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A proposal for the restoration of the Islamic Towers in the Segura de la Sierra Valley (Spain). Significance and values of this cultural landscape

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ABSTRACT: Due to the strategic position of *Segura de la Sierra* valley (Jaén, Spain) during the 12th and 13th centuries, there were built several defensive fortresses both by Muslims and Christians. As a result, there are still remains of a well-preserved medieval tower system using rammed-earth technology, with more than sixteen towers, often with a fortified enclosure, that represents a magnificent heritage. An exhaustive analysis has been carried out in order to do a scientific restoration of some of them. The research methodology has considered different phases in the stages that should be followed in the guardianship of a historical cultural asset: documentation/investigation, conservation/restoration and dissemination, with the development of a patent. The historical significance and cultural references of these towers with their territory, and the interest of the discoveries obtained due to the research made and the restoration project of some of them, are the principal contributions of this paper.

1 INTRODUCTION

Segura de la Sierra valley (*Segura*) is situated in the province of Jaén in the Southeast of Spain. In this valley there are still remains of a unique set of defensive structures built in rammed-earth in the High Middle Ages, making up and defining the cultural landscape of this natural area. These fortresses are placed in a triangular fashion, which eliminates any blind angles resulting from the abrupt topography. There are remains of twelve towers and there are historical accounts of other four, representing a magnificent heritage that is necessary to investigate, preserve and disseminate.

These towers provide an indispensable record for the in-depth study of some of the formal, functional, typological and historical aspects of this kind of medieval military building. They also allow us to glean the criteria of territorial organization and construction technologies and their geometries or typologies that come from the al-Andalus building tradition in both Islamic and Christian periods (Fig. 1).

An exhaustive analysis has been carried out on the towers of *La Puerta de Segura* (*Segura* valley entrance), *Santa Catalina*, *Fuente de la Torre* (Spring Tower), *Gutamarta*, *Altamira*, *Espinareda* and *La Torre* (The Tower). In others, such as *Góntar*, the North and South *Santa Catalina*'s watchtowers, *Torre del Agua* (Water Tower) and *Cardete* an in-depth study has been done of their morphologic, stratigraphic, functional and constructive features. This research and the knowledge obtained have enabled the demonstration of certain hypotheses related to the location of the towers in its territory, their construction and some functional aspects as their access system.

The research methodology has considered the documentation/investigation, the conservation/restoration and the diffusion.

The documentation process derived from the compilation of the documentary and graphical published sources, as well as the photogrammetric survey of the Tower of *Góntar*, *Torre del Agua*, the North and South watchtowers of *Santa Catalina* and the Tower of the Castle of *Cardete*. That permitted the creation of accurate maps of these towers, while, at the same time, the territorial exploration enabled the creation of maps, showing the layout of these defensive structures in the valley.

The phase of conservation and restoration has been limited to work on the Tower of *Góntar*, as well as the production of the restoration projects in the *Torre del Agua* and in the North and South Watchtowers of *Santa Catalina*.

The methodological process for the transmission of this knowledge has been disseminated by means of papers and lectures in specialized symposiums, publications in scientific journals and in the web: www.santiagoquesada.com and <http://picasaweb.google.com/santiagoquesada.com.gontar>.

2 THE DEFENSIVE STRUCTURES IN THE SEGURA VALLEY. THE CONSTRUCTION OF A CULTURAL LANDSCAPE

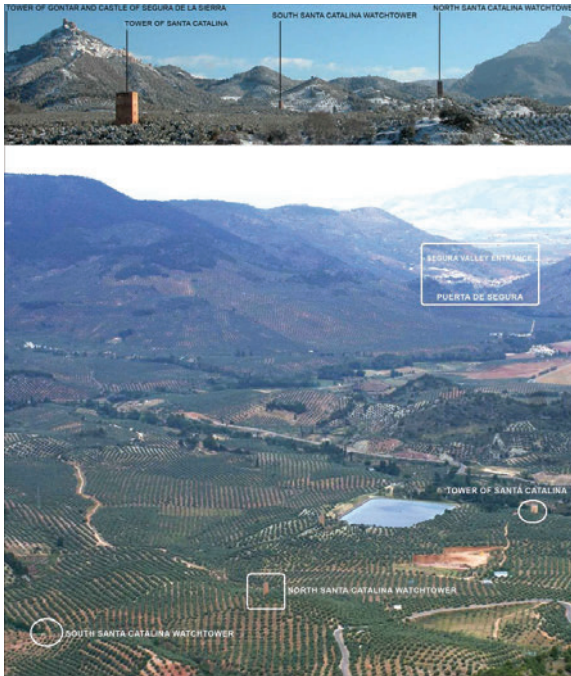


Figure 1. *Santa Catalina* Plains with the situation of the three towers. Above: View towards Segura de la Sierra town. Below: View towards Puerta de Segura village, the natural entrance to this valley from the North and West.

