

## From rural house to “villa of delights”: knowledge and conservation of Villa Murat in the Sorrento peninsula

Andrea Pane<sup>1</sup>, Raffaele Catuogno<sup>2</sup>, Maria Parente<sup>3</sup>

<sup>1</sup>University of Naples Federico II, Napoli, Italy, [a.pane@unina.it](mailto:a.pane@unina.it); <sup>2</sup>[raffaele.catuogno@unina.it](mailto:raffaele.catuogno@unina.it); <sup>3</sup>[parentemaria96@gmail.com](mailto:parentemaria96@gmail.com)

**Topic:** T4.1. Conservation and restoration projects of vernacular architecture

### Abstract

*Thanks to an innovative territorial plan, drafted with the coordination of Roberto Pane and Luigi Piccinato and approved in 1987, many exceptional examples of vernacular architecture have been preserved in the Sorrento peninsula. Some of these, initially built as rural houses inserted in agricultural estates, have been transformed over the centuries by subsequent aggregation of volumes, into more complex structures, in which agricultural and residential usage have long coexisted. This is what happened to Villa Rossi, later known as Villa Murat, in the municipality of Massa Lubrese: an initial nucleus, dating back to the 17<sup>th</sup> century, was expanded during the following century, adding volumes and regularizing an initially spontaneous architecture. Despite such transformations, Villa Murat still retains some constructive features which are typical of vernacular architecture of the Sorrento and Amalfi coasts, such as extradosed vaults covered with beaten lapillus or the loggias facing the sea. The villa, which in the meantime had become property of the Rossi family, intertwined major historical events at the beginning of the 19<sup>th</sup> century, having become the headquarters of king Gioacchino Murat - hence its name - during the “Capture of Capri” against the British in 1808. Villa Murat, located in the quiet hamlet called Annunziata, away from the centres that have undergone major alterations, has still been preserved almost intact, even in the architectural surfaces, both the internal and external ones. For this reason a thorough research was possible, also thanks to an integrated survey with both aerial and terrestrial photogrammetry and laser scanning. The final aim, as the paper will show, is to develop a conservative design proposal, with targeted actions of conservation of architectural surfaces and structural consolidation, that will allow to keep the physical integrity of the villa and its authenticity without giving up a possible but compatible enhancement.*

**Keywords:** Sorrento peninsula; Villa Murat; survey; conservation.

### 1. Vernacular architecture in the Sorrento peninsula: features and protection

The studies conducted on the rural houses of the Sorrento peninsula - and above all on the similar and more well-known cases in the island of Capri or on the Amalfi Coast - are extensive and consolidated (Pagano & Daniel, 1936, pp. 38-44; Pane R., 1936; Pane R., 1954; Pane R., 1961; Fiengo & Abbate, 2001). Less well known is the transformation process that has affected some of

these structures, which had a rural aspect at the beginning and later became aristocratic dwellings, through an expansion by subsequent aggregation of volumes. Villa Murat is an example of how many vernacular architectures of the area have been ennobled: floors have been added to organic systems, composed of cells with a Mediterranean character; the roofs have been transformed, the volumes regularized, and the surfaces decorated. The transformation of the

architecture, on a larger scale, has led to the change of identity of the places, with social repercussions on a previously rural context, which later became a holiday destination for noblemen, and today a place with a strong tourist vocation. As evidence of the roots of these architectures, the materials used, belonging to the local building tradition, are still visible; as well as some morphological-spatial aspects - linked to the genesis of the building and to the functions it housed - and some recurring features, such as arches, vaults and loggias.

The rural houses, as pointed out by Roberto Pane in specific relation to those of the Campania region, stand out because they are «handmade. [...] They are built without the aid of a rigorous geometry, but with a sense of approximation which is perhaps the main reason of their picturesque» (Pane R., 1936, pp. 6-7). This type of construction shows, from the volumetric point of view, the aggregation of different cells, which have grown spontaneously from a primitive nucleus, forming a composition that is the result of «pure and simple necessity» (Pane R., 1936, p. 7), dictated by new needs. The rural house is a «living thing: it forms and transforms itself» (Pagano, Daniel, 1936, pp. 26-28) according to human needs.

