HERITAGE 2025 | International Conference on Earthen and Vernacular Heritage: Conservation, Adaptive Reuse and Urban Regeneration
September 10th – 12th, 2025, Valencia (Spain)
https://doi.org/10.4995/HERITAGE2025.2025.19472

Vernacular Rural Architecture with Extradosed Vaults. Case Studies from the Inland Areas of Southern Italy

M. G. Basilicata[1,*]
[1] University of Salerno, Salerno, Italy, mabasilicata@unisa.it,

Topic: T1.4. Restoration and conservation of vernacular architecture

How to cite: Basilicata, Maria Grazia (2025). Vernacular Rural Architecture with Extradosed Vaults. Case Studies from the Inland Areas of Southern Italy. In C. Mileto, F. Vegas, A. Hueto-Escobar & S. Manzano-Fernández (Eds.) *Earthen and Vernacular Heritage: Conservation, Adaptive Reuse and Urban Regeneration.* September 10th – 12th, 2025, Valencia (Spain). edUPV. https://doi.org/10.4995/HERITAGE2025.2025.19472

Abstract

This paper examines rural dwellings characterized by extradosed vaults, a vernacular architectural typology prevalent throughout the Mediterranean basin. From the Berber ghorfas to coastal residences, and from rural complexes in the Vesuvian area to the traditional structures of the Sorrentine Peninsula, this architectural form has a rich history. While often associated with coastal regions, this typology also manifests inland, as demonstrated by the municipality of Santa Maria a Vico in the Caserta hinterland. Here, many surviving examples- despite frequent alterations - retain essential original features, shedding light on a broader, often overlooked diffusion of this architectural tradition. These structures typically consist of load-bearing masonry walls made from local limestone and vaulted roofs, with the extrados frequently visible. Arranged in south-facing rows, their layouts commonly include shared elements such as courtyards, cisterns, ovens, and rainwater harvesting systems, which are vital in areas lacking natural springs, reflecting a profound adaptation to local environmental conditions. This study focuses on several settlements within Santa Maria a Vico, evaluating their state of conservation through archival research, on-site inspections, as well as detailed metric and material surveys. This methodology has uncovered a wide range of transformations over time, including the enclosure of extradosed vaults and reconfigurations of internal spaces. Ultimately, the research aims to establish guidelines and best practices for interventions that not only preserve the physical integrity of these dwellings but also maintain the intangible heritage they represent - such as historical memory, cultural identity, and traditional construction techniques - while accommodating contemporary functional needs.

Keywords: *rural dwellings; vaulted roofs; restoration; traditional construction techniques*

1. Introduction

The architectural typology of extradosed vaults is typically associated with insular and coastal landscapes, as demonstrated by similar examples found along the shores of Greece, Tunisia, and other Mediterranean countries. In these varied contexts, the typology is adapted to local conditions, resulting in variations that respond to different climatic challenges and the availability of materials. For instance, Tunisian ghorfas, constructed from rammed earth, provide effective thermal insulation in desert regions, whereas the *dammusi* of Pantelleria utilize vaulted forms to direct rainwater into underground cisterns. Moreover, along the Amalfi Coast and on the Campanian islands, the widespread adoption of extradosed vaults stems from the scarcity of sturdy timber suitable for flat or pitched roofs (Fiengo & Abbate, 2001; Arena,

BY-NC-SA 2025, Editorial Universitat Politècnica de València

2011; Valenza, 2015). Notably, this architectural form is also present in the inland area of the province of Caserta, specifically in the municipality of Santa Maria a Vico, where numerous rural structures have retained their distinctive characteristics. Its presence in a non-coastal and culturally dissimilar setting prompts inquiries into the settlement and construction dynamics that led to its adoption in such an unconventional context.

