

# 6 DEFENSIVE ARCHITECTURE OF THE MEDITERRANEAN

XV to XVIII Centuries

Ángel Benigno GONZÁLEZ AVILÉS (Ed.)



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## **Documentation strategy for coastal towers of the Mediterranean: the case of the tower in the archeological site of Saturo (TA-ITA).**

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### **Abstract**

Saturo is a coastal site to the South of Taranto that shows a prolonged frequentation during the time dating back to the Neolithic phases. The tower is part of a series of 21, built as defensive system characterized by punctual elements protecting the Ionian coast from attacks.

This paper reports the survey and restitution experience of the Saturo Tower, conducted through Structure From Motion techniques based on previous surveys. The aim is to define a procedural process which allows to perform accurate and reliable three-dimensional reconstructions for the knowledge and the dissemination of Cultural Heritage, taking advantage of representation and visualization techniques that has been developed in the last decade.

**Keywords:** digital survey, structure from motion, coastal towers

### **1 Introduction**

During the last two decades, the survey techniques so-called “fast survey” has been developed a lot and the variety of digital products which can be produced (video games, 3D models prints, websites, augmented reality applications), allows a different approach to the representation, re-evaluating limits, aims and expressive potential. The virtual representative systems, enriched with cultural content, scientific information and data, allow to develop a more participated and aware path of knowledge by the final users of the products and are able to increase the interaction between user and information. The aim of this work is to define a workflow that allows the operator, who deals with data-discretization-processes in the acquisition and postproduction phase, to make optimal choices based on the type of final output.

### **2 The archeological site**

Saturo is a coastal site to the south of Taranto, whose protostorical settlement was 12 km South-East of Laconical town.

The morphological conformation offers characteristics suitable for a stable settlement: it is a sandstone rock promontory stretched out to the sea between two bays, the largest of Porto Perone in the South, the narrow of Saturo in the North. Saturo has been popular for a long time, up to the Neolithic stages. A modest dome-shaped hill, currently referred to as the "acropolis", rises on the promontory and has a gentle slope on the hillside facing the sea, while it is separated from the inland by a deep and steep slope, which makes the whole peninsula safe.

The first stable presence in the promontory dates back to the Middle Bronze Age (1800-1700 B.C.), an age marked by the imports to the Apulia of Mycenaean Ceramics from the Peloponnese. This settlement is maintained until the arrival of Spartan settlers. The hut village seems to have been destroyed during 1700 B.C. Perhaps in connection with some enemy invasion by the sea, because of a cataclysm or epidemic event; the village was rebuilt during the Middle Bronze Age (1600 B.C.) and then abandoned again. In the mid-twelfth century B.C. a new village, bigger than the previous, was built: the inhabited area extended over the entire

promontory, climbing on the hill and taking protourban characters, with access from the sea through a ramp from the bay of Porto Perone, and a small embankment delimitating the inhabited area made on the eastern edge of the hill. The area was abandoned for about fifty years, during the 12th century B.C., because of a calamity.

The reshaping of the settlement is located during the XI-X centuries, and without any variations it continued throughout the Iron Age (9th-8th century B.C.) until the arrival of Spartan settlers. The events following the precolonial attendance, starting in the 8th century B.C., are documented not only by archaeological data, but also by literary sources.

Saturo represents an area with its own particular configuration: sanctuaries and necropolises show how the site, between 7th and 1st century A.D., was perceived as the geographical epicentre of a rural district.

After the middle of the 8th century A.D., the entire hill is subjected to an arrangement of the tread plan, which resulted in the levelling of the "Iron Settlement".

The next phase immediately shows an evident interruption of the previous settlement tradition,

with a no longer residential but a cultural character, and reveals materials originating from Greece. The highest part of the hill has been occupied by a sanctuary dedicated to Athena and the lack of other elements related to different structures and forms of attendance suggests that, from 7th century A.D., the summit of the altar was intended only for religious purposes.

