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Lucia Toniolo
Maurizio Boriani
Gabriele Guidi *Editors*

Built Heritage: Monitoring Conservation Management

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Lucia Toniolo · Maurizio Boriani
Gabriele Guidi
Editors

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Editors
Lucia Toniolo
Department of Chemistry, Materials and Chemical Engineering "Giulio Natta"
Politecnico di Milano
Milan
Italy

Maurizio Boriani
Department of Architecture and Urban Studies
Politecnico di Milano
Milan
Italy

Gabriele Guidi
Department of Mechanical Engineering
Politecnico di Milano
Milan
Italy

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Foreword

The online volume "Built Heritage: Monitoring Conservation Management" has the ambition to offer to the reader an overview of the global challenge of preserving and studying our rich architectural heritage, from different but highly correlated points of view.

Advancing our knowledge of the Built Heritage is today a technological challenge that often requires sophisticated competences and interdisciplinary studies; therefore, we tried to cover the main areas of interest, presenting the research approach on different technologies and exemplar case studies. The topics range from structural monitoring and strengthening, seismic vulnerability, guidelines for the preservation of complex sites, digital survey and multimedia documentation, 3D digitization of museum collections to the development of innovative surface treatments.

To promote dialogue among the researchers in this wide field has been a challenge into the challenge; we all know that scholars, researchers and professionals involved in the conservation and management of historical and valuable complex architecture often come from different education backgrounds and are sometimes distant from each other. This book aims at showing and analysing the different aspects of the entire process, focusing on new and advanced projects and research results. In addition, it highlights the importance of interdisciplinary research in Built Heritage preservation, where insights and methods from different scientific disciplines are integrated and used to investigate a jointly defined research problem.

The book shows how the development of the safeguarding of Architectural Heritage, through the use of innovative technologies, can escape the traditional and artisanal dimension and be a valuable engine of growth.

Lucia Toniolo
Maurizio Boriani
Gabriele Guidi

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Part I
Hystoric Centers and Cultural Landscapes: Conservation and Management

Farmhouses in the Phlegrean Fields Between Archaeology and Architectural Palimpsest. A Multi-disciplinary Approach

Renata Picone

Abstract The contribution aims to deepen the study of the rural architectures in Campi Flegrei, with particular reference to the territorial area of Pozzuoli. Country houses, manor houses in the countryside, agricultural and lookout towers, rural outbuildings, farms born on archaeological remains, are the components of a rich architectural heritage strewn over agricultural land of Campi Flegrei; a heritage not yet fully known and cataloged, which pours in a state of apparent abandonment and constitutes an irreproducible repertoire of building traditions, materials and local techniques of undeniable interest. The study, which uses the results of a research, started by a group of scholars of the "Federico II" and funded by Regione Campania for the biennium 2004–2006, is characterized by an interdisciplinary approach, and will address (1) the relationship with the landscape of these settlements, (2) the reuse of ancient and existing buildings highlighting the continuity of use, (3) the technical-constructive and typological aspects and more specifically the architectural and materials ones. Two illustrative case-studies will be chosen, detailed through a careful graphic and stratigraphic relief, as well as through diagnostic surveys: the first one, relative to the area of Via Campana, which consists of a farm built on Roman remains witnessed by the presence of a nymphaeum in opus reticolatum, and the second one related to a home-farm, with a more complex plant, arose ex novo in the eighteenth century for the production of wine. In both cases will be highlighted the recurring conservative critical and the mechanisms of degradation and damage, aimed to the detection of correct methods for the conservation of this 'fragile' heritage.

R. Picone (✉)
Department of Architecture, University of Naples 'Federico II', Naples, Italy
e-mail: renata.picone@unina.it

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Rural dwellings, manor houses, agricultural and lookout towers, and rural farmhouses built on archaeological evidence are the main components of a full palimpsest strewn over the agricultural land of the Phlegrean Fields. This heritage, which is in a state of disuse and abandonment, is not yet fully known and catalogued and constitutes an irreproducible repertoire of local building, material, and technical traditions of undeniable interest.