2. Methodology

The research adopted an integrated approach structured into several phases, aimed at investigating the vaulted rural architecture found in the hilly terrain of Santa Maria a Vico. The initial phase involved analyzing satellite imagery, which facilitated the identification of an initial set of buildings characterized by vaulted roofs. These findings were subsequently verified through on-site inspections. Simultaneously, bibliographic and archival research was conducted to explore the dissemination of a construction typology typically associated with insular and coastal regions, within the comparatively rare context of a hilly inland area of Campania. This phase underscored how these structures contributed to shaping the local rural landscape. In the subsequent phase, the investigation focused on two representative building clusters: one fulfilling a productive function and the other designated for residential use. This selection aimed to further examine the typological, material, and functional characteristics of these architectural structures. For both sites, a comprehensive survey campaign was undertaken, combining direct measurement techniques with photogrammetry. Data acquisition was performed using a digital camera, followed by processing through Agisoft Metashape software. The integration of field observations and surveying techniques allowed for a nuanced understanding of the material composition and construction methods employed. Ultimately, the main transformations undergone by this typology over time were analyzed to develop intervention strategies aimed at its conservation and enhancement, from both architectural and landscape perspectives.

3. The geographical, historical and cultural context of the area

The vaulted buildings under examination are located within the historical settlements that line the slopes of Mount Burrano, in the northern section of the municipality of Santa Maria a Vico. This area, commonly referred to as Monticello, is home to approximately one hundred examples of structures featuring extradosed vaults. While these buildings are interspersed among more conventional rural architecture, they retain distinctive characteristics that indicate the former presence of a cohesive and widespread rural settlement. The development of this architectural style in the region is attributed to a combination of geographical and environmental factors. The lack of local water sources prompted communities to create systems for collecting and storing rainwater, while the scarcity of sturdy timber rendered the construction of wooden floor structures impractical.These limitations directly influenced the adoption of a construction technique that effectively met the practical needs of the residents (Ruggiero & Campagnuolo, 1997).

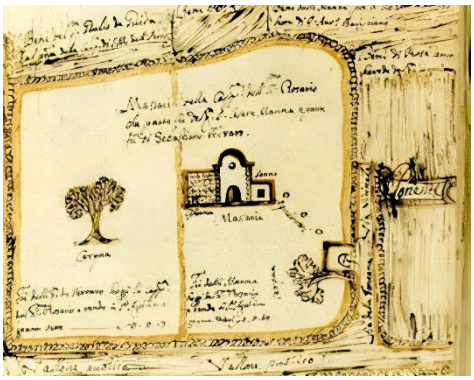

Fig. 1 – *Barrel-vaulted farmhouse* (Episcopal Archive of Sant'Agata de' Goti, 1696, sketch by Tommaso Cognetta).

BY-NC-SA 2025, Editorial Universitat Politècnica de València

As for the chronology of these structures, it can be suggested that they began to proliferate from the 16th century onward, following the migration of artisans from coastal areas who introduced this building practice. The earliest iconographic evidence of these barrel-vaulted structures can be found in a depiction from the 17th century (Fig. 1).

3.1. The construction of the hillside landscape

For centuries, agriculture has served as the principal economic foundation of the region, profoundly influencing both the landscape and land management practices. The cultivation of olive trees, orchards, and vineyards has flourished across a hilly terrain characterized by significant elevation changes and sloping ground, necessitating the implementation of adaptive agricultural strategies aimed at optimizing arable land. A crucial aspect of this adaptation involved the construction of agricultural terrace interventions designed to create flat surfaces conducive to cultivation. The process of excavating and leveling the terrain not only reshaped the landscape but also generated residual materials predominantly composed of limestone. This material was subsequently repurposed in the construction of dry-stone retaining walls, locally known as *murecene*. These structures, constructed without the use of mortar, played a vital role in stabilizing slopes and ensuring effective drainage of rainwater, thereby facilitating the cultivation of steep areas and, in certain instances, integrating dwellings that occasionally acted as retaining elements. The morphological characteristics of the terrain, along with the technical solutions employed in its transformation, can be viewed as manifestations of influences exerted by skilled builders hailing from coastal regions. Upon migrating to the inland territory, these builders transferred and adapted their existing construction knowledge, which had been established in contexts such as the Amalfi Coast. The area under examination exhibits several significant parallels with the Amalfi region, particularly in relation to the availability of local building materials, orographic conditions, and the agricultural utilization of the terrain. These factors underscore a cultural and technical continuity between the two areas, as evidenced by the adoption of shared construction strategies (Fiengo & Abbate, 2001; Russo & Pollone, 2022; Villani, 2024).