The development of a large Roman villa at the end of the promontory shows how the entire area has been contained, since 2nd-1st century B.C., within a fairly sized property; the residential complex has been expanded over time involving the entire area between the two creeks and it survived, judging by the materials, up to the 7th century A.D.. No other structures were found in close proximity to the villa, with the exception of a partially buried large cistern, a water supply functional element for the residential complex and that explains how the entire surrounding area was included in its land ownership. The two nuclei of currently visible structures set at both sides of the 16th Century coastal tower are, according to the current interpretation, part of a single large complex stretching from one port to another, connected to the sea side by an porch of opus incertum structure.



Fig. 1- View of Saturo Tower ( by Monica Bercigli, 2016)

## 2.1 The coastal tower

The Greek myth is full of episodes of banditry and piracy. The Romans tried to eliminate it from the seas in order to make sailing safer, undertaking a real war that has involved the seas for decades with a considerable waste of men and resources. The need for a defence was felt in every age, with both coastal stations against danger coming from the sea, and internal fortifications against the raids of local and foreign bandits. With Norman domination, lacking of urban accentuation, the need for defence of scattered settlements increased. Were therefore created punctual defensive systems, in fact large castles were built in the inland, while the coast was marked by the growth of coastal towers. In the Viceregal period, the coastal defensive system that involved the stretch of the current Province of Taranto was divided into at least 21 towers, 14 of which still exist.

The network of coastal towers was an effective defensive line on the coast with dual defence and sighting functions as well. The towers that were built during almost two centuries played their role as "sentinels" and were an efficient system of fast communication, through fires during the

night and colourful banners during the day. The sighting points were constructed in the highest places, in order to allow the view of the most possible horizon.

The coast of the province of Taranto appears under two distinct morphological aspects: low and continuous to the West and high and jagged to the East. Along the coast to the East of Taranto, where the coves and the promontories offered obstacles to sight and great hiding places for those who attacked, the net of the towers was more dense.

The towers usually were shaped as a truncated pyramid and were rather small and compact. They also had a thick masonry with a "shoe" section to withstand in the best way the cannon shots coming from the sea. The access was from the top floor and a wooden ladder was dropped from the inside to facilitate access.

The towers usually had a top and a lower floor. The latter had no windows and was located directly above a large cistern that ensured water supply. This room was used to store food and ammunition and contained a grinding wheel to grind the grain and make the tower self-sufficient.

The second floor, which could be accessed only



Fig. 2- Extract from the map "Provincia di Terra d'Otranto" from "Mercurio Geografico" by Domenico de Rossi (1714). The map shows all the coastal towers.

by an external staircase, included a sleeping area and a chimney to send smoke signals. Slits and loopholes served to defend the tower. From the covered terrace the guards could observe the horizon. In addition, the towers had a coping equipped for defence with weapons through embrasures and loopholes.

The control of the towers was made up of three or four soldiers and a knight, who usually stood outside the tower, ready to raise the alarm in case of an attack.

Although equipped with effective defensive system, the main function of the coastal towers was to slow down the enemy's attack, allowing the premises to hide or gain time before the arrival of reinforcements to fight the invaders. The chronicles of that period are full of information concerning towers constantly attacked, plundered and destroyed by pirates and Turks.

The Saturo Tower dates back to the 16th century, period of Charles V Spanish domination, and was built in order to defend the Ionian coast against Muslims.

The tower is situated on a slightly sloping ground and is located 20 meters from the coast, lying 9 meters above sea level.

The original structure, made up of a "shoe pyramid-trunk", is now altered by the presence of a building, erected on the Southeast side, probably dating back to the first half of the 21st century A.D..

The parapet of the terrace was partially demolished and this led to the disappearance of the embrasure. Around the tower military structures are found, they were built in the war period and are currently in disuse.

Saturo Tower today appears coated with more or less regular tufts, abundantly plastered and lime painted. The South-East facade has one of the original openings of the tower, the remains of the three embrasures, and, on the terrace, the end of the inner staircase, which from the altitude of 5.00 meters would conduct to the roof.