Another typical feature of the rural buildings of the Sorrento peninsula and the island of Capri is the use of extrados vaults. These, like most of the typical features of rural architecture, developed simply because they were more convenient, given the easier availability of the materials needed to build vaults - lime, lapillus, stone - compared to timber, used for

flat roofs (Pane R., 1936, p. 9). The extrados of the vaults was coated, waterproofed and thermally insulated with a layer of beaten lapillus and lime (Cerio, 1922, p. 172; Picone, 2010, p. 315). The most common vaults are barrel and pavilion ones. The latter are often cut by a plane, «ideally assigned to a fresco» (Pane R., 1954, p. 25).

In the Sorrento peninsula the houses are adapted to the difference in height of the ground and are built on the rock (Pane R., 1936, p. 14). To counteract the horizontal thrust of the vaults and avoid the rotation of the most vulnerable wall of the building - the one which covers the greatest difference in height - buttresses were adopted since the Baroque age. By connecting these with arches and using the floor thus obtained as a terrace, they obtained the loggias (Fiengo, Abbate, 2001, p. 138).

The highlighted features are also found in Villa Murat. The growth by subsequent aggregation of volumes is evident: starting from an initial nucleus - found in the volume facing north with the terrace above (fig. 2) - the building was enlarged, probably at first only on the ground floor, whose irregular plan and rustic character witnesses its origin. Later, the construction of the first floor, organized in rows of rooms, and of the loggias regularized the pre-existing building, making it a villa. The extrados vaults can be found both in the probable initial nucleus of the villa and on the roof, where they have been hidden, as it often happens, with a double pitched roof. The loggias facing the sea solve the greater difference in height and are placed on the side elevation, to avoid introspection.



Fig. 1. The villa and its visual relationship with Capri (photo by drone, 6/6/2020).



Fig. 2. The north elevation of the villa, with the loggias and the volume identified as the initial nucleus of the building (photo by drone, 6/6/2020).

The recognition of the rural architecture of the Sorrento and Amalfi peninsula as a heritage to be protected is due to the well-known Territorial Urban Plan (PUT), drawn up in the 1970s by a commission chaired by Roberto Pane and Luigi Piccinato and approved with some variants only in 1987 (Branduini & Pane A., 2022). In the report attached to the plan a specific paragraph is dedicated to «rustic architecture with extradados vaults» (Pane R., Piccinato et al., 1977, pp. 107-108). The plan regulates the permitted interventions and proposes to catalogue and protect these minor architectures which, «happily well matched with the landscape» (Pane R., 1936, p. 16), contribute so significantly to the image and to the identity of these places.

## 2. Villa Murat: a historical outline

### 2.1 The villa in the Annunziata hamlet in Massa Lubrense

The municipality of Massa Lubrense is set at the extreme edge of the Sorrento peninsula and stands out for its polycentric settlement pattern. It does not have a real historical centre, but is made of numerous hamlets. Among them there is that called *Annunziata* which, located on a hill facing Capri, was chosen as the most suitable place for the foundation of the *Civitas Massae*, a fortified citadel that has been destroyed and rebuilt several times. The fortifications that one still see today date back to the third *castrum*, built in the viceregal period, between the second half of the 16<sup>th</sup> century and the beginning of the 17<sup>th</sup> century, together with the coastal towers, to defend a territory which had been devastated by Saracen raids (Persico, 1646; Filangieri di Candida, 1910). The building born as a rural house and today known as Villa Murat rises immediately outside the viceregal walls, along the path that leads to the Marina.