4. Architectures of the hillside landscape

The architectural forms that define this landscape have been constructed utilizing the residual materials resulting from land excavation, thereby integrating seamlessly into the terrain as essential retaining elements that adhere to the pre-existing hillside topography. These structures consist of homogeneous rows of independent modules, each occupying an approximate area of 30 m². Openings within these modules are minimal, generally restricted to a single entrance door and one window, both of which are oriented toward a shared open space designed for communal activities and services, including the oven, cistern, and washhouse. Although these structures may appear uniform at first glance, a closer examination reveals several variations, largely concerning their intended use and internal spatial configuration. Consequently, two distinct clusters have been selected for in-depth analysis: one that is rural and production-oriented, and another that is residential and urban in character. The first case study focuses on a row of three interconnected units located in a non-urbanized area that has retained its original agricultural function. The contextual framework, characterized by a network of terraces, highlights the cohesion between the constructions and the surrounding landscape. This particular cluster serves as an olive and grape press (*frantoio*) and is composed of a central unit housing a stone mill, with masonry vats strategically placed at each of the four interior corners for the collection of produce. The lateral units are presumed to have been employed for supplementary functions, thus enhancing the overall utility of the cluster (Fig. 2).

BY-NC-SA 2025, Editorial Universitat Politècnica de València

Fig. 2 – *Production unit and masonry* (Author, 2025).

The residential typology most commonly found in the study area is the *casa a botte*, or barrel-vaulted house. The cluster analyzed is located on Papi Road and represents one of the last dwellings at the edge of the natural landscape. It comprises a row of four units, organized around a courtyard that includes a washhouse, a cistern, and a communal oven. Each unit constituted a modest, essential dwelling, characterized by a single interior space. The core of this space was the hearth, which served as the primary architectural and functional element, while small niches carved into the masonry were utilised for storing household items. Some instances of a mezzanine are present, which meet domestic and storage needs simultaneously, suggesting a rational use of space (Fig. 3).

5. Construction and material features

The investigation brought to light a series of recurring constructional patterns - most notably, the consistent use of a specific lithotype and the adoption of a uniform masonry technique - coexisting with substantial variations linked to functional purpose, the number of aggregated housing cells, and the range of solutions employed for vaulted roofing systems. Such variability reflects a pronounced adaptive capacity, grounded in a collectively developed and historically sedimented body of constructional knowledge, capable of articulating spatial configurations in response to functional demands and environmental contingencies (Pane, 1936; Pagano & Daniel, 1936).

5.1. The construction of walls and vaults

After the excavation of the terrain and the construction of the foundations and cisterns, the building process progressed with the construction of the perimeter walls (Ruggiero & Campagnuolo, 1997). The technique utilized involved arranging the wall facings according to the method known as “periodic horizontal courses”, also referred to as the “worksite method”. The masonry was crafted out of roughly hewn limestone blocks of varying sizes, with the largest stones typically positioned at the base of each construction phase (Fig. 4) (D’Aprile, 2001).

Fig. 3 – *South orthophoto of the residential cluster, Via Papi* (Author, 2025).

BY-NC-SA 2025, Editorial Universitat Politècnica de València

Fig. 4 – *East orthophoto of the residential cluster: the masonry with periodic layers* (Author, 2025).

These segments, which varied in size, were erected sequentially, and at each stage, a generous layer of mortar was applied to ensure proper settlement and bonding of the masonry.