After the break-up of the Caliphate of Cordoba, this territory was a *kūrah* or territorial districts with its own autonomy. Segura was the main settlement, and different *qarya*-s and farmhouses surrounded it. There were also walled enclosures or *cortijos* (from Latin *cohors-cohortis*, Martínez, 1985: 9) linked to a tower that controlled the nearest cultivated areas. They fulfilled a dual productive and defensive function, and determined the economic and social development of this territory.

After the conquest and during the first Christian occupation in the years following the battle of Navas de Tolosa (1212), Segura remained as the main town of a wide spatial area being lands over the present day Spanish provinces of Jaén, Albacete, Murcia and Granada. The control over the headwaters of the rivers Guadalimar, Guadalquivir, Segura, Taibilla and Tus and the rich forests of these mountains, gave to this territory an important mercantile value, due to the fact that it was the gate towards Castile of the goods produced in the Islamic kingdoms of Granada and Murcia.

The gift of *Segura* town by the king of Castile included not only the castles, towers and farms, but other adjacent areas with the following productive units: lands, salt mines, vineyards, springs, rivers, mills, fisheries, meadows, pastures, holm oak and pine forests, pasture rights, tolls...

The close relation between the castles and the towns and the pairing of church-castle, as an essential part of the social Christian organization, is one of the linking elements of the landscape. This is combined with the rural situation, as the network of *husûn* (plural of *hişn*, castles in al-Andalus that controlled and defended a territory and its inhabitants) that did not develop into cities. This rural continuity was the result of the Mudejar population remaining in the territory, while the Order of Santiago superimposed feudal structures of power and hierarchy on a spatial Islamic organization. In addition to their productive function, this set of towers and wall enclosures would have formed part of a defensive line constructed between the 12th and 13th centuries in the Levant Corridor. This was a natural route dating back to prehistoric times that connects the Guadalquivir with the east of the Iberian Peninsula (Eslava, 1989; Eslava, 1999).

This set of walled enclosure, each with a tower, allowed for a rapid access from the *qarya-s* spread in the valley to a safe haven, as the urban walls and the Castle of Segura were too far away. These fortresses were usually built on the higher parts of the slopes, controlling from a wing a flat cultivated area of between 250 and 350 hectares. This settlement pattern is shown in the fortresses of *Altamira*, *Gutamarta*, *Catena*, *La Torre*, *Cardete* and *Fuente de la Torre* (Fig. 2).

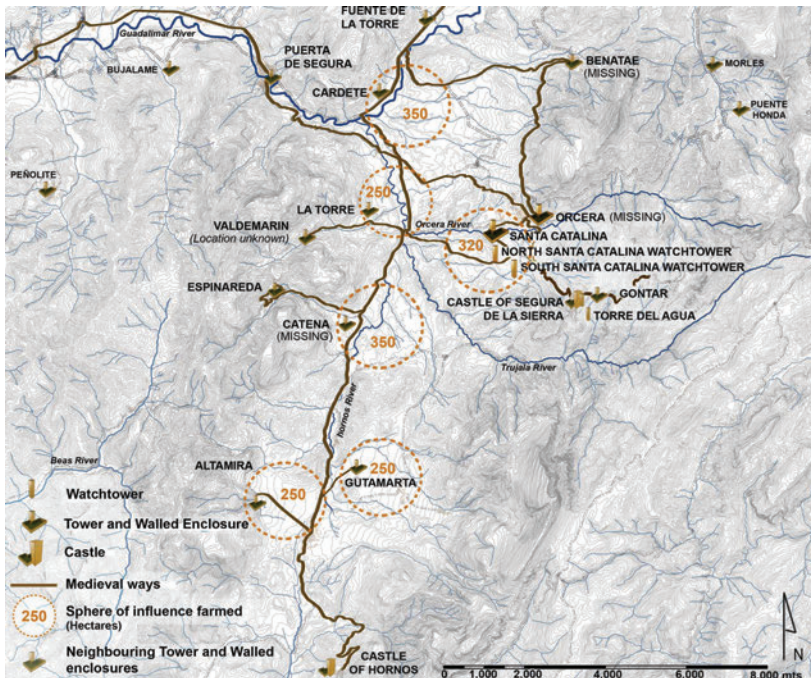


Figure 2. *Segura* valley with its mountainous and fluvial system. Situation of the castles, towers, walled enclosures and watchtowers in relation to the topography and the principal roads. Agricultural areas controlled by the fortified enclosures of this valley.