The close relationship with its landscape, the reuse of ancient and pre-existing constructions, the continuity of use, its typological and more properly architectural technical-constructive specificities, are only some of the aspects that emerge from the analysis of such structures.

In 2006, a research work conducted by a group of scholars of the University of Naples 'Federico II' and funded by Regione Campania[1] compiled an inventory of the farmhouses and rural dwellings located in the area of Pozzuoli, giving rise to a systematic work of knowledge dissemination and protection. This kind of work was urgently needed because of the widespread conditions of degradation of this heritage, or worse, because of the unaware operations being conducted on it.

Setting off from the results of that experience, this paper takes on the study of rural architecture of the Phlegrean Fields, the area west of the city of Naples (Italy) characterised by extraordinary geological and landscape characteristics, by thoroughly analysing all its connoting elements, in view of their conservation and protection.

The Phlegrean Fields consist of many crater belts (Gauro, Astroni, Monte Nuovo, etc.), also transformed into lakes (Lucrino, Agnano, Fusaro, and Miseno) and residual strips of volcanic craters, such as Soccavo, Pianura, and Quartouarto, culminating on the spur of the Hermitage of Camaldoli.

The localization of the largest Phlegrean rural dwellings follows the low-lying areas between the crater belts; these areas are best suited to extensive crops such as vines, which have been historically able to take advantage of the abundant presence of water, as well as of the presence of volcanic slag in the soil, an extraordinary element of fertilization in the entire Campania Felix.

The heritage of rural architecture in the Phlegrean Fields has thus closely followed the structure of its agricultural territory: vine is the main crop, but the presence of fruit trees and woods is historically documented, especially of chestnuts, which provided wood for vine piling. However, in the case of the Phlegrean area, during the classical age historical farmhouses were also built along the routes of the

[1] "*Forma Urbis Flegrea. Catalogazione e Restauro dei Contesti Storico-Ambientali di Pozzuoli e Procida. Proposta di un Codice di Pratica*", Research funded by the Italian Regional Law No. 5, March 28, 2002—financial year 2005; Research group: professors architects Giancarlo Alisio (scientific supervisor), Stella Casiello, Salvatore Di Liello, Andrea Pane, Renata Picone, Pasquale Rossi, Valentina Russo, and Gianluca Vitagliano.

ancient roads of communication of the ager puteolanus, between Rome and Naples: 'via Consolare Campana', Consularis Puteolim Capuam, and 'via Antiniana', Puteolis-Neapolim per colles (Alisio 1995; Annecchino 1996). In the vicinity of these routes—connecting the port of Pozzuoli to Naples and, through Capua and the Via Appia, to Rome—a widespread rural urbanization arose ranging from agricultural warehouses, to cisternae, columbaria, funeral mausoleums, and villae rustiche (Maiuri 1924, p. 48, 1957, p. 37; Quilici 1969; Quilici and Quilici Gigli 1968–1969; Quilici Gigli 1970; Amalfitano et al. 1990).