It can be inferred from the construction technique that employs irregular worksite segments - commonly found in various buildings throughout the region - that the masonry core in question was of a compacted type. This indicates that it was constructed using a three-dimensional method, where the inner and outer facings, alongside the core, were erected simultaneously.

Following the completion of the walls, the construction progressed to the roofing phase. Instead of using centring during this process, a temporary platform was established at the springing level. This platform served as a base where soil was shaped and compacted to create a formwork for the vault. The tuff blocks were then placed, with their arrangement varying according to the geometry of the vault - primarily barrel vaults, and occasionally sail vaults (D'Aprile, 2001). In the case of barrel vaults, the tuff voussoirs were aligned along the vault's geometric generatrices. On the other hand, sail vaults required a different structural configuration, as they rest on a quadrangular base. Geometrically, a sail vault can be described as the intersection of an ellipsoid with four vertical planes.

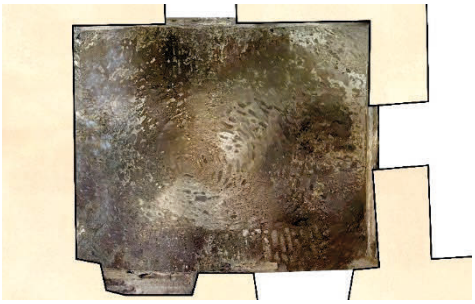

Fig. 5 – *Ortophoto of the vaulted ceiling of the production unit* (Author, 2025).

This layout consists of two distinct construction elements: an elliptical calotte formed with small tuff blocks arranged in concentric circles, and the pendentive zones, composed of larger squared tuff blocks laid out in a radial pattern (Fig. 5).

Following the removal of the formwork, the vault was waterproofed at the extrados using a *battuto di lapillo*, a mixture of compacted volcanic ash. This compound, approximately twenty centimetres thick, was applied to the vault's surface and tamped down with wooden poles, occasionally moistened with limewater. After a full day of compaction, the mixture, having partially hardened, was levelled and given a slight slope to facilitate rainwater drainage. After about a week, the roof received further protection with a layer of straw and soil, which was kept in place for an additional twenty days to shield the surface from atmospheric conditions (Ruggiero & Campagnuolo, 1997). The curved profile of the roofing system enhanced rainwater runoff, directing water onto the narrow flat surfaces between adjacent vaults. From there, the water was channelled into a network of terracotta conduits known as *cantarelle*. These channels guided the water toward cisterns and wash basins, ensuring a reliable water supply - a crucial operation in a region where natural springs are scarce. The *cantarelle* were typically positioned along the main elevation of each vaulted module; however, today, these original elements have largely disappeared or been replaced by modern downpipes (Ruggiero & Campagnuolo, 1997).

BY-NC-SA 2025, Editorial Universitat Politècnica de València

6. Transformations over time

Roberto Pane admired how the dwellings in the inland areas of Campania had retained their original architectural features, in sharp contrast to those along the coast, which had been significantly altered by the influence of tourism (Fig. 6). He noted: "*Vaults cover single-storey spaces, arranged side by side around the courtyard of the rural house, enhancing the beauty of a land whose ancient character remains intact, precisely because it is entirely untouched by tourism*" (Pane, 1936, p. 14).

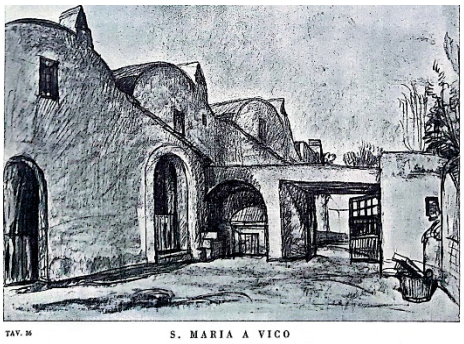

Fig. 6 – *Sketches of barrel-vaulted houses in Santa Maria a Vico* (Pane, 1936).