These small castles were strategically distributed, in a triangulated fashion and favored the maximum protection of the closest agricultural lands. In this way the valley kept a lookout, enabling also a connection with other territorial external zones to control the troop movement over Segura valley and its surroundings.

3 TYPOLOGICAL, CONSTRUCTION, MORPHOLOGIC AND FUNCTIONAL ANALYSIS OF THE TOWERS

Almost all the Segura valley towers and walled enclosures have similar construction features using *tabiya* (rammed-earth), a building process that consisted of the construction of walls with tamped earth and lime using a refined technology that in Spanish was named as “*tapia calicostrada*”, “*calicostrada*” or “*acerada*” (Fig. 3). The mixture was composed of compacted and tamped earth and lime placed in layers inside the timber formwork or shuttering, called “*tapias*” in Spanish. The size of each shuttering sheet was usually between 2.00 to 3.00 meters long and 0.75 to 0.90 m high, which could be managed by a single mason.

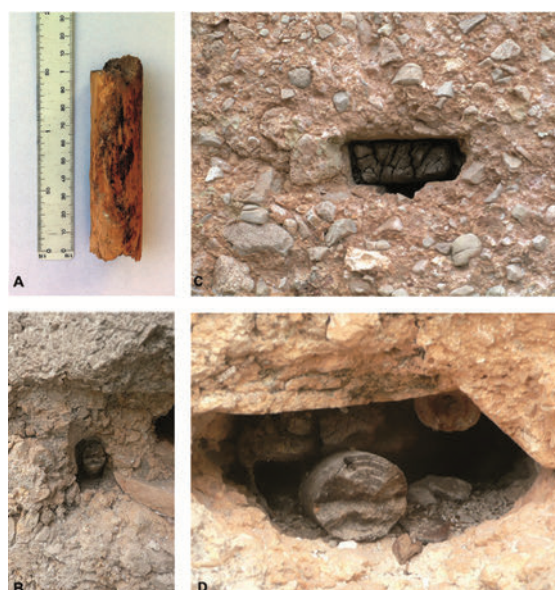


Figure 3. A/ Sample of a reinforcing frame inside the rammed earth wall. B/ Original position of a reinforcing frame inside the rammed earth wall. C/ Non re-usable horizontal timber (70 x 30 mm) inside the rammed earth wall. D/ Cylindrical timber and other timber remains inside the low parts of the rammed earth lifts in the changes of section in the wall, found in each of the floors of the Tower of Góntar. These timbers work as hoops to tie the walls together.

In time, the mixture of lime gravel and earth would become carbonated and turn into a stony material, as has been demonstrated from the chemical and physical results of tests done on the walls of Santa Catalina Watchtowers, the Tower of Góntar and Torre del Agua, with a resistance to simple compression between 29.00 Kp/cm² and 51.13 Kp/cm² a good density and a medium to low porosity. The granulometry results show that the mixture has been well prepared, which results in a good compactness.

In these military buildings, the lower parts of the walls are built with perfect rows of rounded stones, with a diameter of between 15 and 18 cm and laid with a mortar very rich in lime and

gravel. These stones disappear progressively as the height of the wall increases to be replaced with a concrete made of gravel, sand and lime.

The walls of all of these towers have different sections. They are usually stepped internally and they start in their lower part about a *vara* and a half (approximately 1.10 m) wide, reducing progressively to the thickness of one *vara* (over 0.75 m). The narrowest towers, as in the examples of the North and South *Santa Catalina* Watchtowers, have a slope in three of their faces, with the fourth one practically vertical, which gives them a truncated pyramid shape. These slopes were constructed by putting an upper strut smaller than the lower one.

The constructive quality of the towers of the *Segura* valley can be seen in their geometry, outline and modulation, in the way the putlog holes have been carefully shuttered with stones, in the rows of stones inserted into the plinth, in the lintel disposition in hollows and loopholes and in their structural conception, with additional timber in the narrower walls of each of the different floors, as in the Tower of *Góntar*. This timber reinforcement works like a wooden hoop and in some towers has prevented their collapse.

The morphologic and typologic features of the defensive elements of the *Segura* valley are different, depending on their situation and function, and the age of their building. In the next paragraphs there is a detailed description of the military elements that have been restored or have a restoration project.