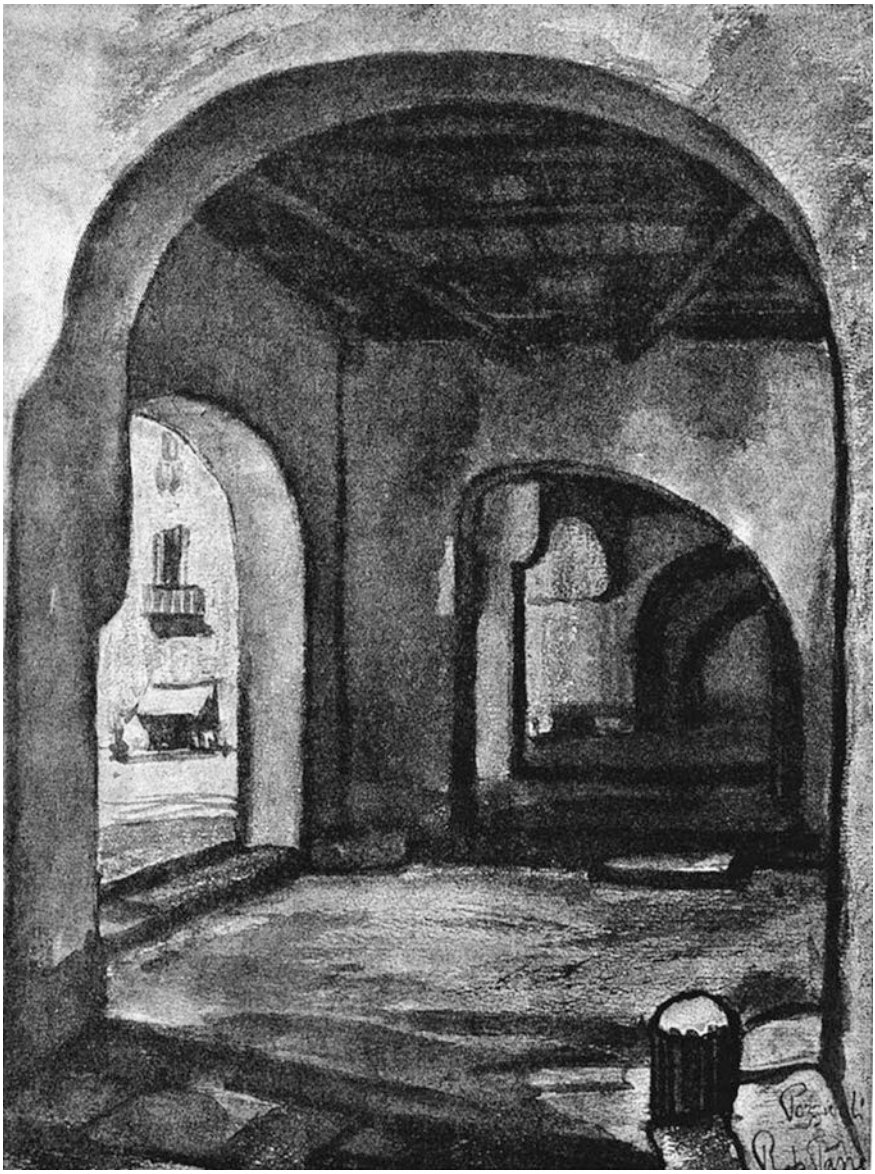
The nuclei of modern hamlets (De Seta 1984a, b) have subsequently been grafted on the Roman ruins of these architectures strictly connected to the purely agricultural vocation of the Ager Campanus. Later, the first structures of the farmhouse complexes were built without formal, material, and functional interruptions (Falcone 2009). They were sometimes complex structures surrounded by a vast cultivated area, as can be seen from the main cartographic maps of the contours of Naples—such as the 'Duca di Noja' map, the 'Rizzi Zannoni' map and the 'Mappa Topografica e Idrografica de' Contorni di Napoli'—drawn between the late eighteenth century and early nineteenth century.[2]

Inside these farmhouses, it is not uncommon to find ruins of Roman nymphs in opus reticulatum reused as cellai (cellars) or inside the ovens, as seen in the case of the Caleo farmhouse in Pozzuoli.

Therefore, it can be argued that the Phlegrean agricultural landscape is characterised not only by the geological naturalistic and agricultural components of the territory, but also by the signs of an ancient and relatively close past, only partially concealed by recent land speculation.

The broad reuse of forms, spaces, and materials of the Roman building tradition (Picone 2008a, pp. 31–61) was often due to economic reasons, as in the case of the use of ancient nymphs as foundations for new rural constructions. As the foundations were the most substantial constructive investment both in economic and technical terms, the reuse of ancient artefacts allowed for an easier and more rapid execution.

[2] Giovanni Carafa Duca di Noja, *Mappa Topografica della Città di Napoli e dè Suoi Contorni*, Napoli 1775; Rizzi Zannoni, *Topografia dell'Agro Napoletano con le Sue Adiacenze,* Napoli 1793; Regio Officio Topografico, *Carta Topografica ed Idrografica dei Contorni di Napoli,* Napoli 1817–'19.