The viceregal citadel, once the raids from the sea ceased and therefore all defensive needs were over, underwent a slow decline in the following

centuries. The walls were gradually incorporated into the building fabric, and the citadel became a quiet hilltop village, which still appears today as

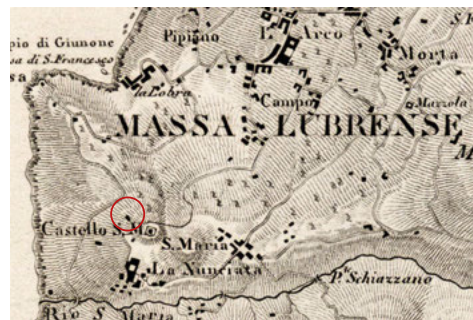


Fig. 3. Reale Ufficio Topografico, Carta topografica e idrografica dei contorni di Napoli, 1817-19.

a timeless place, «unchanged for centuries» (Pane R., 1955, p. 146), in an exceptional landscape context, characterized by the stunning view on the island of Capri.

### 2.2 Historical events and architectural transformation of Villa Murat

The historical investigation of the villa made use of the interweaving of the so-called direct sources (the building) and the indirect sources (archival documents) such as historical land registers, Holy Visits and iconographic sources. With this methodology it was possible to trace back the history of the villa, first known only for having hosted Gioacchino Murat.

The property on which Villa Murat stands, also consisting of the olive grove called *Canfora* overlooking Capri, was quoted, in the *Holy Visit of Bishop Nepita*<sup>1</sup> of 1685, among the properties of the Della Noce family, who had in turn bought it from the Maldacea family. The Holy Visit mentions only rural structures located on the site, so one can infer that the transformation into villa had not happened yet at the end of the 17<sup>th</sup> century.

The Della Noce family still owned the entire *extra moenia* area of the Annunziata hamlet in 1742, when the Land registry (*Catasto onciario*)<sup>2</sup> was drafted. Among the assets of Giuseppe della Noce, who in those years was mayor of Massa

<sup>1</sup> Archivio Diocesano Sorrentino Stabiese, *Santa Visita del Vescovo Nepita*, ff, 25, 27 v, 42 v.

<sup>2</sup> Archivio di Stato di Napoli, *Catasti onciari*, vol. 171.

Lubrense (Filangieri di Candida 1910, p. 281), there is a building corresponding to Villa Murat and described as «the house where he lives consisting of several upper and lower members with all comforts». Thus, the transformation of the first rural nucleus into a villa therefore seems to have taken place between 1685 and 1742.

The subsequent owners were the Rossi family, who hosted Murat in 1808. In addition to the many writings on Murat's stay, a proof of the ownership of the Rossi family is in the Land registry (*Catasto provvisorio*<sup>3</sup>) of 1811, in which a very precise description allows us to know the exact consistency of the building at that time. In Massa, «Andrea Rossi<sup>4</sup> and his brothers from Naples» owned numerous buildings, including a



Fig. 4. Detail of a postcard from 1930s showing the second floor, demolished in the 1940s.



Fig. 5. The main façade of Villa Murat in 1939. The coat of arms of the Della Noce family was still visible.

stable - which corresponds to the volume with the four-lobed window, identified as the initial nucleus of the villa - and «three rooms on the ground floor, eight rooms on the first floor, two small ones on the second floor» which correspond to the rest of the villa. The current ground floor and first floor coincide with what is described in this Land registry, which testifies the existence of a second floor, which is also shown in some postcards from the early 20<sup>th</sup> century (fig. 4).

Andrea Rossi owned also other buildings with an agricultural vocation, such as a rural house, another stable and two *trappeti*, in addition to the neighbouring cultivated land, confirming that even in the 19<sup>th</sup> century, agricultural and residential usage coexisted in the villa and in its surroundings.

In 1920 Villa Murat was purchased by Vincenzo Guerini, a Neapolitan dentist, who was responsible for the apposition on the facade of the plaque commemorating Murat's stay, the wording of which was drawn up with the help of Riccardo Filangieri di Candida. In 1925 the villa was declared of historical interest<sup>5</sup>, pursuant to the Rosadi law no. 364 of 1909. Villa Murat has been preserved almost unchanged since the 1940s when, following the purchase by the Astarita family, the second floor was demolished.