What Pane could not have anticipated was the radical transformation that these dwellings would soon undergo, driven by evolving housing needs and the demand for functional adaptations. A detailed examination of the current built environment uncovers traces of these changes, enabling us not only to pinpoint the original locations of these houses but also to comprehend the nature and extent of their transformation over the decades. In many instances, the original masonry has been incorporated into newer structures, while the vaults have been either removed, concealed, or modified.
These transformations can be classified based on the degree of alteration to the original building fabric:

1. Dwellings that remain intact but are in a state of decay or abandonment: These structures have largely retained their original form, aside from structural reinforcements - often implemented after seismic events - such as the addition of metal tie rods.
2. Dwellings that preserve the vault but have undergone superficial alterations: While their original structural configuration remains intact, these houses have experienced specific interventions, such as the application of waterproofing layers over the battuto di lapillo or the addition of roof tiles along the vault profile.
3. Row houses that maintain their linear configuration, albeit with the vault extrados sealed or covered.
4. Row houses where individual units have been physically connected, thereby altering the original spatial organization.

Structures that present as a single building entity, frequently incorporating vertical expansions that have either integrated the original vault or resulted in its demolition and replacement with a flat slab (Fig. 7).

Fig. 7 – *Barrel vaults incorporated into the attic of a dwelling* (Author, 2025).

As for the ancillary architectural elements - such as ovens, cisterns, wash basins, and water drainage systems - many have been lost over time. Those that remain extant frequently exhibit a condition of neglect and are no longer in use.

BY-NC-SA 2025, Editorial Universitat Politècnica de València

7. Safeguarding tangible and intangible heritage: intervention guidelines and conclusions

In this context, the greatest risk lies in the irreversible transformation of these dwellings, which could result in the loss of a heritage that is both tangible and cultural. These structures represent a way of life that has fostered a sustainable relationship with the surrounding environment for centuries. The contemporary challenge is to identify compatible recovery strategies - at both territorial and architectural scales - that reconcile current needs with the respect for local specificities. This must be accompanied by the development of long-term conservation strategies that protect the built heritage while adhering to the principles of authenticity and material compatibility.

7.1. Conservation and restoration strategies

As an initial step, it is crucial to remove invasive vegetation, which often causes structural damage and undermines the architectural integrity. Equally important is ensuring the structural stability of masonry walls: prolonged exposure to soil, without adequate waterproofing, can lead to moisture-related issues such as water staining, biological growths, and gradual deterioration of interior surfaces. In such instances, waterproofing the masonry that comes into contact with the ground is essential, with interventions customized to the specific conditions of each structure. The primary mechanisms of structural failure observed in these buildings include masonry crushing, frequently indicated by significant erosion of the mortar. Targeted interventions may include compatible reinforcement techniques, such as repointing joints with lime-based mortars. Vaulted elements may exhibit considerable deflections at the crown, stemming from both ageing and water infiltration. These deformations can be mitigated by inserting appropriate metal tie rods. Regarding roof coverings, two main concerns have been identified: the presence of cracks and the utilization of incompatible waterproofing materials. In the case of cracks, the *lacertino* technique may be implemented, which involves injecting a liquid mixture of lime and sand into the fissures to stabilize the affected areas. For the issue of incompatible waterproofing layers, it is necessary to remove modern anti-mould membranes and restore the original waterproofing function by rehabilitating the underlying *battuto di lapillo* layer.

7.2. Strategies for territorial reuse and enhancement

It is crucial to promote strategies aimed at safeguarding rural building clusters by recognizing them as inseparable components of the cultural landscape. This entails regulating land use in ways that preserve their authenticity and prevent alterations that may compromise their identity value, in alignment with local urban planning instruments (PUC) and overarching regulatory frameworks. In contexts marked by a lack of community gathering spaces - especially in urbanized peripheries - abandoned rural cores could be repurposed as community centres. Such an approach would meet social needs through minimal and respectful interventions that enhance the original spatial configuration of the built environment.

The establishment of multifunctional spaces, achieved through the adaptation of interior environments, would facilitate the reintegration of these structures into collective use, transforming them into venues that reinforce a sense of belonging to the territory (Fig. 8).