Roberto Pane, Pozzuoli, passage with a porch, in R. Pane, *Tipi di architettura rustica in Napoli e nei Campi Flegrei*, in "Architettura e Arti Decorative", fasc. 12, agosto 1928

Pozzuoli. farmhouse

However, the ancient spolia continued to be used for purposes similar to those for which they had been originally built, with a functional continuity that recalls the phenomenon defined in the 1960s by Emilio Sereni as “inertia of the agricultural landscape” (Sereni 1961). The expression refers to those centuries-old experiences and lines of cultural continuity for which farmhouses are considered a “deposit of

collective memory" (Gravagnuolo 1989), places which hardly undergo any change, where it is possible to read the historical and cultural evolution of a geographic context, through the interpretation of the materials associated with the 'choral' history of the territory.

The close link between the agricultural community and cultivated lands has been the object of many studies conducted on rural houses by scholars belonging to the fields of sociology, ethnography and geography, both in the Italian (Biasutti 1924, 1932; Sereni 1961) and Neapolitan academic community (Fondi et al. 1964).

In the field of architectural historiography, in the period between the two world wars, there has been an in-depth analysis of the legacies of rural tradition led by Rationalist architects such as Giuseppe Pagano, who in 1936 defined this area as a "huge dictionary of the constructive logic of mankind" (Pagano 1935; Pagano and Daniel 1936). Among the Neapolitan academic community, already Roberto Pane's studies on the environment and architecture having a choral value—which followed the studies by Biasutti (1925), Cerio (1922a, b, 1923) and Castaldi (1930)—had outlined (Pane 1928) some interest in the crucial theme of the twentieth century architectural debate in the Campania region. This topic will be repeatedly investigated by Pane, becoming one of the current topics of his reflections (Picone 1988, 2005a, pp. 81–87, 2008b, pp. 312–320). These insights also influenced many architects (Baculo 1979; La Regina 1980; De Seta 1984a, b; Bruno 2001), which have conducted in-depth investigations on the typological aspects of 'rustic architecture' scattered in the Campania region, using the typical tools of the architectural historiography of the second half of the twentieth century.

Convents or large manor houses arose on the crater belts or along the gentle slopes of the Phlegrean hills and were later on transformed into rural settlements. Also the latter were often handed over to the religious orders as a donation, becoming a major source of livelihood for internal use, for maintaining religious men living in city monasteries, and for annuity. Such complexes, agricultural convents sometimes surrounded by towers and walls for protection against robbery attacks, became farms with complex rural services.

In terms of materials, the Phlegrean hills are made of yellow tuff, pozzolana, rare remains of loose lava, pumice, and lapillus: this provided Phlegrean farmers with excellent materials to build the outer walls and the roofs of their houses (Fondi et al. 1964). Quarto, with its quarry at Poggio Spinelli, is one of the main sources of supply for tuff used in vertical masonry—often grafted on archaeological evidence reused as foundations—and for the traditional extrados vaults, with their coating in beaten lapilli, which is one of the key elements of this heritage. Linked to strong anthropological traditions, apart from technical and constructive ones (Cerio 1922a, b; Di Stefano 1967; Aveta 1987), for centuries the beaten lapillus technique enabled waterproofing of the plastic extrados membranes of barrel vaults, trough vaults,

cloister vaults, and bohemian vaults, which cover rural houses in Campania, connoting their presence in the agricultural landscape: an architecture without architects, where "yardsticks have been replaced with footsteps, levels and plumb lines were ignored, the shape of the walls is influenced by the same plastic vivacity of a clay object created by a craftsman's hands" (Pane 1936, p. 76).