### 2.3 A king in the villa: Gioacchino Murat in Massa Lubrense

As already clarified, Villa Rossi took on the current name of Villa Murat following the stay of Gioacchino Murat in October 1808, when the king chose this place as his headquarters during the second phase of the so-called «Capture of Capri» (Broccoli, 1953; Ciuni, 1990; Barra, 2011; Della Morte, 2021), a military operation with which the French reconquered the island, which had been occupied by the British in 1806.

<sup>3</sup> Archivio di Stato di Napoli, Catasto provvisorio, II versamento, stato sezioni 1060.

<sup>4</sup> We have little information about Andrea Rossi: he joined the secret society called Carboneria (Filangieri di Candida, 1910, p. 218), which may have facilitated contact with

Murat, and was mayor of Massa Lubrense in 1811 (Filangieri di Candida, 1910, p. 283).

<sup>5</sup> Archivio della Soprintendenza Archeologia, Belle Arti e Paesaggio per la Città Metropolitana di Napoli.

The battle began with a daring landing<sup>6</sup>, which took place on 4<sup>th</sup> October 1808 and allowed a quick conquest of Anacapri. However, a stalemate followed, because the French were unable to break through the walls of Capri, within which the British, led by Hudson Lowe, had taken refuge.

It was during these agitated days that the king moved to Massa Lubrense, from where he could better follow the evolution of the battle. Despite the abundance of writings on the «Capture of Capri», the information relating to Murat's stay in Massa Lubrense are few and often contradictory. This is because, starting from 10<sup>th</sup> October, Capri was isolated, due to a naval blockade carried out by the British, which prevented correspondence between the island and the mainland.

The date of arrival of the impatient Murat «in Massa, as close as he could to Capri» (Colletta, 1834, vol. VII, p. 97) is uncertain and fluctuates between 10<sup>th</sup> and 14<sup>th</sup> October<sup>7</sup>. The king did not previously know the Rossi family, who was even absent at his arrival (Fasulo, 1906, p. 187-188), he simply chose their villa because it offered the best view on Capri.



Fig. 6. O. Fischetti, *Gioacchino Murat, Re di Napoli, assiste alla presa di Capri da Massa Lubrense*, 1809, Museo della Certosa di San Martino, Napoli.

<sup>6</sup> Two false attacks on the marinas of Capri were organized to divert the attention of the British from the real landing site, located on the coast of Anacapri, where the brave French soldiers, commanded by Maximilien Lamarque, climbed the rocks overlooking the sea thanks to the use of stairs borrowed from the lamp-makers of Naples.

<sup>7</sup> Umberto Broccoli (Broccoli, 1953, p. 154) claims that Murat left Naples on the 9<sup>th</sup> and arrived at Annunziata hamlet the next day, after having stopped one night at Palazzo

The stalemate ended on 15<sup>th</sup> October (Ciuni, 1990, p. 141), when the French artillery managed to breach the walls of Capri. The difficult negotiation that followed took place precisely in Villa Murat, where the king received the messages with the condition of surrender imposed by Hudson Lowe. Despite the indignation of Murat, who would have liked to impose harsher conditions on the defeated, the latter will get to leave Capri with his men. On the night between 16<sup>th</sup> and 17<sup>th</sup> October, Murat signed the capitulation right in the villa in Massa Lubrense (Ciuni, 1990, p. 152; Della Morte, 2021, p. 99). The next day the French troops entered the city centre of Capri. The victory greatly increased the consensus towards Murat and the fame of the sites where the feat took place, such as the villa in Massa Lubrense, which is the backdrop of the paintings made to celebrate the success against the English (fig. 6).

### 3. Integrated survey process

The operational methodology used for the survey of Villa Murat is illustrated below and is intended as an example of a workflow which is applicable to complexes with similar difficulties. The survey of the villa and its garden - located on terraces and with an overhanging side, not detectable with direct survey procedures - confirmed the need to integrate more techniques based on the use of active (laser scanner) and passive sensors (terrestrial and aerial cameras).