Saturo Tower is the example of a typical coastal tower that could be found in many other coastal sites. A widespread and consolidated constructional typology set in defence of the coast of Taranto and despite being altered in its shapes and sizes, it still recalls an ancient time when "stone sentinels" guaranteed stability and security to an area that has always been flagellated by sea incursions.

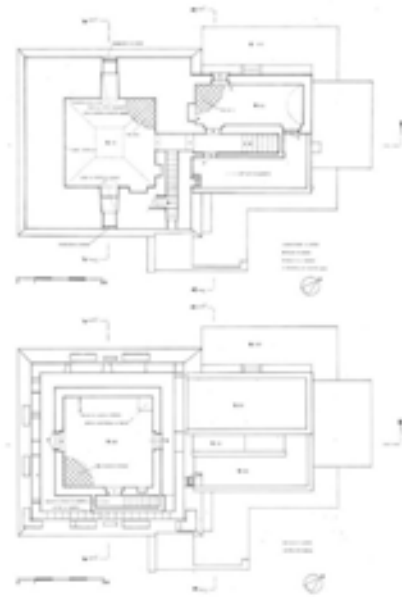


Fig. 3- Plans of Saturo Tower, Scalzo M. (1982).

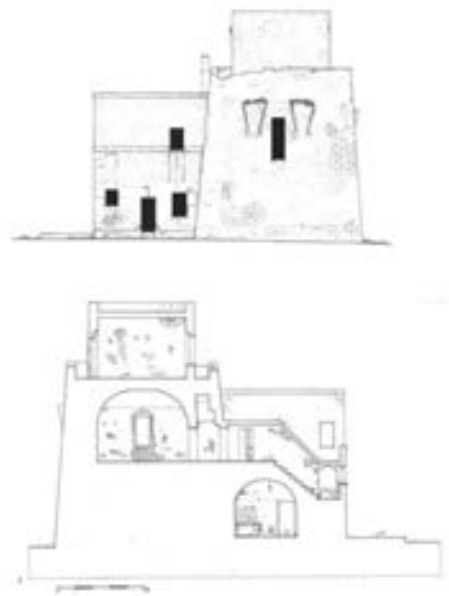


Fig. 4- Elevations and sections of Saturo Tower, Scalzo M. (1982).

### 3. Methodologies and Acquisition

This paper reports the experience of survey and 3D modeling of the Saturo Tower carried out by "expeditious" techniques. The aim of this work is to define a workflow that allows the operator, who deals with data-discretization-processes in the acquisition and postproduction phase, to make optimal choices based on the type of final output. A 3D model, as it is a virtual object that synthesizes the shape and characteristics of the real object, must consider various factors derived from the analysis of the features of the object, including surfaces and volumes, but also of the historical and geographical context in which it is, because it is intrinsically a process of transformation over time.

The choice of a fast methodology, related to SFM survey and subsequent post-production by semi-automated processes, enables to quickly realize 3D models. In addition, using high-resolution cameras, you can obtain realistic models that are just like real artefacts, and that can then be used in virtual and augmented reality applications. The equipment used for this work is cheap and can be readily available. For the future development of the project, we can think of an economic investment for the use of the laser scanner in order to detect all the coastal towers in the area, ensuring greater reliability from the measurement point of view and therefore a better analysis and a comparison of the various towers. In addition to an investment in terms of instruments, it would also take a long time and the use of specialized personnel. In this first phase, however, the SFM survey has made it possible to make a number of useful considerations for understanding the site and the hypothesis of a chronoprogram for future surveys.

The survey campaign, held in 2016, was based on prior knowledge of some plans, elevations and sections of previous surveys (Scalzo M. 1982).

It proceeded with the photographic acquisition of the entire exterior of the tower, being the interiors forbidden to the public. The camera used was a Nikon D3000, reflex digital camera with a sensor 23,6x15,8 mm 12.1 megapixel resolution and 116 photographs were acquired.