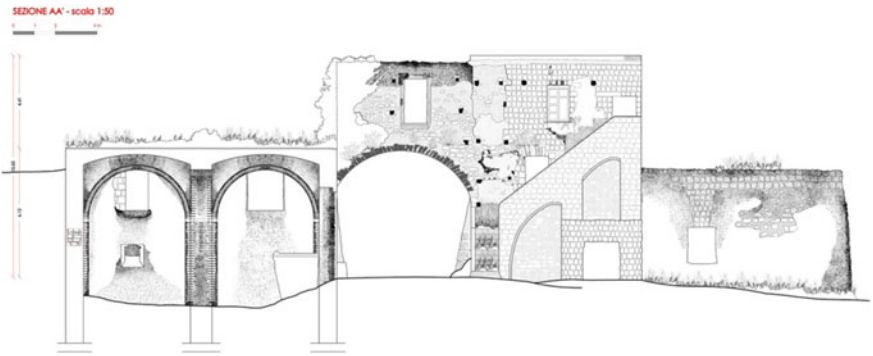
The presence of Phlegrean woods and chestnut fields gave rise to the use of chestnut beams for the horizontal elements of rural houses. The intermediate floors of the farms are made of wooden beams, alternately arranged with respect to the thickness of the section, surmounted by a secondary plank of panconcelle, also known as chiancarelle, which were used to distribute the loads without any further weight increase on the deck and consisted of chestnut bark and a separating boulder made of pumice and lapilli, autochthonous materials easily found in the area. The heads of the beams were supported by a solid brick called 'dormant'.

While the walls, often protected by the thick beaten lapilli, have been kept in an overall good state of preservation, the same cannot be said for the horizontal wood, far more fragile, which over the centuries have been subject to rot, pests, and fires resulting from chimney smoke, and were therefore often replaced with joist floors and vaulted ceilings (in the early twentieth century) or, more recently, with brick and cement floors, which nowadays is one of the major causes of deterioration of these architectures due to the oxidation of their reinforcing bars.

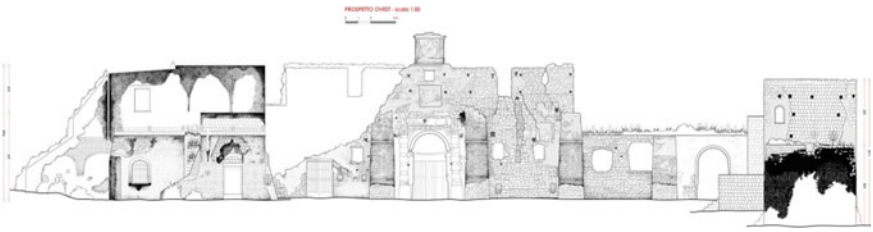
The rainwater regimentation system was particularly complex: starting from the extrados plastic membranes of the covering vaults, water was conveyed to the ground or to a tank by means of exposed gutters made of trapezoidal brick roof tiles that followed the course of the water from the vault and then along the facade, constituting a connoting element of these constructions. In Phlegrean rural houses, bricks were also used as abutments for the vaults of the intermediate floors, as elements of wall reinforcement-the so-called 'chains of bricks', or in the cylindrical elements used for the ventilation of walls, which resemble modern siphons reinforcement-the so-called 'chains of bricks', or in the cylindrical elements used for the ventilation of walls, which resemble modern siphons.

Pozzuoli (NA), Frà Vecchia farmhouse (XVIII sec.). Main facade of the manor house

Even the finishing materials of these historical farmhouses were made of products that could be easily found on site. They were also used for the historical plasters consisting of pozzolan mortars slaked on site, traditionally painted with pinkish lime paints that mark the presence of these farms in the natural landscape. As already observed by Pane in his 'Tipi di architettura rustica a Napoli e nei Campi Flegrei', all the elements that are made of iron in modern constructions, are made of wood in the historical Phlegrean farmhouses, because the availability of wood was higher: window frames, gates, fences, wooden fences are the main decorative elements of this plastic architecture and they offer greater durability.