#### 3.1 Operating methodology. Image-based and range-based

In the course of the survey campaign - which took place over two days, between the end of May and the beginning of June 2020 - the acquisition through SAPR (Remotely Piloted Aircraft System) of aerial images with both nadiral and differently inclined camera was carried out<sup>8</sup>. The process allowed the creation of a three-dimensional model, from which

Barretta in Massa Lubrense. Roberto Ciuni (Ciuni, 1990, p. 135), in accordance with Gabriele Della Morte (Della Morte, 2021, p. 80), postpones the arrival to 13<sup>th</sup> October. According to Riccardo Filangieri (Filangieri di Candida, 1910, p. 216) the king arrived of 14<sup>th</sup> October.

<sup>8</sup> The dataset obtained was 429 frames taken by the drone DJI Phantom 4, at a height of 45 meters with overlap and sidelap of 70%, obtaining orthoprojections with GSD (ground sample distance) of 1.05 cm / px.

orthophotoplanes and sections of the site were extracted. The photographic acquisition with SAPR required a preliminary project, based on the mapping of the area of interest with “Mission Planner”, a software that allows the programming of flight plans through the creation of waypoints, which define the route, the number of shots and the value of the ground resolution.

For the survey with laser instrumentation - aimed at acquiring the morphometric characteristics of the site and at defining the topology of parts of the complex that cannot be reached with other techniques - the phase shift TLS (Terrestrial Laser Scanner) CAM2/Faro Focus3D X330 was used<sup>9</sup>. The survey of the building, both inside and outside, and of the garden required 169 scans.



Fig. 7. Textured model of the villa in the software *Agisoft Metashape*, with the GCP used to link the two point clouds.

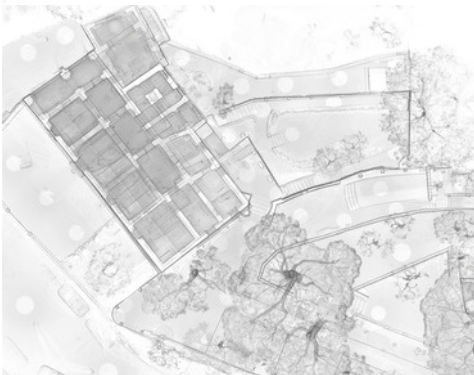


Fig. 8. Point cloud of the villa and its garden in the software *Pointcab*.

### 3.2 The integrated survey

In order to obtain a single model from the two point clouds, GCP (Ground Control Point) have been used. They consisted of checkerboard targets and RAD (Ringed Automatically Detected) targets (Mat et al., 2014), which were visible from the aircraft and identifiable in the point cloud obtained with the laser scanner. The network of control points guaranteed topographical support to georeference the two models (photogrammetric and laser), so that the gaps in both clouds were compensated. The final configuration is the three-dimensional model of the complex (Visintini et al., 2019), which consists of a system of visualization and interrogation of the spaces of the villa, with the possibility of remote measurement and exploration.

The survey of Villa Murat constituted an interesting application of integration of different technologies, which contributed to a further development of a widely tested process for the acquisition and restitution of data documenting the current state of architectural complexes.

## 4. From knowledge to conservation

As highlighted by the in-depth phase of knowledge, Villa Murat and its garden constitute an asset of remarkable cultural interest, as well as a complex of great relevance in the landscape of Massa Lubrense, where the villa is a landmark, which stands out on the hill of Annunziata. The conservation strategies should therefore aim to preserve the integrity of this highly stratified building as much as possible, without renouncing to a possible and compatible re-functionalization which, as it is known, when not in conflict with the protection requirements, constitutes a guarantee for the conservation of the built heritage (Kealy & Musso, 2011).

### 4.1 The conservation project

For the plastered architectural surfaces, the goal is to keep intact their material authenticity. It is proposed, therefore, not to completely repaint

<sup>9</sup> The resolution chosen was 6,136 mm measured on a plane 10 meters from the emitter, with a 3X quality. Each scan lasted 7 minutes.

them, but to proceed with light lime glazes that do not alter the fascination that the villa conveys thanks to the ancient aspect of its surfaces. These were analyzed according to the terminology established by the UNI 11182/2006, identifying the forms of alteration and degradation (fig. 10). The planned interventions include selective and gradable cleaning, mainly dry or with sprayed water (Musso, Torsello, 2003, vol. I, p. 31-34), and punctual additions made with lime-based renders and paints. Particular attention is paid to the decorations made with tempera paint on the intrados of the vaults on the first floor, which are still almost intact (fig.11).