3.1 The Tower and walled enclosure of *Góntar* (UTM X: 0530808 Y: 4239209; Z: 1125 m.s.n.m)

It is situated on the eastern lower slope of the promontory of the Castle of *Segura* close to the road that goes to *Góntar* village (in the current province of Albacete) and facing the hill of the same name. It is a fortified enclosure that would have been linked to the defensive system of the stronghold of *Segura*, but is independent from the castle ramparts (Fig. 4).

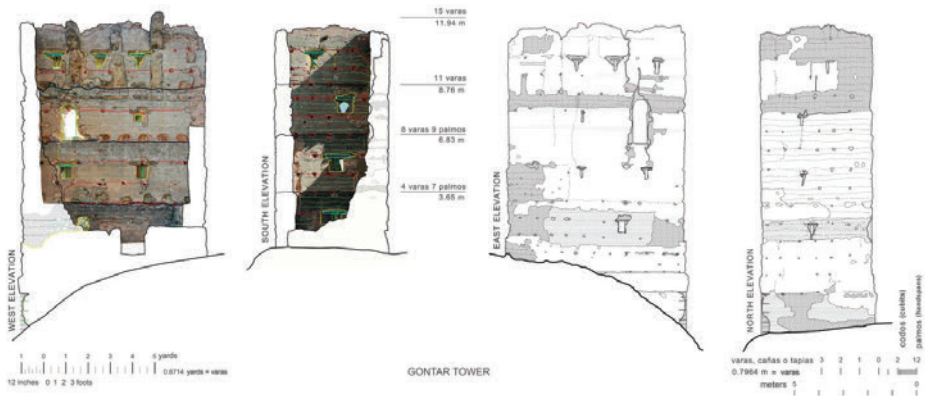


Figure 4. Architectonic survey and façade analysis of the Tower of *Góntar*.

This fortress was at the back of the castle in Islamic times, but at the front when the Order of Santiago controlled this territory. It would be linked to the control of the road that still exists going from *Segura* to *Góntar*. But this tower and walled enclosure were also situated on this spot to defend this weak flank from attackers on the hill of the same name which faces it.

The remains of this fortress belong to a typology defined by a principal tower placed to one side of a walled enclosure, as a part of the actual fortified perimeter. It is 9 *varas* and 10 handspans in length and 6 *varas* in width (7.70 x 4.80 m, 1 *vara* in this tower=0,7984 m). There are no remains of battlements but the total height of the tower would have been around 15 *varas* (11.97 m), and the West and South walls are completely missing. The constructive quality of

this tower can be seen in the lintel disposition in hollows and loopholes and in their structural conception, with additional timber in the narrower walls of each of the different floors.

It was a four-story tower as is shown by the loopholes, holes for the floor beams and the gradual reduction in the thickness of the walls. It is also possible that it would have had three levels, with a loft upper story and a wooden perimeter gallery in the middle. On the upper floor there are a few remains of three missing transverse walls.

The first floor has an irregular hole created by erosion and use. It probably was a former loophole similar to the existing one in the North face. On this story, the marks of the supports of the horizontal timbers that constituted the side formwork can be seen. The second story has three rammed earth lifts with two loopholes in the East façade and one in the North.

The third story has a vertical hollow with a small arch. The disposition and shape of this hollow, lacking any type of structural shape, shows that it was made at a later date than the tower's construction. It would have allowed the access to an exterior timber sentry box, possibly roofed over as a dormer window. This kind of wooden cabin would more directly control the road of *Góntar* that passes near the tower.

On its East side, the Tower of *Góntar* presents marks and geometrical designs over bands of lime applied on the rammed earth lifts and the rows of putlog holes of the horizontal timber. These *graffiti* are similar to other ones in the Castle of *Baños de la Encina*. These geometric bands show that the tower had a simulated stone masonry, commonly used in the rammed earth towers in the Valencia region and in other fortresses of al-Andalus in Almohad times (Azuar et al., 1996: 245-278). These remains were cleaned, stabilized and consolidated during the restoration process carried out in 2009.

3.2 *Torre del Agua* (UTM X: 0530804 Y: 4239237; Z: 1225 m.s.n.m.)

It is situated at a few dozen meters to the South of the fortress of *Góntar*, perpendicular to the hillside with its West side adjoining the rocky cliffs below the Castle of *Segura*. All the façades are completely blind and the typology corresponds to an advanced fortification connected to a main fortress. It was a defensive building to protect a spring or an existing well at this site, according to different chronicles from the 16th century (Eslava 1989: 346; A.H.N., OO.MM, libro, 1080-X-36; Ballesteros 2010: 115).