Pozzuoli (NA), Frà Vecchia farmhouse (XVIII sec.). Materic prospect. University of Naples "Federico II", Faculty of Architecture, course of restoration laboratory, prof. arch. Renata Picone, student: Antonia De Gattis



Pozzuoli (NA), Frà Vecchia farmhouse (XVIII sec.). Manor house, materic prospect. University of Naples "Federico II", Faculty of Architecture, course of restoration laboratory, prof. arch. Renata Picone, student: Antonia De Gattis

Pozzuoli (NA), Frà Vecchia farmhouse (XVIII sec.). Exterior view of the "order to sit", where the harvest was positioned (note the presence of the wooden elements used instead of the iron for the closing of the compartments-window)

The mild and dry climate of the area has also influenced the ways of living and determined certain specific distribution of the Phlegrean farms, which favour outdoor activities. Thus, social life takes place at the threshing floor or in the farmyard; horizontal and vertical connections are created using ramps and walkways outside the core settlement of rural houses, and sanitary installations are located in independent buildings. External masonry stairwells on rampants with gooseneck arches, balconies in solid masonry jutting out on big shelves or supported by arches and vaults, loggias and rampant arches are the key composition elements of rural architecture.

As already noted, the agricultural structuring of a territory determines the various types of rural architecture: the Phlegrean Fields are poorly covered in grass and livestock farming has historically been affected by this unfavourable soil condition, so much so that rural Phlegrean houses are often deprived of stables, while the prevalence of vineyards has led to the construction of big cellars, often, as mentioned, grafted onto pre-existing Roman columbaria, nymphs in opus reticulatum,

or simple agricultural warehouses. In many cases, they are areas used for wine and olive oil processing, with torches, pressing vats, and wine aging barrels. Except for more complex cases, cellars have a rectangular shape and are covered in Lamia, i.e. masonry barrels vaults; they are characterised by a bare prospect on the short side, with an opening in the centre with a rectilinear trabeation surmounted by a square window, enclosed by wooden lattices to ensure internal ventilation. Many rural houses were provided with tanks, an environment under the threshing yard or the outside yard sealed in cocciopesto or lapillus, which, by storing rainwater, ensured the irrigation of appurtenant fields even in periods of low rainfall. This shows how the types of settlements spread around the Phlegrean agricultural land have been influenced by the landscape features of the 'burning fields' (Picone 2005b, pp. 153–159) and by the agricultural use of its soil. However, we should not underestimate the influence that the type of ownership (private or religious) and the sheer size of the estate have had on the conformation of these architectures. Some poor or lofty formal solutions are in fact justifiable on the basis of whether the building belonged to noble families, landowners or to simple peasants. The presence of a private chapel on the farm is usually due to the historical monastic property of the farm where it is located.

Agricultural lands of vast dimensions, usually owned by the feudal nobility or used by religious orders linked to the major monasteries of the capital of the Kingdom, have encouraged the spread of the most complex type of settlement, with a closed court, which borrows its constructive language and composition from the Roman rustic dwellings on which the were often built. The closed court typology of the Frà Vecchia farmhouse in Pozzuoli consists of a main building with two floors where the main rooms were located, a sleeping area on the upper floor accessible from the outside by a brick staircase and through a gallery that serves the various rooms. The main body opens onto the courtyard which is also used as a vegetable garden and is closed on the other sides by low, one floor-areas used for production (stores, warehouses, stables, cellars). The reduction of land ownership resulting from the division of the ancient estates, which occurred between the eighteenth and nineteenth century and then with the agrarian reform, has favoured, conversely, the spread of single or multi-cellular farmhouses, with a square base, consisting of one or more floors, which constitutes the basic settlement model.

Pozzuoli (NA), Frà Vecchia farmhouse (XVIII sec.). Front of the farmhouse

Pozzuoli (NA), Frà Vecchia farmhouse (XVIII sec.). Internal view of the cellaio

The increased farming complexity of the Neapolitan area in comparison with other Italian areas is generated by a greater land fractioning (95 % of the agricultural lands do not exceed five hectares), thus Phlegrean rural houses present a great variety of types, even in very small areas.

It must not be forgotten that the fragmentation of large rural dwellings was dictated by the reduction of land property attached to them and, therefore, also by the change in land use and the gradual substitution resulting in extensive cultivation with others requiring a smaller size property. The agrarian structure of the Phlegrean territory changes as crops change, with special adaptation to the climate, altitude, and to the land structure: the land fractionation and the fragmentation of the ancient nuclei increases, as well as the dispersion of rural architecture settlements, which continue to be isolated and to adapt their typology to the main crops, and hence to the agricultural processes that take place within them.