These pictures were developed within the Agisoft Photoscan software, that generated a cloud of 2,720,127 points and a mesh consisting of 400,271 polygons. The high-definition texture was generated and applied to the obtained 3D model. The model has been scaled and oriented with coordinates based on data obtained from the previous survey and orthographic views of the model have been created and exported, so that two-dimensional elaborations and subsequent insights can be done afterwards.

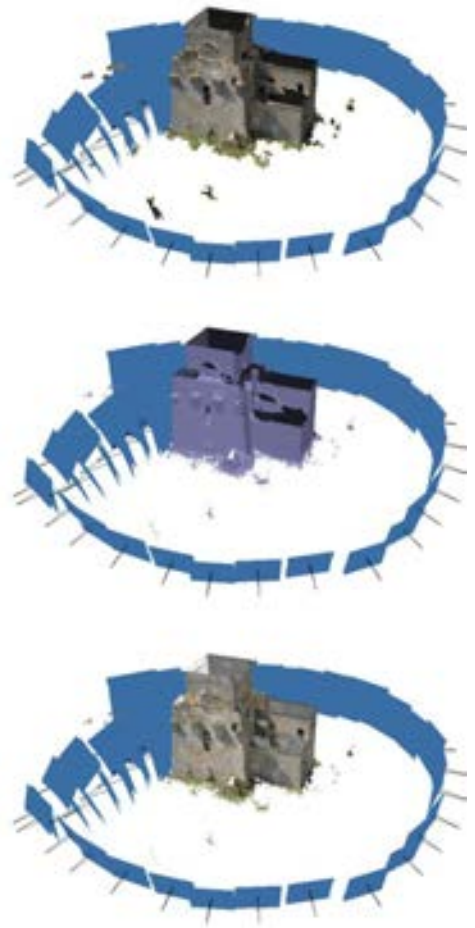


Fig. 5- 3D model building process within the Agisoft Photoscan software. Above the cloud of points, under the mesh, and finally the application of the texture.



Fig. 6- Examples of two-dimensional drawings (cad and material) derived from photogrammetric survey.

### 3.1 3D modeling and virtual reconstruction

The drawings obtained from the 3D model and the comparison with previous drawings, together with the study of historical bibliography and Tarantine coast towers typologies, have allowed to proceed with the three-dimensional reconstruction of the Tower in its original conformation. It proceeded with the redesign in Autocad of plans, sections and elevations to obtain all the drawings and information necessary to the realization of the 3D model.

The 3D model was inserted into virtual settings so as to conclude the documentation process, and thus defining a procedural “iter” for the valorisation and dissemination of Cultural Heritage.

The 3D model was made using NURBS with the software Rhinoceros. During this phases, previous survey and drawings of the indoor rooms were particularly important, because the only the exterior has been acquired through the SFM methods.

In Figure 7, it is possible to see the tower's reconstruction in its original configuration before the factory body was erected on the South-East side, and it is possible to appreciate the type of pyramid trunk tower.

### 4. Conclusions

The survey and restitution techniques which this paper refers to, are now available to everyone, thanks to the use of cheap equipment and software and easily available. The 3D models deriving from them are the result of different

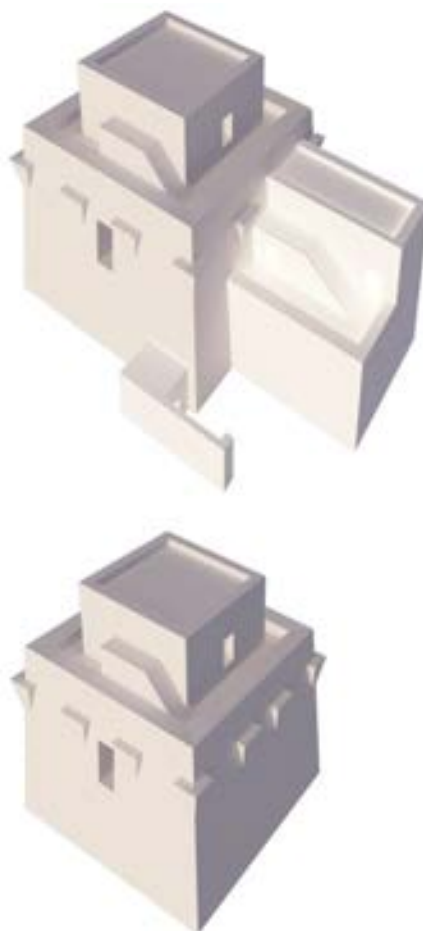


Fig. 7 - 3D model of the current and the original status of the Tower.

processes that depend on the operator, specialized or not, who performs them.