Fig. 8 – *Design concept* (Author, 2025).

BY-NC-SA 2025, Editorial Universitat Politècnica de València

In parallel with this approach, there exists the potential to promote local productive and commercial activities within these clusters, such as the sale of local products (e.g., wine, olive oil, honey), which would serve to emphasize the unique assets of the region. Moreover, buildings deemed unsuitable for public, productive, or commercial functions could be restored as private spaces, with any intervention that might alter their specific characteristics subjected to regulatory oversight.

This methodology could also be applied to ancillary elements, such as cisterns, which could be repurposed for rainwater collection and recycling. This demonstrates the feasibility of integrating sustainability with historical memory to address contemporary needs. Similarly, traditional ovens and external structures could be restored to facilitate community events, while outdoor spaces could be revitalized with gardens and urban farms, thereby breathing new life into these sites while maintaining their original identity.

In conclusion, the protection of both tangible and intangible heritage associated with these rural buildings necessitates an integrated approach that harmonizes the preservation of historical identity with contemporary requirements. Only through conscious and sustained engagement can these assets be transmitted to future generations, keeping historical memory alive while strengthening the connection between communities and their land.

References

Abbate, G., Bocchino, F., & Guerriero, L. (1990). *Sopravvivenze dell'architettura rurale in Campania: Arola*. Grafis Edizioni.

Arena, M. (2011). Architetture nella terra. In M. Giovannini & F. Prampolini (Eds.), *Spazi e culture del Mediterraneo*. Edizioni Centro Stampa d'Ateneo, Università Mediterranea di Reggio Calabria.

Ausiello, G. (2000). *Il paesaggio rurale della Campania: Architettura e caratteri costruttivi*. Luciano Editore.

D'Aprile, M. (2001). *Murature angioino-aragonesi in Terra di Lavoro*. Arte Tipografica.

Fiengo, G., & Abbate, G. (2001). *Casa a volta della costa di Amalfi*. Centro di Cultura e Storia Amalfitana.

Fondi, M., Franciosa, L., Predeschi, L., & Ruocco, D. (1970). La casa rurale nella Campania. In G. Barbieri & L. Gambi (Eds.), *La casa rurale in Italia*. Olschki.

Gravagnuolo, B. (1994). *Architettura rurale e casali in Campania*. La Buona Stampa.

Pagano, G., & Daniel, G. (1936). *Architettura rurale italiana*. Ulrico Hoepli.

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

Pane, R. (1965). *Capri: Mura e volte*. Edizioni Scientifiche Italiane.

Ruggiero, A., & Campagnuolo, F. (1997). *C'era una volta la casa a botte*. Arti Grafiche Solimene.

Russo, V., & Pollone, S. (2022). Di pietre e d'acqua: La conservazione del patrimonio proto-industriale nel paesaggio culturale della Costiera Amalfitana. In S. Caccia, M. De Vita, & C. Francini (Eds.), *1972/2022 World Heritage in transition: About management, protection and sustainability*. *Restauro Archeologico*, *Special issue 2-2022*. Firenze.

Valenza, A. (2015). *Pantelleria e i suoi dammusi*. Dario Flaccovio Editore.

Villani, M. (2017). Le "architetture minori" a carattere rurale nell'area vesuviana: Un patrimonio architettonico a rischio. In A. Aveta, B. M. Marino, & R. Amore (Eds.), *La Baia di Napoli: Strategie integrate per la conservazione e la fruizione del paesaggio culturale* (pp. 209–213). Artstudiopaparo S.r.l.

Villani, M. (2024). Conservation and urban development inside/outside of boundaries: Some case comparisons between Italy and Portugal. In D. Fiorani et al. (Eds.), *Conservation/Sustainable Design: Heritage challenges in historic urban landscapes*. EAAE, Maiadouro.

(cc) BY-NC-SA 2025, Editorial Universitat Politècnica de València