Pozzuoli. Farmhouse on the Averno lake

Nowadays, the Phlegrean farms are in a general state of disuse and abandonment, due not so much to earthquakes or bradyseism as to their progressive abandonment, even by their owners. A heritage that has gradually lost its original function—also due to wild urbanization and ecological conditions that make quality agriculture difficult—is struggling to justify its conservation, although it still preserves its historical-constructive values and also in some cases its landscape value. Consisting of low and compacted buildings with no more than two floors, this heritage has withstood the earthquakes that have historically taken place in the area, but will not stand the lack of maintenance that today is gradually consuming the beaten elements, bringing down the wooden floors, pulverizing the masonry mortars subjected to crushing and deleting the traces of a building tradition that is disappearing because of abandonment.

In compliance with Law N. 378 of 2003 containing "Provisions for the Protection and Enhancement of Rural Architecture", in 2006 the Campania Region issued a draft law "Regulations Regarding the Protection, Preservation and Enhancement of Traditional Rural Architecture", which in the absence of a full awareness of the values and elements necessary to safeguard this heritage, actually encouraged interventions that distorted the technical and anthropological specificities of these architectures, in the name of a misunderstood work of 'enhancement'.

The two case studies chosen are representative of some of the aspects set out above; one, related to the via Consolare Campana, consists of a farmhouse built on pre-existing Roman ruins testified by the presence of a nymph in opus reticulatum, and another, relating to a more complex farm house, was built in the eighteenth century for the production of wine. In both cases, we highlight the conservative issues and the recurrent mechanisms of degradation and damage, to detect the correct methods for the conservation of this 'fragile' asset.

The examples of farmhouses that have been analysed are the 'Capuzzelle' farm in Marano and the rural complex called 'Frà Vecchia' in Pozzuoli. The first example is a two-floor multi-cellular manor farm with a quadrilateral base and an external staircase on a gooseneck arc. The conformation of the farmhouse in Pozzuoli is far more articulated; it has such an extent as to give the name to the toponym of the area, still present in cadastral maps. This type is characterised by an enclosed courtyard: a rural estate belonging to an important noble family, with a large estate attached to it. The complex consists of a two-floor manor house, with a stone portal and a large cellar consisting of two sail-vaulted spaces and two-floor buildings used to house the farmers, with external masonry stairs.

Pozzuoli, Masseria Caleo farmhouse. Remains of the Roman ninfeo reused inside the cellaio and remains of walls in opus reticulatum reused in the structure of the furnace (picture by R. Picone)

Pozzuoli. A farmhouse after the “restoration” works

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Guidelines for Eco-efficiency in the UNESCO Site of Cinque Terre: An Example of Good Practice

Luisa De Marco, Giovanna Franco and Anna Magrini

Abstract The paper discusses the results of a recent research focussed on the formulation of criteria of landscape and architectural compatibility to set up Guidelines to achieve eco-efficiency and install renewable energy source applications for domestic or agricultural use in the rehabilitation of traditional rural buildings within the World Heritage Property of Cinque Terre, Porto Venere and the Islands. The research was commissioned by the Regional Directorate of Liguria to the Universities of Genoa and Pavia and faces a new challenge for this type of sites due to the highly sensitive landscape and heritage values in place. Two factors oriented the research: a continuous passage of scale, from the territorial level to building detail and the continuous exchange among specialists within a trans-disciplinary team. The results of theoretical models of calculation of energetic behaviour and requirements applied by experts in Building Physics have been compared with the evaluation of the actual state of conservation of the buildings, with the local conditions of weather and sun exposure, with the data on relative climatology and on superficial and profound geology, with the possible energetic exigencies and with the reasons for heritage preservation and protection so as to select the possible solutions able to respond to all identified needs.

L. De Marco
Ministry of Cultural Properties, Activities and Tourism – Regional Directorate of Liguria for Cultural and Landscape Property, Genoa, Italy

G. Franco (✉)
Department DSA, University of Genoa, Genoa, Italy
e-mail: francog@arch.unige.it

A. Magrini
Department of Civil Engineer and Architecture, University of Pavia, Pavia, Italy

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