The conformity of the 3D model with the real object depends both on the study of the artefact and its bibliographic documentation, as well as on the knowledge of the correct operating procedures. Choices made by the operator, who discretizes the data during both acquisition and post-production phases, strongly affect the result of the ultimate 3D model. The ultimate goal is to create a model of three-dimensional documentation easily accessible to the public, useable through the currently used devices, such as PCs, smartphones and portable devices in

general. The 'virtual', conceived as the new configuration in which dimensions of 'urban space' and 'architectural space' are located, is one of the main cultural nourishment of contemporary creativity' (Unali, 2014, p. 18).

Virtual space is an infinitely upgradable and impenetrable place and does not need to undergo the constraints of physical space. Virtual representative systems, which are data containers created following a certain process, allow to create educational and experiential tours and thus become a powerful means of sharing and disseminating Cultural Heritage.



Fig. 8- Simulation of virtual navigation. Is possible to find various information linked to the model.

## References

- AA.VV. (1982). *Le torri costiere per la difesa anticorsara in provincia di Taranto*. Il David Editore. Firenze.
- Dell'Aglia A. (1999). *Il parco archeologico di Saturo Porto Perone (Leporano-Taranto)*. Scorpione Editore. Taranto.
- Guidi G., Angeleddu D. (2016). "Displacement mapping as a metric tool for optimizing mesh models originated by 3D digitalization" in *ACM Journal on Computing and Cultural Heritage*, 9(2).
- Lattanzi E. (1973). "La villa romana di Porto Saturo presso Taranto" in *Cenacolo III*. pp. 43-48.
- Levy P. (1997). *Il virtuale*. Cortina editore. Milano
- Nannini A. (2016). Tesi di Laurea "Una questione di sguardi. Riscrittura dell'area archeologia di Saturo (TA). Relatore Michelangelo Pivetta. Università degli Studi di Firenze. Italia.
- Parrinello S., Picchio F., Bercigli M. (2016) "La 'migrazione' della realtà in scenari virtuali: Banche dati e sistemi di documentazione per la musealizzazione di ambienti complessi" in *Musei virtuali dell'architettura e della città, Disegnarecon Vol. 9, N°17*.
- Scalzo M. (1982). "Torre Saturo" rilievi e restituzioni di Ilan Kariv e Arie Padaiver" in *Le torri costiere per la difesa anticorsara in provincia di Taranto*. Il David Editore. Firenze.
- Remondino F. (2011). "Heritage recording and 3D modelling with photogrammetry and 3D scanning" in *Remote Sensing*, 3(6).
- Remondino F., El-Hakim, S., (2006). "Image-based 3D modelling: a review" in *The Photogrammetric Record*, 21(115).
- Rodriguez-Navarro P. (2012) "Automated Digital photogrammetry versus the systems based on active 3D sensors", in *Revista EGA*, n°20, pp. 100-111. Valencia: Universitat Politècnica de València.
- Rodriguez-Navarro P., Verdiani G., Gil Piqueras T. (2015) "Comprehensive methodology for Documenting the Defense Towers of the Valencian Coast (Spain)", in *Defensive Architecture of the Mediterranean. XV to XVIII Centuries*, vol. 1, pp. 321-328. Valencia: Universitat Politècnica de València.
- Unali, M. (2014). *Atlante dell'abitare virtuale. Il Disegno della Città Virtuale, fra Ricerca e Didattica*. Roma, Italia: Gangemi Editore.