The first floor of this tower has a U-shape and is supported on its open side by the cliffs. Its exterior faces are slightly sloped and, as a result, the tower has a truncated pyramidal cross section. It has a length of 21 *varas* (1 *vara* in this tower is equivalent to approximately 0.7535 m) and an average width of 8 *varas* (15.80 x 6.03 m). There are no remains of battlements, so its total height would have been over 20 *varas* (15.35 m). The gradual reduction of the thickness of the walls is also seen towards the exterior in two stages, a characteristic that is not present in the rest of towers of the *Segura* valley. It was done because the plinth of the walls worked as terrain containment.

This tower consists of three interior stories with two stair-shape projections that could support two timber joists. The first story has 8 or 9 rammed earth lifts, with a height of 7.73 m (10 *varas* and 3 handspans). The intermediate story has 4 lifts up to the height of 10.50 m (14 *varas*), and on the upper story there are up to 7 more lifts. The upper floor would have acted as a terrace to defend this tower, because of its massive character and the absence of loopholes or any other kind of hole in the walls.

3.3 *The North Santa Catalina Watchtower* (UTM X: 0528697 Y: 4240433; 759 m.s.n.m.)

This tower is situated in the center of the *Santa Catalina* Plains, at approximately 465 m from the other two towers, on a slight hill in the Northwest of the Castle of *Segura* (Fig. 5). It was built as a single-stage construction and a truncated pyramid shape watchtower, with the exterior faces of the North, East and West sloped. The South facade has an imperceptible inclination, maybe caused by the movement of the tower. It is the smallest one of the three *Santa Catalina* towers both in ground plan (7 x 5 *varas*, 5.00 x 3.96 m) and height, but it is the most regular. The *vara* in this tower is equivalent to approximately 0.7620 m. Its longest side is mainly oriented East-West, in a similar way to the first Tower of *Santa Catalina*.



Figure 5. The North and South *Santa Catalina* Watchtowers, the Tower of *Góntar* and the *Torre del Agua* (from left to right).

The entry to this watchtower is placed at a height of 7.62 m. It is impossible to reach this level by means of a single ladder. The analysis of the hollows and the existing holes of this façade show that the way of climbing to the entrance door was by means of an exterior system of platforms or scaffoldings attached to the wall, situated approximately every two meters (Fig. 6). With this system smaller ladders, handled easily by one person, could be used. These holes from corbels were planned in the building of the tower, as is demonstrated by the stones that shape the formworks of these holes. To balance these platforms, they could be counter weighted in the interior with other boards that allowed for a descent inside the tower, since the first-story was not open to the outside.

The regularity and constructive rationality of this watchtower comes from the homogeneous modulation and the uniform distribution of all its constitutive elements. The tower is approximately 14.27 m tall (18 *varas* and 9/12 handspans), but originally it would have had a total height of 19 *varas*. There are no visible remains of battlements except for what seems to be the base of one of them, situated in the Northwest corner.

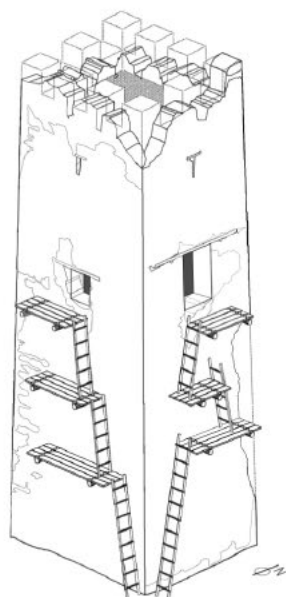


Figure 6. Axonometric view with a volumetric reconstruction of the North *Santa Catalina* Watchtower.

This watchtower has lost its interior timber floor, but the rammed earth walls are almost completely preserved with their wider plinth at the foundation and steps that allow the decreasing thickness of the walls. The absence of remains of a waterproofing coat inside the tower shows that its lower spaces did not function as a cistern. The first floor might have been used as a granary, silo or storage of provisions and military equipment, and maybe also as a dungeon.

3.4 *The South Santa Catalina Watchtower (UTM X: 0529091 Y: 4240129; Z: 785 m.s.n.m.)*

It could be considered a twin watchtower to the North one, though it is bigger and one rammed earth lift higher, that in this tower is equivalent to approximately 0.7575 m. It is also defined by a slightly rectangular ground plan of 7 x 5 *varas* (5.30 x 3.80 m) in an orthogonal position to the North watchtower. The access doors of these two watchtowers face each other.