The structural consolidation interventions were developed starting from the analysis of the crack pattern, drawn on a three-dimensional model, very faithful to reality because it has been obtained from the point cloud of the laser scanner



Fig. 9. Survey of the main facade.

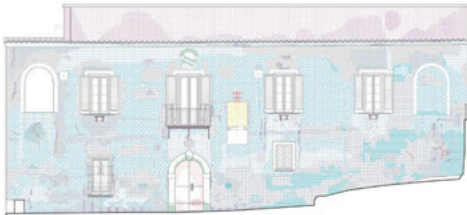


Fig. 10. Survey of degradation phenomena.

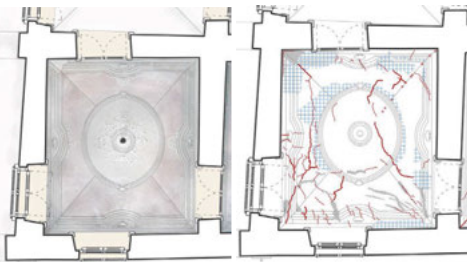


Fig. 11. Detail of the hypoglyphy of the most damaged of the painted vaults of the first floor and relative crack pattern.

<sup>10</sup> The precision of the instrumental survey highlighted a different thickness of the vaults, which corresponds to a

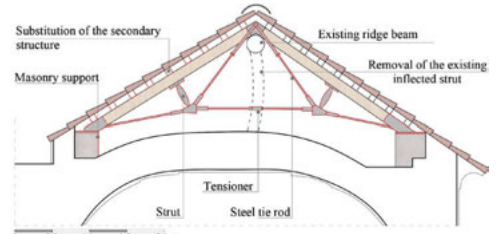


Fig. 12. Truss consolidation with steel tie rods.

survey. Among the planned interventions there is the reinforcement of the vaults of the first floor by affixing FRP (Fiber Reinforced Polymers) to the extrados, with the use of multiaxial non-woven aramid fiber fabric arranged in bands placed along the ribs and parallel to the generatrices of the vaults (Portioli et al., 2003), where the greatest stresses develop, as reported in the crack pattern<sup>10</sup>. Another intervention concerns the wooden roof. The trusses that are closest to the garden, are thrusting structures, because the bottom chord is missing, and the weight is transmitted to the side walls and to the vault below through a strongly inflected strut. The proposal is to modify the structural behaviour, through the use of steel tie rods that simulate a mixed Polonceau-type truss, consisting of a tripartite tie, raised from the extrados of the underlying vault, which is in this case so high that it does not allow the use of a classic horizontal tie rod (fig. 12).

#### 4.2 Villa Murat as an artist residency

Following an in-depth analysis of the spatial and material features of the building and of the



Fig. 13. The first floor plan converted into artist residency.

diversified crack pattern: the thinnest vault, the one near the loggia, is obviously also the most damaged.

peculiarities of the context, a new intended use is proposed: the “Artist residency” which, not far from the original residential use, allows to preserve the spatiality of the building, as well as to take advantage of the landscape context, which is of inspiration for the artists. At the basis of this choice there is also the desire to allow the public use of the villa - on the occasion of events or exhibitions - preventing its becoming an enclave destined for luxury tourism, like many historic houses in the area. The new intended usage is also linked to a consolidated tradition of the Sorrento peninsula where, since the mid-1700s, many artists have stayed in search of inspiration. The design of the interior spaces is based on minimum intervention and flexibility, to allow the artists to organize their atelier as they prefer. According to the new functional layout, the villa can host three artists at the same time, with their workspaces, diversified according to the art practiced, and organized through flexible furnishings and low-height service blocks, dry-built and therefore reversible. In addition to the artists' private spaces, there are common spaces for moments of confrontation among guests as well as rooms for events or small exhibitions of the works created in the residence (fig.13). The hope is to give new life to Villa Murat, but also to introduce a compatible form of tourism in the Sorrento peninsula, capable of bringing innovation to the world of art and to the territory that hosts it.

