. 21).

As for the conservation of the rammed earth, he noted that applying coatings based on transparent resins to the foundations and walls in order to waterproof the rammed earth it could not be considered "as a substitute for the new protective structures" (2). "The main problem is presented by the difficulty of penetration that will be evidenced sooneror later by the foreign substance, resulting in its eventual detachment and further damage to the surface of the original material. For the moment, at least, it seems that no better substitute for the conservation of rammed earth or adobe has been found than a suitable permanent maintenance program" (Rodriguez Camilloni, 1976, p. 21). This recommendation has always been taken into consideration, and the remains of rammed earth in Santa Fe La Vieja have been preserved as a result of this experience.

The need of introducing shelters in archaeological contexts is an issue largely debated and assumed as an inevitable option in same cases (Jerome, 1995, Schmid, 1998).

With regard to shelters in Santa Fe la Vieja, each ruin should be considered as a separate problem, adapting to each the prototype (Rodriguez Camilloni, 1987, p.9), whose proposed design consisted on:

- A semi-open pavilion, equipped with a gabled roof with side gutters and downspouts connected to the general drainage of the site.
- A perimeter fence consisting of fiber-cement panels that serve as windbreaks but allow ventilation, by leaving open spaces at the bottom and at the top.
- The perimeter fence also provides surfaces for mounting explanatory signs and graphic reconstructions of the ruins.
- The course for visitors is accomplished on one side of the ruins (it can also be around the perimeter), and consists of a tile floor directly placed on the existing floor.

The purpose of these structures is to nullify the main causes of deterioration (wind action and rain erosion), to control the access of visitors, and in turn to allow a museographical display. For two decades the Conservation Plan was the guideline for all actions that were undertaken at Santa Fe La Vieja. In the 1990s, six protective structures were built following the prototype designed by Rodriguez Camilloni, one for the Council and five for the houses (González de Ataide, Fernandez Montiel, Paez, Cifuentes and Garay).

4.3 Since 2002: management plan for SFLV

In 2002, given the need to update the diagnostic and management tools, the DEEC convened a team of specialists to design a Management Plan for the Santa Fe La Vieja site. It was coordinated by Dr. Maria Graciela Viñuales, a professional with vast experience in the field of heritage conservation, as well as an earthen architecture specialist. Additional knowledgeable experts covered interpretation, architectural and environmental design, cultural tourism, bio-anthropology, archeology, marketing and management, and financing.

The Management Plan acknowledges that the archaeological structures of raw earth with higher conservation issues should be reburied, aiming to ensure their future survival. However, this recommendation has found huge obstacles as there is no availability of earth with similar characteristics, and the site's soil cannot be used because it is protected as an archaeological site.

Considering specifically the protective shelters, the Management Plan includes a new proposal, whose design was under the charge of a group of professionals from the Faculty of Architecture, Design and Town Planning of the Universidad Nacional del Litoral. The team was led by the architect L. Müller and the architect J. Arroyo.

The effectiveness of shelters built according to Rodriguez Camilloni's prototype was recognized in terms of rammed earth conservation. The new design draws on its strengths and adds new premises that seek to overcome and improve the relationship of the shelters to the landscape.

The "architectural interventions are carefully oriented to generate less physical and visual impact on the site, understanding through the materiality and languages characterized by the criteria of lightness and contemporaneous, the own contingent condition of the intervention (aware that it occurs over a place filled with stories from long ago), while intrinsically belonging to the time of its completion" (Arroyo and Müller, 2011, p. 104).

As protection against weathering, an enclosure is proposed that, similar to the shelters, to ensure adequate control of the rain and wind, but at the same time allowing for permanent ventilation to maintain a balance of the internal and external conditions of temperature and moisture content (Arroyo and Müller, 2011, p.107).

In 2007, the project was developed, based on:

- An independent system of columns and beams holding the roof and the vertical enclosure panels.
- Vertical walls shaped like lattices that allow ventilation, composed of phenolic-plywood panels with treatment for weather protection.
- Roofing with a minimum slope, composed of sandwich-like panels superimposed over rigid-foam insulation and finished with a ceiling.

5. CONCLUSION

Since the first excavations, there has remained the interest in safeguarding the ruins of the ancient city of Santa Fe and to limit the actions to those that are essential for in-situ conservation of rammed earth structures, respecting the authenticity of the excavated remains. There have never been interventions directly to the remains of rammed earth foundations and walls. They have not been altered with reconstructions, nor extra elements for their consolidation, conservation or presentation have been added. This has avoided any falsification, reconstruction or addition of missing parts that could distort and compromise their authenticity. Therefore, the original materials of the walls are as they were found, without alteration to their composition, texture or color. This gives an exceptional degree of authenticity, in which the physical evidence, in-situ location, forms, and materials maintain the evidence of how they were built.

From the onset, the criteria adopted were to protect the archaeological remains from atmospheric agents with shelters. These used the technology and design that was considered the most appropriate for that time. These protective shelters do not bear directly on the walls. Their inevitable presence in the landscape should be assessed based on the absolute need to preserve earth remains, and a respect for the decision taken at the outset, to exhibit the archaeology to the visiting public. However, it should be noted that ultimately, these shelters are reversible interventions, which can be removed if at any time it is deemed possible to preserve rammed earth without them.

Notes

(1) Until 1949, river erosion resulted in the loss of a third of the layout of SFLV. Between 1979 and 1987, defensive protection was implemented. Now, new defensive work greater size and duration is about to commence.
(2) This refers to a technical report by A.V. Elmo (Buenos Aires, 1979). In 1987, Rodriguez Camilloni reemphasized the overall incompatibility of applying transparent coatings based on resins to rammed earth remains (Rodriguez Camilloni, 1987, p. 8).

References

Arroyo, J. & Müller, L. (2011). Architectural Design for the Archaeological Park Santa Fe la Vieja. In: Salazar G. (comp.) *Contemporary Architecture and Urbanism in Historic Contexts*. San Luis Potosí, Argentina:Universidad de San Luis Patosi pp. 102-110.

Calvo, L.M. (2004). Building a Latin American City. Santa Fe la Vieja between 1573-1660. Santa Fé, Argentina: Editions UNL.

Jerome, P. (1995). Proposed permanent shelter for Building 5 at the Bronze Age site of Palaiokastro, *Crete. Conservation and Management of Archaeological Sites*. Vol. 1, No. 1 pp. 35-42, and correction: Vol. 1, No.2, pp. 134-136.

Rodriguez Camilloni, H. (1976). *Valorization of the City of Santa Fe la Vieja, Argentina*. Report prepared on behalf of the Organization of American States. DEEC Technical Archive.

Rodriguez Camilloni, H. (1980, 1982 and 1987). Reports Project Valorization of the Ruins of Santa Fe la Vieja. Argentina: DEEC Technical Archive.

Schmid, M. (1998). Protective shelters at the archaeological sites of Mallia (Crete) and Kalvasos-Tenta (Cyprus). *Conservation and Management of Archaeological Sites*. Vol.2, No. 3, pp. 143-153.

Zapata Gollan, A. (1971). *The Spanish-American Urbanization in the Rio de la Plata*. Santa Fe, Argentina: Government Printing Office.