The change of orientation of the entry to this tower might be related to the purpose of two nearby watchtowers, situated on the top of two hills that do not seem to have any special strategic location with regard to the *Segura* valley. Both watchtowers are equidistant from a medieval road by a little more than 20 m. So, they could be linked to it for the purpose of controlling people, goods or the passage of cattle and perhaps for taxation purposes at some period in time.

The height of this watchtower is 20 *varas* (15.15 m). Its principal access is approximately 9 *varas* (6.85 m) from the ground. Originally, this tower had two elevated doors, but one of them was blocked and turned into a loophole, and in modern days it is still blocked. It is situated on the East façade, where the marks of the corbels that support the scaffoldings can be seen clearly.

As in the case of the North watchtower, this one also has sloped walls in the North, South and East façades but the West face is almost plumb. The drainage of water from the terrace was through a gargoyle that would have been located on the North façade, as can be seen by certain signs and spots.

It is a three-story building, the first being composed of 9 rammed earth lifts, plus one more layer forming a foundation built with compacted rounded stones with lime mortar and earth. The second story has a height of 4 lifts, with the door centered in the North façade and three loopholes in the other sides. The third one is 3 layers in height with centered loopholes in the second one. The terrace would have had another two layers with battlements on top of them.

4 RESTORATION PROCESS IN THE TOWER OF GÓNTAR AND A PROJECT TO RESTORE THE *TORRE DEL AGUA* AND THE NORTH AND SOUTH SANTA CATALINA WATCHTOWERS

Each of the building pathologies has had a separate treatment. The general criterion has been to keep the intervention just to the essential, altering as little as possible the preexistences and the preserved surfaces. The deformations and faults in the materials and historical elements have been preserved and, in general, there has been an attempt to keep visible the patina of time on the building. All the existing timber remains in lintels and loop-holes have been conserved in place, applying to them an insecticide and fungicidal treatment in order to protect them from attack by xylophagous insects, as was also done in the newly inserted pieces. The restoration process has been done from the principle of reversibility, being minimally aggressive on the original elements and barely visible:

4.1 *Bridging for the walls*

In some of the towers has been projected and patented a structural reinforcement solution to tie the walls in a non-rigid way, allowing them some movement. The process consists of the introduction of laminated timber bands connected to the walls with a series of stainless steel rods, which in its exterior part has a cable of the same material that works as a spring to absorb excessive expansion of the walls. These bands are separated by means of an expansion joint of extruded polystyrene 5 cm width (Fig. 7).