### Acknowledgements

The present research is part of a Graduate thesis in Conservation of Architectural Heritage, awarded cum laude and recommended for publication by the University of Naples Federico II in November 2020. The thesis was supervised by Andrea Pane, Professor of Architectural conservation, and Raffaele Catuogno, Professor of Architectural survey.

### References

Barra F. (2011). *Capri “inglese” e napoleonica. Da Hudson Lowe a Murat. 1806-1815*, Il Terebinto.

Branduini P., Pane A. (2022). City and Countryside: A Historical Landscape System to Enhance. The Case of the Territorial Plan of Sorrento-Amalfi Peninsula by Roberto Pane and Luigi Piccinato, 1968-1987. In C. Brisotto, F. Lemes de Oliveira (Eds.), *Re-Imagining Resilient Productive Landscapes. Perspectives from Planning History*, Springer.

Broccoli U. (1953). *Cronache militari e marittime del Golfo di Napoli e delle Isole Pontine durante il decennio francese*, Ministero della Difesa.

Cerio E. (1922). *L'architettura rurale nella contrada delle Sirene*, in «Architettura e arti decorative», n.4.

Ciuni R. (1990). *La conquista di Capri*, Sellerio ed.

Colletta P. (1834). *Storia del reame di Napoli*, Tipografia elvetica.

Della Morte G. (2021). *Ogni resistenza è vana*, Edizioni la Conchiglia.

Fasulo M. (1906). *La penisola sorrentina: Meta, Piano, Sant'Agnello, Sorrento, Massalubrense*, Stabilimento Tipografico G. M. Priore.

Fiengo G., Abbate G. (2001). *Casa a volta della costa di Amalfi: censimento del patrimonio edilizio storico di Lone, Pastena, Pogerola, Vettica Minore e Tovere*, Centro di cultura e storia amalfitana.

Filangieri di Candida R. (1910). *Storia di Massa Lubrense*, Luigi Pierro, reprint by Arte Tipografica Napoli, 1960.

Kealy L., Musso S. F. (2011). *Conservation / transformation. EAAE Transaction on Architectural Education*, Essegroph.

Mat M.S.C., et al. (2014). *Data acquisition and representation of leaves using digital close range photogrammetry for species identification*, IEEE 5th Control and System Graduate Research Colloquium.

Musso S. F., Torsello B. P. (2003). *Tecniche di restauro architettonico*, UTET.

Pagano G., Daniel G. (1936). *Architettura rurale italiana*, Quaderni della triennale, Hoepli.

Pane R. (1936). *Architettura rurale campana*, Rinascimento del libro.

Pane R. (1954). *Capri*, Neri Pozza.

Pane R. (1955). *Sorrento e la costa*, Edizioni scientifiche italiane.

Pane R. (1961). *Campania. La casa e l'albero*, Montanino editore.

Pane R., Piccinato L. et al. (1977). *Piano Territoriale di Coordinamento e Piano Paesistico dell'area Sorrentino – Amalfitana. Proposta*, reprint by Italia Nostra, 2007.

Persico G. B. (1646). *Descrizione della città di Massa Lubrense*.

Picone R. (2010). Capri, mura e volte. Il valore corale degli ambienti antichi nella riflessione di Roberto Pane. In S. Casiello, A. Pane, V. Russo (Eds.), *Roberto Pane tra storia e restauro. Architettura, città, paesaggio*, Marsilio.

Portioli F. et al. (2003). Comportamento strutturale di volte a padiglioni con e senza rinforzi in FRP. *Costruire in laterizio*, n. 95.

Visintini D. et al. (2019). *Advanced 3d modeling versus building information modeling: The case study of Palazzo Ettoreo in Sicile (Italy)*. ISPRS.