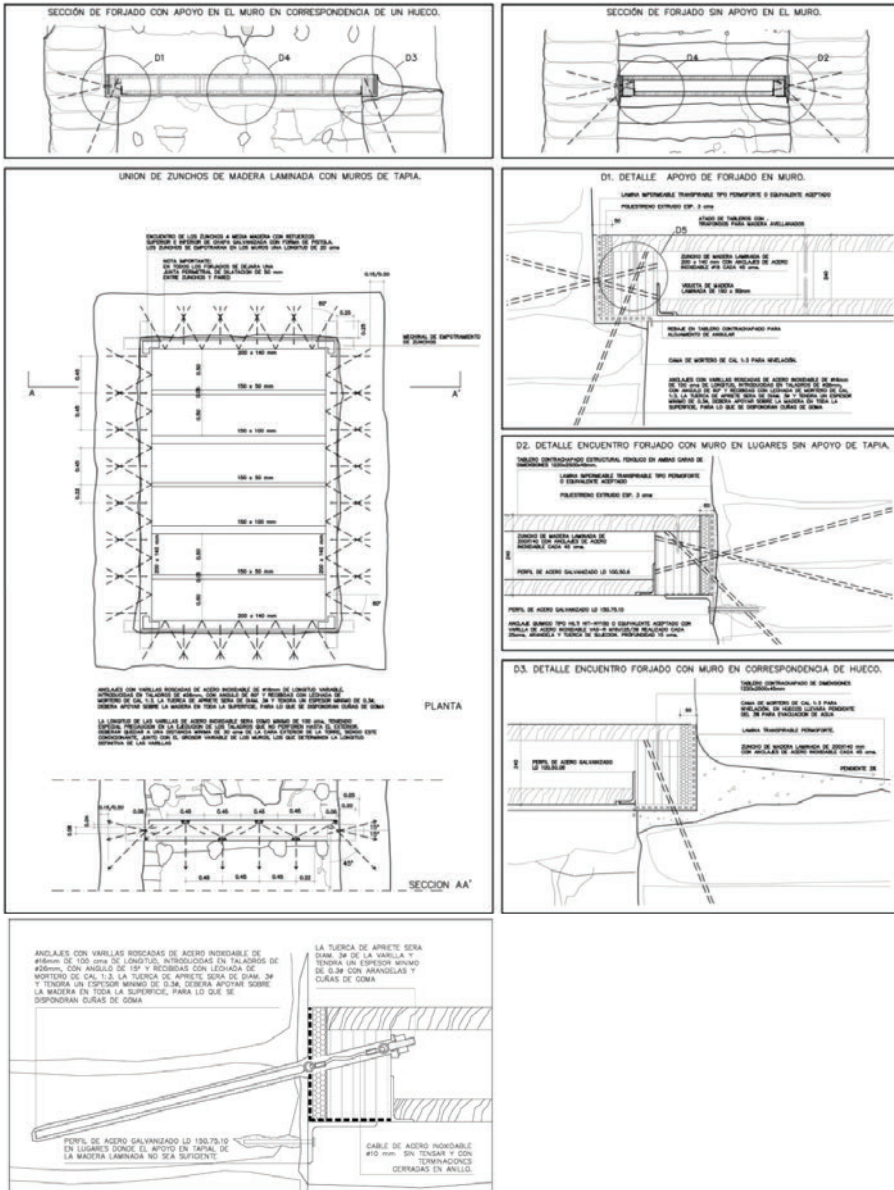


Figure 7. Detail maps of the patented laminated timber bands that allows this rammed-earth walls to be braced without making them an excessively rigid.

4.2 Consolidation of walls and exterior surfaces

As a first step, the lichens and organic deposits existing in the walls have been carefully cleaned by brush, trying not to remove original material. Differing treatments have been applied depending on the different damage degree of the surfaces:

In deep cracks, the sealing has been carried out with slaked lime mortar and well-washed river sand with thin granulometry (dosage 1:3) with addition of 5 to 8 % of plaster and a small

proportion of pozzolana or crushed roof tiles or bricks as aggregate, achieving a plastic or dry/plastic mixing consistency. In the cases of broken walls, it is necessary to join both parts by means of auxiliary metallic rods of stainless steel that will act like clamps to hold the crack together, crossing it transversely at regular intervals. The sealed surface of the deepest cracks will be 8 to 10 cm under the current surface of the wall, and will be coloured if necessary. There has been also injected light mortar slurry of lime and sand (1:4) into small or superficial cracks.

When it has been strictly necessary, an injection of bastard mortar slurry has been applied as reinforcement in horizontal and non-consecutive rammed-earth lifts, with a dosage adapted to each constructive typology (reference dosage, 1:2:5 cement/lime/sand).

In important losses of rammed-earth that could prejudice the structural stability, the wall has been carefully remade, placing the new surface 5 cm deeper than the original one, following the slope of the face and with a rugged finish, leaving visible the marks of the shuttering, with a timber plank 19 cm width.

4.3 Formwork making

Timber formworks (2.00-3.00 m length, 0.80-0.90 m height) are made to complete the lost parts of the rammed-earth lifts, adapted to each tower. The shuttering boards (3-5 cm width) have been reinforced with struts which have been fixed on the outside, and lateral supports and transverse beams have been placed in the inside. In our case, most of the work consists of completing the existing wall in one face, so the wire or rope tensioner can be anchored with nails to the existing wall and in the other end of the shuttering. When a rammed-earth lift is finished, the horizontal timber is absorbed inside the wall, providing support to the shuttering of the next row. This horizontal timber are normally re-usable, but not in the corners, where the part of the wall is removed.

4.4 The mixing process

Building a proper rammed earth wall requires a slow process of tamping down and constant compaction, as well as a correct level of relative humidity. These were the secrets of good rammed earth making. The ideal “recipe” was to mix 10% gravel or aggregate “*garrofo*” (dimension <20 mm), 40% local sand (0.5 mm <Ø <5 mm), 25% silt (0.002 mm <Ø <0.5 mm) and 20 % local clay (Ø <0.002 mm). The 5% remaining ingredient must be lime if stabilized or lime-encrusted earth were used. This mixture of water, lime, gravel and earth is initially prepared in dry.

The mixing process has the following steps: mixing the local red earth with clay and lime; addition of water; addition of aggregate, mixing by hand; addition of water; addition of slaked lime and a new addition of water, just enough and not too much, never exceeding 10% humidity.

4.5 The tamping down of the new rammed-earth

The formwork is filled with layers of similar height (1/4 of *vara*=19 cm), that are cleaned from dust and gravel to receive another one. Initially the earth is spread in continuous layers of 20/25 cm of maximum height. A first tamping down process regularizes the surface. After that the compaction in strict sense is done, using intensively a heavy ram, until there is no single free space in the mixture poured over the formworks. To assure the adherence between the new rammed earth mixture and original wall, new horizontal timbers (70x30 mm) are placed, marked with the current day date, in correspondence with the existing shuttered putlog holes.

4.6 Rammed-earth wall exterior protection

Rammed-earth walls were improved traditionally by coatings based on lime (in “*tapias calicostradas*”) or with a layer of mortar of clay and straw. This was simultaneous to the making of the wall, and so both remained sufficiently linked. Prior to the poring over of the earth, lime is projected against each shuttering board. When the earth is tamped down, the lime penetrates into the mixture avoiding the need for a later covering.

The partial and total loss of this protection has necessitated the repair of the coating, following the traditional technologies. When a new rammed-earth lift has been made, the same technology of “*calicostrado*” has been used. Light lime slurry has been applied in those places where the coating has been completely lost. When the original lime covering is still in place it has been consolidated in different steps by a specialist restorer, testing the solution adopted before being applied.

4.7 Consolidation of hollows and windows notch

The original access hollows and loopholes have suffered important losses of material, basically due to the removing of the timber lintels. These damages affect the stability of the walls, since they begin to suffer flexion efforts that make them weaken. In these specific points the walls have been also repaired, following the criterion explained in point 4.2. The new material has been made with mortar of lime and sand 1:3, with the same granulometry as the existing one, differentiating always the new profile from the original one.

The restitution of the structural capacity in the lintels will be done introducing new timber pieces with the same geometry and size of the replaced one. The new lintels have been dyed, varnished and protected, marking the current day date and leaving their two exterior faces 5 cm deeper than the surface of the existing wall.

5 CONCLUSIONS

The typology of the towers of the *Segura* valley and other surrounding places differs according to their use. Almost all of them are single stage constructions and have a truncated pyramidal shape, as in the examples of the North and South *Santa Catalina* Watchtowers and the towers of *Cardete* and *Peñolite*, probably influenced by the military Levantine architecture, with certain similarities to the towers of *Buñilla*, *Muza*, *Espioca* or *Godelleta*, all of these in the province of Valencia. The *Torre del Agua* is an exception in the *Segura* valley. It belongs to a defensive tower typology destined to protect springs, wells or cisterns, and connected to a main fortress with some fortified structures, called *coracha* in Spanish. In this territory, we can identify two other different types of structures. On the one hand, there is the typology of the tower joined to a defensive perimeter (*cortijo* or *corral* in Castilian medieval accounts). In modern days these towers are an average height of 15-16 *varas* or rammed earth lifts (12-13 m), but it is probable that initially they reached 19-20 *varas* in height. They have a rectangular ground plan with a size between 6.70 x 4.20 m, in the case of the Tower of *Cardete* and to 8.80 x 6.45 m in the tower of *Altamira*. The entrance door to these towers was protected by a walled enclosure, so it was relatively close to the ground as the Tower of *Cardete* reveals, with an entry only 2.45 m high, accessible with a simple ladder.

The other identified typology corresponds to the twin watchtowers preserved on the *Santa Catalina* Plains. They have similar features to the rest, but with the peculiarity of having the entrance at a considerable height, around 7 m from the ground. This means that it was impossible to reach this point with a single ladder due to its weight and handling difficulties. The façade analysis and the existing hollows and holes reveal that the manner of climbing to the entrance door was by means of an exterior system of platforms or scaffoldings anchored to the wall, situated every two meters approximately. These platforms allowed a person to easily maneuver one or two ladders. The high position of this access reveals that they were probably single towers lacking a walled enclosure, contrary to others examples in the valley. This fact and their symmetrical location with regards to the road from the *Puerta de Segura* to *Segura*, seems to support the hypothesis that they could also have been used to control and extract tolls from this route.

These medieval constructions of the *Segura* valley are a living 3D document, not well enough known but indispensable to the in-depth study of the functional, historical, construction and formal aspects of these buildings. They allow us to study and to learn about the criterion for the organization of this territory, the construction technologies proceeding from the al-Andalus tradition, their function, their geometry and their purpose in this border territory between various Islamic and Christian kingdoms.

The knowledge generated during the research of these towers and the need for its consolidation and restoration has enabled its dissemination. That has resulted in diverse and innovative restoration technologies for this kind of rammed-earth architectures, thus patenting a device that allows this type of wall to be braced without making them an excessively rigid, which could make them collapse due to the fragility of this building material.

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